Master Plan

for

Natural Energy Laboratory of Hawai'i Authority

2011

PREFACE

From time to time it is important to update our vision for the future. It gives us great pleasure to present this document which charts the course for NELHA over the next several decades. This document, the **2011 NELHA Master Plan**, is the third update of our master plan since we were established in the mid-1970s. The plan represents a broad vision of where we are headed for the long term.

Our efforts to date are yielding results. NEHLA is taking advantage of its unique access to deep ocean seawater to advance renewable energy research and demonstration plants, education, commercial activities in aquaculture and pharmaceuticals, and nurture market acceptance of green technologies. This success has not happened on its own, and we thank everyone who has helped us: the State administration, Legislature, small and large businesses, Hawaii residents and consumers, and particularly our Board of Directors and NELHA's excellent staff who have taken bold actions over the years to meet the demands and challenges of developing the world's premier ocean science and technology park.

This plan represents countless hours of input and discussions. We especially want to thank Group 70 for their efforts in helping us prepare this plan. They designed an excellent process using the latest techniques in scenario planning to bring forth this flexible long-term plan for NELHA. Their methods allowed the inclusion of factors that are often difficult to formalize and helped us develop novel insights into the future to design a corporate strategy.

We must ensure this trend continues, and this document will help us build our global competitiveness. The plan is especially poignant in stating that the world is in a great transitional time with financial distress, global warming, resource depletion, as well as food and water shortages, to name a few of today's challenges. It further notes that NELHA is well poised to play an important role in this global transformation with its focus on developing a green economy especially in the areas of alternative energy and ocean resources.

Moving forward cannot be done alone by NELHA. To keep the momentum going, we will continue to seek partners and pursue policies that enable entrepreneurs to succeed as well as meet the needs of Hawaii's residents as outlined in this plan.

John DeLong
Chairman of the Board

Gregory P. Barbour
Executive Director

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Executive Summary

NELHA is located on 870 acres of State coastal land in Keāhole Point, Kona just south of Kona International Airport and 4.1 acres of rainforest land in Puna. NELHA was created in 1974 pursuant to Chapter 227-D of the Hawai'i Revised Statutes.

This master plan updates the 1976 NELH Master Plan and the 1989 HOST Park Master plan by merging the content of both plans into a single document. The overall vision and mission statements from these plans were reviewed and reaffirmed with some insights from nearly 40 years of experience. This mission identified four major themes:

1. energy production;
2. food, aquaculture and nutraceuticals;
3. energy research driven programs; and
4. public outreach, education and tourism.

This plan continues this focus with an added emphasis on emerging trends, new technologies and cultural sensitivity. The plan was adopted in concept by the NELHA Board during its April 2009 Board meeting. The already adopted NELHA Green Energy Zone Policy is included as a part of this plan by reference.

This conceptual master plan identifies six zones of use. They include:

1. Applied Renewable Energy Zone;
2. Economic Driver;
3. Applied Technology Labs & Containerization Research;
4. Science and Technology Cultural Center;
5. Ocean, Air, Energy and Biology Research; and
6. Ocean Research Village and Zone.

The Applied Renewable Energy zone would house applications and scale out of technologies related to various renewable energy concepts that are at the cusp of commercialization. In this zone, there is a tenant is working on photovoltaic energy production and a prospective tenant exploring municipal solid waste energy conversion. Other similar endeavors would be housed in this zone.

The Economic Driver zone will cluster uses that have a more established commercial venue of uses related to NELHA research and products. With a frontage along Queen Ka'ahumanu Highway it will highlight NELHA and provide a priority retail outlet for NELHA tenants and secondarily other Hawai'i Island products. A gateway center and Research Inn along with offices for technology firms is envisioned as part of this mix. The hope is that this zone will be a significant revenue generator for NELHA.

The Applied Technology Laboratories and Research Zone will continue and expand the extractive businesses that use the deep ocean water and further include test bed offices for technology development where the test site may be in NELHA or anywhere on the Big Island which is blessed with 11 of the world's 13 climatic zones. Aquaculture will continue to be supported. With an island frame of mind (contained and isolated geography), the zone also proposes to house a center for containerization technologies to make equipment and transport more efficient by miniaturization and increased portability.

The Science Technology and Culture Zone proposes to cluster facilities and programs that take nature and culture and merge the wisdom from cultural knowledge and link it to the transferability that modern science provides. It will also be an education area where science and culture view each other with mutual respect.

The Ocean, Air, Energy and Biology Research zone would focus on more pure research and uses that are dependent on proximity to the Ocean. It is hoped that a series of partnerships be developed with other research institutions and the place become a center for cutting edge programmatic research. A biofuels project is already located here along with several other research partners of long standing.

The final zone is the Ocean Research Zone and Ocean Village. NELHA has authority over a 3290 acre swath of the ocean offshore from the land facilities at Keāhole Point. The plan envisions a more extensive use of this zone for many kinds of research including renewed OTEC activities and research into multi-purpose concepts of oceans and ocean environments including an offshore research facility.

The plan designates 4 nodes of activity which are intended as gathering places or centers of activity. These nodes include:

1. an entrance/gateway for orientation and education;
2. a commercial marketplace;
3. a traditional gathering place of the ahupua‘a; and
4. a research village center.

These nodes are intended to encourage and facilitate the gathering of people and increase dialog, the exchange of ideas and social interaction.

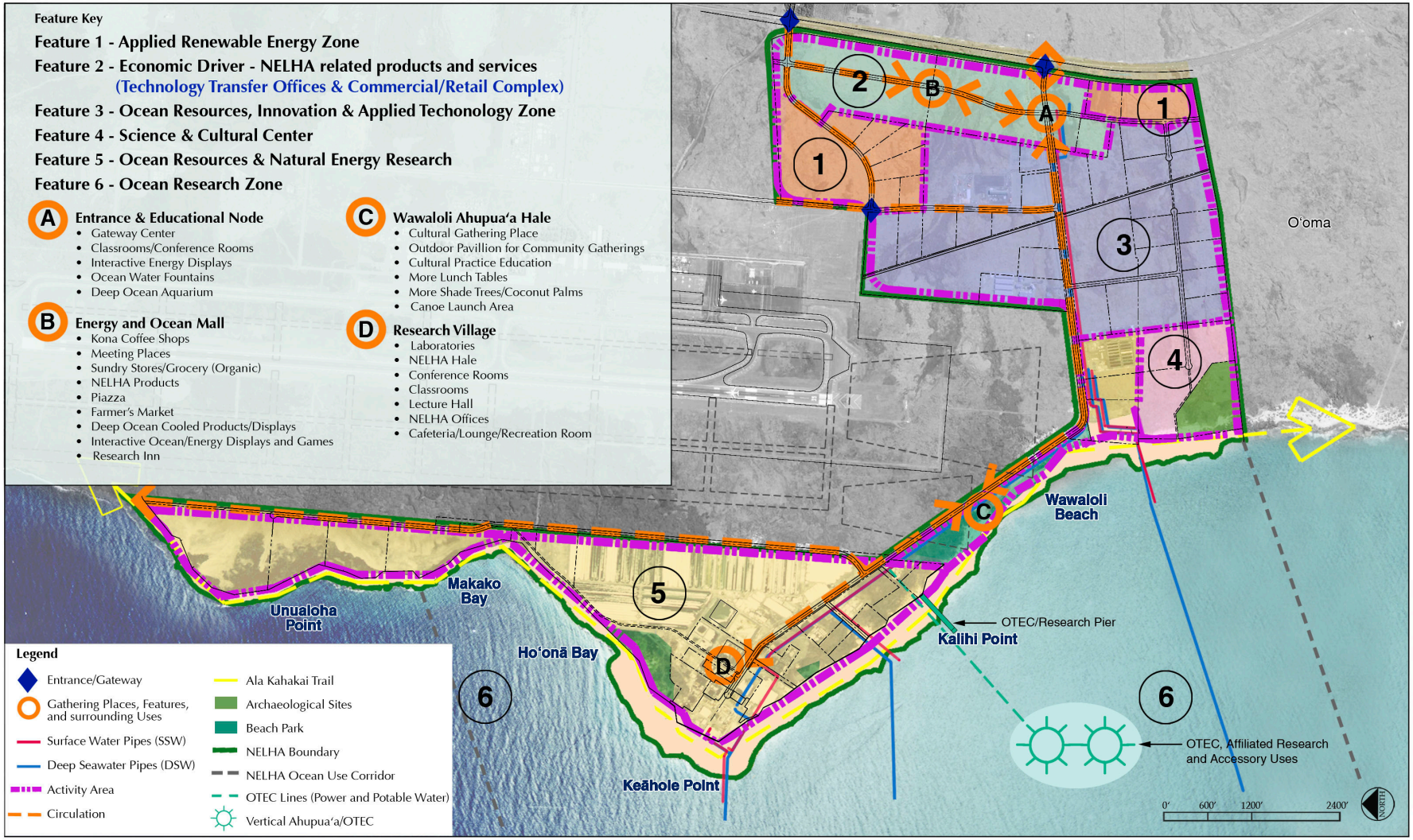
Finally the plan includes a new subdivision plan for NELHA and envisions a series of nodes and gathering places that foster a sense of community and exchange of ideas and goods. Sustainable design, cultural sensitivity and innovative economies will be hallmarks of NELHA. A hybrid campus/industrial park character is envisioned.

Financial self-sufficiency was a policy mandated during the Cayetano administration. This is an extremely difficult goal for any research and development institution and NELHA has struggled with it for many years. However, in the last two years NELHA has approached an operation breakeven point using only sales of warm and deep ocean water and lease rents as revenue sources. This master plan proposes some additional programs, concepts and potential revenue sources to make this a more routinely achieved goal. Based on the proposed master plan revenue/cost projections were made with some sensitivity analysis for other scenarios. The proposed plan generates an internal rate of return of approximately 8% over 15 years.

The plan also suggests several options for future development and sources of revenue. Partnerships with other organizations to leverage resources are deeply encouraged. Some key ideas presented include roles as a master developer, expanded utility and institutional/anchor partners. Carbon trading, stewardship agreements and Angels of Kona Venture Capital formation are suggested.

In addition to the revenue stream an assessment of economic impact projected the creation of 480 new jobs in addition to the current level of employment (335). With a standard economic multiplier observed for other research parks the plan projects and overall job growth of 2700 jobs in West Hawai'i. This does not include the impact of construction related jobs. NELHA can also play a key role in the Hawai'i Clean Energy Initiative of attaining an energy balance of 70% renewable energy use for the State by nurturing and supporting promising renewable technologies that also train Hawai'i's workforce for the emerging green economy.

This new master plan provides a framework for NELHA to play its potentially significant role in Hawai'i's growth in renewable energy technologies and sustainable development.


Feature Key
Feature 1 - Applied Renewable Energy Zone
Feature 2 - Economic Driver - NELHA related products and services
(Technology Transfer Offices & Commercial/Retail Complex)
Feature 3 - Ocean Resources, Innovation & Applied Techonology Zone
Feature 4 - Science & Cultural Center
Feature 5 - Ocean Resources & Natural Energy Research
Feature 6 - Ocean Research Zone
A Entrance & Educational Node
• Gateway Center
• Classrooms/Conference Rooms
• Interactive Energy Displays
• Ocean Water Fountains
• Deep Ocean Aquarium
B Energy and Ocean Mall
• Kona Coffee Shops
• Meeting Places
• Sundry Stores/Grocery (Organic)
• NELHA Products
• Piazza
• Farmer's Market
• Deep Ocean Cooled Products/Displays
• Interactive Ocean/Energy Displays and Games
• Research Inn
C Wawaloli Ahupua'a Hale
• Cultural Gathering Place
• Outdoor Pavillion for Community Gatherings
• Cultural Practice Education
• More Lunch Tables
• More Shade Trees/Coconut Palms
• Canoe Launch Area
D Research Village
• Laboratories
• NELHA Hale
• Conference Rooms
• Classrooms
• Lecture Hall
• NELHA Offices
• Cafeteria/Lounge/Recreation Room
O'oma
Wawaloli Beach
Makako Bay
Unualoha Point
Ho'onā Bay
Keāhole Point
Kalihi Point
OTEC/Research Pier
OTEC, Affiliated Research and Accessory Uses
Legend
Entrance/Gateway
Gathering Places, Features, and surrounding Uses
Surface Water Pipes (SSW)
Deep Seawater Pipes (DSW)
Activity Area
Circulation
Ala Kahakai Trail
Archaeological Sites
Beach Park
NELHA Boundary
NELHA Ocean Use Corridor
OTEC Lines (Power and Potable Water)
Vertical Ahupua'a/OTEC
0' 600' 1200' 2400'
NORTH

1.0 INTRODUCTION

This Master Plan serves as an update to NELHA's existing master plan. As such, information has been incorporated liberally from the existing master plans and the wealth of publicly available prior research and plans created for NELHA and projects in its vicinity. This information has been updated where relevant.

The Master Plan should be a forward looking, broad vision of NELHA's desires for the future. It should be comprehensive in scope and detailed enough to assist NELHA in strategic decision making. It should be a document the Board can point to and engage with potential development partners in joint projects. It should help with decision making on new leases and renewal of existing leases and identify strategies for the larger projects and facilities needed to enhance its mission and fulfill its potential of a world-class research facility, and light industrial park incubating the technologies and businesses of the future.

1.1 BACKGROUND

Directly offshore of Keāhole Point in North Kona, Hawai'i, the ocean bottom gradient drops steeply, making deep cold ocean water accessible through relatively short lengths of pipe. Recognizing the site's potential for ocean related research, thermal energy conversion demonstration, and aquaculture, the State of Hawai'i established the Natural Energy Laboratory of Hawai'i (NELH) at Keāhole in 1974 for these purposes. In 1986, ground was broken on adjacent lands for the first increment of the State's Hawai'i Ocean Science and Technology (HOST) Park, a development which was intended to provide sites for the commercialization of research activities initiated at NELH.

Until 1990, the properties, located next to the Kona Airport at Keāhole, North Kona, Hawai'i (*Figures 1.1 and 1.2*), were separately administered, although their missions were complementary. The 1990 State Legislature (Chapter 227D, HRS) consolidated management of NELH and HOST Park's 870 acres of lands and facilities under a single administrative state agency, the Natural Energy Laboratory of Hawai'i Authority (NELHA). NELHA also manages the Geothermal Research Park at Puna, Hawai'i *(Figure 1.3)*.

A major natural asset of the site is the access to pristine deep, cold ocean water ideal for aquaculture and natural cooling. There are presently three pipeline systems pumping deep and surface seawater including an intake at 3,000 feet deep, making it the world's largest diameter, and deepest oceanic pipeline. The total cold water pumping capacity is more than 43,000 gallons per minute. Other key assets at Keāhole Point include high solar insolation (intensity), stable climactic conditions and location in an Enterprise and Foreign Trade Zone next to the airport.

Existing activities on the sites include more than forty tenants engaged in aquaculture, water bottling, energy projects, research, and education (*Figure 1.4*). Approximate tenant count by sector are as follows: six in Commercial/ Extractive, fifteen in Commercial/ Productive, five in Pre-Commercial, four in Research, five as Gateway Tenants, three in Education/ Outreach, and three in "other" categories.

The NELHA Board of Directors (BOD) sets policy and provides guidance for NELHA.

1.2 MISSION AND PURPOSE

The legislation that established NELHA states, "The purpose of the natural energy laboratory of Hawai'i authority shall be to facilitate research, development, and commercialization of

natural energy resources and ocean-related research, technology, and industry in Hawai'i and to engage in retail, commercial, or tourism activities that will financially support that research, development, and commercialization at a research and technology park in Hawai'i" (HRS 227D-2)

NELHA's mission statement reads, "To develop and diversify the Hawai'i economy by providing resources and facilities for energy and ocean-related research, education, and commercial activities in an environmentally sound and culturally sensitive manner."

During a series of planning meetings for this master plan, the NELHA Board of Directors (BOD) re-affirmed this mission statement. The broad mandate of the mission allows great flexibility and creativity in the types of land uses and endeavors that are undertaken.

1.3 GOALS AND OBJECTIVES

The following goals and objectives were established to guide the preparation of the Master Plan.

Update the 1976 NELH Master Plan and the 1989 HOST Park Master Plan by:

1) Developing a single, comprehensive planning document with a twenty-year horizon for all NELHA lands and activities that reflects its mission, purpose, and goals and assesses alternative development scenarios, including research and commercial application, in light of trends in alternative energy and natural resource management.
2) Update the existing Strategic Plan and Design Guidelines to facilitate implementation of the NELHA Master Plan.
3) Integrate and balance cultural, natural, education/research and recreational values and uses in a physical plan which will provide a framework and structure for the responsible and sustainable stewardship of NELHA and perpetuation of energy and ocean-related research and its application in Hawai'i.

These goals have been carried throughout the master planning process from the integration of data to the formulation of physical plans and a business model. The goals of energy sustainability, application, and environmental and cultural sensitivity should continue to guide the future decision making for NELHA through and beyond the implementation of this plan.

1.3.1 Cultural

1) Respect the cultural resources, Hawaiian cultural practices, and significance of archaeological sites at NELHA through the planning process.
2) Protect and manage cultural sites in a sustainable manner.
3) Protect the opportunities for individuals and groups to engage in cultural practices.
4) Define areas, criteria and support facilities for cultural resources and practices, as applicable, to allow for integrated planning and management.
5) Preserve the cultural landscape to enhance meaning, relationships, and resources for modern appreciation, research, and practice.

The cultural objectives recognize that NELHA is located on ceded lands and includes sites that continue to be utilized for Hawaiian cultural practice today. This plan encourages preservation of cultural resources and at the same time supports use and further understanding of these resources by practitioners and others.

1.3.2 Natural Resources

1) Preserve environmental quality and critical natural resources including flora, fauna, and natural landforms through the planning process.
2) Use natural resource areas for recreation in a manner that both protects the resources and promotes the safety of individuals.
4) Allow for current and future use of natural resources for educational programs and Hawaiian cultural practices for the community, schools and universities, and visitors.
5) Preserve NELHA's scenic values.

As in the case of cultural resources, the Master Plan encourages greater understanding, appropriate use, and preservation of the NELHA's natural resources. The Master Plan objectives call for the integration of natural resources with cultural resources and use, education and research, and recreation components.

1.3.3 Education/Research

1) Expand knowledge of NELHA as an educational resource for the benefit of the community, including native Hawaiians, students, researchers, and visitors.
2) Protect and enhance ocean and energy research at NELHA.
3) Define areas, criteria and support facilities for education and research as applicable, to allow for sustainable, integrated planning and management.

1.3.4 Recreational

1) Retain and enhance recreational opportunities at NELHA while protecting natural resources, cultural resources, and cultural practices.
2) Define areas, criteria and support facilities for recreational uses, sightseeing and commercial tours, as applicable, to allow for sustainable, integrated planning and management.

The above objectives encourage mixed use of NELHA in an organized setting. Recreational activities are guided in a direction that promotes safety and practices that respect Keāhole Point's natural and cultural values.

1.3.5 Physical Plan

1) Create physical plans, maps, and criteria which promote the sustainable use, enhancement and development of NELHA's lands in order to:
    - Protect and enhance research, application, and education potential.
    - Protect natural resources: e.g. anchialine ponds, water quality, etc.
    - Protect historic/cultural resources and practices: e.g. archaeology sites, Hawaiian cultural practices.
    - Protect and enhance recreational opportunities.
2) Analyze physical implications of uses over time; address and mitigate visual and environmental impacts.
3) Guide future physical development, not only locationally, but with respect to character, size, mass, color and other physical attributes through Design Guidelines.
4) Define infrastructure and elements to support goals regarding commercial and research development, natural resources, culture, education/research, and recreation.

These objectives are further detailed in Chapter 3.

1.4 METHODOLOGY

Strengths Weaknesses Opportunities and Threats (SWOT)

In beginning the study for the master plan previous documents were examined. It is noted that in the existing 1993 strategic plan developed for NELHA there was a long and detailed SWOT analysis conducted. The project team reviewed the analysis and amazingly much of the analysis was still relevant. Conditions at NELHA have not changed significantly in 15 years. The same strengths exist: accessible seawater, high solar insulation, proximity to the airport, land use approvals in place and others. Similar weaknesses remain; shortage of capital, distance to markets, lack of core staff for research and others. Many of the same opportunities also exist as well as threats from competitors to the same research and investment dollars.

It was felt that there was not much to be gained from going over the exercise again and it would be better to conduct an assessment of the current global economic situation and look for targets of opportunity. Some things have changed in the interim. NELHA now needs to be economically self sufficient for operational purposes. There is a stimulus package proposed by the Obama administration that has important programs in alternative energy. There has been a global shift toward acceptance of the need for alternative energy and the need to slow global warming and manage climate change. Global warming is no longer a theory but and accepted phenomenon. Population has continued to grow. India and China have awoken as economic powers. However, all these changes have not altered the fundamental SWOT analysis.

For NELHA to move beyond being an institution with great potential to one that is truly a Center for Excellence in Energy and Ocean Resource research and development it must develop new strategies to diversify its revenue stream and develop partnerships with institutions that can provide the needed funds, expertise and will to elevate it to the next step of maturation as a research park and institution. The path will be in partnerships, partnerships and partnerships.

A charette process was conducted with the NELHA BOD to establish strategic direction prior to considering physical planning solutions. The five parts of the charrette are as follows:

1) The lifestyle characteristics and patterns of the community are identified and addressed (present and future).
2) The major themes of the community are selected to serve as a foundation for the strategy plan.
3) The physical characteristics (configuration) of the community are drawn based on the major themes and lifestyle patterns.
4) Minor or supporting themes are worked into the strategy plan which fill out the lifestyle patterns and the physical characteristic.
5) Signature details of the community are identified and characterized in drawings.

In early meetings, NELHA's existing mission statement was affirmed by the BOD, and the following major themes were identified:

1) Energy production
2) Food, aquaculture, and nutraceuticals
3) Energy research driven programs
4) Public outreach, education, and tourism

Financial self-sufficiency which was mandated during the Cayetano administration remains a requirements for NELHA.

Existing uses were studied, and meetings were held to identify user requirements and include community preferences to best accommodate research, education, commercial, and sustainable technology programs. Approximately fifty-five stakeholders representing academia, cultural practitioners and community groups, government agencies, elected officials, potential partners, and tenants and staff of NELHA were interviewed regarding their perception of NELHA and hopes for its future. Based on these communications and BOD input, a zone map was produced defining those areas that should be set aside for use in research and non-research activities.

The first zone map established was based upon the idea that NELHA would become a world-class center for ocean and renewable energy research supported by commercial development. Some BOD members felt this direction was unrealistic, and asked for more balance in the proposal. Four alternative scenarios were established for consideration:

1) Continuation of Current Policies
2) Economic Driver with Applied Technology
3) NELHA/U.S. Department of Energy Research Campus
4) EPCOT/Edutourism Center

The BOD requested alternatives two and three be combined into a final master plan concept, an Energy and Ocean Research Park. Once the zones of use were determined, planning efforts concentrated on refining infrastructure requirements and financial analysis. Lotting schemes and roadways were assessed to determine which encouraged informal interaction of users, preserved open space, facilitated visitor experience, meshed with neighboring airport and development master plans, had the fewest cost and construction constraints, and had the least amount of visual impact on surrounding areas.

In addition to a physical plan, a strategic plan and a financial model were created to address implementation and feasibility issues in a manner that best accomplishes the themes established for NELHA. Design guidelines were updated to create a unifying visual theme.

Once the Master Plan has been approved by the NELHA BOD, an Environmental Assessment (EA) or Environmental Impact Statement (EIS) will need to be prepared to satisfy the requirements of EIS Law (Chapter 343, HRS) regarding the development of the 83 acres of Conservation land south of the NELHA Access Road. Subsequent to the approval of the EA/EIS, a State Land Use District boundary amendment petition will need to be made to the State Land Use Commission to reclassify this area as an Urban District. These permits must be obtained as a part of plan implementation. Finally, Rezoning, Special Management Area permits and Subdivision approvals must be obtained from the County of Hawai'i.

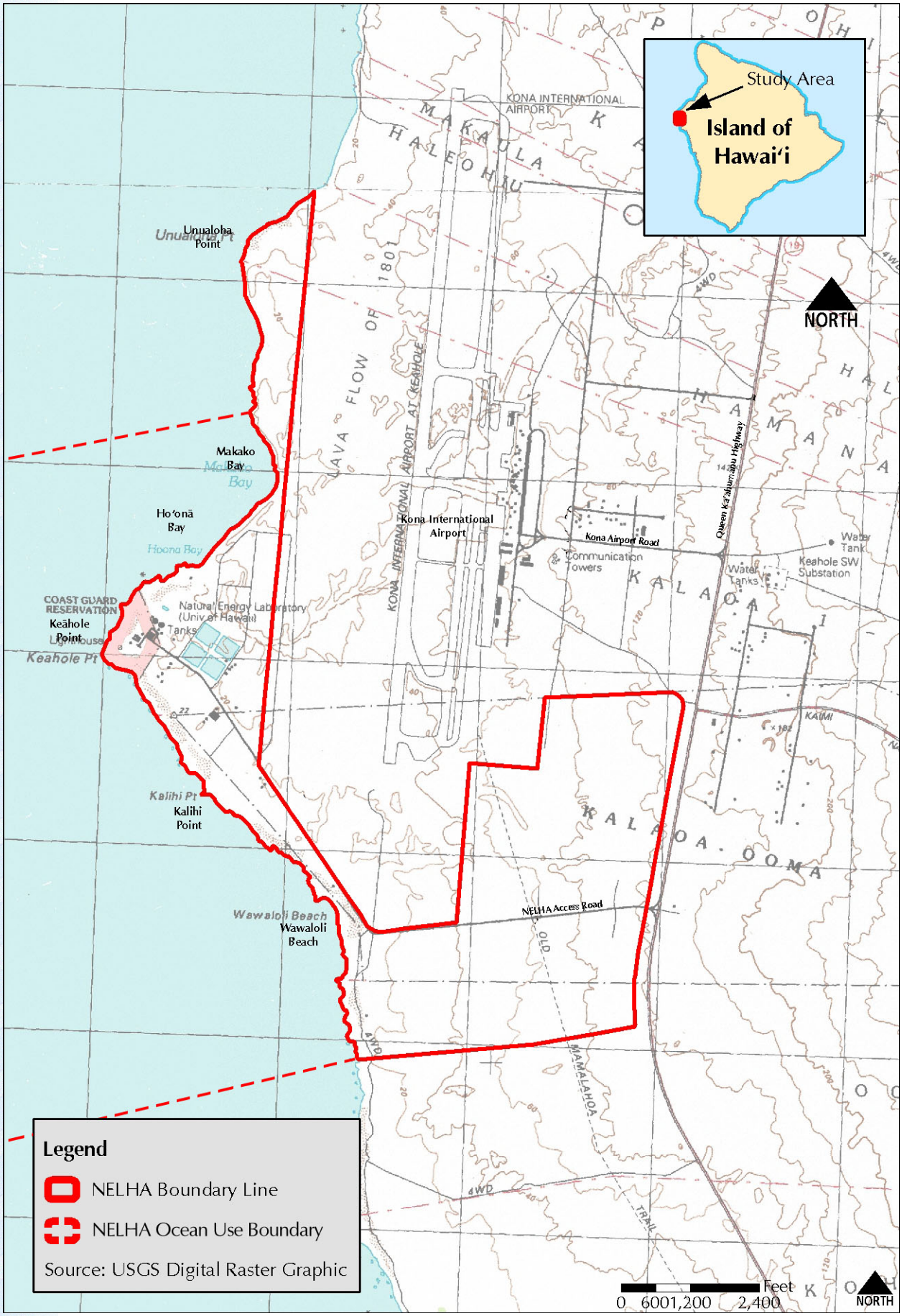


Figure 1.1 Project Location at Keāhole

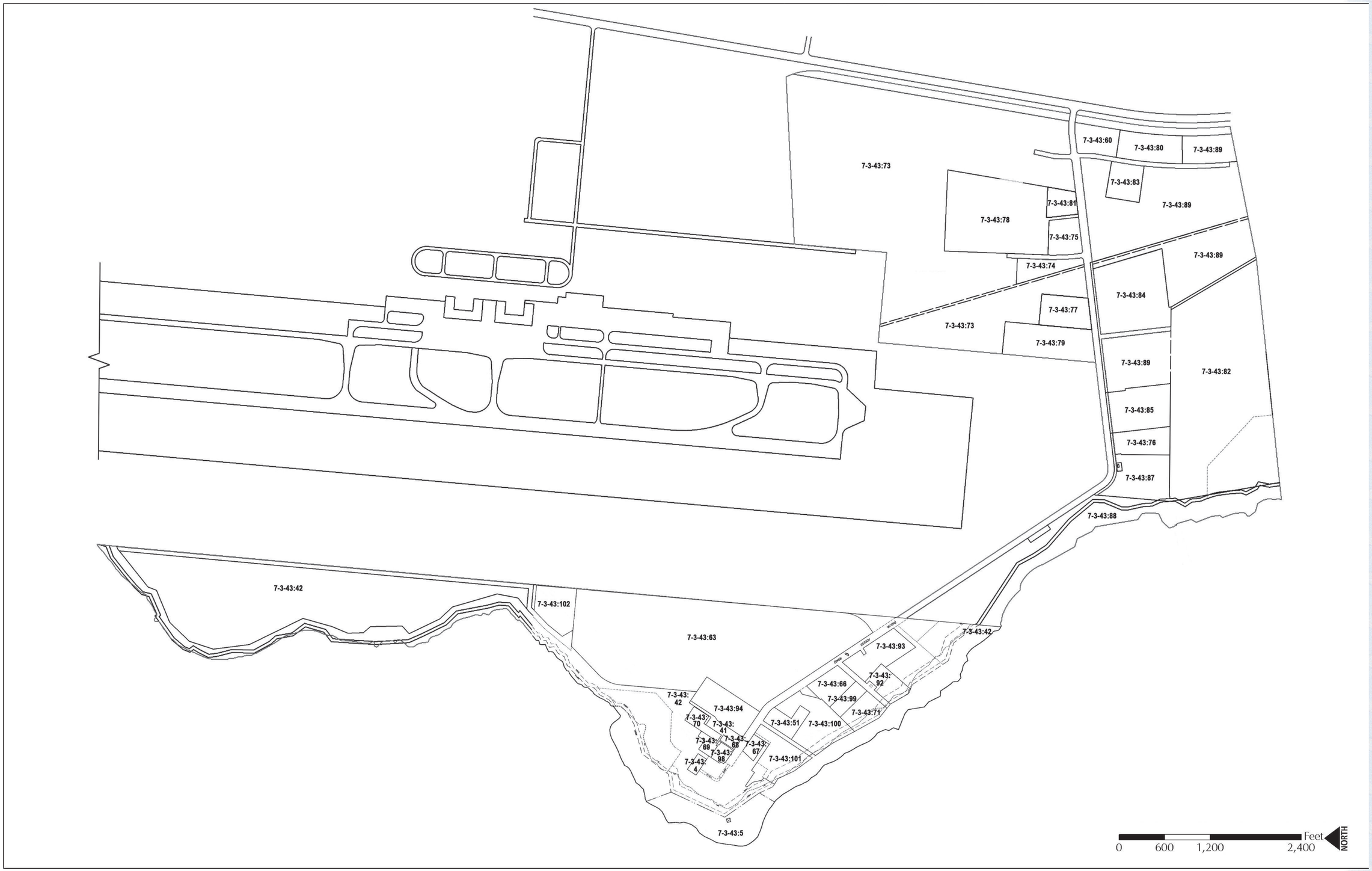


Figure 1.2 TMK Map

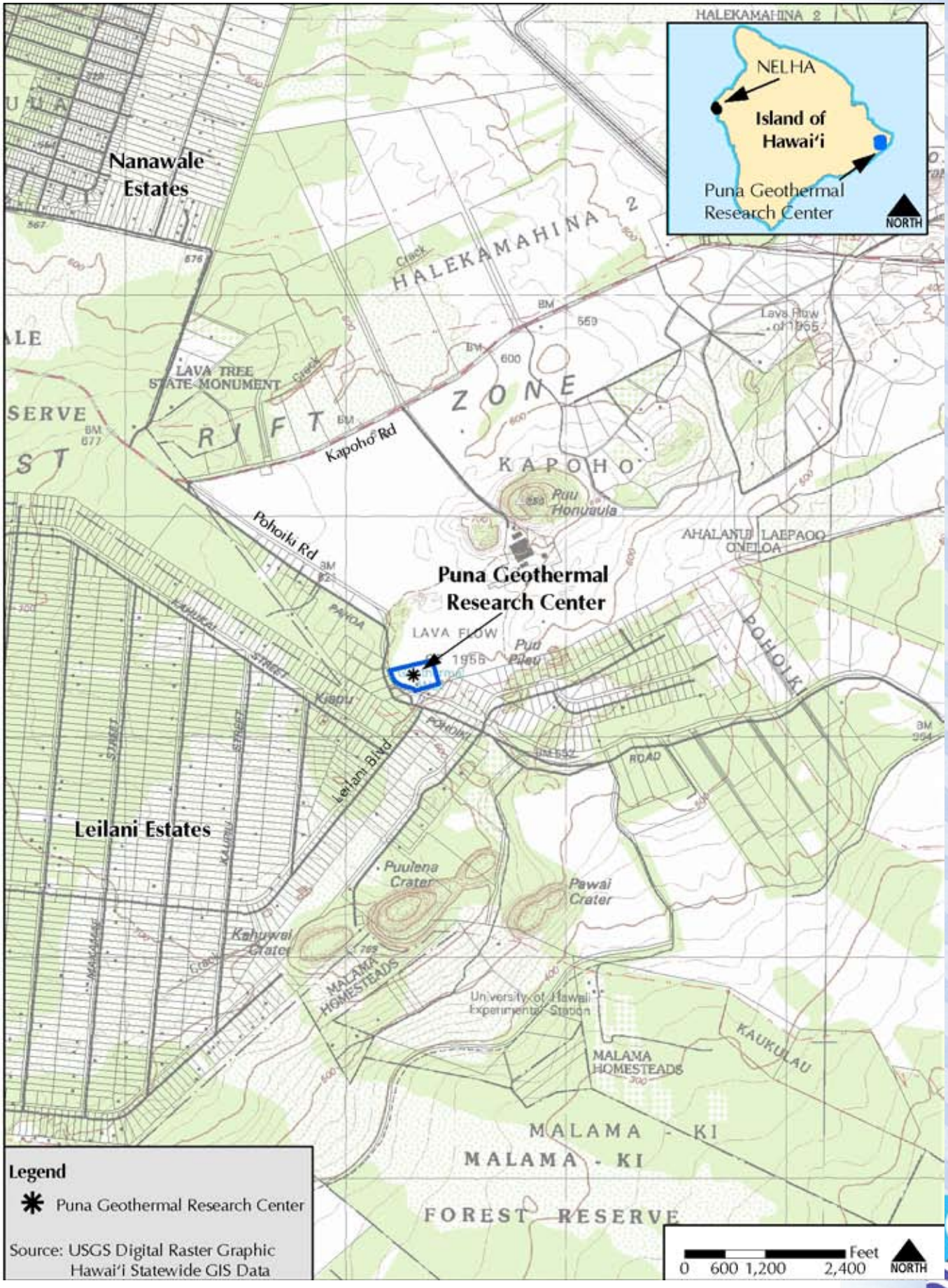
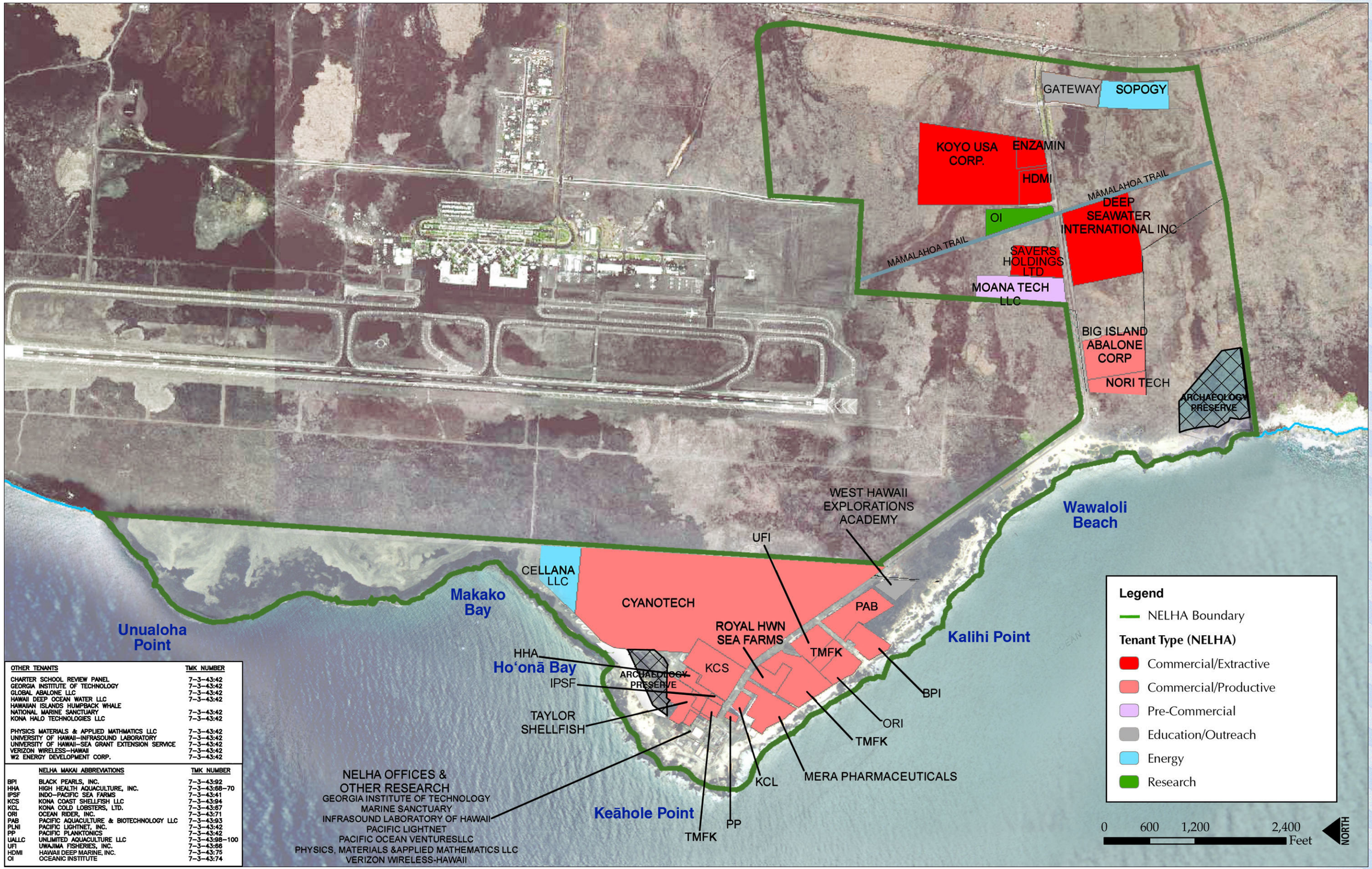


Figure 1.3 Puna Geothermal Site Location



OTHER TENANTS	TMK NUMBER
CHARTER SCHOOL REVIEW PANEL	7–3–43:42
GEORGIA INSTITUTE OF TECHNOLOGY	7–3–43:42
GLOBAL ABALONE LLC	7–3–43:42
HAWAII DEEP OCEAN WATER LLC	7–3–43:42
HAWAIIAN ISLANDS HUMPBACK WHALE NATIONAL MARINE SANCTUARY	7–3–43:42
KONA HALO TECHNOLOGIES LLC	7–3–43:42
PHYSICS MATERIALS & APPLIED MATHMATICS LLC	7–3–43:42
UNIVERSITY OF HAWAII–INFRASOUND LABORATORY	7–3–43:42
UNIVERSITY OF HAWAII–SEA GRANT EXTENSION SERVICE	7–3–43:42
VERIZON WIRELESS–HAWAII	7–3–43:42
W2 ENERGY DEVELOPMENT CORP.	7–3–43:42

	NELHA MAKAI ABBREVIATIONS	TMK NUMBER
BPI	BLACK PEARLS, INC.	7–3–43:92
HHA	HIGH HEALTH AQUACULTURE, INC.	7–3–43:68–70
IPSF	INDO–PACIFIC SEA FARMS	7–3–43:41
KCS	KONA COAST SHELLFISH LLC	7–3–43:94
KCL	KONA COLD LOBSTERS, LTD.	7–3–43:67
ORI	OCEAN RIDER, INC.	7–3–43:71
PAB	PACIFIC AQUACULTURE & BIOTECHNOLOGY LLC	7–3–43:93
PLNI	PACIFIC LIGHTNET, INC.	7–3–43:42
PP	PACIFIC PLANKTONICS	7–3–43:42
UALLC	UNLIMITED AQUACULTURE LLC	7–3–43:98–100
UFI	UWAJIMA FISHERIES, INC.	7–3–43:66
HDMI	HAWAII DEEP MARINE, INC.	7–3–43:75
OI	OCEANIC INSTITUTE	7–3–43:74

Figure 1.4 Tenant Type

2.0 History and Existing Conditions

2.1 MANAGEMENT AUTHORITY

The NELHA was created pursuant to Chapter 227-D of the Hawai'i Revised Statutes which combined the Natural Energy Laboratory of Hawai'i (NELH) and the Hawai'i Ocean Science and Technology Park (HOST Park) into a single State-operated entity.

An eleven-member Board of Directors (BOD), sets policy and provides guidance for NELHA. The BOD consists of three members appointed by the Governor. Six public sector directors represent the University of Hawai'i, the Department of Business, Economic Development and Tourism, the Department of Land and Natural Resources, Hawai'i Strategic Development Corporation, Hawai'i Technology Development Corporation and the Mayor of Hawai'i County. Two research advisory committee members are also selected.

NELHA employs approximately nineteen staff ranging from a Chief Executive Officer to a microbiologist, an engineer, a chemist, a fiscal officer, a tenant review specialist, mechanics, electricians, plumbers, an operations manager, administrative staff, and a groundskeeper with significant understanding of the cultural history of Keāhole Point.

2.2 LEGAL AND REGULATORY STATUS OF THE SITE

NELHA has a General Lease No. S-5619 from the Department of Land and Natural Resources covering 870 acres, commencing on July 3, 2001 for a term of 45 years.

Most of the 870 acres of land administered by NELHA are situated within the State Land Use Urban District. Approximately 126 acres are in the State Conservation District as are an additional 3,290 acres of ocean waters and submerged lands managed by NELHA.

The County of Hawai'i General Plan Land Use Pattern Allocation Guide (LUPAG) Map designates the properties as "Industrial" (*Figure 2.1*). The NELHA properties are zoned MG-1a, MG-3a and Open (*Figure 2.2*). The properties are located within the County of Hawai'i's Special Management Area (SMA).

2.2.1 Legislative History

Since the establishment of the Natural Energy Laboratory of Hawai'i in 1974, there have been legislative acts, environmental impact statements, feasibility studies and master plans which discuss the intended uses of the NELH and HOST Park facilities. Pertinent sections of those documents follow.

In 1974, Hawai'i Revised Statute Chapter 227 established the Natural Energy Laboratory of Hawai'i (NELH).

HRS Chapter 227: "The Natural Energy Laboratory of Hawai'i shall manage and operate research facilities. The facilities shall provide sites for research, development, demonstration and commercialization of natural energy resources and other compatible scientific and technological investigations" 1974, 1979, 1984, 1985

The High Technology Development Corporation (HTDC) was established in 1983.

HRS Chapter 206M - High Technology Development Corporation: This statute lists the powers which enable HTDC to meet the intent of Legislative Act 152 which established HTDC.

Act 152: "...to establish an instrumentality and agency of the State and to grant to such agency the power to develop industrial parks for the location of such high technology enterprises, to assist such high technology enterprises in the construction

and equipping of facilities to be used for such enterprises and related facilities, and to issue special revenue bonds to finance the cost of such development, construction, and equipping." 1983

The Hawai'i Ocean Science and Technology Park (HOST Park) was HTDC'S first industrial park.

In 1990, NELH and HOST Park were merged to form NELHA.

HRS Chapter 227D - Natural Energy Laboratory of Hawai'i Authority: This statute lists the powers which enable the Authority to meet the intent of Legislative Act 224 that established the Authority.

Act 224: "the intent of the legislature is to consolidate the management and organization of these facilities under one authority whose main purpose will be to manage and operate research facilities. It will also serve as a facilitator for the research and development process from fundamental and applied research to pilot commercial projects for developments, which utilize the natural resources available at the Keāhole Point or Puna facilities. The facilities shall provide sites for research, development demonstration, and commercialization of natural energy resources and other compatible scientific and technological investigations. The authority shall also maintain the physical structure of the facilities, provide facilities for lease to tenants who use the natural resources and energy or who support these projects and activities, and provide utilities such as water and electricity, and other support services to the tenants of those facilities."

In 1993, the legislature passed Act 252 to better define the role of NELHA.

Act 252: "The purpose of the Natural Energy Laboratory of Hawai'i Authority, shall be to facilitate research, development, and commercialization of natural energy resources in Hawai'i. Its duties shall include:

1) Establishing, managing and operating facilities that provide sites for:
   (A) Research and development;
   (B) Commercial projects and businesses utilizing natural resources, such as ocean water or geothermal energy;
   (C) Those businesses engaged in other compatible scientific and technological investigations; and
   (D) Businesses or educational facilities that support the primary projects and activities;
2) Providing support, utilities, and other services to facility tenants and government agencies;
3) Maintaining the physical structure of the facilities;
4) Promoting and marketing these facilities; and
5) Promoting and marketing the reasonable utilization of available natural resources."

In 1999 the legislature authorized NELHA to include commercial activities within its research and technology park.

Act 38: "Section 227D-2, Hawai'i Revised Statutes, amended... to read as follows: '(a) ...The purpose of the Natural Energy Laboratory of Hawai'i Authority shall be to facilitate research, development, and commercialization of natural energy resources and ocean-related research, technology, and industry in Hawai'i and to engage in retail, commercial, or tourism activities that will financially support that

research, development, and commercialization at a research and technology park in Hawai'i...'"

2.2.2 Development History

The development of the Authority can be visualized through the various environmental impact statements (EIS) and development plans which were prepared and published between 1976 and 1992.

EIS for the Natural Energy Laboratory of Hawai'i, 1976

"The basic purpose of the NELH is to provide the essential support facilities for future energy research programs and to interest research organizations in using these facilities."

"...the site is especially suited for major OTEC programs"

"The environmental conditions at Keāhole are also suitable for solar energy, aquaculture and biomass conversion projects."

EIS for the Development Plan for the HOST Park and Expansion of the NELH. 1985

"The following land use activities are anticipated…

Ocean-water commercial uses such as high intensity commercial mariculture, marine biotechnology, and renewable energy projects;

Campus industrial uses such as scientific laboratories, research and training facilities and other uses such as desalination and renewable energy which do not use cold ocean water; and,

Service and support uses such as a visitor center/restaurant, light industrial uses, offices, refrigeration, and minimal warehousing and storage related to the primary activities on the site."

"…criteria for selecting the types of tenants to be allowed at the HOST Park … include the following:

Acceptable uses that conform to the stated nature of the HOST Park include: aquaculture, microbiology, biotechnology, oceanography, renewable energy or desalination and other forms of ocean-related high technology deemed appropriate by the HTDC Board of Directors. Within limits, a small portion of the Park can be set aside to accommodate support services that are related to ocean-related uses present in the park.

Priority consideration should be given to mariculture, other ocean-related activities and renewable energy/desalination forms of high technology that are in transition from research and development projects at the adjacent NELH to full commercial application at HOST Park.

Proposed operations should be compatible with other uses of the park present or anticipated; uses that would tend to pollute the environment or might in any way degrade the purity of the surface-level and deep water resource will not be accepted.

Resources should be available to meet the infrastructure requirements of the prospective tenant. In particular, the need for cold ocean water.

Prospective tenants should be evaluated on their potential for success and long term stability.

Priority consideration should be given to applicants who plan to utilize the unique resources of the site extensively."

HOST Park Master Plan, 1989

HOST Park Rules In the section titled PERMITTED USES, the list of uses is quite specific. Please note that although the uses are indicated for particular areas, NELHA received a determination from the Office of Environmental Quality Control in May 1991 which allows more flexibility in determining placement of projects. Therefore, the areas indicated are for guideline use only.

Ocean water use area

Aquacultural applications such as a production of abalone, clam, oyster and other mollusks, lobster, shrimp, prawn and other crustaceans, micro- and macro-algae, and finfish;

Agricultural applications which use the ocean water or brackish water resources;

Research, development and commercialization of ocean related technologies;

Oceanography; Alternate energy applications;

Desalination of ocean water or brackish water.

Industrial support area

Biotechnological, microbiological and pharmaceutical businesses;

Design, manufacture and assembly of ocean related equipment of an electrical, electronic, electro-mechanical or optic nature, only if such equipment requires the special facilities of the HOST Park for its manufacture and/or testing;

Support businesses, including but not limited to processing and packing services, and production and sale of ice for the packing and shipment of products;

Restaurant operations specializing in the preparation of species produced in the ocean water use area; and

Office buildings.

Education/information area

Research and training facilities;

Visitor information center;

Libraries; and

Administrative offices and laboratory facilities of tenants who maintain operations within the ocean water use area.

Accessory operations permitted within all three areas

Administrative offices; Warehousing and distribution;

Research and development operations;

Product testing;

Marketing of products;

Incidental and necessary services for the convenience of persons working at the site that are conducted within an integral part of a principal building with entrances from the interior of the building and having no display or advertising visible from the street;

Manufacture, assembly, testing and repair of testing equipment and the production of tenant owned equipment;

Equipment and instrument storage; and

Other buildings and uses normally considered accessory to the permitted uses.

EIS for the Development of Land Exchange Parcel at NELHA, 1992

"NELHA's objectives for the exchange lands are to subdivide and lease parcels for aquaculture, energy and other uses in conformance with the HOST Park master plan. The State, through NELHA, would provide funding for essential infrastructure development, such as seawater systems, potable water distribution, and power and telecommunications distribution systems."

"The primary tenant for a portion of these lands is KAD Partners. The KAD Project is conceived as an integrated ocean science and technology center which includes marine education and research (Ocean Center), ocean engineering (OTEC Power Plant), and aquaculture (Lobster Farm) components. The KAD Project concept is based on multiple usage of the available ocean resources. The project also includes provision of a Visitor Center for NELHA, extension of Wawaloli Beach and an Archaeological Preserve."

"The remainder of the 83-acre parcel would be available for aquaculture and supporting businesses as provided in the HOST Park Master Plan.

NELHA Strategic Plan, 1993

"Two forces guide the Natural Energy Laboratory of Hawai'i Authority (NELHA): the need for economic development and diversification in Hawai'i, and the quest for natural resource utilization. "

"The locations of the two facilities under the management of the NELHA provide the opportunity to significantly contribute to the geothermal, solar and ocean resources industries while providing economic development and diversification."

2.2.3 Current Status

Figure 2.3 is an overall depiction of existing conditions at NELHA including current tenants, archaeological preserves, and pipe systems.

Tenant Type

Figure 1.3 depicts the tenants at Keāhole Point by types as defined by NELHA. Though until the mid-1990s research projects at Keāhole Point consistently numbered around 12, the commercial projects increased steadily from the first one in 1985 to a total of 10 in 1994. Today, research related tenants have declined in number while commercial/extractive and commercial/productive ventures have increased to 23. Educational and energy production facilities are few in number but expected to increase with the implementation of this master plan.

Acres of Land Leased or Available

Figure 2.4 depicts currently available land at NELHA that has not been designated or leased. There are approximately 349 acres available in the former HOST Park area and approximately 103 acres available on the ma kai former NELH lands. *Figure 2.5* depicts current tenants' terms of lease grouped by expiration dates: 1998-2009, 2010-2016, and 2017-2038. 500.17 acres are available for development by 2015, an additional 90.1 acres by 2020, and the remaining 74.41 acres available by 2021 or beyond.

To gain some perspective on the availability of land at the Keāhole Point facility, consider that of the total 870 acres, approximately 199.5 acres will remain in other lands such as conservation, roads, utility corridors and pipeline easements, and NELHA support services. This leaves 670.5 acres for tenant occupation, of which 273 acres are currently either leased or under option.

The Puna Research Center, Noi'i O Puna is located on 4.1 acres of which approximately 1 acre is developed with a visitor center area and two buildings which include office space and large covered work areas which can be configured for tenant use. These facilities have been vacant for some time, and NELHA staff estimates it would take approximately $50 -$100,000 to refurbish the facilities to marketable conditions.

Funding and Revenues

Until 2006, NELHA received operating funds from both the State of Hawai'i's General Fund and from actual revenues. The revenues were deposited in the NELHA Special Fund and included lease payments, revenues from analytical laboratory contracts, sale of seawater, and reimbursements from the tenants such as electricity and potable water. The intention was that as NELHA's revenues increased, operating funds requested from the State General Fund would decrease.

The 2006 fiscal year was the first year since its inception that NELHA did not receive any support from the State General Fund, which meant close examination by NELHA of opportunities to improve its fiscal health. State Funding enabled NELHA to subsidize aquatic agriculture for several decades through low, below-cost, seawater sales rates and very low land lease rates.

In 2006 NELHA sought to bring these rates more in line with actual costs and market rates. The basic increases raised "extractive" (such as water bottling) tenants' rates from approximately $200/acre-month to $3,000/acre-month and agricultural rates from about $150/acre-month to $500/acre-month. The rate increases affected new leases and affected existing leases when they came up for renewal.

According to tenants, these actions significantly impact aquaculture business viability at NELHA, and reasonably, tenants are eager to see NELHA seek alternate revenue streams and/or renewable energy production that help subsidize water rates and reduce the electrical costs of pumping seawater.

Employment

As previously mentioned, NELHA employs approximately nineteen employees: 8 administrative and 11 operational personnel that are paid from internally-generated revenues, not state general funds.

Based on directives during the Cayetano Administration, NELHA is striving to become financially self-sufficient; to operate like a private enterprise or a private non-profit organization. The hope is to reduce bureaucratic inertia and increase efficiency in meeting its goals for research, technological innovation and enterprise incubation. However, maintenance and retention of needed staff and staff resources for improvement and expansion of facilities and programs to forward the mission have been challenging.

2.3 LOCATION

NELHA is located at Keāhole Point, North Kona, Hawai'i, west of Queen Ka'ahumanu Highway, and adjacent to the western and southern boundaries of the Kona International Airport at Keāhole. Keāhole Point lies within the 'O'oma 2nd District ahupua'a, North Kona Moku (District) on the Island of Hawai'i . A lighthouse operated by the U.S. Coast Guard occupies the tip of Keāhole Point. To the south of the NELHA property is the proposed 'O'oma master planned development.

The Island of Hawai'i is the most recently formed of the Hawaiian Islands. Commonly referred to as the Big Island, it is nearly twice the combined land area of all of the other islands in the state combined. Formed by five volcanoes, its area is still being expanded by volcanic

eruptions. Mauna Kea, the highest of the five, rises 13,796 feet from the northerly part of the island.

The shore areas include small beaches are used for informal recreation. A jeep trail runs from Wawaloli Beach Park along the ocean frontage as part of a continuous casual access system to Pine Trees surf break. Significant Hawaiian archaeological sites have been located and will be managed as per guidelines established by the State Division of Historic Preservation and outlined in later sections. As documented in informational interviews with cultural practitioners, contemporary cultural practices continue along the shoreline including those related to traditional fishing methods.

2.4 CLIMATE

Coastal areas of North Kona have a semi-tropical, semi-arid climate. The average annual temperature is 75°F, with an average high of 83°F, and an average low of 67°F. Relative humidity is generally stable year-round, with the daily average ranging from 71 to 77 percent. Average annual precipitation in Kailua-Kona is 25 inches. NELHA's records from its own station at Keāhole Point indicate an annual precipitation of just over 13 inches. Solar radiation at the site is constant, with the days cloud-free an estimated 95% of the year (HTDC, 1985).

The North Kona Coast is largely sheltered from the predominant trade wind system by the land masses of Mauna Loa, Mauna Kea and Hualālai. Trade winds pass over the east rift of Kīlauea and cross South Point and the lower southern slope of Mauna Loa. As the air passes the southern tip of the island, frictional forces cause it to turn northward into a convergence behind the mountains. At the same time, heating of the protected lee slope of Mauna Loa and, to a lesser extent, Hualalai drives an upslope ashore wind known as the ''Kona Sea Breeze.'' This breeze meets whatever trade wind flow crosses the Saddle to form a precipitating cloud band. This accounts for the mid-elevation band of higher rainfall which lies between the 1,200- and 3,000-foot elevations on the leeward slopes of Hualālai and Mauna Loa. Rainfall decreases at lower elevations near the coast. After sunset the land cools, and a downslope breeze drains offshore.

Typical wind velocities range between 3 and 14 knots. One implication of this circulation pattern is that sulfur dioxide, the predominant pollutant emitted from Kīlauea volcano, oxidizes to sulfur trioxide and is injected into the Kona Sea Breeze where it can meet water vapor in the mid-level clouds and be incorporated as acid rain. A second implication is that air pollutants injected into this system will tend to persist in the area rather than be blown offshore by tradewinds as is the case in most other leeward areas of the state.

Present air quality in the project area is influenced by air pollutants from natural, industrial, agricultural and vehicular sources. Natural sources of air pollutant emissions which may affect the project area include the ocean (sea spray), plants (aero-allergens), wind blown dust and volcanoes. Of the natural sources of pollution, volcanoes are the clearly the most significant. This is especially so since the latest eruption phase of the Kīlauea volcano, which began in 1983. Emissions from this eruption can be seen in the form of volcanic haze (vog) which persistently hangs over West Hawai'i.

The major industrial sources in the project vicinity include the Keāhole Power Plant (operated by Hawai'i Electric Light Company) and the Kailua Landfill, operated by the County of Hawai'i. Emissions from the landfill consist mainly of fugitive dust from heavy equipment operation and noxious fumes from underground fires, which have been the subject of numerous complaints from people residing and working nearby. NELHA is situated far enough away so as not to be adversely impacted by emissions from the landfill.

Kona International Airport at Keāhole is a major source of air pollutant emissions. Aircraft, motor vehicles and fuel handling and storage are a significant source of carbon monoxide, nitrogen oxides, hydrocarbons, and to a much lesser extent, particulate matter and sulfur dioxide. These emissions are expected to increase in coming years as a result of airport expansion.

Queen Ka'ahumanu Highway is the region's major arterial roadway, and motor vehicles traversing it contribute exhaust gases to the air. Vehicle exhausts contain carbon monoxide, nitrogen dioxide, ozone, and lead. The latter three are generally broad-scale problems, if present, and rarely if ever exceed Ambient Air Quality Standards (AAQS) in Hawai'i. In the past elevated concentrations of exhaust were probably limited to areas near intersections during poor dispersion conditions. With increasing congestion along the highway, vehicle-related emissions may become an increasing concern along the transportation corridor. Carbon monoxide is the primary pollutant of concern from vehicle emissions.

2.5 MARINE ENVIRONMENT

Currents off Keāhole Point are dominated by two processes. Tidal oscillations drive reversing currents with diurnal and semi-diurnal periods. Typical maximal tidal current speeds are 3/4 to 1 knot. Tidal currents may be obscured for extended time periods by even stronger currents, large-scale eddies propagated from the 'Alenuihāhā Channel. These eddy currents commonly reach 2 knots. Offshore surface currents range in speed from 10 to 37 cm/sec or, on average, less than half a knot (Bathen, 1975). Deep currents have been measured in the range 1-10 cm/sec (Bretschneider, 1978).

The wave climate of the Kona coast is typically characterized by 2 to 4 foot waves with periods of 9 to 15 seconds. Wave heights rarely exceed seven feet, except during the winter months. Larger waves are generated by local "kona" storms and distant North Pacific storms.

Sea surface temperatures vary relatively little, generally remaining within the 24-28°C range. The wind-mixed surface layer extends 50 to 100 meters deep. The bottom of the thermocline may extend to 150 meters.

Offshore bathymetry at NELHA is rocky and steep, with water depths reaching 2,500 feet within a mile from shore. The rocky basalt shoreline drops abruptly to water depths of about 15 to 20 feet, then the ocean bottom slopes gradually to a shelf break at approximately 40 to 50 foot depths. Between the 500 and 2,500 feet depths, the bottom slope is approximately 30 degrees. Shallower than 500 feet, the slope angle decreases. Passages of white sand up to 30 feet wide occur between basalt outcrops running perpendicular to the shoreline. Lava from the 1801 Hualālai lava flow is present in beds up to 20 feet thick down to depths of 420 feet. At NELHA, cold water pipes gather water from 2,000 to 3,000 feet depths, while warm water pipe intakes are located between 30 and 80 feet below sea level.

2.6 WATER QUALITY

2.6.1 Coastal Waters

The quality of the offshore waters was a major factor in selection of the site for the Natural Energy Laboratory of Hawai'i Authority. In general, the water quality off Keāhole Point is very good due to the excellent circulation patterns and lack of major sources of pollutants. Essential plant nutrients, especially forms of nitrogen and phosphorous, are commonly used as indicators of water quality because they are often major components of waste discharge and, where adequate light is available, can cause undesirable growths of algae. Three distinct

nutrient layers have been identified in offshore depth profiles (Noda, et al., 1980). In the surface, wind-mixed layer, nutrient concentrations are low and uniform, the result of rapid nutrient uptake by phytoplankton, single-celled algae passively suspended in the water column. Below about 150 meters where light can no longer penetrate, nutrient concentrations rapidly increase due to lack of algal uptake, decomposition of particulate organic matter raining down from above, and diffusion from deeper waters. Maximal nutrient concentrations are found below 600 meters.

Coastal waters off Keāhole Point are classified AA by the State Department of Health (DOH). The complex hydrology makes simple monitoring inadequate. As such the monitoring program uses mixing plot models due to the volume of ground water seepage along the coast. The wave and current actions, tidal fluctuations and variations in fresh water inflow create a highly variable and dynamic hydrological regime. Waters classified AA are intended to remain as nearly as possible in their natural pristine state with a minimum alteration of water quality from any human-caused source or action.

The NELHA Cooperative Environmental Monitoring Program discussed later in this section monitors water quality at coastal stations.

2.6.2 Groundwater

Groundwater recharge in the Keāhole Point area is primarily from rainfall.

An unconfined basal lens underlies the coastal region of western Hawai'i from Keāhole northward to beyond Kawaihae and southward to beyond Keauhou. In the Keāhole vicinity, the lens is brackish, probably less than 125 feet thick and discharges freely along the coast in a narrow band a few feet wide in the intertidal zone (WRRC, 1980). The basal lens water does not meet the U.S. Drinking Water Standards even at the top of the lens and at a distance about 3 miles from the shoreline.

At Keāhole Point, brackish water discharges are primarily diffused and not usually visible along the shoreline The coastal part of the lens experiences appreciable ocean tidal influence.

2.6.3 Anchialine Ponds

Anchialine ponds are coastal land-locked bodies of water lacking surface connection to the sea, but with measurable salinities and dampened tidal fluctuations. They are found in porous substrata such as recent lava or limestone adjacent to the sea.

The West Hawai'i coast harbors most of the anchialine ponds in the state.

Two clusters of ponds have been identified on NELHA property. A northern complex of approximately three pools is situated north of the NELHA complex, and another group of seven small ponds lies north of the most southerly bend in the NELHA access road mauka of Wawaloli Beach. Biota in the Anchialine Ponds are discussed further in the *Flora and Fauna* section.

2.6.4 Monitoring Program

NELHA protects the environment through the Cooperative Environmental Monitoring Program (CEMP). Extensive biota, benthic, and water chemistry monitoring of anchialine ponds, nearshore ocean water, groundwater and incoming seawater streams produces data which permits quick response to any negative impact which may be caused by the activities on land. NELHA evaluates nearshore ocean water and groundwater data using a mixing plot model with end points generated from incoming surface seawater and upslope controls wells to determine anthropogenic nutrient subsidies. The comprehensive annual report interprets

long term trends according to the mixing plot model and State of Hawai'i Department of Health Water Quality Standards (Title 11 Chapter 54) and is available to interested parties.

In order to analyze water samples, NELHA invested in a fully staffed first-class analytical laboratory which performs sample collection and water chemistry analysis. An extensive quality control program is in place which involves yearly certification through the EPA's DRMQA program. Sampling and analytical services are utilized by tenants and both state and federal agencies.

2.7 TOPOGRAPHY

The topography of the nearshore portion of the NELHA site at Keāhole Point is generally level and varies from sea level to approximately 20 feet above mean sea level. The coastline is rocky and contains intermittent coral and basaltic (black) sand beaches, as well as basalt boulder beaches. The shoreline varies from level areas to elevations up to 15 feet which drop steeply into the ocean to depths of -10 to -20 feet. The newly vertical areas of the shoreline have numerous caves and lava tubes extending horizontally under them (HTDC, 1985).

Average slopes in the HOST Park area are less than five percent, sloping downward from Queen Ka'ahumanu Highway (elevation approximately 120 feet) toward the ocean.

The predominant land type is pāhoehoe lava with smaller areas of 'a'ā lava flows from Hualālai Volcano 3,000 to 5,000 year ago. The average lava flow thickness is about 10 feet. With the exception of narrow strips of coral beach deposit, very little soil is present at NELHA. Smooth pāhoehoe forms most of the rocky points along the shoreline that extend beyond the coral beach wash at the shoreline.

2.8 SOILS

The U.S. Department of Agriculture Soil Conservation Service Soil Survey report for the area designates soil types as 'a'ā (rLV) and pāhoehoe (rLW) lava flows *(Figure 2.6)*. These lava flows have practically no soil covering and are bare of vegetation except for clumps of dry grasses and a few small noni or naupaka shrubs. According to the Land Study Bureau's Detailed Land Classification report for the Island of Hawai'i, the area is designated as class "E" lands. Class "E" lands are very poor or the least suited for agricultural uses.

2.9 NATURAL HAZARDS

Though not within the scope of work for this master plan, roadways suggested in this plan should improve NELHA's hazard management capacity by providing alternate evacuation routes as discussed in the *Roadways* section of this chapter. While protection of the Māmalahoa Trail is extremely important, its limited crossing for preservation creates a situation where there is only one main route to higher ground via vehicle travel. Thus an evaluation of NELHA's ability to safely evacuate staff and tenants in the case of a tsunami *(Figure 2.7)* and other hazards-- including alternate transportation routes identified in cooperation with DOT Airports-- is recommended.

2.9.1 Volcanic Activity

The Keāhole area could be affected by eruptions of Hualālai and is in Zone 4 of the USGS Lava Flow Hazard Zones. Zone 4 Includes all of Hualālai, where large eruptions are estimated to reach the ocean about once every 300 years, a recurrence interval significantly lower than for either Kīlauea or Mauna Loa. Lava coverage is also proportionally smaller than flows

from these other mountains, or about 5 percent since 1800, and less than 15 percent within the last 750 years. Keāhole Point has also been identified as at risk from particle-and-gas clouds emanating from a Hualālai eruption. Hualālai's last errupion in 1801 covered the entire Keāhole Point area.

2.9.2 Seismic Activity

All of the island of Hawai'i is located in Earthquake Zones 3 and 4 (on a scale of 0-4 of increasing seismic occurrence and danger). The nearest rift zone to NELHA is at least five miles to the north. Earthquakes are frequent in the Kona area; a quake of magnitude 5 was recorded west of Kona in 1972 and another magnitude 6.7 in 2006.

2.9.3 Tsunami Hazards

Keāhole Point is sheltered from the major tsunami generation centers for the Pacific (the Aleutians and Chile); however, the effects of local quakes such as the one occurring in Ka'u in 1868, reported to have been between 7.5 and 8.2 on the Richter scale and to have generated a wave as high as 45 feet, are more severe. *Figure 2.8* illustrates the Tsunami Evacuation and Flood Hazard Zones at NELHA. All areas ma kai of the northwestern bend of the NELHA Access Road are in the Tsunami Evacuation Zone.

Examination of the Federal Emergency Management Agency's Digital Flood Insurance Rate Map (DFIRM), indicates that most coastal areas of NELHA are located within the A Zone, or the 100 year flood plain. The rest of NELHA is in Zone X, which includes areas outside the 500-year floodplain, areas within the 500-year floodplain, areas of 100-year flooding where average depths are less than 1 foot, areas of 100-year flooding where the contributing drainage area is less than 1 square mile, and areas protected from the 100-year flood by levees.

2.10 FLORA AND FAUNA

2.10.1 Flora

Coastal vegetation at Keāhole Point includes tree heliotrope (*Messerschmidia argentea*) naupaka (*Scaevola sericea*), Christmas-berry (*Schinus terebithifolius*), beach morning glory (*Ipomea pescaprae*), 'ilima (*Sida fallax*), and noni (*Morinda citrifolia*). A band of vegetation composed primarily of beach naupaka (*Scaevola taccada*), one to two meters tall, is found along the edge of the beach areas. Among the herbaceous species are nohu (*Tribulus cistoides*), pōhuehue or beach morning glory (*lpommoea brasiliensis*), Bermuda grass (*Cynodon dactylon*), alena (*Boerhavia diffusa*), and the native poppy (*Argemone glauca*).

Fountain grass (*Pennisetum setaceum*) is the dominant plant on the pāhoehoe landscape closest to the shore. Further inland, however, large areas may be dominated by the native piligrass (*Heteropogon contortus*) or by a Natal redtop (*Rhynchelytrum repens*) and 'uhaloa (*Waltheria indica var. Americana*) association. Shrubs of 'ilima (*Sida fallax*) and indigo (*Indigofera suffruticosa*) may be locally common, especially in depressions in the pahoehoe flows.

Widely scattered throughout the ma uka areas of NELHA are taller plants of kiawe (*Prosopis pallida*), Christmas-berry, 'a'ali'i (*Dodonaea viscosa*), maiapilo (*Capparis sandwichiana var. zohari*), and noni.

In some of the collapsed lava tubes which are frequently encountered on the site, ferns such as ki'iāu pueo (*Pteris vittata*), 'iwa'iwa (*Doryopteris decora*), and swordfern or kupukupu (*Nephrolepis multiflora*) may be found, although rarely.

The rough ʻaʻā flows support only a few plants, usually fountain grass, coat buttons (*Tridax procumbens*), or ʻuhaloa.

2.10.2 Fauna

There are low concentrations of birds in the predominant habitat of scattered fountain grass on pāhoehoe lava with occasional shrubs. Most birds in these areas at NELHA have been observed to be passing through on their way to more preferred habitats that provided more food, water, and cover.

The Grey Francolin bird has been observed on a more regular basis and presumably is able to utilize the available food sources more effectively than most of the birds found there. Its habitat usually extends to within 30 meters or so of the shoreline, where it is replaced by coastal birds, which are much more abundant, though also transitory. Many species feed along the coast during daytime hours, but roost elsewhere at night.

Beaches and sections of rocky coastline on the seaward edge of the strand vegetation comprise an important habitat for migratory shorebirds.

Indigenous birds commonly observed at NELHA include the golden plover, wandering tattler and ruddy turnstone. Introduced species known to be present include the Indian grey francolin, barred dove, common mynah, Japanese white-eye, house finch, house sparrow, cardinal and Brazilian cardinal, among other species.

The Indian mongoose, the common home mouse, roof rat, the Polynesian rat, and feral cats are known to inhabit the undeveloped portions of the NELHA site.

In their pristine state, anchialine ponds harbor a distinctive assemblage of organisms. Certain of these organisms, primarily decapod crustaceans, move between the open waters of the ponds and the interconnected water table below. Many of the existing ponds at NELHA have been degraded by the introduction of exotic fish which prey on the natural fauna. Typical populations in NELHA anchialine ponds include an assemblage of opaeʻula (*Halocaridina rubra*) and small unidentified red amphipods. At times, opaeʻoʻhaa (*Macrobrachium grandimanus*) are also present.

2.11 NOISE

A major source of man-made noise affecting NELHA originates from air traffic operations at the Kona International Airport. Otherwise, most of the site is exposed to relatively low ambient noise levels, with wind, surf and occasional traffic being the only noticeable sounds.

In measuring the impacts of noise, it is important to note that although people respond to the noise of single events, the long-range effects of prolonged exposure to noise appear to correlate best with cumulative metrics, which is the Federal Aviation Administration's (FAA) standard metric. Aircraft noise exposure maps with continuous noise contour levels were prepared as part of the Kona Airport's Master Plan Update to be completed in 2009. The Constraints Map (*Figure 2.9)* includes significant effect long range noise contours affecting NELHA from those maps developed by the Department of Transportation Airports Division.

2.12 LIGHT

Light is a potential pollutant resulting from development. With the level of development anticipated along the Kona coast, light pollution has the potential to be an increasing issue of concern. Light is known to affect the biology of marine organisms, and a reduction or

minimization of light pollution will help to preserve the excellent marine research environment at NELHA as well as reducing light pollution.

During the planning of new facilities, low voltage, shielded lights and indirect lighting should be utilized wherever possible. Concerns from the Kona Airport regarding lighting will be addressed through the Federal Aviation Administration's Form 7460, a Notice of Proposed Construction or Alteration that examines navigation concerns which all NELHA potential tenants will likely complete. Lighting considerations are also addressed in the design guidelines.

2.13 VISUAL CHARACTERISTICS

NELHA's location and geography create a landscape that is highly vulnerable to negative visual impact. Negative visual impacts often result from developments that do not blend with the surrounding landscape in terms of scale and contrast, including color and reflectivity. Concerns expressed in the 1989 HOST Park Master Plan by the High Technology Development Corporation, other project participants and the planners remain relevant:

- The site is highly visible from both the Queen Ka'ahumanu Highway and from Kona International Airport at Keāhole.
- The site is also highly visible from airplanes arriving at or departing from Kona International Airport at Keāhole.
- The barren lava terrain and lack of vegetation cover result in a site that is potentially highly vulnerable to adverse visual impacts from poorly sited and poorly designed facilities.

As a State Authority on ceded lands, NELHA's stewardship includes preservation of visual quality that is of increasing import as surrounding areas develop. Public views from public access points and along public roads are of greatest concern for preservation. As the visitor's gateway to West Hawai'i, the view from Kona International Airport at Keāhole is a unique one that should be considered in terms of development guidelines at NELHA. Other views that should be protected are those from the highly appreciated Wawaloli Beach Park, from the heavily traveled Queen Ka'ahumanu Highway, from the NELHA Access Road, and from the new Airport Access Road proposed in this master plan. It is essential that development at NELHA complements, or at the very least does not further detract from, the visual quality of this area of the West Hawai'i coast.

As development at NELHA continues, design guidelines developed as part of the 1989 Host Park Master Plan and updated as part of this plan should be uniformly applied. These guidelines are meant to prevent negative visual impacts by addressing landscaping; walls, fences and gates; exterior lighting; building materials; signs and graphics, and trash container locations and enclosures in an effort to maintain a visual quality that blends with the surrounding lava landscape.

Primary aesthetic criteria of the 1989 HOST Park Mast Plan were:

1) HOST Park should have a relatively low density of development, with emphasis on open spaces, attractively designed ponds and ocean-related facilities, island-style architecture and ample landscaping.
2) The visual clutter typical of industrial parks should not be permitted.
3) The High Technology Development Corporation should maintain high standards for architecture and other aesthetic considerations. These standards should be achieved

through the County administered Design Rules and HOST Park Rules through carefully designed lease agreements.

4) Land areas that are not developed should not be disturbed. It is essential that the natural appearance of the lava fields be preserved by avoiding permanent, defacing scars.

The updated design guidelines accompany this master plan in a separate document. Recommendations for enforcement include legislative action that forms a design review committee and grants NELHA enforcement authority. Enforcement of these guidelines will provide a scenic gateway to a flourishing Kona area and may improve NELHA's relationship with the local community that wants to see NELHA as part of its fabric.

2.14 CULTURE

2.14.1 Native Hawaiian Uses

Interviews conducted with cultural practioners and community members to inform this master plan reiterate that all ahupua'a have sacred sites, and NELHA would do well to let the land and the mo'olelo (stories) relevant to the NELHA area inform its programs and stewardship of its resources, as described in *Appendix B, Culture and Archaeology*. Practitioners believe that the ability to connect to the storied places from the mo'olelo is important for continuing the culture, and NELHA is the steward of some of those storied places. NELHA can help connect Native and non-Native Hawaiians and visitors alike to storied places at Keāhole through educational and interpretive programs.

Interviewees for this master plan affirm that Native Hawaiian practices at NELHA continue today. These activities include traditional forms of fishing and more controversial alterations of archaeological sites in the Ho'ona Preserve by some who claim lineal ties to Keāhole Point. Interviewees remind interested parties that asking kūpuna to share what should be protected puts them in a sensitive position since most cultural sites knowledge is traditionally not to be spoken. The best NELHA can do before beginning development is to conduct as comprehensive a survey of cultural resources as possible, including community consultation, and proceed unless kūpuna with knowledge of a sensitive resource step forward to recommend its protection.

The input of the Hawai'i Island Burial Council (HIBC) was sought to inform the master plan. At its February 21, 2008 meeting, following discussion of the master planning process, proper protocol for creating opportunities for discussion, and NELHA's stewardship of cultural resources, HIBC made the following recommendations for NELHA's master plan:

> Find the names of family and kūpuna (elders) from all ahupua'a connected to Wawaloli Beach Park (this includes most of West Hawai'i Island) and Kalaoa, 'O'oma, the ahupua'a in which NELHA is located, and form a permanent cultural advisory group to NELHA comprised of members of these families.
>
> Oral histories and a complete Archaeological Inventory Survey for all of NELHA should be conducted/compiled.

This master plan recommends that the State legislature and NELHA work together to enable the formation of a cultural advisory committee to enable NELHA to better manage cultural landscapes and activities. Specific goals of this committee include communication with the local community, protecting historical and archaeological resources, providing input on proposed development and programs without disclosing culturally sensitive information,

and ensuring appropriate educational interpretation. Additionally, NELHA's mission to provide education should also include cultural education relevant to its locale.

2.14.2 Historical and Archaeological Resources

A number of surveys of historical and archaeological resources have been conducted on the land NELHA occupies beginning in the 1930s, many of which are summarized in *Appendix B, Culture and Archaeology*. Several of these studies were conducted before recent newer policies and procedures were enacted, e.g. the Island Burial Councils established in section 6E-43.5 of the Hawai'i Revised Statutes as created by Act 306 (Session Laws 1990) and amended under HRS 66-42. The standards by which many of the the studies were conducted might not meet current best practices.

This master plan recommends that NELHA, SHPD, and DLNR work with the local kupuna to create a future management plan for the Ho'ona Site that is coordinated with a cultural management plan for all of Keāhole Point.

2.15 SOCIAL AND ECONOMIC CONTEXT

2.15.1 State of Hawai'i

The 2000 United States Census reported that resident population of Hawai'i County was 148,677 people in 2000.

Population projections commissioned by the State Housing Finance and Development Corporation of Hawai'i (HFDCH) and calculated by SMS Research indicate that the Hawai'i County population reached 170,689 people in 2007 (SMS 2007).

Projections indicate that the Hawai'i County population will increase to 224,573 people in 2030, a 51 percent increase from the 2007 population (SMS 2007). For the North Kona District (Census Tract 215.01) and South Kohala District (Census Tract 217.01), the population is expected to increase to 58,300 people in 2030, a 160 percent increase from the 2007 population and an average annual increase of 4.3 percent (SMS 2007).

The growth of Hawai'i County in terms of employment, population, income, and economic activity has been more closely tied to the visitor industry than any other sector of the economy. As tourism became the primary economic generator during the 1980s, a shift in employment from the non-service to the service industry sector was evident.

In 1980, the service industry accounted for approximately 60.6 percent of average employment, rising to 71.3 percent in 1990 and 78.5 percent in 1997. Between 1981 and 1997, the County experienced the largest growth in hotel job count statewide with an average annual growth rate of 5.2 percent. The principal visitor destination area of the County is the North Kona and South Kohala regions (Hawai'i County 2005).

The County of Hawai'i has supported annual increases in the number of employed persons since 2000. In February 2007, there were an estimated 81,450 employed persons in the County (DLIR 2007).

As NELHA develops into a larger ocean and energy research park, it could help diversify West Hawai'i's economy and provide much-needed jobs that are not dependent on the visitor industry. Simultaneously, NELHA plans to create separate programs reflecting its vision that educate visitors arriving at the Kona Airport and the local community. Based upon feedback received in community interviews, NELHA should encourage its tenants to partner with the University of

Hawai'i Center, West Hawai'i/Hawai'i Community College and other local schools to create job training programs in ocean and energy technology.

2.15.2 Kona

Forty years ago, West Hawai'i was composed of scattered villages with a primarily agricultural economic base. Population was approximately 14,000, and there was limited tourism commercial, and industrial activity. Most of the County's businesses were located in East Hawai'i.

The construction of Queen Ka'ahumanu Highway in the early 1970s led to the development of destination resorts along the North Kona and South Kohala coastlines. Over the last several decades, land uses in West Hawai'i have grown more commercial and development has catered to wealthy second home-owners, particularly ma kai of Queen Ka'ahumanu Highway.

Today, the North Kona and South Kohala districts contain the primary drivers of the region's economy anchored in the visitor, construction, and service industries. Kailua-Kona is the regional hub and has attracted retailers, shopping centers, residential and vacation home development, and industrial uses.

The North Kona/South Kohala area contains approximately 2.1 million square feet of retail space and approximately 500,000 square feet of office space. The majority of the retail and office space is in the North Kona area. Commercial establishments in North Kona serve broad regional markets across the County. Examples of this are Costco and The Pottery Terrace. The retail vacancy rate in the North Kona/South Kohala area is approximately two to three percent, indicating that the retail market is undersupplied. Office vacancies are about seven percent in North Kona, and zero percent in South Kohala.

2.16 EXISTING FACILITIES

2.16.1 Evolution of Business, Energy, and Research at NELHA

NELH

- In 1974 the Hawai'i State Legislature created the Natural Energy Laboratory of Hawai'i (NELH) on 322 acres of land at Keāhole Point. NELH was mandated to provide a support facility for research on the ocean thermal energy conversion (OTEC) process and its related technologies.
- In 1979, a barge dubbed "Mini-OTEC," anchored offshore of Keāhole Point, demonstrated the world's first production of net electrical power via closed-cycle OTEC. In 1980, after necessary environmental impact and other surveys were completed and master permits obtained, the NELH facilities and first pipeline to draw deep seawater from 2000 feet and surface seawater from 45 feet depths were constructed at Keāhole Point.
- In 1981, shore-based OTEC research began with a project testing biofouling and corrosion countermeasures for the closed cycle OTEC process.
- By 1984 it was apparent that the seawater being pumped up for OTEC research had many other profitable uses. New legislation legalizing commercialization on state property allowed NELH tenants to commercialize.

HOST Park

- In 1985, the Legislature created the Hawai'i Ocean Science and Technology (HOST) Park on 548 acres at Keāhole to accommodate NELH's growing businesses.

High Technology Development Corporation

- High Technology Development Corporation was established in 1983 as a state agency by the Hawai'i State Legislature to facilitate the development and growth of Hawai'i's commercial high technology industry.
- HOST Park was HTDC's first development.

NELHA

- In 1990, HOST Park and NELH were melded into one agency, the NELH Authority (NELHA), attached to the Department of Business Economic Development and Tourism of the State of Hawai'i.
- In 1998-99, the Legislature expanded the activities allowed at NELHA to include other business activities that could enhance economic development and generate additional revenues to support the growing park. In 2003, the design and planning of the NELHA Gateway facilities was completed for distributed energy resources and renewable energy research and development.
- In 2004, the Hawai'i Gateway Energy Center at NELHA neared completion, as did NELHA's new 55-inch pipeline seawater delivery system, with the world's largest and deepest (3,000 ft deep) seawater intake.

2.16.2 Evolution of Activites at Puna

- The Noi'i o Puna, or Puna Geothermal Research Center, was built in 1984 for research, demonstration, and commercialization projects that utilize the hot steam available from the Hawai'i Geothermal Project's adjacent geothermal wells as a joint effort between the State of Hawai'i and the United States Department of Energy.
- The Community Geothermal Technology Program, with participants from the Hawai'i Natural Energy Institute of the University of Hawai'i, and the then Department of Business, Economic Development, was formed in 1985 as a public laboratory at Noi'i o Puna to encourage the use of direct heat and by-products from the Hawai'i Geothermal Project's geothermal well and to support Puna District small businesses.
- From 1984-89, the Community Geothermal Technology Program awarded funds to grantees to utilize the heat from geothermal well for projects including glass production, cloth dyeing, fruit product processing, lumber drying, and greenhouse bottom heating.
- The Community Geothermal Technology Program's projects were terminated in 1989, and the Noi'i o Puna facility has been underused or even idle since because there was no available heat for direct heat projects after the Hawai'i Geothermal Project's plant and well were shut down in December 1989.
- In 2001, Puna Geothermal Venture was chosen by NELHA to operate Noi'i o Puna to develop a system to produce hot potable water for new direct heat projects that will allow the reactivation of Community Geothermal Technology Program.
- In a 2001 Senate Concurrent Resolution, the State Senate and House of Representatives concurred that NELHA was requested to revive and update their 1992 Reactivation of the Noi'i o Puna Research Center proposal which includes the installation of a heat exchanger and pipeline to generate waste heat from geothermal reinjection fluids at the Puna Geothermal Venture facility, improvement of the Noi'i o Puna facilities to accommodate expanded Community Geothermal Technology Program operations, and the establishment of direct heat geothermal projects proposed by the community to be conducted under the Community Geothermal Technology Program at Noi'i O Puna.

2.16.3 Business Incubation

A number of aquaculture tenants use the cold seawater to grow high-end marine organisms for national and international retail markets. These products are rarely available in a retail setting at NELHA. Aquaculture products include algae-based nutraceuticals, shrimp brood stock, abalone, aquarium-stock fish and seahorses, kampachi, lobster, and culinary seaweed. Four companies currently bottle desalinated deep seawater destined for individual sales in domestic and Asian markets.

Currently, there is no major retail tenant at NELHA, though past plans have suggested commercial development along Queen Ka'ahumanu as a way to bolster revenues and make research and business incubation more viable. With the expected population growth and development surrounding NELHA, it may be that commercial development at NELHA was not ripe until now.

2.16.4 Education

Providing resources and facilities for energy and ocean-related education is a part of NELHA's mission statement affirmed by the Board of Directors in the current master planning process. Direct education and outreach projects currently in place at NELHA are limited to the West Hawai'i Explorations Academy, a public charter school, and visitor tours and seminars at the Gateway Center and (for fee) at some of the aquaculture operations.

The Hawaiian Islands Humpback Whale National Marine Sanctuary has an office at NELHA, and staff from this office participate in marine education off site. Similarly, the University of Hawai'i Sea Grant Extension Service at NELHA works closely with NELHA and its tenants to improve the effectiveness of community outreach and education regarding coastal stewardship, but programs are generally not held at NELHA.

NELHA provides office space to the Charter School Review Panel, which authorize public charter schools.

2.16.5 Energy

NELHA's Green Energy Zone Plan outlines NELHA's effort to convert to green energy all of its production and consumption of power by 2012. In pursuit of the Green Energy Zone Plan, NELHA began work on a 1 to 3 Mwe photovoltaic solar array project in 2007, when it was intended to generate power for both NELHA and the Kona International Airport. DOT Airports subsequently decided to pursue solar array development at its airports on an independent basis. The plan for the solar array is now for powering one or two of the NELHA seawater pumping stations in order to reduce electrical costs and offset seawater cost for tenants.

Among other initiatives, the plan calls for renewable energy development on the vacant land at Unualoha Point and a 1 MW Ocean Thermal Energy Conversion plant. Areas of renewable energy in which many of the new tenants at NELHA are working include biodiesel, solar-thermal technology, wind energy, and waste to energy gasification.

The Gateway Energy Center, located at NELHA's entrance, is a LEED Platinum building completed in 2005 meant to model the use of green building materials and designs and to demonstrate energy-efficient and renewable technologies. The facility was planned to host renewable and distributed energy research projects. Current tenants are the Friends of NELHA and the Hawai'i Island Economic Development Board, but the Green Energy Zone Plan aims to create a microgrid at NELHA in the near future to encourage more experimental technology tenants to locate at Gateway.

2.16.6 Research

NELHA does not currently conduct original research programs. Tenants engaged in pure research include the University of Hawai'i Infrasound Laboratory, Woods Hole, the University of West Virginia and the Georgia Institute of Technology's lab researching marine biota. Makai Ocean Engineering will begin heat exchanger research in the near future.

2.17 EXISTING USES, LEASES, STRUCTURES, AND ENCUMBRANCES

NELHA houses 43 commercial and research/development tenant companies. *Figures 1.4, 2.3, and 2.5* depict existing tenant type, tenants at NELHA, and terms of leases for those existing tenants. *Figure 2.10* is a spreadsheet of existing tenants, their type, and length of lease. These maps are meant for informational purposes and are not meant to indicate that NELHA will not renew leases of existing tenants.

2.18 RECREATION

The Keāhole Point region provides high value shoreline and ocean recreation on both a regional and island-wide scale. NELHA maintains, at its own expense, a popular beach park with parking, restrooms and showers. The shoreline areas fronting the NELHA site are used by the general public for various recreation activities including fishing, diving and tide pool swimming.

Increasing public use of the shoreline area may generate detrimental effects on the beach recreation areas, the quality of the ocean recreation experience, and the over exploitation of near shore and intertidal marine life. Therefore, it is important that public activities at the shoreline be managed to insure that public access and use are consistent with conservation of the existing natural resources, do not compromise the security of NELHA and meet the recreational needs of the community.

Controls on the shoreline activities are enforced by NELHA personnel. The Hawai'i County Police and/or Department of Land and Natural Resources Division of Conservation and Resources officers are called when needed to deal with specific situations.

The current Shoreline Management Plan (SMP) does not address plans for the area of NELHA between Ho'ona Bay and Unualoha Point. An SMP approval is needed prior to developing this area as part of the implementation of this master plan. Currently some fishermen and hikers periodically access the area though there are no formally designated trails or improvements in the area. A large portion of the site has been previously graded.

2.18.1 Wawaloli Beach Park

The four miles of rocky shoreline from Kaloko to Keāhole Point are backed by a long, sandy reach of storm beach that is frequented by beachcombers, campers, fishermen, sunbathers, picnickers, surfers, and scuba divers. Wawaloli Beach, maintained as a public beach park by NELHA, is one of the most popular stretches of this beach. It is accessible via the NELHA Access Road.

A permanent paved parking area and restroom facility are provided by NELHA at Wawaloli Beach, as mandated in the HOST Park development plan. Trash receptacles are placed near the parking area and in convenient places along the beach to minimize littering. NELHA staff empty and maintain the trash receptacles and separate receptacles for can recycling. Trash is often overloaded on the weekends and becomes a breeding ground for pests and insects.

Signs are posted stating that parking is allowed only in designated areas and parking and driving on the sand are forbidden. The days and hours that the area is open for the public are included on the signs. Signs warning against littering are also installed in various locations along the shoreline. NELHA staff attempt to monitor compliance with these signs; however weekends where the bulk of visitors are present are not monitored by State Employees that only (normally) work Monday-Friday.

Local community members interviewed for this plan almost universally echo their appreciation for the beach park and the NELHA Access Road for exercise and beach-going. The public likes that the shore is not frequented by tourists and maintains cleanliness in its facilities and a low-key community feel with barbecues and picnic tables.

2.18.2 Fishing

The four-and-one-half miles of rocky shoreline from Keāhole Point to Mahai'ula consist of low sea cliffs, some of them veneered by storm beaches of black sand. Keāhole Point and other rocky headlands are used by pole fishermen. 'Opihi picking is no longer common, as most were harvested from shoreline rocks long ago. There is intensive use of the nearshore waters by fishermen trolling from boats which pass close to Keāhole Point. Throw net fishing is practiced from the wave-washed benches along the shoreline of Wawaloli Beach and elsewhere throughout the shoreline area.

2.18.3 Aquaculture Tours

Some aquaculture companies offer tours to the public, but many have stopped due to biosecurity and liability concerns. The most successful aquaculture tours are those where cruise ship tourists and the general public view seahorse production for the aquarium industry. Other tenants note that while they provide tours, their animals are not as charismatic as seahorses and are thus less tantalizing to the public. Big Island Abalone has some success with tours targeted at its main consumptive market, Japanese nationals.

A NELHA central visitor center that acts as a public front for many of the aquaculture tenants' animals could provide public education, help tenants maintain biosecurity, reduce liability concerns, and boost sales and publicity. Such a center is recommended either as part of the Economic Driver or Science and Technology Cultural Center use zones of this master plan. Development options for these facilities will be discussed in Chapters 3 and 4.

2.18.4 Camping

Before NELHA and its predecessors developed Wawaloli Beach Park, the shoreline south of Wawaloli Beach and coastal areas near Ho'ona Bay were frequented by overnight campers. There is only one public beach park where camping is permitted in the entire district of Kona (North Kona and South Kona combined), which begins at Manukā to the south and extends to 'Anaeho'omalu in the north – remote Miloli'i Beach Park.

Earlier plans called for an overnight camping program at NELHA, but due to limited staff and security considerations, camping permits are only offered on a limited basis and only for cultural, religious, or educational purposes. Otherwise, NELHA does not allow camping (which is generally prohibited in the Special Management Area) and has removed campers several times.

In the past, NELHA has experienced some difficulty with individuals claiming lineal descendancy who made semi-permanent encampments in the Ho'ona Bay Archaeological Preserve area. The preserve is currently being maintained by a caretaker with cultural knowledge of Keāhole Point. The recommendation to institute a cultural advisory group

committee composed of kūpuna knowledgeable about Keāhole Point would help address similar conflicts as they arise through proper cultural channels.

2.18.5 Access

Access to Pine Trees
Access to the popular surf break Pine Trees, south of NELHA's property, is commonly begun on a jeep trail south of Wawaloli Beach park and runs across the adjacent 'O'oma property. This trail runs extremely close to archaeological resources. Efforts to close the trail to protect the resources were met with public outcry, so the gates remain temporarily open. This trail is also used for recreational use by bikers, joggers, walkers, and beachcombers' access.

Night Fishing
NELHA issues permits to night fishers for access south of the Ho'ona Preserve.

Cultural Access
Wawaloli Beach has been a historical gathering place for many ahupua'a on the West side of Hawai'i, so in some ways access to the beach park continues this tradition. Cultural practitioners regularly access Keāhole Point for gathering of plants, seafood, and seaweed in traditional ways. There are sensitive offshore and onshore cultural areas in the vicinity of Wawaloli Beach, Kalihi Point, Ho'ona Bay, Makako Bay, and Unualoha Point. Community consultation with kūpuna and practitioners from across West Hawai'i knowledgeable about these resources is strongly recommended when planning development in these areas. The cultural advisory committee recommended for NELHA in this master plan will also address these access issues.

2.19 INFRASTRUCTURE

Group 70 contracted with Austin Tsutsumi and Associates for civil engineering services to provide input to the master plan including a Subdivision Layout Plan and a Drainage Master Plan. This report is included in the master plan in *Appendix C* and discussed further in *3.0 Conceptual Master Plan for NELHA at Keāhole Point*.

2.19.1 Parking

Off-street parking requirements for NELHA will be in compliance with the County of Hawai'i standards. Each lessee is required to meet the minimum parking standards within the compounds of their lease area. Public parking stalls are provided by NELHA at the Gateway Center and Wawaloli Park.

2.19.2 Roadways

The existing site is accessed from Queen Ka'ahumanu Highway via a single 24-foot wide asphalt concrete pavement road, i.e. NELHA Access Road. The right-of-ways vary between 80-feet and 110-feet. The wider 110-foot section begins just after the first interior intersection and ends near the main roadway bend near the booster pump station site. The Access Road is approximately 11,600 feet in length and is a public roadway. The road provides access to the NELHA and tenant facilities, shoreline, "Pine Trees" beach and Wawaloli Beach Park.

2.19.3 Water

The existing on-site potable water system consists of a 12-inch main connecting to the existing County Department of Water Supply (DWS) 12-inch main in Queen Ka'ahumanu Highway, via a master meter near the Access Road entrance. Interior lots are currently individually metered.

The existing off-site DWS system consists of a 12-inch main in Queen Ka'ahumanu Highway. There is a larger line 16-inch main in the Highway, but not fronting the site, which ends south of the property at Kealakehe Parkway. Current source wells are the Palamanui & Makalei wells in the Kalaoa, Kaloko and Honokohau zones, and the Kahalu'u well in the Keauhou zone. The storage tank sites are scattered with the nearest tanks off of Kaiminani Drive, Hinalani Drive and Kealakehe Parkway.

The Hawai'i Ocean Science and Technology (HOST) Park currently receives an allocation of 400,000 gallons per day (gpd) from the DWS.

2.19.4 Fire Protection

Fire protection planning for the proposed project will utilize appropriate provisions of the Uniform Fire Code as required by the County of Hawai'i Fire Department. Prior to constructions the Fire Department will review and approve plans for fire access roads, building access, water supply, fire protection systems and life-safety systems. Minimum fire-flow water requirements will depend on building construction and floor area in accordance with the information provided by the Fire Department.

2.19.5 Sewer

The existing lots are serviced through on-site individual wastewater systems (IWS). Exact wastewater generation totals are not known, as they are maintained and managed by the individual lot owners.

2.19.6 Drainage

The general slope of the site is from ma uka along the Queen Ka'ahumanu Highway boundary (elevation 143-feet mean sea level) down to ma kai at the shoreline (elevation 11-feet). The terrain is very irregular and undulating due to the old volcanic lava flows. Culvert crossings under Queen Ka'ahumanu Highway consist of the following (for reference, the existing NELHA access road is a Queen Ka'ahumanu Highway Station 172+50, with stations increasing in the north direction):

The Queen Ka'ahumanu Highway Widening project by State Department of Transportation may upsize the culverts; however, a timetable has not been given on this project. The design contract for this work was recently awarded (2009) and construction funding is being requested.

Using the TR-55 Method for hydrologic calculations, the total existing runoff from the drainage area above the Highway contributing to the HOST Park section of the site is 3,800 cubic feet per second (cfs), for the 100-year, 24-hour storm.

The on-site areas are broken down into six major drainage areas – four within the HOST Park site and two within NELHA. The total existing runoff from the HOST Park section of the site is estimated at 1,176 cfs. The total existing runoff from the NELHA section of the site is estimated at 659 cfs.

2.19.7 Ocean Water Supply and Disposal

The sea water supply and disposal system is NELHA's signature asset. It provides a tremendous resource for research and application in alternative energy use, aquaculture, pharmaceuticals, mineral extraction and biofuels among others. Its maintenance and expansion in the future are critical to NELHA's special niche and identity.

The most serious potential impact from seawater return flows generally arises from the temperature and density of the return water. Return water must meet DOH standards before discharge. Seawater return flow percolates into the groundwater system, mixing and diffusing to a certain extent before seeping into coastal waters near sea level.

In the original environmental review processes, both HTDC FEIS and the NELH FEIS based their evaluation of potential environmental impacts on the same seawater return flow volumes. Experience revealed that the location and sizes of disposal trenches needed to be modified through return flows with greater dispersal.

De-centralization of disposal now reduces the ratio of seawater return volume to groundwater volume so that the concentrations reaching coastal waters are more diluted than a centralized discharge. Individual subsurface disposal systems now at NELHA are more localized and generate less impact than those associated with a centralized disposal trench system. A dispersed set of monitoring wells provide a comprehensive environmental monitoring program (CEMP) with a good tool for monitoring water quality impacts.

To date the CEMP indicates return water is not a problem. Current discharge volumes are about 10-12,000 gpm and NELHA has the environmental permits for 142,000 gpm, over 10 times that volume.

2.19.8 Electrical/Communications

Electrical power to the area is supplied by the Hawai'i Electric Light Company, Inc. (HELCO) via an existing distribution substation that was sized to serve HOST Park (*2.20.9 Solid Waste)*.

Hawaiian Telephone Company has an existing 3-inch conduit serving the NELHA facilities. The existing capacity is adequate for the proposed project.

2.19.9 Hazardous Materials Storage and Waste Disposal

The Hawai'i Integrated Solid Waste Management Act (Chapter 342G, HRS) establishes guidelines for the counties for development of management plans by January 1, 1993. In order of priority, the recommended practices and processing methods are 1) source reduction, 2) recycling and bioconversion (including composting), and 3) landfilling and incineration.

Future tenants at NELHA may generate significant solid waste streams, including settled solids from exhibits and aquaculture operations, food wastes from food service facilities, green waste from landscaping and miscellaneous wood, paper, plastic and metallic wastes.

Each facility should institute waste management, recycling and waste reduction plans. In particular, composting would be employed if appropriate sites and facilities become available.

Hazardous materials use, generation, storage and transport are subject to regulations under the Resource Recovery and Conservation Act (RCRA) and the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980. As such there are protocols for documentation in a chain of custody from cradle to grave for such use and generation. Each leasee is responsible for complying with the requirements of RCRA and CERCLA on its own. No long term storage on site is permitted.

2.20 SURROUNDING USES

2.20.1 Airport

Master planning efforts for NELHA were done in communication with DOT Airports' 2009 Kona International Airport at Keāhole master planning process. The airport is north of NELHA on 3450 acres of land. The airport currently has an 11,000 foot runway, but plans to build additional runways ma kai of the existing runway, which will impact NELHA's operations, as depicted on *Figure 2.9 Constraints Map*. Additional conceptual plans for the airport include developing the frontage along Queen Ka'ahumanu Highway with operations that complement airport and surrounding development, including a hotel/conference center and a cultural education center.

Potential areas for partnership between the airport and NELHA, further detailed in *3.0 Conceptual Master Plan*, include supplying renewable energy and deep seawater cooling for airport developments, renewable fuel vehicle transport for arriving passengers, and synergy between tenants along the Queen Ka'ahumanu corridor.

2.20.2 University of Hawai'i Center, West Hawai'i Community College

The University of Hawai'i Center, West Hawai'i provides instruction across multiple disciplines, including Hawaiian Lifestyles, hospitality and tourism, tropical forest ecosystem and agroforestry management, and early childhood education. The college is located in Kealakekua, approximately eighteen miles south of NELHA.

Potential areas for partnership between University of Hawai'i Center, West Hawai'i include job training programs, internships in the sciences, and cooperation between tenants catering to the visitor industry at NELHA and the college's hospitality and tourism program.

2.20.3 'O'oma Beachside Village

Bordering NELHA to the South is a proposed 302 acre master-planned development called 'O'oma Beachside Village. 'O'oma is envisioned as a mixed-use sustainably designed community including homes, retail-commercial space, a school, trails, and parks.

Areas for possible partnership between 'O'oma and NELHA include connectivity of public spaces, educational programs with the schools, workforce housing, renewable energy and green design demonstration, cold seawater cooling, and alternative transportation fueling stations.

2.21 CONSTRAINTS

2.21.1 Land Use Designations

State Land Use District

The majority of the NELHA lands are in the State Urban district which offers no constraints to development. Three sections are located in the State Conservation District which does restrict many of the proposed or potential activities identified in the master plan. The three areas in conservation include the tip at Keāhole Point including the lighthouse site, a triangular section north of Wawaloli Beach ma kai of the NELHA Access Road and the end of the airport runway buffer and a larger piece ma uka of one of the deep ocean cold water the pump station and archaeological site and adjacent to 'O'oma. While conservation lands can be used for designated research and recreational uses if structures are to be built or either parcel is to be used for light industrial uses they would need conservation district use application (CDUA) permits (CDUP) for each facility or use. These permits are evaluated on a case by case basis.

Extensive, extractive uses are usually not allowed. For most purposes the parcels need to be redistricted urban and rezoned. State land use boundary amendment (SLUBA) applications are processed though the State Land Use Commission. CDUPs are processed by the State Board of Land and Natural Resources.

Redistricting Conservation lands triggers Chapter 343, the State Environmental Impact Statement (EIS) law. Prior to submitting an application for a SLUBA or a CDUA an EIS will need to be prepared, filed and accepted.

County Land Use

The County General Plan and the Kona Community Development Plan (KCDP) include the NELHA site within their designated urban area. The County Land Use Pattern Allocation Guide (LUPAG) also identifies the shoreline area as an open district. There are restrictions on development in the open district usually limited to open space, recreational uses, single family homes and accessory recreational facilities.

Most of the site is zoned for light industrial use. This is a flexible and useful zone. The industrially designated lands in NELHA are zoned MG-1a, MG-3a and ML-3a. MG stands for general industrial where a wide range of uses are allowed. ML stands for limited industrial which still allows a fairly wide range of uses. The 1 a and 3 a suffixes refer to the minimum lot sizes. Front yard setbacks in this zone are 20 feet.

For compatibility and maximum flexibility the areas currently in the State Conservation District (other than the archaeological preserves) should be rezoned to the adjacent industrial zoning designation.

The rezoned conservation lands will probably need a special management area (SMA) permit since they were not covered in the original permit (SMP) for NELHA.

2.21.2 Shoreline Regulations

Shoreline developments are guided by the National Coastal Zone Management (CZM) act which was adopted in 1972. The State CZM law was passed in the 1970s and regulations were incorporated in the State Special Management Area (SMA) laws. The State delegated SMA regulatory authority to the Counties and permits under CZM are granted by the Counties. In Hawai'i County the final authority for SMA approval is the County Planning Commission. Projects located in the SMA require a special permit (SMP). NELHA has an SMA approval but not all sites are covered and when there are significant changes to the master plans a new SMP or amendment is needed. The conservation district adjacent to 'O'oma is not covered by the existing SMA and any significant development in that area will require and SMP. Each County determines how far inland the SMA boundary is located.

Shoreline developments will generally measure itself from the State Certified Shoreline. This is determined by the State Surveyors office usually based on private surveys certified by the State Surveyor.

Projects that are located in the state shoreline setback zone (40 feet from the State certified shoreline) require a shoreline setback variance (SSV). Usually SSVs are processed concurrently with the SMA if both actions are required. If not they may be processed individually. Both the SMA and the SSV require a State certified shoreline as a necessary part of the application documents.

In addition to the State and County requirements NELHA has established a more restrictive shoreline setback 125 feet from the State certified shoreline.

2.21.3 Heights

Height limits in the ML and MG zoning districts are 45 feet and 50 feet respectively. NELHA Design Guidelines have established a lower limit at 40 feet above grade.

2.21.4 Archaeological and Cultural Constraints

Two large significant complexes and two smaller sites are designated for preservation. The Hoona Fishing Village complex and the Wawaloli complex adjacent to ʻOʻoma are large and conditioned for preservation. Both have lineal ahupuaʻa descendant families associated with them who need to be consulted parties in any future treatment of the sites.

A smaller site near Kalihi Point is also slated for preservation. Additionally three other sites near Kalihi point are designated for further research. There are other sites documented in other sources that need additional research and documentation in the future.

Māmalahoa Trail runs through the ma uka old HOST Park lands. This trail must be preserved and no further breaches of the trail are allowed. An easement designates the trail alignment and buffers and building setback lines from the easement have been established. See design guidelines.

State law under the Public Access Shoreline Hawaiʻi (PASH) case permits traditional cultural practices in most vacant and unused lands. Rights asserted under PASH and Act 50 requires reasonable access in both ma uka – ma kai directions and laterally along the shoreline. The proposed Ala Kahakai National Historic Trail alignment activities will also need to be accommodated through the property.

While not specifically designated as some of these sites and information is kept within families, it has been reported that several fishing koa (fish gathering places) for specific species exist offshore of the Keāhole coastline. These places are sites out in the ocean where certain families have maintained kuleana responsibilities by feeding fish to maintain a bountiful population for subsistence purposes. NELHA activities in the ocean research zone should be mindful of these koa and work with local fishing families to avoid conflicts of use as much as possible.

2.21.5 Tsunami Evacuation Zone

The shoreline areas of all islands are located in the tsunami inundation zone. NELHA is no exception and portion of the site are within this zone, in some places up to 3000 feet inland depending on topography and bathymetry. This area is designated on the constraints map.

2.21.6 Airport Constraints

Proximity to the airport has advantages and disadvantages but constraints are set by flight paths and noise contours. Flight paths set restrictions on the placement and heights of buildings within the landing and approach paths. This restrictive easement is shown on the constraints map. Flight noise creates zones where long term exposure without mitigation may cause ill effects. This zone is identified in the map.

2.21.7 Drainage

While the lava landscape is fairly porous there are defined drainage paths in the landscape. This indicates that runoff is a constraint and drainage improvements are needed. Additionally, existing culverts under Queen Kaʻahumanu Highway allow up slope runoff to come through the highway prism into NELHA lands. Furthermore, site runoff has created some on site drainage paths. The constraint map shows the existing drainage channels (dotted blue lines) and proposed drainage easements to direct this potential runoff and upslope flows into defined channels.

2.21.8 Water Quality

The waters off Keāhole are among the best in Hawai'i. They are classified AA. This clean ocean water is both a resource and a constraint. Because of its quality federal and state regulations require special caution about any discharges into the ocean and even drywell discharges in the coastal zone because of concerns about the potential for groundwater contamination of coastal marine waters. NELHA has existing monitoring programs with water quality tests conducted at its modern water chemistry laboratory.

This constraint is not mapped because essentially the entire site is affected by this condition and there are really no boundary lines to draw. However, all activities on site which involve the use of hazardous and potentially contaminating materials or activities must follow protocols to prevent spills and contamination. Disposal of used water and any discharges of return water must be in compliance with the national clean water act sections 401 through 405 and State Department of Health (DOH) regulations. Section 402 NPDES and Section 401 water quality certifications may be needed depending on the type of activity.

Wastewater disposal must comply with Department of Health Administrative Rules, Chapter 11-62.

Construction activities must also follow DOH regulations for cleaning, dewatering and discharges to preserve clean water.

2.21.9 Road Easement

There is a State of Hawai'i easement that runs through parcel 7-3-43:82. It has been labeled as the Kings Highway. It looks like a remnant roadway easement that does not go anywhere. Retention of this easement places severe restrictions on the lot and street layout for this section of the NELHA site. The easement ultimately connects to Queen Ka'ahumanu Highway on the adjacent 'O'oma property but we note that plans for the adjacent 'O'oma development do not accommodate this easement. It seems they are also planning for its deletion on their side of the property. It is recommended that discussions be held with the appropriate State agency and this easement be extinguished from parcel 82.

2.21.10 Constraints Map

Figure 2.9 depicts the majority of constraints at NELHA as detailed below:

1. Long Range Noise Exposure (Significant Effect) from planned airport runway expansion as defined by DOT Airports in the noise compatibility study for their 2009 master plan. The noise contours do not preclude development entirely, but generally limit appropriate uses within these areas, including residential uses without sound insulation, schools, and public facilities. The noise contour shown on the map represents the 65 decibel noise level (DNL).
2. Airport Easements.
3. Tsunami Evacuation Zones according to the State of Hawai'i GIS information created by the Pacific Disaster Center.
4. Archaeological Resource constraints including designated archaeological preserves at NELHA, the Māmalahoa Trail, and the general area of known archaeological sites requiring future action from studies completed between 1976-2006 as available from the SHPD library in 2007. This map should not be viewed as a comprehensive or complete guide to cultural restraints.
5. Roadways proposed by this master plan, including adjacent utility easements.

6. Conservation State Land Use District designations. The former ʻOʻoma parcel at the southern boundary of NELHA's property will need to obtain a SLUD designation change to implement the recommendations of this master plan in that area.
7. Shoreline Setback as established by the County of Hawaiʻi from the State of Hawaiʻi's State Land Use Allocation Pattern Guide.

Additional constraints presented by existing tenant leases (*Figure 2.5)* are depicted on a separate map for reasons of clarity.

Figure 2.1 Land Use Pattern Allocation Guide Map

Figure 2.2 Zoning Map

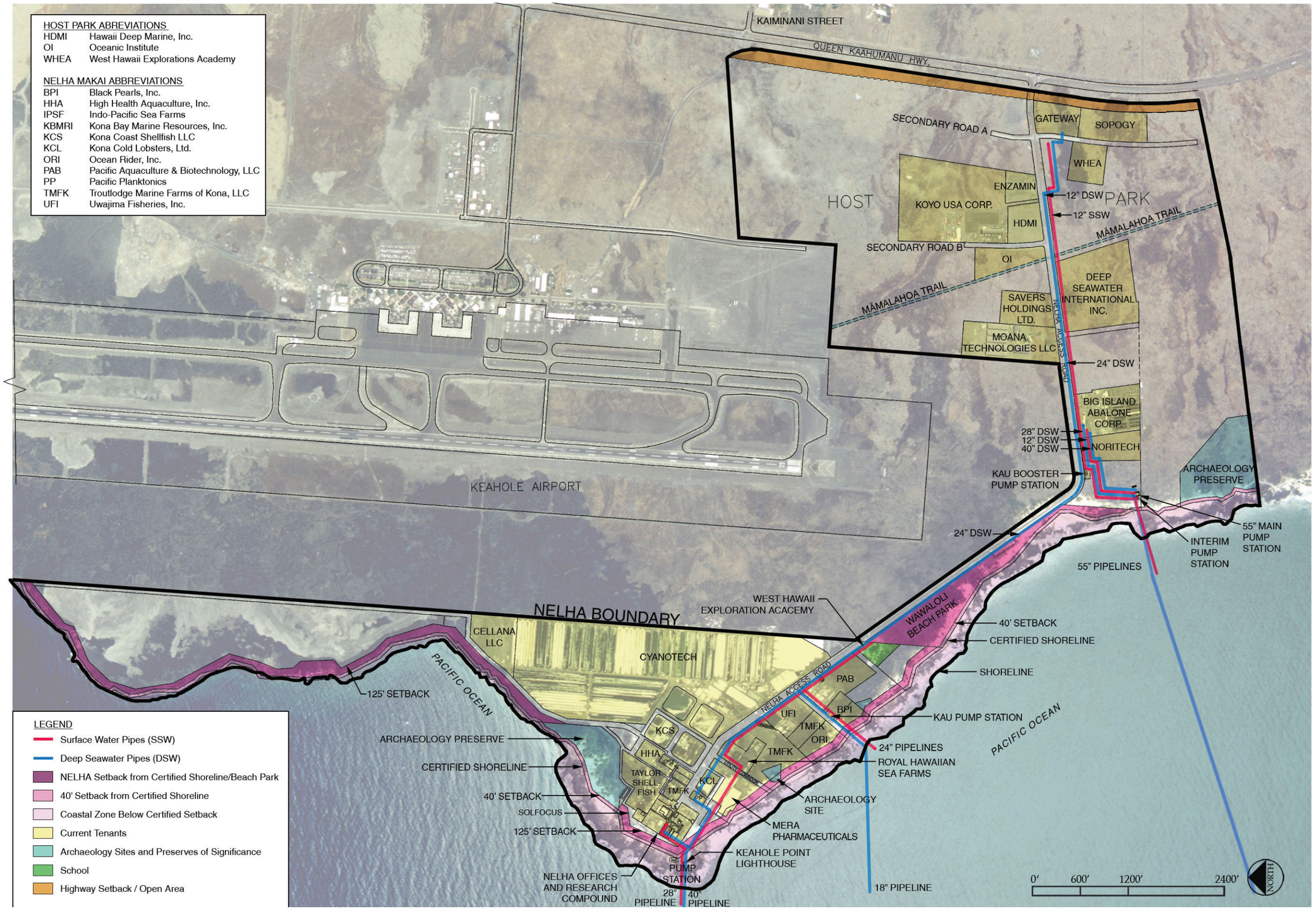


Figure 2.3 Existing Conditions

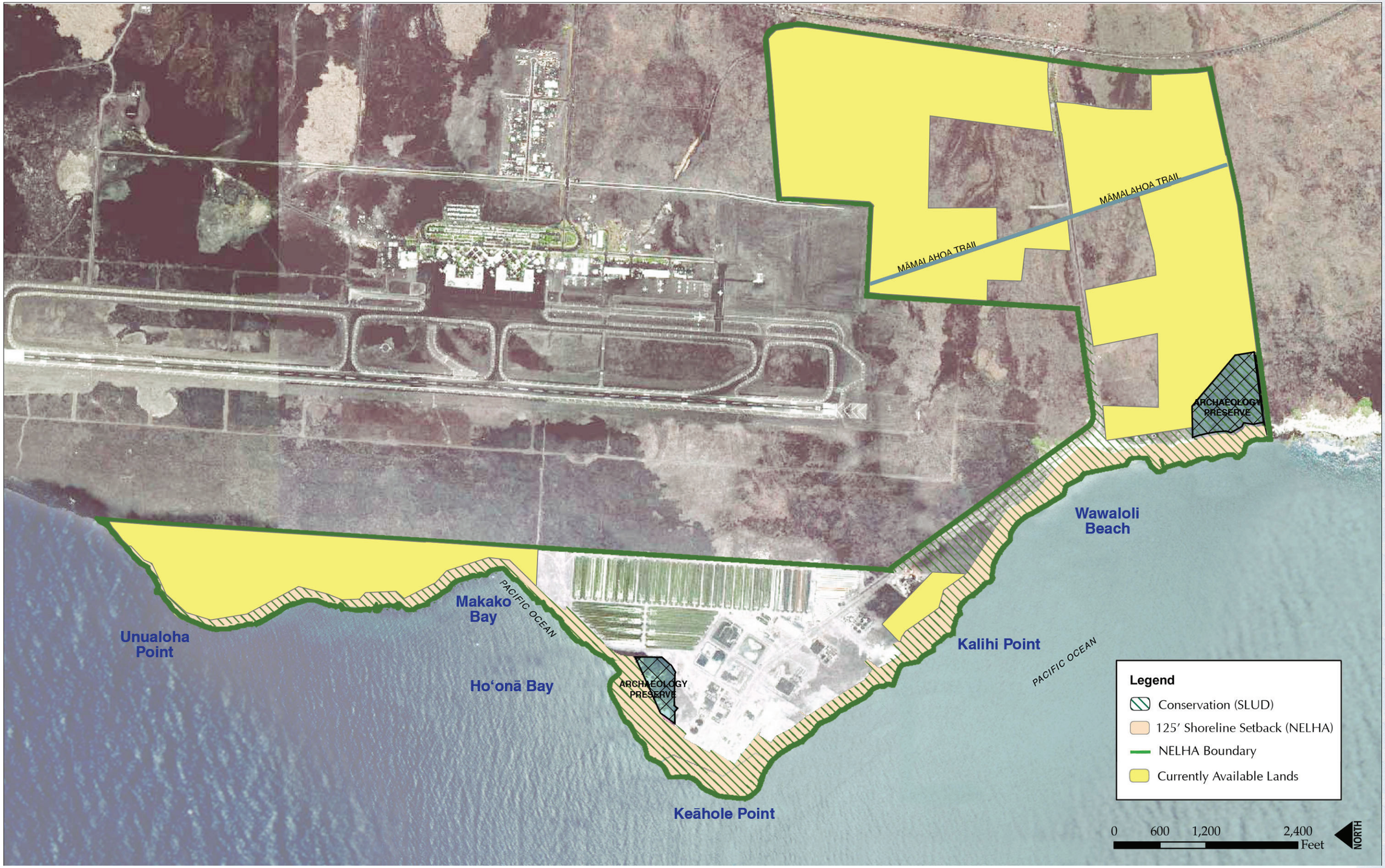
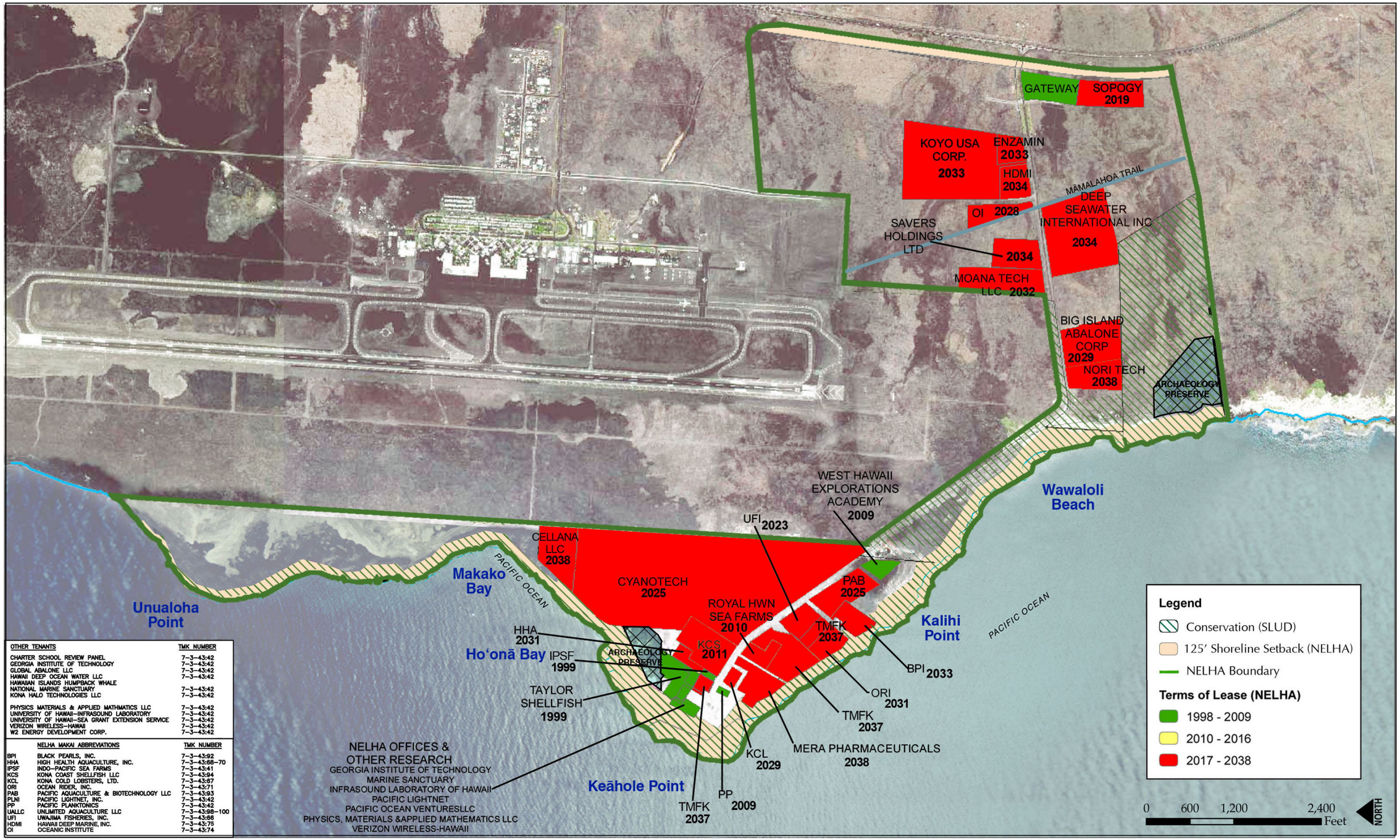


Figure 2.4 Currently Available Land



OTHER TENANTS	TMK NUMBER
CHARTER SCHOOL REVIEW PANEL	7–3–43:42
GEORGIA INSTITUTE OF TECHNOLOGY	7–3–43:42
GLOBAL ABALONE LLC	7–3–43:42
HAWAII DEEP OCEAN WATER LLC	7–3–43:42
HAWAIIAN ISLANDS HUMPBACK WHALE NATIONAL MARINE SANCTUARY	7–3–43:42
KONA HALO TECHNOLOGIES LLC	7–3–43:42
PHYSICS MATERIALS & APPLIED MATHMATICS LLC	7–3–43:42
UNIVERSITY OF HAWAII–INFRASOUND LABORATORY	7–3–43:42
UNIVERSITY OF HAWAII–SEA GRANT EXTENSION SERVICE	7–3–43:42
VERIZON WIRELESS–HAWAII	7–3–43:42
W2 ENERGY DEVELOPMENT CORP.	7–3–43:42

	NELHA MAKAI ABBREVIATIONS	TMK NUMBER
BPI	BLACK PEARLS, INC.	7–3–43:92
HHA	HIGH HEALTH AQUACULTURE, INC.	7–3–43:68–70
IPSF	INDO–PACIFIC SEA FARMS	7–3–43:41
KCS	KONA COAST SHELLFISH LLC	7–3–43:94
KCL	KONA COLD LOBSTERS, LTD.	7–3–43:67
ORI	OCEAN RIDER, INC.	7–3–43:71
PAB	PACIFIC AQUACULTURE & BIOTECHNOLOGY LLC	7–3–43:93
PLNI	PACIFIC LIGHTNET, INC.	7–3–43:42
PP	PACIFIC PLANKTONICS	7–3–43:42
UALLC	UNLIMITED AQUACULTURE LLC	7–3–43:98–100
UFI	UWAJIMA FISHERIES, INC.	7–3–43:66
HDMI	HAWAII DEEP MARINE, INC.	7–3–43:75
OI	OCEANIC INSTITUTE	7–3–43:74

Figure 2.5 Terms of Lease

Figure 2.6 Soils Map

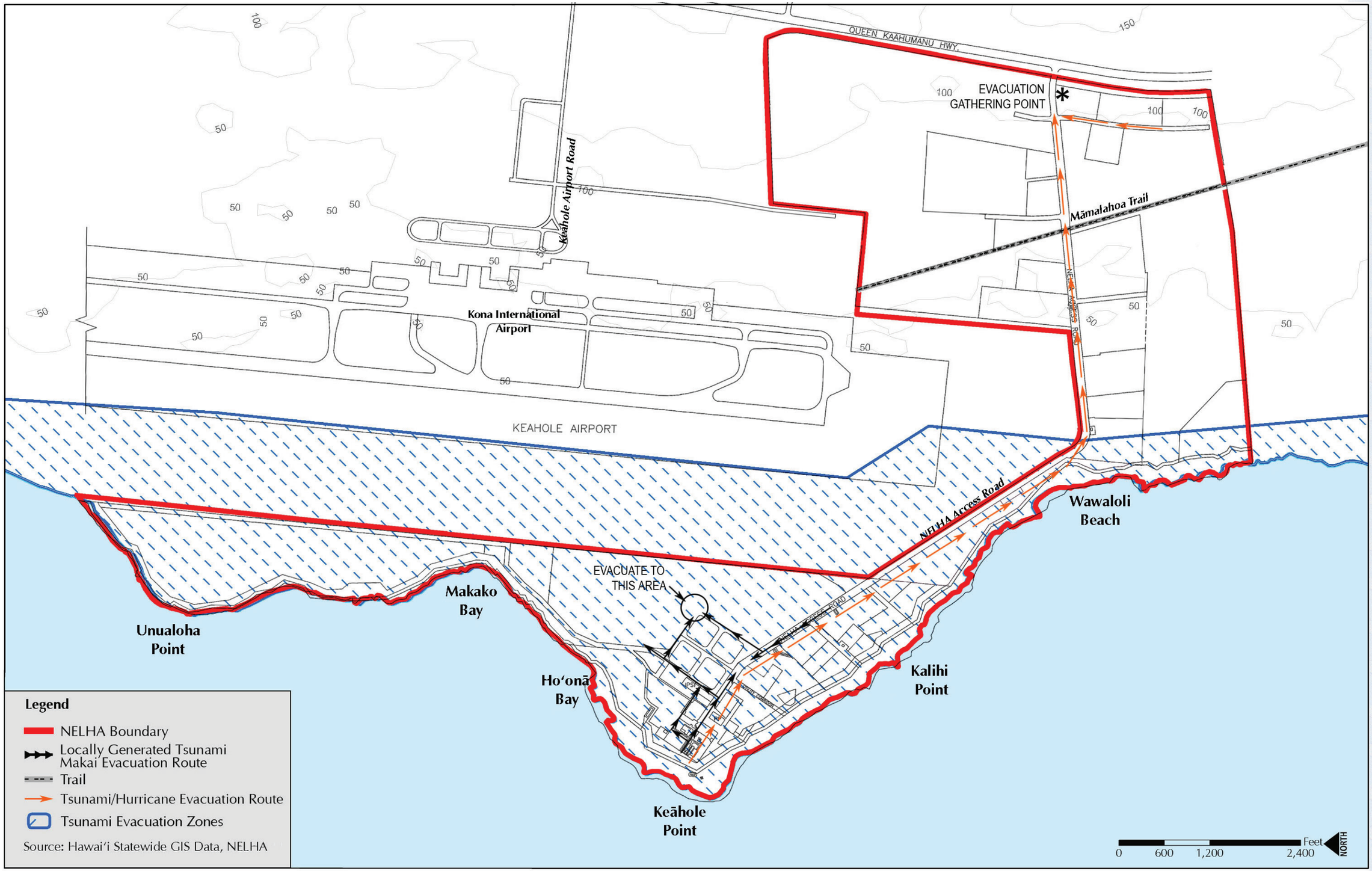


Figure 2.7 NELHA Current Tsunami Evacuation Plan

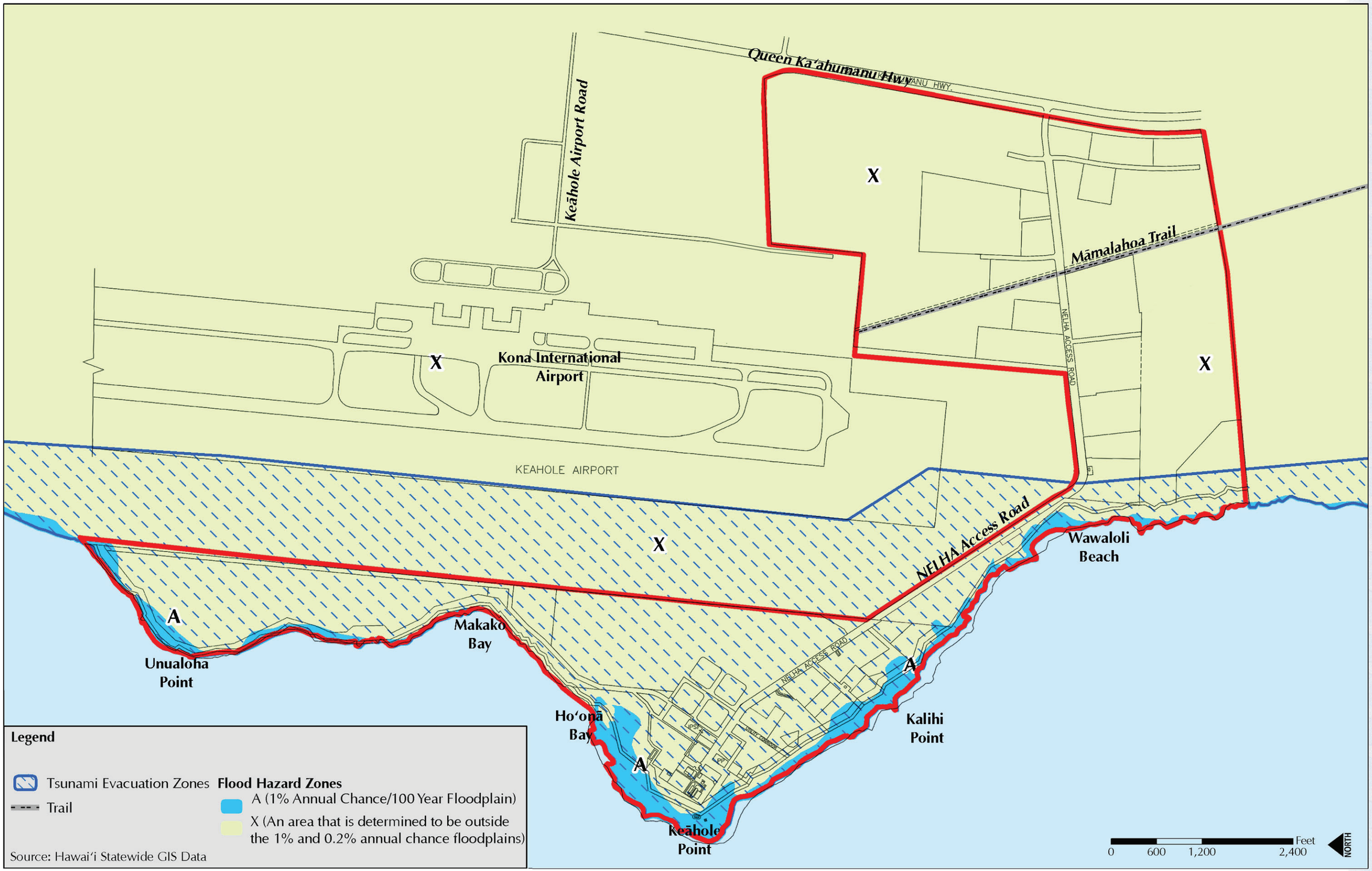


Figure 2.8 DFIRM and Tsunami Evacuation Zone

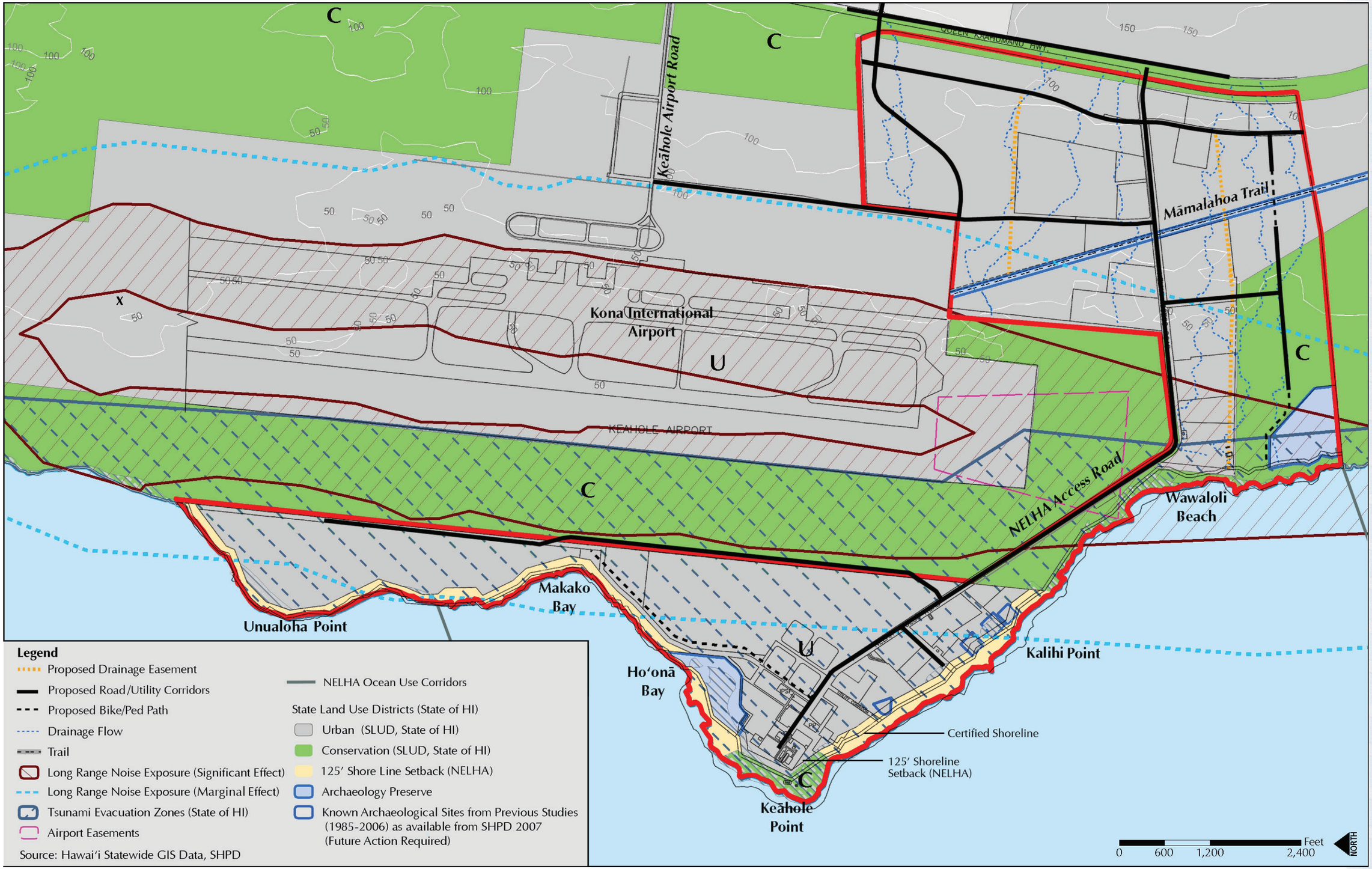


Figure 2.9 Constraints Map

Tenant Name	Lease Type	Term/Exp Date
Big Island Abalone Corporation	Sublease	12/31/2029
Cellana LLC (HR Biopetroleum)	Sublease	12/14/2038
Charter School Adminstrative Office	FUA	4/14/2009
Cyanotech Corporation	Sublease	12/31/2025
Deep Seawater International, Inc.	Sublease	6/30/2034
Enzamin USA, Inc.	Sublease	12/31/2033
Friends of NELHA (FON)	FRA	12/31/2006
Georgia Institute of Technology	FUA	6/30/1998
Hawaii County Economic Opportunity Council	FRA	3/31/2008
Hawaii Deep Marine, Inc.	Sublease	3/31/2034
Hawaii Island Economic Development Board	FRA	N/A
Hawaii Natural Energy Institute (HNEI)	Supp	12/31/2007
HI Islands Humpback Whale National MarineSanctuary	FUA	3/31/2006
High Health Aquaculture, Inc.	Sublease	12/31/2031
Indo-Pacific Sea Farms	FRA	12/31/1999
Infrasound Laboratory of Hawaii	FUA	4/30/2009
Keahole Solar Power LLC	Supp	3/24/2009
Keahole Solar Power LLC	Supp	6/30/2019
Kona Blue Water Farms LLC.	FUA	8/14/2009
Kona Blue Water Farms LLC.	Sublease	5/31/2033
Kona Coast Shellfish LLC	Sublease	10/31/2021
Kona Cold Lobsters Ltd.	Sublease	12/31/2029
Kona Halo Technologies LLC	FRA	7/14/2009
Koyo USA Corp.	Sublease	2/28/2033
Mera Pharmaceuticals, Inc.	Sublease	2/14/2038
Moana Technologies LLC	Sublease	6/30/2032
Noritech Hawaii Inc.	Sublease	2/28/2038
Ocean Rider, Inc.	Sublease	12/31/2031
Oceanic Institute	Sublease	12/31/2028
Pacific Aquaculture and Biotechnology LLC	Sublease	3/31/2025
Pacific Lightnet	Sublease	9/30/2012
Pacific Planktonics	FRA	6/30/2009
Physics, Materials & applied Mathematics LLC	FUA	4/30/2006
Puna Geothermal Venture	FRA	N/A
Royal Hawaiian Sea Farms, Inc.	Sublease	8/31/2020
Savers Holdings Ltd.	FUA	5/31/2008
Savers Holdings Ltd.	Sublease	5/31/2034
SolFocus Inc.	FUA	7/27/2010
Taylor Resources Inc.	FRA	1/14/1999
Troutlodge Marine Farms Kona LLC	Sublease	6/30/2037
Uwajima Fisheries	Sublease	12/31/2023
Verizon Wireless- Hawaii	FRA	12/31/2001
W2 Energy Development Corporation	FUA	6/14/2009
West Hawaii Explorations Academy	FUA	7/31/2009
West Virginia University Corporation	FUA	5/31/2009

Figure 2.10 Existing Tenant, Type, and Lease

Tenant List

1. Keahole Solar Power LLC
2. Gateway
3. Enzamin
4. Hawai'i Deep Marine, Inc.
5. Koyo USA Corp.
6. Oceanic Institute
7. Savers Holdings Ltd.
8. Deep Seawater International Inc.
9. Moana Technologies
10. Big Island Abalone Corp.
11. Noritech
12. West Hawaii Explorations Academy
13. Pacific Aquaculture & Biotechnology LLC
14. Black Pearls Inc.
15. Ocean Rider Inc.
16. Troutlodge Marine Farms of Kona LLC
17. Uwajima Fisheries Inc.
18. Cyanotech
19. Mera Pharmaceuticals
20. Kona Coast Shellfish LLC
21. Kona Cold Lobster, Ltd.
22. Pacific Planktonics
23. Indo Pacific Sea Farms
24. High Health Aquaculture Inc.
25. NELHA Offices & Research Compound
26. Taylor Shellfish
27. Cellana LLC

Figure 2.10 Tenant Type

3.0 Conceptual Master Plan for NELHA at Keāhole Point

3.1 PHYSICAL PLAN METHODOLOGY

As introduced in section *1.4 Methodology*, the conceptual master plan for NELHA was developed through a series of meetings with the NELHA Board of Directors and incorporates feedback from staff, tenants, cultural practitioners, community members, policy makers, potential partners, and researchers in the renewable energy and ocean science fields.

3.2 CONCEPTUAL MASTER PLAN

The conceptual master plan is a combination of two alternative scenarios presented to NELHA: an economic driver/ocean and energy research park and an energy research campus.

In order to create cohesion in the built environment as well as to foster collaboration among tenants, the physical plan is divided into six zones of use (*Figure 3.1*):

1) Applied Renewable Energy Zone
2) Economic Driver-- NELHA-related products and services
3) Applied Technology Laboratories and Containerized Technology Research Center
4) Science and Technology Cultural Center
5) Ocean, Air, Energy, and Biology Research Laboratories
6) Ocean Village

The proposed lotting scheme is meant to aid conceptual planning and is not meant to be submitted as a an official proposal for lot subdivision.

Appendix A provides a more in-depth visual description of the plan.

3.3 ZONES

The location of the zones of use were determined by several factors, in no particular order:

- Need for proximity to ocean/pumped deep ocean water
- Location of existing uses within and in proximity to NELHA
- Concentration of cultural resources
- Traffic and circulation patterns
- Constraints including potential inundation flood zones, airport noise and approach considerations
- State and County land use designations
- Relationship to University of Hawai‘i Center, West Hawai‘i
- Relationship to testbed sites
- Relationship to the airport and the neighboring ‘O‘oma development
- Adjacency to Queen Ka‘ahumanu Highway

The physical plan does not differ greatly from plans proposed previously, but builds on the strengths of those plans by creating a layout that facilitates partnerships between tenants and surrounding developments and is grounded in financial analysis.

3.3.1 Applied Renewable Energy Zone

The location of the renewable energy zone next to the airport allows for generation of energy which may be used for airport operations as well as NELHA. The innovative activities in this area will be visible to the public from the highway, creating a public face for NELHA's renewable energy mission. It is assumed that these tenants will primarily be harnessing technologies that do not require large amounts of deep ocean water.

The Applied Renewable Energy Zone will house energy production and storage including solar, wind, geothermal, and waste-to-energy technologies. The energy produced may be used to power neighboring operations, such as the Kona Airport; be sold to HELCO; be sold for electric vehicle powering; and/or be used by NELHA for operations and to reduce costs of pumping water. It is anticipated that rent a car services for a new generation of automobiles including electric, biodiesel, and hydrogen cell powered vehicles would be located here in close proximity to the airport. Hawai'i Bioenergy LLC has a memorandum of understanding to develop a waste-to-energy and a algae biodiesel energy plant in this location. To that end, installation of microgrids for energy distribution across NELHA's property is recommended.

A second Applied Renewable Energy Zone is located to the south of the Gateway Center along Queen Ka'ahumanu Highway. Part of the site is currently occupied by Keāhole Solar Power LLC (Sopogy). The designation of the sites near the two main entrances to NELHA from Queen Ka'ahumanu Highway for these uses will highlight NELHA's mission in renewable energy sources to the general public.

3.3.2 Economic Driver

A commercial anchor reflective of NELHA's goals along Queen Ka'ahumanu Highway will help bolster NELHA's economic viability and takes advantage of the visibility of the highway frontage as well as the eventual frontage road that will pass ma kai of this development area. This zone should be developed in a manner similar to a shopping center with a mix of retail, commercial and entertainment venues. Offices and administrative offices should be mixed in with the above areas to enhance the technological and incubator mission of NELHA.

An education/orientation hub is identified for the intersection of the Main Access Road and the future frontage road. The Gateway Center is already located here. The future site of the West Hawai'i Explorations Academy has been designated for a parcel next to this hub. A traffic calming measure should be installed at this intersection to slow traffic here as retail and educational uses should foster pedestrian traffic through this intersection. Signage and symbols will highlight the educational and business missions of NELHA for this hub.

Retail stores will reflect NELHA's mission and share its products with the community. Restaurants serving seafood and produce grown at NELHA will offer the community a place to celebrate, share, and be proud of local production. An educational attraction, e.g. a deep ocean aquarium, connects visitors with the invisible deep off Keāhole Point that allows NELHA to harness cold seawater for innovative, sustainable applications.

A potential commercial gathering place for the community, this hub includes shops and restaurants that will cater to the local and tourist communities. Such an area is a perfect place to host an annual Ocean Festival, tying together science, culture, and community in a fun way.

The Research Inn should be located in an area conducive to interaction and yet located far enough away from significant noise contours from the airport so as not to incur extra mitigating construction costs. The preferred location for such a temporary residence is at the NELHA village adjacent to amenities near the commercial driver and Gateway.

Offices mixed with the retail and visitor attractions will foster technology development and business incubation. The location of these commercial office rental spaces near amenities and restaurants foster interaction between employees of the adjacent light industrial research park and research laboratories along the shoreline RE area. Administrative offices of NELHA and the United States Department of Energy (US-DOE) program detailed in section *3.3.5 Ocean, Air, Energy, and Biology Research Laboratories* will be housed here.

An important function of the ED zone is to educate and entertain Big Island residents and visitors. Clearly if a place is entertaining it will attract more people and this in turn is good for business. While education is a mission for all zones of the master plan education and entertainment are highlighted here.

3.3.3 Applied Technology Laboratories and Research Zone

Currently this zone houses most of the extractive businesses like Koyo and Deep Sea Water International. This zone will be the primary area for start-up companies and business development. The reasoning is similar to that of the genesis of HOST Park: as technologies and research matures into the application stage, NELHA will offer a business incubator site that allows cutting edge renewable energy and seawater-related ventures to locate in the state of Hawai'i. Example industries include alternative energy, aquaculture, pharmaceuticals, and minerals/water extraction related to deep seawater.

NELHA will develop as a node in an island-wide testbed for potential technology development utilizing Hawai'i's diverse climactic zones, including semi-arid coastal at Keāhole, leeward transitional, sub-alpine, alpine, and tropical rainforest. Technology demonstration allows partnerships with entities such as the National Oceanic and Atmospheric Administration's (NOAA) weather station at Mauna Loa, University of West Hawai'i Center, Bradshaw Air station, and a revitalized geothermal station at Puna. Applied technology development and deployment in the fields of renewable energy, containerized technologies, transportation, fuel cells, and critical infrastructure are encouraged in this zone.

Containerized technologies seem to be a promising niche for NELHA. Miniaturization and containerization of equipment allows for easy shipment to markets and areas of need such as war zones and disaster areas. NELHA could nurture these technologies and become a global center for containerization of green technologies within this area. Proximity to the airport is advantageous for this concept as prototypes could be shipped anywhere in the world through Kona International Airport.

3.3.4 Science Technology and Cultural Zone

The Science Technology and Cultural Zone will focus on research into the scientific basis behind traditional cultural practices and indigenous knowledge. There will be a baseline focus on native Hawaiian practices but this may be applied to folk knowledge and practices from other places. The Cultural Center will have an educational focus.

A focus of the Center is to inform visitors about Keāhole Point's historical cultural use, modern cultural practices, and the relationship between local culture and current activities at NELHA. Natural points of intersection include aquaculture and fish ponds; cold water refrigeration and food preservation; and irrigation from seawater pipe condensation and dryland agriculture. More than an interpretive attraction or local gathering place, this Center will foster studies in

cultural sciences answering the question, "How do traditional systems work scientifically?" Potential areas of exploration include medicinal plants; natural predation controls; fishpond ecosystems; wood species, moisture and insects; navigation; passive solar design and construction; and ahupua'a resource management.

The center creates an opportunity for local cultural practitioners to interpret their history and modern practices in a meaningful way and for NELHA to honor its location on ceded lands. Institutions dedicated to Native Hawaiian education, history, and research, such as the Bishop Museum and Kamehameha Schools, would be ideal partners in this area.

A number of archaeological sites and features have been identified along the coast in this vicinity. Interpretive displays would be established where appropriate in the archaeological preserve, and additional information provided in the visitor center.

By creating a visitor science and technology cultural center near Wawaloli Beach Park and one of the two large archaeological preserves, NELHA physically and programmatically connects traditional natural resources management practices and cutting edge research at the ma kai laboratories. The ma kai section of the adjacent proposed 'O'oma development is intended to be preserved in a park-like setting because of the archaeological sites in that area, so the center also creates a bridge between resources at NELHA and its neighboring property.

It is anticipated that this zone will be developed in partnership with organizations such as the Bishop Museum, Kamehameha Schools, Kohala Center and the Nature Conservancy. Scientific institutions such as the Hawai'i Institute of Marine Biology (HIMB), Woods Hole, and Scripps Institute will also be welcomed to work with the cultural and community organizations. The proposed cultural center which should be built with the above partners will be the center or "piko" of community and cultural programs in NELHA.

3.3.5 Ocean, Air, Energy, and Biology Research Zone

An integrated science and technology research campus for National Labs in Hawai'i is the root of all activities at NELHA on the ma kai portion of the property. Proximity to the ocean as well as relative seclusion from most public traffic create an environment ripe for innovation and research in this zone. The tenants in this zone will focus on research in renewable energy, deep ocean, and sustainable living since NELHA's location makes possible research of ocean currents, ocean thermal dynamics, wind, sun and marine biology.

Through a joint management structure shared between the State of Hawai'i and the US-DOE, research of regional and national importance is possible. The buildings and infrastructure for the research campus/park would be built primarily with federal funds and cost sharing for specific facilities with either the State of Hawai'i or private partners.

The Hawai'i Clean Energy Initiative has resulted in close coordination between the State of Hawai'i and the Department of Energy (DOE). Staff from DOE have been assigned to DBEDT and Governor Lingle has visited the National Renewable Energy Laboratory (NREL) in Golden, Colorado. The relationship and interest in Hawai'i has been strong and NELHA is on a list of facilities suggested for future facilities and/or programs from DOE. President Obama's stimulus package also increases the possibility of partnerships and funding for renewable energy initiatives.

Establishing a US-DOE Pacific Area Field Office is a strong, reasonable possibility due to the number of US-DOE activities past and present in the region. NELHA is attractive as a site for such a facility as it is an established research facility with an ongoing business incubation mission, close proximity to Kona International Airport. Studies of technologies in tropical conditions is an added enticement for researchers with a prior history of OTEC and geothermal

research and current projects in solar and biodiesel energy projects, NELHA is attractive to NREL as a site for future projects.

The establishment of a US-DOE Field Office in Hawai'i at NELHA would provide an excellent opportunity for partnership between the State of Hawai'i and the US-DOE research in renewable energy. Similar partnerships the US-DOE has developed include the Grand Junction, Colorado Project Office to support US-DOE's Legacy Management programs and the Carlsbad, New Mexico Area Office to support the Waste Isolation Pilot Project for the US-DOE Office of Waste Management.

To facilitate the creation of such a research campus, some relationships have already been established between the State of Hawai'i Department of Business, Economic Development, and Tourism, three Deputy Assistant Secretaries at US-DOE, the National Renewable Energy Laboratories (NREL), and scientists at Sandia National Laboratories. Relationships should be established between the Governor of Hawai'i, the US-DOE Secretary's Office, National Laboratory Directors, and Management and Operations contractors at the National Laboratories.

Other partnerships that should be developed further include the University of Hawai'i's (UH) School of Ocean and Earth Science and Technology, UH Center for Sustainable Design, Cornell University, NOAA, the National Defense Center of Excellence for Research in Ocean Sciences (CEROS), National Aeronautics and Space Administration (NASA), Japan Agency for Marine-Earth Science and Technology, and energy companies.

Possible ares of research include:

1) Alternative energy technology solutions for island ecosystems to support the DOE's EDIN program
2) Containerizing critical infrastructure technologies
3) Island transportation technologies
4) Sustainable island practices
5) Aquaculture
6) Advanced materials testing & evaluation
7) Advanced power grid technologies
8) Biofuels
9) Pharmaceuticals
10) Energy storage
11) Carbon capture and sequestration
12) Deep ocean biology
13) Future OTEC research
14) Wave and current energy research
15) Mariculture systems
16) Biofouling systems and equipment maintenance

3.3.6 Ocean Research Zone and Ocean Village

The sixth general area is the Ocean Research Zone. This area is defined by a corridor that extends from the beach to the deep ocean. It encompasses an area that is 3,290 acres and starts on the south side at the edge of the 'O'oma boundary to the north between Unualoha Point and Makako Bay. This area is specifically designated for ocean research and applications. It

is one of the proximate technology test bed sites. The NELHA sea water pipe systems are also located in this ocean zone.

The conceptual eco-technology village, located offshore of the science and technology cultural center, will demonstrate renewable energy, aquaculture, ocean technology applications in a dynamic visitor center accessed by renewable power water craft and submersibles. Renewable technology and infrastructure will be visible through "windows" into applications.

This facility will compliment the Science, Technology, and Cultural Center. Components of this feature facility include:

- Demonstration of Carbon Neutral and Sustainable Applications
- Sustainable Agriculture
- Hydroponics
- Composting
- Worm Farms
- Recycling and Reuse
- Vertical Ahupua'a
- Algae Biofuel Farms
- Floating Wastewater Treatment Technologies
- Solid Waste Bioconversion Technologies
- Ocean Wave Energy
- Hydro Electricity
- Submersible Underwater Experience
- Solar Powered Water Crafts
- Futuristic Boats for Ocean Science Research

3.4 MASTER PLAN NODES/CENTERS

In addition to the designation into six zones, the concept of the node is the next organizing master planning principle guiding the master plan. In many ways the Native Hawaiian concept of the piko is more germane to the intent of the master plan. This word has many, deeper meanings including the summit of a mountain and a source of things. It also refers to the junction point on a kalo plant from which all the leaves spring forth . The English words, cluster or peak (summit) would be normal synonyms for piko but they are incomplete and more uni-dimensional synonyms. With the concept of many meanings in mind, we have identified four nodes on the master plan:

1. the entrance for orientation and education
2. the commercial marketplace where economic and social activities congregate
3. the traditional gathering place of ahupua'a
4. the research village

Each node has a specific function but they all are gathering places and centers of activity related to their respective areas. We hope these places become places of interaction, synergy, social integration, exchanges of ideas . We hope they become sources of inspiration and collaboration among the people living and working at NELHA. The kernel of each node already exists and a conscious design can enhance these functions so that these nodes become centers of gravity for their functions; strange attractors, if you will, from chaos theory. We

hope wonderful patterns and growth come from them. The radius of the node can spread across use zones and connect different uses under an overarching concept.

Center One is near the entrance to NELHA at the intersection of the Main Access Road and the future Frontage Road. NELHA may consider a roundabout and/or other traffic calming strategies to slow traffic approaching this intersection. The roundabout should have statues or signature sculptures. As traffic from outside NELHA approaches this first intersection they should slow down and receive an orientation to NELHA. The four corners of this intersection and a radius around it should be designed for people and pedestrians. This section is part of the economic driver zone and a mixture of education and commerce should be clustered around this intersection. Part of this node is already in place with the Gateway Center which already serves as an education venue. Part of the location is designated with the future site of the West Hawai'i Explorations Academy. There is a small plaza with signage explaining the history of NELHA and the seawater system. Edu-tourism establishments and possibly a deep sea aquarium may be located in this node. Products of NELHA tenants could be displayed here. The incubator building and job training programs could be located near this node.

Center Two is the commercial marketplace. This should be a piazza like market square surrounded by businesses and offices related to NELHA's mission or theme. The Research Inn should be located near this node. Accessory shops like coffee shops and eating establishments should be mixed with products and services related to NELHA tenants or energy and ocean related items. Technology transfer offices should also be located here. This node should be the heart of a sustainability village which incorporates goods and services of the new green economy of which NELHA is a leader. Aquaculture, hydroponic and other food products could be displayed and sold here. An open air farmers market like atmosphere can be mixed into the plaza along. While the mall concept may be appropriate for the ED zone in general, the node should be more like a town square mixed with public spaces, gathering areas and shops.

Center Three is the ahupua'a gathering place. This concept draws on an old use for the Wawaloli Beach Park site. Traditionally, this site was a gathering place for people of many ahupua'a. The beach and the coastal zone is important to the broader community for cultural, recreational and spiritual reasons. A pavilion is envisioned near the existing restroom facilities where community events can be held. A canoe landing area should also be considered along with a clearer delineation of the Ala Kahakai through the site representing access by water and access by land. Located next to the archaeology preserve, the preserve could be incorporated into the shoreline management plan. More coconut trees and xeriscape shade trees should be planted so that this place truly becomes a kipuka (an oasis like grove) in the middle of the hot Kona landscape.

Center Four is the research village. Located in the existing NELHA complex the concept is for a redevelopment of this area to create a village atmosphere for researchers and the NELHA operations. Inexpensive accommodations for graduate students and research staff will be subsidized by NELHA to encourage use of NELHA for research. Lounges, cafeteria, sundry shop and recreational uses will be added as amenities to make the area self sufficient from an amenity standpoint. Lunch wagons or outside venders can be invited to add variety to the menu. Conference rooms, computer rooms, resource centers and new laboratories will be added to encourage interaction and the sharing of knowledge and ideas. Scientific conferences and lectures should be encouraged and solicited. The feel of the research village should be similar to the center of a small college campus. These facilities should be developed incrementally and expanded in modules as needed.

Each center will need further development work with more detailed programming and site planning. Additional funding or financing is needed for these tasks. The commercial center might be developed by a private developer.

3.5 NATURAL AND CULTURAL RESOURCE COMPONENTS

The Māmalahoa Trail runs across NELHA in its ma uka section. Hard to make out as it crosses the lava fields, yet significant enough for protection, the Māmalahoa Trail will be part of an overall effort plan for stewardship of cultural resources. The evaluation and treatment plan for the Hoʻona cultural site is recommended for completion and implementation. Additionally, all prior archaeological and cultural research at NELHA should be compiled into a single reference document accompanied by a comprehensive management plan encompassing visitor centers, interpretation, preservation, and cultural consultation protocols.

Natural resources should be protected according to measures identified in the Shoreline Management Plan and as prescribed in past and future Environmental Impact Assessments.

This master plan recommends that NELHA work with local kupuna, educational and community groups to form a cultural advisory committee to better manage cultural resources and activities. Recommended members for such a Cultural Advisory Committee include:

- Representatives of ʻohana with lineal ties to Keāhole Point
- Cultural education specialists/community leaders
- NELHA staff person
- SHPD Hawaiʻi Island Archaeologist
- SHPD Hawaiʻi Island Cultural Historian

3.6 RECREATION COMPONENTS

The main public recreational facility within NELHA will continue to be Wawaloli Beach Park and the shoreline and offshore coastal waters. As the importance of the park and ocean for both recreational and cultural values is widely acknowledged, the master plan proposes an ahupuaʻa gathering pavilion within the park. Wawaloli is traditionally recognized as one of the places where people from many ahupuaʻa gathered for special ceremonies and social events. In addition a canoe landing area may be incorporated. Funding for these facilities could come from a number of potential sources both private and public. Along with the proposed cultural advisory group various community friends of NELHA may be encouraged to adopt the Park and work with NELHA staff in maintaining the park. These groups should be encouraged to petition the legislature and engage in a fund raising campaign to raise money for these facilities.

The Na Ala Hele program and the National Park Service have been working on the Ala Kahakai National Historic Trail for several years. Congress has approved the concept of the trail and planning efforts have included work with various public and private entities to determine the alignment of the Ala Kahakai, especially where historic coastal trails have disappeared or been truncated by later development. The final trail is anticipated to run from Kawaihae in South Kohala through Kona and Kaʻu and up to Volcanoes National Park. NELHA will work with the Ala Kahakai effort to identify a proposed alignment of the trail though the project site.

Bikeways and pathways are planned for all the major new roadway extensions to promote these forms of alternate transportation and to improve recreational access. Bikeways and pathways are planned through cul de sacs to make the overall site more pedestrian and bicycle friendly.

Within the economic driver zone of the master plan, recreational uses may be developed as part of a mixed use retail/office/commercial development.

3.7 AFFILIATED RESEARCH

NELHA represents a tremendous opportunity for linkages and spinoffs in affiliated research and education programs. Affiliated research is research that is related to the core ocean related and natural energy focus of the facility either directly or on off site test bed sites on the Big Island or off shore. NELHA can serve as the office, laboratory or logistical base for these projects.

Affiliated research also includes research connected to scale up or commercialization of known technologies to bring them to a point of economic feasibility. The AT zone of the master plan is ideal for these projects but they can be found in any of the zones. Rules and policies of NELHA should encourage these uses through training and networking.

3.8 EDUCATION

Education has always been a key component of the NELHA mission and there have always been educational programs imbedded in NELHA. The cooperation with the Sea Grant Program is one of the best examples of this. However, there is a public misperception that NELHA does not benefit the local population much in this arena and should do more. More partnerships with organizations like the Kohala Center, Kamehameha Schools and Hawaiian Civic Clubs and Kealakehe High School would help. A more coordinated strategy and program seems needed. More direct affiliation with institutions of higher learning such as UH Center West Hawai'i near Palamanui and other units of the University of Hawai'i system such as SOEST and HNEI would help move NELHA further in this direction.

With a goal of moving the country toward a green economy, many programs in the stimulus package and the omnibus spending bills have grants and programs for education. NELHA could be a leader in training for a green economy through classes and internships with its tenants. Working with colleges, universities and other entities like Alu Like, NELHA could be the venue for many kinds of green economy jobs training. The community would welcome such an initiative by NELHA and see it as fulfillment of a long term potential.

All of the above will take dedicated staff focusing on educational programs. The limitation has always been funding for such staff. Federal programs like the Coastal Zone Management program (CZM and its associated SMA programs) and Seagrant can often draw extended funding for such positions. NELHA should solicit these and other sources to fund an educational coordinator position and support staff. Over time as the business model for NELHA leads to greater self sufficiency the positions should become part of the general operating budget.

3.9 INFRASTRUCTURE AND UTILITIES

From its inception NELHA had a vision and mission of sustainability implied in its name, "Natural Energy," and the use of renewable resources in its reliance on the ocean. It is only fitting that is should be a leader in such research. It is also fitting that NELHA be a model and a leader in the application of these resources. The master plan concepts call for the infrastructure and utilities to become ultimately resource neutral. This means goals of carbon, water and energy neutrality or better. In essence zero carbon, zero water and zero energy use. It is understood that these goals have a utopian quality but they are goals which can be achieved. The technology is available or possible in the near term future. NELHA should play a major role in research and scale up of these technologies. These goals will not be achieved in the short term but are possible in the long run (20+ years). The vision should stay focussed on it even when achievement seems challenging. The proposed Green Energy Zone program will be a major part of this along with expansion of the sea water system. Future OTEC development can also play a potentially major role in these goals. Other strategies will evolve over time and NELHA should actively pursue these plans. An operating sustainable, horizontally integrated infrastructure and utility system can be a significant draw for researchers, visitors and funding.

The civil engineering reports provided by Austin Tsutsumi and Associates included a Subdivision Layout Plan and a Drainage Master Plan. These documents are found in *Appendix C* and summarized here. Cost estimates are also included in the appendices.

Due to the conceptual nature of the plans, some site infrastructure sizes and utility alignments are educated estimates. In addition, existing site information was limited; and the following assumptions were made that will need to be confirmed as part of the actual design process in the future:

1) Subsurface conditions as related to existing soils, foundations, structures and underground utilities.
2) Overall conditions of existing underground utilities (assumed to be adequate to meet necessary demands).

3.9.1 Roadways

Existing Conditions

The existing site is accessed from Queen Ka'ahumanu Highway via a single 24-foot wide asphaltic concrete pavement access road, i.e. NELHA Access Road, from Queen Ka'ahumanu Highway station 172+50. The right-of-ways vary between 80-feet and 110-feet. The wider 110-foot section begins just after the first interior intersection and ends near the main roadway bend near the booster pump station site. The Access Road is approximately 11,600 linear feet in length and is a public roadway. The road provides access to the NELHA and tenant facilities, the shoreline, "Pine Trees" beach and Wawaloli Beach Park.

Queen Ka'ahumanu Highway is currently being widened from 2 to 4 lanes from Henry Street to Kealakehe Parkway, south of NELHA. Phase 2 of this widening project is slated to begin in 2009 and will cover from Kealakehe Parkway to the entrance road to Keāhole Kona Airport, with a completion period projected at a little over 2 years.

Proposed Conditions

The proposed lotting plan will add up to 42 leaseable lots ranging in size from 1 to 32.5 acres. An additional 4.8-miles of interior roadways with 60-feet right-of-ways will loop through the undeveloped portion of the site with two connections to Queen Ka'ahumanu Highway at the

existing main NELHA Access Road and at Kaiminani Drive. No new roadways will cross the Māmalahoa Trail.

Improvements at the main intersections with Queen Ka'ahumanu Highway will include left turn storage lanes and additional right turn acceleration and deceleration lanes across Kaiminani Drive, with modifications to the existing traffic signal light. Current discussions with the State Department of Transportation Highways Planning Branch have indicated that the existing Access Road intersection with Queen Ka'ahumanu Highway will be modified to a right-turn in and right-turn out only configuration, conceivably after the access at Kaiminani Drive is constructed.

However, based on the preliminary traffic trip generation estimates, a limited right-turn only configuration at the existing NELHA Access Road is not recommended, due to the probable queueing at Kaiminani Drive onto the Highway from the high volumes of traffic into and out from the site. Therefore, it is recommended that the existing turning storage lanes at the main Access Road entrance be lengthened to accommodate the increase in traffic associated with the full build-out of the project. A new traffic signal will also be required at this location. In the full build-out scenario, double left turn storage lanes on the highway are anticipated. See the Traffic Study Letter Report by Austin, Tsutsumi & Associates, Inc. dated March 2, 2009 (*Appendix C*). In any event, the level of service at the Kaiminani Drive intersection and NELHA Access Road intersection will be LOS F, which is the lowest level of functionality.

Discussions with the State DOT, should include the necessary pavement widening and conduit work with the Queen Ka'ahumanu Highway Widening Phase 2 project to accommodate the future needs at the main intersections. The intent would be to stripe the lanes closed in the interim until such time that the full intersection improvements are needed based on the when the pertinent phase of the NELHA project is undertaken. In addition, discussion should include possible frontage road connections with neighboring parties associated with the Airport's master plan to the north and 'O'oma to the south, to alleviate impacts to the highway.

The following roadway improvements will be required based on the phasing plan:

Phase 1 – Road "B" Extension (currently under design contract negotiation by NELHA), connecting the Airport Road "N" to an existing short segment of road off of the Access Road, and Road "C" tying into Queen Ka'ahumanu Highway across Kaiminani Drive, creating a 4-way intersection. Approximately 3,900' (Road "B") and 3,100' (Road "C").

Phase 2 – Road "A-1" (also recognized as the frontage road) and Road "A-2". Road "A-1" will be the primary road through the commercial phase of the project extending to the boundary of 'O'oma Subdivision, and Road "A-2" is a cul-de-sac. Improvements at the NELHA Access Road intersection with the Highway. Approximately 5,700' (Road "A-1") and 500' (Road "A-2").

Phase 3 – The existing NELHA Access Road will be utilized to access Phase 3 areas of the project. There may be consideration to resurface the roadways below the first intersection either concurrently or prior to this phase.

Phase 4 – Roads "D-1" and "D-2" will primarily service the interior lots of this phase, with a ma uka to ma kai walking path connecting to Road "A-2", along Road "D-2" and down to the ocean. Approximately 1,600' (Road "D-1") and 2,200' (Road "D-2").

Phase 5 – Roads "E-1", "E-2" and "E-3", extending from the NELHA Access Road to provide connection to the Research and Education zone area ma kai of the airport towards Unualoha Point. Approximately 7,300' (Road "E-1"), 500' (Road "E-2") and 700' (Road "E-3").

3.9.2 Water

Existing Conditions

The existing off-site DWS system consists of a 12-inch main in Queen Ka'ahumanu Highway. There is a larger line 16-inch main in the Highway, but not fronting the site, which ends south of the property at Kealakehe Parkway. Current source wells are the Palamanui & Makalei wells in the Kalaoa, Kaloko and Honokohau zones, and the Kahulu'u well in the Keauhou zone. The tank sites are scattered with the nearest tanks off of Kaiminani Drive, Hinalani Drive and Kealakehe Parkway.

The existing on-site potable water system consists of a 12-inch main connecting to the existing County Department of Water Supply (DWS) 12-inch main in Queen Ka'ahumanu Highway, via a master meter near the Access Road entrance. Approximately 2,100 linear feet from the meter, . The line continues as a 12-inch line to the end of the NELHA Access Road within the Research Area. There is a parallel 8-inch line, running between Road B and the bend in the Access Road near the seawater booster pump station. The old Hawai'i Ocean Science and Technology (HOST) Park section currently has an allocation of 400,000 gallons per day (gpd) from the DWS. However, NELHA indicates that overall they use upwards to 600,000 gpd. Interior lots are currently individually metered and charged according to individual usage.

The North Kona Water Master Plan has been drafted by DLNR to coordinate water in the North Kona area. It envisions a system loop bringing water down through Palamanui from ma uka wells down to Queen Ka'ahumanu where it will link to the existing developed system. A series of wells, reservoirs and pump stations are part of this overall plan. The plan is still in the draft stage as the Department of Hawaiian Home Lands has not signed off on the plan. State law gives DHHL preference in water allocations and their participation significantly impacts the overall system. Still, sections of the system are being developed and paid by the State of Hawai'i , County of Hawai'i Department of Water Supply and private developers incrementally as they complete their projects.

NELHA signed a memorandum of understanding (MOU) to participate in the plan. The MOU states that NELHA anticipates an average daily demand of 510,000 gal/day with a cost share contribution of $1.4 million.

Proposed Conditions

For planning purposes, based on a total of 644 acres of leasable industrial zoned land, and assuming a water demand ranging between 3,000 to 4,000 gallons per acre (2002 Water System Standards), the average daily demand is estimated at 2.516 million gallons per day (MGD). The maximum daily demand will be 3.775 million gallons per day (See Table 1). The fire protection demand is 2,000 gpm of flow over a 2 hour period.

Assuming that the project already has an allocation of 400,000 gpd of maximum daily use, the total additional demand will be 3.375 MGD. Therefore, at least 3.5 million gallons of off-site storage will be required. It is noted that the DWS master plan does include a new 16-inch mid-level system, between Hinalani Drive and Kaiminani Drive as well as two 1.0 MG tanks along Kaiminani Drive at overflow elevation 325-feet, tying into an existing 20-inch main. However, to accommodate the project, negotiation with DWS will dictate the necessity to contribute to the development of additional tank sites or provide payment of Facilities Reserve Charges (FRC). The new tanks must be above 325-feet, and will have to remain in a nearby service zone between Kealakehe Parkway and Kaiminani Drive.

For off-site transmission improvements, DWS is currently proposing to extend the existing

16-inch main running in the Highway, from Kealakehe Parkway to the Airport Access Road as part of an agreement associated with the Phase 2 of the Highway Widening project. NELHA may be expected to pay a pro-rata share of this improvement to the DWS.

On-site, a 12-inch main system will connect to the Highway system at both the main NELHA Access Road and across Kaiminani Drive, looping through the site to service the majority of lots. There will be a few 8-inch lines serving the smaller cul de sacs. Fire hydrants will be located within the right-of-ways at a maximum spacing of 300-feet, but it is also anticipated that a number of individual lots will require on-site fire protection systems consisting of hydrants and fire sprinklers due to the depths of lots and uses.

For phasing of the on-site system, generally, the water system improvements will be concurrent with the phasing of the roadway improvements. Therefore, as new phases are undertaken, the water system will be extended as part of the overall roadway improvements.

At ultimate build-out if OTEC is developed, there is a potential for open cycle OTEC systems to generate potable water in sufficient quantities for all land-based consumption, in essence to become self-sufficient in potable water. With that hope in mind the master plan shows a potential fresh water line into the land-based system.

3.9.3 Sewer

Existing Conditions

The existing lots are serviced through on-site individual wastewater systems (IWS). Exact wastewater generation totals are not known, as they are maintained and managed by the individual lot owners.

The Keāhole Airport has a traditional wastewater treatment plant (WWTP) capable of treating up to 100,000 gallons per day. It currently services the airport and is operating at 1/3rd capacity. An existing lift station is located near the end of U'u Street within the airport property, but its capacity is subject to confirmation by DOT Airports.

While the Airport WWTP currently seems to have excess capacity, if it needed to be upgraded using current technology (Membrane bioreactor treatment) the anticipated cost for an upgrade would be roughly $5 million.

Proposed Conditions

For planning purposes, it is assumed that the project will transition to a central wastewater collection system as opposed to individual wastewater systems. Therefore, assuming 644 acres of leasable land and a range of population of 2 to 140 persons/acre, and 25 to 30 gallons/person/day, depending on the land use, the average wastewater flow is estimated at 261,430 gpd. A factor for larger peak flows and wet weather infiltration can be assumed as well, resulting in a potential peak flow of 1.99 million gallons per day.

Due to the available capacity and expansion possibilities for the existing Airport WWTP, it is proposed that the wastewater generated from the NELHA project be pumped to the Airport's wastewater system. The proposed on-site system would consist of a combination gravity collection system and force main system. Based on the size of development and the lengths of line required, two wastewater pump stations (WWPS) each consisting of two wetwells with submersible pumps, control buildings, odor control, and surge tanks will be required. The larger WWPS #1 will be built in Phase 1 within the designated Utility Parcel near the bend in the NELHA Access Road. The smaller WWPS #2 will be within the lower NELHA property and will be built within Phase 3 of the project, possibly near the existing West Hawai'i Exploration Academy site. This is in anticipation of the existing NELHA site transitioning

from its current individual treatment systems to the central collection system. It is possible to postpone the WWPS #1 and wastewater infrastructure installation until Phase 2, but will require that the first 7 new lots of Phase 1 to be on interim individual wastewater systems, until the next phase of the project.

Due to the existing grades in the Research and Education development area north of the existing Cyanotech site, it is recommended that this 5th phase of the project remain on individual wastewater systems. However, as an option, a third WWPS could be located in this area with a force main to the gravity system within the existing NELHA area.

With the extension of the Airport Road "N" and connection to the NELHA Access Road, i.e. Road "B", the installation of the sewer force main should take place with the construction of this road, with eventual connection to the Airport's WWTP via the Airport's Road "N".

As a secondary option, an on-site wastewater reclamation facility (WWRF) utilizing membrane filtration technology to produce R-1 reuse water could be considered. The collection system will still be a gravity system feeding to this central WWRF. For a 300,000 gpd treatment capacity, the facility will require 2 to 3 acres of area to accommodate a 60'x60' main structure housing the membrane system and pumps, a 300,000 gallon storage tank, 40'x40' office and lab space, UV disinfection unit, piping, wetwells, electrical utilities and parking areas. The estimated cost of a WWRF alone would be in the $10 million range. Also to be considered is the distribution system and uses for the R-1 water. This option is presented for consideration, but due to the high cost for such a facility, and the possibility of utilizing the existing Airport WWTP, it is not recommended.

3.9.4 Seawater

Existing Conditions

As a general overview, the four main uses of the NELHA seawater system are:

1. Aquaculture and Marine Biotechnology
2. Deep Seawater Applications
3. Heat Transfer Applications
4. Energy Related Applications

The existing sea water distribution system at NELHA consists of three dual pumping stations where both warm and cold sea water are brought to shore. A separate deep sea water Booster Pump Station receives low pressure, cold sea water and delivers it to the higher elevation lots of the facility. An Interim Surface Seawater Pump Station delivers warm sea water directly to the higher elevation lots of the facility through two 12" distribution pipelines.

The primary sea water system at NELHA is the 55" deep seawater (dsw) pipeline and the 55" surface seawater (ssw) pipeline. Both of these pipelines come ashore to a common pumping station. The 55" dsw pipeline draws in cold seawater from a depth of 3,000' through 10,247' of submerged intake pipe. The 55" ssw pipeline draws in warm seawater from a depth of 80' through 540' of submerged intake pipe. The 55' dual pump station is located on the utility parcel south of the bend in the NELHA Access Road. The 55" dsw pipeline has a design capacity of 27,000 gpm and a current installed pumping capacity of 14,000 gpm (50% of full capacity). The 55" ssw pump pipeline has a design capacity of 40,500 gpm and a current installed pumping capacity of 14,000 gpm (35% of full capacity).

Two other pump stations are the Keāhole Point Pump Station and the Kau Pump Station. The Keāhole Point Pump Station consists of a 40" dsw intake that draws in cold seawater

from a depth of 2,210′ through a 6,284′ long intake pipe and a 28″ ssw intake that draws in warm seawater from a depth of 70′ through a 535′ long intake pipeline. The full capacity and current pumping capacity of the 40″ dsw pipeline is 13,400 gpm and 9,700 gpm for the 28″ ssw pipeline. The Kau Pump Station consists of an 18″ dsw intake that draws in cold seawater from a depth of 2,060′ through a 6,180′ intake pipeline and a 24″ ssw intake that draws in warm seawater from a nominal depth of 40′ through a 266′ long intake pipeline. The full and installed pumping capacity of the 18″ pipeline is 3,000 gpm and 5,400 gpm for the 24″ ssw pipeline.

The current overall seawater system at NELHA is capable of serving the existing tenants within all elevations zones up to 100′ of mean sea level. The elevation at the highway is 110 to 143 above mean sea level. Seawater distribution to the upper elevation lots of the facility is via two existing 12″ ssw distribution pipelines and a single 24″ dsw distribution pipeline. Deep seawater delivery above Big Island Abalone Corporation (el 35-40′) is through the Booster Pump Station via the 24″ dsw distribution pipeline. The primary pumps at the 55″ pump station are capable of pumping seawater to the 35-40′ elevation through a 40″ dsw pipeline and a 28″ ssw pipeline. The 24″ dsw distribution pipeline also bridges the low elevation and high elevation properties of the facility and can deliver dsw in either direction. There is currently no ssw distribution pipeline to bridge the two primary areas of the facility, although plans are underway to install a 28″ ssw pipeline in the future for this purpose.

All of NELHA's pumping stations are backed up by diesel electric generators that automatically transfer during a power outage. Most of NELHA's sweater pumps are operated by variable speed motor controllers that deliver seawater at a constant output pressure despite any changes in demand. NELHA has trained technicians on call 24/7 to respond to emergencies and strives to allow no more than 2 hours of sweater flow interruption for emergencies or schedule outages. NELHA's seawater availability is over 99.99%.

Proposed Conditions

The seawater system is the lifeline of NELHA. Although there will be future tenants that may have other needs beyond the seawater uses, it is the seawater system that will provide the distinction for NELHA from many other research parks and innovation/incubator developments. Extending the seawater and byproducts of the system to adjoining neighbors, and harnessing the energy generation within the Keāhole district has enormous potential to replace current limited and expensive resources.

As such, it is recognized that NELHA has already initiated a project as outlined in the Scope of Work for the 55-inch On-Shore System Infrastructure Upgrades project. NELHA will coordinate with the planners and designers for this phase of work, to size the infrastructure and plan expansion capabilities to implement this Master Plan.

The master plan envisions the extension of the seawater system throughout the site along the main roadway system. The projected costs for several options can be found in *Table 3-1*. This system should be designed to allow the extension of seawater air conditioning options to the airport area and neighboring ʻOʻoma. This is a potential revenue generating system beyond aquacultural, pharmaceutical and mineral extraction uses.

Estimating the costs of a future system is difficult because future flow projects are highly speculative. However, for purely planning purposes the estimates for unit costs in *Table 3-1* were developed by Makai Ocean Engineering.

Full Burial - Ballpark Costs
Supply, fuse, excavate and fully bury HDPE pipe at NELHA
Assume HDPE, DR21

		12”	18”	24”
Supply pipe	$/ft	15.2	30.2	53.7
Fuse and layout	$/ft	16.5	17.8	31.2
Trench, full bury, backfill	$/ft	144.0	202.5	270.0
Totals		175.7	250.5	354.9

Half Burial - Ballpark Costs
Supply, fuse, excavate and half bury HDPE pipe at NELHA
Assume HDPE, DR21

		12”	18”	24”
Supply pipe	$/ft	15.2	30.2	53.7
Fuse and layout	$ft	16.5	17.8	31.2
Trench, half bury, backfill	$/ft	99.7	140.3	187.0
Totals		131.4	188.3	271.9

Table 3-1 Projected Cost Rates and Options

Pump station costs vary greatly with the pump capacity and cost of electrical power distribution. It is assumed the pump stations at NELHA will be close to the roadways to reduce the cost of bringing power to the station.The following are some general budget estimates.

Pump Station Capacity	Cost Range
< 3,000 gpm	$150,000
3,000 - 10,000 gpm	$150,000 - $500,000
>10,000 gpm	$500,000 - $1,000,000+

These estimates include site work, interior power distribution, and accessory structure.

More accurate system costs can be developed after flow demands have been projected. A key issue will be the potential extension of the system into the airport area and/or ‘O‘oma site for seawater air conditioning (SWAC) purposes. This could potentially be a revenue generator as similar proposals in Honolulu suggest that such systems are becoming economically feasible. A study should be commissioned to look into this concept. Actual development of the system may be financed through legislative appropriations or private financing and both options should be explored. A major cost component will be the number of new pump stations needed and the energy to operate them.

Estimation of sea water demand is difficult to project due to a number of factors. A key uncertainty is lack of information about potential users and the kinds of users anticipated in the future. If the list includes future users from the Kona International Airport Master Plan and ‘O‘oma and Kohanaiki developments it further complicates the calculations as there is little information of sufficient detail about some of the uses in these developments. This makes sizing the pipes a difficult exercise. While SWAC uses do not usually generate large volumes since what is used are temperature differences and not the water itself, extractive uses remain hard to estimate.

Another difficulty in design is the erratic and highly fluctuating use by current and potential future users. For example, when operating, a tenant's demand can go from 100 gpm to 8-9,000 gpm which requires larger pipes to accommodate and hastens pump cavitations; thereby increasing maintenance costs for NELHA. It would help if Koyo and other large users of sea water had reservoirs on their sites to even out the flow requirements. This would save on energy costs for pumping and reduce maintenance wear and tear on the pumps. Other than SWAC users NELHA should consider encouraging present high volume users and requiring future users to install reservoirs within their property to even out the flows. This should be negotiated when new leases are being negotiated. Exemptions are of course always possible but if this was a general policy it would reduce costs and extend equipment life for NELHA.

It is generally recommended that the SWAC systems be half buried for aesthetic purposes and for ease of maintenance and driveway crossings.

3.9.5 Drainage

Existing Conditions

The general slope of the site is from ma uka along the Queen Ka'ahumanu Highway boundary (elevation 143-feet mean sea level) down to ma kai at the shoreline. The terrain is very irregular and undulating due to the old volcanic lava flows. Culvert crossings under Queen Ka'ahumanu Highway consist of the following (for reference, the existing NELHA access road is a Queen Ka'ahumanu Highway Station 172+50, with stations increasing in the north direction):

a. Station 160+50 1-30" culvert
b. Station 177+00 1-72" culvert
c. Station 182+50 1-72" culvert
d. Station 186+00 1-96" culvert
e. Station 207+00 2-96" culverts

The Queen Ka'ahumanu Highway Widening project by State Department of Transportation may upsize the culverts; however, a timetable has not been given on this project.

Using the County of Hawai'i Design Curve for Peak Discharge for hydrologic calculations, the total existing peak runoff from the drainage area above the Highway contributing to the old HOST Park section of the site is 3,800 cubic feet per second (cfs), for the peak, 24-hour storm.

The on-site areas are broken down into six major drainage areas – 4 within the ma uka section and 2 within the ma kai section. The total existing peak runoff from the ma uka section of the site is estimated at 1,176 cfs. The total existing peak runoff from the ma kai section of the site is estimated at 659 cfs.

Proposed Conditions

The area of developable lands will remain largely the same as the existing drainage areas. Based on the County of Hawai'i Storm Drain Standards, the peak runoff rate is estimated to increase by 1,022 cfs due to development of roadways and lots; however, the individual lots will be required to construct on-site retention systems to maintain flows at predevelopment conditions.

The roadway drainage will be collected via paved and vegetated swales, grated inlets and drywells. No drainlines are anticipated for the roadway collection systems. However, there will be drainage culverts to handle the existing drainageways and off-site flows from above Queen Ka'ahumanu Highway. As a result, the major drainageways through the site will be regraded to more efficiently direct the runoff through the culverts and on-site retention areas where possible. Major culverts will be installed under the interior roads to accommodate the drainageways as follows:

Phase 1 – Road "B-1": 96-inch, 84-inch, 48-inch

Phase 2 – Road "A-1" (north): 96-inch double barrel, 96-inch, 72-inch, 24-inch

Road "A-1" (south): (2) 36-inch

Road "C": 96-inch double barrel

Phase 3 - None

Phase 4 – Road "D-1": 60-inch, 48-inch

Phase 5 - None.

Drainage easements to accommodate the flowage paths through the site for larger rainfalls will generally follow property lines, with a minimal width of 20-feet.

The projected runoff is anticipated for discharge into drywells and retention basins on site. Some overland sheet flow may result during extremely rare events but overall, the porous, lave terrain of the NELHA site will absorb stormwater on site. Two drainage easements are proposed in the drainage plan to handle calculated runoff from design storm events. Runoff is generally anticipated to percolate along the easement and natural retention sites along the easement.

3.9.6 Power Storage and Distribution

Smart grids and microgrids with advanced metering are recommended for developing a distributed energy system at NELHA. The smartgrid will provide the ability to monitor and control energy utilization in a more efficient and cost-effective manner by using less energy even if the price per kW from HELCO remains constant.

The eventual vision for NELHA's energy supply includes a 30 MW OTEC Plant and other renewable energy sources supplying power for the seawater pumps and all operations at NELHA. Generators could be installed for emergency back-up power for critical equipment. Cold water pumped for power generation will increasingly be used for air conditioning considerably reducing electrical demand. This smart infrastructure will:

- Provide 100% electricity production for NELHA property onsite
- Provide 100% of potable water supply onsite
- Provide 100% of wastewater treatment onsite
- Provide communications and management via a command and control center

HELCO has been working with NELHA tenants to install more efficient equipment with monetary incentives. This load curtailment rate helps the utility meet its peak load, between 5:00 and 9:00 PM by flattening the load at other times of the day, and has the added benefit of reducing tenant operations costs.

Continued cooperation with HELCO is recommended. Conversations with HELCO staff emphasize the utility's openness to power purchase options from third parties generating energy from "exotic" technologies such as geothermal and other renewable sources. HELCO is especially interested in firm sources of energy that do not impact the variability of the energy supply system such as biofuels. However, as in many renewable energy scenarios currently under consideration, energy storage is a consideration due to the relationship between energy demand and energy supply. Many alternative energy sources like wind, solar, wave and ocean current sources are intermittent in their generation and may not be available

when the demand kicks in. For these sources, currently the grid itself is the place to store excess production. Battery systems, gravity pumpage and heat transfer concepts are all under investigation and assessment for technical and financial feasibility. Hydrogen fuel cells are another area of national and international investigation in this area. NELHA is an ideal place for such research and application as many of the sources of these alternative energy options are located at NELHA. The NELHA Green Energy Zone plan is a good context for these efforts.

Alternative energy sources such as waste to energy, biofuels, OTEC and geothermal would not be straddled with this storage constraint.

3.10 ALTERNATIVES

Several alternative scenarios were reviewed in the process of coming up with the proposed master plan concepts. They ranged from a no-change scenario to a futuristic eco-village campus concept. In the end the proposed concept of an economic driver merged with a research park/campus idea was endorsed by the NELHA Board of Directors as enhancing the governmental directive of self sufficiency and fulfilling the mission statements for alternative energy development and ocean resource related research, innovation and business incubation. The business rationale for this alternative is included in Chapter 4. The alternatives were summarized in a PowerPoint presentation and Q&A session with the NELHA Board in two of its earlier board meetings in 2008. The PowerPoint and an economic analysis of the alternatives are included in the appendices.

3.11 TENANCY POLICY

NELHA's policy with existing tenants is that they will be allowed to stay if they choose to. No tenant will be terminated or relocated simply to create consistency with the master plan.

For new tenants, the zones in the master plan will serve as a guide to NELHA in determining the location of that tenant. The idea of clustering tenants into use zones is intended to help guide development into compatible activities and promote a synergy among the users. Supporting infrastructure is also more likely to be compatible. Zoning also gives each area its own identity.

3.12 LOTTING SCHEME

The proposed lotting scheme is developed to coincide with the proposed master plan concepts. Existing lots and lot numbers are retained. New lots are labeled numerically and proposed for designation with the prefix of the master plan zone they are located in followed by the number shown on the lotting plan map. For example, if a new lot is in the applied technology (AT) zone it will be designated as AT-(number). If it is in the research (RE) zone it would be labeled RE-(number).

As a general rule, new lots in the RE zone are recommended between 1-3 acres. New lots in the remaining portions are generally over 3 acres. This is to remain consistent with the existing and proposed future zoning for these site. This is also based on the assumption that research activities will generally require smaller lots than application activities. It is understood that if an enterprise wants a large space than the available lot there is always the option of using two or more adjacent lots if they are available.

The lots at Unualoha Point are an exception to the general pattern due to their remoteness (expense of extending infrastructure) and location in a constricted tsunami zone where high density would place more people and facilities at risk.

All lots will be accessible from existing or proposed new roadways which will be designed to County standards. No new lots will be created that straddles a new or existing roadway.

Since no new breaches of the Māmalahoa Trail are allowed new lot lines will run along the edge of the trail easement alignment.

Ho'ona and the Wawaloli archaeological preserve sites will be incorporated into discrete parcels to clarify their jurisdiction and preservation boundaries. Buffers will be identified that may or may not extend beyond the parcel boundaries. The buffers will be determined after concurrence from the State Historic Preservation Division. These buffers (if applicable) will be incorporated into the lot information plans for lots that are adjacent to the archaeological sites.

Smaller archaeological and potential preservation sites will be incorporated into the surrounding lot and identified as preservation easements.

Miscellaneous lots will be designated for major archaeological sites, infrastructure sites such as pump stations and electrical substations, Wawaloli Park, and roadways. All parts of the NELHA land will be part of a designated lot to identify locations, simplify records and assist with maintenance and management. It is recommended that these parcels be identified as public facility parcels.

If existing tenants do not renew their leases NELHA may consider re-subdividing the lots to facilitate the implementation of the long range master plan. No existing tenants will be forced to relocate to create new parcels. No leases will be terminated simply to facilitate the implementation the master plan.

Utility, infrastructure and roadway easements will be identified as detailed infrastructure plans are developed with each phase. These easements will be identified, mapped and included in the final lotting and subdivision plans.

There is a State of Hawai'i easement that runs through parcel 7-3-43:82. It has been labeled as the Kings Highway. The proposed lotting scheme assumes the deletion of this easement as retention of the easement places unreasonable constraints on the road and access requirements and makes the proposed lotting scheme infeasible.

3.13 AESTHETICS AND VIEWS

Generally, aesthetics and views are not major issues or concerns associated with light industrial parks or research institutions. However, for NELHA these questions have been important since the beginning and the design guidelines administered by the County of Hawai'i govern the site. As part of this master planning effort a topographic, visibility analysis was conducted. However, upon reviewing the computer analysis it was evident that due to the relatively flat terrain much of the site is visible from many areas. As such establishing setbacks and corridor treatments along major roadways proved to be more effective and practical strategy for view protection. Within those parameters landscaping and screening help to mitigate some of the harsher or less attractive aspects of industrial parks. Height restrictions and material selection also help to reduce potential impacts. Details for aesthetic controls are found in the Development and Design Guidelines adopted by NELHA and administered by the County.

3.14 EVACUATION PROCEDURES

One of the most worrisome events from a emergency management point of view is a locally generated tsunami. At NELHA, the coastal RE zone and the Culture and Science zones are vulnerable to such hazards. The primary needs are to educate people to recognize local events that could generate a local tsunami and how to respond to them. This time of response on the Big Island will probably be in the 10-30 minute range depending on the distance to the triggering seismic or geologic event.

For the Culture and Science zone, the appropriate response would be to quickly move inland by foot to higher ground and greater distance from the shoreline. For the RE zone the airport runway fence line poses a potential barrier to moving sufficiently inland to avoid the tsunami. Discussion with the Kona International Airport for emergency gates is recommended.

3.15 NELHA AT PUNA

The Puna Research Center, Noi'i O Puna, should be revitalized as directed by the 2001 Senate Concurrent Resolution as outlined in section *2.16.2 Evolution of Activities at Puna* including installation of a heat exchanger and pipeline to generate waste heat from geothermal reinjection fluids, improvement of the facilities, and possible revitalization of the community geothermal technology program and visitors center.

Additional areas of exploration for utilizing the heat source include supplying hot water to neighboring sites, using the warm water to grow freshwater fish in warmer environments, and creating a spa. Exploration of all uses of geothermal heat sources should be done with an eye toward cultural sensitivity and in consultation with the cultural advisory body recommended for NELHA by this master plan.

The function of the Puna Site should be expanded to make it one of the testbed sites for new technology. Located in a tropical rainforest, it provides one of the biomes found on the Big Island. Access an some facilities have already been developed and the site could be easily rehabilitated as a testbed for equipment beyond geothermal.

Feature Key

Feature 1 - Applied Renewable Energy Zone

Feature 2 - Economic Driver - NELHA related products and services
(Technology Transfer Offices & Commercial/Retail Complex)

Feature 3 - Ocean Resources, Innovation & Applied Techonology Zone

Feature 4 - Science & Cultural Center

Feature 5 - Ocean Resources & Natural Energy Research

Feature 6 - Ocean Research Zone

A Entrance & Educational Node
- Gateway Center
- Classrooms/Conference Rooms
- Interactive Energy Displays
- Ocean Water Fountains
- Deep Ocean Aquarium

B Energy and Ocean Mall
- Kona Coffee Shops
- Meeting Places
- Sundry Stores/Grocery (Organic)
- NELHA Products
- Piazza
- Farmer's Market
- Deep Ocean Cooled Products/Displays
- Interactive Ocean/Energy Displays and Games
- Research Inn

C Wawaloli Ahupua'a Hale
- Cultural Gathering Place
- Outdoor Pavillion for Community Gatherings
- Cultural Practice Education
- More Lunch Tables
- More Shade Trees/Coconut Palms
- Canoe Launch Area

D Research Village
- Laboratories
- NELHA Hale
- Conference Rooms
- Classrooms
- Lecture Hall
- NELHA Offices
- Cafeteria/Lounge/Recreation Room

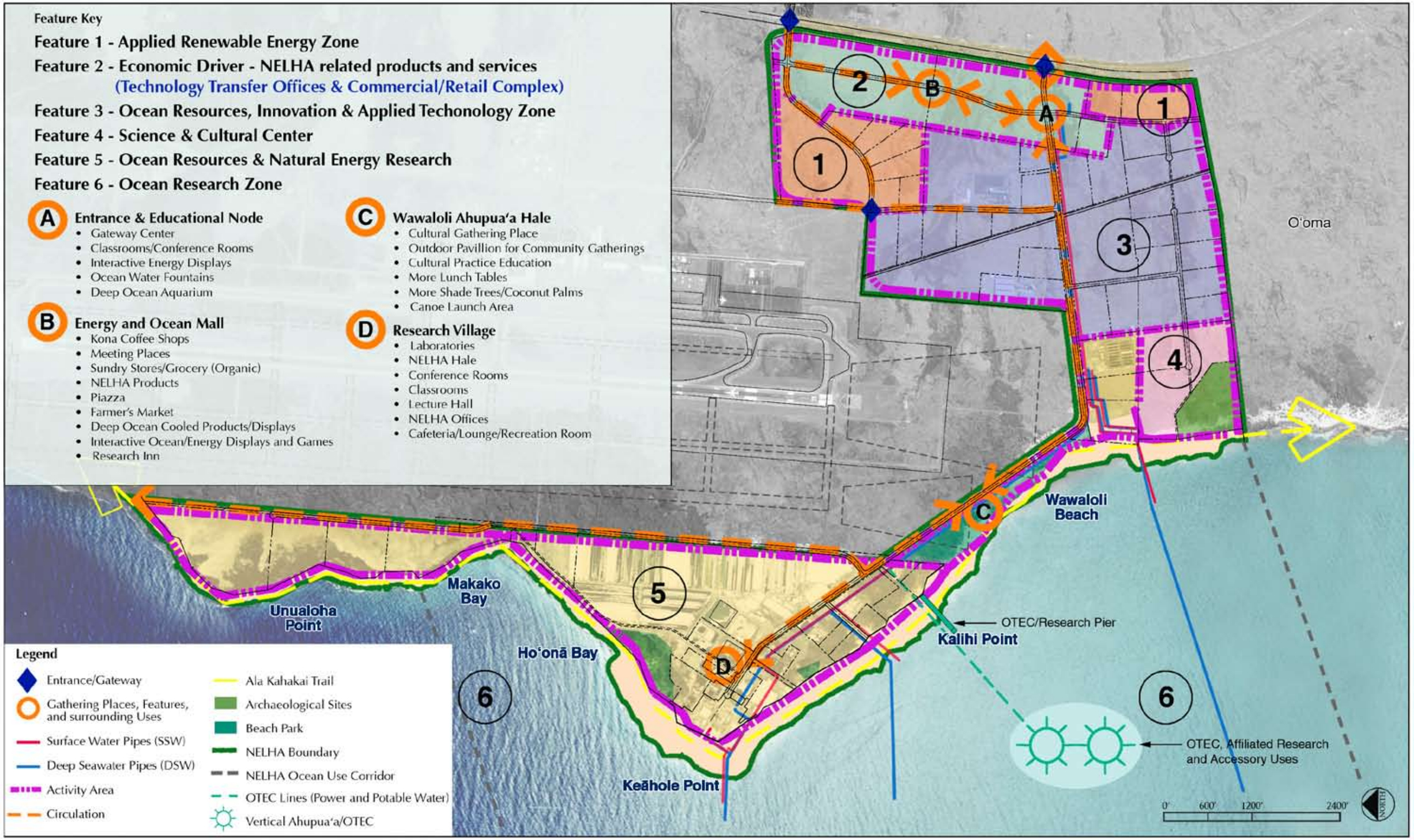


Figure 3.1 Conceptual Master Plan

Phasing Plan

Phase 1	- Stub-out roads North of NELHA Access Road in Applied Technology area. Complete Kaiminani Drive/ Queen Ka'ahumanu Intersection
Phase 2	- Frontage Road to serve Economic Driver
Phase 3	- Redevelopment of NELHA compound into NELHA Research Village and NELHA Hale
Phase 4	- Roads into Applied Technology area south of NELHA Access Road and into Science and Cultural Center
Phase 5	- Road Extension to Unualoha Point

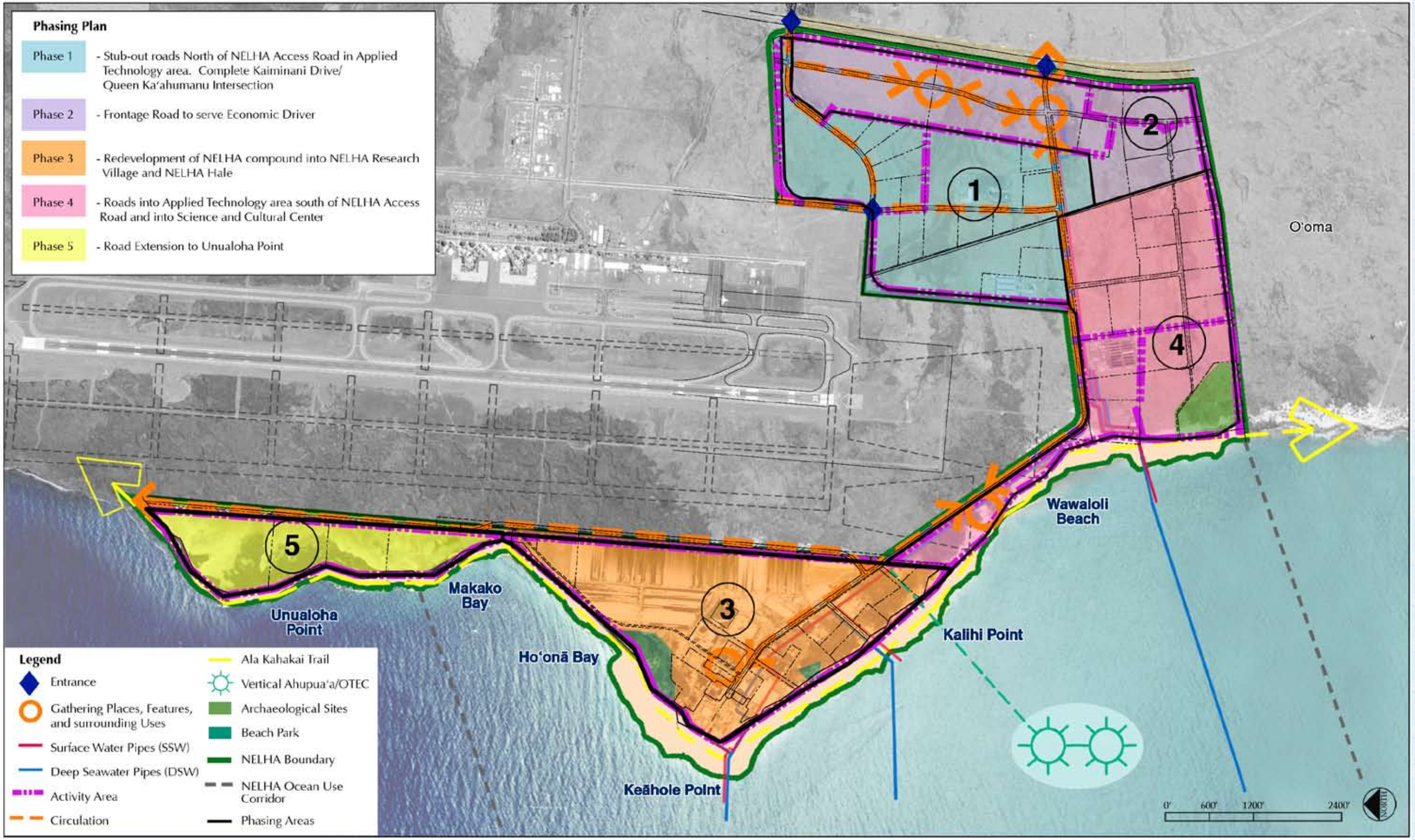


Figure 3.2 Phasing Plan

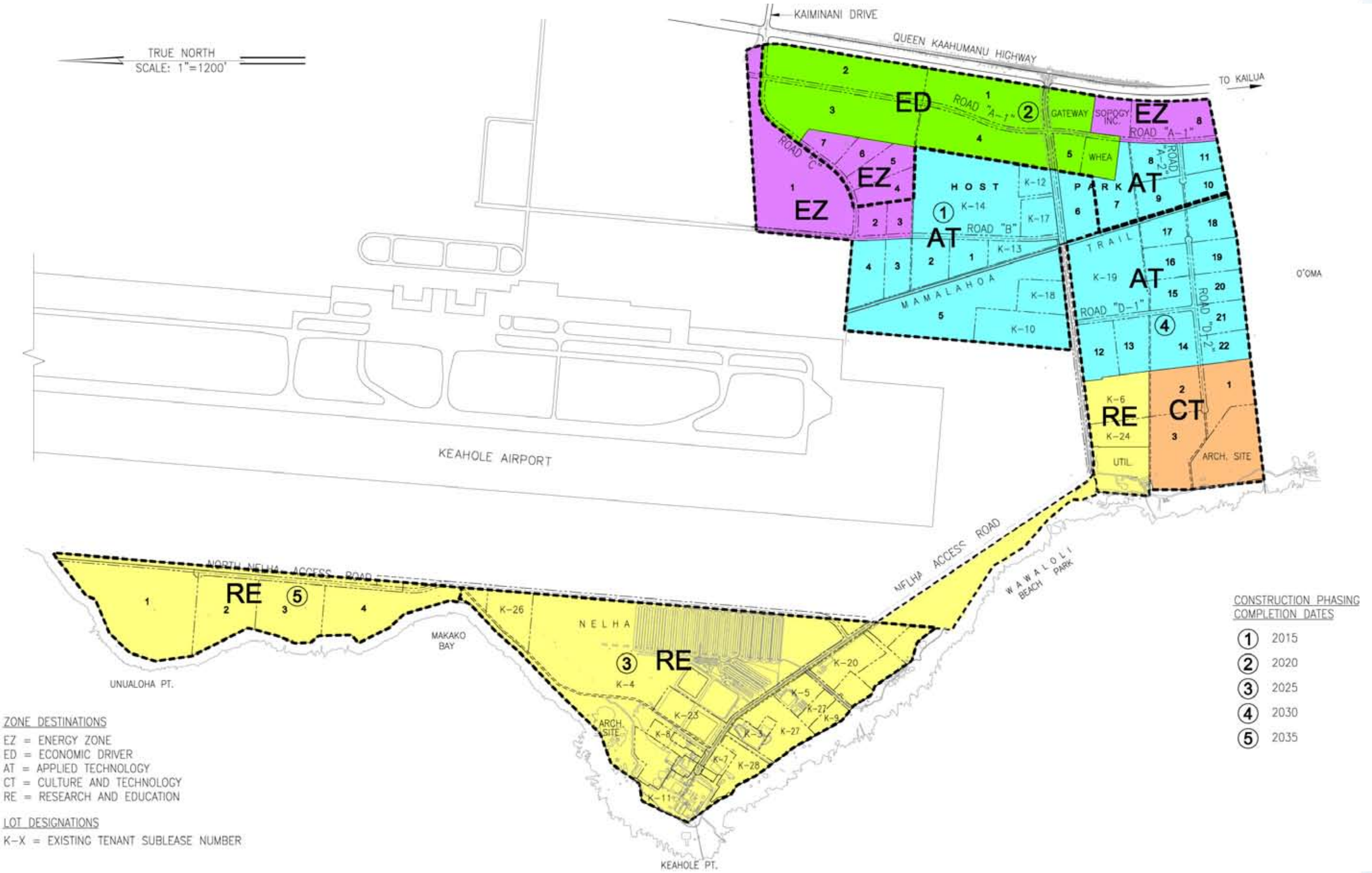


Figure 3.3 Lotting Plan

Figure 3.4 Proposed Water System

TRUE NORTH
SCALE: 1"=1200'

KEAHOLE AIRPORT

QUEEN KAAHUMANU HIGHWAY

TO KAILUA

O'OMA

ROAD "A"

ROAD "B"

ROAD "C"

ROAD "D"

HOST PARK

GATEWAY

SOPOGY INC.

WHEA

TRAN

MAMALAHOA

ARCH. SITE

UTIL

NORTH NELHA ACCESS ROAD

NELHA ACCESS ROAD

NELHA

MAKAKO BAY

UNUALOHA PT.

WAWALOLI BEACH PARK

1-1	4.94	
1-2	10.15	
1-3	32.34	
2-1	25.06	
2-2	55.86	
2-3	9.07	
2-4	22.50	
2-5	31.19	
3-1	5.32	
3-2	25.15	
3-3	49.09	
4-1	15.79	
4-2	63.81	
4-3	6.40	
4-4	72.45	
4-5	103.36	
4-6	3.78	
5	85.66	
6	196.13	

NOTE:
AREA UNIT = ACRES

Figure 3.5 Drainage Area Map

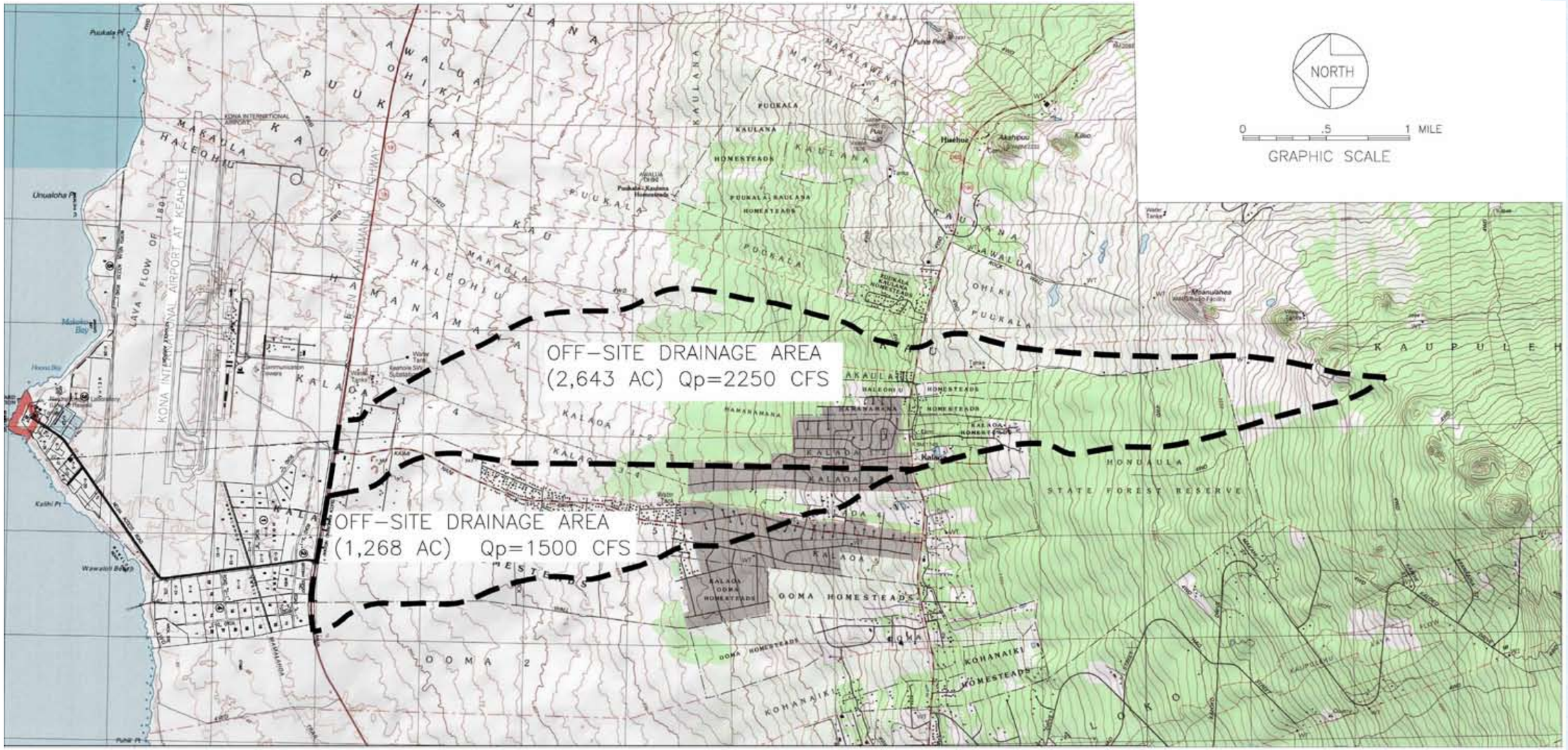


Figure 3.6 Off-Site Drainage Area Map

Figure 3.7 Proposed Sewer Plan

Energy & Ocean Research Park

Proposed Conceptual Master Plan

Existing Tenants of NELHA

Energy and Ocean Research Park

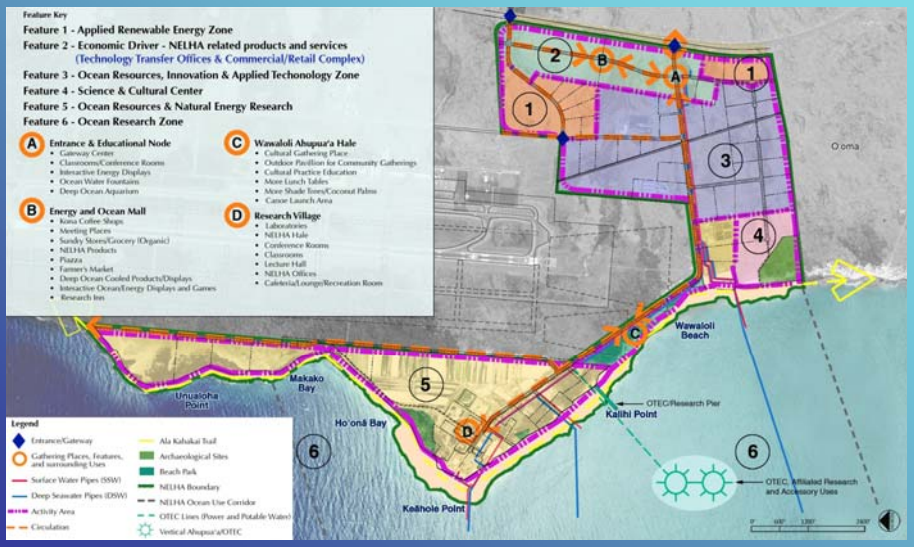
KEY FEATURES

- Integrated Science & Technology Research Campus for National Laboratories in Hawaii
- US-DOE Pacific Area Field Office
- Federal and State Partnership for R&D of Energy Related Technologies
- Create Commercial Anchor Reflective of NELHA Mission: Sale of NELHA Products (Biological, Minerals, and Technical), Edutainment (Sea, Geology, Alternative Energy), Deep Ocean Aquarium
- Innovation, Applied Science, Business Incubation. Apply New Technologies On-Site in Light Industrial Park Such As: Alternative Energy, Aquaculture, Resource Extraction, and Biotechnology
- Energy and Ocean Research Park
- Interpret Research Activities and Links to Cultural Uses: Linking Traditional Knowledge to Western Science

NREL | Sandia National Laboratories | Los Alamos National Laboratory | Oak Ridge National Laboratory | NETL | PNNL

Energy & Ocean Research Park

Features



Feature 1

Applied Renewable Energy Zone

Applied Energy Technologies:

- ***Solar***
- ***Wind***
- ***Geothermal***
- ***Energy Storage***
- ***Waste to energy***

Feature 2

Economic Driver

Create Commercial Anchor Reflective of NELHA Mission: Sale of NELHA Products (Biological, Mineral, and Technical), Edutainment, Ocean Recreation

- ***Retail Reflects Mission and Place***
- ***Educate Visitors***
- ***NELHA Products Available to Public***
- ***Commercial Gathering Space for Community***
- ***Deep Ocean Aquarium***
- ***Seafood Restaurant***
- ***Local/Cultural Ocean Festival***

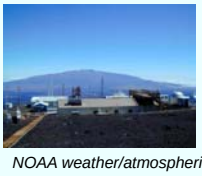
Technology Incubation, Administration, & Commercialization Enterprises:

- ***Technology Development & Incubation Campus***
- ***Technology Commercialization Partnership Offices***
- ***NELHA & US/DOE Program & Administrative Offices***
- ***Work/Office/Visitor Accessible Retail Functions***

UH West Hawaii Center at Palamanui

Bradshaw Air station

Ocean off NELHA



NOAA weather/atmospheric station on Mauna Loa

NELHA geothermal site at Pohoiki in Puna

Semi-arid coastal

Leeward transitional

Sub-alpine

Alpine Zone – Above Treeline

Tropical Rain Forest

Potential Technology Development Testbed Network:

Utilize Diverse Climatic Conditions (Zones) to Support Testbeds

Foster Technology Demonstration Partnerships

Establish Geographic Network of Nodes as Testbed Locations

Linkages with Other Institutions & Agencies

Feature 3

Innovation, Applied Science, Business Incubation

Application of NELHA Research Functions as Light Industrial Park

Example Industries:

- ***Alternative Energy***
- ***Aquaculture***
- ***Pharmaceuticals***
- ***Minerals/ Water Extraction***

Applied Technology Development & Deployment:

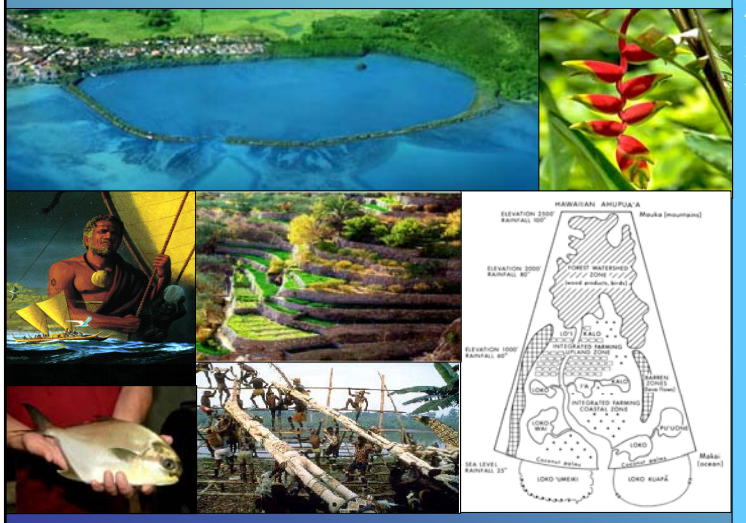
- ***Renewable Energy***
- ***Containerized Technologies***
- ***Transportation***
- ***Fuel Cell***
- ***Critical Infrastructure***

Feature 4

Science, Technology and Cultural Center

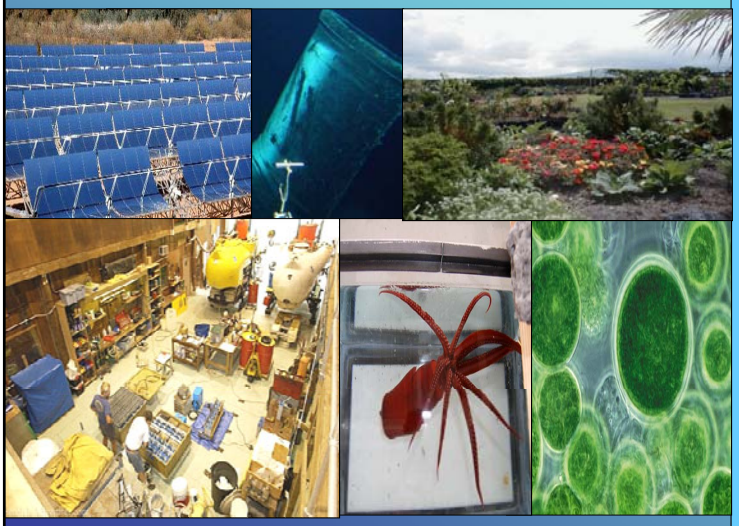
Interpret Research Activities and Links to Cultural Uses; Linking Traditional Knowledge to Western Science

- ***Connecting NELHA Research with Cultural Integrity***
- ***Technology Indigenous Fishing Traditions, ie: Koa / fishponds***
- ***Dry Land Agriculture***
- ***Food Preservation***
  - ***Salt***
  - ***Drying***
  - ***Ocean (as) Refrigeration***
- ***Local Cultural Partnerships***



Cultural Science: How Do Traditional Systems Work Scientifically?

- ***Fish Pond Ecosystems***
- ***Medicinal Plants***
- ***Freshwater species***
- ***Natural Predation Controls***
- ***Wood Species, Moisture, and Insects***
- ***Navigation Without Instruments***
- ***Passive Solar Design and Construction***
- ***Ahupua'a Land Management***



Feature 5

Energy & Ocean Research Park

Renewable Energy Research, Deep Ocean Research, Sustainable Living Research

Potential Research Partnerships:

- ***UH SOEST Group***
- ***UH Center for Sustainable Design***
- ***NREL/DOE***
- ***Cornell Sustainability***
- ***JAMSTEC***
- ***NASA***
- ***CEROS***
- ***NOAA***
- ***SHELL OIL***

Innovative Energy Producing Technologies:

- ***Ocean Current***
- ***Ocean Thermal***
- ***Wave***
- ***Wind***

Feature 6

Ocean-Eco Technology Village

- *Wave Energy*
- *Hydro Electricity Ocean Energy*
- *Vertical Ahupua'a*
- *Algae Biofuel Farms*
- *Wastewater Treatment*
- *Architecture Prototypes*
- *Solar-Powered Watercraft*
- *Submersibles*

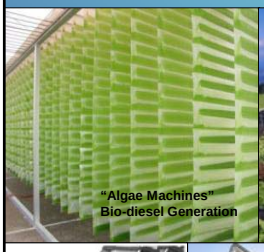
BUSINESS MODEL

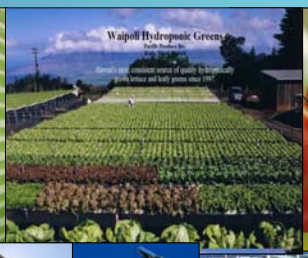
1. **NELHA continues to function as a Landlord. Leasing system is managed like a shopping center. Tenant selection process to enhance mix of revenue generating businesses, technology incubation, and research.**

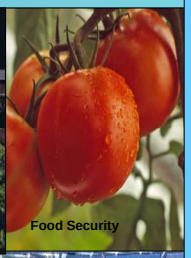
2. **Stable utility costs - NELHA expands utility functions to include power, water, and wastewater and create a horizontally integrated infrastructure grid. Configured with renewable energy sources creating a self-sustaining utility enterprise. Grid expanded to serve airport & other properties for revenue generation. Partnership with others to create this expanded utility infrastructure.**

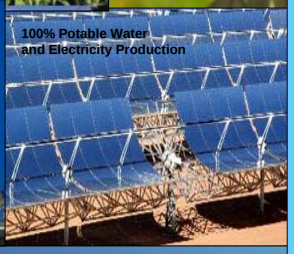
3. **NELHA develops with US/DOE or other partnerships a technology transfer, test bed site, and worldwide "islands" research & development program bringing international science and technology programs to the NELHA campus**

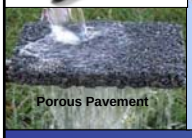
Long Term Goals


"Algae Machines"
Bio-diesel Generation




Food Security


100% Potable Water
and Electricity Production


Porous Pavement

Wind and Solar Street Lights

- *Provide 100% Electricity Production for NELHA Property Onsite*
- *Provide 100% of Potable Water Supply Onsite*
- *Provide 100% of Wastewater Treatment Onsite*
- *No Fossil Fueled Vehicles used On Site*
- *Unified Utility Command & Control*
- *Smart Utilities*
- *Carbon Neutral*
- *Paper Neutral*
- *Waste Neutral*
- *Food Security*

Educational and Technical Training Opportunities for Hawaii's Youth

- *Provide Internship Program in the Central Command & Control for High School Students*
- *Technical Training for High-Tech Industries Based on NELHA Technologies*
- *Edutoursim and Agritourism On-the-Job Training*
- *Cultural Science Training*

4.0 Strategic Plan and Implementation

Strategic plans set targets or goals to be reached, establishes strategies for achieving those goals and sets benchmarks to measure progress. It is important at the outset to determine or clarify the institutional structure of the organization to make sure it is organized properly to pursue both its mission and the specific targets in the master plan and strategic plan. NELHA is a governmental agency organized to conduct research in renewable energy and ocean resource related fields and assist in business incubation. Governed by an appointed Board of Directors and attached to the Department of Business, Economic Development and Tourism for administrative purposes it is subject to state administrative rules, procurement practices and financial constraints. Within this framework it is staffed by an Executive Director and 19 staff members. NELHA has a broad mission and needs partners and outside funding and resources to achieve the master plan described in Chapter 3. Before evaluating the appropriateness of NELHA's structure to achieving the master plan NELHA needs to define what it wishes to be in relation to existing and potential revenue models. Does NELHA want to be a passive landlord, an active landlord, a passive partner, active partner, equity partner or the lead developer / agent.

In coming to recommendations about NELHA's role, key factors considered were past experience and current institutional skill sets.

It is clear that the magnitude of the goals and the resources it will take to make them happen will require partners and outside resources. NELHA brings to these potential partnerships many assets for negotiation. Its key assets are the land and the sea water. The land benefits include Foreign Trade Zone and Enterprise Zone status which envelope the business side of locating within NELHA. The land's proximity to the airport has long been recognized as an asset for logistics and shipping products.

Access to surface and deep ocean seawater is clearly one of NELHA's unique assets. This existing infrastructure gives NELHA a unique advantage over nearly every other research park.

Other important assets include linkage to State Government and the potential for bond financing and legislative appropriations. Even though NELHA has a charge to be economically independent this does not preclude the option of bond financing for projects and special limited legislative appropriations for specific projects that enhance the mission or potentially lead to long term self sufficiency. These tools can all be used in discussions with potential partners and leasees who may take the lead in implementation of the Strategic Plan.

Finally, NELHA is well connected with the institutions and agencies that have some of the best minds in the fields of deep ocean resources and alternative energy. HNEI and SOEST are clearly world leaders in these fields and have individuals who are recognized in their fields. Private companies such as Makai and Sea Engineering are also international leaders in their respective specialities. These connections have not been cultivated well but the potential is there and should be re-evaluated.

4.1. MODELS AND POTENTIAL REVENUE SOURCES

In strategic planning the key is to set the goals. Once that is done, there are many possible strategies that may be used to implement those goals. These strategies all employ some concept of revenue streams and resource allocation. It is often useful to keep the goal clear and focused and the approach flexible since it is difficult to anticipate opportunities or resources that may become available. The following are some strategic business models the Board should consider.

4.1.1 Land Owner and Utility

Currently, NELHA functions as a landowner and utility. As such it receives income from ground rents and the sale of seawater. Tasked with research responsibilities and being an incubator facility for alternative energy, aquaculture and other ocean resource related activities it has conflicting pressures. The mandate to become self sufficient pushes NELHA toward a private for profit model. The incubator function pushes it to keep water rates and ground leases at the lowest possible level while still covering operational costs. Additionally, it must pay DBEDT administrative service fees and as a State agency located on ceded lands it must pay the Office of Hawaiian Affairs 20% of gross revenues above cost. These conditions make it extremely difficult for NELHA to break even in its profit and loss within its current business model. It is recommended that NELHA look at multiple options and roles for revenue streams.

The adoption of this master plan and the development of the new lotting scheme allows NELHA to lease more parcels and potentially generate more land lease revenues and sea water use revenues. Full development of the site may help NELHA generate a long term small positive cash flow position. However, development is anticipated to be slow and incremental under the present scenario. The need for additional land use entitlements such as CDUA and SMA permits makes this process even slower. Subdivision processes require that civil infrastructure be completed or a bond posted before occupancy and these expenses will be slow in coming under the current framework.

4.1.2 Master Developer

If NELHA wants to take on this role, there are vacant undeveloped lands within the boundaries of NELHA. Also, with agreement from the Board of Land and Natural Resources (BLNR) there are lands owned by the State Department of Land and Natural Resources (DLNR) ma uka of Queen Ka'ahumanu Highway that could be used for additional development. In order to play this role NELHA would need to develop the overall site infrastructure, market the property and find contractors and other developers to take on specific chunks of the master plan. Implementation would probably be incremental and dependent on developer agreements with other parties. This in turn would be largely influenced by the state of the external economy. Financing for an endeavor of this magnitude and purpose would normally require an appropriation from the State legislature or authorization to float bonds; possibly through special purpose or revenue bonds.

Another way NELHA could play this role is to partner with another entity and jointly develop the site infrastructure. It would bring in the land asset as its share of the partnership and the other entity would bring in the skill sets and construction financing. There has been interest in this approach expressed by a company specializing in smart grid and horizontal integration of infrastructures. They have the expertise to design and develop these systems and have the capacity to bring their own financing for these projects. Other similar or compatible development partners could be solicited to help NELHA develop the capacity needed to actualize some of these projects.

4.1.3 Expanded Utility

NELHA could expand its utility function beyond the sale of surface and deep ocean sea water. As renewable energy companies like Sopogy and Hawai'i Bioenergy develop on NELHA lands they raise the possibility of energy integration and internal power purchase agreements that could be set up with the leasing activity. NELHA could push for smart grid and microgrid development for which it is a partner or coordinator with the specific company. In the distant future after a 5-10 megawatt scale up OTEC plant has demonstrated its feasibility, OTEC could also be part of the power source as well. However, this concept may be feasible with or

without OTEC. The Hawai'i Bioenergy project and Sopogy combined may generate enough electricity to make this a reality. This strategy allows NELHA to expand into the power utility business. While current laws and regulations place constraints on this option, there is considerable pressure developing in expanding power purchase agreements and loosening this constraint. This direction should be explored with these companies. Regulatory changes should be proposed to allow greater flexibility in power generation and distribution. A partnership with HELCO might be possible if political pressure for change is high.

Additionally, as a consequence of further development and expansion of its sea water delivery system NELHA could develop a sea water air conditioning infrastructure for its own tenants and then possibly expand to the airport and neighboring private developments. The feasibility would depend on the economics of the savings relative to traditional air conditioning. While a specific marketing study and feasibility study have not been done for NELHA, this kind of development is drawing much attention in Honolulu. Private companies are lining up with proposals to provide the service. While Kona is not Honolulu and does not have the customer base that Honolulu has NELHA already has the base infrastructure in place and this should be a tremendous economic advantage to NELHA. A feasibility study is recommended as part of an implementing strategy. Again, a partnership with a private third party group may provide the resources for this kind of endeavor.

The green energy zone that has been developed for NELHA is a good framework for NELHA to use in evolving into this role. The plans and policies of the green energy zone should be incorporated into this master plan by reference.

4.1.4 Carbon Trading

In the future it looks likely with the Obama administration initiatives that zero carbon goals and cap and trade policies would allow NELHA to play a role as a carbon sink. The existing projects at NELHA related to biodiesel are already looking at emissions from the HELCo plant ma uka of the airport as a CO2 source for their algae. The airport is also a high source for CO2 and may be a willing partner in such a cycle. The revenue stream from this kind of operation is as yet untested but NELHA can play a broker role with its tenants and outside emitters of CO2. Any transmission pipelines will require crossing streets and easements and overall NELHA approval and this may be used as leverage in these agreements.

As the policy of cap and trade evolves a secondary market incentive for efficiency and carbon capture and sequestration technologies is likely to evolve. First will be advances in technologies to increase efficiency of combustion to minimize CO2 emissions. Secondly, we can anticipate technologies to scrub or catch emissions at the tailpipe or smoke stack after combustion. Finally we can anticipate new methods of technologies for carbon capture and sequestration. These are areas the NELHA may seek to develop a niche and be part of the growth of new technologies addressing global warming.

4.1.5 Fiscal/Equity Partnerships

Partnerships for utility purposes creates one form of revenue in terms of monthly utility payments. Equity partnerships in development allow another form of revenue stream. In developing the economic driver parcels it is possible to go beyond a simple landlord relationship to a partnership with the potential developer. Again, NELHA's contribution would be the land and any technical and political support it can provide. Sea water delivery at subsidized rates could also be its contribution. The advantage of this model is that NELHA can function as a complex owner, like a shopping center owner or equity partner and could potentially share in a wider range of profits. These agreements would generally be negotiated at the time of lease negotiations.

4.1.6 Institutional Anchors/Partners

A key goal of the master plan is to solicit the presence of major institutions as partners at NELHA such as the Department of Energy's National Renewable Energy Laboratory (NREL). It may be feasible to entice NREL to establish a field office at NELHA. If that is achieved, like all anchors they attract affiliated companies that serve the main institution and help create the critical mass that is needed for successful occupancy. The Governor's Office and DBEDT have been working toward a collaboration that could lead to this. The Hawai'i Clean Energy Initiative is clearly a positive step in that direction. The test bed idea and the potential for OTEC are other factors that increase the possibility that this may happen. It has been reported that NREL is interested in going back into OTEC research and NELHA is a logical place for a scale up facility. This path should be pursued. Additionally, the University of Hawai'i and other college campuses should be actively wooed by various initiatives to place people and programs at NELHA. To that end support facilities will be needed. Preliminary support for this idea has been expressed by the administration and legislative funding for these support facilities is a distinct possibility.

4.1.7 Academic Partners

In order to become a cutting edge facility and center of excellence, NELHA needs to attract world-class researchers and have them affiliated with NELHA. To do this they need facilities to make NELHA attractive to researchers. NELHA operates on a tight budget and does not directly support its own research staff. In order to gain a reputation as a first-class research institution, its needs to have great research facilities and a permanent, direct association with researchers. These researchers can hold multiple chairs and hats and one of those hats should be an affiliation with NELHA. It is with this kind of stronger affiliation with world-class researchers that NELHA can gain a reputation as a place for such researchers to congregate and collaborate without the burden of permanent research staff salary cost. To encourage this affiliation, NELHA should provide the necessary amenities and support facilities in the research village designated around the existing NELHA administrative compound and develop an affiliate faculty program.

4.1.8 Outside Stewardships and Community Partners

While generally not a source of funding, community groups are able to improve community relationships, provide sweat equity and fund raise for smaller projects. Some of the smaller projects like the ahupua'a gathering pavilion or a cultural center by the archaeological preserve along the shoreline next to O'oma are likely candidates for community partnerships. Additionally they may help to self police and help maintain some of the coastal resources. This should be explored further as part of the activities of the cultural and community advisory groups.

4.1.9 "Angels" of Kona Venture Capital

Our fiscal consultant, Knowledge Based Consulting Group, has suggested that NELHA work with wealthy individuals in West Hawai'i to form a venture capital fund to assist start ups and incubation projects. His conversations with wealthy individuals who have first or second homes in Kona indicate an interest in this sort of venture. Many of these individuals have money, time, skill and interest in participating in such a venture. Some have also expressed an interest in playing a mentorship role with new entrepreneurs. Access to funds and business expertise has been identified as key support services that research and technology park managers can provide.

NELHA should develop a list of such individuals and begin a dialogue with the goal of creating a pool of advisors and a venture capital fund or access to such funds. An initial list of such individuals and/or firms should be developed. This concept does not generate revenue for NELHA but helps NELHA support its tenants with a needed service that is likely to increase the tenants viability and chances of success which in turn would benefit NELHA. It would also help

attract additional tenants to NELHA through the independent networks these individuals have and the added attraction that NELHA would have to potential tenants if it was known that such support or access to capital was available at NELHA.

A key to engaging these individuals would be a compelling and inspiring vision for NELHA which we hope the master plan provides. NELHA needs to reach for the "high bar" in its field as these individuals are very sophisticated and worldy. They know what is truly cutting edge in research and technology in the world and would be attracted to leading edge research and development. Additionally, many of them are attracted to efforts to solve major issues like global warming, peak oil scenarios and the green, sustainability movement. They would be excited to engage in efforts geared to such goals.

4.2 STRATEGIC PLAN

NELHA has a long history of grand visions, high expectations and often disappointing results. While many things have contributed to this history, it is important to put this in perspective and remember that many good things have been accomplished. To this day it remains the site for Mini-OTEC, the first net positive energy OTEC experiments in the world and many of the tenants in aquaculture and pharmaceuticals have recorded patents and successes in the fields of aquaculture, renewable energy technology and ocean resource utilization. It is easy to forget the good things because the results and the memories of these accomplishments are scattered between NELHA and individual tenants.

In 1993 NELHA adopted a Strategic Plan; the executive summary has been included as an appendix, which in overall mission and structure is still generally valid. Specific targets and goals have changed and there is less emphasis on the geothermal component. The overall mission statement has been prescient and remains valid today.

> *"To develop and diversify the Hawai'i economy by providing resources for energy and ocean related research and commercial activities in an environmentally sound and culturally sensitive manner."*

The old plan contained a set of objectives and strategies for achievement with some target dates. A series of opportunities and threats and strengths and weakness were evaluated. While this approach remains valid for specific projects and programs as an overall master planning approach and strategy it is too narrow and limiting.

The proposed new strategy can be described as maintaining and expanding the original focus, changing approaches and developing institutional capacity. The original mission is reconfirmed. The changing strategy is to seek targets of opportunity in a broader field with major partnerships. The development of institutional capacity targets, education, staff increases and resources available through partnering and networking. The plan is to have a tool kit of options and institutional capacity to respond to a number of potential choices. A sports analogy is to maintain an attitude of responding to whatever opportunity presents itself as one moves down the field or court. This is not random as a lot of training, conditioning and mental preparation goes into the effort in order to be able to execute when the opportunity presents itself.

NELHA has always desired to become a Center of Excellence for Energy and Ocean Research. This desire is an achievable goal in that in the past it has been a leader in OTEC research and more recently it is on the cutting edge of biofuel research from algae. Over many years it has made great leaps in aquaculture and pharmaceuticals from ocean research utilizing its unique strengths and qualities; i.e. deep ocean water and high solar insolation. With its proximity to many climate zones it has the potential to attract world-class research in fields

where these resources are important. Excellence develops in a tentative fashion starting with opportunities attracting top notch researchers who then attract money which then brings more facilities to accommodate them. To facilitate this increasing interaction between researchers and facilities to conduct research some additional amenities are needed. The concept of the Research Village is geared around the idea of creating a critical mass of amenities to attract world-class research. If this occurs, then its reputation will eventually draw the funds and resources to sustain a Center of Excellence.

NELHA should look beyond standing alone in its efforts to achieve economic self-sufficiency. Instead, it should revise its vision and broaden its scope. To do this it must seek and develop partnerships with key institutions and people starting with the Kona International Airport and strengthening ties with natural partners such as School of Ocean Earth Sciences and Technology (SOEST), Hawai'i Natural Energy Institute (HNEI) and University of Hawai'i Center at West Hawai'i (UHCWH). It should expand its institutional and academic capacity by seeking a field office of a major national lab such as NREL. This will be a key component and milestone in reaching of the master plan vision. Community partnerships for financial, educational and political reasons should also be pursued. In the end it will be the right thing to do and a most beneficial achievement for NELHA.

Technological changes have been accelerating relentlessly. The old cliché, "the only constant is change" certainly applies to the global environment that we are currently living in. Time horizons have shortened as we can only foresee a short distance into the future before change makes most of our predictions false. Assumptions quickly prove false or inadequate and we must revise the basis of our decisions. Global interconnectedness introduces a degree of complexity that we have never seen in the past. These things affect all of NELHA's decisions and actions with a rapidity and complexity that is increasing. In such an environment the best approach seems to be to have a clear focus but armed with a flexible strategy of multi-use facilities, approaches and attitudes. The mission objective remains the same and a clear understanding of it will keep NELHA focused as it approaches individual projects and the overall implementation of a visionary master plan.

Flexibility

In the current economic environment all institutions need flexibility to adapt and survive. Some may say flexibility is not a strategy but a characteristic. It is both. The key to institutional flexibility is corporate structure and culture. In this regard bureaucratic red tape is the enemy of flexibility and methods to streamline red tape will be an important task in creating institutional flexibility. Funding strategies should be flexible and diverse. Facility spaces should be designed for modularity and multiple uses encouraging integrated approaches. A few years ago a Harvard Business School paper titled "Hustle as Strategy" was published. It reinforced the idea that goals should be clear but approaches (strategies) should be flexible and opportunistic. NELHA should adopt this overall approach.

Flexibility, the ability to move with the flow of events is also affected by the ability to replace one resource with another; for example money with labor or one tenant with another. This ability is also closely related to the kinds of partnerships that are potentially possible. The more options NELHA has, the more flexible it can be.

For NELHA flexibility will be affected by the role of the Board and the manner in which this master plan and strategic plan is used. The plans are intended as guidebooks not rigid rules and policies. Flexibility is built into the plans to allow for ranges of options. It should be viewed as an evolving document that changes as circumstances change while keeping a clear and steady focus on NELHA's mission and core competencies. In making this work the role of the NELHA Board is critical as it makes decisions on what projects to pursue, which leases

to accept, which partners to engage with and when to change focus and emphasis in the master plan. In essence a flexible engaged board is necessary for the master plan to be used in the manner in which it is intended. Today's information, perspectives and assumptions will become obsolete or irrelevant quickly. An active board is needed to guide NELHA through these dynamic and changing times.

Diversity/Complexity

Globalization continues to reinforce the importance of the diversity of the planet. Our increasing understanding of linkages and systems is reinforcing the awareness of the complexity of ecosystems. NELHA should welcome and encourage diversity in people, approaches and research topics. A paradox of diversity is that in order to encourage diversity (a group concept) we must protect individuals. Like investment portfolios, diversity protects the institution by spreading the risks and opportunities over a broader field. Therefore even when we are unable to predict threats and opportunities well, we are still positioned to engage in those areas and hopefully take advantage of the opportunity. NELHA should diversify its income stream sources and increase its capacity with partnerships and additional staff.

Creativity

Creativity is the fuel that allows institutions to productively engage in flexible approaches in a diverse and complex environment. NELHA should nurture institutional creativity and encourage it in its lessees, partners and community supporters. A "can do" culture should be encouraged.

Partnerships and Networking

Partnerships and networks expand an organization's capacity and broaden the fields within which it can effectively participate. NELHA has many partners and this should be expanded. The level of engagement with these and new partners should be deepened. The risks of this increased dependency on specific partnerships will be mitigated by diversity in other relationships. Many things that NELHA does not have the resources or capacity to do will be available and achievable in partnerships with others.

Cultural Sensitivity

Cultural sensitivity is the oil that allows a smooth and peaceful operation of diverse and creative components. While the starting point is a base in the awareness of the local host culture of native Hawaiians (kanaka maoli), the end is a global awareness of different peoples. In addition, there are institutional (federal, state and local governments including educational, international and non-profit organizations), and professional (scientific, entrepreneurial, academic, and business) cultures that need to be understood and accommodated.

In summary, the above set of qualities and approaches describe important attributes to operate well in a diverse and complex environment. Developing it is a form of institutional capacity building. While NELHA already exhibits these qualities to some degree it should formalize and encourage their growth. As these values and traits become more deeply imbedded NELHA will be better able to take advantages of the opportunities presented in the vision of the Master Plan.

4.2.1 Targets of Opportunity

The 1993 Strategic Plan identified three areas of threats and opportunities. They were:

- The inability to feed people in the world
- The continued degradation of the environment, and
- The finite supply of fossil fuels for energy production while energy demand continues to increase.

To this list NELHA should add the following:

- Global population increases
- Global warming and global climate change
- Peak oil scenarios resulting in shortages and price increases
- President Obama's 2009 economic stimulus package

The first three in the proposed additions are really closely linked to the original three items in NELHA's 1993 plan. In some ways they can be viewed as an evolution of the understanding of the earlier targets. The stimulus package is new but related to the globalization of the world's economy. Globalization increases the network and opportunities for partnerships.

4.2.2 NELHA Assets and Strategic Choices

In order to participate in all of the above target situations, a review of NELHA's assets is in order. While NELHA has been operating in the red for a long time and cash shortage has been a chronic challenge until recently, it has significant assets that can be utilized to achieve plan objectives. The assets below can be used individually or in tandem.

Land and Sea

First and foremost are its land and sea assets. Land and sea leases are NELHA's primary revenue source along with seawater. In negotiating leases NELHA can be creative in setting lease conditions or generating partnership agreements with the potential lessees. This can include infrastructure development or equity partnerships in new ventures with the land as the collateral.

The use of land as equity in a partnership seems most feasible in developing the economic driver sections of the property. As an example in private shopping center development it is not uncommon for the landowner to either receive a portion of gross revenues or have some equity stake in the project. Some combination of rent, utility cost and sales is usually in the mix. NELHA should review these options in development of the parcels along Queen Ka'ahumanu Highway.

Commercial developers will often put in the infrastructure needed for their project. This may be possible in the development of the frontage road from the current NELHA Access Road to the planned future Kaiminani Road Extension and intersection. This would help build out the master plan roadway system with little expenditure from NELHA.

The use of the offshore research zone needs further exploration for both research and revenue generation purposes.

Bonds

NELHA has the authority to issue revenue and special purpose bonds to fund projects. This bonding ability can be used in negotiations to lower project costs, obtain or complete project financing and can also be negotiated as NELHA's share in any partnership agreements with outside entities.

Sea Water System

The existing pipes, pumps and equipment for seawater delivery represent a tremendous asset for NELHA. This asset is unique in its depth and reliability with many years of operational record. Currently the use of the water is handled like a utility. As such, the only current revenue from this investment is water use. Income is dependent on pricing and demand. While this will continue to remain a major source of funding for NELHA in the future this asset can be used in negotiations with potential partners. Reductions in rates and controls in volumes may be used in negotiating rents and other agreements with leasees and other partners.

While feasibility and revenue streams have not been calculated for Keāhole, sea water air conditioning (SWAC) systems are now attracting private equity money in real projects in Honolulu and elsewhere. This indicates the technology is maturing and that the concept is promising. A special feasibility study for this option should be conducted and private venture capital participation should be encouraged in this endeavor. Alternate financing options should be explored. A policy encouraging or requiring SWAC systems in all new construction as a condition of leases or building permits should be explored.

Utility and Infrastructure

There is revenue potential in NELHA developing into a genuine utility. It already functions that way for the delivery of seawater to its tenants for research, aquaculture and mineral extraction tenants. The potential for a SWAC system operating this way is promising. If the seawater system is treated as a true utility, one possibility would be to spin off a private subsidiary to own and manage the system as a true utility. In this manner, depending on the legal structure it may be possible to attract private financing, and equity partners such that it functions like the power company or the phone company or the Board of Water Supply.

Another program that could also turn into a utility is the concept of developing a smart grid and microgrid system that integrates all the various alternative energy projects in NELHA. Near term potentials include Sopogy and Hawai'i Bioenergy. In the future OTEC and biofuels projects may join the mix. This new utility could partner with these energy producers in a power purchase agreement with them or come in as an equity partner. Without oversimplifying the issues and challenges involved in developing an integrated electrical grid of alternative energy sources such a project would be exciting and may attract Federal research dollars. It might also be just the kind of project, along with OTEC, that could convince NREL to establish a field office at NELHA. Scale up and testing of the grid to resolve technical problems may be the kind of work that will bring NELHA back into the forefront of alternative energy work.

In developing these projects it would be useful to approach HELCO as a potential equity partner. Established utilities are often unwilling to support ventures like this because they are protecting their market. However, if this is the direction the market is moving toward and this seems to be the case, an enlightened utility will see that it is to their benefit to be a part of the trend rather than fighting the trend. Then HELCO's resources may be used in developing the project. It is worth the effort to contact HECO or its subsidiary HELCO.

If HECO is not interested, it is possible that other private equity partners can be found to help create and start the utility. The interest in SWAC on O'ahu indicates significant potential interest. NELHA could act as simply the landlord or a full partner. This would be a decision of the Board of Directors if this approach is taken. Such interests should be proactively pursued.

State Agency

NELHA is a State agency. As such, there is always potential for the receipt of State financing. While the mechanism for State financing is laborious, it is still available. State support can be obtained for specific purposes and these funds could be used to leverage other financing such as federal grants or private capital markets.

As a State agency NELHA is in a good position to network with other State and County agencies in working out cooperative agreements. These agreements allow pooling of resources to achieve mutual goals. Particularly promising potential partners include Kona International Airport and UH Center for West Hawai'i. Some staffing shortages may be addressed by staff from other agencies on loan for specific programs such as Sea Grant and the Coastal Zone Management Program or the Corps of Engineers. Staff from the Corps of Engineers have interned in the office of Senator Daniel Inouye. Similar kinds of programs could be instituted for NELHA. The CZM positions in DLNR have been staffed by Sea Grant personnel for many years.

4.2.3 Hawai'i Clean Energy Initiative (HCEI)

This initiative represents a great opportunity for NELHA to get back into the forefront of alternative energy research and technology development. As Hawai'i tries to achieve a 70% renewable energy goal new programs, technologies and information are needed. NELHA is well positioned to participate in this program. As part of this initiative there should be an aggressive push in NELHA for the next steps in OTEC development and biofuels research. Containerized technologies, plug and play systems and alternative energy vehicles seem to be particularly promising with the proximity of the airport creating logistical advantages for NELHA. Test bed sites on the Big Island's many climatic zones for these emerging technologies and businesses seem to be a potentially fruitful area of investment. Affiliated research in carbon sequestration or recapture also seems to hold some promise as it appears the Obama administration is working on some form of carbon cap and trade regulation. In order to participate, NELHA needs to have projects that are ready to proceed.

The potential partnership with NREL is enhanced by HCEI. As part of HCEI the Department of Energy has personnel imbedded in DBEDT and participating in the Governor's efforts to achieve the target renewable energy goals. These include staff at the assistant secretary level. The Governor and DBEDT staff have visited NREL and had conversations with NREL since last summer. More recently, they have met with Department of Energy Secretary Steven Chu to discuss many things including the stimulus package and a potential State partnership with NREL. NELHA seems like a potentially good candidate for a field office of NREL. NREL's interest in OTEC also makes NELHA a good candidate for a field office. National Laboratories attract many ancillary establishments and could provide a stimulus for the concentration of high technology offices and shops in renewable energy. Strengthening this relationship should be a high priority.

4.2.4 Green Energy Zone

NELHA has already adopted the Green Energy Zone as Policy. This is a good mechanism for moving proactively back into the alternative energy arena. The efforts identified in the Green "Energy Zone are completely compatible with the direction of the master plan. Those programs and initiatives are adopted as part of the master plan by reference. A copy of the quarterly report on the Green Energy Zone initiatives is included in the appendices.

4.2.5 Food Security and Food Production via Aquaculture and Mariculture

Food supply has long been a major focus of NELHA. This is reflected in the 1993 mission objectives. More recently food security has become more prominent. The tie in with food and fuel was most dramatically demonstrated in the 2008 spike in oil prices when the dependence on fertilizers and other inputs into food production became clear as oil prices skyrocketed in 2008 above $140 per barrel and farmers began to see their supply and input costs also sky rocket. Also the conflict represented by competing uses of corn for food and for ethanol raised the specter of a Draconian choice between food and fuel.

NELHA's history is filled with aquaculture for food, pharmaceuticals and mineral extraction. This is expected to continue as a key component of research and development at NELHA into the foreseeable future. The rising cost of land and reduction of arable land globally will continue to push efforts in aquaculture. Use of open cages in the ocean will probably increase though the recent experiences of Kona Blue point to scale and market issues that need to be addressed. Still, as global population continues to grow and urbanization and desertification continue to reduce arable land this issue will continue to press mankind. Aquaculture clearly is part of the solution and there should be increasing efforts to engage in research, incubation and economic scale up of food products related to the ocean and sea water.

Algae and Other Micro-organisms

Research into algae is a multi-functional trend. While algae as food or food supplement is clearly part of the history of NELHA changing markets and technologies are creating many new opportunities for algae research and production. Also, as an organism that is at the start of the food chain we know it is one of the most efficient ways to capture the energy of the sun because it reduces the number of trophic levels before human consumption. This gives these programs a potentially bright future in an increasingly crowded world.

Increasingly, research into fuel or pharmaceutical uses is growing as resource limitations and the search for food supplements and pharmaceuticals expands. NELHA is well positioned to serve as a research site and nurturing ground for this kind of research. Microorganisms and deep sea biota provide an unusual and diverse set of organisms that can be studied for these potential products and uses. The deep water intake pipes and the ocean research zone provide NELHA with great resources to attract researchers and entrepreneurs.

The deep water pipes permit NELHA to grow and culture a wider range of ocean organisms than typical labs or industrial parks because of the range in temperature environments that can be sustained. These waters are also richer in minerals and nutrients than typical semi-tropical surface waters and can increase productivity and yields. This permits a wider range of experiments that can be economically performed at NELHA. Using and enhancing current contacts with world-class scientists at SOEST, Woods Hole and other renowned institutions NELHA could become a gathering place for these researchers. The new Center for Microbial Oceanography Research and Education being developed at UH Mānoa would be an ideal partner in developing this reputation. The proposed research village complex identified in the Master Plan will be a key component in this evolution of NELHA.

Climate Change Research

The oceans drive the world's climate. As global warming and climate change have become some of the dominant emerging issues in the new world perspective NELHA may provide a locus for this kind of field research. While NOAA's facility on Mauna Loa played a pivotal role in supplying the data on atmospheric CO_2, NELHA could play a role in analyzing the role of oceans in climate change and global warming. NELHA should partner with NOAA in such areas as carbon sequestration, thermal change in ocean waters and the impact of living organisms in these

processes. The roles and impacts of microorganisms and men on climate change could be productive areas of ocean-related research. Partnerships with SOEST and other universities and research institutes could evolve into NELHA becoming a desirable place for scientific conferences and field offices for test bed programs in various climatic zones and the ocean.

Ocean and climate change research can go in several directions. One possible focus could be in factors that speed up or slow down the heat absorption rate of the ocean. Whether the cause is anthropogenic or natural or some intersection of the two like pollution and algae blooms research can explore questions relating to the albedo of the sea. Oil slicks and pollution might alter the rate of CO_2 absorption by the ocean. Wet/dry conditions influenced by activities on land may affect salinity and temperatures along the coastal zone. How this may or may not relate to heat island effects or coastal wind patterns may be worth exploring. Nutrients and wind blown particulates impact the chemistry of the seas and NELHA is a good place to study this chemistry. Sandstorms over the Sahara blow miles out to sea in the eastern Atlantic and then can be seen from satellite images. This supports the ocean's role as a pollutant sink and dissipation/absorption rates affecting climate change may be a ripe topic for investigation. NELHA could be a leader in this field.

Facilities to support researchers and visitors are needed. The proposed Research Inn and an Incubation Center in the applied technology area will go a long way toward this goal. Again, funding is always a question mark but these facilities may be funded privately or publicly. One method of financing is discussed in the business plan in the next section. NELHA should try both approaches.

Additional laboratory and office space may be needed as this effort grows and succeeds. However, some of this need could be met in the retail complex along the highway.

4.2.6 Fund Raising and Community Involvement

Naming Ceremonies are culturally important. Place names have many meanings attached to them, sometimes multiple meanings overlain upon each other. Meanings and symbols attach to these names and foster connection with the land. As in the naming of children often hopes and dreams are attached to the naming. In biblical times the gates of the City had names attached to them. One entered through places like the Lion Gate or the King's Gate. It helps to give identity and orientation to a place. NELHA should consider the use of naming of gateways and facilities. In addition to ceremony and symbolism, each naming ceremony can be an opportunity to enhance community engagement or solicit financial and political support.

In the world of finance many institutions honor large donors with names of facilities and names on walls and legacy paths. The entrances to NELHA could be given names that highlight its mission. Donor names could be given to the whole building or specific rooms in the Research Village and the Incubation Center. To encourage this, the buildings should be of a high architectural and institutional quality.

The proposed ahupua'a gathering pavilion at Wawaloli Beach Park could be a community fund raising project. Naming could be for a famous historical person, respected elder or community leader. These kinds of facilities can often draw funds from agencies like OHA or Kamehameha Schools or the State Legislature as community groups are often potentially well connected to these sources.

4.3 BUSINESS PLAN / MARKET ANALYSIS

Market Background

KBCG reviewed the rent rolls and lease terms of NELHA tenants as well as recent business park and retail development activity on the Big Island. From this analysis, we prepared a recommended mix of lot sizes and preliminary pricing program for the Economic Driver (ED), Applied Technology (AT), and Energy Zone (EZ) at NELHA. The results of that analysis are summarized below:

Existing Tenants

Current rental rates for NELHA tenants are based on rates of $100 to $3,000 per month per acre for unimproved land and a range of $100 to $1,500 per month per acre for improved land. There is also a standard fee schedule for office and lab space rents. In addition, NELHA sometimes participates in percentage rents (typically at 2% of sales over the base rents) and also has royalty arrangements with selected tenants. The annual rents under the existing schedule were approximately $1.05 million. The rent schedule as of October 2007 is shown on the following page. More recent leases to Deep Seawater International, Noritech Hawaii, WHEA, and Sopogy are included later In addition to the base rents, royalties to NELHA amounted to about $162,000 and $102,000 was received in percentage rents.

The net rental rates per square foot range from $.03 per year up to $.83 per year. However, approximately 80% of the tenants pay less than $.20 per square foot per year. On an overall basis, the average tenant pays a rental rate of just over $4,500 per acre per year, or $.10 per square foot. Whereas these rental rates are substantially under current market rents, it should be remembered that many of them were negotiated some time ago. Some were also favorably structured to attract research and development tenants that were particularly consistent with the NELHA mission. As we move forward, however, NELHA should seek to bring lease rents more into line with current market conditions.

NELHA Rental Rate Structure for Existing Tenants

Tenant	Tenant Type	Phase	Unimproved Acreage	Improved Acreage	Total Acreage	Office Space (SF)	RC Improved SF	RC Lab Space	RC Office Space Rate	RC Improved Rate	RC Lab Space Rate	Unimproved Rate/ acre	Improved Rate/ Acre	Monthly Fee
EnZamin USA..	Commercial Extractive	1	3.1		3.1							$ 100		$ 308
Hawaii Deep Marine	Commercial Extractive	1	4.5		4.5							$ 2,000		$ 9,000
Koyo USA Corp.	Commercial Extractive	1	8.0		8.0							$ 100		$ 800
Koyo USA Corp.	Commercial Extractive	1	22.0		22.0							$ 775		$ 17,050
Moana Technoiogies	Pre Commercial	1	11.4		11.4							$ 100		$ 1,142
Oceanic Institute	Research	1	3.0	1.0	4.0							$ 200	$ -	$ 600
Savers Holdings	Commercial Extractive	1	6.0		6.0	288	1,362		$ 3.00	$ 0.50		$ 200		$ 2,745
Total Phase1			58.0	1.0	59.0									$ 31,645
Gateway	Education/ Outreach	2	4.8		4.8									
Total Phase 2			4.8	-	4.8									
Cyanotech Corporation '	Commercial Productive	3	83.1	8.0	91.1							$ 100	$ 500	$ 12,313
High Health Aquaculture	Commercial Productive	3	2.2		2.2							$ 400		$ 892
Cellana	Commercial Productive	3		6.2	6.2								$ 1,500	$ 9,324
Indo:Pacific Sea-Farms	Commercial Productive	3		1.1	1.1								$ 500	$ 540
Kona Bay Marine	Commercial Productive	3	6.5		6.5							$ 385		$ 2,500
Kona Blue Water Farms	Commercial Productive	3		1.3	1.3								$ 672	$ 840
Kona Blue Water Farms	Commercial Productive	3		1.0	1.0								$ 400	$ 408
Kona.Coast Shellfish LLC	Commercial Productive	3		3.4	3.4								$ 838	$ 2,850
Kona Cold Lobsters Ltd	Commercial Productive	3	1.2		1.2								$ 100	$ 121
Mera Pharmaceuticals	Commercial Productive	3		5.6	5.6								$ 700	$ 3,920
Ocean Rider, Inc-	Commercial Productive	3	0.5	1.5	2.1							$ 100	$ 400	$ 670
Royal Hawaiian Sea Farms	Commercial Productive	3	3.0		3.0							$ 100		$ 300
Taylor Resources	Commercial Productive	3	4.4	1.7	6.1	44			$ 2.00			$ 200	$ 500	$ 1,806
Unlimited Aquaculture	Commercial Productive	3	10.4		10.4							$ 500	$ 600	$ 6,804
Uwajima Fisheries	Commercial Productive	3	4.0		4.0							$ 100		$ 397
Vacant Lots			9.4		9.4									
Total Phase 3			124.7	29.8	154.6									$ 43,685
Big Island Abalone	Commercial Productive	4	10.0		10.0	300	10,471		$ 2.00	$ 0.25		$ 100		$ 4,218
Total Phase 4			10.0		10.0									$ 4,218
Friends of NELHA	Education/ Outreach					100								
Georgia Institute	Research						2,000			$ 0.10				$ 200
Opportunity council	Education/ Outreach						2,100							
HNEI	Gateway Tenant					100	4,020	1,848	$ 1.00	$ 0.25	$ 0.75			$ 2,898
Infrasound laboratory	Research					1,858	2,940		$ 2.00	$ 0.25				$ 4,451
Pacific Lightnet	Other													
Mathematics LLC	Research					165			$ 2.00					$ 330
Puna Geothermal Venture	Other													
Verizon Wireless	Other													
Total			197.5	30.8	228.4									$ 87,426
Annual Rents														$1,049,117

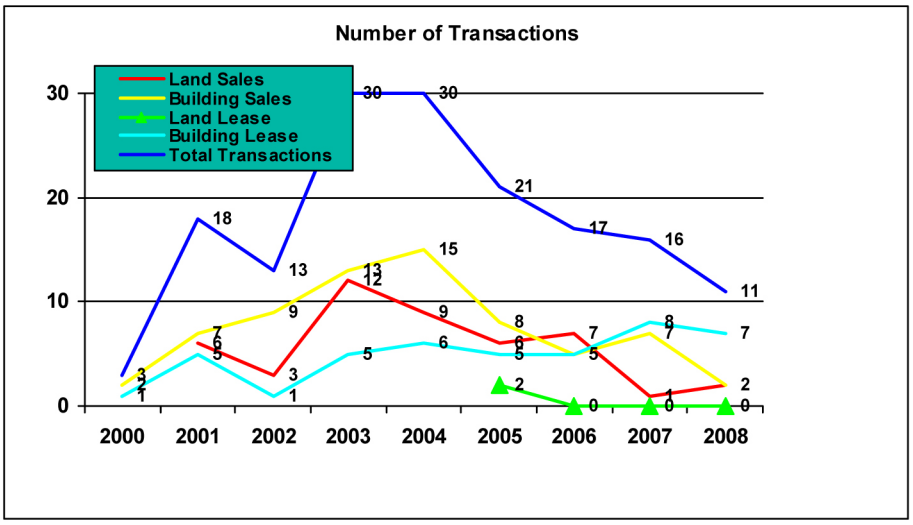
Big Island Light Industrial Market

There is a limited supply of light industrial land available in West Hawai'i. The principal parks include the Kohanaiki Business Park, the Kaloko Light Industrial Subdivision, and the Kona Industrial Subdivision owned by the Queen Lili'uokalani Trust. Moving forward, the Palamanui project (ma uka of the airport) is planned to have some 75 light industrial parcels available starting in 2010/11. The sales performance of the existing projects is discussed below:

Kona Area Transactions

- For 2000 through 2008, there were 159 light industrial real estate transactions in West Hawai'i for an average of about 18 per year
- Building sales represented 43% of transactions followed by land sales and building leases at 29% and 27% respectively
- Sales climbed to 30 parcels per year in 2003 and 2004, but have averaged about 15 per year over the past 4 years.
- The average parcel size was 1.37 acres overall and 1.25 acres for land sales
- Average annual absorption was 24.2 acres overall and 6.4 acres per year for land sales.
- The average building size was about 22,500 square feet for both purchase and lease transactions.

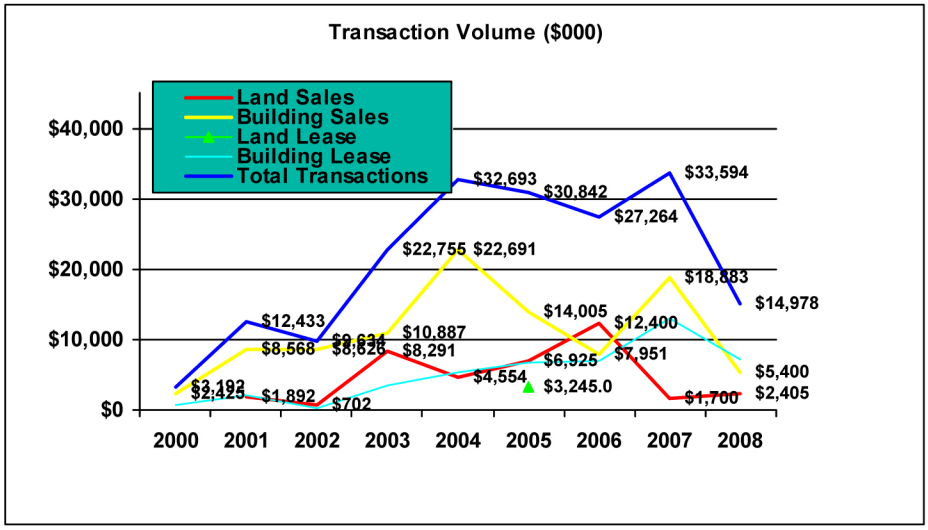
Recent Sales Performance of Light Industrial Subdivisions on the Big Island
Number of Transactions



Sales Volume

- Total light industrial real estate sales for 2000 through 2008 were $187.4 million, or an average of about $21 million per year.
- There has been relatively little land sales activity in the Kona area over the past couple of years. This reflects a relative shortage of well serviced vacant land in existing business parks.

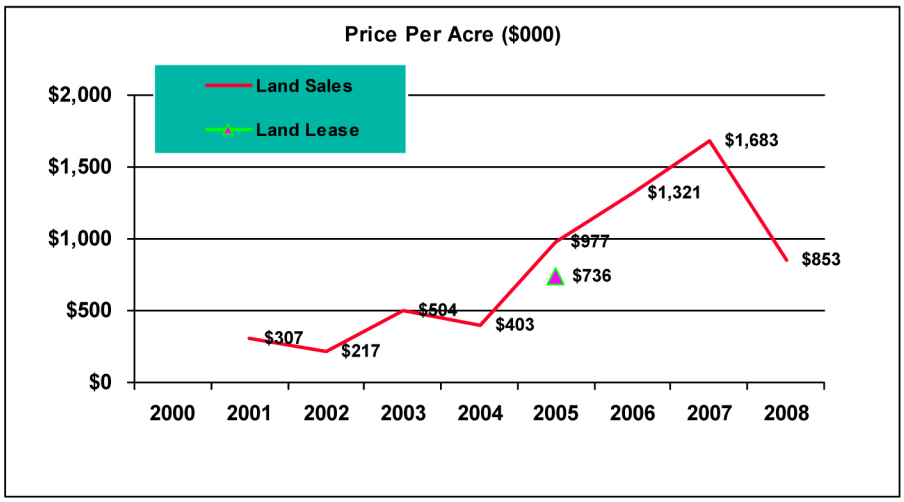
Recent Sales Performance of Light Industrial Subdivisions on the Big Island
Transaction Volume



Pricing

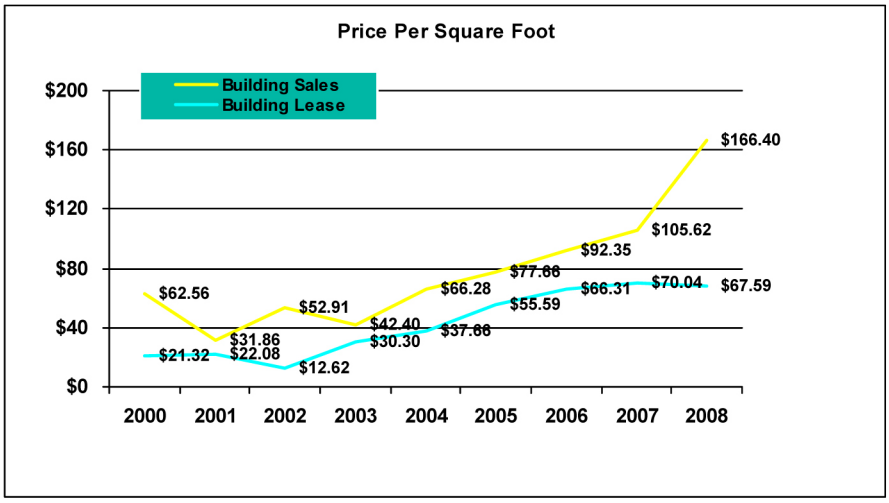
- The prices for light industrial land sales have increased from around $300,000 per acre at the start of the decade to over $1 million per acre in the last three years.

Recent Sales Performance of Light Industrial Subdivisions on the Big Island
Price Per Acre



- The average parcel price increased from around $315,000 in 2000 to about $1.7 million in 2006 and 2007and has settled at $1.2 million in 2008.
- The prices for light industrial for sale buildings have increased from around $60 per square foot at the start of the decade to around $120 per square foot over the past 3 years.
- The prices for leased buildings run about 75% of those on fee simple land.

Recent Sales Performance of Light Industrial Subdivisions on the Big Island
Price Per Square Foot



Comparable Parcel Sizes and Pricing

- New business park projects in Hawai'i have concentrated on ½ acre and 1 acre lots, with some larger parcels.

Distribution of Parcel Sizes for Kapolei Business Park - Phase 2A

Size (Square Feet)	Number of Lots	Percentage of Lots
Less than 20,000	1	2%
20,000 to 30,000	25	45%
30,000 to 40,000	7	13%
40,000 to 50,000	14	25%
50,000 to 60,000	5	9%
60,000 +	4	7%
Total	56	100%
Average 36,015		

- Prices for comparable sales elsewhere in Hawai'i range from $800,000 to $2.6 million per acre.

Comparable Industrial Land Sales in Hawai'i

Timing	Location	Parcel Size	Price Range	Price Per Acre
3Q 2008	Lihue	15,000 SF	$300,000 to $400,000	$1,000,000 to $1,100,000
3Q 2008	Wailuku	86,000 SF	$2,000,000 to $3,000,000	$1,300,000 to $1,400,000
1Q 2008	Kapolei	93,000 SF	$3,000,000 to $4,000,000	$1,500,000 to $1,600,000
1Q 2008	Waipahu	41,000 SF	$2,000,000 to $3,000,000	$2,100,000 to $2,200,000
4Q 2007	Waipahu	45,000 SF	$2,000,000 to $3,000,000	$2,500,000 to $2,600,000
4Q 2007	Kapolei	2 acres	$2,000,000 to $3,000,000	$1,300,000 to $1,400,000
3Q 2007	Kapolei	56,000 SF	$1,000,000 to $2,000,000	$1,300,000 to $1,400,000
3Q 2007	Waipahu	24,000 SF	$1,000,000 to $2,000,000	$2,300,000 to $2,400,000
3Q 2007	Kapolei	73,000 SF	$2,000,000 to $3,000,000	$1,300,000 to $1,400,000
1Q 2006	Kailua Kona	91,000 SF	$1,000,000 to $2,000,000	$800,000 to $900,000

NELHA Recommendations

- Applied Technology (AT) and Energy Zone (EZ): Based on our market review, we recommend a retail land value of about $12 per square foot on a gross basis - which would be about $16/ net square foot using a 75% utilization factor over 219.8 acres (152 acres AT and 67.7 acres EZ). These parameters would yield a net retail value of the light industrial/commercial lots at buildout of $114.9 million. At this point, there are two alternative development strategies. In the first case, it is assumed that NELHA contracts with an outside development entity. Under this scenario, we estimate that the raw land value would be around 24% of retail value, or about $27.6 million. Assuming a lease rate of 7%, this would yield about $1.93 million in annual income to NELHA. The second alternative is for NELHA to act as its own developer which seems reasonable, since these land uses are very similar to what it has already developed. Under this scenario development costs should be in the range of $200,000 per gross acre, or about $44 million (these factors could vary substantially depending upon the size of the individual parcels that will eventually be developed). Subtracting development costs from retail land value yields a gross margin of around $71 million, with absorption probably over a 15 year time frame. On a lease basis, a 5% discount rate applied to land value would provide an annual lease income of about $5.7 million at buildout. Assuming property management costs are 10% of lease revenue, this yields an annual operating income of $5.2 million from the AT and EZ zones. The NELHA development scenario has an estimated annual return of 12% on development costs. We also recommend that the existing plan be modified to provide for more smaller parcels using the Planned Unit Development (PUD) approach. With this approach, it does not seem necessary to significantly modify the subdivision layout.

- Economic Driver (ED) Zone. Applying a similar analysis to the 78.3 acre highway frontage ED Zone, gross commercial land values could be in the $36 per square foot range, which would be around $54 per net square foot using a 67% utilization factor. This yields a retail land value of approximately $82 million. Applying a 35% ratio for raw land value, yields a raw land value of $28.6 million. This yields $2.0 million in annual lease income to NELHA from the area. Because of the specialized nature of the development in this area, the development of this land use would more likely be better suited to an outside development entity - with suitable controls and oversight provided by NELHA.

Economic Considerations of NELHA Development Strategy

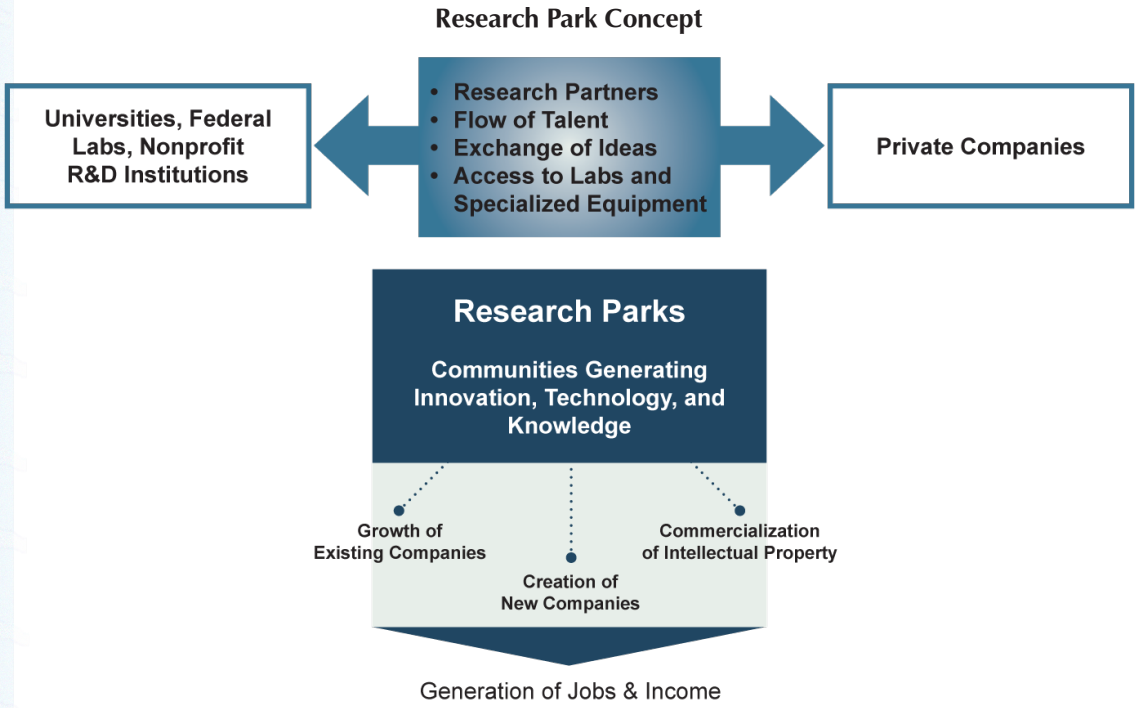
	Land Use Designation	
	AT and EZ Zones	ED Zone
Acres	219.8	78.3
Efficiency	75%	67%
Net acres	165	52
Square Feet	7,180,866	2,271,558
Third Party Developer		
Price per gross SF	$12.00	$36.00
Price per net SF	$16.00	$54.05
Retail land value	$114,893,856	81,776,094
% raw land value	24%	35%
Raw land value	$27,574,525	28,621,633
Lease rate	7%	7%
Lease income to NELHA	$1,930,217	2,003,514
NELHA Development Alternative		
Development cost per acre	$200,000	
Development cost	$43,960,000	
Gross Margin	$70,933,856	
Retail land value	$114,893,856	
Lease rate	5%	
Lease Income	$5,744,693	
Property Management Costs	$574,469	
Operating Income	$5,170,224	
Annual return on investment	12%	

Whereas the above analyses are preliminary indicators of potential performance under different strategies, a more detailed revenue and cost projection/ cash flow is provided by phase and parcel at the end of this section.

RESEARCH PARK BEST PRACTICES IN COMPARISON TO NELHA

Research and technology parks such as NELHA are planned to function as a seedbed for the concentrated development of innovation- and technology-oriented businesses in a region. They have diverse and different models all over the world and are also called science parks, technopoles or technology parks. In recent decades, building research parks has become a crucial strategy in regional economic development in many developed countries such as Japan, Western Europe, and Australia as well as in the United States. For regions faced with the decline of older manufacturing industries, research parks have been considered as alternatives to replace them. In addition, for other regions whose economies have been performing well, they work as a long-term strategy for continuous prosperity of the regions. This research and development (R&D)-based economic development strategy, if successful, leads not only to employment growth and new business creation, but also to changes in the structures of occupation and wage, political cultures, and spatial patterns of development.

According to the International Association of Science Parks (IASP), research parks (or science parks) are defined as an organization managed by specialized professionals, whose main aim is to increase the wealth of the community by promoting the culture of innovation and the competitiveness of its associated businesses and knowledge-based institutions. To enable these goals to be met, a Research Park stimulates and manages the flow of knowledge and technology amongst universities, R&D institutions, companies and markets; it facilitates the creation and growth of innovation-based companies through incubation and spin-off processes; and provides other value-added services, together with high quality space and facilities.



For NELHA, it is useful to examine the characteristics of these comparable research parks and see how their experience can be applied to NELHA business objectives. The following tables and figures from the survey responses of 134 North American research parks are intended to provide this framework.

Overall Size and Scale

Acreage and Space Available in University Research Parks

Size Metric	Total for All Parks	Average	Median
Total acreage	47,274	358	114
Acreage currently developed	21,961	179	30
Total number of buildings open	1,833	16	6
Total square footage of open buildings	123.9 million	1.09 million	314,410
Estimated percentage of space currently occupied		86%	95%
Projected acreage at full buildout	35,354	283	114
Estimated total square feet at full buildout	274.8 million	2.43 million	1.10 million

In terms of acreage, NELHA is over twice the size of the average research park.

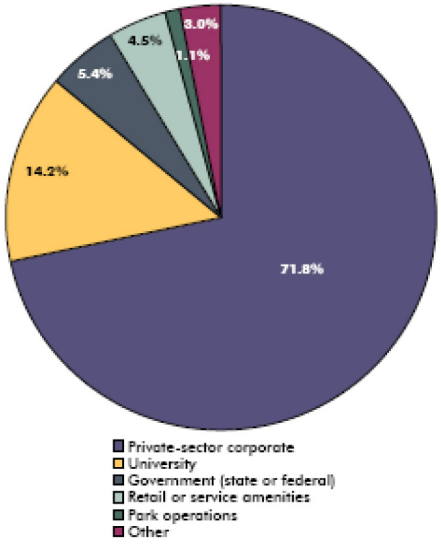
Governance

Profile of a Typical North American Research Park
(data cited as averages are based on median for all research parks)

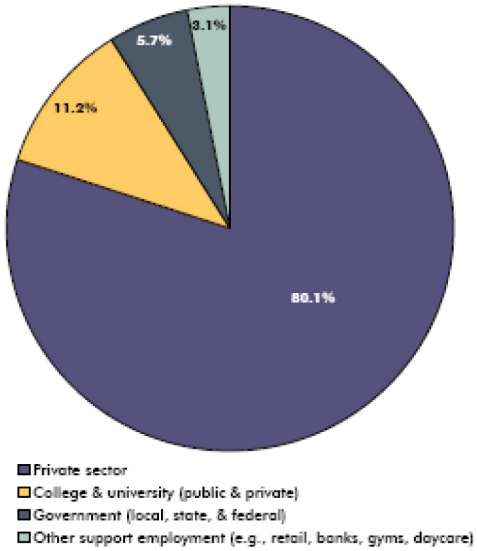
Size	114 acres 6 buildings 314,400 SF of space, 95% occupied Only 30% of total estimated SF at buildout currently developed 30,000 SF of incubator space
Location	Suburban community Less than 500,000 population
Governance	Operated by the university or university-affiliated nonprofit
Tenants	72% are for-profit companies 14% are university facilities 5% are governmental agencies
Employment	Typical park employs 750 Major industry sectors: IT, drugs and pharmaceuticals, and scientific and engineering service providers
Finances	Less than $1 million per year operating budget Revenues primarily from park operations but funds also come from university and state, local and federal government Limited or no profitability; 75% of the parks have no retained earnings or retained earnings of less than 10%
Services	Provide a range of business and commercialization assistance services including: Help in accessing state and other public programs Linking to or providing sources of capital Business planning Marketing and sales strategy advice Technology and market assessment

** Data cited as averages are based on median for all research parks.*

Composition of North American Research Park Tenants by Sector



Composition of North American Research Park Employment by Sector



Research Park Governing Structures

Park is Governed by	Number of Parks	Percentage of Total
Independent, private, nonprofit	35	26%
University-affiliated nonprofit	30	23%
Affiliated university	27	20%
Government agency, quasi-public corporation, or public authority	18	14%
For-profit developer	8	6%
Formal joint venture including diverse organizational types	5	4%
Other	10	8%

NELHA has similar characteristics to the typical research park except that it does not have an incubator building and is not managed by a university related organization. Nevertheless, independent or government related research parks represent about 40% of research parks nationwide and NELHA would fall into this category.

Employment

Research Park Employment by Detailed Industry

Industry	Current Core Park Employment	Percentage of Total Core Employment	R & D Employment Within Core	R & D Employment as Percentage of Core
Total core park employment	264,413	100.00%	125,280	47%
Software	35,734	13.50%	21,841	61%
Computers and Related Hardware	28,969	11.00%	25,050	86%
Drugs/Pharmaceuticals/Diagnostics	28,007	10.60%	25,110	90%
Scientific and Engineering Services	25,747	9.70%	20,059	78%
Healthcare Services	11,357	4.30%	2,754	24%
Centralized Business Support Services	11,134	4.20%	-	0%
Communications Equipment	9,204	3.50%	4,155	45%
Laboratories (medical, biological, environmental testing)	8,344	3.20%	6,340	76%
Management/General Business Consulting/Services	8,021	3.00%	211	3%
Aerospace/Defense	7,540	2.90%	1,123	15%
Advanced Materials	5,773	2.20%	1,823	32%
Instrumentation and Sensors	4,853	1.80%	3,694	76%
Other Scientific R & D	4,295	1.60%	4,295	100%
Medical Instruments and Devices	3,275	1.20%	1,380	42%
Other Bioscience R & D	3,272	1.20%	3,272	100%
Ag/Plant Biosciences and Related Chemicals	2,680	1.00%	2,300	86%
Colleges/Universities	1,772	0.70%	-	0%
Environmental Consulting/Services	1,180	0.40%	417	35%
Alternative/Renewable Energy	1,166	0.40%	864	74%
Insurance	913	0.30%	-	0%
Other Government	815	0.30%	-	0%
Other Electronics	744	0.30%	592	80%
Misc. Manufacturing	36	0.00%	-	0%
Other core employment, not classified	59,583	22.50%	N/A	N/A

The average research park provides employment for about 2,000 people. NELHA has a staff of 20 employees and the National Defense Center of Excellence in Ocean Sciences (CEROS) employs 5 people. NELHA private sector employment is estimated at 310 in 43 companies. In addition, there is substantial contractor employment funded by CEROS and other partner programs. Nevertheless, there is substantial room for employment growth at NELHA.

The indirect impacts of research park employment are also significant. According to surveys conducted by the Battelle Institute, every job in a research park generates an average of 2.57 jobs in the economy.

Services

Some principal reasons for the failure of small businesses are inadequate financial or business/market planning. It is instructive that about 2/3 of the research parks now provide business support services to their tenants. The following table lists some common service offerings provided at research parks. NELHA would be well served to also provide these types of services, perhaps through partnerships with the University of Hawai'i and other professional education providers. We recognize that NELHA does not currently have the human resources to provide these services directly and that additional investments will be necessary to develop and implement these new business support programs.

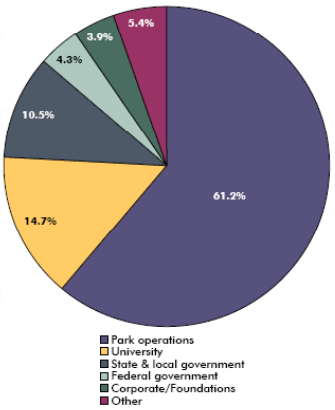
Business and Commercialization Services

Service Offerings	Number of Parks Providing the Service	Percentage of Total Parks
Help access state and other public programs	94	81%
Link to or provide sources of capital	87	76%
Business planning	77	68%
Marketing and sales strategy advice	70	64%
Technology and market assessments	69	62%
Assist with human resource issues	48	45%
Provide proof-of-concept funding	40	38%

Budgets and Funding

Current Annual Operating Budgets

Current Annual Operating Budget	Number of Parks	Percentage of Total
Less than $500,000	49	40%
$500,000 to $999,999	20	16%
$1,000,000 to $2,999,999	26	21%
$3,000,000 to $4,999,999	10	9%
$5,000,000 to $9,999,999	9	7%
$10,000,000 to $14,999,999	4	3%
$15,000,000 or more	4	4%



NELHA has an annual operating budget of about $3.2 million including about $221,000 in OHA transfers, putting it in the top quartile of research parks.

The average research park receives just over 60% of its revenue from park operations. The balance is from a broad combination of university, government, and private sector/foundation support. See table below.

As shown below, NELHA operations are essentially self funding from land base fees, reimbursables, and percentage rents/ royalties.

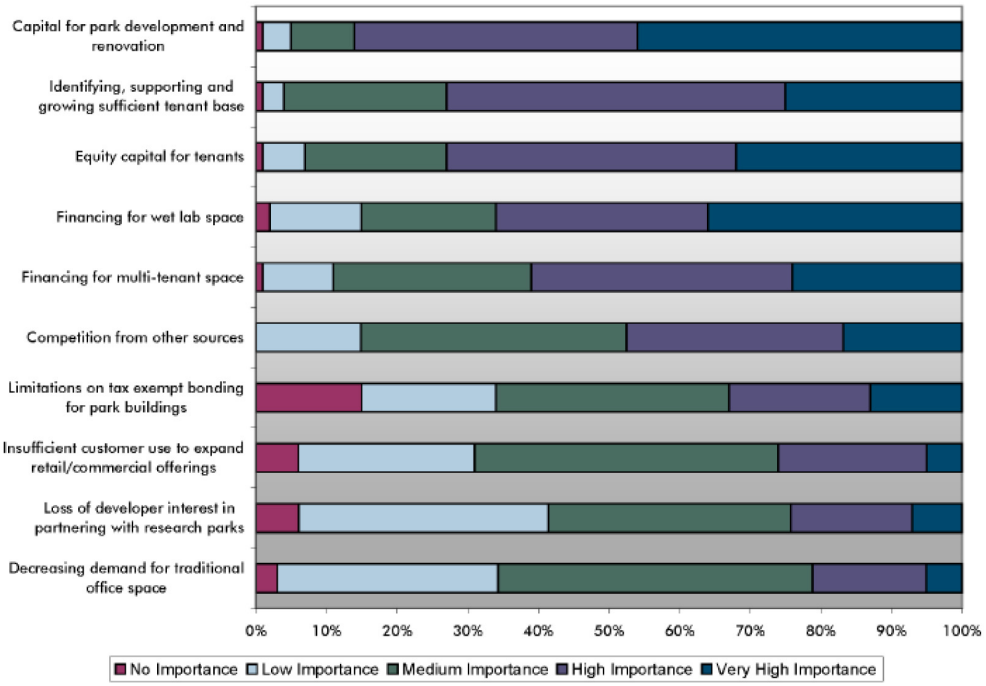
Legislative Subsidy to Aquaculture Tenants

REVENUES		EXPENDITURES	
General Funds		General Funds	
		Salaries	$0.00
State Funds	$365,000.00	Kona Operations*	$365,000.00
Subtotal	$365,000.00	Subtotal	$365,000.00
Special Funds		Special Funds	
Land Use Fees	$1,156,526.49	Salaries	$1,378,760.63
Royalties	$162,000.00	Operations (including OHA transfers)	$1,906,716.21
Reimbursable	$2,136,841.88		
Interest Received	$91,443.61		
Percentage Rents	$101,795.95		
Subtotal	$3,648,607.93	Subtotal	$3,285,476.84
TOTAL	$4,013,607.93	TOTAL	$3,650,476.84

As it implements the Research Village concept and expands its business incubator functions, we anticipate that NELHA can develop a broader base of operational support through on-site partnerships with other energy and ocean research institutions as well as like minded foundations.

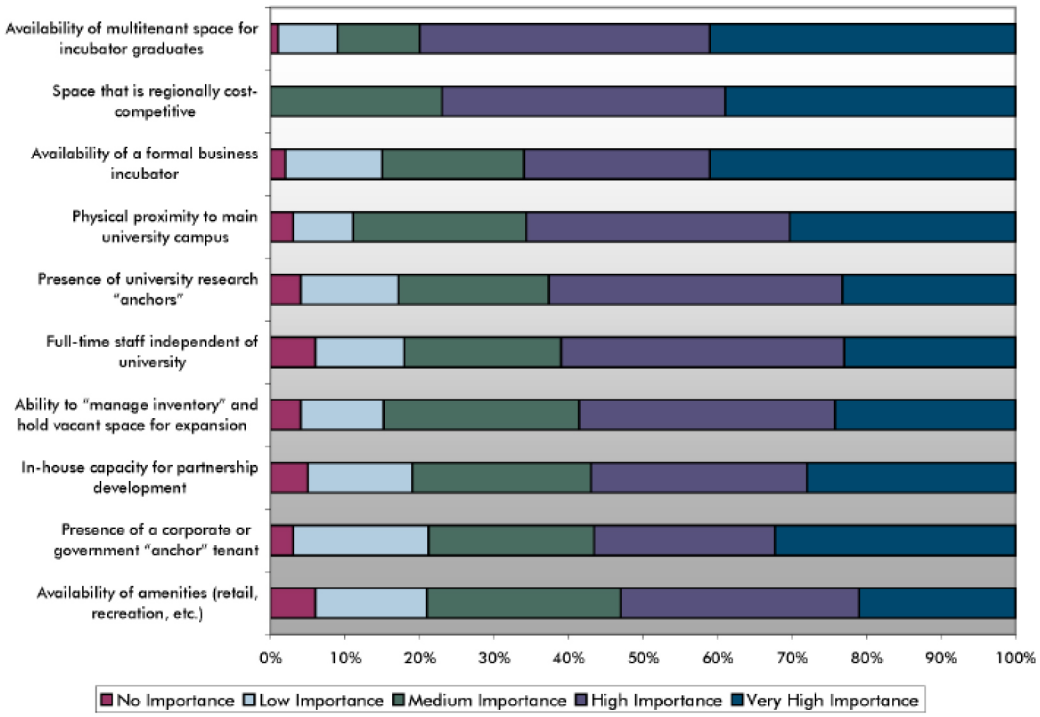
Challenges and Success Factors

Importance of Challenges Facing University Research Parks



Raising capital for park improvements is a key priority along with attracting appropriate tenants. Interestingly, the next most important element is raising equity capital for tenants. As discussed later, this is an area that has substantial opportunity for NELHA.

Key Internal Determinants of Success of University Research Parks

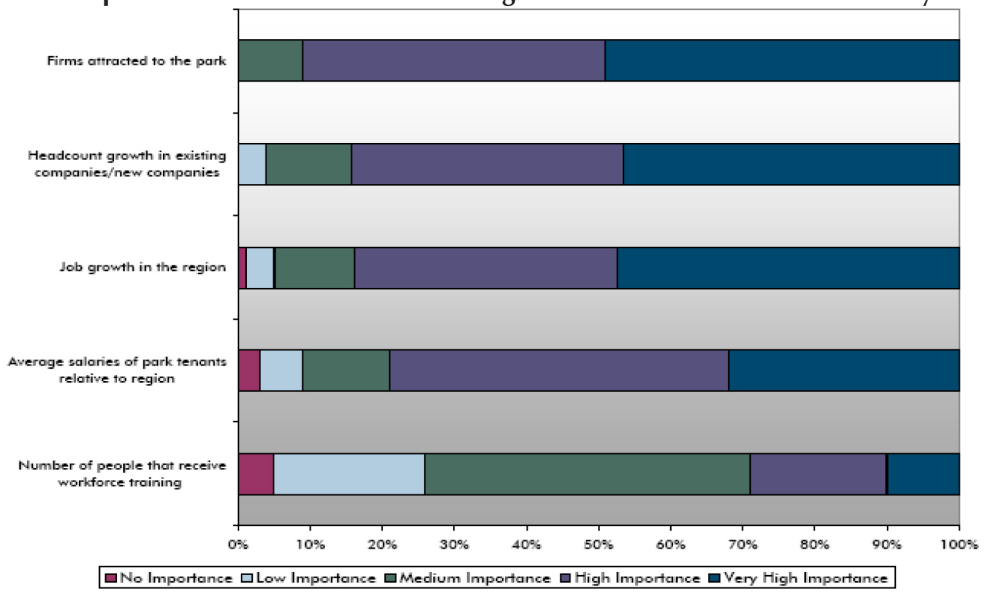


Two of the three key determinants of success relate to research parks having direct facilities and services related to business incubation. This is a shortcoming at NELHA. As discussed later, we recommend a formal business incubator program as part of the NELHA tenant support program. In addition, developing partnerships with recognized leading edge University, National Laboratory, and Scientific Institute research programs is another recommended key priority.

Benefits

Whereas NELHA undoubtedly contributes to the quality of life, economic growth and scientific reputation of West Hawai'i, these benefits are not always well communicated to or appreciated by the local and visitor community at large.

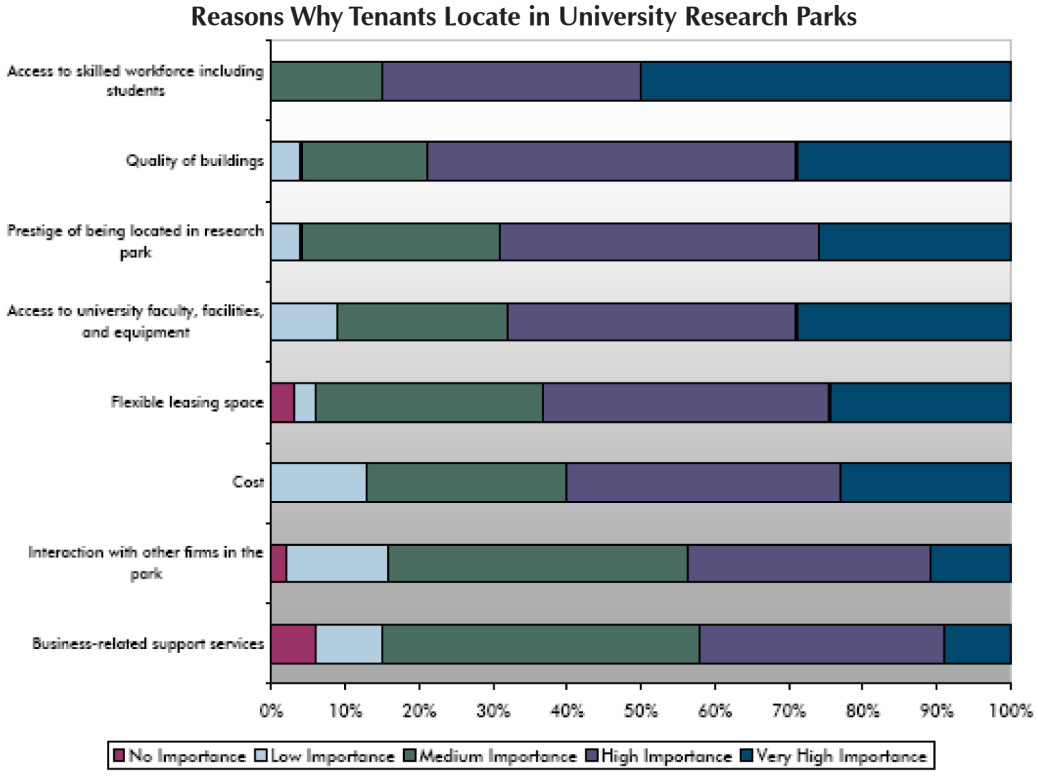
Importance of Methods for Measuring Benefits of a Park to its Community



As the master plan moves forward, there should be a concerted effort to complement the Gateway Center and Friends of NELHA with other facilities and outreach that serve to encourage the local and visitor community to better understand NELHA's research and development role, its achievements, and its relevance to the community and everyday life. To some extent this includes broadening the message of NELHA's economic, employment and social benefits, but more importantly to have on site facilities and services that will involve residents and visitors in the sustainability purposes of NELHA. This is one of the core reasons behind the recommendation of the Sustainability Retail Center in the Economic Driver (ED) zone.

Criteria for Attracting Tenants

Although NELHA has disadvantages in some of the criteria below, such as direct access to a University, it needs to better understand and promote its benefits. Certainly, the superb access to ocean seawater and renewable energy resources is the starting point, but going down the list of key reasons, it is useful to consider NELHA's relative position under the top three criteria:



- Access to a skilled workforce. West Hawai'i does not presently have a large University campus or technical institute that turns out a regular supply of new graduates into the work force. This will be helped to some extent when the Palamanui campus opens in 2012. However, there is an untapped reservoir of highly educated people and successful entrepreneurs who have chosen to relocate to West Hawai'i which may help mitigate this criteria. In our survey work for Palamanui, it was eye opening to see the number of residents in the Kona area who have run a successful company and/or hold advanced degrees. They were in turn very supportive of the new UH West Hawai'i campus and we believe they could also be organized to be an on call resource as mentors and part time employees at NELHA.
- Quality of Buildings. The buildings of NELHA and its tenants are inconsistent and in some cases substandard. In the master plan, we propose two new development

areas which will serve to remedy this appearance. A new incubator building and a Research Inn at the educational node and ocean and energy village will help position it as a place of excellence. In addition, the buildings in the Economic Driver zone will be of sustainable design that will be attractive to tenants, visitors, and passers by.

- Prestige. The prestige factor derives from the quality of facilities and work environment, the nature of the other tenants/on going research and development programs, and the reputation of other organizations/ partnerships that are associated with the NELHA programs. We have made recommendations which we feel will improve the quality of the facilities and work environment. Several of NELHA's tenants are in the forefront of applied ocean and energy research and NELHA is developing relationships and partnerships with prestigious mainland and international institutions. The partnering and facilitation of these relationships through improved facilities should go hand in hand.

The outcome of these improvements will be to provide an R&D environment that both attracts new tenants and grows new businesses through an incubator program.

Incubator Graduates

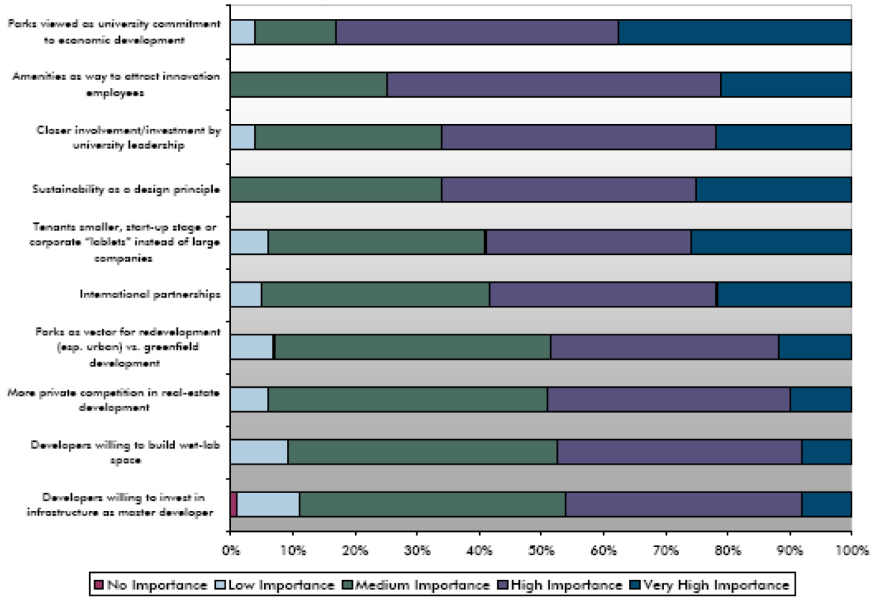
Number of Graduates Who	Number of Firms	Percentage of Total
Left the park but remain in the community	299	39.40%
Moved to multi-tenant space within the park	156	20.60%
Acquired or merged; and other outcomes	115	15.10%
Are no longer in business	97	12.80%
Left the region	73	9.60%
Moved to own building in park	19	2.50%
TOTAL	759	100.00%

As shown above, while not all of these new businesses become successful, the large majority (80%) stays in business and they stay in the region.

Trends

As Research Parks mature and evolve, they relate more to the economic development of their local community, upon partnerships with other institutions, a range of amenities and services that are attractive to potential tenants and visitors.

Importance of Changes in Research Parks in Past 5 to 10 Years



Evolution of University Research Parks

Early Parks: Stand-Alone Physical Space	1990s: Connections	2000 and Beyond: Economic Driver for the Region
• Real-estate operations • Campus-like environment, selling single parcels of land • Focus on industrial recruitment • Few, if any, ties between tenants and university of federal laboratories • Little provided in terms of business assistance or services	• Anchor with R&D facilities aligned with industry focus of park • Innovation Centers and technology incubators more common • Multi-tenant facilities constructed to accommodate smaller companies • Some support for entrepreneurs and start-up companies provided directly	• More and more mixed-use development, including commercial and residential • Increased focus and deeper service support to start-ups and entrepreneurs • Less focus on recruitment • Formal accelerator space and plans for technology commercialization roles emerge • Greater interest on part of tenant firms in partnering with universities • Universities more committed to partnering with research park tenants • Amenities from day care to conference and recreational facilities added

In summary, NELHA needs to improve its response to the underlying trends in research park development and operations.

- NELHA needs to develop a more mixed use development plan that includes both retail and accommodation based economic drivers.
- NELHA needs to provide better systems and facilities for the support of incubator startups as well as access to entrepreneurial capital.
- NELHA needs to further foster its own partnerships and tenant partnerships with Universities, Laboratories, Foundations and Institutes
- NELHA needs to develop on site accommodations, conference facilities, and gathering places that support researcher interaction, scientific conferences, and community involvement.

NELHA RESEARCH INN

Another important part of the Economic Driver (ED) zone is to include a NELHA Research Inn that can accommodate NELHA tenant personnel and their clients/ visitors, as well as visiting researchers from NELHA partners, students, and cultural program participants. Whereas most other research parks are located in urban or suburban destinations that have moderate cost accommodations nearby, NELHA does not have a comparable option for its visitors. Accordingly, we recommend an on site development program. We suggest that the NELHA Research Inn will have rate and advance reservation preferences for persons visiting businesses at NELHA or participating in research activities or attending an on site seminar, symposium, or cultural event. Considering the generally high costs of and distance from NELHA to accommodations on the Big Island, the Research Inn should be a mutually supportive competitive advantage for the Research Village and the Incubator project.

In terms of site location for the Research Inn, we originally thought that it would be best located near the cultural area, along with a cultural resource center (possibly developed and operated in association with the Bishop Museum). Under this scenario, the site would be best located makai of Big Island Abalone. However, this area is subject to substantial aircraft noise during daytime and early evening hours. If that is not feasible, an alternative site closer to the Queen Ka'ahumanu Highway and Gateway Center could be considered.

For planning purposes, we are proposing that the Research Inn be planned for 40 to 60 rooms with a centralized kitchen and community dining facility as well as research support services. Whereas we recognize that there is limited demand for such a facility from current tenant and research activities, demand should grow substantially both through new tenants, incubator startups, new partnerships, education and conference programs and other activities consistent with becoming a Center for Excellence in Energy and Ocean Research.

Economics of the NELHA Research Inn

We have assumed that the NELHA Research Inn will need to be self supporting and have designed a financial approach to development with that in mind. If it happens to be the case that there is government or donor support available, the plan could be modified to allow for cheaper or a different form of accommodation financing than under the plan proposed below. Nevertheless, at this stage, we cannot be assured that separate funding will be available.

The business plan for the NELHA Research Inn envisions a condo hotel approach in which individual buyers/investors buy the individual condo hotel rooms from the NELHA selected developer, who uses the money to help finance the project. When the owners aren't there, they can rent their rooms, usually through a hotel management firm (also selected by NELHA), which takes a cut of the rental revenue. As part of the rental agreement, the hotel pays for most operating expenses such as housekeeping, administration and marketing. The condo hotel owner typically pays the real estate taxes, insurance and capital improvements.

In addition to the investment aspect, condo hotel units usually offer more space and in-room amenities than a standard hotel room. Condo hotels also typically have modest cooking facilities and other features that hotel rooms do not. This makes it ideal for an extended stay NELHA visitor on a business/ research trip and for family use.

According to a poll of its members, the National Association of Condominium Hotel Owners (NACHO), reports the following purchase motivations for a condo hotel unit.

As shown, much of the investment motivation is tied to the appreciation of the real estate asset,

Reasons for Purchasing a Condominium Hotel Unit

Real Estate Investment	46.7%
To Make Money	25.4%
Enjoyment of Life	11.5%
Attract Opposite Sex	9.0%

not to make money off of the rental of the hotel room/ suite. Indeed, the survey also showed that 90% of all perspective condo hotel buyers are interested in the rental program, and they expect it to compensate for 50-75% of annual ownership expenses, excluding mortgage. This is a good thing, because there are no guarantees that owners will have a steady stream of rental income, and many may find that they don't have enough money out of the rental programs to cover their mortgages, insurance and other expenses. In addition, condo-hotel owners face restrictions, such as limits on how often they can use their rooms.

Condo Hotel Business Model – for the Developer

In the current economic environment, even with low-cost and readily available financing, development of a traditional wholly-owned full-service hotel is unlikely to be feasible due to the high costs of construction and depressed room rates. At this point in the development cycle, it would be a rare project where the hotel would be successful without a supplementary source of cash flow from residential, fractional, or condominium hotel sales.

The value difference can be considerable, particularly in the distribution of cash flows to the developer. Condo-hotels generate significant cash flow immediately upon completion. The developer can pay down debt from the condo-hotel sales proceeds whereas the net operating income ramp-up of a new wholly-owned property would typically have debt–service shortfalls in the first year or two operations, requiring the developer to put in additional equity.

Successful condo-hotel projects share distinctive attributes. The projects are typically located in established destinations that are easily accessible to the individual-unit owners. Successful condominium hotel projects need not be feasible as a traditionally financed hotel, but must be located in desirable destinations and designed to the real estate appreciation and desirability of use motivations of potential buyers. Here, the NELHA Research Inn has a built in market advantage through its appeal to current and future NELHA tenants as well as institutional partners and supporters.

We recognize that the condominium approach to hotel development does not have a precedent in other research parks. However, we believe that the Big Island may present some unique advantages that could make it a practical alternative. Accordingly, the below discussion talks about the how hotel condominiums are structured in Hawai'i.

Hotel Condominium Considerations in Hawai'i

There are 10 condo hotel projects in Hawai'i, 6 of which are in O'ahu. Condo hotel offerings in Hawai'i cover a wide range of pricing options from units around $150,000 to over $1 million. Factors that can influence price are the property's location, the quality of the amenities, lease or fee simple ownership, and the management/developer brand name. Individual condo hotel units are priced based on their size, view, floor height, features and furnishings. The importance of brand name is often subjective, but in the sale of the Trump tower project in Waikīkī, it is estimated that the Trump name added as much as $400 per square foot to the selling prices achieved in Japan. On a square foot basis, condo hotel prices run anywhere from 10-30% higher than typical condominiums.

Most condo hotels in Hawai'i are located in the Waikīkī area of Honolulu. Selected properties include:

- Ala Moana Hotel. Crescent Heights (developer of Ko'Olina) purchased the 1,152-room Ala Moana Hotel and has sold off most of the units as condominiums. Resale prices have declined somewhat in the past year.

Hotel Condo Sales

	2005	2006	2007	2008
Number of Sales	764	381	55	41
Average Size	305	323	288	303
Gross Sales Value	$169,650,888	$97,564,123	$12,412,666	$8,168,385
Average Price	$222,056	$256,074	$225,685	$199,229
Price per SF	$728	$793	$784	$657

- Luana Waikīkī. Located on Kalākaua Avenue adjacent to Fort DeRussy, this hotel conversion was completed in 2004 and has done quite well in terms of occupancy and return to the original hotel condominium investors. The property is managed by Outrigger and the location is particularly popular with military visitors.

	2004	2005	2006	2007	2008
Number of Sales	123	39	30	12	3
Average Size	353	395	389	366	313
Gross Sales Value	$24,152,500	$12,620,937	$10,573,700	$4,413,150	$894,500
Average Price	$196,362	$323,614	$352,457	$367,763	$298,167
Price per SF	$556	$819	$907	$1,004	$953

The unit sizes range from 313 to 676 square feet and most have unobstructed views across Fort DeRussy. In 2008, the project had three resales. Prices held at above $950 per square foot.

- Regency at Beachwalk. This is another condominium conversion managed by Outrigger. This project is located in the middle of the Beachwalk project and has a distinctly urban feel in terms of location and decor, rather than a resort atmosphere. There are no ocean views. Unit sizes include a 494 square foot 1 bedroom and a 693 square foot 2 bedroom and prices are in the $900 per square foot range.

	2006	2007	2008
Number of Sales	18	27	4
Average Size	494	590	693
Gross Sales Value	$8,563,000	$13,787,150	$2,459,400
Average Price	$475,722	$510,635	$614,850
Price per SF	$963	866	$887

In 2008, the developer was selling the last of the larger units. Accordingly, average prices were somewhat higher.

- Ilikai. The Ilikai is a 1,016 room property made famous in the Hawai'i 5-0 credits. At one time it was a Westin and then a Renaissance. Like the Luana, condo hotel prices at the Ilikai have shown strong appreciation since 2003.

	2003	2004	2005	2006	2007	2008
Number of Sales	62	79	67	60	138	37
Sales Volume	$19,202,300	$31,408,109	$35,443,000	$32,370,000	$71,520,230	$16,246,260
Average Size (SF)	604	626	690	565	549	580
Average Price	$309,715	$397,571	$529,000	$539,500	$518,263	$439,088
Sales Price per SF	$513	$635	$767	$955	$944	$757

In 2008, sales declined in large part due to a legal dispute with the developer over the nonpayment of association dues.

On the Big Island there are no true condo hotels, but there are a number of condominium rental programs. We reviewed two such programs, both managed by Outrigger. These included the Fairway Villas at Waikoloa Resort, and the Kanaloa project in Keauhou. Both of these properties are within established resorts and include access to the overall resort amenities and services.

A summary of their performance is provided below, along with a comparison to the sales prices of the selected condo hotel projects in Honolulu .

As shown, the Big Island properties are much larger units than the Waikīkī comparables. Accordingly, average sales prices are higher, but the sales price per square foot is less. On

Average Daily Rates and Values for Condo Hotel Comparables (ADR for 2008)

Planned Community Project Unit Type and Orientation	Waikoloa Resort Fairway Villas	Keauhou Kanalaoa	Waikīkī Condo Hotel Comparables			
1 Bedroom Fairway View		$151				
1 Bedroom Partial Ocean View		$173				
1 Bedroom Ocean View		$188				
2 Bedroom Golf View	$183	$174				
2 Bedroom with Loft	$217					
2 Bedroom Partial Ocean View		$192				
2 Bedroom Ocean View		$208				
2 Bedroom Ocean Front		$241				
3 Bedroom Golf View	$300		Luana Waikīkī	Regency Beachwalk	Ilikai	Ala Moana
Total ADR	$201	$197	$163	$240		
Overall Occupancy Rate	80%	70.4%	86%	70%		
RevPAR	$161	$139	$140	$168		
Average Sales Price 2008	$594,188	$530,233	$298,167	$614,850	$439,086	$199,229
Average Size	1,348	1,411	313	693	580	303
$/SF	$441	$376	$953	$887	$757	$658
Average Room Revenue	$58,692	$50,621	$51,100	$61,320		
Owner Share @50%	$29,346	$25,311	$25,550	$30,660		
Gross Cap Rate	4.9%	4.8%	8.6%	5.0%		

average, new buyers who purchase these units will receive a 4% to 8% return on their investment, before property taxes and debt service. This is reasonably good, and, of course, owners who had bought in prior years would be receiving a higher return.

NELHA Inn Site Characteristics

The NELHA energy and ocean mall site provides an attractive oceanfront setting that is outside the direct flight path of the Keāhole airport. We suggest that the design should provide for a four story property with good ocean views from each room.

Overall Market Parameters for the NELHA Research Inn

KBCG recommends that the studio units consist of a moderate 29' by 14' module (410 square feet) with a larger than average 6' by 14' lanai. The reason for the larger deck is that a key factor in the sale of Hawai'i condominiums is indoor/ outdoor lifestyle and large lanai. For the one bedroom lockoff units, we are recommending sizes of 750 square feet, also with spacious lanais.

The average daily rate is projected at $144 for the studio units and $180 for the 1 bedroom suites. Lockoff studios without a mini kitchen have an ADR of $120. These rates reflect a balance between a number of factors affecting rates and occupancy and are conditioned upon staying below allowable government rates for Hawai'i. A full benchmarking and market research study with principal market segments would be appropriate to confirm these rates.

In terms of real estate sales, most condo hotel units are not priced in a way that they'll provide an immediate return on investment. As discussed above, they are purchased primarily as a real estate investment hoping for long-term capital gain – with some usage and lifestyle benefits thrown in. For the NELHA Inn, a reasonable pricing expectation would be as follows:

General Economics for Research Inn at NELHA

Unit Type	Studio	1 Bedroom w/ Lockoof Studio	1 Br Lockoff Rental Breakdown		
Unit Size	410	750	1 Br	60%	$180
Average Room Rate	$144	$180	Studio A	20%	$140
Occupancy	80%	75%	Studio B	20%	$120
RevPAR	$115	$135	Average		$160
Rooms Revenue	$42,048	$49,275	Government Rates for Hawai'i		
Split	50%	50%	O'ahu	$177	
Return to Owner	$21,024	$24,638	Big Island Hilo	$112	
Gross Cap Rate	6.5%	5.5%	Big Island Other	$180	
Average Price	$323,446	$447,955	Mau	$160	
$/SF	$789	$597			
			TOTAL		
Rooms Revenue to Operator	$504,576	$295,650	$800,226		
Other Revenue	$100,915	$59,130	$160,045		
Total Revenue	$605,491	$354,780	$960,271		
Lease Revenue to NELHA	8%				
From Owners	$40,366	$23,652	$64,018		
From Operator	$48,439	$28,382	$76,822		
Total Lease Revenue	$88,805	$52,034	$140,840		

This model provides an owner return that is consistent with what is being achieved under current selling prices at the Luana, and Regency Beachwalk. The actual sales price for the NELHA condo hotel units, however, are about $300 per square foot less in order to account for the economic disadvantages of a leasehold ownership and the rate preferences offered to NELHA guests and tenants. The annual lease revenue to NELHA under these operating conditions is estimated at just under $141,000.

In terms of mix of units, a 2/3 to 1/3 split between the condo studios and combination units is appropriate in order to provide a variety of accommodation types suitable for singles, couples and families. Some dormitory style units suitable for students could also be added to the program, but these would have to be separately funded. The recommended room mix for the NELHA Research Inn is shown in the following table.

Within this overall development envelope, KBCG developed a pricing schedule by floor in order to properly reflect height and view premiums in the market. This schedule is shown below.

Recommended Room Mix

Unit Type	Studio	1 Bedroom w/ Lockoof Studio	
Unit Size	410	750	
Number of Units			
4	8	4	6,280
3	8	4	6,280
2	8	4	6,280
1	common area		6,280
Total	24	12	25,120
% of Product	67%	33%	
Number of Keys			
4	8	8	
3	8	8	
2	8	8	
1	common area		
Total	24	24	48
% of Keys	50	50	

As shown, there is a good breadth of sales points ranging up from a base price of $300,000 for a 2nd floor studio. The total sales value under this pricing and unit mix recommendation is approximately $13.1 million which represents an overall average sales value of $522 per square foot.

Per Unit Prices ($000) By Floor

Floor	Studio	1 Bedroom w/ Lockoof Studio
Unit Size	410	750
4	$347	$550
3	$321	$420
2	$300	$375
1	-	-
Average	$323	$448

Summary

On a "back of the envelope" basis, the NELHA Research Inn generates a gross margin of about $1.4 million. Cost estimates and public space requirements need to be confirmed.

Distribution of Sales Revenue ($000) for NELHA Inn

Floor	Studio	1 Bedroom w/ Lockoff Studio	Total
Unit Size	410	750	
4	$2,773	$2,201	$4,974
3	$2,568	$1,680	$4,248
2	$2,400	$1,500	$3,900
1	-	-	-
Total	$7,741	$5,381	$13,122
Price per SF	$787	$598	$522
Price per unity	$322,560	$448,400	

Considering the potential for 100% ocean views, and the stimulating research environment, units at the NELHA Research Inn should find a ready sales market among NELHA businesses, corporate, and institutional/ educational partners as well as provide an acceptable return to potential independent investors and supporters of NELHA.

Summary Economics of NELHA Inn

		Total ($000)	Public Area Program and Costs		
Gross Sales Revenue ($000)		$13,122	Lobby	SF	3,000
Marketing Costs	12%	$1,575	Meeting Room	SF	4,000
Upgrade Revenue	6%	$787	Other/BOH	SF	3,000
Upgrade Margin	30%	$236	Subtotal	SF	10,000
Net Overall Revenue		$11,784	Construction	$175	$1,750
Rooms Construction Cost per Net SF	$250	$4,710	Furnishings	$100	$1,000
Room Furnishings	$30,000	$1,440	Pools/Landscape		$1,500
Construction/Fitout of Public Spaces	Lump Sum	$4,250	Total		$4,250
Total Construction		$10,400			
Cost per Key	$216,667				
Gross Margin		$1,384			

The above economics should be attractive to a private sector developer and a local hotel management company.

Research Inn Tie in with the NELHA Master Plan

The success of the NELHA Research Inn will be closely tied to the NELHA leasing program and the development of the Economic Development zone and Incubator building. Together, these factors provide a strong underlying base of economic support for the Master Plan development.

In terms of scale, the NELHA Research Inn is similar to the facility at Kellogg College of Oxford University. Kellogg College is in charge of the continuing education programs for Oxford. At their property, Dr. Geoffrey Thomas manages an existing hotel (called Rewley House) that is used by program participants who come from all over the world.

Other examples of on site hotel accommodations at research parks include Research Triangle Park in Raleigh Durham which has four on site hotels (Radisson, Comfort Inn, Crestwood Suites, and Courtyard by Marriott) totaling some 513 rooms. There is also a Marriott Spring Hill Suites brand on site at the University Research Park in Charlotte, and a Wingate Inn at the Missouri Research Park.

In terms of the National Laboratories, Brookhaven National Laboratory (BNL) reports that it attracts more than 4,500 visiting scientists from all over the world each year to perform scientific research and work with BNL staff. To support this demand, there are 422 on-site housing units. These units are comprised of 66 family-style apartments, 46 efficiency apartments, 265 dormitory rooms, 13 Guest House rooms, 30 seasonal houses and 2 year round private houses. Rates at the Guest House are $106 per day which is reasonably consistent with the NELHA Hale approach. Whereas we do not see the need for NELHA to try to meet the level of accommodations demand as either Research Triangle or Brookhaven, a modest facility as proposed would be highly desirable in terms of attracting the level and stature of research partnerships envisioned in the master plan.

In addition to the Research Inn, it is appropriate for NELHA to offer lower cost accommodations for graduate students and others that are conducting research that complements the NELHA mission. These low cost accommodations, probably modular housing, could be included in the RE Zone. This housing will be subsidized housing for research and should be around a $100/night or less in 2009 dollars. The availability of these units in close proximity to research areas would be attractive to potential researchers. There are experiments that require checking equipment and monitors at odd hours in the night and accommodations close to the location of the experiments would be a great convenience for such experiments. Along with this amenity NELHA could negotiate the rental rates to further encourage researchers to locate their programs at NELHA.

These inexpensive accommodations should be located within the Research Village area to access the other amenities in this location as well as foster dialogue and interchange between researchers. Initially, 6-8 units should be built and as demand expands more unit could be added incrementally. Units should be designed flexibly like hotel/timeshare units to expand from studios to one, two and three bedroom units depending on the size of parties accommodated.

ECONOMIC DRIVER (ED) ZONE/ SUSTAINABILITY MALL

Within the Master Plan, we have recommended a commercial/ education area that will be the economic driver to support the research and institutional activities of NELHA. Importantly, the permitted activities within ED Zone will be consistent with the types of activities permitted under the NELHA tenant guidelines. The retail area will be branded as the NELHA Ocean and Energy Center and include the sales of those products that provide environmental, social, and economic benefits, while protecting public health, welfare, and environment over their full commercial cycle, from the extraction of raw materials to final disposition. Examples of retail outlets and services within such a sustainability mall could include:

- Agriculture & Gardening
- Art, Crafts & Jewelry
- Body & Skin Care
- Books and Publications
- Building & Design
- Business Services
- Business Supplies
- Climate Change & Offsets
- Clothing & Accessories
- Education & Research
- Energy & Fuel
- Environmental Action
- Fair Trade & Imports
- Finance & Investing
- Food & Beverages
- Health & Healing
- Home Furnishings
- Household Goods
- Music

- Outdoor Recreation and Tours
- Paper & Fiber Products
- Pet Care
- Technology & Computers
- Toys & Games
- Transportation
- Travel

Products that would relate directly to NELHA core research mission could include:

- Electric Car Dealership(s)
- Solar Car Wash
- Renewable Energy Support Systems and Store
    - Residential and Commercial Solar Electric systems
    - Batteries
    - Meters and System Monitors, Data Loggers
    - PV Mounting Systems
    - Combiner boxes
    - Compact fluorescents and LED Lighting
    - DC and RF Power supplies
- Wind Turbine Outlet
    - Less than 400w
    - 400w to 1,000w
    - 1,000w to 5,000w
- Sustainability Mall
    - Organic Gardening and Farming Processes/ Products
    - Water Capture and Conservation Tools
    - Food Preparation and Preservation
- Carbon Footprint Exchange
- Deep Ocean Store and Exhibits
    - Bottled water and sea salt
    - Jewel tanks of deep Ocean Life
    - Remote Sensing and Exploration Adventures (Jason Project)
- Aquaculture/ Sales of NELHA produced products
    - Abalone, lobster, etc.
    - Ocean based nutriceuticals
- Demonstration Projects/ Visitor Attractions. Since NELHA was established, several visitor attractions concepts have been proposed that are felt to be consistent with the NELHA mission to educate and entertain visitors about issues of energy and water conservation and sustainability. Two that we are aware of include the Lunar Base Hawai'i project and Spark Park.

- Lunar Base Hawai'i is an attraction that demonstrates how one would work, live, and experience a habitat on the moon. This appears to be quite consistent with the NELHA mission in terms of demonstrating the virtues of resource conservation and sustainable development. A similar idea has been developed by James Cameron (Director of the movie Titanic) and it is based on a "Mars on Earth" theme. Participants in his team include several former Biospherians. A brief description of the Lunar Base idea is attached. Note, that we see this attraction as less of an astronomical adventure, but rather as a lesson in sustainability. Therefore, while at first glance, it seems more suitable to be part of the Hilo planetarium/ museum, we think it fits better with NELHA. And, from an economics point of view, it is important to place attractions where the people are. We should remember that NELHA occupies a remarkable piece of real estate in one of the most desirable visitor locations on the planet. We should have elements of the ED zone that leverage this location advantage.
- Spark Park. A family entertainment and education center themed around energy and the deep ocean

- LEED Certified Building Systems such as the Living Homes group that developed the first prefabricated Platinum level home (www.livinghomes.net).
- Support Facilities
  - Restaurants and convenience outlets
  - Gas/ Battery Exchange Station

Incubator Building

Business incubators are buildings that help accommodate the transfer of research from individuals and institutions to the commercial market by addressing the special needs of small startup companies. Incubator buildings typically include customized spaces that facilitate ongoing scientific study, as well as specific services that promote the commercialization of promising research. Most often, incubators are located near research hubs and act as extensions of these hubs. This proximity is advantageous for the developer/ owner of the incubator building because it appeals to new startup companies that can utilize the resources of these hubs. It also benefits the startups by making them more visible to the venture capital and private equity organizations that are most likely to fund them.

Some incubators receive government funding or tax reductions that they can pass on to small companies in the form of financial incentives or rent subsidies. Many incubator buildings are designed to reflect the research activities that take place within them. Young, forward-looking companies look for buildings that support their goals and mission, so incubator buildings are almost always certified as environmentally friendly under the Leadership in Energy and Environmental Design (LEED) green building program because sustainable design attracts such tenants.

Because incubator companies are often engaged in cutting-edge research, building designs typically advertise technology as a metaphor for the work of resident companies. High-tech materials such as metal cladding and porcelain tile are common, as are large areas of glass. Glazing, atriums, and skylights are especially prevalent because they allow plenty of natural light to enter the public spaces where researchers often meet. It is important that buildings be able to support the transitional steps that startup companies take as they develop commercially viable products. This process includes research, then testing, and finally small-scale production. Provision of equipment labs, office spaces, and all the basic services and infrastructure should nurture this development. Floors typically are divided into the small

suites that are most economical for startup firms, yet the buildings have to be large and flexible enough to allow companies to expand incrementally over time.

Since the early part of this decade, the private equity community has become increasingly conservative, which has limited the amount of seed money available to young companies. As a result, startups often want to stay in incubators longer than they did previously. To retain tenants, an incubator should be capable of supporting their expansion. The key goal is to achieve the right mix of labs and infrastructure that will make an incubator competitive in the marketplace while keeping the tenants' costs low. Incubators typically provide companies with shared utilities and communal services and amenities that help young companies develop their businesses. Conference centers with state-of-the-art videoconference capabilities, cafeterias, and fitness centers are the kind of perks that attract new companies. Some owners offer extras, such as business planning and legal services.

For NELHA, the incubator building should initially be about 25,000 square feet, which will allow for some 25 offices as well as three conference rooms for tenants to hold meetings, seminars and training forums. At least one conference room should be equipped with video conferencing facilities. There will also be a common business services area with shared receptionist, and kitchen/ dining/ gathering area to encourage interchange among the tenants. The incubator should focus on helping startup companies in the energy and ocean resource disciplines. For master planning purposes, future expansion up to 40,000 square feet should be allowed. We also believe that the best place for the incubator building is as part of the Economic Development (ED) zone in close proximity to the Research Inn upgrading and redevelopment of the Research Compound. Target lease rates of $2 to $3 per square foot, and tenants will be limited to three years occupancy before tenants are asked to consider moving on to their own facility in other NELHA Areas. It is an open question as to whether the incubator building should be independently developed or needs to be done under the auspices of Hawai'i's High Technology Development Corp. (HTDC) which has existing facilities in Honolulu, Maui, and Hilo. If HTDC chooses not to be involved, we recommend that NELHA move forward independently and solicit the support of the numerous venture capitalists in the local community.

To support the incubator approach, we also recommend the formation of a venture capital support group (Big Island Angels) that will provide mentorship and seed capital to our budding entrepreneurs. It is our experience from discussions with residents of the high end resorts and other high net worth individuals who live permanently or seasonally on the Big Island that they would welcome being involved in such an activity – and some informal groups are already active in searching for local investment opportunities. For financial purposes, we have assumed that NELHA will partner with an overall master developer for the development of the Research Village and the Ocean and Energy Mall complex, including the Research Inn as discussed below:

Criteria for Participation in the Ocean and Energy Mall

In setting the criteria for acceptance into the Ocean and Energy Sustainability Center, NELHA should develop partnerships with the appropriate standards and certifying agencies to ensure that proper standards are met. Such agencies could include:

ANSI/BIFMA Furniture Emission Standards, www.bifma.org/standards/FES/FES.html. Standards for furniture products with low indoor air quality impacts

EcoLogo, www.ecologo.org. An ISO-14024 Type I environmental labeling program that certifies environmentally friendly products based on criteria developed for individual classes of products and focuses primarily on product use, despite lifecycle basis and is the oldest in North America with a very broad range of products

Energy Star program, www.energystar.gov. Certifies products and buildings that meet energy efficiency guidelines established by the US EPA and U.S. Department of Energy

EPA Comprehensive Procurement Guidelines, www.epa.gov/cpg. Provides specifications for recycled and reclaimed material contents for a broad range of products

EPA WaterSense, www.epa.gov/watersense. A labeling program for quality, water efficient products and currently focused only on bathroom products and irrigation services

EPA Design for Environment (DfE) label, www.epa.gov/dfe/pubs/projects/formulat/label.htm. A labeling program based on thorough environmental, health and safety assessments based on product composition, including a broad range of environmental impacts and focuses on cleaning products

EPEAT - Electronic Product Environmental Assessment Tool, www.epeat.net. Provides criteria for the design of environmentally friend electronic products and has three tiers of ratings: gold, silver, and bronze

FEMP Energy Efficient Products, www.eere.energy.gov/femp/procurement. Provides specifications for two levels of energy-efficient designations - "recommended" and "best available," for a broad range of products - complementary to the U.S. Energy Star program

Forest Stewardship Council (FSC) certification, www.fscus.org. Standards for sustainability harvested forests, applicable to wood and paper products; products can be certified to meet FSC standards through several certification agencies, including Bureau Veritas, Scientific Certification Systems, SGS, and the SmartWood program.

GREENGUARD, www.greenguard.org. Certifies interior and building products and buildings with low indoor air quality impact

GreenSeal, www.greenseal.org. An ISO-14024 Type I environmental labeling program that certifies environmentally friendly products based on criteria developed for individual classes of products and focuses primarily on product use, despite lifecycle basis

NSF140 Sustainable Carpet Standard, www.nsf.org/info/carpet. Standard for environmentally friendly carpet products based on overall lifecycle environmental impacts and is used by carpet certification programs such as SCS sustainable carpets and CRI green label

SCS Indoor Advantage and Indoor Advantage Gold, www.scscertified.com. Certifies furniture and interior products with low indoor air quality impact

SCS Recycled Content, http://www.scscertified.com/ecoproducts/materialcontent/recycled.html. Certifies building products that meet minimum specifications for recycled and reclaimed material contents.

SCS Sustainable Choice, www.scscertified.com/ecoproducts/epd/sustainablechoice.html.

Certifies environmentally friendly products, primarily building and interior products, based on overall lifecycle environmental impacts

USDA BioPreferred, www.biopreferred.gov. Designates products, primarily lubricants and other chemicals, made of bio-based material instead of petroleum-based or other non-renewable materials commonly used for products

Positioning Within NELHA

With the breadth of product opportunities that could be included in the Mall, NELHA should allocate approximately 50 acres to this development. Whereas some uses are particularly land intensive (e.g., an electric car dealership) others function well within a typical retail environment. And, the mutually supportive message is that the mall informs the public about NELHA's core values, the public receives assurance that the merchants within the mall live up to sustainability standards, and the merchants/ NELHA tenants benefit from a product window and critical mass development that is built around the values and products that they are bringing to the consumer. It is a value added proposition for NELHA, its tenants, and the public – and it is authentic to the place and the NELHA mission.

The NELHA Sustainability Mall is best developed by a private developer, with appropriate ground and percentage rents accruing to NELHA.

SUMMARY FINANCIAL ANALYSIS

The NELHA Master Plan sets out five development zones and phases. The development zones include AT (Applied Technology), EZ (Energy Zone), ED (Economic Driver), RE (Research and Education), and CT (Culture and Technology). The number of parcels and acreage devoted to each use by phase are shown.

NELHA Development Program

	Phase											
	1		2		3		4		5		Total	
	Parcels	Acres	Parcels	Acres	Parcels	Acres	Parcels	Acres	Parcels	Acres	Parcels	Acres
New Development												
AT	6	60.0	5	28.4			11	63.7			22	152.1
EZ	3	38.7	5	29.0							8	67.7
ED			5	78.3							5	78.3
RE					8	9.4			4	72.8	12	82.2
CT							3	30.6			3	30.6
Subtotal	9	98.7	15	135.7	8	9.4	14	94.3	4	72.8	50	410.9
Existing Development	6	59.0	3	10.5	15	154.6	3	35.5			27	259.6
Total	15	157.7	18	146.2	23	164.0	17	129.8	4	72.8	77	670.5
Utilities and Archeology Sites						11.3		25.1				36.4
Other Lands												163.1
Total Land												870.0

Notes:

1. Existing Lots were based on TMK areas
2. Future Lots were based on conceptual lot layout
3. Other Lands include conservation lands, setback areas, archaeological sites and utility lots.

There are 50 development parcels available for lease, including 42 newly plotted lots and 8 already plotted vacant lots in the RE Zone.

Benchmark Rental Rates

As NELHA moves forward with the master plan, it will be important to work toward self sufficiency in its leasing structure. To this end, we recommend that the commercial uses in the ED Zone be assessed closer to commercial rates using the approximate benchmark lease rates as shown below by parcel size. For the other zones, appropriate reductions in rents would be appropriate and we have included suggested Zone adjustment factors. In addition to these basic lease rates, percentage rent overages would also apply to the ED Zone and selected tenants in the AT and EZ Zones.

Benchmark Rental Rates for NELHA Master Plan

ED Zone			
Parcel Size	Lease Rate/ S	$/ Acre	Annual Rent
Less than 2 acres	$ 0.84	$ 36,590	$ 73,181
3	$ 0.76	$ 32,931	$ 98,794
4	$ 0.68	$ 29,638	$ 118,553
5	$ 0.61	$ 26,674	$ 133,372
6	$ 0.55	$ 24,007	$ 144,042
7	$ 0.50	$ 21,606	$ 151,244
8	$ 0.45	$ 19,446	$ 155,565
9	$ 0.40	$ 17,501	$ 157,510
10	$ 0.36	$ 15,751	$ 157,510
10 to15	$ 0.33	$ 14,176	$ 177,198
15 to 20	$ 0.29	$ 12,758	$ 223,270
20+	$ 0.26	$ 11,482	$ 258,355
Zone Adjustment Factors			
AT Zone	55%		
EZ Zone	55%		
RE Zone	40%		
CT Zone	25%		

Rental Parameters for Economic Driver Zone

			Coverage	Rentable Space	Sales	Retail Sales	Rent to Developer	Ground Rent to NELHA	
Parcel		Parcel Size	SF (@25%)	60%	$/SF	$	8%	20%	Participation
1	Commercial	710,028	177,507	106,504	$400.00	$42,601,680	$3,408,134	$681,627	$85,203
2	Commercial	814,572	203,643	122,186	$350.00	$42,765,030	$3,421,202	$684,240	$ -
3	Office	1,014,948	253,737	228,363			$6,850,899	$1,370,180	
4	Research Inn	261,360	65,340	39,204				$140,840	
	Incubator	226,512	56,628	33,977			$951,350	$76,108	
	Other	222,156	55,539	66,647			$1,749,479	$139,958	
5	Commercial	161,172	40,293	24,176	$350.00	$8,461,530	$676,922	$135,384	$ -
Total		3,410,748	852,687	621,057		$93,828,240	$7,506,259	$3,228,338	$85,203

For the development parcels in the Economic Driver Zone (78.3 acres), the master plan includes an allowable coverage of 25%. We anticipate that 60 % of this potential will be built out as rentable retail, restaurant, attraction or other allowable commercial activity. Anticipated annual sales for retail and other commercial activity are on the order of $110 million.

We recommend that NELHA solicits bids from experienced commercial real estate developers for the development of each parcel. Assuming that the developer revenues are 8% of sales, it is reasonable that NELHA has an overage of 20% once base rents have been met. As shown, this allows for additional percentage rents of about $85,000 per year. Office rents are estimated at $2.50 per square foot.

Anticipated Lease Revenue from NELHA Master Plan Implementation

			Area		Lease Rate		
Zone	Lot #		Square Feet	Acres	$/square foot	$/acre	Annual Rent
Phase 1							
AT	1	Light Industrial	196,167	4.5	$ 0.37	$ 16,301	$ 73,410
	2	Light Industrial	265,716	6.1	$ 0.30	$ 13,204	$ 80,543
	3	Light Industrial	230,868	5.3	$ 0.34	$ 14,671	$ 77,756
	4	Light Industrial	348,480	8.0	$ 0.25	$ 10,695	$ 85,561
	5	Light Industrial	1,239,125	28.4	$ 0.14	$ 6,315	$ 179,649
	6	Light Industrial	334,144	7.7	$ 0.27	$ 11,883	$ 91,157
	Subtotal		2,614,500	60			$ 588,075
EZ	1	Hawaii Bioenergy (poss.)	1,415,143	32.5	$ 0.14	$ 6,315	$ 205,168
	2	Light Industrial	135,036	3.1	$ 0.42	$ 18,112	$ 56,148
	3	Light Industrial	135,036	3.1	$ 0.42	$ 18,112	$ 56,148
	Subtotal		1,685,215.0	38.7			$ 112,296
Subtotal			4,299,715	98.7			$ 700,371
Existing	K-10	Moana Technologies	497,017	11.4			
	K-12	Enzamin	134,427	3.1			
	K-13	Oceanic Institute	174,563	4.0			
	K-14	Koyo	1,305,675	30.0			
	K-17	HDMI	195,344	4.5			
	K-18	Savers Holdings	261,722	6.0			
	Subtotal		2,568,748	59.0			
Total Phase 1			6,868,463	157.7			
Phase 2							
AT	1	Light Industrial	370,095	8.5	$ 0.25	$ 10,695	$ 90,868
	2	Light Industrial	270,072	6.2	$ 0.30	$ 13,204	$ 81,864
	3	Light Industrial	252,107	5.8	$ 0.34	$ 14,671	$ 84,909
	4	Light Industrial	174,240	4.0	$ 0.37	$ 16,301	$ 65,204
	5	Light Industrial	169,884	3.9	$ 0.42	$ 18,112	$ 70,638
	Subtotal		1,236,398	28.4			$ 393,483
EZ	4	Light Industrial	222,156	5.1	$ 0.34	$ 14,671	$ 74,822
	5	Light Industrial	243,936	5.6	$ 0.34	$ 14,671	$ 82,157
	6	Light Industrial	161,172	3.7	$ 0.42	$ 18,112	$ 67,015
	7	Light Industrial	160,666	3.7	$ 0.42	$ 18,112	$ 66,805
	8	Light Industrial	474,804	10.9	$ 0.18	$ 7,797	$ 84,984
	Subtotal		1,262,734	29.0			$ 375,783
ED		(Includes Ocean and Energy/ Sustainability Mall, Research Inn, Incubator Building, Offices and Conf. Center)					
	1	Community Commercial	710,028	16.3	$ 0.84	$ 36,590	$ 596,424
	2	Community Commercial	814,572	18.7	$ 0.84	$ 36,590	$ 684,240
	3	Offices	1,014,948	23.3	$ 0.84	$ 36,590	$ 852,556
	4	Research Inn, Incubator, Off.	710,028	16.3	$ 0.50	$ 21,896	$ 356,906
	5	Community Commercial	161,172	3.7	$ 0.84	$ 36,590	$ 135,384
		Base Rent	3,410,748	78.3			$ 2,625,511
		Percentage Participation					$ 85,203
	Subtotal		5,909,880	135.7			$ 3,479,980
Existing	EZ	Gateway	209,088	4.8			
	EZ	WHEA	74,052	1.7	$ 0.07	$ 2,838	$ 4,824
	EZ	Sopogy	174,240	4.0	$ 0.17	$ 7,200	$ 28,800
	Subtotal		457,380	10.5			
Total Phase 2			6,367,260	146.2			

Anticipated Lease Revenue from NELHA Master Plan Implementation

Zone	Lot #		Area		Lease Rate		
			Square Feet	Acres	$/square foot	$/acre	Annual Rent
Phase 3							
RE	K-11	NELHA Research Comp.	409,464	9.4			
Existing	K-3	Royal Hwn Sea Farms	130,680	3.0			
	K-4	Cyanotech	3,968,316	91.1			
	K-5	Uwajima Fisheries	174,240	4.0			
	K-7	Kona Cold Lobsters	52,779	1.2			
	K-8	High Health Aquaculture	95,832	2.2			
	K-9	Ocean Rider	91,476	2.1			
	K-15	KBWF	100,188	2.3			
	K-20	Kona Bay Marine	283,140	6.5			
	K-23	Kona Coast Shellfish	148,104	3.4			
	K-26	Cellana	270,769	6.2			
	K-27A	Unlimited Aquaculture	400,752	9.2			
	K-27B	Unlimited Aquaculture	52,272	1.2			
	K-28	Mera Pharmaceuticals	243,936	5.6			
		Taylor Shellfish	265,716	6.1			
		Indo Pacific	47,916	1.1			
Vacant Lots (8)			409,464	9.4	$ 0.34	$ 14,636	$ 137,580
	Subtotal		6,735,580	154.6			$ 137,580
Total Phase 3			7,145,044	164.0			$ 137,580
Phase 4							
CT	1	Community Commercial	396,396	9.1	$ 0.10	$ 4,375	$ 39,815
	2	Community Commercial	357,192	8.2	$ 0.11	$ 4,861	$ 39,864
	3	Community Commercial	579,348	13.3	$ 0.08	$ 3,544	$ 47,135
	Subtotal		1,332,936	30.6			$ 126,813
AT	1	Light Industrial	313,632	7.2	$ 0.27	$ 11,883	$ 85,561
	2	Light Industrial	283,140	6.5	$ 0.30	$ 13,204	$ 85,825
	3	Light Industrial	396,396	9.1	$ 0.22	$ 9,626	$ 87,593
	4	Light Industrial	200,376	4.6	$ 0.37	$ 16,301	$ 74,985
	5	Light Industrial	226,512	5.2	$ 0.34	$ 14,671	$ 76,289
	6	Light Industrial	204,732	4	$ 0.37	$ 16,301	$ 76,615
	7	Light Industrial	257,004	5.9	$ 0.34	$ 14,671	$ 86,558
	8	Light Industrial	235,224	5.4	$ 0.34	$ 14,671	$ 79,223
	9	Light Industrial	217,800	5.0	$ 0.34	$ 14,671	$ 73,355
	10	Light Industrial	222,156	5.1	$ 0.34	$ 14,671	$ 74,822
	11	Light Industrial	217,800	5.0	$ 0.34	$ 14,671	$ 73,355
			2,774,772	63.7			$ 874,179
Subtotal			4,107,708	94.3			$ 1,000,992
Existing	K-6	Big Island Abalone	435,072	10.0			
	K-19	Deep Seawater Int'l	871,211	20.0	$ 0.06	$ 2,400	$ 48,000
	K-24	Noritech Hawaii	239,580	5.5	$ 0.14	$ 6,000	$ 33,000
Subtotal			1,545,863	35.5			
Total Phase 4			5,653,571	129.8			
Phase 5							
RE	1	Light Industrial	1,315,512	30.2	$ 0.11	$ 4,593	$ 138,708
	2	Light Industrial	592,416	13.6	$ 0.13	$ 5,670	$ 77,117
	3	Light Industrial	566,280	13.0	$ 0.13	$ 5,670	$ 73,715
	4	Light Industrial	696,960	16.0	$ 0.12	$ 5,103	$ 81,653
Total Phase 5			3,171,168	72.8			$ 371,192
Total Leases			29,205,506	670.5			
		Arch Site	492,228	11.3			
		Arch Site	662,112	15.2			
		Utilities	431,244	9.9			
		Other Lands	7,106,110	163.1			
Grand Total			36,311,616	870.0			$ 5,690,116

In accordance with the above leasing structure and the phasing program described earlier, the anticipated lease revenues to NELHA by phase are shown in the following pages.

As shown, the incremental lease revenue to NELHA from base rents in all zones and percentage rents in the ED zone amount to approximately $5.69 million upon buildout of the existing NELHA lands. Future expansion mauka of the Queen Ka'ahumanu highway could also be considered once these goals are met.

A summary of the lease revenue by phase is shown on the following page, including an allowance for leases executed between October 2007 to April 2009 and percentage rents from selected tenants in the AT and EZ Zones. Including these additional leases ($115,000) and percentage rents ($625,000), yields a total lease revenue potential of $6.43 million.

NELHA Lease Revenue Buildup by Phase

($000)

	Phase																	
	1			2			3			4			5			Total		
	Parcels	Acres	Lease $	Parcels	Acres	Lease $	Parcels	Acres	Lease $	Parcels	Acres	Lease $	Parcels	Acres	Lease $	Parcels	Acres	Lease $
New Development																		
AT Base	6	60.0	$ 588	5	28.4	$ 393				11	63.7	$ 874				22	152.1	$ 1,856
AT %			$ 157			$ 105						$ 233						$ 495
AT Total			$ 745			$ 498						$ 1,107						$ 2,351
EZ Base	3	38.7	$ 112	5	29.0	$ 376										8	67.7	$ 488
EZ %			$ 30			$ 100												$ 130
EZ Total			$ 142			$ 476												$ 618
ED (Base + %)				5	78.3	$ 2,711										5	78.3	$ 2,711
RE							8	9.4	$ 138				4	72.8	$ 371	12	82.2	$ 509
CT										3	30.6	$ 127				3	30.6	$ 127
Subtotal New Leases	9	98.7	$ 887	15	135.7	$ 3,685	8	9.4	$ 138	14	94.3	$ 1,234	4	72.8	$ 371	50	410.9	$ 6,315
2008/9 Leases				2	5.7	$ 34				2	25.5	$ 81				4	31.2	$ 115
Existing Development	6	59.0		1	4.8		15	154.6		1	10.0					23	228.4	
Total	15	157.7	$ 887	18	146.2	$ 3,719	23	164.0	$ 138	17	129.8	$ 1,315	4	72.8	$ 371	77	670.5	$ 6,430
Utilities and Archaeology Sites								11.3			25.1						36.4	
Other Lands																	163.1	
Total Land		157.7			146.2			175.3			154.9			72.8			870.0	

Comparison of Incremental Lease Revenues and Development Costs

A comparison of the incremental lease revenues and infrastructure development costs by phase is shown on the following page. Over a development period of approximately 15 years, the total lease revenues from new development and leases executed in 2008 and 2009 are $71.0 million. The annual lease revenue from new development in year 15 is $6.31 million. Adding in the annual revenue from leases executed in 2008/9 ($115,000) yields total new lease revenue in Year 15 of $6.43 million. Total infrastructure and development costs are $57.4 million. When you capitalize the ongoing lease revenue in the 15th year ($6.43 million) at an 8% rate, the value of the ongoing lease revenue stream is $80.4 million. Thus the total incremental value of the lease revenue under the master plan is $151.4 million ($71.0 + $80.4). Comparing this value to the estimated development costs of $57.4 million yields a benefit to cost ratio of about 2.6. We have also made an estimate of the increase in revenues from the NELHA seawater allocation fee and that provides an additional $8.75 million in revenue support over the life of the project ($3.4 million over the development period plus a capitalized value of future fees at a rate of 8%, equal to $5.35 million in year 15). For planning purposes, seawater allocation fees are based on a ratio of seawater fees to lease rents by Zone. These ratios are: AT 10%, EZ 0%, ED 3%, Research Village 8%, CT 0%, and RE 20%.

On a per acre basis, the overall lease revenue per month from new tenants is estimated at just under $1,300 at buildout. This compares to lease revenue of approximately $380 per acre per month from the existing tenant mix.

Absorption, Lease Revenue, and Development Cost Schedule for New NELHA Tenants

		Land Leases		Lease Revenue				Development Costs ($000)						
Zone	Phase/ Year	Number of Parcels	Acres	Annual Increment ($000)	Cumulative ($000)	Per Acre Per Month	Average	Infrastructure Costs	Mobilization	Contingency	Total	Seawater Allocation Fee	Increment	Cumulative
	Phase 1								10%	15%				
AT	1	3	30.0	$ 372		$ 1,034						10%	$ 37	
EZ	1	1.5	19.3	$ 71	$ 444	$ 306	$ 749	$ 8,960	$ 896	$ 1,478	$11,335		$ -	$ 37
AT	2	3	30.0	$ 372		$ 1,034			$ -	$ -	$ -	10%	$ 37	$ 74
EZ	2	1.5	19.3	$ 71	$ 887	$ 306	$ 749	$ 8,960	$ 896	$ 1,478	$11,335		$ -	
	Phase 2													
AT	1	2	11.4	$ 199		$ 1,463			$ -	$ -	$ -	10%	$ 20	
EZ	1	2	11.6	$ 190		$ 1,368			$ -	$ -	$ -		$ -	
ED	1	2	31.3	$ 1,084	$ 2,361	$ 2,885	$ 1,286	$ 4,304	$ 430	$ 710	$ 5,444	3%	$ 33	$ 127
AT	2	2	11.4	$ 199		$ 1,463			$ -	$ -	$ -	10%	$ 20	
EZ	2	2	11.6	$ 190		$ 1,368			$ -	$ -	$ -		$ -	
ED	2	2	31.3	$ 1,084	$ 3,835	$ 2,885	$ 1,542	$ 4,304	$ 430	$ 710	$ 5,444	3%	$ 33	$ 179
AT	3	1	5.7	$ 100		$ 1,463			$ -	$ -	$ -	10%	$ 10	
EZ	3	1	5.8	$ 95		$ 1,368			$ -	$ -	$ -		$ -	
ED	3	1	15.7	$ 542	$ 4,572	$ 2,885	$ 1,626	$ 4,304	$ 430	$ 710	$ 5,444	3%	$ 16	$ 206
	Phase 3													
RE	1	4	4.7	$ 69	$ 4,641	$ 1,220	$ 1,618	$ 3,336	$ 334	$ 550	$ 4,220	8%	$ 6	$ 206
RE	2	4	4.7	$ 69	$ 4,710	$ 1,220	$ 1,610	$ 3,336	$ 334	$ 550	$ 4,220	8%	$ 6	$ 211
	Phase 4													
AT	1	4	23.2	$ 403		$ 1,449			$ -	$ -	$ -	10%	$ 40	$ 251
CT	1	1	10.2	$ 42	$ 5,155	$ 345	$ 1,550	$ 1,278	$ 128	$ 211	$ 1,617		$ -	
AT	2	4	23.2	$ 403		$ 1,449			$ -	$ -	$ -	10%	$ 40	$ 292
CT	2	1	10.2	$ 42	$ 5,600	$ 345	$ 1,503	$ 1,278	$ 128	$ 211	$ 1,617		$ -	
AT	3	3	17.4	$ 302		$ 1,449			$ -	$ -	$ -	10%	$ 30	$ 322
CT	3	1	10.2	$ 42	$ 5,944	$ 345	$ 1,465	$ 1,278	$ 128	$ 211	$ 1,617		$ -	
	Phase 5													
RE	1	1	30.2	$ 109	$ 6,053	$ 301	$ 1,370	$ 1,006	$ 101	$ 166	$ 1,272	20%	$ 22	$ 344
RE	2	1	13.6	$ 109	$ 6,162	$ 669	$ 1,345	$ 1,006	$ 101	$ 166	$ 1,272	20%	$ 22	$ 366
RE	3	1	13.0	$ 109	$ 6,271	$ 700	$ 1,323	$ 1,006	$ 101	$ 166	$ 1,272	20%	$ 22	$ 387
RE	4	1	16.0	$ 44	$ 6,315	$ 227	$ 1,281	$ 1,006	$ 101	$ 166	$ 1,272	20%	$ 9	$ 396
Total		50	410.9		$ 62,951		$ 1,281	$ 45,361	$ 4,536	$ 7,484	$57,381			$ 3,398
Year 15 Revenue					$ 6,315									
15 Year Revenue From Leases Executed in 2008/9					$ 1,719									
Total 15 Year Lease Revenue					$ 70,985									

Summary Cash Flow

Summary cash flows both before and after NELHA fees to DBEDT and OHA are shown below. In addition to the infrastructure costs, we have allowed for an increase in operating costs of 25% of incremental lease revenue as well a 2 % reinvestment allowance. Lease rates for existing tenants are brought up to 50% of market rents over 10 years. Lease revenues are capitalized at an 8% capitalization rate in year 15 in order to account for the future value of ongoing lease payments. This is why there is a capitalized value entry of $80,372,000 in Year 15. To be consistent, ongoing operating costs and other revenues and allowances are also capitalized in Year 15. Under these conditions, the maximum financing requirement is $31.6 million in Year 7. Importantly, however, the proposed development program pays for itself over time and has an internal rate of return of 8%.

Incremental NELHA Cash Flow Before Fees									
		1	2	3	4	5	6	7	8
Lease Revenue		$ 558	$ 1,002	$ 2,476	$ 3,950	$ 4,687	$ 4,756	$ 4,824	$ 5,269
Capitalized Value	8%								
Seawater Allocation Fee		$ 37	$ 74	$ 127	$ 179	$ 206	$ 206	$ 211	$ 251
Infrastructure Costs		$ 11,335	$ 11,335	$ 5,444	$ 5,444	$ 5,444	$ 4,220	$ 4,220	$ 1,617
Operating Costs	25%	$ 140	$ 250	$ 619	$ 987	$ 1,172	$ 1,189	$ 1,206	$ 1,317
Exist Tenant Adj.		$ 104	$ 207	$ 311	$ 414	$ 518	$ 518	$ 518	$ 518
Reinvestment Allowance	2%	$ 227	$ 453	$ 562	$ 671	$ 780	$ 864	$ 949	$ 981
Cash Flow		$ (11,002)	$ (10,755)	$ (3,712)	$ (2,559)	$ (1,985)	$ (795)	$ (822)	$ 2,123
Cumulative Cash Flow		$ (11,002)	$ (21,757)	$ (25,469)	$ (28,028)	$ (30,014)	$ (30,808)	$ (31,630)	$ (29,507)
		9	10	11	12	13	14	15	Total
Lease Revenue		$ 5,714	$ 6,059	$ 6,168	$ 6,277	$ 6,386	$ 6,430	$ 6,430	$ 70,985
Capitalized Value								$ 80,372	$ 80,372
Seawater Allocation Fee		$ 292	$ 322	$ 344	$ 366	$ 387	$ 396	$ 5,348	$ 8,746
Infrastructure Costs		$ 1,617	$ 1,617	$ 1,272	$ 1,272	$ 1,272	$ 1,272	$ -	$ 57,381
Operating Costs	25%	$ 1,429	$ 1,515	$ 1,542	$ 1,569	$ 1,597	$ 1,607	$ 21,700	$ 37,839
Exist Tenant Adj.		$ 518	$ 518	$ 518	$ 518	$ 518	$ 518	$ 6,989	$ 13,201
Reinvestment Allowance	2%	$ 1,014	$ 1,046	$ 1,071	$ 1,097	$ 1,122	$ 1,148	$ 15,493	$ 27,478
Cash Flow		$ 2,465	$ 2,721	$ 3,144	$ 3,222	$ 3,300	$ 3,316	$ 54,956	$ 43,617
Cumulative Cash Flow		$ (27,042)	$ (24,321)	$ (21,177)	$ (17,955)	$ (14,655)	$ (11,339)	$ 43,617	
IRR	8%								

Scheduled fee payments to DBEDT and OHA will increase the financing requirement by about $5.8 million and reduce the IRR to about 1%.

Incremental NELHA Cash Flow After Fees									
		1	2	3	4	5	6	7	8
NELHA Cash Flow Before Fees		$ (11,002)	$ (10,755)	$ (3,712)	$ (2,559)	$ (1,985)	$ (795)	$ (822)	$ 2,123
DBED	5%	$ 30	$ 54	$ 130	$ 206	$ 245	$ 248	$ 252	$ 276
OHA	20%	$ 119	$ 215	$ 521	$ 826	$ 979	$ 992	$ 1,007	$ 1,104
Total Fees		$ 149	$ 269	$ 651	$ 1,032	$ 1,223	$ 1,240	$ 1,259	$ 1,380
NELHA Cash Flow After Fees		$ (11,151)	$ (11,024)	$ (4,362)	$ (3,591)	$ (3,209)	$ (2,035)	$ (2,081)	$ 743
		9	10	11	12	13	14	15	Total
NELHA Cash Flow Before Fees		$ 2,465	$ 2,721	$ 3,144	$ 3,222	$ 3,300	$ 3,316	$ 54,956	$ 43,617
DBED	5%	$ 300	$ 319	$ 326	$ 332	$ 339	$ 341	$ 4,607	$ 8,005
OHA	20%	$ 1,201	$ 1,276	$ 1,302	$ 1,328	$ 1,355	$ 1,365	$ 18,430	$ 32,021
Total Fees		$ 1,501	$ 1,595	$ 1,628	$ 1,661	$ 1,693	$ 1,706	$ 23,037	$ 40,026
NELHA Cash Flow After Fees		$ 963	$ 1,126	$ 1,516	$ 1,561	$ 1,607	$ 1,610	$ 31,919	$ 3,591
IRR	1%								

It is also important to remember that this financial performance is in addition to the significant other economic and environmental benefits and job creation opportunities inherent in the NELHA master plan.

Alternative Lease Rates and Financial Sensitivity

Whereas lease rates in the ED Zone are marked at commercial rates, the lease rates for the other zones have been reduced by suggested Zone adjustment factors. These are at 55% of market for the AT and EZ zones, 40% for the RE zone, and 25% for the CT zone. We subsequently tested the effects on the Internal Rate of Return (IRR) of policies that are more aggressive in bringing existing and future rents more in line with market. Rents for existing tenants were also increased to the rates for the AT and EZ zones. This analysis is summarized below:

Effects of Alternatives in Preferential Rate Structure

	Zone					IRR	
	AT	EZ	ED	RE	CT	Before Fees	After Fees
Base Case	55%	55%	100%	40%	25%	8%	1%
Alternative 1	65%	65%	100%	45%	30%	10%	3%
Alternative 2	75%	75%	100%	50%	30%	12%	5%

As shown, the IRR is increased substantially by a lease rate structure that brings rates in the AT and EZ zones closer to market.

Alternative lease rate impact analyses are attached as *Appendix G.*

The initial rates of return fluctuate greatly based on a number of scenarios. The above Initial Rates of Return (IRR) only refer to scenarios with no public subsidies and incomes based on lease rates projected from the current lease structure and seawater utilization to compare present operations with operations of a similar kind. From this analysis it is clear that without larger future increases in lease rents and water rates to levels closer to market values, the implementation of the Master Plan is barely breaking even. From a standard business calculation it is not an attractive business proposition. However, changing the rate structure clearly makes a significant difference in IRR. This is something the NELHA board should seriously consider.

Another possibility is the idea of a one-time public subsidy to start the project. Projections based on such a subsidy indicate that a $10 million subsidy would raise the IRR from a break even proposition to one with an IRR of 12%. Similarly, a $20 million infusion would raise it to 25%. During discussions with the board, a suggestion was made that if a new subsidy for a specific number of years would result in a self sustaining NELHA at the end of a specified period of time, the State administration would be willing to lobby the State Legislators to obtain the financial support needed to achieve this goal. The projections indicates this is possible and should be considered. This kind of approach would lower impacts on leases and may lessen resistance from current tenants.

Conservatively, the projections did not include future potential revenues from an expansion of the seawater system to include a sea water air conditioning system that might serve the airport and O‘oma developments as well as NELHA, It also does not include development of a microgrid renewable energy system identified in the Green Zone plan. Implementation of both concepts provides opportunities for energy cost savings and potential increases in future revenue.

The projections also do not reflect potential revenue that may come from partnerships with developers in implementing the Master Plan. Also, if NELHA can retain some of the rights to the innovations that are developed at NELHA through lease negotiations or program funding there is even more potential of revenues from royalties and other sources.

Economic Impact

Implementation of the NELHA Master Plan will have a substantial economic impact that benefits West Hawai'i and the entire state. The incremental expansion of the research and technology park will create approximately 480 new jobs in addition to the 335 currently employed at NELHA. According to the multiplier effect observed at other research parks; these new direct jobs will create a total of just over 1,200 jobs in the greater West Hawai'i community. In addition to the research and technology park employment, the economic driver zone will support another 1,500 jobs upon buildout. Thus, taken together, implementation of the NELHA master plan should support some 2,700 direct jobs in West Hawai'i.

In addition to direct ongoing employment, the construction improvements for the implementation of the NELHA master plan will provide over 490 person years of construction industry employment. Indirect impacts of these construction expenditures will include an additional 920 jobs and $43 million in household income. Clearly, the investment in NELHA is good for the community.

Methodology

Since NELHA has neither the staff nor the institutional experience in developing and operating commercial malls, it is recommended that this portion of the site be developed by agreements with developers experienced in such malls. NELHA will receive the ground lease and possibly negotiate a percentage of sales or gross revenue.

4.4 PHASING PLAN AND IMPLEMENTATION

4.4.1 Phasing Plan

The Phasing Plan for the NELHA Master Plan is based on two basic criteria: 1, program priorities and 2, feasibility based on likely infrastructure development. Program priorities are driven by the NELHA mission and purpose and organizational business needs. The infrastructure feasibility is based on funding and financing along with engineering considerations for design and sequencing of development.

The establishment of the phasing plan is not intended to suggest that projects within each zone must wait for development of earlier phase before it can proceed. The plan is advisory, not prescriptive as NELHA must remain flexible and proactive in developing the master plan. The intention of the plan is to identify the planned sequence of large infrastructure projects that set the broad pattern of development. Individual projects and proposals in other zones can still be considered independently at any time by NELHA or other parties.

Both the lotting scheme and the phasing plan are affected by the restriction against new breaches of the historic Māmalahoa Trail. Therefore, road access and design are constrained by this condition and sets some of the framework for the phasing.

Another consideration of rezoning is available potable water. Since only the old HOST Park area has a water allocation, at some point additional future development may require additional water allocations from the County or an alternate source of potable water. Both options will require additional funding. The NELHA master plan has alternative options for additional potable water sources but decisions are needed on the options and the source, transmission and possible storage facilities must be developed. This requirement is not tied to any particular phase but will need to be addressed.

Five phases were developed based primarily upon anticipated development of roadway segments that would serve different parts of the project site. Secondarily, needed land use entitlements are included in assessing the feasibility of the projected timing. Five phases were developed and shown in the phasing plan (Figure 3-2).

The time frames for the master plan implementation schedule and the business plan business plan are not completely coincident. Master plan time frames are usually very general in nature, more an order of magnitude frame which encompasses a big picture context. Often build-out is projected at 20 to 30 years. Business plans tend to be shorter term with anticipated income streams based on assumptions and beginning with specific current dollars. The further into the future revenues are projected the more speculative they tend to be. Decisions on business plans, even long term business plans, generally take a shorter time frame; usually 2-6 years and rarely beyond 10 years. Although there is no direct, item by item correlation between the Master Plan phasing and the business plan revenue and cost time tables, the model used in this report takes a 15 year frame which bridges the two time frames and summarizes future projections in year 15.

Phase I

This section was chosen as phase one because planning and design funds have already been allocated for this new connector road between the airport and the Road B-1 stub out that currently extends from the NELHA Access Road. It is assumed that this road will be completed in the near term and will make all parcels adjacent to the road readily accessible. Water, wastewater, power and telecommunication service lines need to be developed with this road. Extension of the sea water air conditioning (SWAC) line toward the facilities associated with the Keāhole Airport facilities is also made more feasible with the construction of this road.

The Kaiminani Drive extension from Queen Ka'ahumanu Highway to the airport connection road is also part of the same program. The Kaiminani Street extension and intersection are being designed in conjunction with the Phase II Queen Ka'ahumanu Highway improvements. Design funds for this project were recently contracted. Timing for construction will depend on completion of design and allocation of funds for construction. This will be several years in the future.

NELHA has been running short on an inventory of leasable lots to interested parties. Making this section phase one is the quickest and most rational way to address this shortfall with minimum cost. This action also potentially increases revenues with new leasable lots. If lots are to be available upon completion of the airport connector road, NELHA must process a subdivision application and approval should be considered as one of the implementing actions of Phase I. It is possible that the issue of potable water allocation and NELHA's fair share contribution may come up at this time. The possibility will exist no matter which section of NELHA is selected as Phase I.

Another important benefit is the creation of a direct link to the Airport. This allows NELHA tenants who ship products out of Keāhole Airport to have a shorter trip to and from the airport and avoid adding to the congestion along Queen Ka'ahumanu Highway.

Phase II

The frontage along Queen Ka'ahumanu Highway is recommended for phase two. This was based on the understanding that it is important for NELHA to develop an economic driver to improve the economic viability of NELHA so it can fulfill its overall mission and goals as a research and innovation incubation facility. Development of this phase requires the completion of the new frontage road.

The frontage road can be built in two increments on either side of the NELHA Access Road. The main segment on the Airport side of the existing Access Road would service the new retail and commercial developments which we hope will be the economic driver for NELHA. The new Kaiminani intersection and connection with the Frontage Road should be developed at the same time or prior to full build out of the retail/commercial lands. This area is expected to generate the highest traffic volumes within NELHA and a second entrance and exit to NELHA will be desired to accommodate this expected traffic demand. The Frontage Road might be constructed by NELHA or by developers of the retail and commercial lots.

The extension of the Frontage Road to the ʻO'oma boundary is needed to develop this smaller section of the site. This section runs to the ma uka edge of the Māmalahoa Trail and can be developed later separately.

Phase III

Phase three makes up the heart of the original NELH site. It is a largely built up and leased portion of the site and there is little unallocated space in this part of the property. Since most of the site is already developed phasing will be contingent on release of leases by existing establishments, infill of the few vacant areas within this section and redevelopment of the existing NELHA compound. Improvements needed here will be primarily in roadway extensions and new booster pumps.

This section is a key to NELHA's identity as a place for research and the ocean. Redevelopment should continue even as other earlier phases are identified for infrastructure improvements. Re-visioning as a research village will include retrofits and renovations to position NELHA for scientific meetings and lectures with a focus on renewable energy, ocean resources, research and education. Facility renovations should focus on these areas including development of facilities for the next generation of OTEC related research and applications.

Phase IV

Phase IV includes the area presently in the State Conservation District and vacant inaccessible lands towards ʻO'oma ma kai of the Māmalahoa Trail. Development of this area will require a standard roadway to access the vacant sections toward the ʻO'oma side of the property. While present plans show a "T" shaped roadway pattern, this is contingent on final subdivision approval by the County. Ordinarily County ordinances do not allow roadways ending in a dead end that are longer than 600 feet without a variance to the subdivision regulations. On the ma uka leg there is a justification for this due to constraints from existing lots and the barrier of the Māmalahoa Trail. On the ma kai leg there may be less of a reason and the County may require a connection to the main access road.

A pedestrian and bicycle pathway linking the ocean to the Frontage Road through the cul de sacs is proposed to improve circulation and access, provide alternative modes of travel and meet the spirit of the Public Access Shoreline Hawai'i (PASH) State Supreme Court decision on access and traditional cultural practices.

Development of this area will require an Environmental Impact Statement, a State Land Use Boundary Amendment (SLUBA) and subsequent County approvals which include rezoning, SMA amendment and subdivision approval.

Phase V

Phase V is the remaining shoreline area of land from Makako Bay to Unualoha Point. This is an isolated piece that will require a full complement of infrastructure improvements for potentially 4 lots.

4.4.2 Community Consensus Building

To many segments of the Kona community, NELHA is viewed as unresponsive and not providing much benefit to the local community. These views represent a misperception of NELHA but came up frequently in the community contacts Group 70 made. This issue should be proactively addressed. The community can help with the implementation of the master plan. Legally the NELHA Board could simply adopt this master plan and move on but it would be good to have community support for the plan. The community can be a source of political support which is useful when involved with legislative funding, programs or regulations that affect NELHA. At the County level it can facilitate approvals for land use actions needed to implement the master plan. The community may also become a resource in maintenance of shoreline areas and an ad hoc enforcement presence in the public areas of NELHA. They may also lead in obtaining funding for programs and facilities that may be lower on the Board's priorities list but still beneficial to the community and the long term mission of NELHA. Lack of community support can sometimes kill projects and programs. Community support can also blunt the impact of potential opposition groups.

NELHA should identify additional ways in which it intends to engage with the community. In addition to the Cultural Advisory Group identified earlier NELHA should consider the formation of a general community support group composed of community residents and leaders. The NELHA staff person responsible for public education functions should be the point of contact with the group. They should be kept informed of events at NELHA and given areas and programs where they may become involved. They could serve as docents and community clean-up volunteers at NELHA. The Gateway Center/ entrance and education node identified in the plan and the Wawaloli Beach Park ahupua'a gathering place nodes can be the areas where they can play important and leading roles in development and operation. Like a PTA for a school, this group could solicit extramural funding to support the institution.

Community engagement policy should encourage interaction with schools and community groups like the Kohala Center. Some of this already occurs but a formal policy should support and encourage it. Local political and social leaders should be included in the network that NELHA develops. The master plan should be presented at different venues and reasonable amendments should be made to accommodate issues and ideas that come from the community.

The Kona Angels Group mentioned earlier should also be formed and supported. This group can potentially provide financial and mentoring support for NELHA, its tenants and the general community.

Cooperative partnership with other government agencies will also extend NELHA's community outreach and provide institutional support for mutually beneficial initiatives.

Partnership is the mantra for successful growth and implementation of the master plan concepts. The Kona community is one of the most important partnerships NELHA could cultivate.

4.4.3 Entitlements

Several land use approvals and entitlements will be needed to implement the master plan. While development involves dozens and dozens of permits and approvals from Federal, State and County agencies the following actions/approvals are critical, major areas for master plan development: compliance with HRS Chapter 343 (EA/EIS requirement), Chapter 205 & 205A [State Land Use Districts and Coastal Zone Management (CZM)], County of Hawai'i Chapter 23 and 25 (Subdivision Code and Zoning). Entitlement processes have formal deadlines and timetables but often take longer due to controversy, the need for additional studies, logistical issues related to the approving agencies and applicant decisions. Sometimes these delays can last for several years.

State Land Use Boundary Amendment (SLUBA)

The portion of land that was part of a previous land swap with O'oma is still in State Conservation. The section of this parcel that is outside the archaeology preserve needs to be converted to an "Urban" designation in order to implement the master plan. SLUBA is processed through the State Land Use Commission (SLUC) in a quasi-judicial procedure and takes anywhere from 10 months to 2 years depending on the complexity and the controversy. Approval involves a decision and order and the process allows for a contested case hearing. SLUBA for conservation lands require compliance with Chapter 343.

Environmental Assessment/Environmental Impact Statement

Chapter 343 is the State's environmental impact statement law and links with historic sites, endangered species, clean water act and other environmental regulations. In Hawai'i it also ties into Cultural Impact Assessments. The EA/EIS is an informational decision making document necessary as a prerequisite for many land use actions. Individual projects from lessees may be subject to Chapter 343 depending on the nature of the project. Changes to County General and Development Plans, use of State and County lands or funds, conversion and/or use of conservation lands are some of the triggers that require compliance with Chapter 343. EA/EIS are processed through the Office of Environmental Quality Control (OEQC). Prior to any major development the question of Chapter 343 should be addressed early and budgeted in order to facilitate approvals. The cost of the environmental documents vary with each project but range from $150,000 to more than a million. Costs may vary with the complexity of the project and the number of special studies that are needed. They take between one to two years to complete.

The EA/EIS can be done separately or together in one EIS. Additionally, individual leasees may also need to conduct separate EIS documentation for special facilities and uses that may occur on individual parcels. These individual project EISs should be conducted and paid for by the individual leasee.

Finally, if Federal funding for a project is significant, an EIS under NEPA, the National Environmental Protection Act, may be required. These EISs would follow NEPA guidelines and processes. These too, should be conducted and paid by the individual project.

County of Hawai'i Zoning and Subdivision Codes

Zoning: After redistricting from Conservation to Urban designation the land must undergo a zone change. Zoning approvals can also take between 8 months to two years to complete. The appropriate zoning category to implement the master plan should be selected and processed. The current zoning of the nearby developed parcels (MG-3a) seems most appropriate except for the archaeology site which should probably remain in conservation. Zone changes are processed by the County Planning Department and require Planning Commission recommendation and County Council approval.

Special Management Area (SMA)

Both the land redistricted from conservation and the undeveloped northern parcel along the shoreline ma kai of the Kona International Airport (approximately 90 acres) will need SMA approval before they can be used for development. The SMA Permit (SMP) is processed by the Planning Department with final approval given by the Planning Commission. The process generally takes from 6 months to a year after submission. The SMA policies and regulations are authorized by the Coastal Zone Management (CZM) law adopted by the State. Permitting functions were delegated to the Counties.

Subdivision of Land

The recently adopted Kona CDP requires standard subdivision improvements for any kind of land development that parcels land into smaller development increments, including

condominium lots. Some have interpreted this to include licensing and lease arrangements. If this is accepted then either the improvements need to be constructed or a bond needs to be placed before the actions can proceed. This is a new area of requirement and its application to NELHA is a question. As a State entity these questions may generate a different conclusion from private developments but that is not certain. This question needs to be resolved prior to any final parcelization or subdivision of the site into new lots. The requirements for infrastructure or bonding may force NELHA to complete the phases as separate subdivision applications since it is unlikely that NELHA can develop the entire infrastructure in one phase.

Subdivision approvals are granted by the County Planning Department under Chapter 23 of the County Regulations. Normally a tentative subdivision approval is granted first. Under this approval roadways and infrastructure can be developed. Final subdivision approval will require completed infrastructure and allocation of water credits or bonds to cover costs to complete the infrastructure. It may also require negotiated impact fees with the County. These funds and the timing for compliance should be factored into project schedules and budgets.

4.4.4 Targets and Benchmarks

The following is a list of the major targets and benchmarks to successful implementation. Sequencing is somewhat chronological though many of the bench marks are not directly linked to the previous one:

- Approval of Master Plan and Lotting Plan.
- Subdivision Application and approval.
- Reach agreement with DWS on water allocation and cost share amounts.
- Roadway construction.
- The proposed roadways are identified by discrete sections. Completion of each roadway segment within the phasing plan is a target and a benchmark of progress in the plan. This extends through all phases of the phasing plan.
- Amend State of Hawai'i PUC regulations as needed to implement infrastructure partnerships agreements.
- Partnership development with NREL, UH, DOT Airports, Kohala Center, Bishop Museum, Kamehameha Schools, and others.
- Organize Kona Angels Venture Group.
- Organize community and cultural advisory groups.
- SWAC system expansion and upgrade. Complete user agreements with Airport and neighbors.
- Obtain developers for economic driver parcels.
- Complete EIS and State Land Use Boundary Amendment from Conservation to Urban for lands next to 'O'oma.
- Complete rezoning and SMA approvals
- Development of smart and microgrid systems with private sector partners.
- Development of key elements at each node of activity in the plan according to each phase
- Subdivision development
- OTEC project comes to NELHA
- Carbon agreements with emitters
- Full development and occupancy of NELHA/Long term diversified revenue stream for NELHA. World class research/technology development conducted and a high rate of successful incubator enterprises is achieved.

4.4.5 Pending and Unresolved Issues and Costs

There are many unresolved issues related to NELHA and the Master Plan. These issues relate to priorities, timing, financing and strategy. NELHA has achieved a certain measure of success in approaching economic self sufficiency in the past fiscal year. This is a culmination of years of focus and decisive decision making. However, we know this situation is both fluid and tenuous as current sources of funding and cash flows may change. We live in extraordinary times and the tried and true often turn up false. As someone once said, "the future is not what it used to be". In such a time flexibility of approach and clarity of focus are extremely important in achieving goals. This section summarizes the major areas of unresolved issues, and costs that are impossible to determine at this time, and therefore, are not included in the master plan development costs.

Entitlements: Costs, Timing And Responsibility

In order to implement the master plan several important land use entitlements must be obtained.

Subdivision: The first item of focus should probably be the subdivision of the remaining unleased portions of NELHA. This action will trigger the need for an SMA as Chapter 205A notes that any subdivision of 4 or more lots within the SMA triggers the need for a permit. Therefore the subdivision will trigger a need for an SMA. The conservation lands should be subdivided at a later time as this action will trigger the need for an EIS prior to subdivision. The subdivision action will also probably trigger the need to negotiate and pay water infrastructure development charges to the County Department of Water Supply. The timing and cost for this action will depend on a number of factors.

The following are ballpark estimates for budgeting purposes:

Engineering/design Costs	$500,000
Water infrastructure development charges	(unknown – to be negotiated with DWS based on pending North Kona Water Plan – still in draft form but expect $1.5 Million)
Subdivision processing	$100,000
SMA application and processing:	$150,000

90 Acres Unualoha Point: This area between Unualoha Point and Makako Bay was included in previous EISs and the SMA approval. A subdivision or proposed uses not covered in the previous EISs may require an EA/EIS. The level of Chapter 343 compliance will depend on the type of activities that will be allowed in this zone. EAs typically run from $25,000 to $100,000 depending on the issues involved. EISs usually range from $150,000 to a million, again depending on the proposed use. Processing time is normally 6 months to 10 months for an EA and a year to 2 years for an EIS.

Conservation Lands – O'oma Boundary: 83 acres adjacent to O'oma are in State Conservation. For the Master Plan to be implemented the land use district classification should be changed from "conservation" to "urban". This site includes the archaeology preserve near the ocean that spills over into the O'oma side. Reclassification of conservation lands is a Chapter 343 trigger for and EA/EIS. EIS cost and schedule for 83 acre conservation area will be similar to those mentioned above for Ulualoha Point 90 acres. NELHA should consider the potential time and cost savings of including both the Unualoha and O'oma sections into one EIS.

The SLUC process for reclassifying lands from conservation to urban is a quasi-judicial process involving a land use attorney, planning and other consultants. The process will usually take between 8 -12 months. Anticipated budgets for this process, exclusive of the EIS are probably in the $200-300,000 range.

Rezoning and SMA: After the land has been reclassified it will need to be rezoned and receive an SMA permit. Rezoning and SMA approvals can be processed concurrently. The estimated fee for rezoning and SMA is another $200 -300,000. During the SMA application acceptance phase the status of compliance of previous SMA requirements will come up. Normally, if there are outstanding conditions the application will not be accepted. These processes usually take between 8-12 months but there can be some (usually about 4 months) overlap with the LUC process.

Cost of renovations of existing facilities: The cost of maintaining existing facilities was not included in the master plan as that was beyond the scope of this contract. However, it needs to be included in the overall planning and revenue/cost analysis for NELHA. Estimates will need to assume which buildings, utility lines, and facilities will be retained, demolished or expanded.

Smart Grid: The development of a smart grid system is recommended in this Master Plan and the Green Energy Zone plans. Costs for this development have not been provided as there are many kinds of smart grid systems in the marketplace and this is one of the fastest growing areas of energy conservation and alternative energy technology. The differences in sophistication and cost may vary by several magnitudes and should be treated as a project in itself.

Alternative Energy Sources: The costs and timing issues related to transitioning to alternative energy systems remain uncertain. A lot depends on the marketplace and contracts and arrangements NELHA enters into with distributed energy providers. The existing potentials with Sopogy and Bioenergy Hawaii demonstrate both the potential and wide variability of the sources and costs. A lot depends on such partnerships and new technologies that are evolving. Cost estimates will vary greatly. As with the smart grid this should be treated as a long term NELHA wide project.

Sea water system unit costs have been provided but system costs have not been provided. Until the parameters of the system are defined it is impossible to make cost estimates. Discussions with NELHA staff and Makai Engineering note that flow requirements, pipe diameters, distances and design all need to be defined before coming up with a design from which cost estimates could be developed. The number of pumps, types of uses, and end users all affect flow and capacity and will need to be determined in a design before realistic costs can be developed. Whether the system is expanded to include external users like the Airport and O'oma will also affect flows and costs. Hypothetically, if the system needs to expand by 4,000 linear feet of 18" half buried piping, the expansion cost would be about $752,000. Pump stations will cost anywhere from $150,000 to $1,000,000, depending on size. Whether the pipes are half buried or fully buried increases line costs by 33%. Until the system is designed, these numbers are simply educated guesses.

Research Village and Incubator Buildings: The business plan places a strong recommendation on the development of a research village complex near the ocean and an incubator building. Specific costs for these recommendations were not developed due to the need to develop a more detailed site complex program and design. Until the program and at least a conceptual site plan are developed estimates will be largely speculative. However, given the costs of construction in 2009 a square foot cost of $200-300 for construction of the shell would be a reasonable rate. The initial phase of the incubator building was projected at 25, 000 sf. which

would bring the construction cost of this building into the $5,000,000 to $7,500,000 range. Fully constructed laboratories are much higher. The new UH CMORE lab estimates have come in at $607/sf., not including equipment. Recently, construction costs have declined significantly.

Beach Park Facilities: The proposed public facilities at Wawaloli Beach Park have also not been estimated. Again, the reason is lack of a specific program and design which should be developed in consultation with the community. However, a reasonable ballpark rate would be about $200/sf for such facilities.

Revenue Streams/Financing Sources: In this economy the question of feasibility is often tied to fund sources and future revenues. While the recent experience demonstrates the extreme challenges for any development it is useful to remember that a master plan is a long term evolving document. Many things are fixed or unavailable in the short term. However, this may change in the future. The opportunities and potentials mentioned in the first part of this chapter identified potential sources of revenue and implementing strategies. The NELHA Board will be critical in determining what projects will be pursued and the speeds with which different strategies are implemented. The current environment is extremely fluid and the Board and staff will need to steer implementation strategies to optimize the development of the Master Plan.

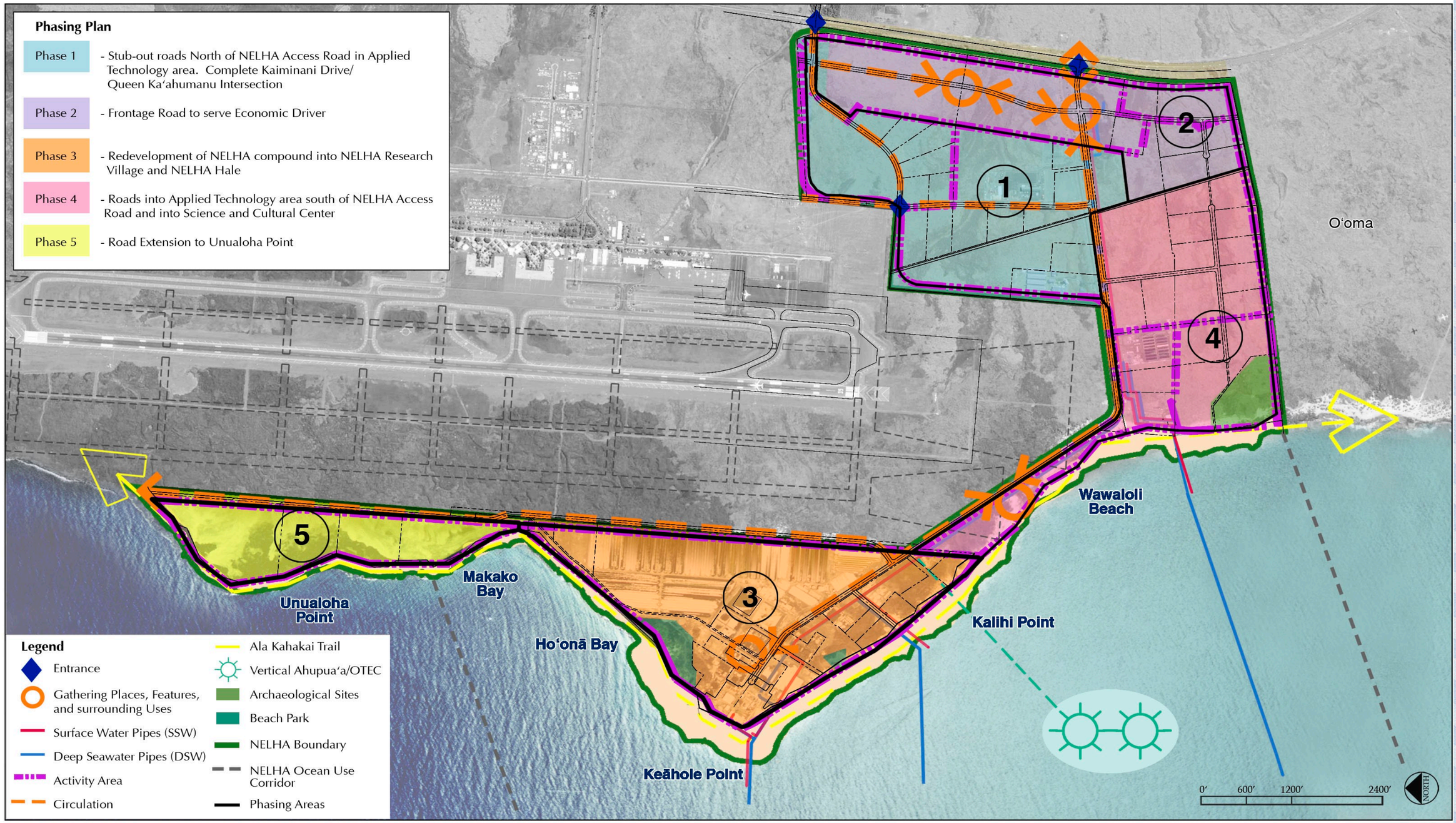


Figure 4.1 Phasing Plan

5.0 Summary and Conclusions

The world is in a great transitional time. The global economic downturn has resulted in a recession that represents the greatest financial distress since the Great Depression of 1929. Climate change from global warming is creating environmental problems that require global cooperation and technological solutions. Emerging peak oil scenarios in conjunction with climate change are necessitating a conversion to alternative renewal energy sources. A whole new technology and economy is evolving as a result of this need. Finally global population increases and growing affluence and consumerism are resulting in resource depletion, food and water shortages and a need to look beyond conventional sources for these commodities. These trends and forces are globally transformational requiring new attitudes and new technology.

NELHA is well-poised to play an important role in this transformation. With its focus on renewable energy and ocean resources, its mission leads NELHA to the two areas with great potential to address these global issues, renewable energy sources and the deep ocean. Whether it be energy, water, fuel or food, NELHA is in a position to advance research in these areas or stimulate scale-up models and market acceptance or nurture business development and market production of goods and services that address these issues. NELHA can also lead in education and training for jobs in the new, green economy.

In all of this NELHA cannot do it alone. To fulfill its potential in these areas NELHA needs to seek partners who complement its skills and resources while it grows its own capacity. With its partners, NELHA's special qualities of access to deep ocean water and very high annual solar insolation can lead it to the forefront of research and development to address these global challenges.

APPENDICES

Appendix A. Alternative Master Plans PowerPoint

NELHA

Natural Energy Laboratory of Hawaii Authority

MASTER PLAN OPTIONS

1: Continuation of Current Policies

2: Economic Driver with Research and Applied Technology

3: NELHA / US-DOE Research Campus

4: EPCOT / Edutourism Center

All Options Should be Considered as Inter-Changeable with Phased Integration of Multiple Options by the Board

August 19, 2008

Existing Tenants of NELHA

NELHA

Natural Energy Laboratory of Hawaii Authority

MISSION STATEMENT

"To develop and diversify Hawai'i's economy by providing resources and facilities for energy and ocean related research, education, and commercial activities in an environmentally sound and culturally sensitive manner."

(NELHA Annual Report 2006)

NELHA Boundary and Constraints

Issues and Context

1. Roadway Issues
   - Highway Access
   - Frontage Road
   - Links to Airport
2. Tenant Policies
   - Clarify Tenancy Criteria
3. High Utility Costs (Energy and Water)
4. Community Interface
   - What is NELHA's relationship to the Kona Community?
   - What is NELHA's relationship to its immediate neighbors?
5. Other Major Developments (Public)
   - Kona Airport
   - University of Hawaii Center at West Hawaii

NELHA Existing Master Plan
NELH & HOST
Past Land Use & Circulation Plans

Scenario 1:
Continuation of Current Policies

KEY FEATURES

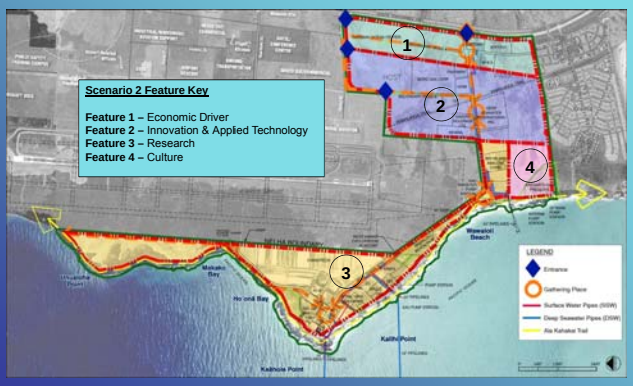
- Implement Existing Master Plan
- Economic Self Sufficiency
- Maintain and Extend Cold Water Pipe and Other Utility Systems to the Entire Site
- Completion of Lotting Scheme

Extend Lotting Scheme

BUSINESS MODEL

- **NELHA continues to function as a Landlord and as a utility company.**

Scenario 2: Economic Driver With Research and Applied Technology



Scenario 2: Economic Driver with Research and Applied Technology

KEY FEATURES

- **Create Commercial Anchor Reflective of NELHA Mission: Sale of NELHA Products (Biological, Minerals, and Technical), Edutainment (Sea, Geology, Alternative Energy), Abyss Aquarium**
- **Innovation, Applied Science, Business Incubation. Apply New Technologies On-Site in Light Industrial Park Such As: Alternative Energy, Aquaculture, Resource Extraction, and Biotechnology**
- **Energy and Ocean Research Park**
- **Interpret Research Activities and Links to Cultural Uses: Linking Traditional Knowledge to Western Science**

Economic Structure

- **NELHA as utility and Landlords; shopping center development mode of ownership**

Feature 1
Economic Driver

Create Commercial Anchor Reflective of NELHA Mission: Sale of NELHA Products (Biological, Mineral, and Technical), Edutainment, Ocean Recreation

- ***Retail Reflects Mission and Place***
- ***Educate Visitors***
- ***NELHA Products Available to Public***
- ***Commercial Gathering Space for Community***
- ***Abyss Aquarium***
- ***Seafood Restaurant***
- ***Local/Cultural Ocean Festival***

Feature 2
Innovation, Applied Science, Business Incubation

Application of NELHA Research Functions as Light Industrial Park

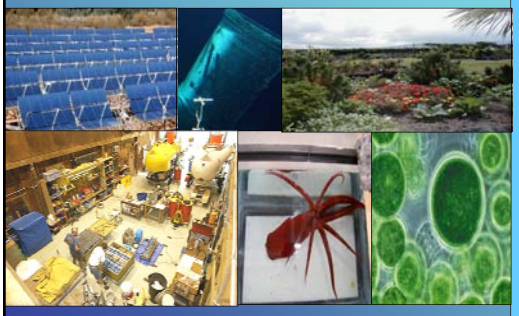
Example Industries:

- ***Alternative Energy***
- ***Aquaculture***
- ***Pharmaceuticals***
- ***Minerals/ Water Extraction***

Feature 4
Culture

Interpret Research Activities and Links to Cultural Uses; Linking Traditional Knowledge to Western Science

- ***Connecting NELHA Research with Cultural Integrity***
- ***Technology Indigenous Fishing Traditions, ie: Koa / fishponds***
- ***Dry Land Agriculture***
- ***Food Preservation***
  - ***Salt***
  - ***Drying***
  - ***Ocean (as) Refrigeration***
- ***Local Cultural Partnerships***



Feature 3
Energy & Ocean Research Park

Renewable Energy Research, Deep Ocean Research, Sustainable Living Research

Potential Research Partnerships:

- ***UH SOEST Group***
- ***UH Center for Sustainable Design***
- ***NREL***
- ***Cornell Sustainability***
- ***JAMSTEC***
- ***NASA***
- ***CEROS***
- ***NOAA***
- ***SHELL OIL***

BUSINESS MODEL

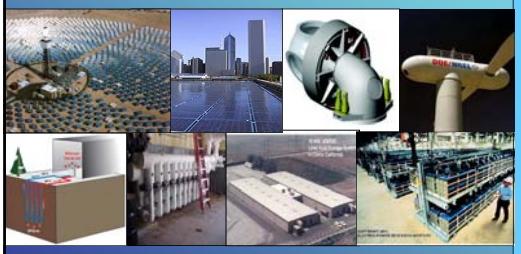
- **NELHA continues to function as a Landlord and as a utility company with renewable energy options.**
- **Leasing system is managed like a shopping center.**

Scenario 3: NELHA / US – DOE Research Campus

KEY FEATURES

- Integrated Science & Technology Research Campus for National Laboratories in Hawaii
- US-DOE Pacific Area Field Office
- Federal and State Partnership for R&D of Energy Related Technologies

NREL · Sandia National Laboratories · Los Alamos National Laboratory · Oak Ridge National Laboratory · NETL · PNNL

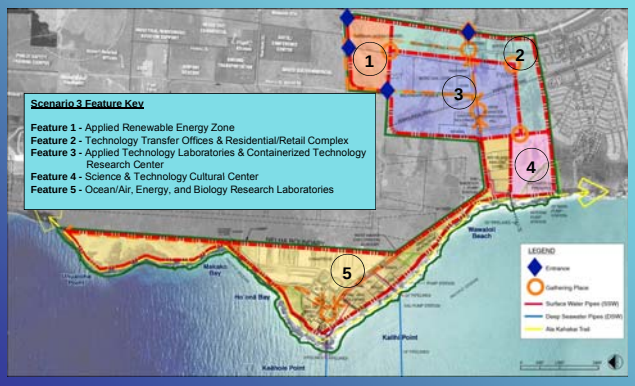


Feature 1
Applied Renewable Energy Zone

Applied Energy Technologies:

- *Solar*
- *Wind*
- *Geothermal*
- *Energy Storage*

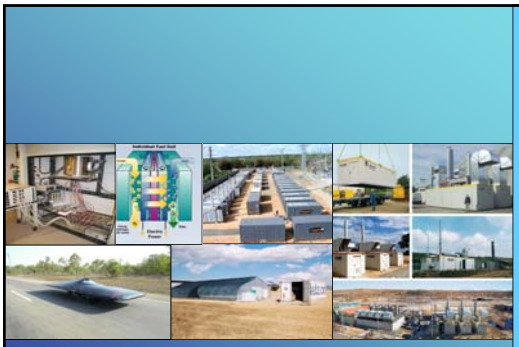
Scenario 3: NELHA / US-DOE Research Campus



Feature 2
Technology Transfer Offices & Residential / Retail

Technology Transfer Enterprises:

- *Technology Development Partnership Offices*
- *Technology Developers Residential Campus*
- *Live-Work-Play Retail Functions*
- *NELHA & US/DOE Program Offices*



Feature 3
Applied Technology Laboratories & Containerized Technology Research

Applied Technology Development & Deployment:

- ***Renewable Energy***
- ***Containerized Technologies***
- ***Transportation***
- ***Fuel Cell***
- ***Critical Infrastructure***

Feature 5
Ocean / Air Energy Research Laboratories

Innovative Energy Producing Technologies:

- ***Ocean Current***
- ***Ocean Thermal***
- ***Wave***
- ***Wind***

Feature 4
Science & Technology Cultural Center

Science & Technology Integration with Hawaiian Culture:

- ***Learning Centers***
- ***Agriculture – Aquaculture***
- ***Environment***
- ***Critical Infrastructure***
- ***Cultural Sustainability***

BUSINESS MODEL

- **NELHA becomes a US/DOE partnership research & development campus providing offices, laboratories, and technology transfer facilities.**
- **NELHA develops with US/DOE partnership a worldwide “islands” research & development program bringing international science and technology programs to the NELHA campus.**

Scenario 4: EPCOT / Edutourism Center

Experimental Prototype Campus of Tomorrow

KEY FEATURES

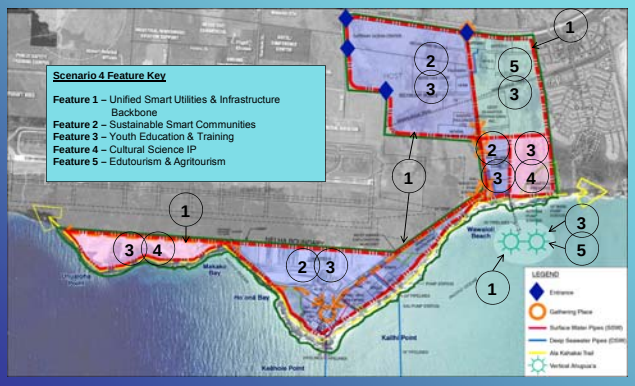
- **Build Plug-In Sustainable Smart Utilities & Infrastructure Backbone**
- **Feature Cutting Edge Science and Technology that Complement 'Sustainable Smart Communities' Worldwide**
- **Integrate Educational and Technical Training Opportunities for Youth**
- **Establish Cultural Science Intellectual Property Assets**
- **Build an International Edutourism, Agritourism, and Edutainment Destination**

Feature 1

Build Plug-In Unified Sustainable Smart Utilities & Infrastructure Backbone

- *Provide 100% Electricity Production for NELHA Property Onsite*
- *Provide 100% of Potable Water Supply Onsite*
- *Provide 100% of Wastewater Treatment Onsite*
- *No Fossil Fueled Vehicles used On Campus*
- *Unified Utility Command & Control*
- *Smart Utilities*
- *Carbon Neutral*
- *Paper Neutral*
- *Waste Neutral*
- *Food Security*

Scenario 4: EPCOT / Edutourism Center



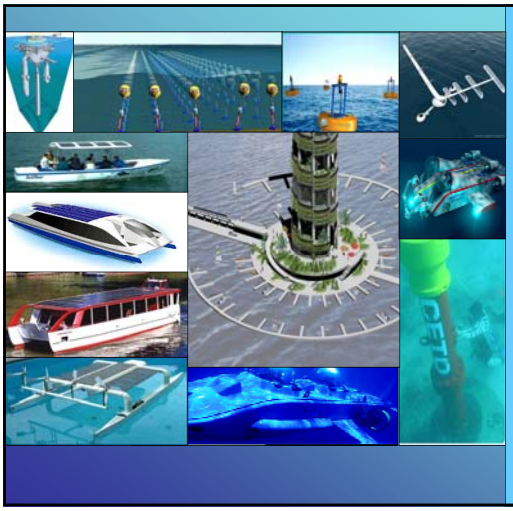
Feature 2

Cutting Edge Science and Technologies that Complement 'Sustainable Smart Communities' Worldwide

- *Sustainable Agriculture*
- *Hydroponics*
- *Electric Scooters*
- *Personal Light Transi*
- *Stackable PHEV*
- *Algae Biofuel Farms*
- *Wastewater Treatmen*
- *Architecture Prototypes*
- *Vertical Low-Impact Wind Turbines*
- *Solid Waste Separation and Bio-Conversion*
- *Deep Ocean Biology*

Feature 3
Educational and Technical Training Opportunities for Hawaiian Youth

- *Provide Internship Program in the Central Command & Control for High School Students*
- *Technical Training for High-Tech Industries Based on NELHA Technologies*
- *Edutoursim and Agritourism On-the-Job Training*
- *Cultural Science Training*



Feature 5
Edutourism featuring Sustainable Smart Communities Technologies, Culture, and Ocean Sciences and Technology

- *Wave Energy*
- *Hydro Electricity Ocean Energy*
- *Vertical Ahupua'a*
- *Algae Biofuel Farms*
- *Wastewater Treatment*
- *Architecture Prototypes*
- *Solar-Powered Watercraft*
- *Submersibles*

Feature 4
Cultural Science: How Do Traditional Systems Work Scientifically?

- *Fish Pond Ecosystems*
- *Medicinal Plants*
- *Freshwater species*
- *Natural Predation Controls*
- *Wood Species, Moisture, and Insects*
- *Navigation Without Instruments*
- *Passive Solar Design and Construction*
- *Ahupua'a Land Management*

BUSINESS MODEL

Optimizing NELHA's innovations in sustainable technologies to a worldwide edutourism industry brings:

- **Recurring edutourism revenue**
- **Training of Hawaiian youth in jobs that are relative to their vision of a future Hawaii based on sustainability**
- **Builds an international reputation, free publicity and media attention**
- **Becomes a landmark destination for sustainable development attracting eco-city developers and experts worldwide**

Appendix B. Culture and Archaeology

Master Plan

Appendix B. Culture and Archaeology

Information regarding cultural uses and archaeological resources were primarily sourced from existing studies (PBR Hawai'i 2007, Rechtman 2006, and GK and Associates 1992) and supplemented by interviews with community members and Native Hawaiian practitioners conducted to inform this master plan as summarized in *Appendix A*. Citations included in the text below are as cited in the source reports.

B.1 NATIVE HAWAIIAN USES

In Hawaiian culture, natural and cultural resources are one and the same. Native traditions describe the formation of the Hawaiian Islands and the presence of life on and around them.

> "Cultural attachment is demonstrated in the intimate relationship (developed over generations of experiences) that a people of a particular culture share with their landscape – for example, the geographic features, natural phenomena and resources, and traditional sites, etc., that make up their surroundings. This attachment to environment bears direct relationship to the beliefs, practices, cultural evolution, and identity of a people. In Hawai'i, cultural attachment is manifest in the very core of Hawaiian spirituality and attachment to landscape. The creative forces of nature which gave birth to the islands (e.g., Hawai'i), mountains (e.g. Mauna Kea) and all forms of nature, also gave birth to nā kānaka (the people), thus in Hawaiian tradition, island and humankind share the same genealogy." (Maly, 1999)

In the beginning of the 1600s, during the time of Umi, the Hawaiian Islands were divided into political regions. The larger islands (mokupuni) were divided into districts (moku). The moku were divided into ahupua'a, and large ahupua'a were divided into 'ili. Ahupua'a were often entire valleys spanning from the top of the mountain ridge to the ocean. The konohiki managed the day-to-day operations of the ahupua'a with the aid of luna who were experts in various fields such as planting and fishing. Each ahupua'a contained nearly all of the resources Hawaiians required for survival from fresh water, plants, and a variety of animals, and was managed so that these resources could be sustained over time. (The Ahupua'a, 1994)

> "Kona, like other large districts on Hawai'i, was further divided into 'okana or kalana (regions of land smaller than the moku-o-loko, yet comprising a number of smaller units of land). In the region now known as Kona 'akau (North Kona), there are several ancient regions (kalana) as well. The southern portion of North Kona was known as "Kona kai 'ōpua" (interpretively translated as: Kona of the distant horizon clouds above the ocean), and included the area extending from Lanihau (the present-day vicinity of Kailua Town) to Pu'uohau (now known as Red Hill). The northern-most portion of North Kona was called "Kekaha" (descriptive of an arid coastal place). Native residents of the region affectionately referred to their home as Kekaha-wai-'ole o nā Kona (Waterless Kekaha of the Kona District), or simply as the āina kaha. It is within this region of Kekaha, that the lands of 'O'oma are found." (Rechtman 2006)

Writers today have varying opinions and theories pertaining to the history of Kekaha, residency patterns, and practices of the people who called Kekaha-wai-'ole-o-nā-Kona home. For the most part, interpretations are limited by the fragmented nature of the physical remains and historical records, and by a lack of familiarity with the diverse qualities of the land.

Kihe-- who worked as a translator on the Hawaiian Antiquities collections of A. Fornander and was a prolific writer himself-- and his co-authors provide readers with several references to places and events in the history of 'O'oma and neighboring lands. Through the narratives,

we learn of place name origins, areas of ceremonial significance, how resources were managed and accessed, and the practices of those native families who made this area their home.

One example of a moʻolelo (legend) translated by Kihe, "Ka Punawai o Wawaloli" (The Pond of Wawaloli), describes that the pond of Wawaloli, on the shore of ʻOʻoma, was named for a supernatural ocean being, who could take the form of the loli (sea cucumber *Holothuria spp.*) and of a handsome young man. Through this account it is learned that people regularly traveled between the uplands and shore of ʻOʻoma; the kula lands were covered with ʻilima (*Sida spp.*); and that a variety of fish, seaweeds, and shellfish were harvested along the shore. Also, the main figures in the tradition are memorialized as places on the lands of ʻOʻoma, Kalaoa, and neighboring ahupuaʻa. These individuals and places include Kaluaʻōlapa (a hill on the boundary of Hāmanamana and Haleohiʻu), Wawaloli (a bay between ʻOʻoma and Kalaoa), Hoʻohila (on the boundary of Kaū and Puʻukala), Pāpaʻapoʻo (a cave site in Hāmanamana), Kamakaoiki and Malumaluiki (locations unknown).

B.2 HISTORICAL AND ARCHAEOLOGICAL RESOURCES

Findings from previous surveys and plans regarding the NELHA area include:

1) In 1929-1930, John Reinecke conducted a survey of Hawaiian sites in West Hawaiʻi, including the ʻOʻoma and Kekaha region. A portion of Reinecke's survey fieldwork extended north from Kailua as far as Kalāhuipuaʻa. His work was the first attempt at a survey of sites of varying function, ranging from ceremonial to residency and resource collection.

   During his study, Reinecke traveled along the shore of Kekaha, documenting near-shore sites. The sites documented indicate Precontact and Historic use of the Property for habitation, burial, and resource extraction activities. A prominent landscape feature that dates to the Historic Period is the Māmalahoa Trail, which runs roughly north-south course through the mauka third of the Property.

2) Two emergency service roads at Keāhole Airport were surveyed by Barrera in 1979. Two sites were recorded and a test excavation was done in a walled shelter [Barrera 1979].

3) Barrera [1980] found and dismantled two C-shaped enclosures south of the Keāhole Airport terminal.

4) In 1980, Archaeological Research Center Hawaii conducted excavations in nineteen sites in the Keāhole Agricultural Park area inland of the highway [Hammatt and Fold 1980], and a reconnaissance of a small section in Kalaoa 1 near the highway was conducted. Personnel at the State Historic Preservation Office have been unable to locate the map for the sites that were found.

5) In 1984 Bishop Museum conducted further work at the NELH facility, including a field reconnaissance and the establishment of a single set of site numbers for the sites of the various previous surveys [Clark 1984].

6) In 1984 a brief reconnaissance-level walk-through of the HOST parcel was conducted, resulting in the identification of 45 sites [Barrera 1985a]. This was followed in 1985 by an identical effort in the present project area, consisting of 350 acres situated between the coastal jeep road and the HOST parcel boundary [Barrera 1985b].

7) In 1986 and 1987 Barrera excavated a number of sites in the HOST parcel [Barrerra 1988] immediately adjacent to the present project area. His work suggested the following sequence:

   Earliest occupation of the area was around the middle of the sixteenth century. Structural

remains were not present at this period, and if shelters were present at all they were undoubtedly of a relatively temporary nature. Evidence for the exploitation of a wide variety of marine resources was present, including mollusks, crustacean, echinoderms and fish. Birds were clearly a part of the diet. Aleurites moluccana was present at this early period, indicating that exploitation of the forested uplands played a part in the economy as well.

During the seventeenth century an increase in the number of sites being utilized paralleled a corresponding increase in exploitation of the marine environment, and there was clearly a continuing emphasis on birds. The presence of Porzana sp. [a flightless rail] from one site is of particular interest. Domestic dogs were probably being raised at or near two sites, suggesting an agricultural component alongside a continuing strong reliance on marine products. The first use of structural remains is found in the early part of this century, suggesting a tendency toward nucleation of habitation features.

Utilization continues at eight sites and possibly at one more during the eighteenth century, and new utilization is evident at five sites. Marine exploitation continued as before, but unmodified bones of *Canis familiaris* appear in quantity for the first time, suggesting that these animals were being raised locally. All but one of the sites at which these remains were found were characterized by structural remains, providing further indication of the development of a sedentary lifestyle.

One structure appears to have been built with more than just casual use in mind, and is probably evidence of a relatively late tendency toward permanent occupation of coastal locales. By the end of the eighteenth century most sites have been abandoned, and only two appear to continue into the 1800s.

The archaeological evidence demonstrates that the main reason people had for being at the coast of Keāhole Point was to exploit the marine resource environment. Mollusks were regularly taken, and in quantity, but this activity was probably an adjunct to the main business of fishing and squidding.

The contribution of the non-marine environment was not inconsiderable. Birds certainly had a place in the subsistence pattern, perhaps more in the early periods than in the later, and *Canis familiaris* was no doubt a valuable source of meat towards the middle of the sequence, as well as of raw material for the manufacture of fish-hooks throughout the sequence.

It is difficult to ascertain in the degree of interaction with uplands, either directly or through trade or gift exchange with residents of that area, but clear evidence that this took place is present in the form of shells *Aleurites moluccana* in many of the sites.

The entire range of habitation types from temporary to permanent are represented in the area. At the one end of the scale are those sites which were utilized on an extremely temporary basis, perhaps for as few as just one or two nights. These are characterized by very crude, very low walls and a virtual absence of any midden or artifactual materials. Those that are situated near the coast in the midst of the other more permanently utilized sites may have served as storage areas. The functions of those that are more isolated and located further inland are more problematical, and it is worth considering that they may have been blinds for bird hunters. Next up the scale, but still probably only temporarily utilized, are sites that were more substantially built than the former sites and for the most part the presence of midden and artifacts argues for more than just casual use. The inland location of two suggest that they may have served as temporary overnight shelters for regular travelers between the uplands and the coast. Permanently occupied sites are larger,

well-built structures with moderate to dense deposits of midden and artifacts and were the only sites [with only two exceptions] which produced specimens of basaltic glass.

Barrera concluded his excavation report with the following:

"In conclusion, recent work in North Kona suggests the following regional settlement pattern. Certain especially favorable locales [small protected bays such as Kaloko, North Kona and Anaehoomalu, South Kohala, for example] were being exploited by the tenth and eleventh centuries. A permanent inland agriculturally-oriented population developed by the fifteenth century, preceding most of the permanent coastal habitation. This is supported by recent excavation data in sites four miles from the ocean in the ahuapua'a of Kohanaiki. Here, several permanent habitation structures and a large, well-built Men's House situated in the midst of agricultural fields were being utilized by the late fifteenth century. There was indirect access to ocean products through trade, and possibly temporary or intermittent direct access [Barrera 1987]. Lateral expansion from the early exploitation centers along the relatively less productive coastlines did not occur until the sixteenth century. This is followed in the late seventeenth and early eighteenth centuries by a period during which temporary coastal habitation evolves into more permanent occupation with full-time exploitation of marine and agricultural resources. The end of the sequence is marked by an abandonment of the agricultural fields in the early eighteenth century, with a concentration on marine resources and a tendency toward nucleation of coastal settlements that was interrupted by historic contact" [Barrera 1988:231]

Views differ slightly concerning the regional prehistoric sequence. Barrera feels that the data from Kohanaiki indicate a permanent presence in the inland agricultural fields as early as the fifteenth century, with contemporary permanent coastal settlements only at particular favored locations such as Kaloko and Anaehoomalu. His interpretation suggests that the denser coastal habitation of later centuries developed via process of daughter communities spreading laterally along the coast from these early centers [Barrera 1991]. An alternate view also suggests that population growth at coastal settlements was the impetus for outward expansion along the shore from these centers, but differs in proposing that the settlement of the inland agricultural fields was also a result of this expansion process [Rosendahl 1972; Cordy 1978; 1985; Donham 1986].

As for O'oma itself, the pattern is in general similar to that of Kalaoa. Crude and almost certainly temporary habitation areas are found throughout the coastal areas, although in Yuma they extend further inland and are found at a distance of about 400 meters from the ocean [Barrera 1985b; Donham 1986]. Habitation caves with associated habitation or burial platforms are present, and midden scatters are not uncommon. In contrast with the absence of large, obvious religious structures in coastal Kalaoa, two sites have been identified as such in O'oma [Cordy 1985], and it has been suggested that several habitation sites incorporate possible shrines [Cordy 1978; Donham 1986].

Trails consisting primarily of work footpaths across the lava have been found in Kalaoa, but not in O'oma. They extend to the east, connecting the coastal sites with inland agricultural and permanent habitation areas at about the 800 to 1000 foot elevation [Cordy 1985, Barrera 1991]. They pass through a wide area where sites are scarce, and consist primarily of temporary resting places along the trails and various scattered low walled features that may have served as bird-hunting blinds [Barrera 1988, 1991].

8) In 2006, NELHA requested Rechtman Consulting, LLC to prepare a preservation plan for seven archaeological sites surveyed in the 1987 Donham study and located within the 82 acre parcel that resulted from the exchange with the neighboring 'O'oma parcel. All

seven of the archaeological sites addressed in that preservation plan are protected within a single roughly 15 acre archaeological preserve created and maintained by NELHA. This large single preservation easement was designed to help maintain the visual integrity and context of the preservation sites, which are part of an overall physical cultural landscape. The preservation elements of this plan were arrived at following conversations with identified descendants of the ‘O‘oma area who were consulted as part of the burial treatment planning process associated with SIHP Site 1915 (Rechtman Clark 2006). This preserve is depicted on the Constraints Map *(Figure 2.9)*.

9) Currently, NELHA and SHPD are working on developing an appropriate treatment plan for the Ho’ona Preserve area.

Appendix C. Engineering Reports: Traffic Studies and Site Infrastructure

AUSTIN, TSUTSUMI & ASSOCIATES, INC. CIVIL ENGINEERS • SURVEYORS
CONTINUING THE ENGINEERING PRACTICE FOUNDED BY H. A. R. AUSTIN IN 1934

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#07-103

March 2, 2009

Revised April 28, 2009

Mr. George Atta
Group 70 International
925 Bethel Street, 5th Floor
Honolulu, Hawaii 96813

Dear Mr. Atta:

Subject: Preliminary Assessment of Potential Traffic Impacts for NELHA Energy & Ocean Research Park Master Plan Kailua-Kona, Hawaii

Austin, Tsutsumi & Associates, Inc. (ATA) has conducted a preliminary assessment of potential traffic impacts for the proposed Energy & Ocean Research Park located in Kailua- Kona, on the island of Hawaii.

Project Description

We understand that the NELHA lands will be further developed to create an Energy and Ocean Research Park referred to as the "Project." The Project site generally borders the western, eastern and southern boundaries of Keahole Airport and is located on the western (makai) side of Queen Kaahumanu Highway. Figure 1 shows the location of the Project. Vehicular access to the project site will be from the existing NELHA Access Road and from a new road located across Kaiminani Drive. The Project site is approximately 870 acres with 55 percent estimated to be currently used by existing tenants.

Study Scope

This study will provide a preliminary level assessment of potential traffic impacts to the study intersections on Queen Kaahumanu Highway. Existing conditions will be assessed, the trip generation potential of the Project will be estimated and the potential resulting impact of the new trips will be evaluated on future conditions. It should be noted however, the scope of this assessment is **not** intended to provide the same level of analysis and detail of a Traffic Impact Analysis Report (TIAR) which evaluates and analyzes conditions in greater detail than provided in this study. The intersections included in this study are listed below.

- Queen Kaahumanu Highway/Kaiminani Drive
- Queen Kaahumanu Highway/NELHA Access Road

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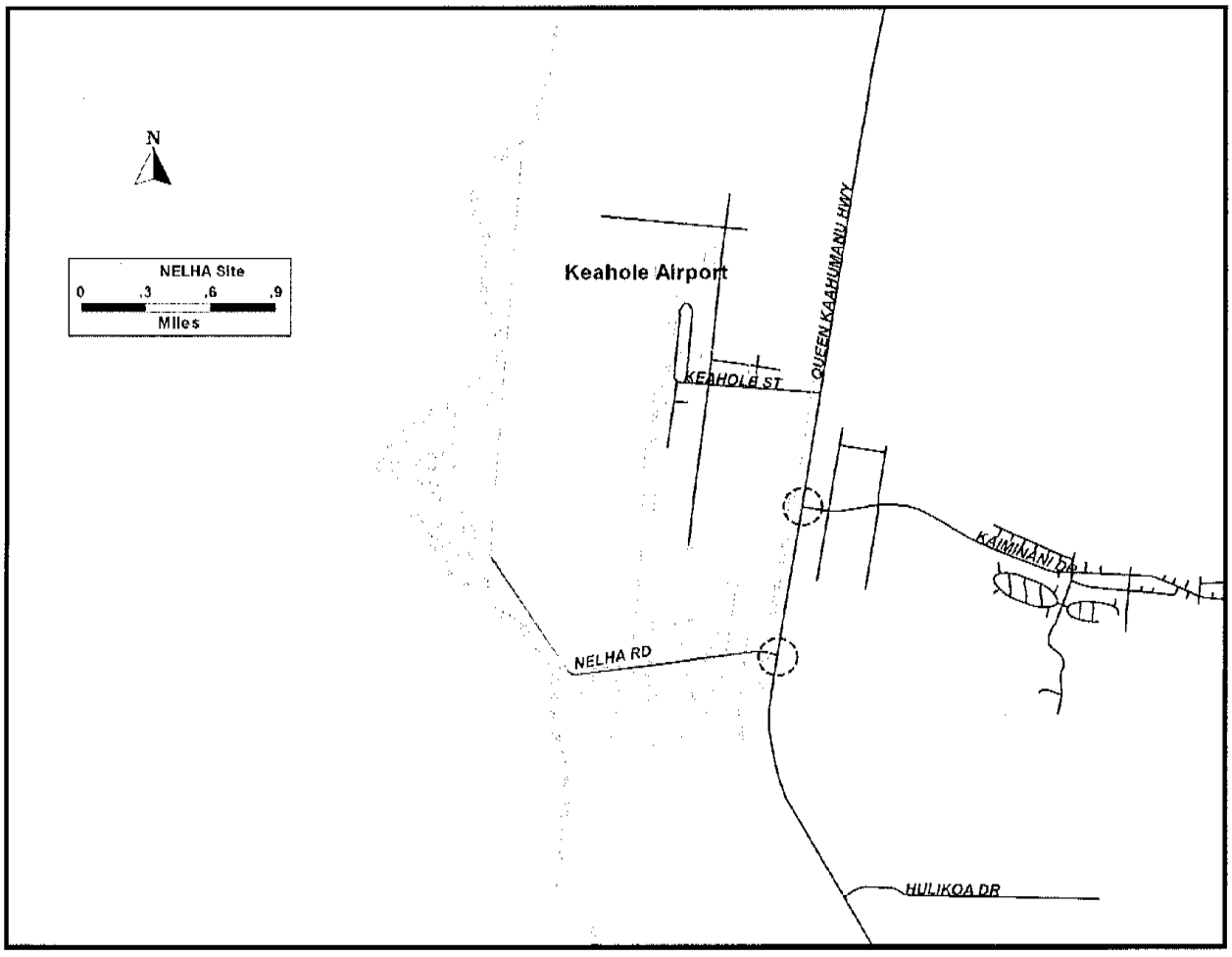
Figure 1

Project Location



Existing Roadways

In the immediate vicinity of the Project, traffic is served by Queen Kaahumanu Highway. Queen Kaahumanu Highway is a two-way, two-lane, principal State arterial highway that is oriented in the north-south direction, and provides regional access between Kawaihae and Kona. Queen Kaahumanu Highway forms a "tee"-intersection with Kawaihae Road at its northern terminus and links to Kuakini Highway at its southern terminus in Kailua-Kona. The posted speed limit on Queen Kaahumanu Highway is generally 55 miles per hour (mph), decreasing to 35 mph near Kailua-Kona.

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Kaiminani Drive is a two-way, two-lane, County of Hawaii collector roadway that is oriented in the east-west direction providing access between Mamalahoa Highway and Queen Kaahumanu Highway in the Keahole region. Kaiminani Drive is the primary access to the Keahole View, Keahole Heights, and Kona Palisades Estates subdivisions. Kaiminani Drive is the stem of the "tee"-intersection with Queen Kaahumanu Highway on its western end.

NELHA Access Road is a two-way, two-lane roadway that is oriented in the east-west shifting to a southeast to northwest direction as it follows the coast line terminating near Keahole Point. NELHA Access Road provides the only vehicular access for the existing NELHA tenants as it forms the stem of the "tee"-intersection with Queen Kaahumanu Highway on its eastern end.

It is our understanding from NELHA that the State of Hawaii, Department of Transportation (HDOT) has stipulated that the Queen Kaahumanu Highway/NELHA Access Road intersection be limited in the future to a right turn in/ right turn out only configuration.

Study Intersections

Manual peak hour of traffic turning movement counts were conducted at the following intersections on Tuesday, February 24, 2008.

- Queen Kaahumanu Highway/NELHA Access Road (unsignalized)
- Queen Kaahumanu Highway/Kaiminani Drive (signalized)

The peak hour traffic count data collected at the study intersections indicates that intersections along Queen Kaahumanu Highway exhibit the following peak hours: the AM Peak hour of traffic at intersections along Queen Kaahumanu Highway occurred from 7:30 AM to 8:30 AM and the PM peak hour of traffic occurred from 3:30 PM to 4:30 PM.

The study intersections are described below.

Queen Kaahumanu Highway/Kaiminani Drive

Kaiminani Drive forms the stem of a signalized "tee"-intersection with Queen Kaahumanu Highway. The Queen Kaahumanu Highway northbound approach provides an exclusive right-turn lane and a through lane. The Queen Kaahumanu southbound approach provides an exclusive left-turn lane and a through lane. The Kaiminani Drive westbound approach provides an exclusive left-turn lane and an exclusive right-turn lane that connects to a northbound acceleration lane on Queen Kaahumanu Highway, forming a "free" right-turn.

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Queen Kaahumanu Highway/NELHA Access Road

The NELHA Access Road forms the stem of an unsignalized "tee"-intersection with Queen Kaahumanu Highway. The Queen Kaahumanu Highway southbound approach provides an exclusive right-turn lane and a through lane. The Queen Kaahumanu northbound approach provides an exclusive left-turn lane and a through lane. The NELHA Access Road eastbound approach provides an exclusive left-turn lane and an exclusive right-turn lane that connects to a northbound acceleration lane on Queen Kaahumanu Highway, forming a "free" right-turn. Eastbound left-turn traffic on the NELHA Access Road is provided a short northbound acceleration merge lane on Queen Kaahumanu Highway which allows the movement to occur in two (2) phases by crossing the southbound traffic stream and merging with the northbound traffic stream.

Existing Traffic Conditions

Level of Service (LOS) is a qualitative measure used to describe the conditions of traffic flow at intersections, with values ranging from free-flow conditions at LOS A to congested conditions at LOS F. The Highway Capacity Manual – Special Report 209 (HCM), dated 2000, methods for calculating volume to capacity ratios, delays and corresponding Levels of Service were utilized in this study. Analysis for the study intersections was performed using Synchro, which is able to prepare reports based on the methodologies prescribed by the HCM.

Intersection Analysis

The existing peak hour traffic volumes and LOS are shown in Figure 2. The analysis indicates LOS D conditions or better except for the following critical movements.

Queen Kaahumanu Highway/NELHA Access Road: The unsignalized Queen Kaahumanu Highway/NELHA Access Road eastbound left-turns on to Queen Kaahumanu Highway operates at LOS E during the AM peak hour of traffic and at LOS F during the PM peak hour of traffic.

Existing traffic volumes at this intersection are not likely to meet the traffic signal warrants described in the Manual on Uniform Traffic Control Devices, 2003 Edition (MUTCD). It is not uncommon, however for a low volume side street approach to experience long delays when negotiating traffic on a principal arterial roadway such as Queen Kaahumanu Highway. The traffic count indicates that 24 vehicles during the AM peak hour of traffic and 53 vehicles during the PM peak hour of traffic were observed to turn left from NELHA Access Road onto Queen Kaahumanu Highway.

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Queen Kaahumanu Highway/Kaiminani Drive: The signalized Kaiminani Drive westbound left-turn operates at LOS F during the AM and PM peak hours of traffic.

Trip Generation

The Project is anticipated to be a multi-phased development and was analyzed using the following land uses light industrial, commercial, research and development, cultural/educational uses and a 40-unit multi-level NELHA Hale residential building for researchers. A review of the trip rates published by ITE in Trip Generation, 8th Edition, indicates that the Project is most closely represented by the following Land Use Codes for the following Project phases.

- 110 Light Industrial — Phases AT & EZ
- 820 Shopping Center — Phase ED
- 760 Research and Development Center — Phase RE
- 418 National Monument — Phase CT
- 230 Residential Condo./Townhouse — Phase RE

The following floor area ratios (FAR) were assumed and used in the calculation of trips for the Project.

- 25% Research and Development Center (RE)
- 25% Light Industrial (AT & EZ)
- 30% Commercial (ED)

The 40-unit NELHA Hale complex is anticipated to be used by personnel working in the research facilities within the Project, therefore, these trips are expected to be captured by the Project and represent trips internal to the Project site. The trip generation estimate has been adjusted to account for the internal trips and is shown in Table 1.

Trips for culture and educational component (CT) used the National Monument trip generation rate which is based on acres.

Overall, the Project is estimated to generate a net two-way volume of 3,733 vehicles per hour (vph) during the AM peak hour of traffic and 6,494 vph during the PM peak hour of traffic.

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Table 1

Trip Generation

		AM Peak Hour of Traffic		PM Peak Hour of Traffic	
Land Use Designation	**No. of Units**	**Enter (vph)**	**Exit (vph)**	**Enter (vph)**	**Exit (vph)**
Light Industrial (KSF)	8,653	2,089	285	333	2,446
Commercial (KSF)	3,417	371	237	1,482	1,543
Research and Development (KSF)	3,079	631	131	104	588
Cultural/Education (Acres)	39.60	7	7	13	13
Subtotal		*3,098*	*660*	*1,932*	*4,590*
Apartment (units) – internal capture	40	(4)	(21)	(19)	(9)
Total Net Trips (external)		3,094	639	1,913	4,581

KSF = 1,000 square feet

Future Conditions With Project Generated Traffic

Future traffic was estimated by applying a defacto growth rate, to existing hourly vehicular traffic volumes, Project-generated traffic was added resulting in the Future Conditions With Project Generated Traffic scenario. A prevailing growth rate of approximately 4 percent per year was estimated to occur along Queen Kaahumanu Highway for future conditions based on historic traffic volumes obtained from HDOT. The Project is planned as a multi phased development with an anticipated completion date of Year 2029; 4 percent growth over 20 years represents a 219 percent increase in traffic.

Planned Roadway Improvements

HDOT is planning to widen Queen Kaahumanu Highway. Currently, HDOT is constructing Phase I, which is projected to be completed by Year 2009. Phase I will widen Queen Kaahumanu Highway from Henry Street to Kealakehe Parkway from two (2) lanes to four (4) lanes. Phase II of the widening project will widen Queen Kaahumanu Highway between Kealakehe Parkway and Keahole Airport Road from two (2) lanes to four (4) lanes and is currently out to bid as a design-

build project. The Future Condition scenario assumes that the widening of Queen Kaahumanu Highway will be completed to Keahole Airport Road.

Intersection Analysis

Vehicular access to the Project site will be provided by the existing Queen Kaahumanu Highway/NELHA Access Road intersection and by a new road, i.e. Kaiminani Extension, located across Kaiminani Drive. This new road will form a four-legged intersection with Queen Kaahumanu Highway.

The access scenario with existing Queen Kaahumanu Highway/NELHA Access Road intersection was evaluated as an intersection allowing only right turns in and right turns out in conjunction with full access at the Queen Kaahumanu Highway/Kaiminani Drive intersection. Under this scenario, the left turn traffic entering the site will be approximately 1,900 vph at and approximately 1,700 vph exiting the site at the Queen Kaahumanu Highway/Kaiminani Drive intersection. These projected volumes will far exceed the capacity of a double left turn lane in conjunction with high through demand on Queen Kaahumanu Highway. The Kaiminani Extension within the project site would also need to be a four-lane roadway until its intersection with the existing NELHA Access Road.

Therefore, the study focused on an access scenario allowing left turns at the existing Queen Kaahumanu Highway/NELHA Access Road intersection. The projected peak hour traffic volumes for future conditions with Project-generated traffic and LOS for the full access scenario are shown in Figure 3.

Queen Kaahumanu Highway/NELHA Access Road: It is most likely that the Project traffic demand will likely warrant a traffic signal at the Queen Kaahumanu Highway/NELHA Access Road intersection. This intersection will operate at overall LOS E during the AM peak hour of traffic and at LOS F during the PM peak hours of traffic, even with the widening of Queen Kaahumanu Highway to four lanes.

Queen Kaahumanu Highway/Kaiminani Drive: This intersection will also operate at overall LOS F during the AM and PM peak hours of traffic, even with the widening of Queen Kaahumanu Highway to four lanes.

Discussion of Future with Project Conditions

Traffic analysis indicates a lack of regional north-south capacity on Queen Kaahumanu Highway. The preliminary analysis indicates that Queen Kaahumanu Highway will need to be widened to a six- or eight-lane highway to accommodate the projected demands without additional north-south improvements. However widening Queen Kaahumanu Highway beyond four

lanes is not included in the recommended plan contained in the HLRLTP and therefore, is not assumed as a regional improvement by this study.

Other alternatives to increase north-south capacity other than the Queen Kaahumanu Highway from a two-lane highway to a four-lane highway from Kealakehe Parkway to Keahole Airport Road, is the construction of the Henry Street Extension and Kealakaa/Kealakehe Extension. The Hawaii Long-Range Land Transportation Plan, 1998 (HLRLTP) and the Keahole to Honaunau Regional Circulation Plan, 2003 recommend the construction of alternative north-south roadways. However, vehicle diversion data with the proposed north-south roadways is not documented in published sources.

It is beyond the scope of this study to determine the specific traffic impacts resulting from the additional north-south roadways since it is unknown what the alignment of the roadways are, number and locations of connections, and the future land uses of the surrounding area. A larger scale study is required such as the development of an island-wide travel demand forecast model (TDFM) to provide a regional capacity analysis to properly determine the regional improvements in the Kona area.

Findings

This study provides a preliminary level assessment of potential traffic impacts to the study intersections on Queen Kaahumanu Highway; it is not intended to be used as a TIAR. The following are the findings of the traffic assessment study.

Project-Generated Traffic

- Based on the land use provided, the Project is estimated to generate a two-way net volume of approximately 3,750 vph during the AM peak hour of traffic and 6,500 vph during the PM peak hour of traffic.

- The light industrial component of the Project contributes to approximately 65 percent of the traffic during the AM peak hour of traffic and 45 percent of the traffic during the PM peak hour of traffic.

- The commercial component of the Project contributes to approximately 15 percent of the traffic during the AM peak hour of traffic and 45 percent of the traffic during the PM peak hour of traffic.

- The 40-unit NELHA Hale complex is anticipated to be used by personnel working in the research facilities within the Project, these trips are expected to be captured and represent trips internal to the Project site.

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Queen Kaahumanu Highway

- The Future Condition scenario assumes that the widening of Queen Kaahumanu Highway will be completed to Keahole Airport Road.

- Over a 20-year planning horizon, traffic volumes on Queen Kaahumanu Highway are estimated to more than double (219 percent) if historic traffic trends continue. Over a 10-year planning horizon, traffic volumes would increase by approximately 150 percent.

- Without the addition of north-south regional capacity on existing or new roads, Queen Kaahumanu Highway will require widening beyond the planned four-lane configuration that is currently under construction or additional north-south roadways will be required.

- Determining the facilities and improvements that are required to provide additional north-south regional capacity would require a higher level island-wide analysis requiring the development of a TDFM and is beyond the scope of this study.

Project Access

The access scenario with existing Queen Kaahumanu Highway/NELHA Access Road intersection was evaluated as an intersection only allowing right turns in and right turns out in conjunction with the Queen Kaahumanu Highway/Kaiminani Drive intersection reveals the following.

- The left turn traffic entering the site will be approximately 1,900 vph entering and approximately 1,700 vph exiting the site at the Queen Kaahumanu Highway/Kaiminani Drive intersection will far exceed the capacity of a double left turn configuration.

- The Kaiminani Extension within the project site would also require four-lanes until its intersection with the existing NELHA Access Road.

An evaluation of only the Project-generated traffic demands providing full access scenario at both intersections indicates that the following intersection improvements are most likely required at the study intersections.

Queen Kaahumanu Highway/NELHA Access Road: This intersection will operate at overall LOS E and LOS F even with the widening of Queen Kaahumanu Highway to four (4) lanes. It should be noted that recent amended HDOT policy requires mitigation to LOS D conditions or better.

- It is most likely that the Project traffic demand will likely warrant a traffic signal at this intersection.

- The projected eastbound left-turn volume exiting the site, 895 vph, will require two (2) left-turn lanes.

- The projected eastbound right-turn volume exiting the site, 1,645 vph, will require a separate right-turn lane connected to an acceleration/merge lane, creating a free right-turn, similar to the existing intersection configuration.

- The projected northbound left-turn volume entering the site, 1,170 vph, will require two (2) left-turn lanes. The NELHA Access Road will have to be widened to provide two (2) westbound lanes to receive the traffic from the two left-turn lanes.

- The projected southbound right-turn volume entering the site, 645 vph, will require a separate right-turn deceleration lane, similar to the existing intersection configuration.

Queen Kaahumanu Highway/Kaiminani Drive: This intersection will operate at overall LOS F even with the widening of Queen Kaahumanu Highway to four (4) lanes. It should be noted that recent amended HDOT policy requires mitigation to LOS D conditions or better.

- The projected eastbound left-turn volume exiting the site, 825 vph, will require two (2) left-turn lanes.

- The projected eastbound right-turn volume exiting the site, 1,045 vph, will require a separate right-turn lane connected to an acceleration/merge lane, creating a free right-turn, similar to the existing intersection configuration.

- The projected northbound left-turn volume entering the site, 705 vph, will require two (2) left-turn lanes. The New Access Road will have to provide two (2) westbound lanes to receive the traffic from the two left-turn lanes.

- The projected southbound right-turn volume entering the site, 560 vph, will require a separate right-turn deceleration lane, similar to the existing intersection configuration.

- Other improvements that may be caused by the indirect effect of the Project-generated traffic are likely to include.

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- Widening the Kaiminani westbound approach to include a second left-turn lane.

- Adding a second southbound left-turn lane for traffic entering Kaiminani Drive. Kaiminani Drive will have to be widened to provide two (2) eastbound lanes to receive the traffic from the two left-turn lanes.

We appreciate the opportunity to prepare this traffic assessment for the Project. Should you require clarification, please call me or Neal Kasamoto at (808) 628-3681.

Sincerely,

AUSTIN, TSUTSUMI & ASSOCIATES, INC.

By
TERRANCE S. ARASHIRO, P.E.
Senior Vice President & Chief Engineer

TSA:NHK:mt

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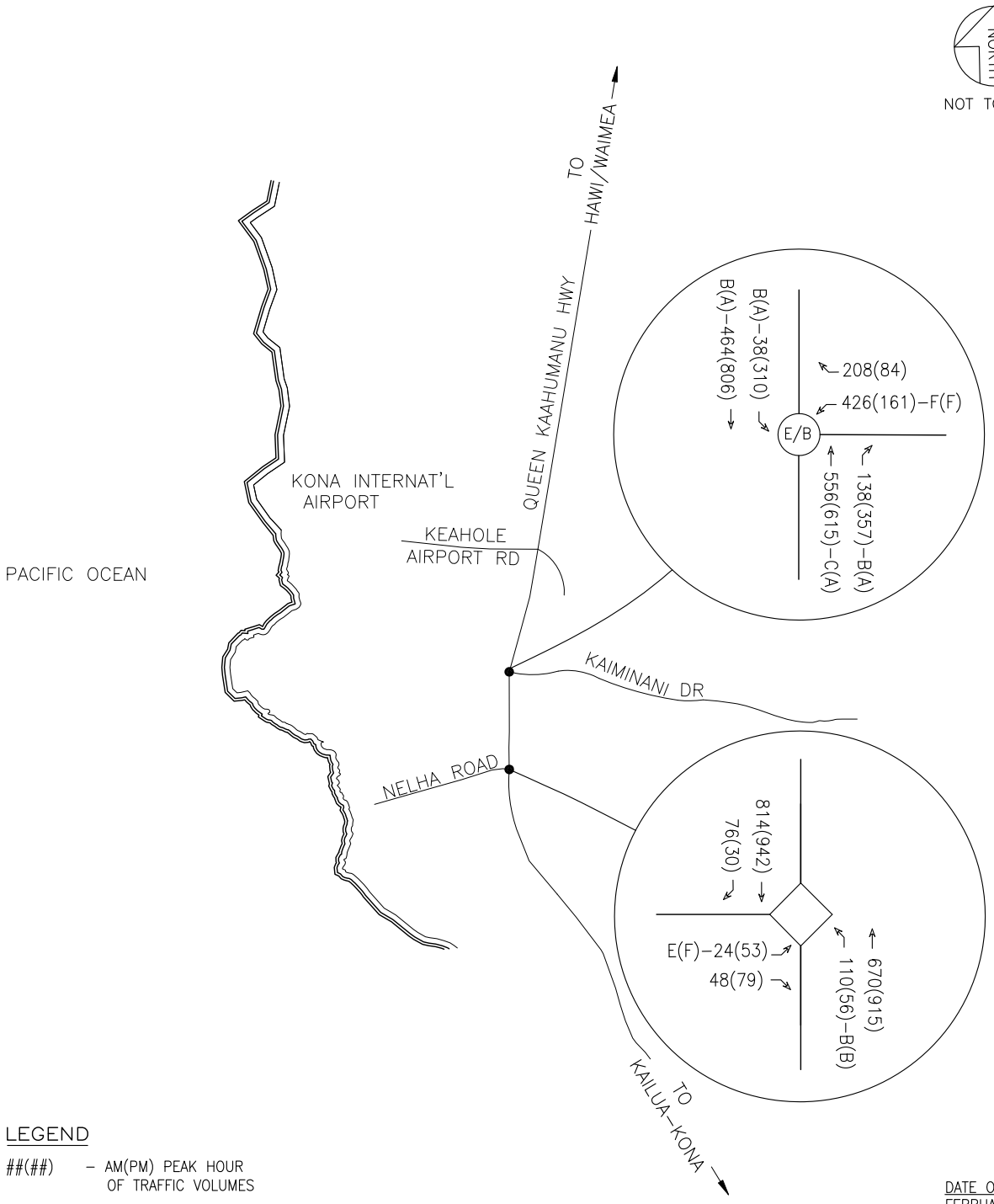


LEGEND

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

(X/X) – SIGNALIZED INTERSECTION AM/PM LOS

◇ – UNSIGNALIZED INTERSECTION

X(X) – AM(PM) LOS

DATE OF COUNTS
FEBRUARY 24, 2009

AM PEAK HOUR
7:30 – 8:30 AM

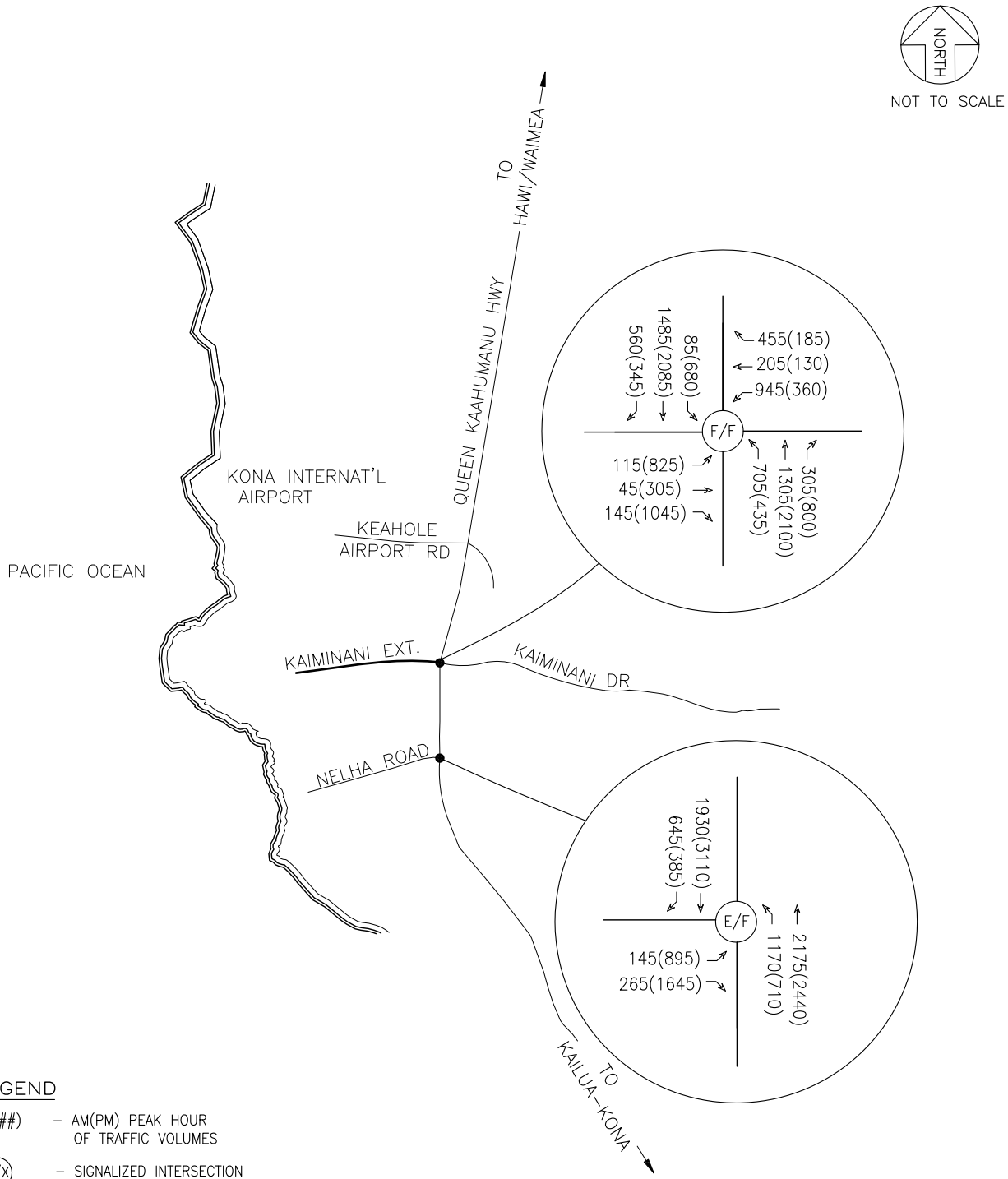
PM PEAK HOUR
3:30 – 4:30 PM

ENERGY AND OCEAN RESEARCH PARK
KEAHOLE, HAWAII, HAWAII

AUSTIN, TSUTSUMI & ASSOCIATES, INC.
ENGINEERS, SURVEYORS HONOLULU, HAWAII

EXISTING TRAFFIC VOLUMES AND LEVEL-OF-SERVICE

FIGURE 2



LEGEND

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

(X/X) – SIGNALIZED INTERSECTION AM/PM LOS

X(X) – AM(PM) LOS

—— – NEW PROJECT ACCESS

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FUTURE TRAFFIC VOLUMES AND LEVEL-OF-SERVICE

FIGURE 3

NELHA Master Plan
Site Infrastructure

A. Roadways

Existing Conditions

The existing site is accessed from Queen Kaahumanu Highway via a single 24-foot wide asphaltic concrete pavement access road, i.e. NELHA Access Road, from Queen Kaahumanu Highway station 172+50. The right-of-ways vary between 80-feet and 110-feet. The wider 110-foot section begins just after the first interior intersection and ends near the main roadway bend near the booster pump station site. The Access Road is approximately 11,600 linear feet in length and is a public roadway. The road provides access to the NELHA and tenant facilities, the shoreline, "Pine Trees" beach and Wawaloli Beach Park.

Queen Kaahumanu Highway is currently being widened from 2 to 4 lanes from Henry Street to Kealakehe Parkway, south of NELHA. Phase 2 of this widening project is slated to begin in 2009 and will cover from Kealakehe Parkway to the entrance road to Keahole Kona Airport, with a completion period projected at a little over 2 years.

Proposed Conditions

The proposed lotting plan will add up to 55 lots ranging in size from 3 to 32.5 acres. Additional 4.8-miles of interior roadways with 60-feet right-of-ways will loop through the undeveloped portion of the site with two connections to Queen Kaahumanu Highway at the existing main NELHA Access Road and at Kaiminani Drive. No new roadways will cross the Mamalahoa Trail.

Improvements at the main intersections with Queen Kaahumanu Highway will include left turn storage lanes and additional right turn acceleration and deceleration lanes across Kaiminani Drive, with modifications to the existing traffic signal light. Current discussions with the State Department of Transportation Highways Planning Branch have indicated that the existing Access Road intersection with Queen Kaahumanu Highway will be modified to a right-turn in and right-turn out only configuration, conceivably after the access at Kaiminani Drive is constructed.

However, based on the preliminary traffic trip generation estimates, a limited right-turn only configuration at the existing NELHA Access Road is not recommended, due to the probable queueing at Kaiminani Drive onto the Highway from the high volumes of traffic into and out from the site. Therefore, it is recommended that the existing turning storage lanes at the main Access Road entrance be lengthened to accommodate the increase in traffic associated with the full build-out of the project. A new traffic signal will also be required at this location. In the full build-out scenario, double left turn storage lanes on the highway are anticipated. See the Traffic Study Letter Report by Austin, Tsutsumi & Associates, Inc. dated March 2, 2009. In any event, the level of service at the Kaiminani Drive intersection and NELHA Access Road intersection will be LOS F, which is the lowest level of functionality.

It would be prudent for NELHA to initiate discussion with the State DOT, to include the necessary pavement widening and conduit work with the Queen Kaahumanu Highway Widening Phase 2 project to accommodate the future needs at the main intersections.

The intent would be to stripe the lanes closed in the interim until such time that the full intersection improvements are needed based on the when the pertinent phase of the NELHA project is undertaken. In addition, NELHA will need to discuss possible frontage road connections with neighboring parties associated with the Airport's master plan to the north and O'oma to the south, to alleviate impacts to the highway.

The following roadway improvements will be required based on the phasing plan:

Phase 1 – Road "B" Extension (currently under design contract negotiation by NELHA), connecting the Airport Road "N" to an existing short segment of road off of the Access Road, and Road "C" tying into Queen Kaahumanu Highway across Kaiminani Drive, creating a 4-way intersection. Approximately 3,900' (Road "B") and 3,100' (Road "C").

Phase 2 – Road "A-1" (also recognized as the frontage road) and Road "A-2". Road "A-1" will be the primary road through the commercial phase of the project extending to the boundary of O'oma Subdivision, and Road "A-2" is a cul-de-sac. Improvements at the NELHA Access Road intersection with the Highway. Approximately 5,700' (Road "A-1") and 500' (Road "A-2").

Phase 3 – The existing NELHA Access Road will be utilized to access Phase 3 areas of the project. There may be consideration to resurface the roadways below the first intersection either concurrently or prior to this phase.

Phase 4 – Roads "D-1" and "D-2" will primarily service the interior lots of this phase, with a mauka to makai walking path connecting to Road "A-2", along Road "D-2" and down to the ocean. Approximately 1,600' (Road "D-1") and 2,200' (Road "D-2").

Phase 5 – Roads "E-1", "E-2" and "E-3", extending from the NELHA Access Road to provide connection to the Research and Education zone area makai of the airport towards Unualoha Point. Approximately 7,300' (Road "E-1"), 500' (Road "E-2") and 700' (Road "E-3").

B. Water

Existing Conditions

The existing on-site potable water system consists of a 12-inch main connecting to the existing County Department of Water Supply (DWS) 12-inch main in Queen Kaahumanu Highway, via a master meter near the Access Road entrance. Approximately 2,100 linear feet from the meter, the line reduces to an 8-inch line, running to the bend in the Access Road near the seawater booster pump station. The line continues as a 12-inch line to the end of the NELHA Access Road within the Research Area.

The existing off-site DWS system consists of a 12-inch main in Queen Kaahumanu Highway. There is a larger line 16-inch main in the Highway, but not fronting the site, which ends south of the property at Kealakehe Parkway. Current source wells are the Palamanui & Makalei wells in the Kalaoa, Kaloko and Honokohau zones, and the Kaahuluu well in the Keauhou zone. The tank sites are scattered with the nearest tanks off of Kaiminani Drive, Hinalani Drive and Kealakehe Parkway.

The Hawaii Ocean Science and Technology (HOST) Park currently receives an allocation of 400,000 gallons per day (gpd) from the DWS. However, NELHA indicates that they use upwards to 600,000 gpd. Interior lots are currently individually metered and charged according to individual usage.

Proposed Conditions

For planning purposes, based on a total of 644 acres of leasable industrial zoned land, and assuming a water demand ranging between 3,000 to 4,000 gallons per acre (2002 Water System Standards), the average daily demand is estimated at 2.516 million gallons per day (MGD). The maximum daily demand will be 3.775 million gallons per day (See Table 1). The fire protection demand is 2,000 gpm of flow over a 2 hour period.

Assuming that the project already has an allocation of 400,000 gpd of maximum daily use, the total additional demand will be 3.375 MGD. Therefore, at least 3.5 million gallons of off-site storage will be required. It is noted that the DWS master plan does include a new 16-inch mid-level system, between Hinalani Drive and Kaiminani Drive as well as two 1.0 MG tanks along Kaiminani Drive at overflow elevation 325-feet, tying into an existing 20-inch main. However, to accommodate the project, negotiation with DWS will dictate the necessity to contribute to the development of additional tank sites or provide payment of Facilities Reserve Charges (FRC). The new tanks must be above 325-feet, and will have to remain in a nearby service zone between Kealakehe Parkway and Kaiminani Drive.

For off-site transmission improvements, DWS is currently proposing to extend the existing 16-inch main running in the Highway, from Kealakehe Parkway to the Airport Access Road as part of an agreement associated with the Phase 2 of the Highway Widening project. NELHA may be expected to pay a pro-rata share of this improvement to the DWS.

On-site, a 12-inch main system will connect to the Highway system at both the main NELHA Access Road and across Kaiminani Drive, looping through the site to service the majority of lots. There will be a few 8-inch lines serving the smaller cul-de-sacs. Fire hydrants will be located within the right-of-ways at a maximum spacing of 300-feet, but it

is also anticipated that a number of individual lots will require on-site fire protection systems consisting of hydrants and fire sprinklers due to the depths of lots and uses.

For phasing of the on-site system, generally, the water system improvements will be concurrent with the phasing of the roadway improvements. Therefore, as new phases are undertaken, the water system will be extended as part of the overall roadway improvements.

C. Sewer

Existing Conditions

The existing lots are serviced through on-site individual wastewater systems (IWS). Exact wastewater generation totals are not known, as they are maintained and managed by the individual lot owners.

The Keahole Airport has a traditional wastewater treatment plant (WWTP) capable of treating up to 100,000 gallons per day. It currently services the airport and is operating at 1/3rd capacity. An existing lift station is located near the end of U'u Street within the airport property, but its capacity is subject to confirmation by DOT Airports.

Proposed Conditions

For planning purposes, it is assumed that the project will transition to a central wastewater collection system as opposed to individual wastewater systems. Therefore, assuming 644 acres of leasable land and a range of population of 2 to 140 persons/acre, and 25 to 30 gallons/person/day, depending on the land use, the average wastewater flow is estimated at 261,430 gpd. A factor for larger peak flows and wet weather infiltration can be assumed as well, resulting in a potential peak flow of 1.99 million gallons per day.

Due to the available capacity and expansion possibilities for the existing Airport WWTP, it is proposed that the wastewater generated from the NELHA project be pumped to the Airport's wastewater system. The proposed on-site system would consist of a combination gravity collection system and force main system. Based on the size of development and the lengths of line required, two wastewater pump stations (WWPS) each consisting of two wetwells with submersible pumps, control buildings, odor control, and surge tanks will be required. The larger WWPS #1 will be built in Phase 1 within the designated Utility Parcel near the bend in the NELHA Access Road. The smaller WWPS #2 will be within the lower NELHA property and will be built within Phase 3 of the project, possibly near the existing West Hawaii Exploration Academy site. This is in anticipation of the existing NELHA site transitioning from its current individual treatment systems to the central collection system. It is possible to postpone the WWPS #1 and wastewater infrastructure installation until Phase 2, but will require that the first 7 new lots of Phase 1 to be on interim individual wastewater systems, until the next phase of the project.

Due to the existing grades in the Research and Education development area north of the existing Cyanotech site, it is recommended that this 5th phase of the project remain on individual wastewater systems. However, as an option, a third WWPS could be located in this area with a force main to the gravity system within the existing NELHA area.

With the extension of the Airport Road "N" and connection to the NELHA Access Road, i.e. Road "B", the installation of the sewer force main should take place with the construction of this road, with eventual connection to the Airport's WWTP via the Airport's Road "N".

As a secondary option, an on-site wastewater reclamation facility (WWRF) utilizing membrane filtration technology to produce R-1 reuse water could be considered. The collection system will still be a gravity system feeding to this central WWRF. For a 300,000 gpd treatment capacity, the facility will require 2 to 3 acres of area to accommodate a 60'x60' main structure housing the membrane system and pumps, a

300,000 gallon storage tank, 40'x40' office and lab space, UV disinfection unit, piping, wetwells, electrical utilities and parking areas. The estimated cost of a WWRF alone would be in the $10 million range. Also to be considered is the distribution system and uses for the R-1 water. This option is presented for consideration, but due to the high cost for such a facility, and the possibility of utilizing the existing Airport WWTP, it is not recommended.

D. Seawater

Existing Conditions

As a general overview, the four main uses of the NELHA seawater system are:

1. Aquaculture and Marine Biotechnology
2. Deep Seawater Applications
3. Heat Transfer Applications
4. Energy Related Applications

The existing dual seawater system is comprised of three intake pump systems, pumping deep seawater and surface seawater, submerged pipelines, on-shore booster pumps and distribution system. The primary system is the 55" deep seawater (dsw) line extending 9,600' to a depth of 3,000', and the 55" surface seawater (ssw) line extending 500' off-shore to a depth of 80'. The primary pump station is located on the utility parcel south off the bend in the NELHA Access Road, and has a dsw pump capacity of 27,000 gpm, but is currently pumping at 14,000 gpm, roughly 50% capacity. The ssw pump has a capacity of 40,500 gpm, but is also pumping at 50% capacity.

The other two pump systems are the Keahole Point Pump Station and the Kau Pump Station. The Point Pump Station has a 40" dsw line extending 6,000' to a depth of 2,000', and a ssw line extending 300' out to a depth of 80' deep. Installed in 1987, the dsw pump is at 50% capacity and pumps to the HOST Park, while the ssw pumps primarily to the NELHA area. The Kau Pump Station has a 18" dsw line extending 6,000' out and to a 2,000' depth. The 24" ssw line extends 300' to a depth of 80'. The dsw pump for this station is off-shore and was installed in 1996.

The current overall seawater system is capable of serving the HOST Park tenants within the elevation zone up to 100' mean sea level, via the existing dual 12" and single 24" lines and a booster pumping station. The elevation at the Highway ranges between 100' to 143' msl. The Gateway Facility is serviced by the seawater system.

Proposed Conditions

The seawater system is the lifeline of NELHA. Although there will be future tenants that may have other needs beyond the seawater uses, it is the seawater system that will provide the distinction for NELHA from many other sustainable developments. Extending the seawater and byproducts of the system to adjoining neighbors, and harnessing the energy generation within the Keahole district has enormous potential to replace current limited and expensive resources.

As such, it is recognized that NELHA has already initiated a project as outlined in the Scope of Work for the 55-inch On-Shore System Infrastructure Upgrades project. It would be our intent to coordinate with the planners and designers for this phase of work, to size the infrastructure and plan expansion capabilities looking forward.

D. Drainage

Existing Conditions

The general slope of the site is from mauka along the Queen Kaahumanu Highway boundary (elevation 143-feet mean sea level) down to makai at the shoreline (elevation 11-feet). The terrain is very irregular and undulating due to the old volcanic lava flows. Culvert crossings under Queen Kaahumanu Highway consist of the following (for reference, the existing NELHA access road is a Queen Kaahumanu Highway Station 172+50, with stations increasing in the north direction):

a. Station 160+50 1-30" culvert
b. Station 177+00 1-72" culvert
c. Station 182+50 1-72" culvert
d. Station 186+00 1-96" culvert
e. Station 207+00 2-96" culverts

The Queen Kaahumanu Highway Widening project by State Department of Transportation may upsize the culverts; however, a timetable has not been given on this project.

Using the County of Hawai`I Design Curve for Peak Discharge for hydrologic calculations, the total existing peak runoff from the drainage area above the Highway contributing to the HOST Park section of the site is 3,800 cubic feet per second (cfs), for the peak, 24-hour storm.

The on-site areas are broken down into six major drainage areas – 4 within the HOST Park site and 2 within NELHA. The total existing peak runoff from the HOST Park section of the site is estimated at 1,176 cfs. The total existing peak runoff from the NELHA section of the site is estimated at 659 cfs.

Proposed Conditions

The area of developable lands will remain largely the same as the existing drainage areas. Based on the County of Hawai`i Storm Drain Standards, the peak runoff rate is estimated to increase by 1,022 cfs due to development of roadways and lots; however, the individual lots will be required to construct on-site retention systems to maintain flows at predevelopment conditions.

The roadway drainage will be collected via paved and vegetated swales, grated inlets and drywells. No drainlines are anticipated for the roadway collection systems. However, there will be drainage culverts to handle the existing drainageways and off-site flows from above Queen Kaahumanu Highway. As a result, the major drainageways through the site will be regraded to more efficiently direct the runoff through the culverts and on-site retention areas where possible. Major culverts will be installed under the interior roads to accommodate the drainageways as follows:

Phase 1 – Road "B-1": 96-inch, 84-inch, 48-inch

Phase 2 – Road "A-1" (north): 96-inch double barrel, 96-inch, 72-inch, 24-inch
Road "A-1" (south): (2) 36-inch
Road "C": 96-inch double barrel

Phase 3 - None.

Phase 4 – Road “D-1”: 60-inch, 48-inch

Phase 5 - None.

Drainage easements to accommodate the flowage paths through the site for larger rainfalls will generally follow property lines, with a minimal width of 20-feet.

PRELIMINARY ESTIMATE OF PROBABLE CONSTRUCTION COST								
PROJECT: NELHA								
Date: March 23, 2009								
By: Austin Tsutsumi & Associates, Inc.								
	DESCRIPTION	**QUANTITY**	**UNIT**	**UNIT PRICE**	**TOTAL**			
Phase 1								
ROADWAY								
	Road B	3,856	L.F.	$ 550.00	$ 2,120,949			
	Road C	3,094	L.F.	$ 550.00	$ 1,701,640			
	Queen Kaahumanu Hwy. - Kaiminani Dr.	1	L.S.	$ 2,000,000.00	$ 2,000,000			
	Erosion Control	1	L.S.	$ 200,000.00	$ 200,000			
				Subtotal Roadway	**$ 6,022,588**			
WATER								
(Incl. all trenching, backfill, appurtenances)								
	12-Inch Waterline	10,683	L.F.	$ 350.00	$ 3,739,050	16" to be installed under DOT's Widening Project		
				Subtotal Water	**$ 3,739,050**			
WASTEWATER								
(Incl. all trenching, backfill, appurtenances)								
	8-Inch Sewerline	5,711	L.F.	$ 300.00	$ 1,713,300			
	8-Inch Forcemain	10,126	L.F.	$ 300.00	$ 3,037,800			
	12-Inch Sewerline	4,291	L.F.	$ 350.00	$ 1,501,850			
	Wastewater Pump Station	1	EA	$ 1,000,000.00	$ 1,000,000			
				Subtotal Sewer	**$ 7,252,950**			
DRAINAGE								
(Incl. all trenching, backfill, appurtenances)								
	48 inch pipe	120	L.F.	$ 250.00	$ 30,000			
	84 inch pipe	120	L.F.	$ 500.00	$ 60,000			
	96 inch pipe	360	L.F.	$ 600.00	$ 216,000			
	Drywells	28	EA	$ 10,000.00	$ 280,000	Assuming 1 drywell/500' of road		
	Culvert inlet/outlet headwall (single 24" to 48" HDPE)	2	EA	$ 10,000.00	$ 20,000			
	Culvert inlet/outlet headwall (single 84" to 96" CMP)	2	EA	$ 30,000.00	$ 60,000			
	Culvert inlet/outlet headwall (dual 96" CMP)	6	EA	$ 40,000.00	$ 240,000			
				Subtotal Drainage	**$ 906,000**			
				TOTAL PHASE 1	**$ 17,920,588**			

	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL			
Phase 2								
ROADWAY								
	Road A-1	5,724	L.F.	$ 600.00	$ 3,434,550			
	Road A-2	496	L.F.	$ 550.00	$ 273,037			
	Queen Kaahumanu Hwy. - NELHA Access Rd.	1	L.S.	$ 2,000,000.00	$ 2,000,000			
	Erosion Control	1	L.S.	$ 200,000.00	$ 200,000			
				Subtotal Roadway	**$ 5,907,587**			
WATER								
(Incl. all trenching, backfill, appurtenances)								
	8-Inch Waterline	2,301	L.F.	$ 300.00	$ 690,300			
	12-Inch Waterline	4,794	L.F.	$ 350.00	$ 1,677,900			
				Subtotal Water	**$ 2,368,200**			
WASTEWATER								
(Incl. all trenching, backfill, appurtenances)								
	8-Inch Sewerline	11,774	L.F.	$ 300.00	$ 3,532,200			
	12-Inch Sewerline	493	L.F.	$ 350.00	$ 172,550			
				Subtotal Sewer	**$ 3,704,750**			
DRAINAGE								
(Incl. all trenching, backfill, appurtenances)								
	24 inch pipe	120	L.F.	$ 150.00	$ 18,000			
	36 inch pipe	240	L.F.	$ 200.00	$ 48,000			
	72 inch pipe	120	L.F.	$ 400.00	$ 48,000			
	96 inch pipe	360	L.F.	$ 600.00	$ 216,000			
	Drywells	26	EA	$ 10,000.00	$ 260,000	Assuming 1 drywell/500' of road		
	Culvert inlet/outlet headwall (single 24" to 48" HDPE)	6	EA	$ 10,000.00	$ 60,000			
	Culvert inlet/outlet headwall (single 60" to 72" HDPE)	2	EA	$ 20,000.00	$ 40,000			
	Culvert inlet/outlet headwall (dual 96" CMP)	6	EA	$ 40,000.00	$ 240,000			
				Subtotal Drainage	**$ 930,000**			
				TOTAL PHASE 2	**$ 12,910,537**			

	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL			
Phase 3								
ROADWAY								
	NELHA Access Road (Resurface)	11,600	L.F.	$ 50.00	$ 580,000			
	Erosion Control	1	L.S.	$ 200,000.00	$ 200,000			
				Subtotal Roadway	**$ 780,000**			
WATER								
(Incl. all trenching, backfill, appurtenances)								
	12-Inch Waterline	7,016	L.F.	$ 350.00	$ 2,455,600			
				Subtotal Water	**$ 2,455,600**			
WASTEWATER								
(Incl. all trenching, backfill, appurtenances)								
	8-Inch Sewerline	3,627	L.F.	$ 300.00	$ 1,088,100			
	8-Inch Forcemain	3,829	L.F.	$ 300.00	$ 1,148,700			
	Wastewater Pump Station	1	EA	$ 1,000,000.00	$ 1,000,000			
				Subtotal Sewer	**$ 3,236,800**			
DRAINAGE								
(Incl. all trenching, backfill, appurtenances)								
	Drywells	20	EA	$ 10,000.00	$ 200,000	Assuming majority of runoff is existing		
				Subtotal Drainage	**$ 200,000**			
				TOTAL PHASE 3	**$ 6,672,400**			

	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL			
Phase 4								
ROADWAY								
	Road D-1	1,545	L.F.	$ 550.00	$ 849,481			
	Road D-2	2,171	L.F.	$ 550.00	$ 1,194,067			
	Erosion Control	1	L.S.	$ 200,000.00	$ 200,000			
				Subtotal Roadway	**$ 2,243,547**			
WATER								
(Incl. all trenching, backfill, appurtenances)								
	8-Inch Waterline	2,126	L.F.	$ 300.00	$ 637,800			
	12-Inch Waterline	1,619	L.F.	$ 350.00	$ 566,650			
				Subtotal Water	**$ 1,204,450**			
WASTEWATER								
(Incl. all trenching, backfill, appurtenances)					none			
DRAINAGE								
(Incl. all trenching, backfill, appurtenances)								
	48 inch pipe	120	L.F.	$ 250.00	$ 30,000			
	60 inch pipe	120	L.F.	$ 300.00	$ 36,000			
	Drywells	26	EA	$ 10,000.00	$ 260,000	Assuming 1 drywell/500' of road		
	Culvert inlet/outlet headwall (single 24" to 48" HDPE)	2	EA	$ 10,000.00	$ 20,000			
	Culvert inlet/outlet headwall (single 60" to 72" HDPE)	2	EA	$ 20,000.00	$ 40,000			
				Subtotal Drainage	**$ 386,000**			
				TOTAL PHASE 4	**$ 3,833,997**			

	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL			
Phase 5								
ROADWAY								
	North NELHA Access Road	9,000	L.F.	$ 550.00	$ 4,950,000			
	Road E-2	504	L.F.	$ 550.00	$ 277,200			
	Road E-3	684	L.F.	$ 550.00	$ 376,200			
	Erosion Control	1	L.S.	$ 200,000.00	$ 200,000			
				Subtotal Roadway	**$ 200,000**			
WATER								
(Incl. all trenching, backfill, appurtenances)								
	8-Inch Waterline	1,186	L.F.	$ 300.00	$ 355,800			
	12-Inch Waterline	8,935	L.F.	$ 350.00	$ 3,127,250			
				Subtotal Water	**$ 3,483,050**			
WASTEWATER								
(Incl. all trenching, backfill, appurtenances)					none			
DRAINAGE								
(Incl. all trenching, backfill, appurtenances)								
	Drywells	34	EA	$ 10,000.00	$ 340,000	Assuming 1 drywell/500' of road		
				Subtotal Drainage	**$ 340,000**			
				TOTAL PHASE 5	**$ 4,023,050**			
				Subtotal All Phases	**$ 45,360,572**			
				Mobilization/Demobilization (10%):	$ 4,536,057			
				Contingency (15%):	$ 7,484,494			
				TOTAL:	**$ 57,382,000**			
Notes:								
1. Assume 3 feet of typical cut/fill.								
2. Based on March 20, 2009 Conceptual Master Plan.								

Drainage Summary
Natural Energy Laboratory of Hawaii Authority
February 23, 2009

Drainage Area	Q_{10} (cfs) Existing	Q_{10} (cfs) Proposed	Q_{10} (cfs) Difference	Q_{50} (cfs) Existing	Q_{50} (cfs) Proposed	Q_{50} (cfs) Difference	Q_{peak} (cfs) (100 ac or more)
1	55	99	44	65	117	52	N/A
2	162	262	100	203	328	125	400
3	118	154	37	150	197	47	N/A
4	259	392	133	289	437	148	560
5	133	241	108	169	306	137	N/A
6	449	449	0	710	710	0	490
Total	1,176	1,597	421	1,585	2,094	509	

Existing Drainage
Natural Energy Laboratory of Hawaii Authority
February 23, 2009

Drainage Area	Undeveloped Area (acres)	Developed Area (acres)	Total Area (acres)	C (Undeveloped) Infiltration	Relief	Vegetal Cover	Dev't. Type	Total C	C (Developed) Infiltration	Relief	Vegetal Cover	Dev't. Type	Total C	Average C	Time of Concentration Length	Velocity	Tc	i_{10} (in/hr)	i_{50} (in/hr)	Q_{10} (cfs)	Q_{50} (cfs)
1	46.7	0.0	46.7	0.2	0	0.07	0.15	0.42	0.14	0	0.07	0.55	0.76	0.42	2620	5.0	8.7	2.8	3.3	54.9	64.7
2	122.1	21.6	143.7	0.2	0	0.07	0.15	0.42	0.14	0	0.07	0.55	0.76	0.47	3800	5.0	12.7	2.4	3.0	162.5	203.1
3	42.1	37.5	79.6	0.2	0	0.07	0.15	0.42	0.14	0	0.07	0.55	0.76	0.58	3270	5.0	10.9	2.6	3.3	117.8	150.1
4	197.1	49.3	246.4	0.2	0	0.07	0.15	0.42	0.14	0	0.07	0.55	0.76	0.49	4800	5.0	16.0	2.2	2.4	258.5	288.6
5	85.6	0.0	85.6	0.2	0	0.07	0.15	0.42	0.14	0	0.07	0.55	0.76	0.42	1200	5.0	4.0	3.7	4.7	133.0	169.0
6	12.4	183.7	196.1	0.2	0	0.07	0.15	0.42	0.14	0	0.07	0.55	0.76	0.74	3450	5.0	11.5	3.1	4.9	448.9	709.6

Notes:

1. Plates 1 and 2 were used to find the Intensity of 1-hr Rainfall for the 10 and 50 year storms as follows:

Tm (yr)	Intensity of 1-hr Rainfall (in.)
10	1.9
50	2.4

2. Assume that the non-developed areas are lava and act similar to a pavement surface.

Proposed Drainage
Natural Energy Laboratory of Hawaii Authority
23-Feb-09

Drainage Area	Undeveloped Area (acres)	Developed Area (acres)	Total Area (acres)	C (Undeveloped) Infiltration	Relief	Vegetal Cover	Dev't. Type	Total C	C (Developed) Infiltration	Relief	Vegetal Cover	Dev't. Type	Total C	Average C	Time of Concentration Length	Velocity	Tc	i_{10} (in/hr)	i_{50} (in/hr)	Q_{10} (cfs)	Q_{50} (cfs)
1	0.0	46.7	46.7	0.2	0	0.07	0.15	0.42	0.14	0	0.07	0.55	0.76	0.76	2620	5.0	8.7	2.8	3.3	99.4	117.1
2	0.0	143.7	143.7	0.2	0	0.07	0.15	0.42	0.14	0	0.07	0.55	0.76	0.76	3800	5.0	12.7	2.4	3.0	262.1	327.6
3	0.0	79.6	79.6	0.2	0	0.07	0.15	0.42	0.14	0	0.07	0.55	0.76	0.76	3270	5.0	10.9	2.6	3.3	154.3	196.6
4	15.2	231.2	246.4	0.2	0	0.07	0.15	0.42	0.14	0	0.07	0.55	0.76	0.74	4800	5.0	16.0	2.2	2.4	391.5	437.0
5	0.0	85.6	85.6	0.2	0	0.07	0.15	0.42	0.14	0	0.07	0.55	0.76	0.76	1200	5.0	4.0	3.7	4.7	240.7	305.8
6	12.4	183.7	196.1	0.2	0	0.07	0.15	0.42	0.14	0	0.07	0.55	0.76	0.74	3450	5.0	11.5	3.1	4.9	448.9	709.6

Notes:

1. Plates 1 and 2 were used to find the Intensity of 1-hr Rainfall for the 10 and 50 year storms as follows:

Tm (yr)	Intensity of 1-hr Rainfall (in.)
10	1.9
50	2.4

2. Assume that the non-developed areas are lava and act similar to a pavement surface.
3. Assume that all lots except archaeological sites will be developed as industrial/business.

Table 1. WATER DEMAND CALCULATION: NELHA
April 2009

ZONE	PARCEL	LAND USE	AREA	ACRES	DEMAND or Gal/Acre/Avg Day or Gal/Acre/Avg Day	DEMAND Ave. Day Gal/Day	DEMAND** (16 Hr Day) GPM	DEMAND Max Day GPM	DEMAND Max Day Gal/Day	DEMAND Peak GPM	FIRE FLOW*** FF Req't GPM	FIRE FLOW*** 2 Hr Fire Flow Gal	ASSUMPTIONS
Phase 1													
AT	1	Light Industrial	196,167	4.5	4,000	18,000	18.75	28.13	27,000	56.25	2,000	240,000	
	2	Light Industrial	264,140	6.1	4,000	24,400	25.42	38.13	36,600	76.25	2,000	240,000	
	3	Light Industrial	229,804	5.3	4,000	21,200	22.08	33.13	31,800	66.25	2,000	240,000	
	4	Light Industrial	346,799	8	4,000	32,000	33.33	50.00	48,000	100.00	2,000	240,000	
	5	Light Industrial	1,239,125	28.4	4,000	113,600	118.33	177.50	170,400	355.00	2,000	240,000	
	6	Light Industrial	334,114	7.7	4,000	30,800	32.08	48.13	46,200	96.25	2,000	240,000	
EZ	1	Light Industrial (Hawaii Bioenergy)	1,415,143	32.5	4,000	130,000	135.42	203.13	195,000	406.25	2,000	240,000	
	2	Light Industrial	136,282	3.1	4,000	12,400	12.92	19.38	18,600	38.75	2,000	240,000	
	3	Light Industrial	135,262	3.1	4,000	12,400	12.92	19.38	18,600	38.75	2,000	240,000	
Existing	K-10	MOANA TECHNOLOGIES LLC	497,017	11.4	4,000	45,600	47.50	71.25	68,400	142.50	2,000	240,000	
	K-12	ENZAMIN	134,427	3.1	4,000	12,400	12.92	19.38	18,600	38.75	2,000	240,000	
	K-13	OI	174,563	4	4,000	16,000	16.67	25.00	24,000	50.00	2,000	240,000	
	K-14	KOYO USA CORP.	1,305,675	30	4,000	120,000	125.00	187.50	180,000	375.00	2,000	240,000	
	K-17	HDMI	195,344	4.5	4,000	18,000	18.75	28.13	27,000	56.25	2,000	240,000	
	K-18	SAVERS HOLDINGS LTD.	261,722	6	4,000	24,000	25.00	37.50	36,000	75.00	2,000	240,000	
		Phase 1 Totals		157.7		630,800	657		946,200				
Phase 2													
AT	7	Light Industrial	370,095	8.5	4,000	34,000	35.42	53.13	51,000	106.25	2,000	240,000	
	8	Light Industrial	270,057	6.2	4,000	24,800	25.83	38.75	37,200	77.50	2,000	240,000	
	9	Light Industrial	252,107	5.8	4,000	23,200	24.17	36.25	34,800	72.50	2,000	240,000	
	10	Light Industrial	176,200	4	4,000	16,000	16.67	25.00	24,000	50.00	2,000	240,000	
	11	Light Industrial	170,619	3.9	4,000	15,600	16.25	24.38	23,400	48.75	2,000	240,000	
EZ	4	Light Industrial	222,397	5.1	4,000	20,400	21.25	31.88	30,600	63.75	2,000	240,000	
	5	Light Industrial	244,513	5.6	4,000	22,400	23.33	35.00	33,600	70.00	2,000	240,000	
	6	Light Industrial	160,666	3.7	4,000	14,800	15.42	23.13	22,200	46.25	2,000	240,000	
	7	Light Industrial	162,436	3.7	4,000	14,800	15.42	23.13	22,200	46.25	2,000	240,000	
	8	Light Industrial	474,593	10.9	4,000	43,600	45.42	68.13	65,400	136.25	2,000	240,000	
ED*	1	Community Commercial		16.3	3,000	48,900	50.94	76.41	73,350	152.81	2,000	240,000	
	2	Community Commercial		18.7	3,000	56,100	58.44	87.66	84,150	175.31	2,000	240,000	
	3	Community Commercial		23.3	3,000	69,900	72.81	109.22	104,850	218.44	2,000	240,000	
	4	Community Commercial		16.3	3,000	48,900	50.94	76.41	73,350	152.81	2,000	240,000	
	5	Community Commercial		3.7	3,000	11,100	11.56	17.34	16,650	34.69	2,000	240,000	
Existing	n/a	GATEWAY	207,547	4.8	3,000	14,400	15.00	22.50	21,600	45.00	2,000	240,000	
	n/a	SOPOGY, INC.	174,233	4	4,000	16,000	16.67	25.00	24,000	50.00	2,000	240,000	
	n/a	WHEA		1.7	4,000	6,800	7.08	10.63	10,200	21.25	2,000	240,000	
		Phase 2 Totals		146.2		501,700	523		752,550				
Phase 3													
Existing	K-3	ROYAL HWN. SEA FARMS	130,680	3	4,000	12,000	12.50	18.75	18,000	37.50	2,000	240,000	
	K-4	CYANOTECH		91.1	4,000	364,400	379.58	569.38	546,600	1138.75	2,000	240,000	
	K-5	UWAJIMA FISHERIES, INC.	172,595	4	4,000	16,000	16.67	25.00	24,000	50.00	2,000	240,000	
	K-7	KONA COLD LOBSTERS, LTD.	52,779	1.2	4,000	4,800	5.00	7.50	7,200	15.00	2,000	240,000	
	K-8	HIGH HEALTH AQUACULTURE, INC.		2.2	4,000	8,800	9.17	13.75	13,200	27.50	2,000	240,000	
	K-9	OCEAN RIDER, INC.		2.1	4,000	8,400	8.75	13.13	12,600	26.25	2,000	240,000	
	K-11	NELHA OFFICES (incl. IPSF, PP)		9.4	3,000	28,200	29.38	44.06	42,300	88.13	2,000	240,000	
	K-15	BLACK PEARLS, INC.		2.3	4,000	9,200	9.58	14.38	13,800	28.75	2,000	240,000	
	K-20	KONA BAY MARINE RESOURCES, INC.	283,017	6.5	4,000	26,000	27.08	40.63	39,000	81.25	2,000	240,000	
	K-23	KONA COAST SHELLFISH, LLC		3.4	4,000	13,600	14.17	21.25	20,400	42.50	2,000	240,000	
	K-26	HR BIOPETROLEUM, INC.		6.2	4,000	24,800	25.83	38.75	37,200	77.50	2,000	240,000	
	K-27a	UNLIMITED AQUACULTURE	399,260	9.2	4,000	36,800	38.33	57.50	55,200	115.00	2,000	240,000	

Table 1. WATER DEMAND CALCULATION: NELHA
April 2009

ZONE	PARCEL	LAND USE	AREA	ACRES	DEMAND or Gal/Acre/Avg Day or Gal/Acre/Avg Day	DEMAND Ave. Day Gal/Day	DEMAND** (16 Hr Day) GPM	DEMAND Max Day GPM	DEMAND Max Day Gal/Day	DEMAND Peak GPM	FIRE FLOW*** FF Req't GPM	FIRE FLOW*** 2 Hr Fire Flow Gal	ASSUMPTIONS
	K-27b	UNLIMITED AQUACULTURE		1.2	4,000	4,800	5.00	7.50	7,200	15.00	2,000	240,000	
	K-28	MERA PHARMACEUTICALS		5.6	4,000	22,400	23.33	35.00	33,600	70.00	2,000	240,000	
	-	UNLIMITED AQUACULTURE	46,692	1.1	4,000	4,400	4.58	6.88	6,600	13.75	2,000	240,000	
	-	TAYLOR SHELLFISH	241,063	6.1	4,000	24,400	25.42	38.13	36,600	76.25	2,000	240,000	
	X	VACANT LOTS		9.4	4,000	37,600	39.17	58.75	56,400	117.50	2,000	240,000	
		Phase 3 Totals		164.0		646,600	674		969,900				
Phase 4													
CT	1	Community Commercial/Educational	397,467	9.1	4,000	36,400	37.92	56.88	54,600	113.75	2,000	240,000	
	2	Community Commercial/Educational	358,363	8.2	4,000	32,800	34.17	51.25	49,200	102.50	2,000	240,000	
	3	Community Commercial/Educational	580,843	13.3	4,000	53,200	55.42	83.13	79,800	166.25	2,000	240,000	
AT	12	Light Industrial	315,366	7.2	4,000	28,800	30.00	45.00	43,200	90.00	2,000	240,000	
	13	Light Industrial	281,061	6.5	4,000	26,000	27.08	40.63	39,000	81.25	2,000	240,000	
	14	Light Industrial	397,182	9.1	4,000	36,400	37.92	56.88	54,600	113.75	2,000	240,000	
	15	Light Industrial	200,563	4.6	4,000	18,400	19.17	28.75	27,600	57.50	2,000	240,000	
	16	Light Industrial	225,878	5.2	4,000	20,800	21.67	32.50	31,200	65.00	2,000	240,000	
	17	Light Industrial	204,705	4.7	4,000	18,800	19.58	29.38	28,200	58.75	2,000	240,000	
	18	Light Industrial	256,270	5.9	4,000	23,600	24.58	36.88	35,400	73.75	2,000	240,000	
	19	Light Industrial	233,852	5.4	4,000	21,600	22.50	33.75	32,400	67.50	2,000	240,000	
	20	Light Industrial	218,117	5	4,000	20,000	20.83	31.25	30,000	62.50	2,000	240,000	
	21	Light Industrial	223,988	5.1	4,000	20,400	21.25	31.88	30,600	63.75	2,000	240,000	
	22	Light Industrial	216,925	5	4,000	20,000	20.83	31.25	30,000	62.50	2,000	240,000	
RE	UTIL.	Light Industrial		9.9	4,000	39,600	41.25	61.88	59,400	123.75	2,000	240,000	
Existing	K-6	BIG ISLAND ABALONE CORP.	435,072	10	4,000	40,000	41.67	62.50	60,000	125.00	2,000	240,000	
	K-19	DEEP SEAWATER INTER. INC.	871,211	20	4,000	80,000	83.33	125.00	120,000	250.00	2,000	240,000	
	K-24	NORITECH HAWAII, INC.		5.5	4,000	22,000	22.92	34.38	33,000	68.75	2,000	240,000	
		Phase 4 Totals		139.7		558,800	582		838,200				
Phase 5													
RE	1	Light Industrial/Research/Education		30.2	4,000	120,800	125.83	188.75	181,200	377.50	2,000	240,000	
	2	Light Industrial/Research/Education		13.6	4,000	54,400	56.67	85.00	81,600	170.00	2,000	240,000	
	3	Light Industrial/Research/Education		13.0	4,000	52,000	54.17	81.25	78,000	162.50	2,000	240,000	
	4	Light Industrial/Research/Education		16.0	4,000	64,000	66.67	100.00	96,000	200.00	2,000	240,000	
		Phase 5 Totals		72.8		291,200			436,800				
		GRAND TOTAL LEASABLE AREA		**670.5**		2,629,100			3,943,650				
		Total Area (includes Utility Lot)		680.4									
Existing Set Aside Lots:													
		Utility Lot	419,440	9.6	200	1,920	2.00	3.00	2,880	6.00	2,000	240,000	
		Arch Site 1	655,965	15.1	-	-	0.00	0.00	0	0.00	2,000	240,000	
		Arch Site 2	10,098	0.2	-	-	0.00	0.00	0	0.00	2,000	240,000	
		Arch Site 3	502,225	11.5	-	-	0.00	0.00	0	0.00	2,000	240,000	
		SUBTOTAL		36		1,920			2,880				

Table 2. WASTEWATER CALCULATIONS: NELHA
April 2009

ZONE	PARCEL	LAND USE		AREA (acres)	UNITS	CAPITA PER ACRE (cpa)	POP. COUNT (persons)	GALLON PER CAPITA PER DAY (gpcd)	AVERAGE FLOW (gpd)	MAX. FLOW FACTOR	MAX. FLOW (gpd)	WEATHER INFILTRATION/ INFLOW (I/I)	DESIGN AVE. FLOW (gpd)	DESIGN MAX. FLOW (gpd)	WET WEATHER INFILTRATION/ INFLOW RATE	DESIGN PEAK FLOW (gpd)
Phase 1																
AT	1	Light Industrial	196,167	4.5	Acres	2	9	25	225	4.35	979	5	45	1,024	5,625	6,649
	2	Light Industrial	264,140	6.1	Acres	2	12	25	305	4.35	1,327	5	61	1,388	7,625	9,013
	3	Light Industrial	229,804	5.3	Acres	2	11	25	265	4.35	1,153	5	53	1,206	6,625	7,831
	4	Light Industrial	346,799	8	Acres	2	16	25	400	4.35	1,740	5	80	1,820	10,000	11,820
	5	Light Industrial	1,239,125	28.4	Acres	2	57	25	1,420	4.35	6,177	5	284	6,461	35,500	41,961
	6	Light Industrial	334,114	7.7	Acres	2	15	25	385	4.35	1,675	5	77	1,752	9,625	11,377
EZ	1	Light Industrial (Hawaii Bioenergy)	1,415,143	32.5	Acres	2	65	25	1,625	4.35	7,069	5	325	7,394	40,625	48,019
	2	Light Industrial	136,282	3.1	Acres	2	6	25	155	4.35	674	5	31	705	3,875	4,580
	3	Light Industrial	135,262	3.1	Acres	2	6	25	155	4.35	674	5	31	705	3,875	4,580
Existing	K-10	MOANA TECHNOLOGIES LLC	497,017	11.4	Acres		15	25	375	4.35	1,631	5	75	1,706	14,250	15,956
	K-12	ENZAMIN	134,427	3.1	Acres		3	25	75	4.35	326	5	15	341	3,875	4,216
	K-13	OCEANIC INSTITUTE	174,563	4	Acres		2	25	50	4.35	218	5	10	228	5,000	5,228
	K-14	KOYO USA CORP.	1,305,675	30	Acres		29	25	725	4.35	3,154	5	145	3,299	37,500	40,799
	K-17	HAWAII DEEP MARINE, INC.	195,344	4.5	Acres		2	25	50	4.35	218	5	10	228	5,625	5,853
	K-18	SAVERS HOLDINGS LTD.	261,722	6	Acres		2	25	50	4.35	218	5	10	228	7,500	7,728
		Phase 1 Totals		157.7			250		6,260		27,231					225,608
Phase 2																
AT	7	Light Industrial	370,095	8.5	Acres	2	17	25	425	4.35	1,849	5	85	1,934	10,625	12,559
	8	Light Industrial	270,057	6.2	Acres	2	12	25	310	4.35	1,349	5	62	1,411	7,750	9,161
	9	Light Industrial	252,107	5.8	Acres	2	12	25	290	4.35	1,262	5	58	1,320	7,250	8,570
	10	Light Industrial	176,200	4	Acres	2	8	25	200	4.35	870	5	40	910	5,000	5,910
	11	Light Industrial	170,619	3.9	Acres	2	8	25	195	4.35	848	5	39	887	4,875	5,762
EZ	4	Light Industrial	222,397	5.1	Acres	2	10	25	255	4.35	1,109	5	51	1,160	6,375	7,535
	5	Light Industrial	244,513	5.6	Acres	2	11	25	280	4.35	1,218	5	56	1,274	7,000	8,274
	6	Light Industrial	160,666	3.7	Acres	2	7	25	185	4.35	805	5	37	842	4,625	5,467
	7	Light Industrial	162,436	3.7	Acres	2	7	25	185	4.35	805	5	37	842	4,625	5,467
	8	Light Industrial	474,593	10.9	Acres	2	22	25	545	4.35	2,371	5	109	2,480	13,625	16,105
ED*	1	Community Commercial		16.3	Acres	140	2,282	30	68,460	4.35	297,801	5	11,410	309,211	20,375	329,586
	2	Community Commercial		18.7	Acres	140	2,618	30	78,540	4.35	341,649	5	13,090	354,739	23,375	378,114
	3	Community Commercial		23.3	Acres	140	3,262	30	97,860	4.35	425,691	5	16,310	442,001	29,125	471,126
	4	Community Commercial		16.3	Acres	140	2,282	30	68,460	4.35	297,801	5	11,410	309,211	20,375	329,586
	5	Community Commercial		3.7	Acres	140	518	30	15,540	4.35	67,599	5	2,590	70,189	4,625	74,814
Existing	n/a	GATEWAY	207,547	4.8	Acres	2	10	25	240	4.35	1,044	5	48	1,092	6,000	7,092
	n/a	SOPOGY, INC.	174,233	4	Acres	2	8	25	200	4.35	870	5	40	910	5,000	5,910
	n/a	WHEA		1.7	Acres	40	68	25	1,700	4.35	7,395	5	340	7,735	2,125	9,860
		Phase 2 Totals		146.2			11,162		333,870		1,452,335					1,690,897
Phase 3																
Existing	K-3	ROYAL HWN. SEA FARMS	130,680	3	Acres		3	25	75	4.35	326	5	15	341	3,750	4,091
	K-4	CYANOTECH		91.1	Acres		52	25	1,300	4.35	5,655	5	260	5,915	113,875	119,790
	K-5	UWAJIMA FISHERIES, INC.	172,595	4	Acres		3	25	75	4.35	326	5	15	341	5,000	5,341
	K-7	KONA COLD LOBSTERS, LTD.	52,779	1.2	Acres		8	25	200	4.35	870	5	40	910	1,500	2,410
	K-8	HIGH HEALTH AQUACULTURE, INC.		2.2	Acres		6	25	150	4.35	653	5	30	683	2,750	3,433
	K-9	OCEAN RIDER, INC.		2.1	Acres		6	25	150	4.35	653	5	30	683	2,625	3,308
	K-11	NELHA OFFICES (incl. IPSF, PP)		9.4	Acres		40	25	1,000	4.35	4,350	5	200	4,550	11,750	16,300
	K-15	BLACK PEARLS, INC.		2.3	Acres		48	25	1,200	4.35	5,220	5	240	5,460	2,875	8,335
	K-20	KONA BAY MARINE RESOURCES, INC.	283,017	6.5	Acres		7	25	175	4.35	761	5	35	796	8,125	8,921
	K-23	KONA COAST SHELLFISH, LLC		3.4	Acres		14	25	350	4.35	1,523	5	70	1,593	4,250	5,843
	K-26	HR BIOPETROLEUM, INC.		6.2	Acres		17	25	425	4.35	1,849	5	85	1,934	7,750	9,684
	K-27a	UNLIMITED AQUACULTURE	399,260	9.2	Acres		5	25	125	4.35	544	5	25	569	11,500	12,069
	K-27b	UNLIMITED AQUACULTURE		1.2	Acres		5	25	125	4.35	544	5	25	569	1,500	2,069
	K-28	MERA PHARMACEUTICALS		5.6	Acres		5	25	125	4.35	544	5	25	569	7,000	7,569
	-	UNLIMITED AQUACULTURE	46,692	1.1	Acres		5	25	125	4.35	544	5	25	569	1,375	1,944
	-	TAYLOR SHELLFISH		6.1	Acres		10	25	250	4.35	1,088	5	50	1,138	7,625	8,763
	X	VACANT LOTS		9.4	Acres		10	25	250	4.35	1,088	5	50	1,138	11,750	12,888
		Phase 3 Totals		164.0			244		6,100		26,535					232,755
Phase 4																
CT	1	Community Commercial/Educational	397,467	9.1	Acres	40	364	25	9,100	4.35	39,585	5	1,820	41,405	11,375	52,780
	2	Community Commercial/Educational	358,363	8.2	Acres	40	328	25	8,200	4.35	35,670	5	1,640	37,310	10,250	47,560

Table 2. WASTEWATER CALCULATIONS: NELHA
April 2009

ZONE	PARCEL	LAND USE		AREA (acres)	UNITS	CAPITA PER ACRE (cpa)	POP. COUNT (persons)	GALLON PER CAPITA PER DAY (gpcd)	AVERAGE FLOW (gpd)	MAX. FLOW FACTOR	MAX. FLOW (gpd)	WEATHER INFILTRATION/ INFLOW (I/I)	DESIGN AVE. FLOW (gpd)	DESIGN MAX. FLOW (gpd)	WET WEATHER INFILTRATION/ INFLOW RATE	DESIGN PEAK FLOW (gpd)
	3	Community Commercial/Educational	580,843	13.3	Acres	40	532	25	13,300	4.35	57,855	5	2,660	60,515	16,625	77,140
AT	12	Light Industrial	315,366	7.2	Acres	2	14	25	360	4.35	1,566	5	72	1,638	9,000	10,638
	13	Light Industrial	281,061	6.5	Acres	2	13	25	325	4.35	1,414	5	65	1,479	8,125	9,604
	14	Light Industrial	397,182	9.1	Acres	2	18	25	455	4.35	1,979	5	91	2,070	11,375	13,445
	15	Light Industrial	200,563	4.6	Acres	2	9	25	230	4.35	1,001	5	46	1,047	5,750	6,797
	16	Light Industrial	225,878	5.2	Acres	2	10	25	260	4.35	1,131	5	52	1,183	6,500	7,683
	17	Light Industrial	204,705	4.7	Acres	2	9	25	235	4.35	1,022	5	47	1,069	5,875	6,944
	18	Light Industrial	256,270	5.9	Acres	2	12	25	295	4.35	1,283	5	59	1,342	7,375	8,717
	19	Light Industrial	233,852	5.4	Acres	2	11	25	270	4.35	1,175	5	54	1,229	6,750	7,979
	20	Light Industrial	218,117	5	Acres	2	10	25	250	4.35	1,088	5	50	1,138	6,250	7,388
	21	Light Industrial	223,988	5.1	Acres	2	10	25	255	4.35	1,109	5	51	1,160	6,375	7,535
	22	Light Industrial	216,925	5	Acres	2	10	25	250	4.35	1,088	5	50	1,138	6,250	7,388
RE	UTIL.	Light Industrial	435,072	9.9	Acres	2	20	25	495	4.35	2,153	5	99	2,252	12,375	14,627
Existing	K-6	BIG ISLAND ABALONE CORP.	435,072	10	Acres		17	25	425	4.35	1,849	5	85	1,934	12,500	14,434
	K-19	DEEP SEAWATER INTER. INC.	871,211	20	Acres		6	25	150	4.35	653	5	30	683	25,000	25,683
	K-24	NORITECH HAWAII, INC.		5.5	Acres		10	25	250	4.35	1,088	5	50	1,138	6,875	8,013
		Phase 4 Totals		139.7			1,404		35,105		152,707					334,353
Phase 5																
RE	1	Light Industrial/Research/Education		30.2	Acres	2	60	25	1,510	4.35	6,569	5	302	6,871	37,750	44,621
	2	Light Industrial/Research/Education		13.6	Acres	2	27	25	680	4.35	2,958	5	136	3,094	17,000	20,094
	3	Light Industrial/Research/Education		13	Acres	2	26	25	650	4.35	2,828	5	130	2,958	16,250	19,208
	4	Light Industrial/Research/Education		16	Acres	2	32	25	800	4.35	3,480	5	160	3,640	20,000	23,640
		Phase 5 Totals		72.8			146		3,640		15,834					107,562
		GRAND TOTAL LEASABLE AREA		**670.5**			13,207		384,975		1,674,641					2,591,174
		Total Area (includes Utility Lot)		680.4												
Existing Set Aside Lots:																
		Utility Lot	419,440	9.6	Acres	1	10	25	240	4.35	1,044	5	48	1,092	12,000	13,092
		Arch Site 1	655,965	15.1	Acres	1	15	0	0	4.35	0	5	76	76	18,875	18,951
		Arch Site 2	10,098	0.2	Acres	1	0	0	0	4.35	0	5	1	1	250	251
		Arch Site 3	502,225	11.5	Acres	1	12	0	0	4.35	0	5	58	58	14,375	14,433
		SUBTOTAL		36.4			36		240		1,044					46,726

Existing Facilities demand estimated at 10,390 gpd

Appendix D. Green Energy Zone Quarterly Report

Master Plan

Natural Energy Laboratory of Hawaii Authority (NELHA) 2009 Green Energy Zone Quarterly Report

In today's climate, renewable energy is discussed everywhere: in government halls, research institutions, among venture capitalists, investment conferences and daily, among citizens. When the successful Ocean Thermal Energy Conversion (OTEC) plant was built at NELHA and then halted, this park was looked at as "the solution that *should* have been." However, NELHA is re-emerging on the map; fulfilling its original mission: creating an example of energy sustainability from our abundant renewable resources.

In August 2007, NELHA developed the ideas for creating a 'Green Energy Zone'. The goal of the Green Energy Zone is to develop a diversified portfolio of renewable projects to produce enough clean energy to power NELHA by 2012. The idea was met with great enthusiasm and support. Since then, this concept has been communicated to a broad range of audiences and led to attempts at legislation paving this path.

Since the seeds of the Green Energy Zone were planted, NELHA is enjoying the fruits of its labor with new clean energy projects coming on line. From SOPOGY's 500 kW solar-thermal farm to SunPower's 600 kW photovoltaic array; from Shell-Cellana's algae-to-biofuel project to Lockheed's OTEC research, NELHA is becoming a model of 'greening' and 'cleaning' Hawaii's energy source. With the continued support of our State and Federal government, community and businesses, NELHA is optimistic that these successes will continue and Hawaii will grow into the leading State in renewable technologies.

Hawaii has fast become the clear leader: setting the bar high for renewable energy goals with the State of Hawaii and the Department of Energy signing of the Hawaii Clean Energy Initiative (HCEI). This initiative aims at increasing Hawaii's clean indigenous energy source to 70% and NELHA's Green Energy Zone can be an example of *how to achieve* this aggressive goal.

Today, we have implemented the initial stages of the Green Energy Zone with much success. There has never been a better time to be at the forefront of Renewable Energy and it is vital that the State recognizes NELHA's potential role in creating Renewable Energy Zones and bringing this model to other Hawaiian Islands and Island Nations.

A NATURAL TEST-BED AND RENEWABLE ENERGY ZONE

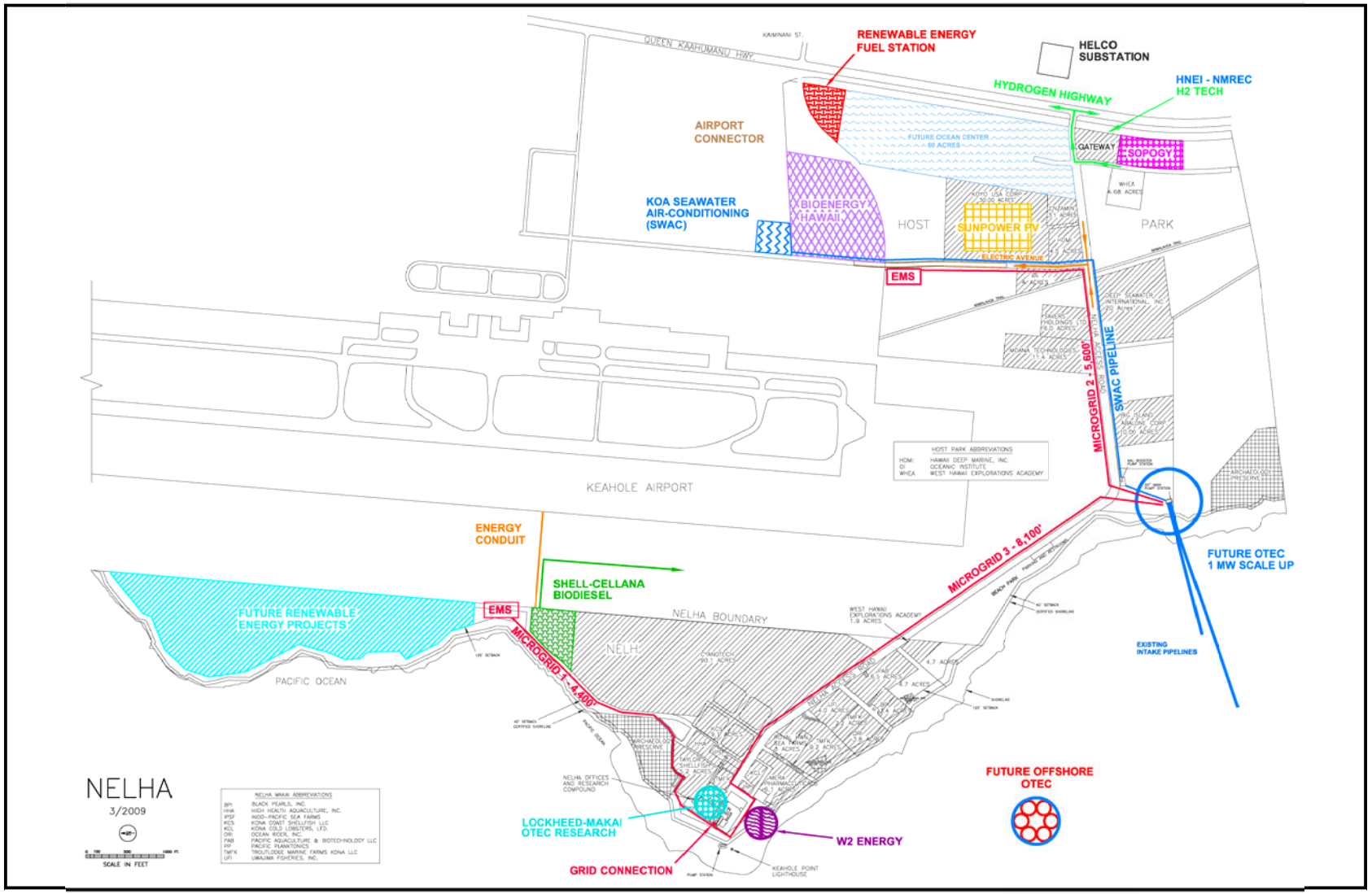
The success and growth of DBEDT/DOE's – Hawaii Clean Energy Initiative (HCEI) is dependent on continuing its early successes in Renewable Energy Projects and the important component of Education/Outreach. NELHA's compact site with location surrounding an international airport is a perfect location for demonstration of HCEI implementation and education. With the most diverse renewable resources in a 3 mile drive, NELHA is able to build a flexible portfolio of technologies for mixing, testing and optimization. On one site – you can view world-changing renewable technologies and demonstrate their positive impact on a diverse set of Hawaii for-profit, private businesses.

Every Renewable Energy Advocate that visits this location is awestruck by the potential. The potential for:

- Energy savings demonstrations in water distribution/pump costs (peak shaving – smart controls)
- Microgrid/smartgrid 'plug-and-play' experiments
- Airport - Homeland energy security and energy back-up system
- Education/outreach at the Gateway Energy Center which is the lead (outside of Universities) renewable education facility in the Islands with over 5000 visitors per year: including over 100 businesses and 200 foreign country representatives
- Continuation of the OTEC legacy that created this place
- Deploying deep and surface ocean experiments in the roughly 2 mile square (depths of 9000') Ocean Corridor that has the potential for wave and ocean-current testing, as well as deep sea pipe deployment and inter-island cable models

In the past, many dedicated government officials and researchers recognized the unique confluence of resources here. They came here to create renewable energy technologies that could provide an alternative for our dependence on fossil-fuels. As a direct result of the efforts of these researchers, employees, Legislators and community, NELHA has enjoyed many first-time achievements. But the future is even more promising with many opportunities to continue the charter of renewable energy invention and development. In partnership with DBEDT/DOE – we hope to surpass even the milestones we have reached and dreamed so far.

A description of our modern day milestones and sequence to success follows (please view attached map for location of projects):


RENEWABLE ENERGY FUEL STATION
HELCO SUBSTATION
HNEI - NMREC H2 TECH
HYDROGEN HIGHWAY
AIRPORT CONNECTOR
KOA SEAWATER AIR-CONDITIONING (SWAC)
BIOENERGY HAWAII
HOST
SUNPOWER PV
PARK
GATEWAY
SOPOGY
EMS
MICROGRID 2 - 5,600'
SWAC PIPELINE
KEAHOLE AIRPORT
ENERGY CONDUIT
SHELL-CELLANA BIODIESEL
FUTURE RENEWABLE ENERGY PROJECTS
NELHA BOUNDARY
MICROGRID 3 - 8,100'
FUTURE OTEC 1 MW SCALE UP
EXISTING INTAKE PIPELINES
PACIFIC OCEAN
MICROGRID 1 - 4,400'
FUTURE OFFSHORE OTEC
LOCKHEED-MAKAI OTEC RESEARCH
W2 ENERGY
GRID CONNECTION
NELHA
3/2009
SCALE IN FEET

NELHA's Renewable Projects Sequence – Phase I

1. **Cellana – HRBP/Shell Oil – Algae-to-Biodiesel (January 2009)**
   - Construction completed January 2009
   - Passed first phase of experimentation
   - Next 12 months will prove proper algal varieties
   - Currently building an additional Lab
   - Biodiesel production for power plants
   - Biodiesel processed for Jet Fuel
   - R&D project/technology that can be exported

2. **SOPOGY (online April 2009)**
   - Solar-Thermal Technology (500 kW to 1 MW)
   - SOPOGY ribbon cutting scheduled for April 2009
   - First Sterling Engine – Natural Energy Engine of this size
   - 4 acre farm across from Gateway now in construction phase
   - $10 million Special Revenue Bond passed by Governor
   - Solar Energy to Engine– Generator system compatible with Utility
   - IPO will allow plant to be owned and operated by others
   - Highway location becomes source of community interest

3. **RENEWABLE ENERGY RFP (issue April 2009)**
   - Smartgrid funded by the National Renewable Energy Laboratory (NREL). Funding deadline June 2009
   - Northwest Coast of NELHA up to 3 MW
   - Powers NELHA, then Tenants, and then Airport
   - Potential for an Array of Solar and other Renewable Technologies
   - Phase-in project allows it to right size as NELHA park and Airport grow
   - Energy Storage component sought: Hydrogen, Battery, Molten Salt, etc.
   - Electric Vehicle plug-ins for Transportation
   - EV Battery Trucks allow battery movement all over NELHA park

4. **SUNPOWER 600 kW PHOTOVOLATIC ARRAY (online April 2009)**
   - Generates 1/3 electricity needs of KOYO – largest exporter (water bottling and revenues ('07) in the Hawaii Islands
   - PV array tilted to the North
   - Potential for up to 1.8 MWs of PV to cover KOYO's load
   - Net metering agreement with HELCO – sends power back to grid on the weekends

5. **LOCKHEED-MAKAI OCEAN THERMAL ENERGY TESTING (May 2009)**
   - Heat Exchanger Testing at the 3000 foot depth and 2000 foot depth pipelines
   - OTEC Technology continues its legacy at NELHA
   - NELHA participates with the leading firms in OTEC development
   - International Partnership and new business potentials

NELHA's Renewable Projects Sequence – Phase II

6. W2 ENERGY WIND WINGS (coming June 2009)

- A new designed wind harvesting design
- Increases efficiency over 60% of wind turbine design
- 2 experimental Wind Wings to be placed at NELHA
- Manufacturing agreement to happen at NELHA once technology is honed

7. OTEC SCALE UP (scheduled issue June 2009)

- A 1 MW (gross) project that would produce 640 kW of net base load energy that can be readily used for NELHA's 55" Pumping Station
- This project is critical step to scale up to the next size plant.
- 500,000 gallons a day of fresh water to be used in a variety of ways – Irrigation, Drinking water, Bottled OTEC water – support Renewable Energy water. Possible pumped storage.
- "People keep asking us why Hawaii doesn't have one. It will also elevate Hawaii to its rightful place as the showcase for OTEC; it will be the plant we bring the world to see. The vision is widespread use of this technology within the next 30 to 50 years. OTEC could replace fossil fuels during this time."

8. GATEWAY DISTRIBUTED ENERGY CENTER (December 2009)

- Continue Education and Outreach past 5000 visitors/year
- Install Photovoltaic testing site on demonstration areas
- Build 2 more Renewable Energy Laboratory Buildings
- Lengthen Gateway Chimneys so building functions as designed ($100K)
- Implement Gateway Energy Conservation Program to save 33% Energy
- Encourage more Experimental technologies to test at the Gateway Demonstration Grounds (now filled with 3 projects)
- HNEI – National Marine Renewable Energy Lab possibilities

9. HYDROGEN HIGHWAY (June 2010)

- ***Green (Hydrogen*** Storage at Lab)
- **$50 Million – Special Revenue Bond given to H2 Technologies**
- **H2 Tech in discussions on locating at NELHA**
- Hydrogen Engine Conversion Station
- Hydrogen Vans to transport from Airport to Ocean Center
- Hydrogen Vehicles to pickup Hydrogen from excess capacity at Renewable Energy Projects

10. Renewable Energy Fueling Station (December 2011)

- First Renewable Fuel Station
- Biodiesel, Hydrogen, Electric Fuelling Station/swap-out
- Partnership with Auto Maker for vehicle rental
- NELHA Partnership with Hydrogen, Biodiesel, Electricity Providers

NELHA's Renewable Projects Sequence – Phase III

11. Airport Partnership (in DOT-Airports Master Planning phase)

- First Seawater Air-conditioned Airport **(SWAC)**
- Renewable Energy Back-up power in case of Utility Grid Disturbance
- Homeland Secure Airport
- Renewable Energy Vehicle rental
- Renewable Energy Fueling station
- Edu-tourism destination
- NELHA product sales partnership
- Airports of the Future - Harvard Presentation (August 2008)

12. ELECTRIC AVENUE (in NELHA's Master Planning phase)

- Electric Vehicles dominate the traffic here – all vehicles from NELHA to the Airport will be powered this way.
- Part of the Airport Access Road where AquaFarms, Water Bottlers, etc can ship directly to Airport and avoid/prevent traffic and accidents
- Our intention is to keep a fleet of Trucks hooked to plug-ins from Renewable power to be used by Farms.
- Excess energy not used could be put back in the Micro-grid as from the battery storage – a way of having mobile batteries
- Electricity Train could be one big battery for the Airport or NELHA and the start of a monorail from Airport to O'oma and Kohanaiki

13. OFFSHORE OTEC (2012)

- A 50 to 100 MW Power plant capable of relocating – an OTEC ship
- ***Blue Hydrogen*** export to NELHA station to provide fuel for Hydrogen Highway.
- Producing 25 million gallons of drinkable water per day to be used for drinking for irrigation for local community for Aquafarms using fresh water for Transport to Water deficient zones
- Surrounding Aquafarms around perimeter of plant – Algae to Biodiesel
- Becomes World Recognized Marine Research Platform with capabilities of getting to Deep unexplored areas – quickly and safely

14. KONA INNOVATIONS CENTER (KICK)

- Important to set NELHA's 'marquee' 80 acre land (Future Ocean Center) at top of property for Visiting Researchers office space and for a cultural center for Hawaii
- First Phase: Solar-powered Whale Tail – Second Phase is Whale Tail Solar-thermal - Third phase is Research/Office Center
- Deep Sea National Marine Research Technology Center with
    i. Renewable Energy Research
    ii. Project based College internships
    iii. Renewable Energy Education
    iv. International Partnerships Headquarters
    v. Remote operated vehicles to deep-sea OTEC platform
    vi. Deep Sea Aquarium & Symphony Hall

NELHA Energy Vision

To become a *Green Energy Zone* – a research and business park powered by *maximum* Renewable Energies

Today NELHA has:

- Longest, Deepest and Widest Ocean pipelines in the world
- Base infrastructure for the next OTEC experiments
- Highest Solar Intensity in the coastal USA
- Acres of algae farms ready to convert to the next biofuel
- International airport as neighbor for partnership and export
- Fastest growing area of Hawaii Island with West Hawaii University campus planned
- Fertile business environment which includes Foreign Trade and Enterprise Zone status
- Energy, Food, Medical, Water, Airport Security all at one 870 acre facility

To implement the Green Energy Zone - NELHA needs:

- Tax Map Key (TMK) Wheeling allowed to NELHA Tenants
- Utility Fee-Free zone = No Transmission, Wheeling and other fees
- NREL-funded Microgrid must have HECO/HELCO's partnership/blessing to be installed and to allow Renewable Generation at NELHA
- Fast Track Permitting
- Fast Track Procurement
- EIS and SMA permits for Renewable Energy Development areas
- MOU with DOT-Airports for SWAC and Renewable Power
- NELHA must provide Better Incentives for Renewable Developers
    - Rent Free for first years
    - 2% Gross Sales percentage rent after threshold achieved
    - Clean Energy companies automatically QHTB

NELHA needs help in these areas to achieve its Green Energy Zone:

- Favorable Legislative Initiatives (Legislature, Governor, DBEDT)
    - TMK Wheeling Allowed
    - Public Utilities Commission exemptions allowed
- Procurement streamlined (DBEDT)
- Promotion of renewable energy projects at NELHA (DBEDT)
- Partnership building with other federal, state, local agencies and commercial organizations (DBEDT/DOE)
- Incentive structures and funding (Legislature, Governor, DBEDT)

NELHA's Present Support and Future Legislation

August 2007 – NELHA initiates the Green Energy Zone

January 2008 – Hawaii and DOE Sign Agreement

The State of Hawaii and DOE formed a partnership on January 28 that will work towards dramatically shifting Hawaii's energy system from one that is fueled primarily by oil to one that is powered primarily by renewable energy.

July 2008 – U.S. and New Zealand Take Steps to Launch International Partnership NASSAU, BAHAMAS

The U.S. Department of Energy's (DOE) Assistant Secretary for Energy Efficiency and Renewable Energy Alexander "Andy" Karsner and New Zealand's Ambassador to the U.S. Roy Ferguson today signed terms of reference for the International Partnership for Energy Development in Island Nations (EDIN), an initiative to further the development of energy efficient and renewable energy technologies on island nations and territories.

April 2009 – NELHA declared a *Renewable Energy Zone*

- NELHA is chartered with developing full Renewable Energy Capacity
- NREL-funded HELCO-partnered 1st microgrid is installed
- Green Energy Zone Legislation is passed including
    - TMK Wheeling to NELHA Tenants allowed
    - PUC free zone (no wheeling, transmission, utility fees)
    - Fast Track Permitting
    - Fast Track Procurement
- MOU is signed with Kona Airport to provide SWAC and renewable/supplemental back-up power from NELHA to Airport

May 2009

NELHA to partner with DBEDT/HCEI to create study for the first Renewable Energy Zone, and then model more Renewable Energy Zones

January 2010

An energy technology microgrid/smartgrid test site is created at NELHA with the help of DOE–DBEDT/HCEI and HELCO-HNEI funding from Federal and State money

December 2012 – NELHA creates first Renewable Energy Park and the *Green Energy Model* = *GEM*

- ***GEM*** is brought to other islands in Hawaii
- …then to other Island Nations around the World

Appendix E. 1993 Strategic Plan - Executive Summary

EXECUTIVE SUMMARY

Two forces guide the Natural Energy Laboratory of Hawaii Authority (NELHA): the need for economic development and diversification in Hawaii, and the quest for natural resource utilization. World wide emphasis on the value of natural resources is increasing dramatically and the appropriate utilization of these resources is of significant concern. Hawaii has the advantage of favorable geophysical and bathymetric characteristics in the state which allow the study and promotion of ocean, solar and geothermal resources application. The locations of the two facilities under the management of the NELHA provide the opportunity to significantly contribute to the geothermal, solar and ocean resources industries while providing economic development and diversification. The strategic plan presented in this document was developed to provide guidance to the NELHA Board of Directors and staff as they take steps to realize this opportunity.

Strategic Plan Development The evolution and current status of NELHA were reviewed to ascertain the intent of the legislature and to evaluate past practices and the extent of NELHA's fulfillment of the legislative intent. This review also revealed the limited breadth of NELHA's reputation. While NELHA is well known in the aquaculture and OTEC industries, it is not well known in the biotechnology and solar industries.

Workshops and literature searches were used to determine the current status and anticipated future of industries which influence NELHA such as aquaculture, alternate energy, and biotechnology. The conclusions reached for these three particular areas were: 1) the market for specialized aquaculture - either high profit margin species or species that are at an advantage when cultured as toxic free products - will continue to grow; 2) there is a world wide demand for alternate energy development, specially from non-polluting, renewable sources; 3) biotechnology is a growing industry and a niche of that industry is in microalgae, suitable for development at NELHA. It was also recognized that use of geothermal heat for drying, plant propagation, sterilization, etc. is a non-polluting form of alternate energy utilization.

Objectives for NELHA were established using the NELHA mission statement and an evaluation of existing opportunities, threats, strengths, and weaknesses. The final step was to determine specific strategies to accomplish the objectives.

Evolution of the Natural Energy Laboratory of Hawaii Authority

In this section of the strategic plan, the history of NELHA is traced through its legislative history and the various environmental impact statements and master plans. From its beginning in 1974 as an outdoor laboratory at Keahole Point for

the study of OTEC, NELHA has become a center for research, development and commercial activities using natural resources at two facilities: Keahole Point and the Puna Research Center.

Graphs display the growth in number of tenants, acres of land utilized, tenants' revenues and employment and in capital investment. The graphs also indicate projected growth in these areas through fiscal year 1998 based on identified new projects and expansion of existing projects. The information presented shows that although tenant capital investment and revenues have shown significant increase, the growth in number of projects and land utilized has not accelerated as anticipated in the master plan.

Opportunities and Threats There are three circumstances in the world today that result in opportunities for NELHA. These are:

- *the inability to feed the people of the world,*
- *the continued degradation of the environment, and*
- *the finite supply of fossil fuels for energy production while energy demand continues to increase.*

Pertinent opportunities for NELHA are the need for research and commercial development in alternate energy, biotechnology, toxic free aquatic species, and other appropriate non-polluting uses of renewable natural resources.

The threat to NELHA's success is competition - competition for funding from governmental agencies and the anticipated competition from other Pacific islands as the potential for deep seawater is recognized.

Strengths and Weaknesses The greatest strength we have is our location. Both facilities are ideally located for access to the natural resources of the area. The Puna Research Center is situated in the geothermal resource area of the east rift zone; while Keahole Point is onshore of a steeply descending ocean floor allowing access to deep seawater. Keahole Point also has more insolation than any other coastal site in the United States.

The current lack of a geothermal heat resource is the principal weakness or problem at the Puna Research Center. Hawaii's high cost of living and doing business is the foremost identified weakness at Keahole Point. This condition plus the lack of available housing is a drawback for both research and commercial development at NELHA.

Other strengths and weaknesses are listed in the chapter.

Objectives for NELHA *Objectives were developed based on the history of NELHA, the status of pertinent industries, the opportunities, threats, strengths and weaknesses; and the message of the NELHA mission statement:*

> *"To develop and diversify the Hawaii economy by providing resources for energy and ocean related research and commercial activities in an environmentally sound and culturally sensitive manner."*

Each objective relates to particular functions within the organization and to specific facilities. These objectives are listed below for each facility. The strategies to accomplish the objectives follow each objective.

MARKETING OBJECTIVES:

Keahole Point - to attract and promote ocean and solar related research and commercial activities.

Puna - to promote research and pre-commercial applications of geothermal resources (heat, fluids, minerals); promote use of the Puna Research Center by other agencies in support of State objectives.

STRATEGIES

- *Develop a marketing plan for Keahole Point. This plan is to take into consideration the external and internal analyses developed in this document.*

  ACTION: By January 31, 1994, distribute a draft of the marketing plan for review by the Board.

- *Define the potential market for the Puna Research facility.*

  ACTION: Begin collaboration with energy and agriculture extension services, Hawaii County Economic Opportunity Council and other business and industry organizations to identify potential candidate activities. Survey regulatory agencies and private developers to determine needs and available fiscal support.

- *Develop and execute a sales/promotion program for the Keahole Point facility based on the marketing plan. The program should be sized to fit the available funds but have the flexibility to take advantage of future funds.*

ACTION: This goal depends on the completion of the marketing plan. Action should begin immediately upon approval of the marketing plan and be completed within six weeks.

INNOVATION OBJECTIVES:

Keahole Point - to facilitate and promote new and unique uses of the seawater and solar rays.

Puna - To facilitate and promote new and unique uses of the geothermal resource.

STRATEGIES

- *Utilize the available natural resources on site. The deep seawater, abundant sunshine and geothermal heat (when available) can be used by both NELHA and its tenants.*

  ACTION: Include in the orientation packages for prospective and new tenants a list of potential uses of the resources such as air conditioning, heating water, chilling water... Advise tenants of previously designed systems.

ORGANIZATION OBJECTIVES:

Keahole Point - to provide trained staff to operate the support facilities and infrastructure, market the property and services, provide services to tenants and other clients, and perform the required administrative and funding tasks.

Puna - to provide cost effective and productive staff assistance to ongoing projects at PRC.

STRATEGIES

- *Develop an organization chart based on the anticipated results of the marketing plan and the infrastructure plan. Project organizational needs over the next five years. The organization should be structured so that NELHA can provide quality services and support as indicated in the sales and promotion activities.*

  ACTION: This action is dependent on development of the marketing and infrastructure plans. Complete a draft

organizational chart with position descriptions and costs by June 1, 1994.

FINANCIAL RESOURCES OBJECTIVES:

Keahole Point - to increase funding and diversify funding sources.

Puna - to seek diversified funding from public and private sources.

STRATEGIES

- *Develop plan for soliciting funds from private and public sources other than the state government. Investigate possible private endowments.*

  ACTION: Prepare a draft funding plan by March 1, 1994.

- *Develop a financial plan for the next five years which estimates the cost of planned infrastructure development and organizational changes and projected occupancy. This plan should also include estimated revenues assuming the re-establishment of the special fund.*

  ACTION: This action is dependent on the marketing, infrastructure and organization plans. Complete the financial plan by August 1, 1994.

PHYSICAL RESOURCES OBJECTIVES:

Keahole Point - to provide infrastructure and support facilities/equipment suitable for optimal operation of NELHA and tenants.

Puna - to develop and maintain a heat resource. Provide a facility that can be jointly used by the local agricultural and business community, State and County regulatory personnel, and the geothermal industry for research, monitoring, and testing of geothermal applications and processes.

STRATEGIES

- *Design and install pipelines/power for vacated property adjacent to the NELHA compound at Keahole Point. This property has significant value because it is well developed. It is necessary to provide a source of surface seawater prior to locating tenant(s) on the property.*

ACTION: By December 31, 1993, install surface seawater pipeline between the main distribution pipeline on the makai side of the access road to the property on the mauka side. Utilize the previously installed under-road conduits.

- *Develop an infrastructure implementation plan for Keahole Point considering full buildout with efficient pipeline distribution systems, shell buildings for tenant buildout, and greenways. An implementation plan will allow an orderly development of roads, utility corridors, pipeline systems, and buildings. Consideration of distribution of deep seawater for air conditioning off-site should be included. With this plan, an estimate of anticipated infrastructure costs can be developed.*

  ACTION: Prepare a draft overall infrastructure plan by April 1, 1994.

- *Develop a phased facility modification plan for the Puna Research Center which incorporates the market analysis and considers available funding.*

  ACTION: Prepare a conceptual design for the Puna Research Center based on the results of the market and funding analysis by May 1, 1994. Concurrently, explore a collaborative program with CTAHR on Malama Ki agricultural research station property.

- *Secure a source of geothermal heat for the Puna Research Center.*

  ACTION: Upon determination that the HGP-A well remains in the control of NELHA, begin negotiations with PGV to dispose of PGV geothermal fluids. Concurrently, explore the feasibility of developing a second source of heat on site from shallow thermal wells.

PRODUCTIVITY OBJECTIVES:

Keahole Point - to increase the number of quality research and commercial tenants while improving the cost-effective utilization of staff and facilities to increase and upgrade services.

Puna - to increase the number of quality research and commercial tenants while improving the utilization of staff and facilities to increase and upgrade services.

STRATEGIES

- *Re-establish the Special Fund. The ability to use a special fund rather than budgeting for funding from the general fund with the revenues returning to the state general fund allows the NELHA to operate more efficiently. Efforts are toward a bottom line and toward less reliance on state funding. The special fund also provides the flexibility needed to respond to emergencies and to the addition of new tenants and expansions of existing tenants.*

  ACTION: By December 15, 1993, prepare justification for re-establishment of special fund. Use the justification in presentations to legislators and to prepare testimony for the legislative committees.

- *Develop a facility management plan for the Puna Research Center.*

  ACTION: By February 1, 1994, identify, prioritize and establish a system to track tasks and staff time.

- *Annually evaluate facility, services, and employees. Implement employee training program to correct any disclosed deficiencies and to upgrade capabilities of staff.*

  ACTION: By January 1, 1994, prepare and distribute a survey to the tenants requesting input on how we are doing, what new services are desired, and any preferred changes. Determine possible actions to meet requests. Prepare a report based on the survey for the annual meetings beginning in 1994.

- *Track and report to the Board: number of tenants, acres utilized, tenant employment and tenant revenues.*

  ACTION: Submit first tenant status report to the Board at the November, 1993 meeting. Update on a six months schedule.

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SOCIAL RESPONSIBILITY OBJECTIVES:

Keahole Point - to facilitate and develop educational and information programs for ocean and solar subjects which relate to NELHA activities. To operate the facility in an environmentally sound and culturally sensitive manner.

Puna - to provide opportunities for economically viable and environmentally compatible uses of geothermal fluids. Assist in the regulatory overview of the geothermal industry. Provide a center for information and education regarding geothermal utilization.

STRATEGIES

- *Develop an education program which may include developing a curriculum for use by DOE, a student intern program with the tenants, a high school science academy, and a summer program or Saturday academy with the university.*

  ACTION: Prepare a draft education program plan by February 1, 1994.

- *Educate the community and the visitor industry in the activities occurring at NELHA. Encourage community participation by hosting community organization meetings in order to better communicate the activities at NELHA.*

  ACTION: By March 1, 1994, prepare brochures specifically intended to educate the community and visitor industry about the facilities operated by NELHA. Review and update on an annual basis.

PROFIT REQUIREMENT OBJECTIVES:

Keahole Point - to provide a positive total economic impact to the community and state through generating revenues to NELHA, commercial tenant revenues and non-state employment.

Puna - to provide access to geothermal fluids for both research and development of economically viable applications of geothermal energy.

STRATEGIES

- *Establish a lease/rental fee structure which considers comparable facilities in Hawaii and the types of businesses and their anticipated profits.*

  ACTION: Distribute draft of plan to Board members in January, 1994. Re-evaluate the rent structure every three years.

Appendix F. Economic Analysis of Alternatives

Master Plan

3/19/2008

To: George Atta
Group 70

Re the evaluation of NELHA Alternatives.

At our meeting in February, we understand that the following alternative scenarios were established for consideration:

1. Continuation of Current Policies
2. Economic Driver with Research and Applied Technology
3. NELHA / US-DOE Research Campus
4. EPCOT / Edutourism Center

To follow up on the business aspects, some comments:

Re Alternative 1. Continuation of Current Policies

As shown below, NELHA operations are essentially self funding from land use fees, reimbursables, and percentage rents/ royalties.

REVENUES		**EXPENDITURES**	
General Funds		**General Funds**	
		Salaries	$0.00
State Funds*	$365,000.00	Kona Operations*	$365,000.00
Subtotal	$365,000.00	Subtotal	$365,000.00
Special Funds		**Special Funds**	
Land Use Fees	$1,156,526.49	Salaries	$1,378,760.63
Royalties	$162,000.00	Operations (including OHA transfers)	$1,906,716.21
Reimbursable	$2,136,841.88		
Interest Received	$91,443.61		
Percentage Rents	$101,795.95		
Subtotal	$3,648,607.93	Subtotal	$3,285,476.84
TOTAL	$4,013,607.93	TOTAL	$3,650,476.84

*Legislative subsidy to aquaculture tenants

Annual operating revenues exceed expenditures by about $ 363,000.

By taking this model and developing out the existing lotting scheme as a light industrial subdivision, NELHA is unlikely to show a positive return on investment. But more importantly, this alternative does not take advantage of the commercial opportunities inherent to the Highway frontage and proximity to the airport. In addition, based on current lease up patterns it will have an extended absorption period and does not address nor fulfill the mission of NELHA.

Re Alternative 2: Economic Driver with Research and Applied Technology

This alternative takes advantage of the commercial opportunities in the NELHA location and combines that with a Research Village and business incubator role that expands NELHA's market and encourages future tenants. With this in mind, we have prepared ballpark" economic estimates as follows:

Application Technology Area: I would use a retail land value of about $12 per square foot on a gross basis - which would be about $16/ net square foot using a 75% utilization factor over 360 acres. These parameters would yield a net retail value of the light industrial/ commercial lots at buildout of $188 million. At this point, there are two alternative development strategies. In the first case, it is assumed that NELHA contracts with an outside development entity. Under this scenario, we estimate that the raw land value would be round 28% of retail value, or about $52.7 million. Assuming a lease rate of 7%, this would yield about $3.7 million in annual income to NELHA. The second alternative is for NELHA to act as its own developer (which seems reasonable, since these land uses are very similar to what it has already developed. Under this scenario development costs should be in the range of $125,000 per gross acre, or about $45 million (These factors could vary substantially depending upon the size of the individual parcels that will eventually be developed). Subtracting development costs from retail land value yields a gross margin of around $143 million, with absorption probably over a 15 year time frame. On a lease basis, a 7% discount rate applied to land value would provide an annual lease income of about $13.2 million at buildout. Assuming property management costs are 10% of lease revenue, this yields an annual operating income of $11.9 million from the Application area. The NELHA development scenario has an estimated annual return of 26% on development costs.

Applying a similar analysis to the 135 acre Economic Driver area, gross commercial land values could be in the $28 per square foot range, which would be around $42 per net square foot using a 67% utilization factor. This yields a retail land value of just under $110 million. Again assuming a 28% ratio for raw land value, yields a raw land value of $30.7 million. This yields $2.1 million in annual lease income to NELHA from the Economic Driver area. Because of the specialized nature of the development in this area, the development of this land use would more likely be better suited to an outside development entity - with suitable controls and oversight provided by NELHA.

I have summarized these calculations in the below Excel table.

Economic Considerations of NELHA Development Strategy

	Land Use Designation	
	Application Area	Education Area
Acres	360	135
Efficiency	75%	67%
Net acres	270	90
SF	11,761,200	3,916,480
Price per gross SF	$ 12.00	$ 28.00
Price per net SF	$ 16.00	$ 42.04
Retail land value	$ 188,179,200	$ 109,661,429
% raw land value	28%	28%
Raw land value	$ 52,690,176	$ 30,705,200
Lease rate	7%	7%
Lease income	$ 3,688,312	$ 2,149,364
NELHA Development Alternative		
Development cost per acre	$ 125,000	
Development cost	$ 45,000,000	
Gross Margin	$ 143,179,200	
Retail land value	$ 188,179,200	
Lease Rate	7%	
Lease Income	$ 13,172,544	
Property Management Costs	$ 1,317,254	
Operating Income	$ 11,855,290	
Annual return on Investment	26%	

Alternative 3: NELHA / US-DOE Research Campus

We anticipate that NELHA can develop a broader base of operational support through on site partnerships with other energy and ocean research institutions as well as like minded foundations. In terms of an economic model, however, this can be contained within the development strategy of Alternative 2. By fostering relationships with potential Research Partners (such as UH SOEST Group, UH Center for Sustainable Design, NREL, Cornell Sustainability, Scripps Institute, Woods Hole, Monterey By Aquarium, JAMSTEC, NASA, CEROS, NOAA, and SHELL OIL) NELHA should build a constituency of support that will extend its market reach, shorten the absorption period and provide additional support for the business incubator and research village activities.

Alternative 4: EPCOT / Edutourism Center

The Edutourism Center is certainly an innovative concept, but it is our experience that such a center requires either a critical mass of complementary attractions (e.g., EPCOT in Orlando, Florida) or a substantial nearby permanent resident population (e.g., theme parks near major cities) in order to sustain visitation and hence feasibility. Nevertheless, certain elements of the Edutourism concept which stress sustainability and organic practices (which do not require mass attendance) can be incorporated within the economic driver concept, and we highly recommend that they be encouraged as potential tenants.

As we understand it, the NELHA BOD requested alternatives two and three be combined into a final master plan concept, an Energy and Ocean Research Park.

Appendix G. Lease Rate Alternatives

The following financial alternatives analyze the effects of bringing the base case lease rates in the AT, EZ, RE, and CT Zones closer to the commercial market rates in the ED Zone. Whereas lease rates in the ED Zone are set at commercial rates, the lease rates for the other zones have been reduced by suggested Zone adjustment factors. In the base case, the lease rates are set at 55% of market for the AT and EZ zones, 40% for the RE zone, and 25% for the CT zone. In Alternative 1, these preferential lease rates are increased to 65% of market for the AT and EZ zones, 45% for the RE zone, and 30% for the CT zone. In Alternative 2, the lease rates are further increased to 75% of market for the AT and EZ zones, 50% for the RE zone, and remain at 30% for the CT zone. These lease rate policy changes result in the following changes in the overall IRR

Effects of Alternatives in Preferential Rate Structure

	Zone					IRR	
	AT	EZ	ED	RE	CT	Before Fees	After Fees
Base Case	55%	55%	100%	40%	25%	8%	1%
Alternative 1	65%	65%	100%	45%	30%	10%	3%
Alternative 2	75%	75%	100%	50%	30%	12%	5%

As shown, the IRR is increased substantially by a lease rate structure that brings rates in the AT, EZ, RE, and CT zones closer to market.

NELHA Lease Rate Alternative 1

Benchmark Rental Rates for NELHA Master Plan

ED Zone			
Parcel Size	Lease Rate/ SF	$/ Acre	Annual Rent
Less than 2	$ 0.84	$ 36,590	$ 73,181
3	$ 0.76	$ 32,931	$ 98,794
4	$ 0.68	$ 29,638	$ 118,553
5	$ 0.61	$ 26,674	$ 133,372
6	$ 0.55	$ 24,007	$ 144,042
7	$ 0.50	$ 21,606	$ 151,244
8	$ 0.45	$ 19,446	$ 155,565
9	$ 0.40	$ 17,501	$ 157,510
10	$ 0.36	$ 15,751	$ 157,510
10 to15	$ 0.33	$ 14,176	$ 177,198
15 to 20	$ 0.29	$ 12,758	$ 223,270
20+	$ 0.26	$ 11,482	$ 258,355
Zone Adjustment Factors			
AT Zone	65%		
EZ Zone	65%		
RE Zone	45%		
CT Zone	30%		

Anticipated Lease Revenue from NELHA Master Plan Implementation

Zone	Lot #		Area		Lease Rate		Annual Rent
			Square Feet	Acres	$/square foot	$/acre	
Phase 1							
AT	1	Light Industrial	196,167	4.5	$ 0.44	$ 19,265	$ 86,757
	2	Light Industrial	265,716	6.1	$ 0.36	$ 15,605	$ 95,188
	3	Light Industrial	230,868	5.3	$ 0.40	$ 17,338	$ 91,893
	4	Light Industrial	348,480	8.0	$ 0.29	$ 12,640	$ 101,117
	5	Light Industrial	1,239,125	28.4	$ 0.17	$ 7,464	$ 212,312
	6	Light Industrial	334,144	7.7	$ 0.32	$ 14,044	$ 107,731
	Subtotal		2,614,500	60			$ 694,998
EZ	1	Hawaii Bioenergy (poss.)	1,415,143	32.5	$ 0.17	$ 7,464	$ 242,471
	2	Light Industrial	135,036	3.1	$ 0.49	$ 21,405	$ 66,357
	3	Light Industrial	135,036	3.1	$ 0.49	$ 21,405	$ 66,357
	Subtotal		1,685,215.0	38.7			$ 132,713
Subtotal			4,299,715	98.7			$ 827,711
Existing	K-10	Moana Technologies	497,017	11.4			
	K-12	Enzamin	134,427	3.1			
	K-13	Oceanic Institute	174,563	4.0			
	K-14	Koyo	1,305,675	30.0			
	K-17	HDMI	195,344	4.5			
	K-18	Savers Holdings	261,722	6.0			
	Subtotal		2,568,748	59.0			
Total Phase 1			6,868,463	157.7			
Phase 2							
AT	1	Light Industrial	370,095	8.5	$ 0.29	$ 12,640	$ 107,389
	2	Light Industrial	270,072	6.2	$ 0.36	$ 15,605	$ 96,748
	3	Light Industrial	252,107	5.8	$ 0.40	$ 17,338	$ 100,347
	4	Light Industrial	174,240	4.0	$ 0.44	$ 19,265	$ 77,059
	5	Light Industrial	169,884	3.9	$ 0.49	$ 21,405	$ 83,481
	Subtotal		1,236,398	28.4			$ 465,025
EZ	4	Light Industrial	222,156	5.1	$ 0.40	$ 17,338	$ 88,426
	5	Light Industrial	243,936	5.6	$ 0.40	$ 17,338	$ 97,095
	6	Light Industrial	161,172	3.7	$ 0.49	$ 21,405	$ 79,200
	7	Light Industrial	160,666	3.7	$ 0.49	$ 21,405	$ 78,951
	8	Light Industrial	474,804	10.9	$ 0.21	$ 9,214	$ 100,436
	Subtotal		1,262,734	29.0			$ 444,108
ED		(Includes Ocean and Energy/ Sustainability Mall, Research Inn, Incubator Building, Offices and Conf. Center)					
	1	Community Commercial	710,028	16.3	$ 0.84	$ 36,590	$ 596,424
	2	Community Commercial	814,572	18.7	$ 0.84	$ 36,590	$ 684,240
	3	Offices	1,014,948	23.3	$ 0.84	$ 36,590	$ 852,556
	4	Research Inn, Incubator, Off.	710,028	16.3	$ 0.50	$ 21,896	$ 356,906
	5	Community Commercial	161,172	3.7	$ 0.84	$ 36,590	$ 135,384
		Base Rent	3,410,748	78.3			$ 2,625,511
		Percentage Participation					$ 85,203
	Subtotal		5,909,880	135.7			$ 3,619,847
Existing	EZ	Gateway	209,088	4.8			
	EZ	WHEA	74,052	1.7	$ 0.07	$ 2,838	$ 4,824
	EZ	Sopogy	174,240	4.0	$ 0.17	$ 7,200	$ 28,800
	Subtotal		457,380	10.5			
Total Phase 2			6,367,260	146.2			

Anticipated Lease Revenue from NELHA Master Plan Implementation

Zone	Lot #		Area		Lease Rate		Annual Rent
			Square Feet	Acres	$/square foot	$/acre	
Phase 3							
RE	K-11	NELHA Research Comp.	409,464	9.4			
Existing	K-3	Royal Hwn Sea Farms	130,680	3.0			
	K-4	Cyanotech	3,968,316	91.1			
	K-5	Uwajima Fisheries	174,240	4.0			
	K-7	Kona Cold Lobsters	52,779	1.2			
	K-8	High Health Aquaculture	95,832	2.2			
	K-9	Ocean Rider	91,476	2.1			
	K-15	KBWF	100,188	2.3			
	K-20	Kona Bay Marine	283,140	6.5			
	K-23	Kona Coast Shellfish	148,104	3.4			
	K-26	Cellana	270,769	6.2			
	K-27A	Unlimited Aquaculture	400,752	9.2			
	K-27B	Unlimited Aquaculture	52,272	1.2			
	K-28	Mera Pharmaceuticals	243,936	5.6			
		Taylor Shellfish	265,716	6.1			
		Indo Pacific	47,916	1.1			
Vacant Lots (8)			409,464	9.4	$ 0.38	$ 16,466	$ 154,777
	Subtotal		6,735,580	154.6			$ 154,777
Total Phase 3			7,145,044	164.0			$ 154,777
Phase 4							
CT	1	Community Commercial	396,396	9.1	$ 0.12	$ 5,250	$ 47,778
	2	Community Commercial	357,192	8.2	$ 0.13	$ 5,834	$ 47,836
	3	Community Commercial	579,348	13.3	$ 0.10	$ 4,253	$ 56,562
	Subtotal		1,332,936	30.6			$ 152,176
AT	1	Light Industrial	313,632	7.2	$ 0.32	$ 14,044	$ 101,117
	2	Light Industrial	283,140	6.5	$ 0.36	$ 15,605	$ 101,429
	3	Light Industrial	396,396	9.1	$ 0.26	$ 11,376	$ 103,519
	4	Light Industrial	200,376	4.6	$ 0.44	$ 19,265	$ 88,618
	5	Light Industrial	226,512	5.2	$ 0.40	$ 17,338	$ 90,159
	6	Light Industrial	204,732	4	$ 0.44	$ 19,265	$ 90,545
	7	Light Industrial	257,004	5.9	$ 0.40	$ 17,338	$ 102,296
	8	Light Industrial	235,224	5.4	$ 0.40	$ 17,338	$ 93,627
	9	Light Industrial	217,800	5.0	$ 0.40	$ 17,338	$ 86,692
	10	Light Industrial	222,156	5.1	$ 0.40	$ 17,338	$ 88,426
	11	Light Industrial	217,800	5.0	$ 0.40	$ 17,338	$ 86,692
			2,774,772	63.7			$ 1,033,121
Subtotal			4,107,708	94.3			$ 1,185,297
Existing	K-6	Big Island Abalone	435,072	10.0			
	K-19	Deep Seawater Int'l	871,211	20.0	$ 0.06	$ 2,400	$ 48,000
	K-24	Noritech Hawaii	239,580	5.5	$ 0.14	$ 6,000	$ 33,000
Subtotal			1,545,863	35.5			
Total Phase 4			5,653,571	129.8			

Anticipated Lease Revenue from NELHA Master Plan Implementation

Zone	Lot #		Area		Lease Rate		Annual Rent
			Square Feet	Acres	$/square foot	$/acre	
Phase 5							
RE	1	Light Industrial	1,315,512	30.2	$ 0.12	$ 5,167	$ 156,047
	2	Light Industrial	592,416	13.6	$ 0.15	$ 6,379	$ 86,756
	3	Light Industrial	566,280	13.0	$ 0.15	$ 6,379	$ 82,929
	4	Light Industrial	696,960	16.0	$ 0.13	$ 5,741	$ 91,860
Total Phase 5			3,171,168	72.8			$ 417,591
Total Leases			29,205,506	670.5			
		Arch Site	492,228	11.3			
		Arch Site	662,112	15.2			
		Utilities	431,244	9.9			
		Other Lands	7,106,110	163.1			
Grand Total			36,311,616	870.0			$ 6,205,224
Base Rents for Existing Tenants							$ -
		Unimproved	$ 2,400	per acre	$ 0.06	psf	
		Improved	$ 6,000	per acre	$ 0.14	psf	
Percentage Rents			2%	of sales			

NELHA Development Program

	Phase											
	1		2		3		4		5		Total	
	Parcels	Acres	Parcels	Acres	Parcels	Acres	Parcels	Acres	Parcels	Acres	Parcels	Acres
New Development												
AT	6	60.0	5	28.4			11	63.7			22	152.1
EZ	3	38.7	5	29.0							8	67.7
ED			5	78.3							5	78.3
RE					8	9.4			4	72.8	12	82.2
CT							3	30.6			3	30.6
Subtotal	9	98.7	15	135.7	8	9.4	14	94.3	4	72.8	50	410.9
Existing Development	6	59.0	3	10.5	15	154.6	3	35.5			27	259.6
Total	15	157.7	18	146.2	23	164.0	17	129.8	4	72.8	77	670.5
Utilities and Archeology Sites						11.3		25.1				36.4
Other Lands												163.1
Total Land												870.0

NELHA Lease Revenue Buildup by Phase

($000)

	Phase																	
	1			2			3			4			5			Total		
	Parcels	Acres	Lease $	Parcels	Acres	Lease $	Parcels	Acres	Lease $	Parcels	Acres	Lease $	Parcels	Acres	Lease $	Parcels	Acres	Lease $
New Development																		
AT Base	6	60.0	$ 695	5	28.4	$ 465				11	63.7	$ 1,033				22	152.1	$ 2,193
AT %			$ 185			$ 124						$ 275						$ 585
AT Total			$ 880			$ 589						$ 1,309						$ 2,778
EZ Base	3	38.7	$ 133	5	29.0	$ 444										8	67.7	$ 577
EZ %			$ 35			$ 118												$ 154
EZ Total			$ 168			$ 563												$ 731
ED (Base + %)				5	78.3	$ 2,711										5	78.3	$ 2,711
RE							8	9.4	$ 155				4	72.8	$ 418	12	82.2	$ 572
CT										3	30.6	$ 152				3	30.6	$ 152
Subtotal New Leases	9	98.7	$ 1,048	15	135.7	$ 3,862	8	9.4	$ 155	14	94.3	$ 1,461	4	72.8	$ 418	50	410.9	$ 6,944
2008/9 Leases				2	5.7	$ 34				2	25.5	$ 81				4	31.2	$ 115
Existing Development	6	59.0		1	4.8		15	154.6		1	10.0					23	228.4	
Total	15	157.7	$ 1,048	18	146.2	$ 3,896	23	164.0	$ 155	17	129.8	$ 1,542	4	72.8	$ 418	77	670.5	$ 7,059
Utilities and Archaeology Sites								11.3			25.1						36.4	
Other Lands																	163.1	
Total Land		157.7			146.2			175.3			154.9			72.8			870.0	

Absorption, Lease Revenue, and Development Cost Schedule

		Land Leases		Lease Revenue				Development Costs ($000)						
Zone	Phase/ Year	Number of Parcels	Acres	Annual Increment ($000)	Cumulative ($000)	Per Acre Per Month	Average	Infrastructure Costs	Mobilization	Contingency	Total	Seawater Allocation Fee	Increment	Cumulative
	Phase 1								10%	15%				
AT	1	3	30.0	$ 440		$ 1,222						10%	$ 44	
EZ	1	1.5	19.3	$ 84	$ 524	$ 362	$ 885	$ 8,960	$ 896	$ 1,478	$11,335		$ -	$ 44
AT	2	3	30.0	$ 440		$ 1,222			$ -	$ -	$ -	10%	$ 44	$ 88
EZ	2	1.5	19.3	$ 84	$ 1,048	$ 362	$ 885	$ 8,960	$ 896	$ 1,478	$11,335		$ -	
	Phase 2													
AT	1	2	11.4	$ 236		$ 1,729			$ -	$ -	$ -	10%	$ 24	
EZ	1	2	11.6	$ 225		$ 1,617			$ -	$ -	$ -		$ -	
ED	1	2	31.3	$ 1,084	$ 2,593	$ 2,885	$ 1,413	$ 4,304	$ 430	$ 710	$ 5,444	3%	$ 33	$ 144
AT	2	2	11.4	$ 236		$ 1,729			$ -	$ -	$ -	10%	$ 24	
EZ	2	2	11.6	$ 225		$ 1,617			$ -	$ -	$ -		$ -	
ED	2	2	31.3	$ 1,084	$ 4,138	$ 2,885	$ 1,664	$ 4,304	$ 430	$ 710	$ 5,444	3%	$ 33	$ 200
AT	3	1	5.7	$ 118		$ 1,729			$ -	$ -	$ -	10%	$ 12	
EZ	3	1	5.8	$ 113		$ 1,617			$ -	$ -	$ -		$ -	
ED	3	1	15.7	$ 542	$ 4,911	$ 2,885	$ 1,746	$ 4,304	$ 430	$ 710	$ 5,444	3%	$ 16	$ 228
	Phase 3													
RE	1	4	4.7	$ 77	$ 4,988	$ 1,372	$ 1,739	$ 3,336	$ 334	$ 550	$ 4,220	8%	$ 6	$ 228
RE	2	4	4.7	$ 77	$ 5,065	$ 1,372	$ 1,732	$ 3,336	$ 334	$ 550	$ 4,220	8%	$ 6	$ 234
	Phase 4													
AT	1	4	23.2	$ 476		$ 1,712			$ -	$ -	$ -	10%	$ 48	$ 282
CT	1	1	10.2	$ 51	$ 5,592	$ 414	$ 1,681	$ 1,278	$ 128	$ 211	$ 1,617		$ -	
AT	2	4	23.2	$ 476		$ 1,712			$ -	$ -	$ -	10%	$ 48	$ 330
CT	2	1	10.2	$ 51	$ 6,119	$ 414	$ 1,642	$ 1,278	$ 128	$ 211	$ 1,617		$ -	
AT	3	3	17.4	$ 357		$ 1,712			$ -	$ -	$ -	10%	$ 36	$ 365
CT	3	1	10.2	$ 51	$ 6,526	$ 414	$ 1,609	$ 1,278	$ 128	$ 211	$ 1,617		$ -	
	Phase 5													
RE	1	1	30.2	$ 123	$ 6,649	$ 339	$ 1,505	$ 1,006	$ 101	$ 166	$ 1,272	20%	$ 25	$ 390
RE	2	1	13.6	$ 123	$ 6,772	$ 753	$ 1,478	$ 1,006	$ 101	$ 166	$ 1,272	20%	$ 25	$ 414
RE	3	1	13.0	$ 123	$ 6,895	$ 787	$ 1,455	$ 1,006	$ 101	$ 166	$ 1,272	20%	$ 25	$ 439
RE	4	1	16.0	$ 49	$ 6,944	$ 256	$ 1,408	$ 1,006	$ 101	$ 166	$ 1,272	20%	$ 10	$ 449
Total		50	410.9		$ 68,765		$ 1,408	$ 45,361	$ 4,536	$ 7,484	$57,381			$ 3,836

Incremental NELHA Cash Flow Before Fees ($000)									
Year		1	2	3	4	5	6	7	8
Lease Revenue		$ 639	$ 1,163	$ 2,708	$ 4,253	$ 5,025	$ 5,103	$ 5,180	$ 5,707
Capitalized Value	8%								
Seawater Allocation Fee		$ 44	$ 88	$ 144	$ 200	$ 228	$ 228	$ 234	$ 282
Infrastructure Costs		$ 11,335	$ 11,335	$ 5,444	$ 5,444	$ 5,444	$ 4,220	$ 4,220	$ 1,617
Operating Costs	25%	$ 160	$ 291	$ 677	$ 1,063	$ 1,256	$ 1,276	$ 1,295	$ 1,427
Exist Tenant Adj.		$ 161	$ 321	$ 482	$ 642	$ 803	$ 803	$ 803	$ 803
Reinvestment Allowance	2%	$ 227	$ 453	$ 562	$ 671	$ 780	$ 864	$ 949	$ 981
Cash Flow		$ (10,878)	$ (10,507)	$ (3,350)	$ (2,083)	$ (1,424)	$ (227)	$ (247)	$ 2,767
Cumulative Cash Flow		$ (10,878)	$ (21,385)	$ (24,734)	$ (26,817)	$ (28,242)	$ (28,468)	$ (28,715)	$ (25,949)
		9	10	11	12	13	14	15	Total
Lease Revenue		$ 6,233	$ 6,641	$ 6,764	$ 6,887	$ 7,009	$ 7,059	$ 7,059	$ 77,429
Capitalized Value								$ 88,231	$ 88,231
Seawater Allocation Fee		$ 330	$ 365	$ 390	$ 414	$ 439	$ 449	$ 6,059	$ 9,896
Infrastructure Costs		$ 1,617	$ 1,617	$ 1,272	$ 1,272	$ 1,272	$ 1,272	$ -	$ 57,381
Operating Costs	25%	$ 1,558	$ 1,660	$ 1,691	$ 1,722	$ 1,752	$ 1,765	$ 23,822	$ 41,415
Exist Tenant Adj.		$ 803	$ 803	$ 803	$ 803	$ 803	$ 803	$ 10,834	$ 20,465
Reinvestment Allowance	2%	$ 1,014	$ 1,046	$ 1,071	$ 1,097	$ 1,122	$ 1,148	$ 15,493	$ 27,478
Cash Flow		$ 3,177	$ 3,486	$ 3,922	$ 4,013	$ 4,104	$ 4,125	$ 62,034	$ 58,912
Cumulative Cash Flow		$ (22,772)	$ (19,286)	$ (15,364)	$ (11,351)	$ (7,247)	$ (3,122)	$ 58,912	
IRR	10%								

Incremental NELHA Cash Flow After Fees ($000)									
Year		1	2	3	4	5	6	7	8
NELHA Cash Flow Before Fees		$ (10,878)	$ (10,507)	$ (3,350)	$ (2,083)	$ (1,424)	$ (227)	$ (247)	$ 2,767
DBED	5%	$ 34	$ 63	$ 143	$ 223	$ 263	$ 267	$ 271	$ 299
OHA	20%	$ 137	$ 250	$ 570	$ 891	$ 1,051	$ 1,066	$ 1,083	$ 1,198
Total Fees		$ 171	$ 313	$ 713	$ 1,113	$ 1,313	$ 1,333	$ 1,354	$ 1,497
NELHA Cash Flow After Fees		$ (11,049)	$ (10,820)	$ (4,063)	$ (3,196)	$ (2,738)	$ (1,560)	$ (1,601)	$ 1,270
		9	10	11	12	13	14	15	Total
NELHA Cash Flow Before Fees		$ 3,177	$ 3,486	$ 3,922	$ 4,013	$ 4,104	$ 4,125	$ 62,034	$ 58,912
DBED	5%	$ 328	$ 350	$ 358	$ 365	$ 372	$ 375	$ 5,067	$ 8,778
OHA	20%	$ 1,313	$ 1,401	$ 1,431	$ 1,460	$ 1,490	$ 1,501	$ 20,270	$ 35,111
Total Fees		$ 1,641	$ 1,752	$ 1,788	$ 1,825	$ 1,862	$ 1,877	$ 25,337	$ 43,889
NELHA Cash Flow After Fees		$ 1,536	$ 1,734	$ 2,133	$ 2,188	$ 2,242	$ 2,249	$ 36,696	$ 15,023
IRR	3%								

NELHA Lease Rate Alternative 2

Benchmark Rental Rates for NELHA Master Plan

ED Zone			
Parcel Size	Lease Rate/ SF	$/ Acre	Annual Rent
Less than 2	$ 0.84	$ 36,590	$ 73,181
3	$ 0.76	$ 32,931	$ 98,794
4	$ 0.68	$ 29,638	$ 118,553
5	$ 0.61	$ 26,674	$ 133,372
6	$ 0.55	$ 24,007	$ 144,042
7	$ 0.50	$ 21,606	$ 151,244
8	$ 0.45	$ 19,446	$ 155,565
9	$ 0.40	$ 17,501	$ 157,510
10	$ 0.36	$ 15,751	$ 157,510
10 to15	$ 0.33	$ 14,176	$ 177,198
15 to 20	$ 0.29	$ 12,758	$ 223,270
20+	$ 0.26	$ 11,482	$ 258,355
Zone Adjustment Factors			
AT Zone	75%		
EZ Zone	75%		
RE Zone	50%		
CT Zone	30%		

Anticipated Lease Revenue from NELHA Master Plan Implementation

Zone	Lot #		Area		Lease Rate		
			Square Feet	Acres	$/square foot	$/acre	Annual Rent
Phase 1							
AT	1	Light Industrial	196,167	4.5	$ 0.51	$ 22,229	$ 100,104
	2	Light Industrial	265,716	6.1	$ 0.41	$ 18,005	$ 109,832
	3	Light Industrial	230,868	5.3	$ 0.46	$ 20,006	$ 106,031
	4	Light Industrial	348,480	8.0	$ 0.33	$ 14,584	$ 116,674
	5	Light Industrial	1,239,125	28.4	$ 0.20	$ 8,612	$ 244,976
	6	Light Industrial	334,144	7.7	$ 0.37	$ 16,205	$ 124,304
	Subtotal		2,614,500	60			$ 801,921
EZ	1	Hawaii Bioenergy (poss.)	1,415,143	32.5	$ 0.20	$ 8,612	$ 279,775
	2	Light Industrial	135,036	3.1	$ 0.57	$ 24,699	$ 76,565
	3	Light Industrial	135,036	3.1	$ 0.57	$ 24,699	$ 76,565
	Subtotal		1,685,215.0	38.7			$ 153,131
Subtotal			4,299,715	98.7			$ 955,052
Existing	K-10	Moana Technologies	497,017	11.4			
	K-12	Enzamin	134,427	3.1			
	K-13	Oceanic Institute	174,563	4.0			
	K-14	Koyo	1,305,675	30.0			
	K-17	HDMI	195,344	4.5			
	K-18	Savers Holdings	261,722	6.0			
	Subtotal		2,568,748	59.0			
Total Phase 1			6,868,463	157.7			
Phase 2							
AT	1	Light Industrial	370,095	8.5	$ 0.33	$ 14,584	$ 123,911
	2	Light Industrial	270,072	6.2	$ 0.41	$ 18,005	$ 111,632
	3	Light Industrial	252,107	5.8	$ 0.46	$ 20,006	$ 115,785
	4	Light Industrial	174,240	4.0	$ 0.51	$ 22,229	$ 88,915
	5	Light Industrial	169,884	3.9	$ 0.57	$ 24,699	$ 96,324
	Subtotal		1,236,398	28.4			$ 536,567
EZ	4	Light Industrial	222,156	5.1	$ 0.46	$ 20,006	$ 102,030
	5	Light Industrial	243,936	5.6	$ 0.46	$ 20,006	$ 112,032
	6	Light Industrial	161,172	3.7	$ 0.57	$ 24,699	$ 91,385
	7	Light Industrial	160,666	3.7	$ 0.57	$ 24,699	$ 91,098
	8	Light Industrial	474,804	10.9	$ 0.24	$ 10,632	$ 115,888
	Subtotal		1,262,734	29.0			$ 512,432
ED		(Includes Ocean and Energy/ Sustainability Mall, Research Inn, Incubator Building, Offices and Conf. Center)					
	1	Community Commercial	710,028	16.3	$ 0.84	$ 36,590	$ 596,424
	2	Community Commercial	814,572	18.7	$ 0.84	$ 36,590	$ 684,240
	3	Offices	1,014,948	23.3	$ 0.84	$ 36,590	$ 852,556
	4	Research Inn, Incubator, Off.	710,028	16.3	$ 0.50	$ 21,896	$ 356,906
	5	Community Commercial	161,172	3.7	$ 0.84	$ 36,590	$ 135,384
		Base Rent	3,410,748	78.3			$ 2,625,511
		Percentage Participation					$ 85,203
	Subtotal		5,909,880	135.7			$ 3,759,713
Existing	EZ	Gateway	209,088	4.8			
	EZ	WHEA	74,052	1.7	$ 0.07	$ 2,838	$ 4,824
	EZ	Sopogy	174,240	4.0	$ 0.17	$ 7,200	$ 28,800
	Subtotal		457,380	10.5			
Total Phase 2			6,367,260	146.2			

Anticipated Lease Revenue from NELHA Master Plan Implementation

Zone	Lot #		Area		Lease Rate		Annual Rent
			Square Feet	Acres	$/square foot	$/acre	
Phase 3							
RE	K-11	NELHA Research Comp.	409,464	9.4			
Existing	K-3	Royal Hwn Sea Farms	130,680	3.0			
	K-4	Cyanotech	3,968,316	91.1			
	K-5	Uwajima Fisheries	174,240	4.0			
	K-7	Kona Cold Lobsters	52,779	1.2			
	K-8	High Health Aquaculture	95,832	2.2			
	K-9	Ocean Rider	91,476	2.1			
	K-15	KBWF	100,188	2.3			
	K-20	Kona Bay Marine	283,140	6.5			
	K-23	Kona Coast Shellfish	148,104	3.4			
	K-26	Cellana	270,769	6.2			
	K-27A	Unlimited Aquaculture	400,752	9.2			
	K-27B	Unlimited Aquaculture	52,272	1.2			
	K-28	Mera Pharmaceuticals	243,936	5.6			
		Taylor Shellfish	265,716	6.1			
		Indo Pacific	47,916	1.1			
Vacant Lots (8)			409,464	9.4	$ 0.42	$ 18,295	$ 171,975
	Subtotal		6,735,580	154.6			$ 171,975
Total Phase 3			7,145,044	164.0			$ 171,975
Phase 4							
CT	1	Community Commercial	396,396	9.1	$ 0.12	$ 5,250	$ 47,778
	2	Community Commercial	357,192	8.2	$ 0.13	$ 5,834	$ 47,836
	3	Community Commercial	579,348	13.3	$ 0.10	$ 4,253	$ 56,562
	Subtotal		1,332,936	30.6			$ 152,176
AT	1	Light Industrial	313,632	7.2	$ 0.37	$ 16,205	$ 116,674
	2	Light Industrial	283,140	6.5	$ 0.41	$ 18,005	$ 117,034
	3	Light Industrial	396,396	9.1	$ 0.30	$ 13,126	$ 119,445
	4	Light Industrial	200,376	4.6	$ 0.51	$ 22,229	$ 102,252
	5	Light Industrial	226,512	5.2	$ 0.46	$ 20,006	$ 104,030
	6	Light Industrial	204,732	4.7	$ 0.51	$ 22,229	$ 104,475
	7	Light Industrial	257,004	5.9	$ 0.46	$ 20,006	$ 118,034
	8	Light Industrial	235,224	5.4	$ 0.46	$ 20,006	$ 108,031
	9	Light Industrial	217,800	5.0	$ 0.46	$ 20,006	$ 100,029
	10	Light Industrial	222,156	5.1	$ 0.46	$ 20,006	$ 102,030
	11	Light Industrial	217,800	5.0	$ 0.46	$ 20,006	$ 100,029
			2,774,772	63.7			$ 1,192,063
Subtotal			4,107,708	94.3			$ 1,344,238
Existing	K-6	Big Island Abalone	435,072	10.0			
	K-19	Deep Seawater Int'l	871,211	20.0	$ 0.06	$ 2,400	$ 48,000
	K-24	Noritech Hawaii	239,580	5.5	$ 0.14	$ 6,000	$ 33,000
Subtotal			1,545,863	35.5			
Total Phase 4			5,653,571	129.8			

Anticipated Lease Revenue from NELHA Master Plan Implementation

Zone	Lot #		Area: Square Feet	Area: Acres	Lease Rate: $/square foot	Lease Rate: $/acre	Annual Rent
Phase 5							
RE	1	Light Industrial	1,315,512	30.2	$ 0.13	$ 5,741	$ 173,385
	2	Light Industrial	592,416	13.6	$ 0.16	$ 7,088	$ 96,396
	3	Light Industrial	566,280	13.0	$ 0.16	$ 7,088	$ 92,143
	4	Light Industrial	696,960	16.0	$ 0.15	$ 6,379	$ 102,066
Total Phase 5			3,171,168	72.8			$ 463,990
Total Leases			29,205,506	670.5			
		Arch Site	492,228	11.3			
		Arch Site	662,112	15.2			
		Utilities	431,244	9.9			
		Other Lands	7,106,110	163.1			
Grand Total			36,311,616	870.0			$ 6,694,969
Base Rents for Existing Tenants							$ -
		Unimproved	$ 2,400	per acre	$ 0.06	psf	
		Improved	$ 6,000	per acre	$ 0.14	psf	
Percentage Rents			2%	of sales			

NELHA Development Program

	Phase											
	1		2		3		4		5		Total	
	Parcels	Acres	Parcels	Acres	Parcels	Acres	Parcels	Acres	Parcels	Acres	Parcels	Acres
New Development												
AT	6	60.0	5	28.4			11	63.7			22	152.1
EZ	3	38.7	5	29.0							8	67.7
ED			5	78.3							5	78.3
RE					8	9.4			4	72.8	12	82.2
CT							3	30.6			3	30.6
Subtotal	9	98.7	15	135.7	8	9.4	14	94.3	4	72.8	50	410.9
Existing Development	6	59.0	3	10.5	15	154.6	3	35.5			27	259.6
Total	15	157.7	18	146.2	23	164.0	17	129.8	4	72.8	77	670.5
Utilities and Archeology Sites						11.3		25.1				36.4
Other Lands												163.1
Total Land												870.0

NELHA Lease Revenue Buildup by Phase

($000)

	Phase																	
	1			2			3			4			5			Total		
	Parcels	Acres	Lease $	Parcels	Acres	Lease $	Parcels	Acres	Lease $	Parcels	Acres	Lease $	Parcels	Acres	Lease $	Parcels	Acres	Lease $
New Development																		
AT Base	6	60.0	$ 802	5	28.4	$ 537				11	63.7	$ 1,192				22	152.1	$ 2,531
AT %			$ 214			$ 143						$ 318						$ 675
AT Total			$ 1,016			$ 680						$ 1,510						$ 3,205
EZ Base	3	38.7	$ 153	5	29.0	$ 512										8	67.7	$ 666
EZ %			$ 41			$ 137												$ 177
EZ Total			$ 194			$ 649												$ 843
ED (Base + %)				5	78.3	$ 2,711										5	78.3	$ 2,711
RE							8	9.4	$ 172				4	72.8	$ 464	12	82.2	$ 636
CT										3	30.6	$ 152				3	30.6	$ 152
Subtotal New Leases	9	98.7	$ 1,210	15	135.7	$ 4,039	8	9.4	$ 172	14	94.3	$ 1,662	4	72.8	$ 464	50	410.9	$ 7,547
2008/9 Leases				2	5.7	$ 34				2	25.5	$ 81				4	31.2	$ 115
Existing Development	6	59.0		1	4.8		15	154.6		1	10.0					23	228.4	
Total	15	157.7	$ 1,210	18	146.2	$ 4,073	23	164.0	$ 172	17	129.8	$ 1,743	4	72.8	$ 464	77	670.5	$ 7,662
Utilities and Archaeology Sites								11.3			25.1						36.4	
Other Lands																	163.1	
Total Land		157.7			146.2			175.3			154.9			72.8			870.0	

Absorption, Lease Revenue, and Development Cost Schedule

		Land Leases		Lease Revenue				Development Costs ($000)						
Zone	Phase/ Year	Number of Parcels	Acres	Annual Increment ($000)	Cumulative ($000)	Per Acre Per Month	Average	Infrastructure Costs	Mobilization	Contingency	Total	Seawater Allocation Fee	Increment	Cumulative
	Phase 1								10%	15%				
AT	1	3	30.0	$ 542		$ 1,504						10%	$ 54	
EZ	1	1.5	19.3	$ 103	$ 645	$ 446	$ 1,089	$ 8,512	$ 851	$ 1,405	$10,768		$ -	$ 54
AT	2	3	30.0	$ 542		$ 1,504			$ -	$ -	$ -	10%	$ 54	$ 108
EZ	2	1.5	19.3	$ 103	$ 1,290	$ 446	$ 1,089	$ 8,512	$ 851	$ 1,405	$10,768		$ -	
	Phase 2													
AT	1	2	11.4	$ 290		$ 2,128			$ -	$ -	$ -	10%	$ 29	
EZ	1	2	11.6	$ 277		$ 1,990			$ -	$ -	$ -		$ -	
ED	1	2	31.3	$ 1,084	$ 2,942	$ 2,885	$ 1,602	$ 5,988	$ 599	$ 988	$ 7,575	3%	$ 33	$ 170
AT	2	2	11.4	$ 290		$ 2,128			$ -	$ -	$ -	10%	$ 29	
EZ	2	2	11.6	$ 277		$ 1,990			$ -	$ -	$ -		$ -	
ED	2	2	31.3	$ 1,084	$ 4,593	$ 2,885	$ 1,847	$ 5,988	$ 599	$ 988	$ 7,575	3%	$ 33	$ 231
AT	3	1	5.7	$ 145		$ 2,128			$ -	$ -	$ -	10%	$ 14	
EZ	3	1	5.8	$ 138		$ 1,990			$ -	$ -	$ -		$ -	
ED	3	1	15.7	$ 542	$ 5,418	$ 2,885	$ 1,927	$ 5,988	$ 599	$ 988	$ 7,575	3%	$ 16	$ 262
	Phase 3													
RE	1	4	4.7	$ 103	$ 5,522	$ 1,830	$ 1,925	$ 3,169	$ 317	$ 523	$ 4,009	8%	$ 8	$ 262
RE	2	4	4.7	$ 103	$ 5,625	$ 1,830	$ 1,923	$ 3,169	$ 317	$ 523	$ 4,009	8%	$ 8	$ 270
	Phase 4													
AT	1	4	23.2	$ 528		$ 1,901			$ -	$ -	$ -	10%	$ 53	$ 323
CT	1	1	10.2	$ 51	$ 6,204	$ 414	$ 1,865	$ 1,214	$ 121	$ 200	$ 1,536		$ -	
AT	2	4	23.2	$ 528		$ 1,901			$ -	$ -	$ -	10%	$ 53	$ 376
CT	2	1	10.2	$ 51	$ 6,783	$ 414	$ 1,820	$ 1,214	$ 121	$ 200	$ 1,536		$ -	
AT	3	3	17.4	$ 396		$ 1,901			$ -	$ -	$ -	10%	$ 40	$ 416
CT	3	1	10.2	$ 51	$ 7,230	$ 414	$ 1,782	$ 1,214	$ 121	$ 200	$ 1,536		$ -	
	Phase 5													
RE	1	1	30.2	$ 164	$ 7,394	$ 452	$ 1,673	$ 955	$ 96	$ 158	$ 1,209	20%	$ 33	$ 448
RE	2	1	13.6	$ 164	$ 7,557	$ 1,003	$ 1,649	$ 955	$ 96	$ 158	$ 1,209	20%	$ 33	$ 481
RE	3	1	13.0	$ 164	$ 7,721	$ 1,050	$ 1,629	$ 955	$ 96	$ 158	$ 1,209	20%	$ 33	$ 514
RE	4	1	16.0	$ 66	$ 7,787	$ 341	$ 1,579	$ 955	$ 96	$ 158	$ 1,209	20%	$ 13	$ 527
Total		50	410.9		$ 76,711		$ 1,579	$ 48,793	$ 4,879	$ 8,051	$61,723			$ 4,444

Incremental NELHA Cash Flow Before Fees ($000)										
Year		1	2	3	4	5	6	7	8	
Lease Revenue		$ 719	$ 1,324	$ 2,940	$ 4,556	$ 5,364	$ 5,450	$ 5,536	$ 6,136	
Capitalized Value	8%									
Seawater Allocation Fee		$ 51	$ 102	$ 161	$ 221	$ 251	$ 251	$ 258	$ 313	
Infrastructure Costs		$ 11,335	$ 11,335	$ 5,444	$ 5,444	$ 5,444	$ 4,220	$ 4,220	$ 1,617	
Operating Costs	25%	$ 180	$ 331	$ 735	$ 1,139	$ 1,341	$ 1,362	$ 1,384	$ 1,534	
Exist Tenant Adj.		$ 217	$ 435	$ 652	$ 870	$ 1,087	$ 1,087	$ 1,087	$ 1,087	
Reinvestment Allowance	2%	$ 227	$ 453	$ 562	$ 671	$ 780	$ 864	$ 949	$ 981	
Cash Flow		$ (10,754)	$ (10,258)	$ (2,987)	$ (1,607)	$ (863)	$ 341	$ 328	$ 3,404	
Cumulative Cash Flow		$ (10,754)	$ (21,012)	$ (23,999)	$ (25,607)	$ (26,469)	$ (26,129)	$ (25,801)	$ (22,397)	
		9	10	11	12	13	14	15	Total	
Lease Revenue		$ 6,735	$ 7,198	$ 7,334	$ 7,471	$ 7,607	$ 7,662	$ 7,662	$ 83,694	
Capitalized Value								$ 95,774	$ 95,774	
Seawater Allocation Fee		$ 368	$ 409	$ 436	$ 463	$ 491	$ 502	$ 6,771	$ 11,045	
Infrastructure Costs		$ 1,617	$ 1,617	$ 1,272	$ 1,272	$ 1,272	$ 1,272	$ -	$ 57,381	
Operating Costs	25%	$ 1,684	$ 1,799	$ 1,834	$ 1,868	$ 1,902	$ 1,915	$ 25,859	$ 44,867	
Exist Tenant Adj.		$ 1,087	$ 1,087	$ 1,087	$ 1,087	$ 1,087	$ 1,087	$ 14,680	$ 27,729	
Reinvestment Allowance	2%	$ 1,014	$ 1,046	$ 1,071	$ 1,097	$ 1,122	$ 1,148	$ 15,493	$ 27,478	
Cash Flow		$ 3,876	$ 4,232	$ 4,681	$ 4,785	$ 4,889	$ 4,915	$ 68,854	$ 73,836	
Cumulative Cash Flow		$ (18,520)	$ (14,288)	$ (9,608)	$ (4,823)	$ 66	$ 4,981	$ 73,836		
IRR	12%									

Incremental NELHA Cash Flow After Fees ($000)										
Year		1	2	3	4	5	6	7	8	
NELHA Cash Flow Before Fees		$ (10,754)	$ (10,258)	$ (2,987)	$ (1,607)	$ (863)	$ 341	$ 328	$ 3,404	
DBED	5%	$ 39	$ 71	$ 155	$ 239	$ 281	$ 285	$ 290	$ 322	
OHA	20%	$ 154	$ 285	$ 620	$ 955	$ 1,123	$ 1,140	$ 1,159	$ 1,290	
Total Fees		$ 193	$ 356	$ 775	$ 1,194	$ 1,404	$ 1,425	$ 1,448	$ 1,612	
NELHA Cash Flow After Fees		$ (10,946)	$ (10,615)	$ (3,763)	$ (2,801)	$ (2,267)	$ (1,084)	$ (1,121)	$ 1,792	
		9	10	11	12	13	14	15	Total	
NELHA Cash Flow Before Fees		$ 3,876	$ 4,232	$ 4,681	$ 4,785	$ 4,889	$ 4,915	$ 68,854	$ 73,836	
DBED	5%	$ 355	$ 380	$ 389	$ 397	$ 405	$ 408	$ 5,510	$ 9,526	
OHA	20%	$ 1,421	$ 1,521	$ 1,554	$ 1,587	$ 1,620	$ 1,633	$ 22,041	$ 38,103	
Total Fees		$ 1,776	$ 1,902	$ 1,943	$ 1,984	$ 2,024	$ 2,041	$ 27,552	$ 47,628	
NELHA Cash Flow After Fees		$ 2,101	$ 2,330	$ 2,738	$ 2,801	$ 2,865	$ 2,875	$ 41,303	$ 26,208	
IRR	5%									