

# **University of Hawai'i Center – West Hawai'i**

---

## **Long Range Development Plan**

### ***2009 Revision and Update***



**Hawai'i Campus Developers, LLC**

**Final Report**  
October 2009



# UNIVERSITY OF HAWAI'I CENTER - WEST HAWAI'I

---

- LONG RANGE DEVELOPMENT PLAN •  
*2009 REVISION AND UPDATE*

**Prepared for:**

**University of Hawai'i**  
**Office of Capital Improvements**  
1960 East West Road  
Biomedical Sciences, B102  
Honolulu, Hawai'i 96822  
and  
Hawaii Community College  
400 West Kawili Street  
Hilo, Hawaii 96720

**Prepared by:**

**Hawai'i Campus Developers, LLC**  
999 Wilder Avenue, #1203  
Honolulu, Hawai'i 96822

APPROVED BY:

---

Chancellor, Hawai'i Community Colleges  
University of Hawai'i

---

Date

---

Associate Vice President, UH Office of Capital Improvements

---

Date

---

Vice President, Community Colleges  
University of Hawai'i

---

Date

---

President, University of Hawaii

---

Date

October 2009



**UNIVERSITY OF HAWAII CENTER - WEST HAWAII**  
**LONG RANGE DEVELOPMENT PLAN 2009 REVISION AND UPDATE**

*EXECUTIVE SUMMARY*

This Long Range Development Plan (LRDP) updates the original LRDP for the University of Hawaii Center – West Hawaii (UHCWH) that was completed in 1998. In the years since then, changing circumstances and expanded educational requirements have necessitated a revision and update to the original document. The purpose of this project is to develop a permanent campus for the UHCWH. West Hawaii is the only remaining major geographic area and population center in the State of Hawaii that does not have a permanent facility for higher education.

Changes to the long-term vision for the UHCWH, as well as changes in the West Hawaii community and the progression of nearby development projects have all contributed to the need to update the LRDP as well as to supplement the corresponding Environmental Impact Statement (EIS) that was completed in 2000. The revised and updated LRDP and the Supplemental EIS (SEIS) are being prepared concurrently such that issues identified during the SEIS process can be incorporated into the LRDP update and revision process and vice versa.

This LRDP update incorporates two (2) major changes from the 1998 LRDP. The first is the change in location of the campus core from the southwestern portion of the 500-acre state-owned parcel that was designated for University use, to the northwestern corner. The second major change in the LRDP is the inclusion of additional instructional programs. The updated LRDP will document the steps taken and the information compiled throughout the update and revision process.

The most important event that precipitated this LRDP update is the Memorandum of Understanding (MOU) between the University and Hiluhilu Development, LLC, which discussed joint development opportunities. *Hiluhilu Development, LLC is now known as Palamanui, LLC. All references to the UHCWH and references to the Kalaoa or University site, are now also known as the Hawaii Community College Campus at Palamanui.* Hiluhilu owns the 725-acre parcel of land adjacent to the northern boundary of the 500-acre University parcel and is developing Palamanui, a master-planned community to include single- and multi-family residential, health facilities, mixed-commercial development, a small hotel, passive and active parks, and a dry forest preserve. The MOU addressed the concept of a university-centered village that Hiluhilu planned to develop on its property. The university-centered village would be a residential/commercial community with a town center (the Palamanui Village Town Center) spanning its lands and the University's property. This town center was envisioned as a walkable village, which would link the University's facilities with compatible commercial, recreational and cultural facilities.

Joint development with Palamanui is advantageous to UHCWH in that the campus will be able to tie into the Palamanui utility system for water, wastewater, power and telecommunications. This will save the University a considerable amount of money that would ordinarily be needed to develop infrastructure and utilities. In addition, in approving Palamanui's application for rezoning the county has imposed several conditions on Palamanui, two (2) of which are a direct benefit to the UHCWH. The first condition is that Palamanui must build the Main Street Road, a two-lane connector road that will provide access to the campus from Queen Ka'ahumanu Highway via Kaiminani Drive. The second condition is that Palamanui will be required to build the first building

**UNIVERSITY OF HAWAI'I CENTER - WEST HAWAI'I  
LONG RANGE DEVELOPMENT PLAN 2009 REVISION AND UPDATE**

*EXECUTIVE SUMMARY*

(Culinary Arts) at UHCWH up to an amount of \$5,000,000. This first building will be able to accommodate the transition from the present site of the UHCWH at Kealakekua to the new campus at Kalaoa.

The planning process for the UHCWH consists of four (4) major components.

- Educational Specifications (Ed Specs) The Ed Specs translate the program needs formulated by UHCWH and Hawai'i Community College into physical form in terms of square footage, equipment and utility requirements for each functional area and sub-area.
- Long Range Development Plan. This document summarizes the planning activities included in the LRDP. The process begins with a thorough study of UH program requirements, existing site conditions, site planning criteria, site utilization, and analysis of alternate site plans. These tasks culminate in the development of an ultimate site plan for 1,500 full-time equivalent students (FTES) and attendant ultimate plans for grading and drainage, water and wastewater systems, landscaping, electrical and communication systems, mechanical systems, and barrier-free access. The ultimate site plan proposes a core of approximately 73 acres on the 500-acre site, although more than half of this acreage is occupied by an archaeological preserve centered on a large lava tube running the full length of the property.
- Transition Plans. This phase involves the formulation of detailed plans for moving the existing facilities and programs from Kealakekua to the new site at Kalaoa.
- Supplemental Environmental Impact Statement. This final step in the planning process involves the preparation and processing of a SEIS based on the action proposed in the LRDP. The purpose of the SEIS is to analyze the environmental consequences of the proposed educational facility at Kalaoa. The SEIS is being prepared that reflects changes to the project since the original EIS for UHCWH was completed in 2000.

The UHCWH campus site is located in the midst of lava lands that have never been developed for modern use. The site is adjacent to a large archaeological preserve consisting of an extensive lava tube complex containing various archaeological features and human burials. This provides the opportunity to create a unique spirit and Hawaiian sense of place. The UH administration would like to preserve this unique and pristine environment as much as possible, essentially "walking softly on the land." Unlike the traditional college campus, large tracts of graded land covered with grassed lawns will not be found at UHCWH. Instead the natural lava rock environment will be preserved in pockets of open space throughout the campus, and buildings and walkways will appear to float above the natural lava terrain.

**UNIVERSITY OF HAWAI'I CENTER - WEST HAWAI'I  
LONG RANGE DEVELOPMENT PLAN 2009 REVISION AND UPDATE**

**Table of Contents**

<b>1.0</b>	<b>INTRODUCTION .....</b>	<b>1-1</b>
1.1	BACKGROUND .....	1-1
1.2	PURPOSE AND OBJECTIVES.....	1-4
1.3	METHODOLOGY .....	1-4
1.3.1	<i>Educational Specifications</i> .....	1-4
1.3.2	<i>Long Range Development Plan</i> .....	1-5
1.3.3	<i>Supplemental Environmental Impact Statement</i> .....	1-7
1.3.4	<i>Public Participation</i> .....	1-8
<b>2.0</b>	<b>SITE CONSIDERATIONS.....</b>	<b>2-1</b>
2.1	LOCATION .....	2-1
2.2	SIZE, CONFIGURATION AND BOUNDARIES .....	2-1
2.3	CLIMATE.....	2-2
2.4	TOPOGRAPHY.....	2-2
2.5	GEOLOGY .....	2-13
2.6	SOILS .....	2-16
2.7	HYDROLOGY .....	2-17
2.8	NATURAL HAZARDS .....	2-18
2.9	AIR QUALITY .....	2-19
2.10	ACOUSTIC QUALITY.....	2-20
2.11	BIOLOGICAL RESOURCES.....	2-21
2.11.1	<i>Flora</i> .....	2-21
2.11.2	<i>Fauna</i> .....	2-25
2.12	ARCHAEOLOGICAL AND CULTURAL RESOURCES.....	2-26
2.12.1	<i>Archaeological Resources</i> .....	2-26
2.12.2	<i>Cultural Resources and Uses</i> .....	2-30
2.13	AESTHETIC RESOURCES AND VISUAL PLANES.....	2-35
2.14	SURROUNDING LAND USE.....	2-35
<b>3.0</b>	<b>PROGRAM PLANNING .....</b>	<b>3-1</b>
3.1	DESIGN ENROLLMENT .....	3-1
3.2	EDUCATIONAL PROGRAM REQUIREMENTS.....	3-1
3.3	FUNCTIONAL RELATIONSHIPS.....	3-3
3.4	SPACE REQUIREMENTS .....	3-4
3.5	SPACE ALLOCATION SUMMARY.....	3-10
<b>4.0</b>	<b>PLANNING CRITERIA .....</b>	<b>4-1</b>
4.1	SITE ACCESSIBILITY .....	4-1
4.1.1	<i>External Roadway Network</i> .....	4-1
4.1.2	<i>Public Transportation</i> .....	4-2
4.2	INTERNAL CIRCULATION, ACCESSIBILITY, PARKING AND LOADING.....	4-2
4.2.1	<i>Internal Circulation and Access</i> .....	4-2
4.2.2	<i>Accessibility for the Physically Disabled</i> .....	4-2
4.2.3	<i>Parking</i> .....	4-5
4.2.4	<i>Loading</i> .....	4-5

**UNIVERSITY OF HAWAI'I CENTER - WEST HAWAI'I  
LONG RANGE DEVELOPMENT PLAN 2009 REVISION AND UPDATE**

4.2.5	Emergency Service Access .....	4-6
4.3	LEADERSHIP IN ENERGY AND ENVIRONMENTAL DESIGN (LEED™) .....	4-6
4.4	UTILITY SERVICES.....	4-6
4.4.1	Electricity.....	4-6
4.4.2	Water Supply and Fire Flow.....	4-6
4.4.3	Wastewater.....	4-7
4.4.4	Gas.....	4-7
4.4.5	Solid Waste Disposal.....	4-7
4.4.6	Telecommunications .....	4-7
4.4.7	Cable Television (CATV) .....	4-8
4.5	DRAINAGE AND SITE GRADING.....	4-8
4.6	ENVIRONMENTAL CONTROLS .....	4-8
4.6.1	Ventilation and Air Conditioning.....	4-8
4.6.2	Lighting .....	4-9
4.6.3	Noise Control and Acoustical Treatment.....	4-9
4.7	SECURITY AND SAFETY .....	4-10
4.7.1	Security System .....	4-10
4.7.2	Fire Alarms and Detectors .....	4-10
4.7.3	Security Fencing .....	4-10
4.7.4	Railings and Gates.....	4-11
4.7.5	Night Lighting .....	4-11
4.7.6	Emergency Telephone.....	4-11
4.7.7	Fire Protection .....	4-11
4.8	VISUAL CONTROL.....	4-11
4.9	HISTORIC AND CULTURAL SITES .....	4-12
4.10	LAND USE CONTROLS AND POLICIES .....	4-12
4.11	BUILDING ENVELOPE.....	4-16
<b>5.0</b>	<b>SITE UTILIZATION .....</b>	<b>5-1</b>
5.1	SITE UTILIZATION SCHEMES.....	5-1
5.1.1	Site Utilization Scheme 1 .....	5-2
5.1.2	Site Utilization Scheme 2.....	5-3
5.1.3	Site Utilization Scheme 3.....	5-4
5.2	EVALUATION OF SITE UTILIZATION SCHEMES.....	5-13
5.3	SELECTION OF THE PREFERRED SITE UTILIZATION SCHEME .....	5-14
5.4	LOCATION OF THE CAMPUS CORE .....	5-14
<b>6.0</b>	<b>ALTERNATIVE SITE PLANS .....</b>	<b>6-1</b>
6.1	COMMON DESIGN ELEMENTS .....	6-1
6.2	DEGREE OF COMPATIBILITY TO MAJOR SITE CONSTRAINTS.....	6-2
6.3	ALTERNATIVE SITE PLAN 1 .....	6-3
6.4	ALTERNATIVE SITE PLAN 2 .....	6-4
6.5	ALTERNATIVE SITE PLAN 3 .....	6-5
6.6	THE SELECTION OF THE PREFERRED ALTERNATIVE SITE PLAN.....	6-6
<b>7.0</b>	<b>ULTIMATE PLANS.....</b>	<b>7-1</b>
7.1	ULTIMATE SITE PLAN .....	7-1
7.2	ULTIMATE CIVIL PLAN.....	7-9
7.2.1	Grading and Drainage .....	7-9

**UNIVERSITY OF HAWAI‘I CENTER - WEST HAWAI‘I  
LONG RANGE DEVELOPMENT PLAN 2009 REVISION AND UPDATE**

7.2.2	<i>Water and Wastewater</i> .....	7-9
7.3	ULTIMATE LANDSCAPING PLAN.....	7-15
7.4	ULTIMATE ELECTRICAL AND COMMUNICATION PLAN.....	7-21
7.4.1	<i>Power System</i> .....	7-21
7.4.2	<i>Lighting</i> .....	7-21
7.4.3	<i>Telecommunications/Building Automation System</i> .....	7-21
7.5	ULTIMATE MECHANICAL PLAN.....	7-31
7.5.1	<i>Air Conditioning and Ventilation Systems</i> .....	7-31
7.5.2	<i>Plumbing Systems</i> .....	7-33
7.5.3	<i>Fire Sprinkler Systems</i> .....	7-34
7.5.4	<i>Propane Gas Systems</i> .....	7-34
<b>8.0</b>	<b>ARCHITECTURAL BARRIER-FREE PROGRAM .....</b>	<b>8-1</b>
8.1	SITE CONSIDERATIONS .....	8-1
8.2	BUILDING CONSIDERATIONS.....	8-1
<b>9.0</b>	<b>DESIGN CONSIDERATIONS AND GUIDELINES .....</b>	<b>9-1</b>
9.1	ARCHITECTURAL DESIGN GUIDELINES .....	9-1
9.1.1	<i>Access, Circulation, Plaza</i> .....	9-1
9.1.2	<i>Building Orientation</i> .....	9-1
9.1.3	<i>Building Form</i> .....	9-1
9.1.4	<i>Building Materials</i> .....	9-2
9.1.5	<i>Colors</i> .....	9-2
9.1.6	<i>Peripheral Design Elements</i> .....	9-2
9.2	LEED™ .....	9-2
9.3	DESIGN CONSIDERATIONS .....	9-4
9.3.1	<i>Campus Security</i> .....	9-4
9.3.2	<i>Maintenance</i> .....	9-4
9.3.3	<i>Safety</i> .....	9-5
9.3.4	<i>Operation</i> .....	9-5
9.3.5	<i>Daylighting and Indoor Environment</i> .....	9-6
9.4	CONCEPTUAL LANDSCAPE DESIGN GUIDELINES.....	9-7
9.4.1	<i>Purpose and Location of Landscaped Areas</i> .....	9-7
9.4.2	<i>Planting Types and Sizes</i> .....	9-8
9.4.3	<i>Irrigation System</i> .....	9-10
9.5	ARCHITECTURAL STYLE AND CHARACTER .....	9-10
<b>10.0</b>	<b>IMPLEMENTATION AND TRANSITION PLAN .....</b>	<b>10-1</b>
10.1	PHASING.....	10-1
10.1.1	<i>Phase 1</i> .....	10-1
10.1.2	<i>Phase 2</i> .....	10-2
10.1.3	<i>Phase 3 – Completion of the 750 FTES Campus</i> .....	10-2
10.1.4	<i>Phase 4 – The 1,500 FTES Campus</i> .....	10-3
10.2	SPACE ALLOCATION .....	10-13
10.3	IMPLEMENTATION.....	10-13
10.4	TRANSITION PLAN.....	10-14
<b>11.0</b>	<b>COST ESTIMATE .....</b>	<b>11-1</b>
<b>12.0</b>	<b>REFERENCES.....</b>	<b>12-1</b>

**UNIVERSITY OF HAWAI‘I CENTER - WEST HAWAI‘I  
LONG RANGE DEVELOPMENT PLAN 2009 REVISION AND UPDATE**

**13.0 LIST OF PREPARERS .....13-1**  
**14.0 GLOSSARY OF ACRONYMS.....14-1**

**Appendices**

---

APPENDIX A      ARCHAEOLOGICAL REPORT  
APPENDIX B      BIOLOGICAL REPORT  
APPENDIX C      GEOTECHNICAL REPORT

**List of Figures**

---

FIGURE 1. LOCATION MAP, ISLAND OF HAWAI‘I.....2-3  
FIGURE 2. LOCATION MAP, NORTH KONA.....2-5  
FIGURE 3. LOCATION MAP, UNIVERSITY SITE.....2-7  
FIGURE 4. REGIONAL SIGNIFICANCE.....2-9  
FIGURE 5. TOPOGRAPHY ..... 2-11  
FIGURE 6. BOTANICAL RESOURCES ..... 2-23  
FIGURE 7. ARCHAEOLOGICAL PRESERVES ..... 2-31  
FIGURE 8. ARCHAEOLOGICAL SITE LOCATIONS ..... 2-33  
FIGURE 9. VISUAL PLANES..... 2-37  
FIGURE 10. RECLASSIFICATION OF STATE LANDS..... 2-39  
FIGURE 11. CONSOLIDATION AND RE-SUBDIVISION MAP ..... 2-41  
FIGURE 12. IDEALIZED FUNCTIONAL RELATIONSHIP DIAGRAM.....3-5  
FIGURE 13. REVISED FUNCTIONAL RELATIONSHIP DIAGRAM .....3-7  
FIGURE 14. REGIONAL ACCESS .....4-3  
FIGURE 15. TAX MAP..... 4-13  
FIGURE 16. SITE CONSTRAINTS.....5-5  
FIGURE 17. SITE UTILIZATION SCHEME 1 .....5-7  
FIGURE 18. SITE UTILIZATION SCHEME 2 .....5-9  
FIGURE 19. SITE UTILIZATION SCHEME 3 ..... 5-11  
FIGURE 20. LOCATION OF THE CAMPUS CORE ..... 5-17  
FIGURE 21. ALTERNATIVE SITE PLAN 1 .....6-9  
FIGURE 22. ALTERNATIVE SITE PLAN 2..... 6-11  
FIGURE 23. ALTERNATIVE SITE PLAN 3..... 6-13  
FIGURE 24. ULTIMATE SITE PLAN.....7-7  
FIGURE 25. ULTIMATE GRADING AND DRAINAGE PLAN..... 7-11  
FIGURE 26. ULTIMATE WATER AND WASTEWATER PLAN..... 7-13  
FIGURE 27. ULTIMATE LANDSCAPING PLAN..... 7-19  
FIGURE 28. ULTIMATE ELECTRICAL PLAN..... 7-23  
FIGURE 29. ULTIMATE SINGLE LINE DIAGRAM..... 7-25  
FIGURE 30. ULTIMATE LIGHTING PLAN..... 7-27

**UNIVERSITY OF HAWAI‘I CENTER - WEST HAWAI‘I  
LONG RANGE DEVELOPMENT PLAN 2009 REVISION AND UPDATE**

FIGURE 31. ULTIMATE TELECOMMUNICATIONS/BUILDING AUTOMATION SYSTEM PLAN.....	7-29
FIGURE 32. ARCHITECTURAL BARRIER-FREE ACCESS PLAN .....	8-3
FIGURE 33. SKETCH 1 .....	9-11
FIGURE 34. SKETCH 2 .....	9-11
FIGURE 35. SKETCH 3 .....	9-11
FIGURE 36. SKETCH 4 .....	9-13
FIGURE 37. SKETCH 5 .....	9-13
FIGURE 38. SKETCH 6 .....	9-15
FIGURE 39. SKETCH 7 .....	9-15
FIGURE 40. SKETCH 8 .....	9-15
FIGURE 41. MODEL IMAGE 1 .....	9-17
FIGURE 42. MODEL IMAGE 2.....	9-19
FIGURE 43. SITE ELEVATIONS .....	9-21
FIGURE 44. DEVELOPMENT PLAN PHASE I.....	10-5
FIGURE 45. DEVELOPMENT PLAN PHASE 2 .....	10-7
FIGURE 46. DEVELOPMENT PLAN PHASE 3 .....	10-9
FIGURE 47. DEVELOPMENT PLAN PHASE 4 .....	10-11
FIGURE 48. TRANSITION SITE PLAN.....	10-17
FIGURE 49. EXISTING CENTER AT KEALAKEKUA.....	10-19
FIGURE 50. TRANSITION PLAN .....	10-21
FIGURE 51. TRANSITION SECTIONS.....	10-23
FIGURE 52. TRANSITION ELEVATIONS .....	10-25

**List of Tables**

TABLE 1. PROGRAM AND PLANNING REQUIREMENTS – PROJECTIONS.....	3-2
TABLE 2. SPACE REQUIREMENTS 750 FTES .....	3-4
TABLE 3. SPACE REQUIREMENTS 1,500 FTES.....	3-9
TABLE 4. COMPARATIVE SUMMARY OF SPACE REQUIREMENTS.....	3-10
TABLE 5: SUMMARY OF THE ULTIMATE PARKING PLAN.....	7-4
TABLE 6. SUMMARY OF DOMESTIC WATER DEMAND AND SEWAGE FLOWS.....	7-10
TABLE 7. ESTIMATED COOLING REQUIREMENTS .....	7-31
TABLE 8. COMPARISON BETWEEN A VRV SYSTEM AND A CHILLED WATER SYSTEM.....	7-32
TABLE 9. PLANT LIST .....	9-8
TABLE 10: CUMULATIVE SUMMARY OF MAJOR SITE PLANNING COMPONENTS AT EACH PHASE OF DEVELOPMENT....	10-1
TABLE 11: SPACE ALLOCATION (BASED ON 1,500 FTES) .....	10-13
TABLE 12. CONSTRUCTION COST ESTIMATE .....	11-1
TABLE 13. ESTIMATED COST SUMMARY .....	11-3

**UNIVERSITY OF HAWAI'I CENTER - WEST HAWAI'I  
LONG RANGE DEVELOPMENT PLAN 2009 REVISION AND UPDATE**

**This Page is Intentionally Blank**

**1.0**

---

**Introduction**



## 1.1 BACKGROUND

This Long Range Development Plan (LRDP) updates the original LRDP for the University of Hawai'i Center – West Hawai'i (UHCWH) that was completed in 1998. In the years since then, changing circumstances and expanded educational requirements have necessitated a revision and update to the original document. The purpose of this project is to develop a permanent facility for the UHCWH. West Hawai'i is the only remaining major geographic area and population center in the State of Hawai'i that does not have a permanent facility for higher education. *Hiluhilu Development, LLC is now known as Palamanui, LLC. All references to the UHCWH and references to the Kalaoa or University site, are now also known as the Hawai'i Community College Campus at Palamanui.*

Changes to the long-term vision for the UHCWH, as well as changes in the West Hawai'i community and the progression of nearby development projects all need to be considered in updating the LRDP as well as a supplement to the corresponding Environmental Impact Statement (EIS) that was completed in 2000. The revised and updated LRDP and the Supplemental EIS (SEIS) are being prepared concurrently such that issues identified during the SEIS process can be incorporated into the LRDP update and revisions process and vice versa.

There are two (2) major changes from the 1998 LRDP and this revised and updated LRDP. The first is the change in the campus core's location from the southwestern portion of the 500-acre state-owned parcel that was designated for University use, to the northwestern corner (refer to Figure 20, *Location of Campus Core*). The second major change in the LRDP is the inclusion of additional instructional programs. The updated LRDP will document the steps taken and the information compiled throughout the update and revision process.

In 1971 the University of Hawai'i (UH), through the University of Hawai'i at Hilo (UH Hilo) Center for Continuing Education and Community Services, began offering courses in West Hawai'i relying on hotels and public schools for classroom space. In 1981 Hawai'i Community College (HawCC) also began offering courses in West Hawai'i. Administrative, instructional, and support service functions for these UH courses were consolidated and centralized at the Kealakekua Business Plaza in the fall of 1987. In the summer of 1990, the University of Hawai'i Board of Regents (BOR) commissioned the *University of Hawaii at Hilo, West Hawaii Campus Site Assessment Study*.<sup>1</sup> Based on this study's findings and on unanimous testimony by the affected community, the BOR in July 1991 selected the 500-acre Kalaoa site (hereafter referred to as the University site or project area) as the location for West Hawaii's future center for higher education. This site was the preferred choice for the majority of West Hawai'i residents because of its central location between the urban center of Kailua-Kona and the resort nodes of South Kohala and North Kona, and its proximity to the airport and high tech facilities (Natural Energy Laboratory of Hawai'i [NELHA] and the Hawaiian Ocean Science and Technology Park). The rapid growth of the region and increasing demand for higher education resulted in the 1996 establishment of the UHCWH by BOR action. Since July 1, 1998, UHCWH has become the administrative responsibility of HawCC and continues to be housed at the Kealakekua Business Plaza. Among other drawbacks, the UHCWH's present location allows no room for growth, which provides further incentive to relocate and construct a permanent facility at Kalaoa for the UHCWH.

---

<sup>1</sup> DPD Associates, 1992

# 1 Introduction

---

In February 1996, the *University of Hawai'i Center at West Hawai'i Long Range Development Plan* was submitted to the BOR. With the absence of an Academic Development plan (unavailable when the 1996 LRDP was being prepared), the 1996 LRDP focused on the physical and tangible aspects of the UHCWH that were considered to be constant and timeless elements. The 1996 LRDP was updated in October 1998 when the *University of Hawai'i Center at West Hawai'i: Educational Specifications*<sup>2</sup> became available. The 1998 LRDP translated the program needs as formulated in the 1998 Ed Specs into physical space, equipment, and utility requirements for each functional area and sub-area. The UHCWH's 2000 EIS was prepared based upon the 1998 LRDP.

A Project Development Report for Phase I of the UHCWH at Kalaoa was completed in 2000. Subsequently, the Department of Accounting and General Services (DAGS) contracted out the design work for Phase I. Design work was partially completed in March 2002 when work was halted pending UH Administration decisions on relocating the UHCWH.

On November 21, 2002, with the BOR's approval, the University of Hawai'i entered into a Memorandum of Understanding (MOU) with Hiluhilu Development, LLC (Hiluhilu). Hiluhilu owns the 725-acre parcel of land adjacent to the northern boundary of the 500-acre University site and is developing Palamanui, a master-planned community to include single- and multi-family residential, health facilities, mixed-commercial development, a small hotel, passive and active parks, and a dry forest preserve, among other things. Hiluhilu expressed its willingness to coordinate its development with the University for the West Hawai'i campus. By the MOU, the University of Hawai'i agreed to consult and discuss joint development opportunities for the two (2) adjacent properties, with Hiluhilu providing critical infrastructure for the University's development. On April 16, 2004, the BOR approved an amended MOU, which incorporated understandings that had been reached as a result of discussions since November 2002. This MOU discussed potable water, roadway, wastewater treatment and similar infrastructure issues.

The MOU also addressed discussions about the concept of a university-centered village that Hiluhilu planned to develop on its property. The university-centered village would be a residential/commercial community with a town center (the Palamanui Village Town Center) spanning its lands and the University's property. This town center was envisioned as a walkable village, which would link the University's facilities with compatible commercial, recreational and cultural facilities.

In the initial MOU discussions, the plan was for UHCWH to relocate from Kealahou and lease space in the Palamanui Village Town Center until the University was ready to build a campus on its own property.

Recognizing that state funds for this and other large capital projects were not abundant and may take a long time to materialize, the University included the development of the UHCWH as part of a larger effort aimed at improving community college facilities on the Big Island. The combined project became one of five (5) that the University intended to develop as public-private ventures (ppv). In pursuit of the project, the University issued an RFP in 2005 and awarded a "Real Estate Development Services Agreement," or master development agreement, in 2006 to

---

<sup>2</sup> Wil Chee – Planning, Inc., 1998.

Hawaii Campus Developers, a strong development team of local and mainland firms. This update of the 1998 LRDP is part of the combined Big Island ppv project.

In the meantime, while the University's ppv effort was underway, Hihuhulu's circumstances changed. In 2006, the County of Hawai'i in exchange for approving Hihuhulu's application to reclassify their 725 acres from Agriculture (A-3a) and Open to Project District, placed conditions on Hihuhulu. It is common for the county to place conditions on developers during reclassification. These conditions, such as building parks and roadways, are intended as a means for developers to contribute to the community in return for the right to develop large tracts of land. Conditions placed on Hihuhulu relative to the relocation of the UHCWH, as excerpted from Section EE of Ordinance 06-105 amending Chapter 25 (Zoning Code) of the Hawai'i County Code, are as follows:

1. Applicant shall allow the University of Hawai'i to connect with its wastewater and water supply systems. Applicant shall also allow the University of Hawai'i to connect electrical and telecommunication systems to facilities installed within the project. These connectivity sites shall be to the University's satisfaction and located along its northern boundary on Road "1" [the future University Drive].
2. Build Applicant's wastewater treatment system to handle the wastewater from the initial University of Hawai'i building and design the wastewater treatment system to accommodate future expansion for wastewater from future expansion of the University of Hawai'i operations.
3. Design and construct an initial classroom and administration building of 20,000 square feet, with associated parking, at Applicant's expense. ...Applicant shall be responsible for the first \$5,000,000 and the University shall be responsible for the balance. Construction on the building shall commence as soon as the University has required the necessary consents and approvals. If the necessary consents and approvals cannot be obtained by the State, the University shall have the right to lease from Applicant appropriate space to house University of Hawaii at West Hawai'i until the necessary consents and approvals are obtained at comparable lease rates now being paid by the University of Hawaii until the 20,000 square foot building can be constructed on the State land at Applicant's expense. Applicant shall commence construction of the building, or assure its construction by a bond or other security accepted by the Planning Director<sup>3</sup> and the Chancellor of Hawai'i Community College, before the issuance of a certificate of occupancy for any building, other than the DOE building, or final subdivision approval for any subdivision creating single-family residential lots. ...The location and design of the building (interior and exterior) and related improvements will be on terms determined by the University of Hawai'i. The University of Hawai'i shall consult on design of said building with Applicant.

Currently, UHCWH and Hawaii Campus Developers, its public-private venture partner, with assistance from Palamanui, LLC (successor to Hihuhulu, LLC), is working to create a campus that brings together the educational resources of the University of Hawai'i with the financial resources of the private sector. Palamanui will assist in building the initial complex of classrooms, offices, and support spaces.

The new University campus will serve the needs of West Hawai'i residents who wish to pursue lifelong learning programs. The connection between Palamanui and UHCWH is a mutually

---

<sup>3</sup> Reference is to the Director of the County of Hawai'i Planning Department. The position currently is held by Ms. Bonnie Jean Leithead-Todd.

# 1 Introduction

---

beneficial private-public sector partnership that will improve the educational opportunities that will broaden and enhance the lives of West Hawai'i residents.

## 1.2 PURPOSE AND OBJECTIVES

The intent of the LRDP is to guide initial and future physical development of the UHCWH, beginning with the transition from existing leased facilities in Kealahou, South Kona and culminating in a final long range plan for the new site at Kalaoa, North Kona. Academic policy directives as stated in the *University of Hawai'i Center: West Hawai'i Development Plan 1998-2007*<sup>4</sup> and its translation into physical needs and space projections as identified in the *Update 1998 Educational Specifications: Final Report*<sup>5</sup> (2008 Ed Specs) are important components of the planning process.

The objectives of the LRDP project are as follows:

- Develop the site and facilities ultimate plan that will best accommodate the educational program needs of the UHCWH, is economical in cost, and complies with government, utility and historical/aesthetic/environmental requirements;
- Develop civil, landscaping, electrical/communications and mechanical ultimate schematic plans to implement the LRDP;
- Develop a facilities implementation plan that will satisfy the short- and long-range requirements of the UHCWH. Provide square foot cost estimates for each phase of implementation, including ultimate costs of total phases;
- Establish architectural design and landscaping guidelines to ensure cohesive development of the UHCWH;
- Document the above items for reference and control during implementation of construction projects for the UHCWH; and
- Prepare a report (the LRDP) to document the planning criteria, evaluations and decisions made during the planning process.

## 1.3 METHODOLOGY

The planning effort for the UHCWH includes the five (5) components described in this section. Listed documents are published separately from the LRDP. The mentioned activities are necessary before design and construction at the University site can begin.

### 1.3.1 Educational Specifications

The purpose of the 2008 Ed Specs, prepared by Hawai'i Campus Developers, was to recommend updates or changes to the 1998 Ed Specs for UHCWH. The 2008 Ed Specs, in conjunction with new site information and guidance from UH, were used to update the 1998 UHCWH LRDP. The Ed Specs examine functional relationships, space projections, space allocations and requirements for design and equipment according to each program. Preparation of the Ed Specs is the first

---

<sup>4</sup> University of Hawai'i, Hawai'i Community College, 1997.

<sup>5</sup> Hawai'i Campus Developers, 2008.

major activity of the LRDP process. Data from the Ed Specs is used to formulate a basis for physical planning and any required incremental development strategies.

The basis for the 2008 Ed Specs was data furnished by UHCWH and information developed by Hawaii Campus Developers from focused research of space planning in other large public universities across the country and the renewed interest by educators, planners and architects in the design of learning spaces and the integration into the classroom of new social media and other learning technologies.

The 2008 Ed Specs provide functional relationship diagrams for five (5) major activity areas: Instruction, Academic Support, Student Services, Continuing Education and Institutional Support. A space allocation table with the space name, number of rooms and known or estimated square footage for each space follows the functional relationship diagrams. Furniture and equipment requirements and general design requirements for the spaces in each of the five (5) activity areas are also provided. The Ed Specs thereby reflect the physical space needs and space requirements of the UHCWH. The 2008 Ed Specs Update were approved by UH in September 2008.

In addition to the 2008 Ed Specs Update, two (2) other documents were prepared by Hawai'i Campus Developers as addenda to the main 2008 Ed Specs document. The "Educational Technology Plan", dated October 23, 2008, addresses the future of educational technology and how UHCWH envisions integrating that technology into their new campus. The directions established in the plan will help determine the design of the data, audio and video systems of the new campus. The second addenda, "The Learning Landscape," also dated October 23, 2008, addresses formal spaces, academic support spaces and corridors. The primary purpose of this document is to suggest an approach and present concepts and ideas on how to design these spaces.

### **1.3.2 Long Range Development Plan**

With the UHCWH functions, square footage, and design requirements established in the Ed Specs, an actual site plan for the University Center was developed via the LRDP process. This process addresses long range site planning, infrastructure and utility requirements, general design considerations and implementation strategies. Subsections of the LRDP are described in the following paragraphs.

Site Considerations: This section of the LRDP evaluates all existing conditions on the University site including traffic, roadway improvements, adjacent land use, easements and right-of-ways, environmental concerns, archaeological concerns, and soil conditions. Careful analysis of sewage disposal, drainage, and water supply systems as they affect site utilization is also accomplished.

Program Planning and Planning Criteria: These sections of the LRDP establish specific program and planning requirements for the UHCWH. The UHCWH organization, educational programs, staffing and student enrollment provided in the Ed Specs is summarized. The last task in Program Planning is the preparation of a functional relationship diagram that shows the ideal functional groups and relationships between the elements. The difference between this functional relationship diagram and the one in the Ed Specs is that each component is drawn

# 1 Introduction

---

to scale based on data provided in the Ed Specs. Planning Criteria are issues and concerns germane to the planning of the UHCWH. Criteria include, among others, site accessibility; internal circulation, accessibility, parking and loading; utility services such as electricity and water; preservation of historic and cultural sites; environmental controls such as ventilation, air conditioning and lighting; and security and safety devices such as fire and security alarms.

Site Utilization: The task entails the preparation of three (3) site utilization schemes in the form of bubble diagrams. These bubble diagrams are a refinement of the functional relationship diagram produced in Program Planning. Two (2) new elements—topographic contours and parking—are introduced. Following an evaluation of the three (3) site utilization schemes, one (1) scheme is adopted as the preferred scheme that is further refined in the Alternative Site Plans section.

Alternative Site Plans: In this section, the factors derived in the previous sections are translated into three (3) alternative site plans that are drawn to scale. Each site plan includes the following elements:

- a. Building locations, configurations, functions and number of stories;
- b. Major structures and appurtenances for utilities;
- c. Archaeological sites;
- d. Access roadway alignments;
- e. Service and emergency driveway locations;
- f. Fire access roads or acceptable alternatives;
- g. Parking lot configurations and capacities;
- h. Major pedestrian walkways and ramps, and designation of malls and courtyards;
- i. Major existing trees (with trunk diameter of 6" or greater);
- j. Open spaces, utility structures, easements, and setbacks; and
- k. General landscaping.

On the basis of this evaluation, one (1) scheme is chosen as the preferred site plan upon which the ultimate site plan is based.

Ultimate Plans: In this section of the LRDP, an ultimate site plan, based on the adopted alternative site plan is prepared. The ultimate site plan incorporates recommendations from the UHCWH and University administration. The following schematic plans prepared by engineering sub-consultants and the architect are presented:

- a. Ultimate Civil Plans;
- b. Ultimate Landscaping Plan;
- c. Ultimate Electrical & Communication Plans; and
- d. Ultimate Mechanical Plan.

Architectural Barrier-Free Program: The intent of this section is to ensure that the UHCWH is designed for accessibility. A barrier-free access plan is included.

Design Considerations and Guidelines: In this section, guidelines are established to provide an architectural style and character for the UHCWH. These guidelines will

be used to control building materials, colors and other peripheral design elements. Building security, operations, ease of maintenance and safety are also considered.

Implementation and Transition Plan: The Implementation and Transition Plan addresses how existing facilities and programs located in Kealahou will be moved or transitioned into the Phase 1 development at the new University site. The first building at UHCWH, Culinary Arts is being designed to accommodate all of the facilities and programs currently existing at the Kealahou site (approximately 14,400 square feet).

There are several concerns associated with the existing facilities at Kealahou:

- The location of the facilities is not centralized;
- The present site does not offer the image of an institution of higher education;
- The existing space is under-sized, especially the classrooms, and there is a lack of space for meetings and support activities;
- The classrooms are not sound-proof (i.e. some classroom doors cannot be closed during use); and
- Lease rent is being paid because the land is not state owned.

All of these concerns will be mitigated in the transfer to the new Phase I facilities. Since the programmed area for the new Phase I facilities is more than the existing square footage at Kealahou, the transition should accommodate all of the existing UHCWH programs and facilities as well as provide some room for expansion. During the transition phases, however, the Phase I buildings will initially contain a variety of uses that are not programmed for these buildings in the long-term.

Cost Estimates: The preferred site plan is used to derive a cost estimate that encompasses all the physical facilities and infrastructure necessary to serve 1,500 full-time equivalent students (FTES) at the UHCWH site in Kalaoa. The detailed cost estimate will be used to determine phasing and budgeting for implementation of the LRDP and the actual design and construction of the UHCWH.

### **1.3.3 Supplemental Environmental Impact Statement**

The final component of the planning process for the UHCWH is the preparation and processing of a SEIS. The purpose of an EIS is to analyze the environmental consequences of the proposed action—the development of the UHCWH at Kalaoa. The EIS document must disclose this analysis for public and government review. This document is required of any state- or county-funded construction project or any project that uses state or county land in the State of Hawai'i under Chapter 343, Hawai'i Revised Statutes (HRS), and Chapter 200 of Title 11, Hawai'i Administrative Rules. The original EIS for the UHCWH completed in 2000 currently is being updated in a SEIS.

The processing of the SEIS begins with an SEIS Preparation Notice that is submitted to the Office of Environmental Quality Control (OEQC) for publication in *The Environmental Notice*. Interested

# 1 Introduction

---

parties have 30 days to comment on the project and suggest issues that they feel should be addressed in the EIS. After the receipt of comments, responses are prepared and preparation of the Draft SEIS begins. Upon filing and publication of the Draft SEIS, the public has a 45-day review period during which they can submit comments on the draft. Responses are prepared to address comments on the Draft SEIS and the Final SEIS is produced. Once the Final SEIS has been accepted by OEQC, the UHCWH project can proceed with design and construction, thereby achieving proposed development as outlined in the LRDP.

## **1.3.4 Public Participation**

During the course of the LRDP update process, several presentations were made to UH administration, faculty, staff, and an advisory group comprised of interested parties from the local community. The comments and concerns voiced during these presentations have been duly considered. Various suggestions have been incorporated in this LRDP Update.

**2.0**

---

**Site Considerations**



## **2.1 LOCATION**

The University of Hawai'i Board of Regents' (BOR) action in 1990 promulgated the search for alternative sites for the UHCWH. A commissioned evaluation applied the following criteria to candidate sites: the site must comprise public land with a minimum size of 500 acres and be reasonable in shape and topography for ease of design and construction. The 500-acre University site was selected from a total of seven (7) candidate sites and approved by the BOR in 1991. The UHCWH campus core is to be developed within an approximately 73-acre subdivision located in the northwestern corner of the 500-acre parcel, proximal to the Palamanui Village Town Center.

Hereafter, in this chapter of the LRDP the usage of the term "**project area**" is used interchangeably with the "University site" and refers to the 500-acre parcel of land that has been set aside for University use. The term "**project site**" refers to the 73-acre northwest corner of the project area, where the UHCWH campus core will be located.

The University site is located along the leeward or southwestern slopes of Mt. Hualalai in North Kona on the western coast of the island of Hawai'i (see Figures 1 through 4). It comprises a portion of the 2,640 acres of state-owned lands that are located approximately 4,500 feet mauka of the Queen Ka'ahumanu Highway. No improved vehicular access to the proposed site is available at this time. The nearest existing road is Kaiminani Drive, a mauka-makai improved county roadway roughly one (1) mile south of the project site, near the southern boundary of the project area. While it is understood that the entire 500-acre parcel is set aside for University use; at present the University does not control the entirety of the property, which remains under the jurisdiction of the State of Hawai'i Department of Land and Natural Resources (DLNR).

## **2.2 SIZE, CONFIGURATION AND BOUNDARIES**

The University site covers 500 acres and is trapezoidal in shape. The mauka or eastern boundary of the project area is determined by the Urban Land Use Petition boundary for the 2,640-acre state parcel and is delineated by the proposed Waena Drive road alignment. The makai or western boundary is dependent on the future Main Street Road alignment (formerly referred to as the Mid-Level Road). The privately-owned Palamanui development abuts the University site along its northern border. The Kona Palisades Subdivision lies to the immediate south of the site.

The project area is located on lava lands covered in scrub grass, small trees and shrubs. Although there is some evidence of agricultural use by ancient Hawaiians, the site has never been developed for modern use. The University site is identified by Tax Map Key (TMK) 7-3-010:042.

## 2 Site Considerations

---

### 2.3 CLIMATE

Most of Hawai'i is characterized by slight seasonal variations that create a climate of year-round mild and equitable temperatures, moderate humidity and predominantly northeast trade winds.<sup>6</sup> However, the climate at the project area is characteristically hot and arid. The landmasses of Mauna Loa, Mauna Kea and Mt. Hualalai shelter the project area from the prevailing trade winds such that southerly and southwesterly land and sea breezes predominate in the project area. From season to season, coastal temperatures typically vary approximately 15 to 20 degrees Fahrenheit (°F) and the average temperature is about 75°F.<sup>7</sup> Data recorded at the Kailua monitoring station (located at an elevation of 30 feet) indicates the mean low annual temperature ranges from 60° to 65°F and the mean high annual temperature ranges from 80° to 82°F.<sup>8</sup> Weather data recorded at Keahole Point and Kona International Airport indicate that calm conditions prevail in the North Kona district approximately 28.8 and 23.6 percent of the time, respectively.<sup>9</sup>

Rainfall distribution patterns for West Hawai'i closely follow topographic contours. A high rainfall belt exists between the 2,000- and 3,000-foot elevations on the leeward slopes of Mt. Hualalai and Mauna Loa; the annual rainfall decreases at lower elevations near the coast and at higher elevations above the rain-bearing trade system.<sup>10</sup> The University site is located between 300 and 600 feet above mean sea level (msl), well below the rainfall belt and has been estimated to receive less than 20 inches of rain per year.

In the vicinity of the University site, rainfall is more frequent during the late afternoon and evening periods. Offshore cloud masses form to the west, picking up precipitation from the ocean during the day. Sea breezes that blow from the south-southwest move this band of clouds, along with warm moist air, onto shore, pushing the clouds upslope throughout the day. As these clouds rise in elevation, the air begins to cool and condense creating a drop in pressure, causing them to drop their load in the form of rain. This mechanism is known as the orographic effect and accounts for most rainfall received at higher elevations on mountain ranges throughout the Hawaiian Islands.<sup>11</sup>

### 2.4 TOPOGRAPHY

The University site is located within a lowland area on the southwestern slopes of Mt. Hualalai (see Figure 5). Slopes vary from five (5) to ten (10) percent for the lower portion to over ten (10) percent for the upper portion of the site. Much of the University site is situated at elevations ranging from 400 to 600 feet above msl. Localized mounds and depressions that are characteristic of lava flows are present throughout the site. Small ridges or high areas dominate the northwestern and southeastern boundaries of the site. Relative to the proposed site, elevations range from approximately 400 to 500 feet above msl.

---

<sup>6</sup> Armstrong, R.W., 1983, p. 59.

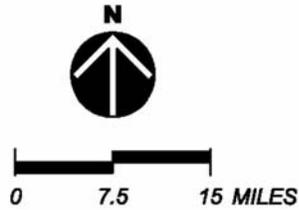
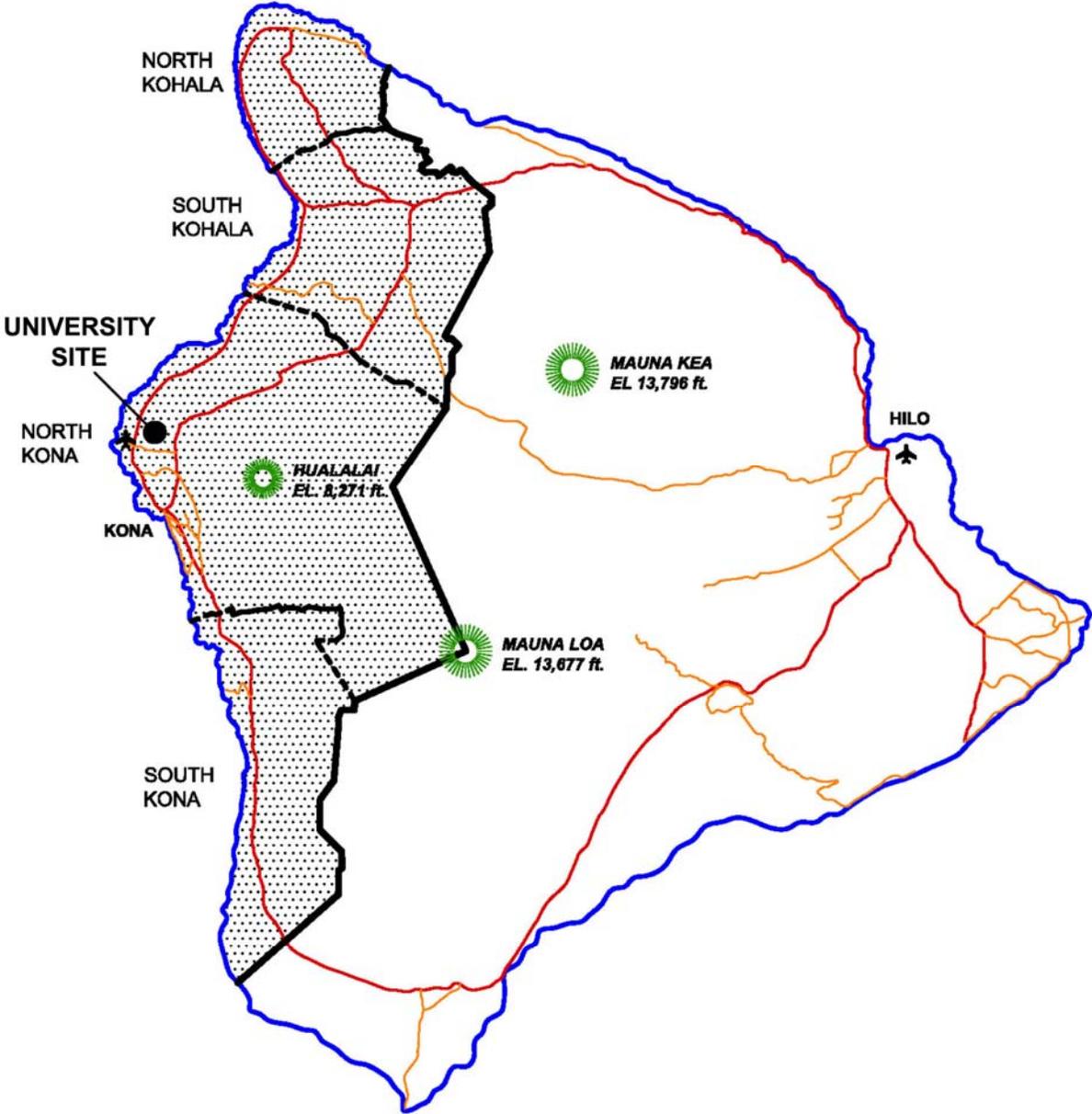
<sup>7</sup> Fukunaga & Associates, Inc., 1994, p. II-1.

<sup>8</sup> National Weather Service, Pacific Region, 1982 in Armstrong, R.W., 1983, p. 62 and 63.

<sup>9</sup> Ibid., p. 65.

<sup>10</sup> Helber Hastert & Fee, Planners, 1993, p. 4-3.

<sup>11</sup> Juvik & Juvik, 1998.



 West Hawai'i District

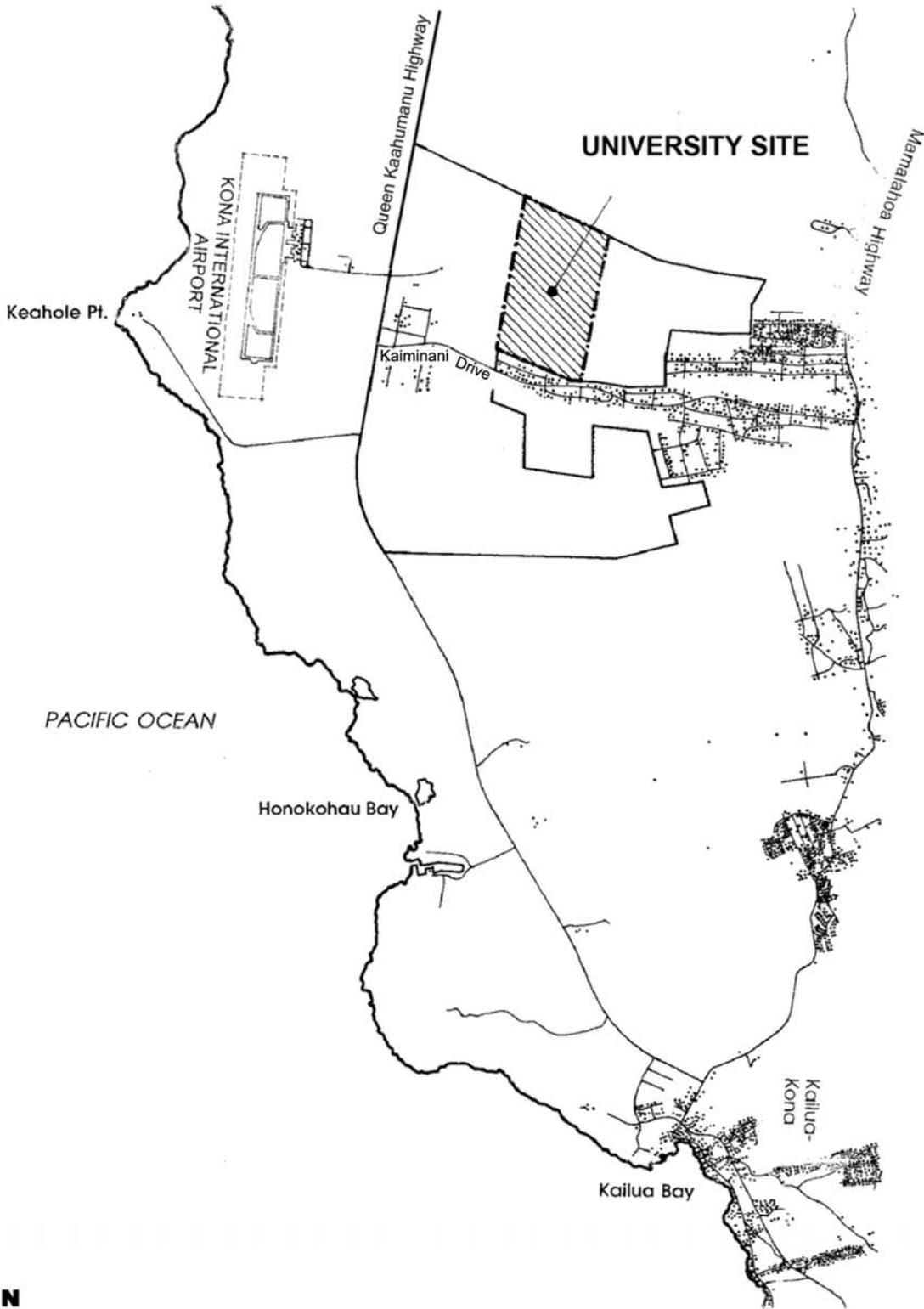
LOCATION MAP  
ISLAND OF HAWAI'I

1

## 2 Site Considerations

---

**This Page is Intentionally Blank**

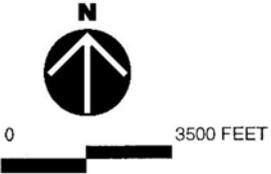
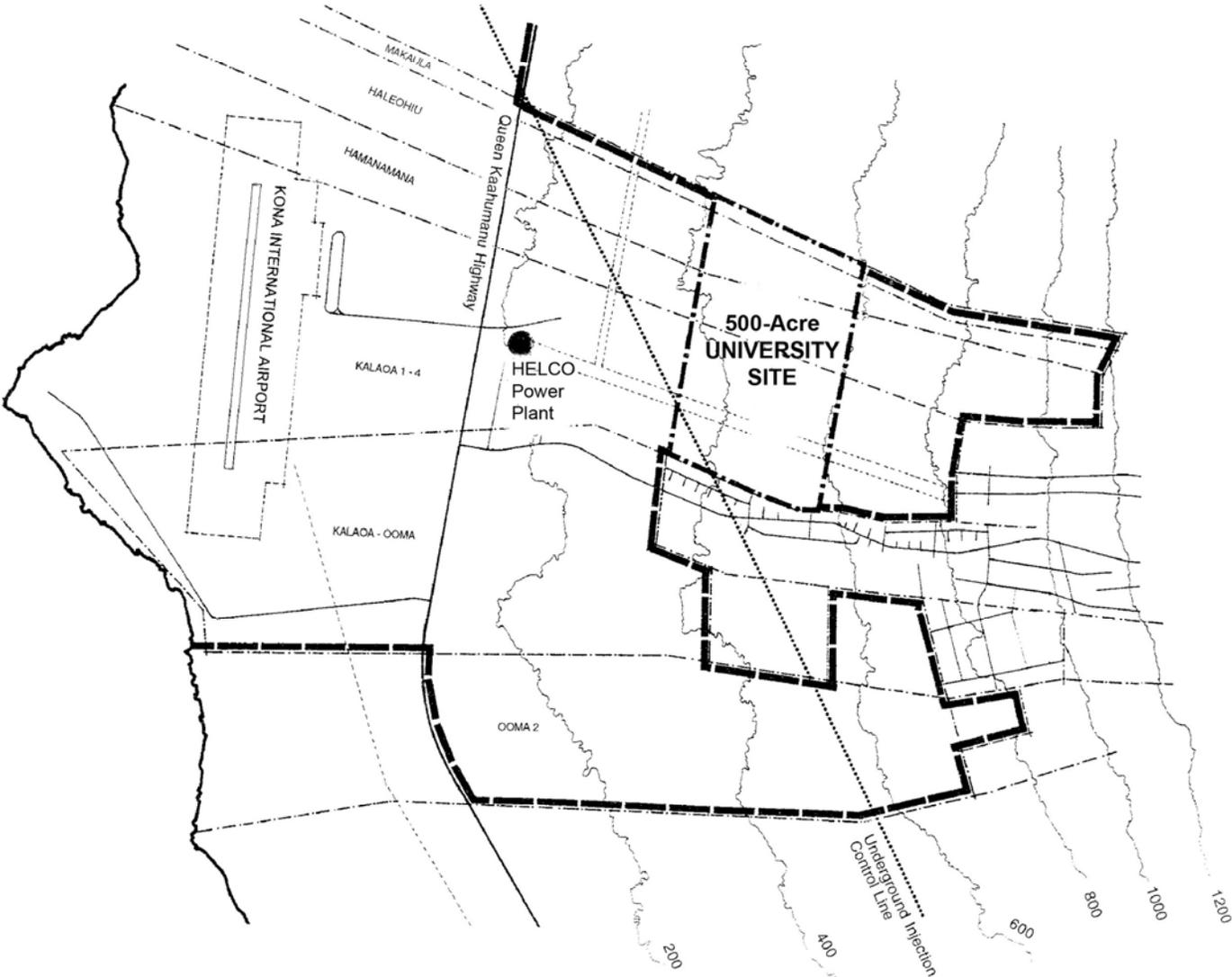


LOCATION MAP  
NORTH KONA

## **2 Site Considerations**

---

**This Page is Intentionally Blank**



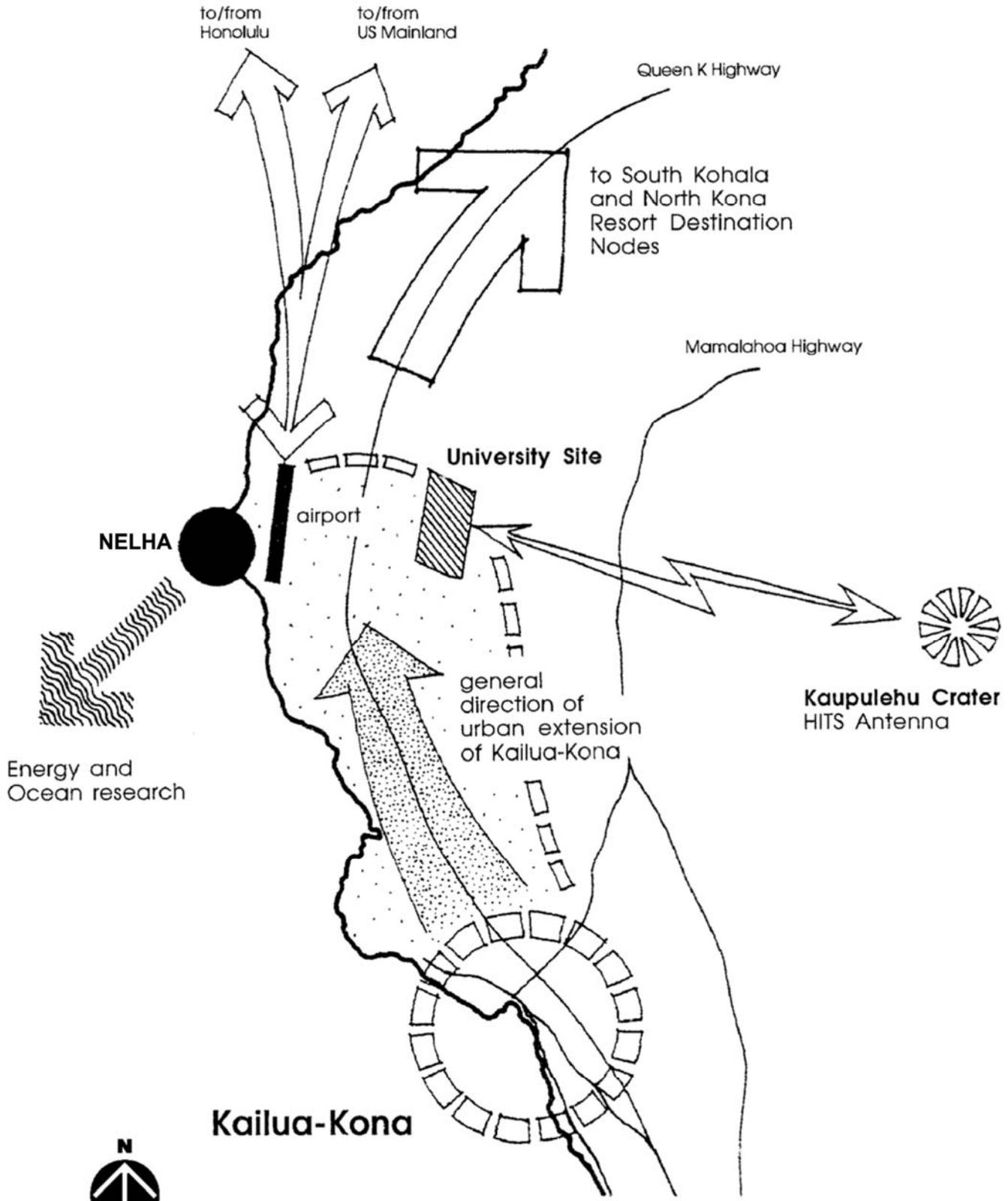
LOCATION MAP  
UNIVERSITY SITE

3

## 2 Site Considerations

---

**This Page is Intentionally Blank**



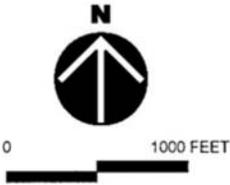
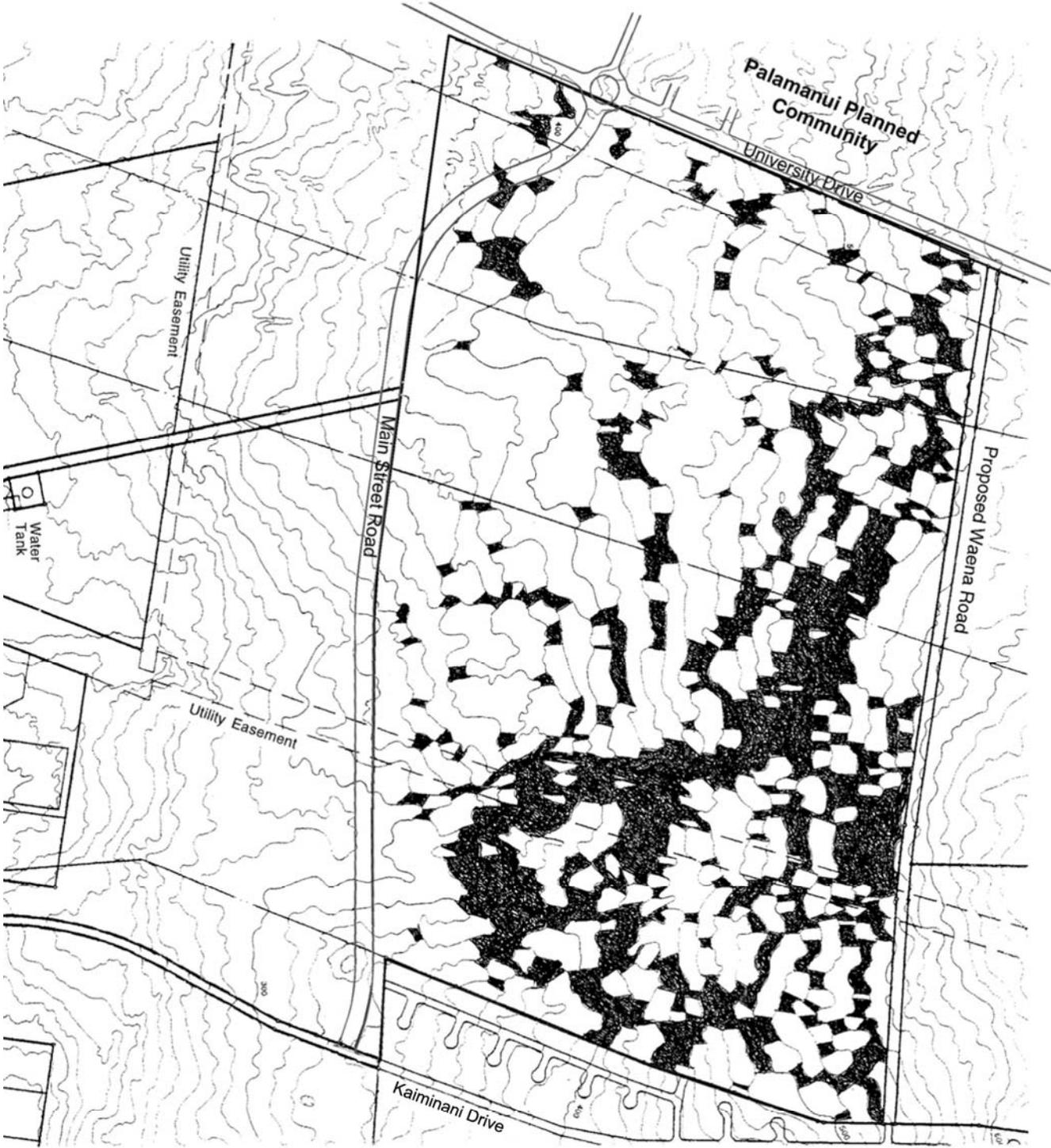
REGIONAL SIGNIFICANCE

4

## **2 Site Considerations**

---

**This Page is Intentionally Blank**



 Slope over 10%

TOPOGRAPHY

5

## **2 Site Considerations**

---

**This Page is Intentionally Blank**

## 2.5 GEOLOGY

The information in this section is excerpted from the geotechnical engineering exploration report dated July 9, 1998 that was prepared by Geolabs-Hawaii to support preparation of the original LRDP (refer to Appendix C).

Regional Geology: The existing geomorphology in the project area is the product of large-scale eruptions from Mt. Hualalai—a now-dormant shield volcano. Large-scale eruptions from this volcano may have ceased some 130,000 years ago; however, the most recent lava flows occurred ca. 1800-1801.

The bulk of Mt. Hualalai formed “during the shield stage of volcanism where voluminous and rapid outpouring of lava flows occurred from the summit and rift zones to form a broad, massive shield extending from below sea-level to near the present day summit elevations.”<sup>12</sup>

The general composition of the surface slopes of Mt. Hualalai consists of post-shield stage lava flows of multiple interbedded pahoehoe and a’ā flows. A pahoehoe flow hardens to form a generally smooth surface whereas a’ā flows form splintered or jagged fragments. Multiple flows of differing ages overlap each other creating a layered landscape of varying colors, each reflecting the differences in age, chemical composition, and each flow’s state of weathering. The terrain is rough; rolling embankments of crusted pahoehoe flows continuously change the contour of the surface, while uneven, sharp edged a’ā rocks jut out, making it difficult to traverse.

Both types of lava can contain subsurface voids like pockets, blisters, extensive lava tubes and tunnels that form as a result of residual lava draining beneath the solidified surface of cooled molten rock. Numerous lava tubes and/or voids including several prominent lava tube features have been discovered in the vicinity of the project area. A prominent lava tube feature in northwestern portion of the project area, within the proposed site, has been documented by several studies conducted over the past 15 plus years.

“Due to the relatively recent age of the volcanics of Hualalai, and much of the island of Hawai’i, soil deposits derived from rock weathering are generally rare and thin in extent. Where residual soils are absent, the ground surface may typically consist of a thin brown silty soil representing volcanic ash, which mantles competent rock formation at shallow depth. Much of the ground surface may be exposed as barren rock with the soil having been deposited within the surface cracks of the rock.”<sup>13</sup>

Surface Conditions: “The exposed ground surface has been mapped as alkali basalt and trachyte lava flows of 1,500 to 3,000 years (Holocene) in age.”<sup>14</sup> There is good distinction between the observed pahoehoe and a’ā flow types at the University site. Remnant volcanic rock features including spatter cones and depressions exist near the perimeter of the site. There is little ground surface soil deposits. “A rubbly and fractured ground surface consisting of rock formation should provide for good infiltration and permeability at the existing ground surface...Groundwater levels are anticipated to be relatively deep beneath the site and are likely of brackish to saline groundwater quality.”<sup>15</sup>

Subsurface Conditions: Four (4) borings were drilled to a depth of about 25 feet below the existing ground surface. The exploration revealed a surficial clinker layer of about 0.5 to 1.5 feet in thickness containing loose to medium dense basalt gravels and cobbles that were “generally underlain by slightly to moderately weathered, medium hard to hard basalt

---

<sup>12</sup> Geolabs-Hawaii, 1998, p. 6.

<sup>13</sup> Ibid., pp. 6 and 7.

<sup>14</sup> Ibid., p. 7.

<sup>15</sup> Ibid., 1998, p. 8.

## 2 Site Considerations

---

formation extending to the maximum depth explored of approximately 25.5 feet below the existing ground surface.”<sup>16</sup> Two (2) of the borings included “thin layers of loose clinker up to about 2.5 feet in thickness.”<sup>17</sup> No significant cavities and/or voids were encountered; no groundwater was detected at the time of the field exploration.

Conclusions: Findings from the preliminary broad-scale geotechnical site evaluation suggest that there are no significant geologic and/or geotechnical constraints at the University site that would preclude proposed development of the UHCWH. “A design-level geotechnical engineering exploration should be conducted to provide recommendations for design and construction of [the UHCWH] facilities planned at the site.” Geotechnical engineering factors or considerations that should be addressed in the design and construction of the project are described below:

- Potential for surface and buried lava tubes or voids. Common features found in basalt lava flows include lava tubes, pockets and blisters. There is an anticipated high potential for encountering near-surface and shallow buried lava tubes or voids at the University site. Numerous lava tubes and/or voids have been discovered in the vicinity of the University site and “several prominent lava tube features were observed at northwestern portions of the site during [geotechnical] field reconnaissance.”<sup>18</sup> The inclusion of appropriate provisions in design and construction to account for the presence of lava tubes in the area of development is recommended. Possible actions to require during construction include (1) proof-rolling the basalt rock subgrade using heavy construction equipment prior to filling operations and during construction to aid in the detection and collapse of near surface voids and lava tubes; and (2) probing and grouting at foundation locations for proposed structures.
- Mass grading and excavation in rock formations. Mass grading operations are expected to be a significant part of site development due to the local irregularity of the ground surface—localized mounds and depressions exist as a result of natural lava flow patterns. The geotechnical exploration report that is appended to this LRDP recommends general site grading guidelines for preliminary design purposes.
  - i. Thoroughly clear and grub affected area prior to grading to remove existing vegetation such as native grasses and small shrubs. Screening to separate excavated fill material from organic matter may be necessary since “excessive amounts of organic matter are not suitable for use as fill materials and should be screened, disposed of off-site, or used in landscape areas, where appropriate.”<sup>19</sup>
  - ii. Proof-roll areas designated to receive fill or finished subgrades in cuts with appropriate heavy equipment, (e.g., Caterpillar D-9 bulldozer or 20-ton vibratory drum roller). Make a minimum of six (6) passes over the area to assist in the detection and possible collapse of near-surface cavities.
  - iii. Over-excavate soft/loose, weak or yielding areas, or cavities to expose firm ground. Backfill these excavated areas with general fill material compacted to a minimum of 90 percent relative compaction. Re-use over-excavated material for general fills if said material has been processed to meet general fill requirements.
  - iv. Use well-graded granular material of less than six (6) inches in maximum dimension with sufficient fines to prevent the occurrence of voids in the compacted mass for structural fill (6-inch minus fill). Use “well-graded granular materials, of which the majority portion is less than 12 inches in size with an absolute maximum

---

<sup>16</sup> Ibid.

<sup>17</sup> Ibid.

<sup>18</sup> Ibid.

<sup>19</sup> Ibid., p. 12.

dimension of 18 inches”<sup>20</sup> for general fill and backfill. On-site cut and/or stockpiled material that has been processed to meet gradation requirements may be suitable material for structural fill, general fill or backfill. Off-site borrow or on-site rock crushing or large-sized rock fragments or boulders may be accomplished to provide materials of required gradation and particle size.

- v. Place structural fill material in level lifts not to exceed 12 inches in loose thickness. The material should be “moisture-conditioned to above the optimum moisture, and compacted to at least 95 percent relative compaction.”<sup>21</sup> Similarly place and moisture-condition general fill and backfill material but compact said material to 90 percent relative compaction.
  - vi. Follow the requirements pertaining to the use of boulders (i.e., rock fragments larger than 12 inches in maximum size but less than 5 feet in largest dimension). Place these rock fills in lifts not to exceed the maximum dimensions of the rocks. Heavily water the rock fill during placement and compact with appropriate heavy compaction equipment.
  - vii. Design permanent cut slopes to a slope inclination of 1.5 horizontal to 1 vertical (1.5H:1V) or flatter with steeper cut slopes of 1H:1V or flatter in areas of dense basalt rock formations. Fill slopes constructed from processed, excavated materials may be 2H:1V or flatter. Fills placed on slopes with inclinations steeper than 5H:1V should be stabilized to prevent sliding. Form a well-compacted slope face. Divert water away from the tops of slopes and plant finished slopes as soon as possible to reduce the erosion potential.
  - viii. Keep excavations into the rock formation to less than 15 to 20 feet of excavation. Variable levels of effort and handling during mass grading and excavation work may be necessary due to the various types of materials present. Ripping or excavation efforts on pahoehoe or a’a lava flows may produce varying aggregate sizes due to the different fracture characteristics of lava flow types. Sizes could range from “predominantly gravel and cobbles with some small boulders to predominantly massive boulder products.”<sup>22</sup> Basalt formations may range from “medium hard to very hard with increasing depth.”<sup>23</sup> The rippability of this material may “depend on the degree of fracturing and amount of clinker materials contained therein.”<sup>24</sup> Some blasting may be needed to achieve required grades.
- Acceptable subsurface permeability for site drainage. Injection tests, performed using the constant head method, indicate that “the project site is situated on generally permeable ground with subsurface conditions comprised of fractured rock formation.”<sup>25</sup> From a geotechnical engineering perspective, the use of drywells for the disposal of storm water runoff may be considered favorable. The use of drywells is a normal occurrence for projects with similar site conditions. An Underground Injection Control (UIC) permit must be filed with the State of Hawai‘i, Department of Health (DOH), Safe Drinking Water Branch for the use of drywells to dispose of storm water runoff.

---

<sup>20</sup> Ibid.

<sup>21</sup> Ibid., p. 13.

<sup>22</sup> Ibid., p. 15.

<sup>23</sup> Ibid.

<sup>24</sup> Ibid.

<sup>25</sup> Ibid.

## 2 Site Considerations

---

- Future pavement sections. The UHCWH may utilize two- and four-lane roadways. Subgrade soils at the site are expected to consist of compacted granular fill material or basalt rock formation such that a subbase course for stabilization/foundation purposes may not be necessary. Current County of Hawai'i requirements include a 6.0-inch select borrow subbase that will serve as a foundation or stabilizing course upon which the subsequent 4.0-inch base course and 2.0-inch surfacing layers are laid (for a total pavement thickness of 12.0 inches over the subgrade). This standard pavement section "does not take into consideration good quality subgrade conditions."<sup>26</sup> It is recommended that near-surface ash soils exposed at the roadway subgrade "be removed and replaced with structural fill material (6-inch minus material) compacted to a minimum of 95 percent relative compaction."<sup>27</sup> It is further suggested that compacted rock fill or basalt rock formation below the base course layer be considered as subbase material since its pavement support characteristics would be equal to or greater than that the county-specified select borrow subbase course. Preliminary pavement design recommendations are as follows:
  - i. Main roads and collector roads: Use a 6.0-inch base course with 95 percent relative compaction beneath a 3.0-inch asphaltic concrete surface layer (for a total pavement thickness of 9.0 inches on a compacted subgrade).
  - ii. Minor streets: Use a 6.0-inch base course with 95 percent relative compaction beneath a 2.0-inch asphaltic concrete surface layer (for a total pavement thickness of 8.0 inches on a compacted subgrade).

Scarify subgrade soil under pavement areas to a minimum depth of eight (8) inches, moisture-condition to above the optimum moisture and compact to at least 95 percent relative compaction. Use crushed basalt aggregate compacted to a minimum of 95 percent relative compaction for the base course.

Slope and maintain paved areas such that surface water is carried to drainage structures. No surface water ponding should be allowed during or after construction. Extend curbs to a minimum of two (2) inches into the subgrade soils or alternately construct a subdrain system to collect excessive water from landscaping irrigation.

### 2.6 SOILS

The soils in the project area are designated as lava flows association and are categorized as rLV or a'a flows, and rLW or pahoehoe flows.<sup>28</sup> This soil association consists of gently sloping to steep, excessively drained, nearly barren lava flows. Coarse-textured and medium-textured soils exist. Pahoehoe lava flows make up about 40 percent of this association and a'a flows about 30 percent. This soil association is used for grazing, wildlife habitat and recreation. The carrying capacity for grazing and wildlife is low.

Primarily, the ground surface is exposed as barren rock with soils deposited within the cracks of the hardened lava flows. For most of the project area, the surface layer of soil is thin and does not provide the most suitable growing conditions for vegetation. This surface layer consists of approximately four (4) inches of rapidly permeable black peat. A less-permeable pahoehoe lava bedrock composes the subsurface. This combination results in slow flowing surface runoff and

---

<sup>26</sup> Ibid., p. 16.

<sup>27</sup> Ibid.

<sup>28</sup> Soil Conservation Service (SCS), U.S. Department of Agriculture, 1973.

minor erosion.<sup>29</sup> A thin layer of brown, silty volcanic ash may reside in pockets where residual ground soils are absent. There are a few resilient species of plants that are able to grow in this type of volcanic environment due to the combination of meager soil and inhospitable terrain.

## **2.7 HYDROLOGY**

Groundwater. The project area overlies the Keauhou Aquifer System, a system of basal and high-level aquifers which consist of a fresh to brackish water lens floating on a layer of salt water. This basal aquifer presumably extends about 1.5 to 4.5 miles inland from the coastline.<sup>30</sup> The aquifer water is mostly brackish and non-potable for at least 1.5 miles inland with the exception of the Kahaluu Shaft (south of Kailua-Kona), which is approximately one (1) mile from the coast.<sup>31</sup> The brackish water extends increasingly inland as one moves northward. Brackish water is found approximately 1.5 miles inland at Holualoa, two (2) miles inland at Kailua-Kona, and three (3) miles inland at Keahole.<sup>32</sup>

Fresh water is found at an approximate elevation of 1,800 feet above msl. The fresh water layer becomes thinner and more saline (higher level of total chlorides) as it approaches sea level. Under ideal conditions, fresh groundwater flows downgradient from the recharge area at 2,000 feet to sea level. However, when too much ground water is extracted, the fresh water layer thins and becomes non-existent at lower elevations.

Groundwater in the vicinity of the project area is recharged by precipitation from the rain belt, which sits at approximately 2,000 feet above msl, on the slopes of Mt. Hualalai. Over one-third of the rain falls within a four (4)- to five (5)-mile wide belt and most of the annual 30 to 75 inches of rain percolates into the ground and recharges the aquifer.<sup>33</sup> Most of this rainfall recharges the basal aquifer that extends from the upper slopes of Mt. Hualalai to the shoreline. Seawater intrusion at the shoreline results in the creation of brackish groundwater. Perched water may exist at the upper elevations of Mt. Hualalai.

Surface Water. There are no streams and no surface water flows into the Pacific Ocean from or through the project area. The lack of streams is due to the porosity of the bedrock, which is characteristic of the interbedded pahoehoe and hardened a'a flows of the Hualalai volcanic sequence. Even during periods of heavy rainfall, surface runoff in the Kona region rarely reaches the coast in a direct manner or flows into drainage ways that reach the coast, because most of it percolates into the porous volcanic bedrock.<sup>34</sup>

---

<sup>29</sup> Ibid.

<sup>30</sup> Fukunaga & Associates, Inc., 1994, p. III-1 – III-3.

<sup>31</sup> Ibid.

<sup>32</sup> Ibid.

<sup>33</sup> Waimea Water Services, Inc., 2003

<sup>34</sup> Fukunaga & Associates, Inc., 1994, p. III-1.

## 2 Site Considerations

---

### 2.8 NATURAL HAZARDS

Natural hazards of greatest potential impact to West Hawai'i and the project area are volcanic eruptions, earthquakes, and tsunamis. The following paragraphs are excerpted from *Volcanic and Seismic Hazards on the Island of Hawai'i* (Heliker, 1990).

Volcanic Eruptions. Lava flow hazard zones are numerically ranked based on the probability of coverage by lava flows, with "1" posing the greatest hazard and "9" posing the least. The project site lies in lava flow hazard zone "4" which encompasses the entire region affected by Mt. Hualalai. Twenty-five percent of Mt. Hualalai is covered by lava flows of less than 1,000 years old. Hualalai is the least active volcano on the island of Hawai'i and its eruptions are infrequent and appear to occur in clusters separated by intervals of centuries. The last eruption from the Hualalai volcano occurred in ca. 1800-1801 from several vents on the northwest rift zone. One of the flows reached the area south of Kiholo Bay and partially underlies a portion of the Kona Village resort. Another lava flow from the 1800-1801 eruption underlies what is now the Kona International Airport. The flanks of the Hualalai volcano "do not have a distinctly lower hazard zone than its rift zones because the distance from the vents to the coast is short and the slopes are steep."<sup>35</sup>

The use of lava diversion barriers on the University site has been suggested due to the perceived threat of the potentially active Hualalai volcano. It is stated, however, that "diverting lava flows by artificial means is a largely untested and costly option for protecting developed areas. Well-placed barriers may successfully divert short-lived lava flow, but during a longer eruption, keeping up with the sheer volume of lava and the number of flows involved may prove impossible...Artificial diversion of lava onto property that otherwise would have been spared could lead to complex legal problems. Lava diversion, however, is a reasonable option in unpopulated areas where isolated, high value property is at risk. For example, diversion structures have been constructed in Hawai'i to protect the Mauna Loa Observatory, NOAA's atmospheric research station, from future lava flows."<sup>36</sup>

No provisions for lava diversion barriers are included in this LRDP due to the high cost and legal ramifications of said barriers (i.e., an existing residential subdivision lies immediately to the south of the University site). At some time in the future, given the necessary budget allowances, the UHCWH administrators may consider building these barriers to protect its facilities, particularly if the technology for such barriers has improved and their effectiveness in other areas has been proven. There is adequate room on the University site to build barriers above the proposed campus core.

Earthquakes. The island of Hawai'i is seismically active with most of the earthquakes occurring on the southern flank of the island. In general, earthquakes on the island of Hawai'i "are concentrated beneath Kilauea and Mauna Loa...and in the Kaoiki region between them."<sup>37</sup> However, the Kona area is subject to earthquakes with intensities up to VIII on the Modified Mercalli Scale, which roughly corresponds to magnitudes 6.0 to 6.9 on the Richter scale. This intensity is enough to damage structures and buildings with inadequate foundations or that have not been structurally reinforced to withstand such tremors. Both the precise time and magnitude of earthquakes "are impossible to

---

<sup>35</sup> Heliker, C.C., 1990, p. 31.

<sup>36</sup> Ibid., p. 45.

<sup>37</sup> Ibid., p. 34.

predict.”<sup>38</sup> Earthquake hazards are highly localized such that broad zones characterized by the same relative degree of hazard are difficult to define.

The last major earthquake to hit Kona was on October 15, 2006. The epicenter of the quake was located approximately ten (10) miles to the west of Kiholo Bay, reaching a magnitude of 6.6 on the Richter scale.<sup>39</sup> Prior to that, a 6.9 magnitude quake hit Kona in August of 1951 causing extensive damage island-wide.

Tsunamis. Tsunami considerations are a threat to West Hawai'i in general, but do not apply within the framework of this study. The general tsunami inundation lines are concentrated within short distances of the shoreline. The project area is located some 2.5 miles from the coastline of West Hawai'i and at elevations of 400 feet or more above msl. These conditions presumably place the project area outside high risk areas that are subject to a tsunami hazard.

Lava tube collapse is another potential hazard associated with the project area. Flooding also is briefly discussed below, but its risk of occurrence is low.

Lava Tube Collapse. Lava tubes form when the molten pahoehoe surface flows begin to cool and crust over, eventually forming a hardened outer surface layer. As the supply of fluid magma decreases during an eruption, the level of its residual subsurface flow gradually drops as it drains from primary pathways. This essentially leaves pockets of open space between a ceiling and floor of solidified magma, forming hollow underground cavities and tunnels just below the hardened surface. The closer lava tubes are to the surface, the thinner their roofs, which make them more hazardous as they are more likely to collapse if significant weight is added at the ground surface or even just due to natural weathering processes.

Flood Potential. The project area is located in a dry and arid environment where flood risks are low. The combination of low rainfall, a thin soil layer and the porosity of the bedrock create a condition of very low to almost non-existent flood potential. During periods of heavy rainfall, ponding and some scouring by flowing surface water may occur, but normally it does not last long. Storm water rapidly percolates into the substrate and does not reach the sea. Flood maps indicate that the area is designated as Zone X, which represents areas that are determined to be outside of the 500-year floodplain.

## 2.9 AIR QUALITY

The air quality of a given location is affected by regional and local climatology. Other factors that influence air quality include wind, temperature, atmospheric turbulence, mixing height and rainfall. Two factors that affect local wind patterns, and hence, local air quality within the project region are the presence of Mauna Kea and Mt. Hualalai.

Air pollutants from natural, industrial, and vehicular sources influence the air quality in the project area. The University site is located within an area that, at times, is exposed to high levels of natural air pollution. This pollution is the result of Sulfur Dioxide (SO<sub>2</sub>) out-gassing from volcanic activity. Volcanic out-gassing, referred to as volcanic haze or vog, is the most significant of these pollution sources that influence air quality in the project area.

---

<sup>38</sup> Ibid., p. 38.

<sup>39</sup> Wyss and Koyanagi, 2006.

## 2 Site Considerations

---

The island of Hawai'i has very active volcanoes along its eastern side. The Hawai'i Volcanoes National Park—with Kilauea Caldera, one of the most active volcanic craters in the world—is roughly 40 to 50 miles from the University site.

Although the volcanic emissions are vented on the other side of a mountain barrier, emissions do reach West Hawai'i. Typically, the winds in Hawai'i follow a northeast or east-northeast track. This wind pattern is referred to as “tradewinds.” Tradewinds carry vog from Kilauea around Mauna Kea and Mauna Loa, where it amasses in the Kona and Kohala districts. On days when volcanic activity is most vigorous and winds are calm, it is common for a thick layer of persistent vog to hang over the West Hawai'i region.

The Hawai'i Electric Light Company's (HELCO) Keahole Generating Station is an industrial source of air pollution in the vicinity of the project area. The Keahole Generating Station is located approximately .7 miles (3,700 feet) west of the University site. Meteorological monitoring data taken at the HELCO site from March 1993 to February 1994 suggests that winds from the west-northwest, west, west-southwest, and southwest have the most potential to carry windborne pollutants from the HELCO site to the project area. These winds generally occur 4.5, 4.0, 10.0 and 8.5 percent of the time, respectively.<sup>40</sup> According to the Climate and Air Quality Assessment in the *Final Environmental Impact Statement for Keahole Generating Station and Airport Substation Urban Reclassification*, air emissions from CT-4 and CT-5 in conjunction with other existing diesel and combustion turbine units will meet both federal and state Ambient Air Quality Standards (AAQS).<sup>41</sup>

Another potential industrial source of airborne contaminants is the Pu'u Anahulu Landfill, about 15 miles northeast of the project area. Pu'u Anahulu is the only landfill in West Hawai'i, accommodating approximately 51.3 percent of the island's solid waste disposal. Smoke and noxious fumes from underground fires at the landfill may influence the region's air quality.

Other sources of air pollution are motor vehicle exhaust from traffic on Queen Ka'ahumanu Highway, located less than a mile due west of the project area and Mamalahoa Highway, approximately two (2) miles to the east. Both are major West Hawai'i arterial roadways in close proximity to the project area. Elevated concentrations of exhaust are generally attributed to periods of traffic congestion in limited areas near intersections during poor dispersion conditions.

Currently, concentrations of man-made pollutants do not exceed state and federal AAQS. The only threat to human health from degraded air quality is due to concentrations of volcanic emissions or vog.

### 2.10 ACOUSTIC QUALITY

The University site is exposed to relatively low noise levels. Major sources of noise that may potentially affect the acoustical environment of the project area are aircraft operations at Kona International Airport and the Keahole Generating Station. According to the master plan adopted

---

<sup>40</sup> Belt Collins Hawaii, 2005.

<sup>41</sup> Ibid.

by the State of Hawai'i Department of Transportation (DOT), Airport Division, the project area is situated outside the 55 Day-Night Average Sound Level (Ldn) contour line that roughly parallels the makai border of the Kalaoa-O'oma ahupua'a and Queen Ka'ahumanu Highway.<sup>42</sup> Validation of the noise level was achieved from aircraft noise measurements of about 50 Ldn in the vicinity of the Keahole Generating Station.<sup>43</sup> The Keahole Generating Station is located roughly .7 miles (3,700 feet) west of the project area. An acoustical study conducted for the Keahole Generating Station improvements indicated that the plant was clearly audible 2,000 feet northeast of the facilities; however, HELCO as part of their plant improvements will be installing noise controls measures to mitigate noise impacts in compliance with regulatory requirements.<sup>44</sup>

Background ambient noise levels reflect the natural setting and the absence of vehicular traffic and development in the immediate vicinity of the project area. Existing traffic and background ambient noise levels currently do not exceed the U.S. Federal Highway Administration (FHWA) and DOT, Highways Division noise abatement criteria. An acoustic study conducted in 2005 for the Proposed Main Street Collector Road Environmental Assessment (EA) found that existing ambient noise levels at noise sensitive receptor locations along the proposed road alignment were less than the FHWA and DOT noise abatement criteria of 66 dBA Equivalent (or Average) Hourly Sound Level [Leq(h)]<sup>45</sup>.

### 2.11 BIOLOGICAL RESOURCES

A biological survey of the 73-acre project site was conducted by AECOS Consultants in 2009 (attached as Appendix C). Previous studies of the project area were conducted in 1992 by Char Associates and Helber Hastert & Fee, Planners; in 1998 by Derral R. Herbst, Ph.D.; and in 2000 and 2005 by AECOS Consultants. The 2005 study assessed conditions along the proposed Main Street Collector Road corridor that extends north to south and generally forms the western boundary of the project area. The four (4) studies completed between 1992 and 2005 were conducted as part of previous planning efforts related to the UHCWH. The dry and arid conditions that affect most of North Kona may contribute to the low diversity of biological resources observed within the project area. Cumulative findings from all five (5) studies are compiled and described in the following sections.

#### 2.11.1 Flora

The main objective of the five (5) surveys was to determine if any endangered, threatened, proposed or candidate plants, as federally listed by the U.S. Fish and Wildlife Service (FWS) under the Endangered Species Act (ESA) of 1973, as amended (16 United States Code 1531-1543), were located within the 500-acre University site.

Vegetation over the 500-acre project area changes distinctly from the southern part of the parcel to the northern part within the Collector Road corridor. The entire 500-acre project area can be classified as a Lowland Vegetation Community. Included in this community are two distinctive

---

<sup>42</sup> KPMG Peat Marwick, 1987 in Helber Hastert & Fee, Planners, 1993, p. 2-4.

<sup>43</sup> CH2M Hill, 1992 in Helber Hastert & Fee, Planners, 1993, pp. 2-4 and 4-1.4.

<sup>44</sup> Belt Collins Hawaii, 2005.

<sup>45</sup> Y. Ebisu & Associates, 2005, p. 9.

## 2 Site Considerations

---

vegetation associations: the Lowland Dry Grassland and the Lowland Dry Shrubland.<sup>46</sup> The northern portion of the project area exhibits characteristics of the *Fountain Grass Grassland* subtype of the Lowland Dry Grassland community. It is a nearly monotypic stand of fountain grass (*Pennisetum setaceum*), a non-native from northern Africa that was introduced into the Kona District in the 1920s, which now dominates much of the arid, lava-strewn landscape in the project area. Sparsely scattered throughout the grassland are pockets of mostly native trees and shrubs, such as ‘ilima (*Sida fallax*), alahe‘e (*Psydrax odoratum*), maua (*Xylosma hawaiiensis*), naio (*Myoporum sandwicense*) and maiapilo (*Capparis sandwichiana* DC), a plant listed by the FWS to be a species of concern. The maiapilo may be vulnerable because it is located in areas likely to be affected by urban development or human disturbances. The southern portions of the project area may be classified as a degraded ‘A‘ali‘i Lowland Shrubland subtype of the Lowland Dry Shrubland community; however, it is also dominated by fountain grass. The 2005 plant survey recorded 42 species growing across the 500-acre project area.<sup>47</sup> Of the 42 species, 10 (23.8 percent) were recognized as native, with three (3) categorized as endemic and seven (7) as indigenous.

The 73-acre project site is entirely within the northern portion of the 500-acre project area and exhibits characteristics of the *Fountain Grass Grassland* as described in the above paragraph. There is an east-west gradient in vegetation across the 73-acre project site as well. The higher elevations show a transition from a *Fountain Grass Grassland* to a Lowland Dry Shrubland, which is still dominated by fountain grass with scattered shrubs and trees. In the current survey (2009), 38 plant species were recorded in the 73-acre project site, 26 of which are ferns and flowering plants. Of the 26, nine (9) or 35 percent are native, of which five (5) are endemic. The majority of plants were alien introductions that have become naturalized at lower elevation environments along the leeward slopes of Hualalai. The site varies from relatively bare to relatively dense growth of fountain grass. Trees are very sparsely distributed and widely scattered within the project site and are limited mostly to the eastern half (upper elevation) (see Figure 6, *Botanical Resources*). Maiapilo was not recorded within the 73-acre project site.

The project area lies within the historical distributional range<sup>48</sup> of several flora species included on the FWS ESA list for threatened, endangered, and candidate threatened or endangered species such as ko‘oko‘olau (*Bidens micrantha* ssp. *Ctenophylla*), uhiuhi (*Caesalpinia kavaiensis*), kauila (*Colubrina oppositifolia*), hala pepe (*Pleomele hawaiiensis*), and ‘aiea (*Nothocestrum breviflorum*). At this time however, only a single ‘aiea tree has been recorded within the 73-acre project site. The ‘aiea is protected under the ESA and cannot be destroyed, which would be considered a “take” under the ESA. The ‘aiea tree was located and verified by GPS (geographic positioning system). It is shown on the site plans and labeled “Endangered ‘Aiea Tree.”

---

<sup>46</sup> Gagne and Cuddihy, 1990 in Herbst 1998.

<sup>47</sup> Guinther, David, and Montgomery, 2009.

<sup>48</sup> An historical distributional range is defined as the extent or limits of a spatial region over which a population or species is scattered, arranged or located, characteristic of past records and research.



## 2 Site Considerations

---

**This Page is Intentionally Blank**

### 2.11.2 Fauna

The information contained in the following section represents cumulative results from studies conducted by various consultants during five (5) faunal surveys that entailed a search for invertebrates and vertebrates within and in the vicinity of the 500-acre University site. The most recent survey was performed by AECOS Consultants in 2009, which focused on the 73-acre project site. As a whole, the main objective of the surveys was to determine if any of the faunal resources present are federally listed as threatened, endangered, or proposed threatened or endangered species. Findings of all previous surveys conducted have been fairly consistent.

Invertebrates. During a survey conducted by AECOS Consultants in 1999, no more than fifteen (15) different invertebrates were detected, with all encountered species presumably alien. Commonly encountered species included various wasps (*Polistes sp.* and *Vespula sp.*), the honey bee (*Apis mellifera*), and the garden orb-weaver spider (*Argiope sp.*). Conditions within explored caves (i.e., lava tubes) were found to be quite dry. The caves harbored bigheaded ants (*Pheidole megacephala*) and a harvestman spider (*Phalangidae* or *Pholcidae*).

In 2005, AECOS consultants conducted both surface and lava tube investigations during the day and again at night, preceding a period of above average rainfall. This resulted in healthy, well-developed host plants which invertebrate populations depend upon, as well as the absence or low levels of introduced predators.

The results of the 2005 study turned up only a few native arthropods. No native invertebrates on the federal or state endangered, threatened, proposed or candidate lists were observed. Only one (1) native snail was seen, *Succinea sp.* That individual was found on a rotting log. It is possible that if a survey was made immediately following a rain, more would be found since this genus is a very prevalent native snail.

The most recent survey (2009) was conducted at the end of the winter rains and vegetation was in good condition to support arthropod populations. A few native arthropods were collected or observed; however, no native arthropods or other invertebrates on the federal or state endangered, threatened, proposed, or candidate lists were seen during the survey. The area provides habitat for only a few native arthropods. The lack of native host plants is a major factor in the lack of native invertebrates. Further, goat feeding damage and the presence of predatory ant species combine to create a setting that is unlikely to support high levels of native arthropods. No native snails were observed in the survey.

Many alien species of medical importance (e.g., centipedes, scorpions, widow spiders) were not observed during the most recent survey, but could be present. Honey bee colonies and common paper wasp nests, however, were observed.

Caves (lava tubes) in the project area, to the extent that they have been explored in these surveys, have revealed no native invertebrates, or habitat to support native invertebrates. Despite the absence of significant cave fauna found during the faunal surveys, cave habitats may harbor unique endemic arthropods. It remains possible that unknown lava tubes or inaccessible segments of known tubes could contain native fauna.

The sphinx moth (*Manduca blackburni*), which is listed as an endangered species under the ESA (Federal Register, 2004) is known to occur on the island of Hawai'i and may occur in the vicinity of the project area. No adult moths were seen in the most recent survey (2009). None of the introduced hosts suitable for moth caterpillars was seen (e.g., tree tobacco). One native host, the 'aiea tree, is located within the project site; however, no caterpillars or feeding evidence was seen.

Vertebrates. Evidence of five (5) alien mammalian species was detected during the five (5) surveys completed between 1992 and 2009. Evidence of dogs (*Cannis f. familiaris*), cats

## 2 Site Considerations

---

(*Felis catus*), goats (*Capra h. hircus*), pigs (*Sus s. scrofa*) and cattle (*Bos taurus*) was found in the area. During a 1992 survey, six (6) small Indian mongoose (*Herpestes a. auropunctatus*) were detected.<sup>49</sup> Though no rodents (*Rattus rattus*, *Mus domesticus*) were visually observed, it is almost a certainty that these species use resources in the project area. It is difficult to assess the population densities of any of these mammals unless more comprehensive and costly studies are performed. All of these species are threats to avian and floral components of the remaining native ecosystem.

In a 1999 assessment conducted by Eric Guinther and Reginald David of AECOS Consultants, a single gecko (*Geytha mutilata*) was observed in the project area, which suggests that the environment may support populations of similar small lizards.

No endemic (or native) birds are expected to frequent the project area. The habitat found in the project area is typical of the fountain grass dominated, xeric communities of the North Kona District which are not conducive to supporting native bird species. Faunal surveys suggest that the project area contains no particularly special or unique birds, including threatened or endangered species. Species that could potentially be present, yet uncommon, to the area include the Short-eared Owl or Pueo (*Asio flammeus sandwichensis*) and the endangered Hawaiian Hawk or 'Io (*Buteo solitarius*). The only migratory species recorded during any faunal survey was the Pacific Golden Plover (*Pluvialis fulva*). A total of fourteen (14) plovers were counted in a 1992 study.<sup>50</sup>

During the most recent study (2009), which focused on the 73-acre project site, 61 individual birds of 10 different species were recorded. All species detected are considered alien to Hawai'i. Avian diversity and densities were exceptionally low, typical of the xeric nature of the habitat on the project site. The most abundant avian species sighted were the African Silverbill (*Lonchura cantans*), the Northern Mockingbird (*Mimus polyglottos*), and the Black Francolin (*Francolinus francolinus*), accounting for over half of the total avian sightings. In previous studies the more abundant species were the Rock Pigeon (*Columba livia*), Zebra Dove (*Geopelia striata*), Warbling Silverbill (*Lonchura malabarica*), Japanese White-eye (*Zosterops japonicus*), and Nutmeg Mannikin (*Lonchura punctulata*). The 2009 survey also recorded one incidental sighting of a passing Barn Owl (*Tyto alba*).

Current survey techniques available for gathering information on the distribution, abundance and usage of resources in a given area by Hawaiian hoary bats (*Lasiurus cinereus semotus*), or 'ope'ape'a as they are known locally, are inadequate and/or time and cost prohibitive. Hawaiian hoary bats can be expected to fly over the project area. However, the project area currently has little to offer a passing bat due to the relative absence of suitable trees for roosting and the low diversity of volant (flying) insect life that may attract bats.<sup>51</sup> However, after the campus is constructed, increased water and trees within the project site will attract Volant insect, and thus may provide a new foraging resource for bats on a seasonal basis.

### 2.12 ARCHAEOLOGICAL AND CULTURAL RESOURCES

#### 2.12.1 Archaeological Resources

The 2,640-acre state-owned land that encompasses the University site was the subject of an archaeological assessment study by Paul H. Rosendahl, Ph.D., Inc. (PHRI) in 1993. The study included a background synthesis of existing studies, prior archaeological and historical work, and some new historical work (e.g., aerial reconnaissance, intensive ground surveys, etc.).

---

<sup>49</sup> Bruner, 1992

<sup>50</sup> Bruner, 1992.

<sup>51</sup> David and Guinther, 2000.

Another archaeological inventory survey was conducted in December 1992 and January 1993 by PHRI specific to the 500-acre University site on the northeastern portion of the state parcel. PHRI identified a total of 11 historic sites within the University site that were recommended for preservation "as is" or preservation with some level of interpretive development. The northwestern portion of the project area contains four (4) sites; six (6) sites are located in the central region; and one (1) site is located near the southern boundary of the project area.

The results of the PHRI surveys were intended to serve as a baseline study for future archaeological studies within the state parcel. As a result, the historic sites that were identified during the ground surface survey and the archaeological assessment survey have not been recorded to inventory level. In addition, only 11.5 percent of the state parcel and selected sections of the project area have been subjected to an intensive ground survey.<sup>52</sup> The following conditions must therefore be satisfied prior to development of the state parcel and the project area:

- "1. Each prospective future developer shall have an archaeological inventory survey conducted by a professional archaeologist prior to submitting an application to the County of Hawai'i for rezoning. The findings of this survey shall be submitted to the State's Historic Preservation Division in report format for adequacy review. This Division must verify that the survey report is acceptable, must approve significance evaluations, and must approve mitigation commitments for significant historic sites.
- "2. If significant historic sites are present, then each prospective future developer shall agree to develop and execute a detailed historic preservation mitigation plan—prior to any ground altering construction in the area. The State's Historic Preservation Division must approve this plan, and that Division must verify, in writing to the Land Use Commission that the plan has been successfully executed."<sup>53</sup>

The location of archaeological sites is considered critical to the site planning efforts for the UHCWH. As part of the previous LRDP effort, an archaeological investigation was commissioned that concentrated on the area (approximately 275 acres) that was proposed for the campus core in the southwestern portion of the 500-acre project area. The results of that investigation conducted by Pacific Legacy, Inc. in 1998, under the direction of Paul L. Cleghorn, Ph.D. are summarized below.

Numerous late prehistoric sites are present within the study area. These archaeological sites appear to be part of the "Kona Field System"—an extremely extensive and intensive agricultural complex in the Kona region. Archaeological sites within this area include lava tubes, modified outcrops, walls, and excavations in the pahoehoe lava flows. Primary activities in the area were presumably related to agricultural pursuits and temporary shelter. Ceremonial activities may also have been performed and selected areas may have been used for burials.

Archaeological sites in the study area are evidence of the adaptability of the early Hawaiian inhabitants. Residents apparently established productive uses on harsh and forbidding land. Lava tubes and outcrops were modified into shelters and habitats. Planting areas were created in broken and roughly circular pits on the surfaces of pahoehoe lava flows. Concentrations for planting areas were made from mountains of stone rubble on the surface of

---

<sup>52</sup> PHRI, 1993 in Helber Hastert & Fee, Planners, 1993, p. 4-19.

<sup>53</sup> DLNR-SHPD, 1992 in Helber Hastert & Fee, Planner, 1993, p. 4-28.

## 2 Site Considerations

---

the flows. Arid-tolerant plants such as sweet potato and gourds may have been the focus of the agricultural pursuits that took place here.

It is recommended that five (5) archaeological preserves be established and managed (refer to Figure 7).<sup>54</sup>

- “Preserve 1: This is the eastern site cluster composed of sites 15290, 15291, 15292, 15293, 15294, 15295, and 15296. This cluster consists of two extensively modified lava tubes (15292 and 15297), and several platforms, enclosures, terraces, and pavements. This cluster is an excellent example of how temporary habitations were situated and constructed in the area. This complex should be accessed by a walking trail from the proposed [University Center], and developed (using signs, brochures, etc.) into an interpretive and educational venue.
- “Preserve 2: This is the northern site cluster composed of sites 15298 and 15302, which are two extensively modified lava tubes. Because these sites contain human burials (15298) and possible ceremonial areas (15302), they should be barricaded or sealed and protected from public access.
- “Preserve 3: This is a cluster of features in the central portion of the proposed campus. The cluster consists of site 15281, a linear portion of site 15283, site 15282, and site 15285. Sites 15281 and 15282 are temporary habitation areas, and site 15285 is a possible religious shrine. Site 15283 is a large complex of agricultural features. It is proposed that a linear preserve extending from Site 15281, through the southern portion of site 15283, and incorporating sites 15282 and 15285 be established in the central portion of the proposed campus. The sites could be accessed from sidewalks and other walkways in the campus and have interpretive signage explaining the function and antiquity of the sites and how they exemplify the original Hawaiian adaptation to this area.
- “Preserve 4: This is a small cluster of two sites (15263 and 15287) located on the western edge of the study area. The cluster consists of a small temporary habitation complex and a papamu, or game board for konane, or Hawaiian checkers. This small complex could be incorporated into the campus landscaping and identified with appropriate signage.
- “Preserve 5: This is a complex of lava tubes (site 6418) at the SW corner of the study area. This complex consists of three sections – a collapsed section of lava tube, a lava tube containing a large stone platform, and a lava tube section with a platform and panels of petroglyphs. The proposed Mid-Level Road runs right through these sites. It is recommended that the road be rerouted to avoid these sites and that they be preserved. Interpreting these features by means of established walkways and interpretive signs may be the most feasible way of preserving these sites and protecting them from vandalism. Petroglyphs are extremely fragile and can be destroyed by even well-intentioned visitors.”<sup>55</sup>

As an outgrowth of Pacific Legacy’s 1998 archaeological investigation, the *Conceptual Historic Preservation Plan for the Proposed University Center at West Hawai’i, North Kona, Hawai’i Island* (HPP) (Cleghorn, 2000) was developed with considerable input from the University of Hawai’i

---

<sup>54</sup> Cleghorn, 1998.

<sup>55</sup> Cleghorn, Paul L., Ph.D. & Pacific Legacy, Inc., 1998, pp. 29 - 31.

Center at West Hawai'i Advisory Council on Kalaoa Cultural Site Preservation.<sup>56</sup> The HPP offered guidance for the protection of the cultural resources located within the project area.

Note that the recommendations in Cleghorn's 1998 study and the HPP described above were applicable to the location of the campus core in the southwestern corner of the 500-acre University site. Now that the location of the campus has been changed to the northwestern corner of the University site, some of these recommendations may no longer be appropriate to the current proposal (See Figure 20 for change of campus location.). As shown in Figure 7, the current campus layout within the 73-acre subdivision only impacts Archaeological Preserve 2, the lava tube system. The other proposed Preserve Areas 1, 3, 4 and 5 are not impacted by the current University development.

Thus, UH has two options regarding access to the archaeological preserves and the requirement to prepare a historic preservation plan.

- 1) If the University does not provide access to Preserve Areas 1, 3, 4 and 5, there is no need to prepare a Historic Preservation Plan because the preserve areas are outside the area of development.
- 2) If the University wants to develop the archaeological preserve areas into an educational and interpretive venue with a trail system, interpretive signage, etc., a historic preservation plan must be submitted and approved by DLNR's State Historic Preservation Division (SHPD). The 2000 HPP was labeled "Conceptual" because it did not contain details concerning long-term preservation measures and interpretation. The Kalaoa Advisory Council wished to defer completion of the plan to allow the students and staff of the Center to participate in the process after construction was completed and the first phase of the Center was fully operational. Therefore, the 2000 HPP must be updated and completed if the University wishes to develop an educational and interpretive venue.

If option 2 is exercised, the interpretive value of existing archaeological sites could be used to educate current and future residents, and visitors to West Hawai'i. The creation of interpretive venues may follow the guidelines set forth in the *Design Specifications for Outdoor Recreation* authored by the State of Hawai'i Architectural Access Committee in 1994 that are used by Hawai'i State Parks. Alternative means of experience for inaccessible venues may include an interpretive panel and photo board in a centralized and accessible portion of the campus; brochures or interpretive pamphlets describing inaccessible resources; and/or a video of the resources that may be viewed at the UHCWH. The goal with respect to historic resources and interpretive venues is to provide the same or similar life experience to all members of the community.

The most recent investigation, completed in late November 2008 by Pacific Legacy, concentrated on the new 73-acre project site, which is situated in the northwest corner of 500-acre project area. This investigation focused largely on mapping archaeological sites within the project site,

---

<sup>56</sup> The University of Hawai'i Center at West Hawai'i Advisory Council on Kalaoa Cultural Site Preservation was convened as part of the previous UHCWH LRDP/EIS effort (1998 – 2000) to provide guidance in protecting the numerous cultural resources associated with the project area. This advisory group is no longer in existence. A new advisory group has been convened to provide community input for the current LRDP effort.

## 2 Site Considerations

---

with particular emphasis on Archaeological Preserve 2 (refer to Figures 7 and 8). Seven (7) sites were identified in the project site; however, only the sites within the lava tube system are slated for “preservation.”

Preserve 2 is a lava tube complex that stretches across the proposed site from southwest to northeast, just east of the proposed Main Street Road. In 1993, the Hawai‘i State Inventory of Historic Properties designated site number 50-10-28-15298 for the eastern section of the lava tube, while 50-10-28-15302 was designated for the western section. Sixteen (16) separate openings along the length of Preserve 2 were identified. A total of 196 archaeological features were found in Preserve 2, most determined to probably date to the pre-Contact period. The findings suggest that the tube system was used for refuge, ceremonial and burial purposes. Evident bulldozing damage to some of the openings leading into the lava tube was visible. It is supposed that loose pahoehoe slabs at these areas were harvested for masonry.

The 2008 investigation report recommended that future planning be conducted with close consultation with SHPD and the Hawai‘i Island Burial Council to ensure that the cultural properties within Preserve 2 and the other preserves identified within the 500-acre University site be protected.

### 2.12.2 Cultural Resources and Uses

A Cultural Impact Assessment was completed in 2005 by Pacific Legacy for the Main Street Collector Road EA. Interviews and background research indicate that the project area does not support any current traditional cultural uses. The area is not frequented by spiritual and cultural practitioners nor does it provide for any other traditional activity. The area’s only cultural significance appears to lie in its archaeological resources, which have interpretative value. Previous archaeological assessments, as well as the 2000 HPP recommended protection and preservation of these sites.

Hunting and gathering activities continue to be practiced in the area. However the locations of these practices are very general for the area and not site specific. Faunal surveys conducted within the project area have turned up evidence of a goat skeleton, goat scat and donkey scat suggesting larger vertebrates once inhabited the land. The investigators did not see or hear any goats, pigs or donkeys, nor was there any recent evidence of their presence. The 2009 biological survey of the 73-acre project site did not find ko‘oko‘olau (*Bidens micrantha* ssp.) or hala (*Pandanus tectorius*), and only a one (1) or two (2) instances of noni (*Morinda citrifolia*), each of which have important roles in cultural practices of Hawaiians.



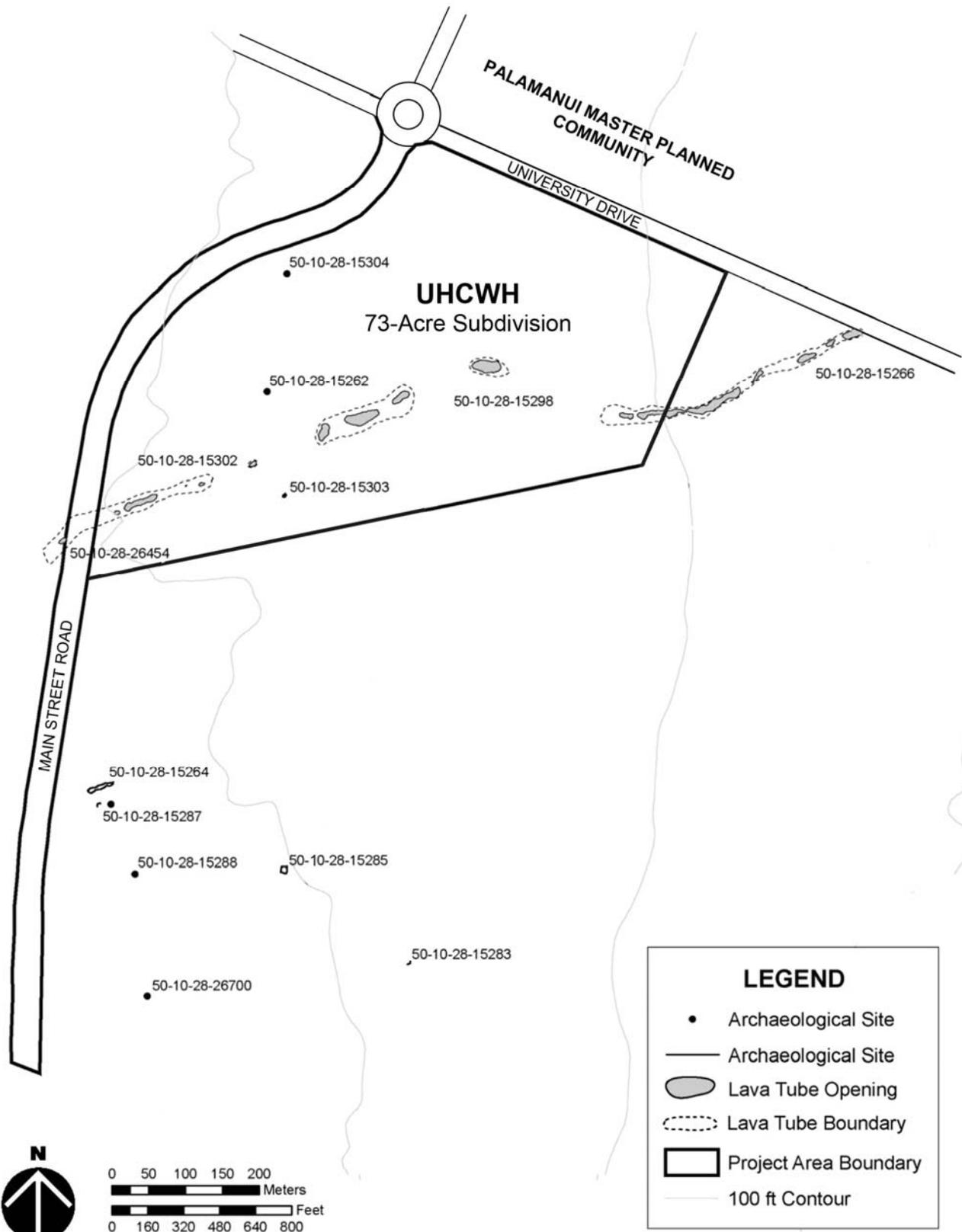
ARCHAEOLOGICAL PRESERVES

7

## 2 Site Considerations

---

**This Page is Intentionally Blank**



Source: Pacific Lagacy, "Cultural Resource Identification and Mapping at the UH Center - West Hawai'i North Kona, Hawai'i", December, 2008

**ARCHAEOLOGICAL SITE LOCATIONS**

## 2 Site Considerations

---

**This Page is Intentionally Blank**

### **2.13 AESTHETIC RESOURCES AND VISUAL PLANES**

The existing visual character of the University site can be described from two perspectives: the first perspective considers the 500-acre University site itself as a visual resource when viewed from outside the project area. The second perspective looks at the visual resources and view planes as seen from within the University site. Refer to Figure 9 for a diagrammatic depiction of the two (2) visual perspectives relative to the project area. Surrounding development and nearby structures can impede views from outside the project area. Localized mounds and depressions within the site influence views from within the project area.

The visual character of the project area is defined by expanses of pristine lava lands that have never been developed for modern use, and are covered by fountain grass, small trees and shrubs. The best views of the project area are from the vicinity of the Kona International Airport; it is part of the initial viewshed for those arriving in West Hawai'i. On a clear day, it is possible to view the western slopes of Mt. Hualalai including the University site and development within the vicinity of Mamalahoa Highway and Kaiminani Drive. Due to the proximity and visibility of the site from the Kona International Airport (a gateway to West Hawai'i), special attention must be given to the types of development that would signify the importance of the UHCWH as a regional institution.

Glimpses of the project area can also be seen from Mamalahoa Highway (located upslope of the project area) where breaks in vegetation exist, as well as at streets and private driveways. However, these views do not hold the same bearing as from the airport. Although the project area can also be seen from the Queen Ka'ahumanu Highway, views are limited due to obstruction by existing topographical features. Furthermore, current land uses between the highway and the project area restrict continuous views of the property, which can only be seen intermittently as one drives along the highway.

The other visual perspective that can be considered is the visual resources and view planes seen when looking out from the project area. The most expansive views are from the steeper, higher elevations, most notably at areas above the 500-foot elevation. At elevations below 450 feet, makai views are somewhat restricted by the HELCO power plant, the 0.5-million gallon water tank and the Keahole Agricultural Park. Localized ridges and depressions profoundly affect the quality of views at lower elevations throughout the project area. Looking makai (westward or seaward), expanses of pristine lava lands covered by fountain grass, small trees and shrubs create a distinct contrast between sparsely vegetated lava fields and the Pacific Ocean in the distance. To the east, Mt. Hualalai (mauka of the site) comprises the major visual resource seen from the project area. This feature is a chief natural element in the mauka viewshed. Overall, the expansiveness of views is determined by the specific viewing position within the project area.

### **2.14 SURROUNDING LAND USE**

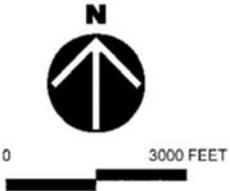
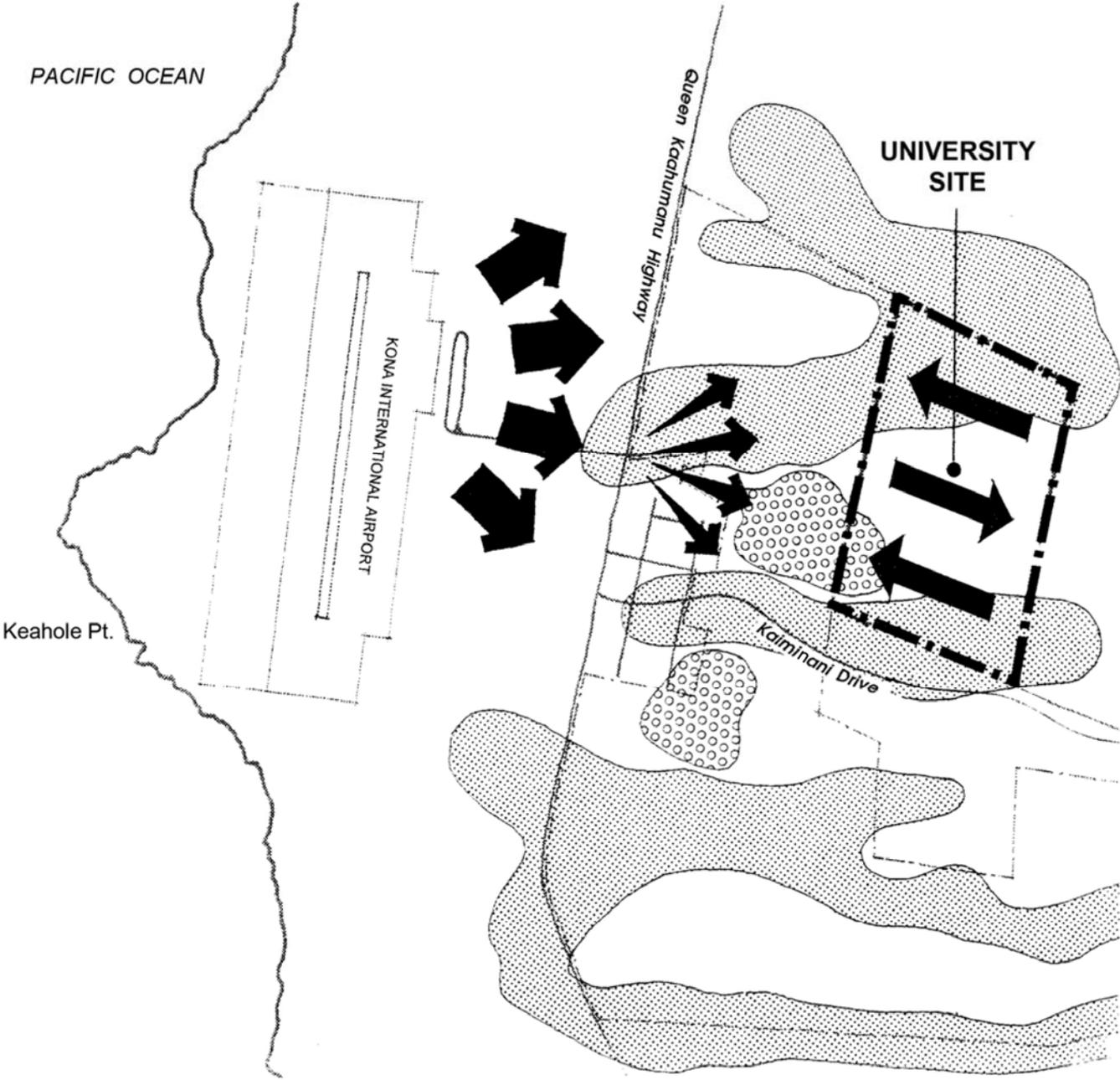
In August of 1999, the 2,640 acres of state-owned land that was reclassified from Agriculture and Conservation to Urban (1993) were consolidated and re-subdivided into thirteen (13) parcels (see Figures 10 and 11). The University site is now designated as (3)7-3-010:042. All of the subdivided parcels remain government-owned. The majority of the area surrounding the

## 2 Site Considerations

---

University site is largely State of Hawai'i property, managed by the DLNR and the Department of Hawaiian Homelands (DHHL).

Surrounding the project area are various private and state-owned land uses. Land immediately north of the project area, in the Kau ahupua'a, is private land on which the Palamanui Master Planned Community is being developed. Mass grading and sitework has been initiated for Palamanui. Palamanui includes a mix of residential villages, a 20-acre regional park, a 120-room hotel, a small-town commercial village and a 55-acre lowland native dry forest preserve. The undeveloped parcels (TMKs 7-3-010:033, 039, 040 and 044) abutting the western border of the site are state-owned and managed by the DLNR and DHHL. Along the southern border of the project area is the existing Kona Palisades residential subdivision. Another residential area is being developed just south of the Kona Palisades subdivision. Adjoining the eastern border of the project area are two (2) undeveloped state-owned parcels of lands (TMKs 7-3-010:032 and 041), one of which is controlled by the DHHL. Residential land uses are situated upslope of the University site, beyond these state-owned lands.



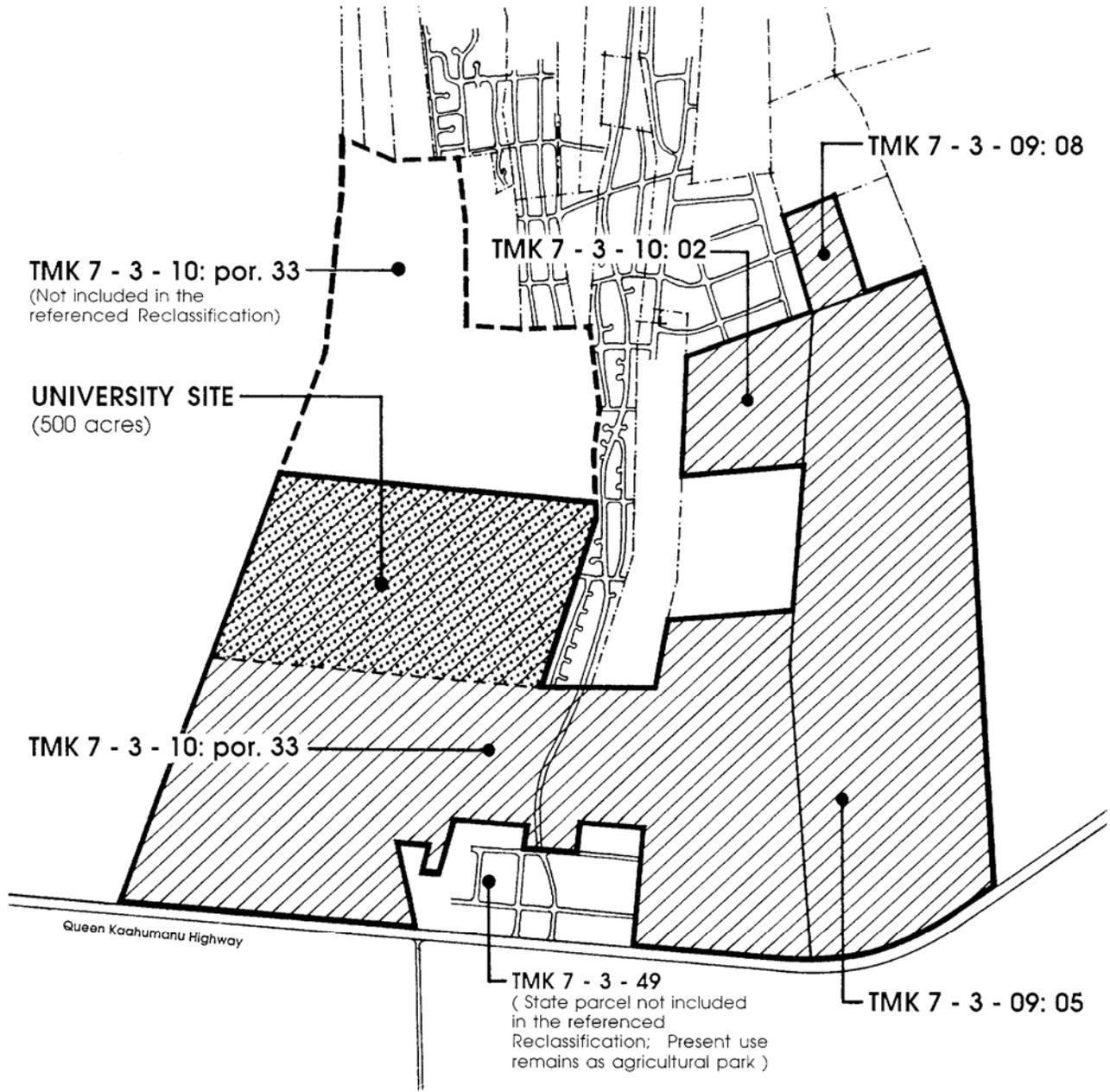
-  Small Ridges/High Areas
-  Depression
-  View Corridor

VISUAL PLANES

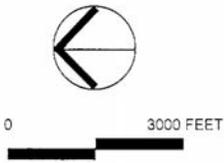
## 2 Site Considerations

---

**This Page is Intentionally Blank**



-  Area reclassified from Agricultural and Conservation District to Urban District by Land Use Commission Decision and Order of December 9, 1993
-  University Site



RECLASSIFICATION OF STATE LANDS

## 2 Site Considerations

---

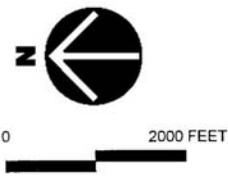
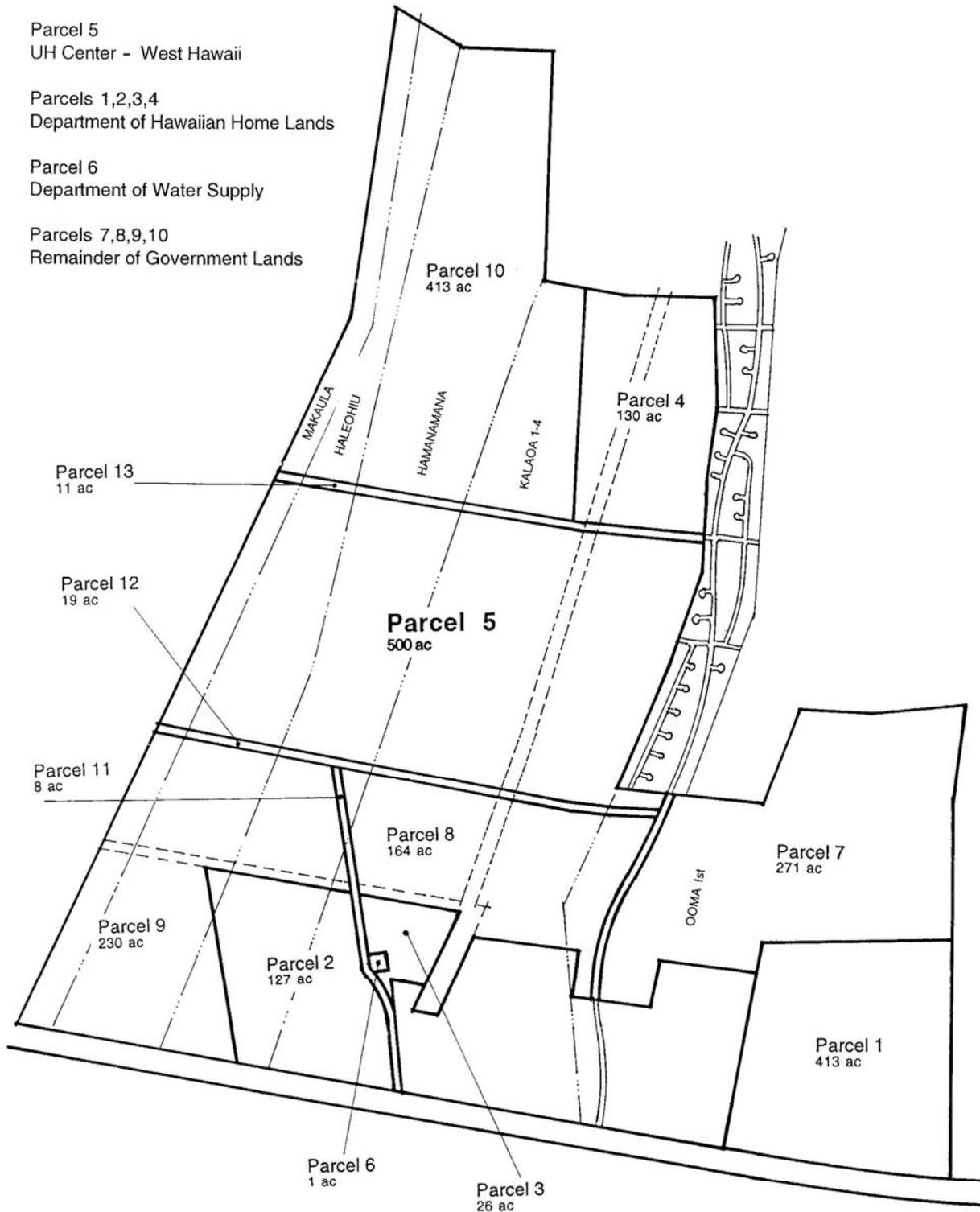
**This Page is Intentionally Blank**

Parcel 5  
UH Center - West Hawaii

Parcels 1,2,3,4  
Department of Hawaiian Home Lands

Parcel 6  
Department of Water Supply

Parcels 7,8,9,10  
Remainder of Government Lands



**CONSOLIDATION AND  
RE-SUBDIVISION MAP**

## 2 Site Considerations

---

**This Page is Intentionally Blank**

**3.0**

---

**Program Planning**



### **3.1 DESIGN ENROLLMENT**

Information contained in the *Update 1998 Educational Specifications: Final Report* dated September 30, 2008 (Ed Specs), provide the basis for the planning of spaces that will influence the initial development of the UHCWH campus at Kalaoa. Physical space needs have been projected using the planning assumptions of 750 Full-time Equivalent Students (FTES) and 1,500 FTES.

### **3.2 EDUCATIONAL PROGRAM REQUIREMENTS**

Estimates of Assignable Square Feet (ASF) and descriptions of program division needs are documented in the Ed Specs<sup>57</sup>. Program planning involves translating the requirements identified in the Ed Specs into estimates of Gross Square Feet (GSF) (refer to Table 1). The Ed Specs and planning of the UHCWH campus must include facilities for the following major components of the campus:

- Instruction
  - Division Office
  - Liberal Arts
  - Career and Technical
    - Business Education
    - Culinary Arts
    - Health Science
  - Public Services (Administration of Justice, Early Childhood Education, Fire/Environmental Emergency Response, Human Services, Substance Abuse Counseling)
  - Technology (Architecture/Engineering/CAD Technology; Electrical Installation and Maintenance Technology; Hawaiian Lifestyles; and Carpentry)
- Academic Support
  - Library
  - Learning Skills
  - IT Support
- Student Services
  - Admissions and Records
  - Counseling and Guidance
  - Student Activities
- Continuing Education
  - Administration
  - Instruction (shares classroom space with the Instruction component)
- Institutional Support
  - Director, Business Operations and Personnel
  - Operations and Maintenance
- Assembly
- Parking

---

<sup>57</sup> Subsequent to finalization of the Ed Specs in September 2008, additional functions for the Culinary Arts program and several support positions were added to the program requirements. Also, site and cost considerations required a reduction in the amount of space allocated to General Education in the initial phases of development, but this square footage is reclaimed in later phases. These modifications account for the differences between the numbers shown here and those shown in the 2008 Ed Specs

### 3 Program Planning

**Table 1. Program and Planning Requirements – Projections**

Program Division	750 FTES			1,500 FTES		
	No. of Spaces	Total ASF	Total GSF	No. of Spaces	Total ASF	Total GSF
<b>Instruction</b>						
Division Office	5	990	1,386	5	990	1,386
General Education*	29	15,429	21,601	60	33,009	46,213
Culinary Arts	27	12,709	17,792	27	12,709	17,792
Health Science	25	8,574	12,004	25	8,574	12,004
Architecture/Engineering/CAD Technology	--	--	--	14	6,632	9,285
Electrical Installation and Maintenance Technology	--	--	--	15	8,538	11,953
Hawaiian Lifestyles	--	--	--	6	7,688	10,763
Carpentry	--	--	--	12	7,688	10,763
<b>Academic Support</b>						
Library	16	9,174	12,844	16	9,174	12,844
Learning Skills	5	2,694	3,772	6	2,838	3,973
IT/Media Support	7	1,410	1,974	7	1,410	1,974
<b>Student Services</b>						
Admissions and Records	6	1,013	1,418	7	1,157	1,620
Counseling and Guidance	8	1,226	1,716	10	1,514	2,120
Student Activities	11	3,324	4,654	12	3,444	4,822
<b>Continuing Education and Training</b>						
Administration	3	544	762	4	688	963
Instruction						
<b>Institutional Support</b>						
Director, Business Operations and Personnel	16	4,556	6,378	16	4,556	6,378
Operations and Maintenance	18	7,390	10,346	19	7,590	10,626
<b>SUBTOTALS</b>	<b>176</b>	<b>69,033</b>	<b>96,647</b>	<b>262</b>	<b>118,439</b>	<b>165,815</b>
Assembly	--	--	--	1	--	12,000
Parking and Roadways	240	--	237,600	454	--	340,000
<b>TOTALS</b>	<b>176</b>	<b>69,033</b>	<b>334,247</b>	<b>262</b>	<b>118,439</b>	<b>517,815</b>

\* General Education includes instructional programs that use general classrooms and class labs. Included are Liberal Arts, Business Education, Public Services and Hawaiian Studies until Phase 4.

Four (4) development phases are proposed to reach the 1,500 FTES campus. Phases 1 through 3 will encompass development of the 750 FTES campus. Included within the 750 FTES campus will be all of the functions to serve Student Services, Academic Support, Institutional Support and Continuing Education and Training. Roughly half of the programmed Instruction space will be provided with the 750 FTES campus. Expansion to the 1,500 FTES campus will provide the remaining Instruction space, which includes facilities to serve the new Technology programs that will be phased in with the increase to 1,500 FTES.

Housing and athletic facilities are not included as part of the initial program for the UHCWH due to the more immediate needs and priorities identified in *University of Hawai'i Center: West Hawai'i Development Plan 1998-2007* dated September 1997. These functions may be included in any future expansion to develop the UHCWH beyond the 1,500 FTES campus. As indicated in the Ed Specs, it is estimated that the UHCWH campus will require 69,033 ASF and 118,439 ASF to accommodate the immediate space needs as determined by the enrollment goals of 750 and 1,500 FTES, respectively.

Basic planning assumptions used to translate the projected ASF estimates (from the Ed Specs) into projected GSF estimates in Table 1 are listed below. All buildings are to be one story and all parking is expected to be at grade level (i.e., no parking structures are planned). Other assumptions and considerations that have less bearing on space projections and more impact on design are discussed in Chapter 9.0.

Non-Assigned Space and Internal Circulation Factor of 40 Percent. University of Hawai'i, Office of Capital Improvements (OCI) recommends an internal circulation factor of 50 percent, which has been applied to other community college campus facilities in the State of Hawai'i. However, due to the large amount of outdoor circulation planned for the UHCWH, a lower internal circulation factor of 40 percent should be utilized. The internal circulation factor takes into account Non-Assigned Space such as custodial space, mechanical rooms and public circulation zones such as corridors and stairways, but does not include outdoor circulation.

Parking Requirements. OCI recommends a parking ratio of one (1) stall for every two (2) students. The Hawai'i County Code requires one (1) parking stall for every ten (10) students of design capacity, plus one (1) stall for every 400 square feet of office floor space. Paved and marked parking shall be provided to meet the requirements of the Hawai'i Count Code. Unpaved, overflow parking can be provided to meet the higher parking ratio recommended by OCI.

Area per Parking Stall of 350 Square Feet. This factor is based on the recommendations of OCI and has been applied to other HawCC campus facilities.

### 3.3 FUNCTIONAL RELATIONSHIPS

Facility planning strives to draw appropriate associations between the identified program elements. The UHCWH and HawCC generated the idealized functional relationship diagram presented as Figure 12. The diagram illustrates the desired organization of the UHCWH campus according to generalized campus components. As depicted in the diagram, Academic Support facilities are central to the UHCWH campus and surrounded by Instructional facilities. Continuing Education, Student Services and Institutional Support are other components that complete the core of the UHCWH campus. Parking areas create a buffer between the core area and the two campus access points (one main entry and a back entry). Institutional support facilities in the form of auxiliary services are located away from core facilities at the edge of the campus.

A revised functional relationship diagram is presented as Figure 13. The diagram refines the UHCWH campus organization according to six (6) major campus components: Instruction, Academic Support, Student Services, Continuing Education, Institutional Support and Parking. Program groupings within and relationships among the major program divisions are depicted. The revised functional relationship diagram also illustrates at a basic level the relative sizes of the major campus components from the square footage estimates in Table 3. The diagram represents

### 3 Program Planning

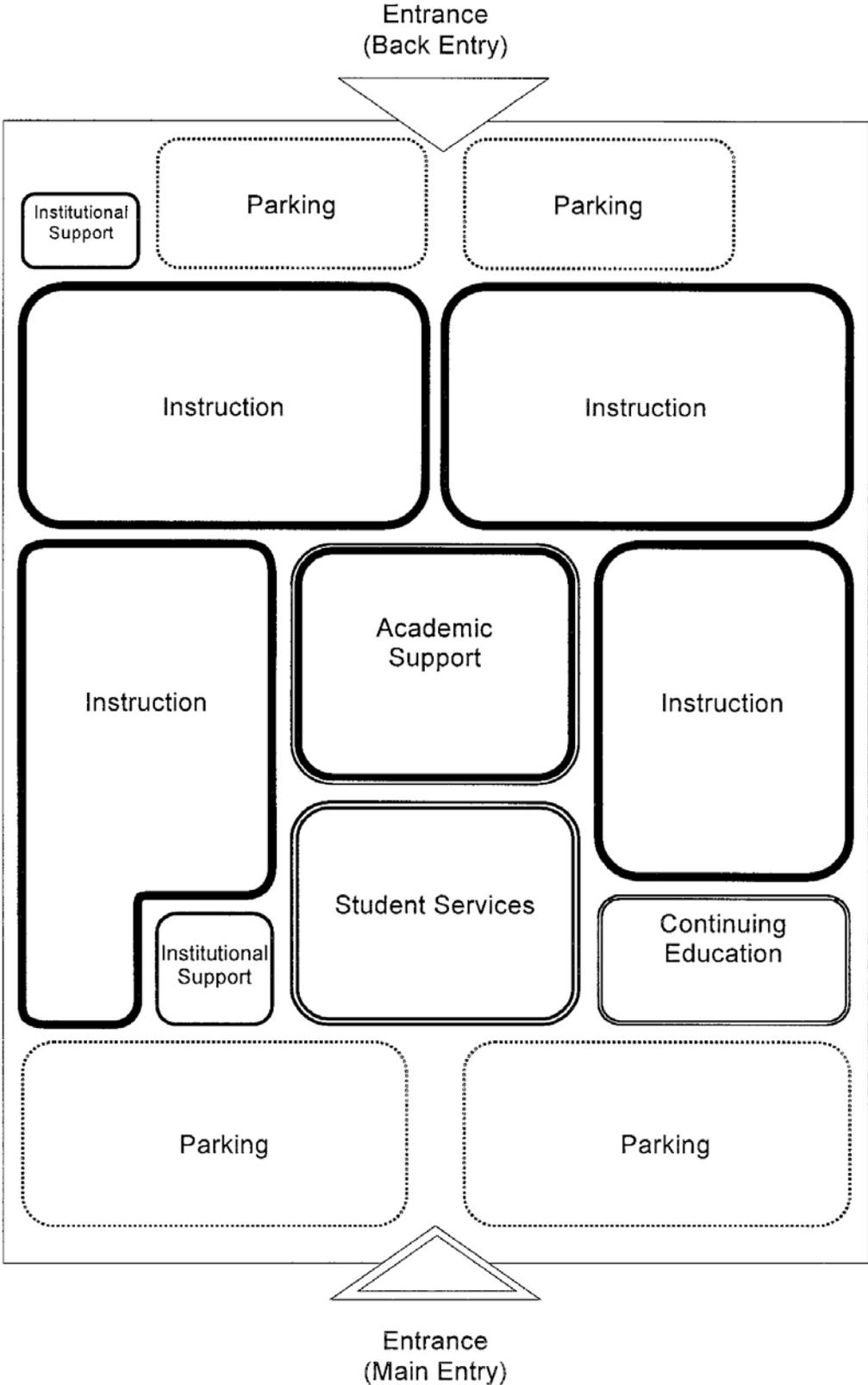
space projections (assigned plus non-assigned square footage estimates) for the UHCWH campus with 1,500 FTES.

#### 3.4 SPACE REQUIREMENTS

Space projections presented in the *Update 1998 Educational Specifications* considered physical space needs for both 750 and 1,500 FTES since the campus will be developed in phases. Tables 2 and 3 summarize the space allocations for the 750 and 1,500 FTES campuses respectively. The space allocation data includes assigned square footage estimates only.

**Table 2. Space Requirements 750 FTES**

Programs at 750 FTES	Classrooms and Class Lab (CR & LB)		Faculty & Staff Offices (FS)		Accessory / Other Spaces (AC)		Total	
	Spaces	ASF	Spaces	ASF	Spaces	ASF	ASF	Percent
<b>Instruction</b>	<b>27</b>	<b>25,325</b>	<b>31</b>	<b>4,567</b>	<b>28</b>	<b>7,810</b>	<b>37,702</b>	<b>55</b>
Division Office	--	--	1	300	4	690	990	
General Education	14	13,125	15	2,304	--	--	15,429	
Culinary Arts	7	6,000	8	1,024	12	5,685	12,709	
Health Science	6	6,200	7	939	12	1,435	8,574	
<b>Academic Support</b>	<b>1</b>	<b>1,250</b>	<b>6</b>	<b>1,248</b>	<b>21</b>	<b>10,780</b>	<b>13,278</b>	<b>19</b>
Library	--	--	3	624	13	8,550	9,174	
Learning Skills	1	1,250	1	144	3	1,300	2,694	
IT/Media Support	--	--	2	480	5	930	1,410	
<b>Student Services</b>	<b>--</b>	<b>--</b>	<b>14</b>	<b>1,898</b>	<b>11</b>	<b>3,665</b>	<b>5,563</b>	<b>8</b>
Admissions and Records	--	--	2	288	4	725	1,013	
Counseling and Guidance	--	--	5	726	3	500	1,226	
Student Activities	--	--	7	884	4	2,440	3,324	
<b>Continuing Education and Training</b>	<b>--</b>	<b>--</b>	<b>1</b>	<b>144</b>	<b>2</b>	<b>400</b>	<b>544</b>	<b>&lt;1</b>
Administration	--	--	1	144	2	400	544	
Instruction	--	--	--	--	--	--	--	
<b>Institutional Support</b>	<b>--</b>	<b>--</b>	<b>7</b>	<b>1,310</b>	<b>27</b>	<b>10,636</b>	<b>11,946</b>	<b>17</b>
Director, Business Operations and Personnel	--	--	5	910	11	3,646	4,556	
Operations and Maintenance	--	--	2	400	16	6,990	7,390	
<b>TOTALS</b>	<b>28</b>	<b>26,575</b>	<b>59</b>	<b>9,167</b>	<b>89</b>	<b>33,291</b>	<b>69,033</b>	<b>100</b>

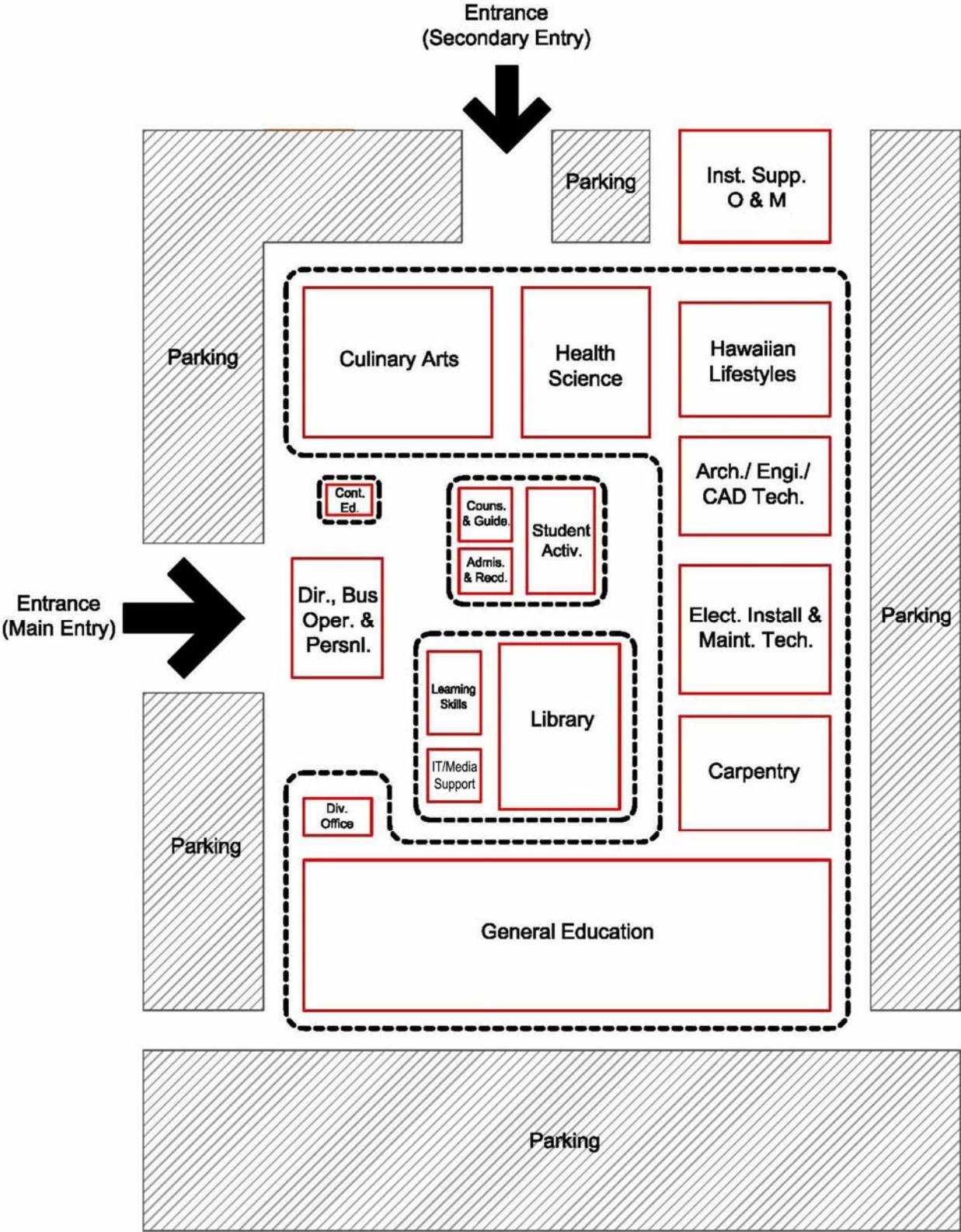


**IDEALIZED FUNCTIONAL RELATIONSHIP DIAGRAM**

### **3 Program Planning**

---

**This Page is Intentionally Blank**



REVISED FUNCTIONAL RELATIONSHIP DIAGRAM

### **3 Program Planning**

---

**This Page is Intentionally Blank**

Table 3. Space Requirements 1,500 FTES

Programs at 1,500 FTES	Classrooms and Class Lab (CR & LB)		Faculty & Staff Offices (FS)		Accessory / Other Spaces (AC)		Total	
	Spaces	ASF	Spaces	ASF	Spaces	ASF	ASF	Percent
<b>Instruction</b>	<b>55</b>	<b>60,175</b>	<b>53</b>	<b>8,023</b>	<b>56</b>	<b>17,630</b>	<b>85,828</b>	<b>72</b>
Division Office	--	--	1	300	4	690	990	
General Education	29	27,375	28	4,464	3	1,170	33,009	
Culinary Arts	7	6,000	8	1,024	12	5,685	12,709	
Health Science	6	6,200	7	939	12	1,435	8,574	
Architecture/Engineering/CAD Technology	3	3,800	3	432	8	2,400	6,632	
Electrical Installation and Maintenance Technology	3	5,400	2	288	10	2,850	8,538	
Hawaiian Lifestyles	3	5,400	2	288	1	2000	7,688	
Carpentry	4	6,000	2	288	6	1,400	7,688	
<b>Academic Support</b>	<b>1</b>	<b>1,250</b>	<b>8</b>	<b>1,632</b>	<b>21</b>	<b>10,780</b>	<b>13,662</b>	<b>12</b>
Library	--	--	3	624	13	8,550	9,174	
Learning Skills	1	1,250	2	288	3	1,300	2,838	
IT/Media Support	--	--	3	720	5	930	1,650	
<b>Student Services</b>	<b>--</b>	<b>--</b>	<b>18</b>	<b>2,450</b>	<b>11</b>	<b>3,665</b>	<b>6,115</b>	<b>5</b>
Admissions and Records	--	--	3	432	4	725	1,157	
Counseling and Guidance	--	--	7	1014	3	500	1,514	
Student Activities	--	--	8	1004	4	2,440	3,444	
<b>Continuing Education and Training</b>			<b>2</b>	<b>288</b>	<b>2</b>	<b>400</b>	<b>688</b>	<b>&lt;1</b>
Administration	--	--	2	288	2	400	688	
Instruction	--	--	--	--	--	--	--	
<b>Institutional Support</b>	<b>--</b>	<b>--</b>	<b>7</b>	<b>1,310</b>	<b>27</b>	<b>10,636</b>	<b>12,146</b>	<b>10</b>
Director, Business Operations and Personnel	--	--	5	910	11	3,646	4,556	
Operations and Maintenance	--	--	3	600	16	6,990	7,590	
<b>TOTALS</b>	<b>56</b>	<b>61,425</b>	<b>89</b>	<b>13,903</b>	<b>117</b>	<b>43,111</b>	<b>118,439</b>	<b>100</b>

### 3 Program Planning

#### 3.5 SPACE ALLOCATION SUMMARY

The following table compares the space requirements for 750 and 1,500 FTES according to the five (5) program elements and subdivisions. The space allocation data includes assignable square footage estimates only.

**Table 4. Comparative Summary of Space Requirements**

Programs at 750 and 1,500 FTES	Total (750 FTES)		Total (1,500 FTES)		Differences
	ASF	Percent	ASF	Percent	
<b>Instruction</b>	<b>37,702</b>	<b>55%</b>	<b>85,828</b>	<b>72%</b>	<b>48,126</b>
Division Office	990		990		0
General Education	15,429		33,009		17,580
Culinary Arts	12,709		12,709		0
Health Science	8,574		8,574		0
Architecture/Engineering/CAD Technology	--		6,632		6,632
Electrical Installation and Maintenance Technology	--		8,538		8,538
Hawaiian Lifestyles	--		7,688		7,688
Carpentry	--		7,688		7,688
<b>Academic Support</b>	<b>13,278</b>	<b>19%</b>	<b>13,662</b>	<b>12%</b>	<b>384</b>
Library	9,174		9,174		0
Learning Skills	2,694		2838		144
IT Support	1,410		1650		240
<b>Student Services</b>	<b>5,563</b>	<b>8%</b>	<b>6,115</b>	<b>5%</b>	<b>552</b>
Admissions and Records	1,013		1,157		144
Counseling and Guidance	1,226		1514		288
Student Activities	3,324		3444		120
<b>Continuing Education and Training</b>	<b>544</b>	<b>&lt;1%</b>	<b>688</b>	<b>&lt;1%</b>	<b>144</b>
Administration	544		688		144
Instruction	--				
<b>Institutional Support</b>	<b>11,946</b>	<b>17%</b>	<b>12,146</b>	<b>10%</b>	<b>200</b>
Director, Business Operations and Personnel	4,556		4,556		0
Operations and Maintenance	7,390		7,590		200
<b>TOTALS</b>	<b>69,033</b>	<b>100%</b>	<b>118,439</b>	<b>100%</b>	<b>49,406</b>

**4.0**

---

**Planning Criteria**



## 4.1 SITE ACCESSIBILITY

### 4.1.1 External Roadway Network

The 500-acre University site is located on the slopes of Mt. Hualalai approximately 1.7 miles east of the Kona International Airport. The University site is accessible from other parts of the island via the Queen Ka‘ahumanu Highway (Route 19) that generally parallels the shoreline. This arterial roadway is a two-lane, Class I state highway. Mamalahoa Highway (Route 109) is the only other trans-island roadway accessible to the UHCWH. It runs roughly parallel to Queen Ka‘ahumanu Highway and is more inland at the 1,600- to 1,800-foot elevation.

The only existing east-west roadway proximal to the University site is Kaiminani Drive, a county road. This roadway runs mauka-makai and connects the Queen Ka‘ahumanu Highway with Mamalahoa Highway.

Although presently there are no roadways to access the 73-acre project site, two (2) new roadways are being constructed. The first roadway is Main Street Road, which will start from the existing Kaiminani Drive and end at Palamanui’s future University Drive. Main Street Road will provide the major access to the UHCWH and will be built approximately within the former Mid-Level Road right-of-way. Palamanui, which is constructing Main Street Road, anticipates its completion in 2011. Main Street Road is included in the Kona Community Development Plan (KCDP) as Phase IV of the proposed Keohokalole Highway, which will function as the trunk transit route connecting Kailua Village with the airport (see Figure 14). This 60-foot wide roadway, within a 120-foot right-of-way, will be two (2) lanes with paved shoulders. The second roadway is University Drive, which is planned along the northern boundary of the project site. This road also will be constructed by Palamanui and will connect at its western (makai) end to Queen Ka‘ahumanu Highway. University Drive also is anticipated to be completed in 2011. University Drive will have an 88-foot wide right-of-way, two (2) lanes with paved shoulders, and a bike path.

It is recommended that the main vehicular access to the project site and campus core be via Main Street Road. A service access should be provided from University Drive. The campus core is defined as the actual developed portion of the 73-acre project site that contains buildings, roadways, parking lots, pedestrian sidewalks, and landscaped areas.

In 2005 a traffic impact analysis report (TIAR) was prepared for the construction of Main Street Road. The conclusion of the level-of-service analysis is that poor levels-of-service will be experienced at the intersections along Queen Ka‘ahumanu Highway. Main Street Road will improve conditions by diverting traffic from Queen Ka‘ahumanu Highway. However, enough traffic will not be diverted to improve the afternoon level-of-service above E or F. It is recommended that Queen Ka‘ahumanu Highway should be widened from two to four lanes to accommodate traffic demand as soon as possible. The low levels-of-service at these intersections are the result of regional traffic.

Other roadway improvements that the TIAR recommends are:

1. The intersection of Mamalahoa Highway at Kaiminani Drive should be signalized to accommodate 2015 conditions without and with Main Street or UHCWH.

## 4 Planning Criteria

---

2. The intersection of Kaiminani Drive at Main Street Road should also be signalized to accommodate 2015 conditions with Main Street Road and with UHCWH traffic.

An updated traffic study currently is being prepared to evaluate current and projected traffic conditions, which could be impacted by the development of the UHCWH campus.

### 4.1.2 Public Transportation

A transit stop should be provided near the UHCWH campus. The location of this transit stop should be located on Main Street Road, close to Palamanui's roundabout and the campus' pedestrian entry. The rationale for this location is that Main Street Road will be the first access road constructed to serve the UHCWH. UH should work with the county-run Hele-On Bus (Hawai'i County Mass Transit Agency) to provide service to and from the new UHCWH. The Hele-On Bus currently serves UHCWH at Kealakekua four times a day.

## 4.2 INTERNAL CIRCULATION, ACCESSIBILITY, PARKING AND LOADING

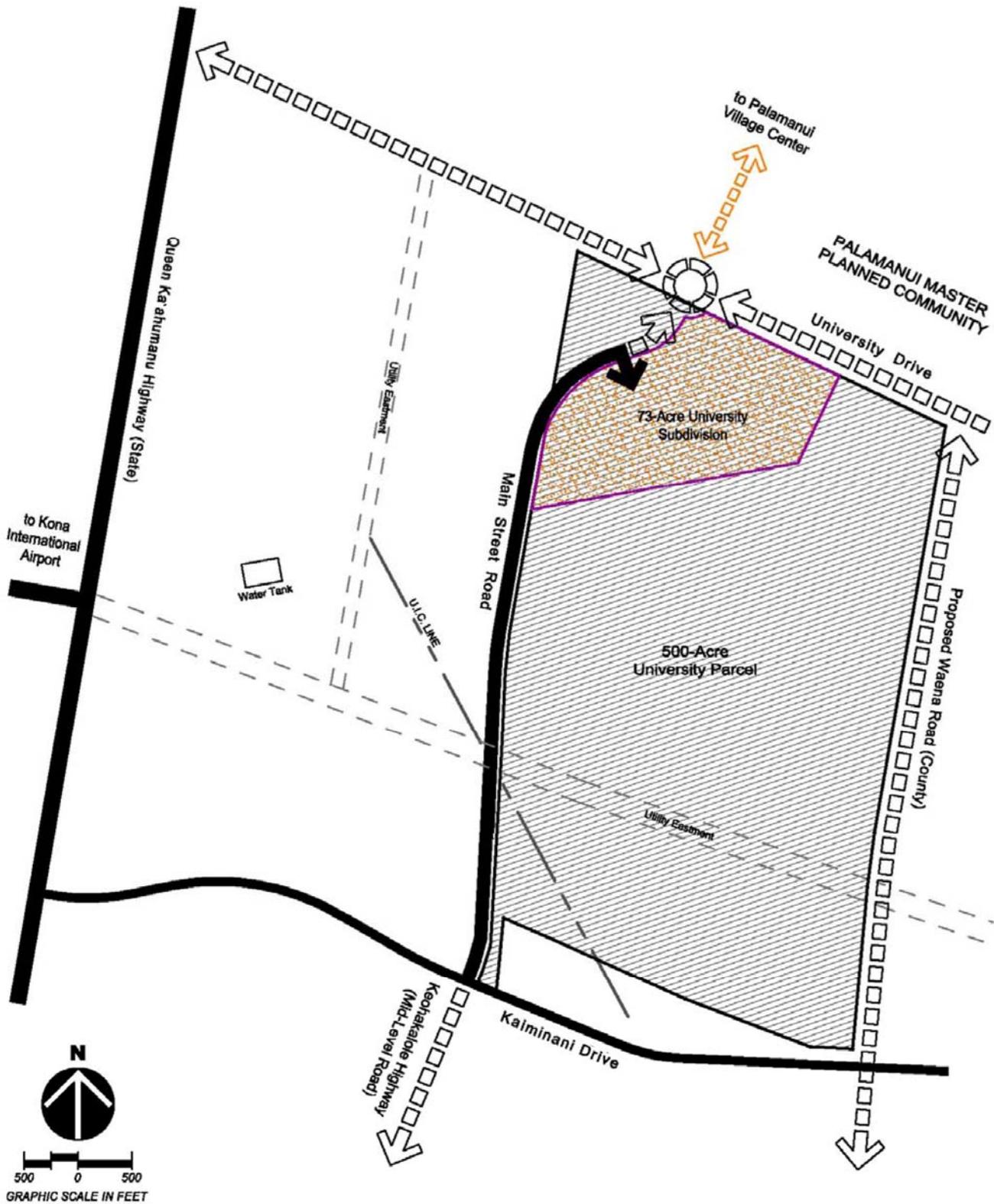
### 4.2.1 Internal Circulation and Access

The circulation system must provide vehicular access to all major building groups and facilities on the UHCWH campus. Since the UHCWH is adjacent to the Palamanui Master Planned Community, students and faculty who reside in the community would be able to walk or bike to the campus. To accommodate the pedestrian and bicycle traffic, such facilities as walkways, bike paths, and bike racks should be included in the campus layout. Users of UHCWH may access the campus via motor bikes, mopeds and motorcycles. Parking facilities for these vehicle types should also be provided. An integral component of the circulation system is parking which takes up a considerable amount of space on the campus. See Section 4.2.3 below for a discussion on parking requirements.

### 4.2.2 Accessibility for the Physically Disabled

The Americans with Disabilities Act Accessibility Guidelines (ADAAG Revised 2004) sets the guidelines for physical accessibility to buildings and facilities by persons with disabilities. These guidelines are applied during the design, construction and alteration of campus buildings and facilities. The State of Hawai'i administers the ADAAG guidelines through the State Commission on Persons with Disabilities. This Commission is part of the DOH. All state and county facilities and projects are subject to ADAAG standards and review by the Commission. Therefore, provisions must be made for the physically disabled as described in ADAAG and the Hawai'i County Code requirements (Section 25-4-55).

ADAAG requires that the site as a whole be accessible to the physically disabled from major roadways. At least one accessible route complying with ADAAG provisions must be provided within the boundary of the site from public transportation stops, accessible parking spaces, passenger loading zones, and public streets and sidewalks to an accessible building entrance. According to the County Code, the accessible route should have a minimum clear width of thirty-six (36) inches. If vehicles specifically for the physically disabled will service the UHCWH, properly located drop-off and pick-up areas should be designated in the campus circulation plan. Parking stalls should be provided for vans and larger vehicles.



**This Page is Intentionally Blank**

At this time no public transportation exists at the UHCWH site, but it is anticipated that the county's Hele-On Bus will provide service when the first two (2) buildings of the UHCWH are completed. Toward this end, a transit stop should be located on Main Street Road near the Palamanui roundabout. Handicap parking stalls should be provided at each building and an accessible route within the campus should connect the buildings with the transit stop.

#### 4.2.3 Parking

The UHCWH initially may be accessible by personal vehicles only. Public transportation is presently unavailable to the project site; however its availability should be coordinated with the county to coincide with the opening of the new UHCWH. Parking is therefore a critical functional element of UHCWH.

There are two major standards used to determine the number of parking spaces for the campus. The first standard is the County of Hawai'i parking requirement for schools, which requires one (1) parking stall for every ten (10) students of design capacity, plus one (1) stall for every 400 square feet of office floor space.<sup>58</sup> Based on the County Code, the campus needs 238 parking stalls for the initial enrollment of 750 FTES, and 463 stalls for the ultimate enrollment of 1,500 FTES. The second standard is from the OCI, which recommends a parking ratio of one (1) parking stall for every two (2) students. This standard is based on past experience with other campuses in the UH Community College system. Under OCI's standard, the 750 FTES campus would have to provide 375 parking stalls, and 750 stalls would be needed to serve the 1500 FTES campus. For planning purposes, a factor of 350 square feet per stall is being used to derive the required parking area.

In designing the parking layout, both standards should be considered. The paved parking lots and marked stalls could be designed to meet the County Code requirements, while additional landscaped areas designated as "overflow parking" could be provided to accommodate the higher UH parking ratio.

Stalls for the physically disabled must be provided. The number of stalls should be based on the size and arrangement of buildings, and the requirements set by ADAAG. The paved parking area(s) should be without curbs or curbed with accessible openings.

Parking for fuel-efficient and low-emission vehicles (e.g., hybrids) should be provided. These stalls should be reserved for such vehicles and be given preferential locations within the parking lot. At a minimum, 5 percent of the total parking capacity should be allocated for fuel-efficient and low-emission vehicles if achieving the related LEED credit is desired.

#### 4.2.4 Loading

Loading spaces should be located to facilitate deliveries and should be compatible with the overall circulation system of the campus. The number of loading spaces and design of the spaces shall be in accordance with the Hawai'i County Code. The actual number will depend on building layout and square footage. Although there is currently no public transportation to the University site, it is conceivable that public transportation or private groups may provide shuttle type service between the campus and locations around the West Hawai'i region at some future date. In

---

<sup>58</sup> Hawai'i County Code, Chapter 25, Section 25-4-51(20).

## 4 Planning Criteria

---

anticipation of this, a number of loading areas for vans and buses should be designated within the campus. Parking spaces should also be provided for these larger vehicles.

### 4.2.5 Emergency Service Access

Access for emergency service vehicles such as ambulances and fire trucks must be considered in designing the overall circulation system for the UHCWH campus. The campus road system should meet all requirements for road widths and turnarounds based on size and type of emergency and large delivery/maintenance vehicles.

## 4.3 LEADERSHIP IN ENERGY AND ENVIRONMENTAL DESIGN (LEED™)

Design and development of the UHCWH must achieve, at a minimum, a LEED Silver rating as mandated by the State of Hawai'i for public facilities. Attainment of a higher LEED rating is encouraged. While some LEED credits can be achieved through the planning phase, most credits are specific to site and building design and are addressed during the design phase. Further discussion of LEED is provided in Chapter 9 *Design Consideration and Guidelines*.

## 4.4 UTILITY SERVICES

### 4.4.1 Electricity

HELCO presently has a 69 kilovolt (kV) overhead transmission line that runs below the UHCWH project site and above Queen Ka'ahumanu Highway. HELCO plans to install new 12.47 kV lines on the existing transmission line poles below the 69 kV lines. These lines initially will be used to serve the UHCWH campus before a new Substation is built for the Palamanui project. Ultimately, the UHCWH campus will be served by the new HELCO Substation.

The UHCWH electrical system should be supplied by two (2) underground feeders connected to HELCO service on University Drive via four (4) 5-inch concrete encased polyvinyl chloride (PVC) Schedule 40 conduits. A new primary switchgear substation should be provided adjacent to the Operations and Maintenance (O & M) building to serve the UHCWH campus. The primary campus distribution system should consist of two (2) conduits two (2) spare conduits for the campus distribution feeders. Each transformer for the campus buildings should be provided with switching equipment for the two (2) campus feeders. This will allow each building to operate on a normal feeder and an alternate feeder if there is a problem with the normal feeder.

Alternative sources of electrical power should be considered and implemented where feasible. Such sources could include wind turbines and photovoltaics, among other technologies.

### 4.4.2 Water Supply and Fire Flow

There is no existing source of water to serve the 500-acre University site. The Palamanui development will provide the potable water source, storage and transmission infrastructure to support the UHCWH campus; however, the University must make its own arrangements with County of Hawai'i Department of Water Supply (DWS) for water quota and service. Within the campus, the University will be responsible for providing all potable water infrastructure beyond the first building. The LRDP shall provide schematic designs of the on-campus water system.

Water improvements will be phased, but master planned to accommodate all four (4) phases of campus development. Use of rainwater, graywater, etc. should be considered for irrigation and other non-potable uses to minimize the demand for potable water.

Fire hydrants must be provided at 300-foot intervals and be able to deliver 2,000 gallons per minute (gpm) for a two-hour duration. These hydrants should be located a minimum of 50 feet away from the buildings. The water main size should be a minimum of 10 inches in diameter, preferably in a looped system.

#### **4.4.3 Wastewater**

There is no existing wastewater treatment facility to serve the 500-acre University site. The municipal sewer system in West Hawai'i currently serves the Keahou and Kailua areas only. It does not extend as far north as Kalaoa. As such, the project site is situated beyond existing municipal wastewater service. As conditioned by the County of Hawai'i (refer to Section 1.1), the wastewater treatment plant being constructed for the Palamanui development will accommodate wastewater from the UHCWH. Wastewater generated by the UHCWH will be piped to a 12-inch sewerline located in University Drive that continues west to Palamanui's proposed wastewater treatment plant (WWTP). Within the campus, the University will be responsible for providing all wastewater infrastructure beyond the first building. The LRDP shall provide schematic designs of the on-campus wastewater system. Wastewater improvements will be phased, but master planned to accommodate all four (4) phases of campus development. Consideration should be given to alternative methods of wastewater disposal that are more sustainable, such as a Living Machine<sup>TM</sup>.<sup>59</sup>

#### **4.4.4 Gas**

There are no gas mains located near the University site. Liquid propane gas is available in the area in the form of bottle or tank storage. This service is provided in the Kona area.

#### **4.4.5 Solid Waste Disposal**

The Kailua-Kona landfill, located south of the UHCWH, is closed. A new County of Hawai'i landfill at Pu'u Anahulu south of Waikoloa is privately operated. Pick-up and disposal service is available from this company for the UHCWH campus. The Pu'u Anahulu landfill is located approximately 15 miles north of the UHCWH off the Queen Ka'ahumanu Highway.

#### **4.4.6 Telecommunications**

Encased ducts running from the utility corridor in University Drive will provide telephone service to UHCWH. A centralized telecommunications center, which includes a switch room for telephone equipment, should be provided within the UHCWH campus. Dedicated fiber should run from the telecommunications center to all buildings on the campus. Wireless capability must be incorporated into the telecommunications system.

Hawai'i Interactive Television System (HITS) will be delivered via fiber service to the telecommunications center for distribution throughout the campus. From the telecommunications

---

<sup>59</sup> A Living Machine is a trademark and brand name of a biological wastewater treatment system. It is a bioremediation system that copies the cleansing function of wetlands by utilizing the cleaning and trophic functions of plants, bacteria, algae, protozoa, plankton, snails, clams, fish and other organisms.

## 4 Planning Criteria

---

center concrete encased ductlines should be installed along the same route as other telecommunications equipment.

### 4.4.7 Cable Television (CATV)

The Oceanic Time Warner Cablevision system should be extended via underground cables from University Drive for CATV service at the UHCWH site. CATV lines should be distributed to each building from the telecommunications center.

## 4.5 DRAINAGE AND SITE GRADING

The potential rainfall at the UHCWH site is less than 20 inches per year. The amount of rainfall increases with the tributary land elevations to approximately 50 inches at the 4,000-foot elevation. There are no known drainageways on the site. Most of the storm water percolates into porous lava rock. Proposed facilities and structures should be constructed on level elevations (i.e., graded areas) to divert and deflect any storm water around buildings to lower elevations.

The project site is situated on generally permeable ground with subsurface conditions of fractured rock formations. The use of drywells for the disposal of storm water runoff is the norm in this area. The entirety of the UHCWH parcel is situated above the UIC line. Thus, the use of drywells for the disposal of storm water runoff will require the filing of a UIC permit with the DOH, Safe Drinking Water Branch. The UIC permitting process may include the need to publish a public notice of the intent to utilize drywells or injection wells at the site for the disposal of storm water runoff. Engineering reports and geologic inspection may be required to satisfy UIC permit conditions to operate the facility.

Although the overall site has a rather gentle slope averaging less than 10 percent, the rough and rocky landscape contains localized mounds and depressions. This will require mass grading for the placement of buildings, roadways and parking. The slope within the campus core is gentle enough not to require high (more than three [3] feet tall) retaining walls.

## 4.6 ENVIRONMENTAL CONTROLS

### 4.6.1 Ventilation and Air Conditioning

Both passive ventilation and air conditioning should be considered during design. It is recommended that occupant spaces have the option of both passive ventilation and air conditioning with mixed mode controls. Air conditioning is an absolute necessity in “tech” spaces where heat and moisture-sensitive equipment requires a controlled environment. Air conditioning could be divided into zones to provide local temperature control to the occupants and reduce energy consumption. Areas such as lounges and dining areas may be naturally ventilated and designed to be continuous with outdoor courtyards and landscaped areas. Natural/passive ventilation may be used during the cooler months and air conditioning may be used during the hotter months to promote a comfortable and consistent learning environment, especially in the hot, arid climate of Kalaoa. Passive/natural ventilation will reduce energy costs and promote a healthier educational environment.

Volcanic air pollution (VOG) is a concern for the air quality. MERV 13 filters can capture most particulates; however, they cannot capture gases and aerosols. In order to catch all gases, small particles and aerosols, HyperHEPA and gas media filters would be needed. Pre-cool AC units delivering fresh air into the building have limitations on the static pressure. Adding more filters may require adding more pre-cool AC units, which would significantly increase cost. Under “Mixed-Mode” operation (i.e., using natural/passive ventilation during conducive climatic conditions), AC unit would be shut down when doors/windows are kept open for natural ventilation. In natural ventilation mode, VOG cannot be addressed by the AC.

Concealed ceiling ducted chilled water fan-coil units (FCUs) are recommended to serve the spaces in each building. This type of system should best accommodate mixed-mode building use and allow for the highest level of individual building zone control.

Different options for the air conditioning systems are discussed in section 7.5 under the Ultimate Mechanical Plan. Designs must be in accordance with the American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE) *ASHRAE Handbook – HVAC Applications*. Indoor design conditions should be 75°F and 50 percent relative humidity for classrooms, offices and administrative spaces. The use of central pre-cooled handling units (PCUs) is recommended for classrooms & dining areas where high volumes of people require large amounts of outside air. Makeup air intakes should be located to avoid taking in exhaust air and other sources of potential contamination. PCUs should be located in mechanical rooms in each building. Outside air for each building must be in accordance with DOH regulations and ASHRAE 62.1-2007.

All restrooms should be naturally ventilated, window openings shall be provided to comply with the free area of the opening requirements per the sanitation code. In the event that mechanical restroom exhaust is used, exhaust will be sized at 2 cubic feet per minute (cfm)/square foot (sf) where makeup air is drawn from air-conditioned areas, and at 4 cfm/sf where makeup air is drawn from unconditioned areas.

#### **4.6.2 Lighting**

Interior lighting throughout the UHCWH campus should use the most efficient source available. Classroom, offices, support areas and corridors should use fluorescent T-8 lamps with electronic ballast. Where downlighting is desirable, compact fluorescent type luminaires can be utilized. Dimmable ballasts in conjunction with the fluorescent base sources should be used in rooms that require varying levels of lighting. In HITS rooms, directional luminaires could utilize quartz-based lamps. Consideration should be given to maximizing the use of natural daylighting.

#### **4.6.3 Noise Control and Acoustical Treatment**

The UHCWH campus is located in a remote area and should be free of any major noise disturbances except for HELCO's Keahole Generating Station and the occasional airplane landing or take-off noise at Kona International Airport located approximately 1.7 miles (9,000 feet) away. Noise contours indicate that airport noise at this distance is fairly low and should not create a long-term negative impact for the campus. The campus is located sufficiently far from major roads and highways. As a result, the noise from motor vehicles should not be of great concern.

## 4 Planning Criteria

---

Noise generating equipment such as generators and heavy equipment activities (albeit a perceived temporary source of noise impacts) as well as mechanical and electrical control rooms should be situated away from classrooms and offices. These potential noise sources should also be sited upwind from quieter areas to minimize noise disturbance. Mechanical noise generating equipment such as chillers, cooling towers, air handlers and exhaust fans should be provided with sound attenuation. Noise in interior occupied spaces should be attenuated as follows:

- Classrooms, Offices, Lounges and Conference Rooms – 35 Noise Control (NC)
- Storage and Restrooms – 45 NC
- Parking and Workshops – 55 NC

Exterior noise from mechanical equipment should be limited to a maximum of 75 dbA at a distance of 25 feet from the equipment.

Concrete and masonry is recommended as the basic construction materials for buildings at the UHCWH campus. Concrete and masonry have excellent noise isolating properties. Since the campus is planned to be air-conditioned throughout, selection and design of windows and openings should consider noise transmission from adjacent activities.

Interior building noise can be attenuated with acoustical insulation materials and assemblies. For example, interior noise traveling from room to room can be attenuated by the use of partitions extending past the ceiling to the underside of the roof structure. Sound attenuation blankets in cavity walls will also decrease sound transmission. The strategic placement of landscaping can also be used to minimize noise transfer from exterior to interior areas.

### 4.7 SECURITY AND SAFETY

#### 4.7.1 Security System

A central security system is recommended throughout the UHCWH campus. The main equipment should be located in the same room as the fire alarm control panel and will be similar in topology as the fire alarm system. Each building should have a sub-panel that will communicate with the main panel. Key rooms (e.g. main telecommunications room, computer laboratory, etc.) and building entrances should be monitored. A mass notification system should be considered as part of the security system.

#### 4.7.2 Fire Alarms and Detectors

The UHCWH campus should incorporate a centralized fire alarm system. Each building should have its own control panel, pull stations, speakers, ADAAG flashers, smoke detectors, heat detectors, duct detectors and required sprinkler monitors. Each building should be connected back to the central fire alarm panel. The main panel and the satellite panels should be capable of communicating with each other. The system should be fully addressable and electrically supervised. There should be a separate ductline and handhole system installed throughout the campus to facilitate interconnection of the system components.

#### 4.7.3 Security Fencing

To enhance the appearance of an open campus, it is recommended that the use of security fencing, such as chain link or barbed wire, be kept to a minimum. Where security fencing is

essential (e.g., open areas with sensitive equipment or hazardous materials), aesthetically designed rock walls or plant-covered fencing should be utilized.

#### **4.7.4 Railings and Gates**

Railings will be required under the various life safety codes to prevent falls, to aid the physically disabled on ramps and to direct pedestrian traffic. Although these are a functional necessity, railings can be selected and designed to be aesthetically pleasing. Design guidelines that encourage continuity of aesthetic elements such as railings should be followed throughout the UHCWH campus. Instead of the standard picket railing system, fences can be designed with a repeatable motif in appropriate materials and colors to create a Hawaiian theme.

As with fencing, gates should be minimized to create an open campus theme. Gates are necessary to allow access to fenced areas such as archaeological sites. The design of gates should follow the motif set for fencing.

Welded steel fencing, railings, and gates that are properly galvanized and painted offer the best material for flexibility and expression of design motifs. Aluminum does not have the flexibility or choice of color that steel has, but may be selected as an alternative building material. Wood lacks durability and requires more maintenance. Where visual security and surveillance is not critical, rock walls can be designed and constructed in lieu of fences and railings. Rock walls used selectively can relieve monotonous runs of fencing and railing.

#### **4.7.5 Night Lighting**

Exterior lighting must comply with the Hawai'i County Ordinance 92-01, which requires all exterior luminaires to be fully shielded and to utilize low-pressure sodium lamps. All roadways, parking lots and pathways must be illuminated for nighttime safety and security. Building perimeters should be tastefully illuminated with shielded low-pressure sodium luminaires.

#### **4.7.6 Emergency Telephone**

Security phones, clearly marked, should be located in various key locations throughout the campus. Phones should be free standing.

#### **4.7.7 Fire Protection**

The Statewide Water Supply requirements are for a hydrant system capable of supplying 2,000 gpm at 20 pounds per square inch (psi) residual for a 2-hour duration.

### **4.8 VISUAL CONTROL**

Design of a single-story open campus with clusters of buildings rather than a small number of large massive structures would create a more intimate village-like atmosphere. Pedestrian malls and open space can provide opportunities for viewing the sweeping vistas of the mountain and ocean that are available at this unique campus site on the slopes of Mt. Hualalai.

## 4 Planning Criteria

---

### 4.9 HISTORIC AND CULTURAL SITES

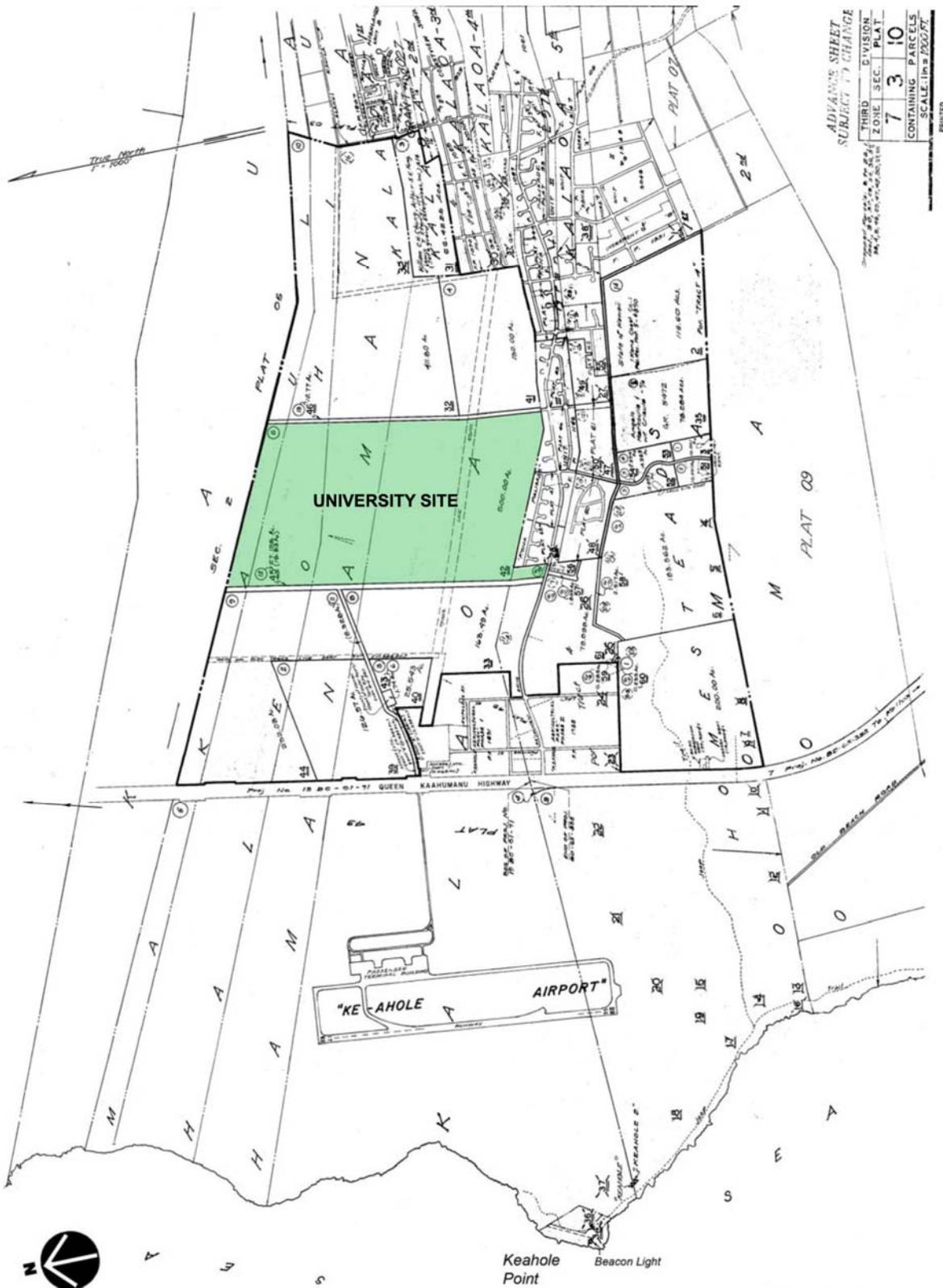
Since 1991 four (4) major archaeological survey and assessment studies have been conducted within the 500-acre University site (See Section 2.12). The most recent study in 2008 focused on archaeological resources within the 73-acre subdivision in the northwestern corner of the University site, which is the current location for the UHCWH. The study confirmed that a lava tube system runs the full length of the subdivision from east to west. This lava tube system has been identified as Archaeological Preserve 2 (see Figure 16). The lava tube system is a major site constraint because of the presence of human burials and archaeological artifacts found within the tubes. These burials require a buffer zone on either side of the lava tubes. For planning purposes 164 feet (50 meters) is used as the buffer distance. However, in a Draft Burial Treatment Plan, the project archaeologist has proposed a buffer of 50 feet (15.24 meters), subject to approval by the Hawai'i Island Burial Council. In either case the lava tube system is a major site constraint in planning the UHCWH campus. Using the 50-meter buffer, the lava tube system covers approximately 25 acres or 34 percent of the total subdivision. This leaves only 28.5 acres north of the lava tube system available for the development of UHCWH facilities.

Below Archaeological Preserve 2, four (4) other archaeological preserves have been identified containing sites worthy of preservation and interpretation (see figure 7). Although they are outside of the 73-acre subdivision, the University may wish to develop Archaeological Preserves 1, 3, 4 and 5 into an educational and interpretive venue with a trail system and interpretive signage for students and faculty. Archaeological Preserve 2 (the lava tube system) cannot be included in this venue because of the human burials; the tube system must be sealed from access except to lineal descendants of the area. If the University wishes to pursue this educational venue the Conceptual Historic Preservation Plan of 2000 must be updated, completed and submitted to SHPD for approval.

### 4.10 LAND USE CONTROLS AND POLICIES

Land use controls and planning documents exist for the UHCWH site on both the state and county levels. The official government identification of the UHCWH property is Third Tax Division (the island of Hawai'i), Zone 7, Section 3, Plat 10, parcel 042 or TMK (3)7-3-010: 042 (refer to Figure 15). Major land use policies are summarized below.

State Land Use Classification. On December 9, 1993, the State of Hawai'i Land Use Commission (LUC) issued a Decision and Order to reclassify 2,640 acres of state lands from the Agriculture and Conservation Districts to the Urban District (see Figure 10). Urbanization of the area was recommended by the Office of State Planning (OSP) for the purpose of allocating sufficient land for future urban growth in West Hawai'i. This action included the proposed subdivision of the affected state lands into 13 parcels (See Figure 11). The 500-acre University site is identified as Parcel 5 of the subdivision. The LUC Decision and Order regarding these state lands contains 34 conditions. Condition 32 specifically designates Parcel 5 for the proposed West Hawai'i campus of the UH System.



ADVANCE SHEET  
SUBJECT TO CHANGE

THIRD DIVISION	PLAT
ZONE	SEC.
7	3 10

CONTAINING PARCELS  
SCALE: 1 in = 200 FT  
PRINTED

Source: Tax Maps Bureau and Survey Department, County of Hawai'i

MAKAULA - OOMA - 1st,  
NORTH KONA, HAWAII

TAX MAP KEY **15**

**This Page is Intentionally Blank**

West Hawai'i Regional Plan. This plan by the OSP, dated November 1989, addresses the long-range planning issues of West Hawai'i. Its main objectives are the coordination of state activities and capital improvements program within the regional planning framework of West Hawai'i. The plan designates two (2) subregional planning areas to outline the areas of most probable and desirable expansion. The goal is to concentrate future regional urbanization within these areas and provide for their planning and future development, while optimizing or mitigating subregional problems, issues and opportunities. The Northern Subregional Area includes Kawaihae Harbor and the support communities of Kawaihae, Lalamilo, Waikoloa and Signal Puako. The Southern Subregional Planning Area, of which the University site is a part, extends from Kailua-Kona to Kona International Airport and includes the support community of Kealakehe.

Agricultural Lands of Importance in the State of Hawai'i (ALISH) System. No lands within the project site are included in the ALISH system.

Hawai'i County General Plan. This is the County of Hawai'i policy document for long-range comprehensive development of the island of Hawai'i. It contains land use maps referred to as "General Plan Land Use Pattern Allocation Guides" (LUPAG). According to the LUPAG, the 500-acre parcel has been designated as "University Use."

Keahole to Kailua Development Plan (K to K Plan). The K to K Plan was adopted by the County of Hawai'i in April 1991. It has been superseded by the Kona Community Development Plan, which was adopted in 2008. The K to K Plan emphasized the siting of major infrastructure intended to serve the region. The K to K Plan identified three (3) north-south roadways (a Mid-Level arterial, Waena Drive and Kealakehe Street extension) and three (3) east-west roadways (University Drive, Hina Lani Drive, and Kealakehe Drive) as part of the major future road pattern mauka of the Queen Ka'ahumanu Highway. The 500-acre University site is identified for "University" uses. Its mauka and makai boundaries are defined by the proposed alignments of Waena Drive and the Mid-Level arterial, respectively.

Kona Community Development Plan (KCDP). The KCDP was adopted in 2008 and supersedes the 1991 K to K Plan. The KCDP outlines current and future visionary statements and strategies for guiding growth patterns and maintaining community goals. The KCDP seeks to protect cultural, environmental, and land use conditions inherent to the Kona community. Within the KCDP, Urban Area Growth Management strategies are identified for the Kona region, which consists of the North Kona and South Kona districts of Hawai'i County. The UHCWH is addressed in the KCDP in regards to how the facility should be compatible with the following elements:

- Actual and future land uses,
- Development and design elements as specified in the KCDP, and
- Requirements for future transportation and accessibility between the campus, the surrounding community, and the region as a whole.

Changes in land use allocation and zoning regulations have already been implemented and are presented under the Land Use Pattern Allocation Guide. The KCDP designates land use for the future site of the UHCWH as an Urban - University Use zone. Within this zone, as well as all other urban zones in the region, development is controlled by the implementation of Urban Growth Management strategies. The KCDP determines that Urban Growth Management strategies comply with principles of village-style development congruent with strategies for Transit-Oriented Development (TOD) and Traditional Neighborhood Development (TND). Both TODs and TNDs are mixed-use communities consisting of a village

## 4 Planning Criteria

---

center within a high density Urban Core. Encompassing the Urban Core in a concentric-ring development pattern is a Secondary Core surrounded by a non-developed Greenbelt.

The KCDP designates the University Village as a TOD and future Regional Center. A Regional Center is one of two (2) varieties of Urban Cores determined as appropriate models for controlling the scale and intensity of development within an Urban Core, the other acceptable model being a Neighborhood Village. A Regional Center is a higher-density residential, retail, and commercial area that contains civic, educational, entertainment, and other various facilities and is designed to surround a commercial center. The commercial center serves as a Village focal point, and must be designed to encourage pedestrian activity. In accordance with the KCDP, University Village is to be a TOD that focuses commercial activity around the campus, which will attract students, faculty, and staff to live on or near campus, as well as provide an economic link to the neighboring Palamanui Village Town.

Policy TRAN-1.2 in the KCDP proposes the new Keohokalole Highway. This will be a trunk transit route that will alleviate congestion along the coastline and connect Kailua-Kona with the airport and new TODs, including the UHCWH. Development and construction of the highway is broken down into functional sections. Phase IV of the process is the construction of the functional section of the highway connecting UHCWH via Kaiminani Drive to University Drive. This stretch of road is being built by Palamanui as a condition imposed by the county for rezoning of their property from Agriculture (A-3a) and Open to Project District. It has been renamed “Main Street Road” since it will connect with the main street of Palamanui Village.

Hawai'i County Zoning. The 500-acre University site is zoned A-5a, Agriculture – minimum 5-acre site. Under Chapter 25 of the Hawai'i County Code, section 25-5-72(d)(7), schools are permitted provided that a “use permit” is issued.

State of Hawai'i Environmental Review Process. Chapter 343, HRS, mandates the environmental review process for the State of Hawai'i. Chapter 343 as adopted in 1974 and patterned after National Environmental Protection Act regulations provides the statutory basis for developing and processing EAs and EISs. It requires the systematic consideration of the environmental, social and economic consequences of state, county or private actions (projects). The OEQC is the designated authority that implements the provisions of Chapter 343, HRS. Since the UHCWH campus will be a state-funded project on state-owned land, the environmental review process is automatically triggered. A SEIS is being prepared concurrently with this LRDP. The action reviewed in the SEIS process will be based on the LRDP.

### 4.11 BUILDING ENVELOPE

Chapter 25 (Zoning) of the Hawai'i County Code, Sections 25-5-72 through 76 define the building envelope requirements in an agricultural zone. The building height limit for any non-residential use is 45 feet. This requirement will be met since the LRDP recommends one-story buildings throughout the UHCWH campus. Any building or structures taller than 45 feet will require a zoning variance or a zone change to a higher density use. Minimum front and rear yards (space between building and street or building and rear property line) are 30 feet, and minimum side yards (space between buildings) are 20 feet.

**5.0**

---

**Site Utilization**



## 5.1 SITE UTILIZATION SCHEMES

Site utilization analysis is the first step in the LRDP planning and design process; the main purpose of which is to provide the University with rational information that can be used in deciding which part of the project area would be the best location for the UHCWH campus core. The analysis also illustrates other significant site considerations, such as connections to the adjacent community, connections to infrastructure and utilities, vehicle and pedestrian circulation patterns, compatibility with various site constraints, and potential impacts on the environment. Site utilization schemes are presented in the form of bubbles, which portray major site elements. These elements include major campus educational components, vehicular and pedestrian circulation patterns, parking and open space. These schemes are based on the functional relationships identified in Chapter 3.0. Although drawn to scale, the schemes indicate the diagrammatic relationships of the major site elements and do not represent actual buildings. As a result of the site utilization analysis, a Preferred Site Utilization Scheme is chosen following an evaluation of the alternative utilization schemes. The campus core location is dictated by the selection of the Preferred Site Utilization Scheme.

During the site utilization phase, three (3) alternative site utilization schemes were developed. The development of these schemes is based on space projections and requirements contained in the *Update 1998 Educational Specifications*, a document prepared separately from the LRDP. According to this document, the five (5) major campus components are instruction, academic support, student services, continuing education, and institutional support. Assembly space is added into the program as an important supporting function for both the University and the community. The UHCWH space requirements contained in the *Ed Specs* are designed for three (3) campus options: 750, 1,500, and 3,000 FTES. The three (3) site utilization schemes show the incremental development of the 750 and 1,500 FTES campuses as the first phase, and the 3,000 FTES campus as the second or expansion phase of the UHCWH's full development.<sup>60</sup>

For consistency, these site utilization schemes were developed using the same concept for vehicular and pedestrian circulation patterns. A perimeter roadway and central pedestrian access were adopted in all three (3) schemes. The perimeter roadway concept was selected because it promotes efficient vehicular circulation and ease of access throughout the campus. At the same time, it leaves the interior of the campus core free from vehicles. Wide pedestrian malls and walkways were laid out to form perpendicular and diagonal circulation patterns for pedestrians within the campus core.

Three (3) critical site constraints were considered in developing the alternative site utilization schemes (refer to Figure 16). These constraints include:

- 1) The size and configuration of the subdivision boundaries.

DLNR, which has jurisdiction over the 500-acre University site has determined that a subdivision of seventy-three (73) acres shall be set aside for the development of the initial UHCWH campus. The subdivision is located at the northwestern corner of the

---

<sup>60</sup> During the planning process, it became evident that the 3,000 FTES campus facilities would not entirely fit within the allotted 73-acre subdivision. Thus, during preparation of the Ultimate Site Plan the project was adjusted downward to a 1,500 FTES campus. See Section 7.1 for a full explanation of this issue.

## 5 Site Utilization

---

500-acre University parcel. It can be accessed from either the proposed University Drive or the proposed Main Street Road.

### 2) The Open Zone area.

The County of Hawai'i has designated an Open Zone line that runs along the western edge of the 500-acre University parcel. Makai of this line is the Open Zone. Neither structures nor parking are allowed within the Open Zone unless they are for public use and approved by the Director of the County of Hawaii's Planning Department.

### 3) Archaeological/Cultural Sites and Preserves.

According to the recently completed survey by Pacific Legacy, Inc. (2008), there are two (2) archaeological sites and one (1) archaeological preserve located within the 73-acres subdivision boundary. The most critical site constraint is Archaeological Preserve 2. It contains lava tubes, human burials, and possible ceremonial sites. The lava tube system runs from the western boundary toward the northern boundary of the project site, effectively separating it into two (2) portions. As previously recommended by the 2000 HPP, a buffer guideline of 164 feet (50 meters) is maintained on both sides of the lava tube. During the site utilization phase of the planning process, no development was proposed within these 164-foot archaeological buffers.

Despite adopting the same circulation pattern concept, sharing the same basic assumptions, and responding to the same site constraints, the three (3) site utilization schemes have distinctive arrangements and characteristics. The following are brief descriptions of the three (3) alternative site utilization schemes:

#### **5.1.1 Site Utilization Scheme 1**

Scheme 1 places the entire campus core on the northwestern corner of the 500-acre University site adjacent to the Palamanui Village Center. Restricted by the archaeological buffers and the Open-zoned area, this site only has approximately 28 acres of developable land out of the total 73 acres of the subdivision. The first phase of campus development for 1,500 FTE covers a land area of about 20 acres and is located on the western portion (makai side) of the 28-acre area. The expansion phase for the 3,000 FTES campus takes up another 6.6 acres and is located on the eastern portion (mauka side) of the 28-acre site. Refer to Figure 17 for a plan of Scheme 1.

Scheme 1 has two (2) vehicular access points. The main vehicular access for students and staff is from the proposed Main Street Road that runs along the western border of the 500-acre University site. Secondary campus access for emergency service vehicles is provided through the proposed University Drive that runs along the northern border of the 500-acre University site.

In terms of the spatial organization of major campus components, Scheme 1 follows the functional relationships presented in the *Ed Specs*. Academic Support facilities are accessible from Instruction, Institutional Support, Student Services, and Continuing Education. Institutional Support (Business Operations & Administration) and Student Services are located close to the entrance of the campus and adjacent to academic support facilities. Instruction is located on land with higher elevation at the northern and eastern portions of the campus, so it can be prominently viewed from outside the site, especially from University Drive. Institutional Support (Operations & Maintenance) is separated from Institutional Support (Business Operations & Administration) and Instruction to avoid noise and odors generated by maintenance activities.

### 5.1.2 Site Utilization Scheme 2

Scheme 2 demonstrates an effort to cope with one of the most critical site constraints—the Archaeological Preserve 2—while maintaining close proximity to the Palamanui Master Planned Community (refer to Figure 18). This scheme divides the campus into two (2) parts: the upper and lower campuses. The upper campus is located in the northwestern corner of the project area, adjacent to the Palamanui Village Town Center. The upper campus area could accommodate the 750 and 1,500 FTES campuses. The lower campus is located below the Archaeological Preserve 2 and utilizes approximately the same acreage of land as the upper campus. The lower campus represents the expansion phase for the 3,000 FTES campus. The 3,000 FTES campus likely will not be built for many years until educational demands and enrollment approach a level to warrant expansion. Although separated by the archaeological preserve, the two (2) campuses could be connected by a wide pedestrian pathway located between the two overlapping buffer areas. Locating the pedestrian pathway within the buffer area is an issue that would have to be discussed with the Hawai'i Island Burial Council. To implement this 3,000 FTES campus, the University will have to request from DLNR, an additional subdivision of land.

A perimeter roadway concept and pedestrian-oriented interior space is adopted in Scheme 2. The perimeter roadway encircles almost the entire upper campus, except for the Palamanui building (Culinary Arts)<sup>61</sup> and entry plaza. The plaza functions as the main pedestrian access to the campus and creates a visual and pedestrian link between the upper campus and the Palamanui Village Center. In the lower campus, a perimeter road is configured as another loop that contains expanding functional areas required for the 3,000 FTES campus. Via central pedestrian malls and walkways, pedestrian and bicycle use, and safety are promoted within the core areas of both upper and lower campuses.

The upper campus has two (2) vehicular accesses. The main entrance for students and staff would be from the proposed north-south roadway—Main Street Road. The main entrance transitions to the campus perimeter roadway via a roundabout. The roundabout would manage traffic flow and help create a grand entry to the campus. Secondary campus access for emergency and service vehicles would be from the proposed east-west roadway named University Drive that runs along the northern border of the project area. The secondary access would be aligned with a Palamanui roadway to create a four-way intersection. The upper campus has three (3) large parking lots located on the northern, eastern, and western ends. For convenient access to all buildings, another four (4) small parking lots are provided along the perimeter road directly adjacent to major functional areas.

In addition to these two (2) access points, another main entry from Main Street Road is proposed to access the lower campus. In the lower campus, parking lots are located in three (3) areas, along the western (close to the entrance), southern, and eastern (along the perimeter road) ends.

In terms of spatial organization of major campus components, the Scheme 2 follows the functional relationships refined in LRDP. Academic Support facilities are accessible from Instruction,

---

<sup>61</sup> What is being referred to as the Palamanui Building is the initial building to be constructed by Palamanui LLC as mandated by one of the conditions imposed by the County of Hawai'i for approval of their zoning reclassification. In the LRDP, this building is designated in the long-term for the Culinary Arts program.

## 5 Site Utilization

---

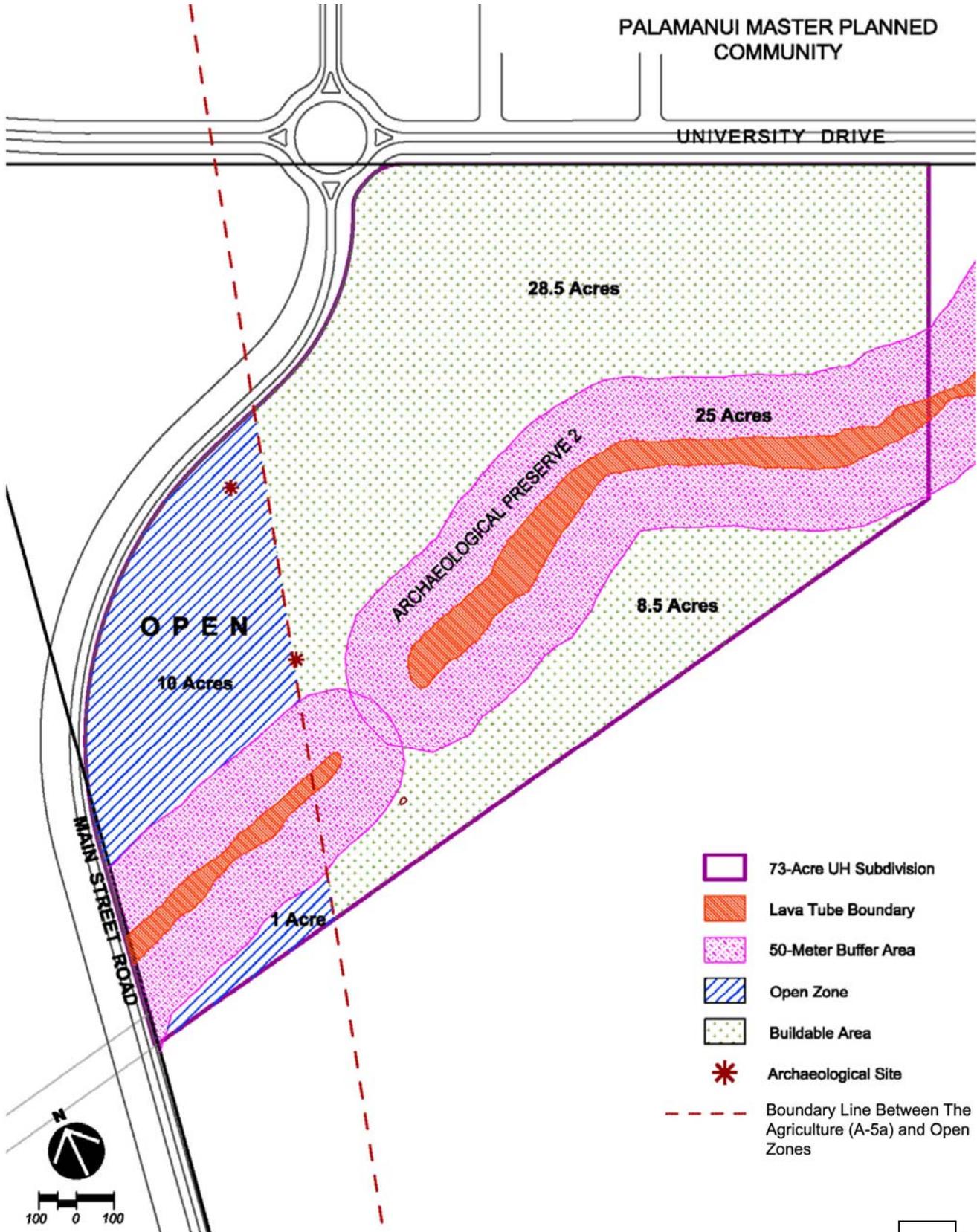
Institutional Support, Student Services, and Continuing Education. Institutional Support (Business Operations & Administration) and Student Services are located close to the entrance of the campus and adjacent to academic support facilities. Instruction is located on land with higher elevation at the northern and eastern portions of the campus, so it can be prominently viewed from outside the site, especially from University Drive. Institutional Support (Operations & Maintenance) is separated from Institutional Support (Business Operations & Administration) and Instruction to avoid noise and odors generated by maintenance activities.

A distinguishing characteristic of the Scheme 2 scheme is that each campus has its own academic support facilities, student services, and institutional support (Operations & Maintenance). There are only two (2) campus components, Institutional Support (Business Operations & Administration) and Continuing Education, that are not located in the lower campus, as they are simply expanded from their initial location in the upper campus.

### 5.1.3 Site Utilization Scheme 3

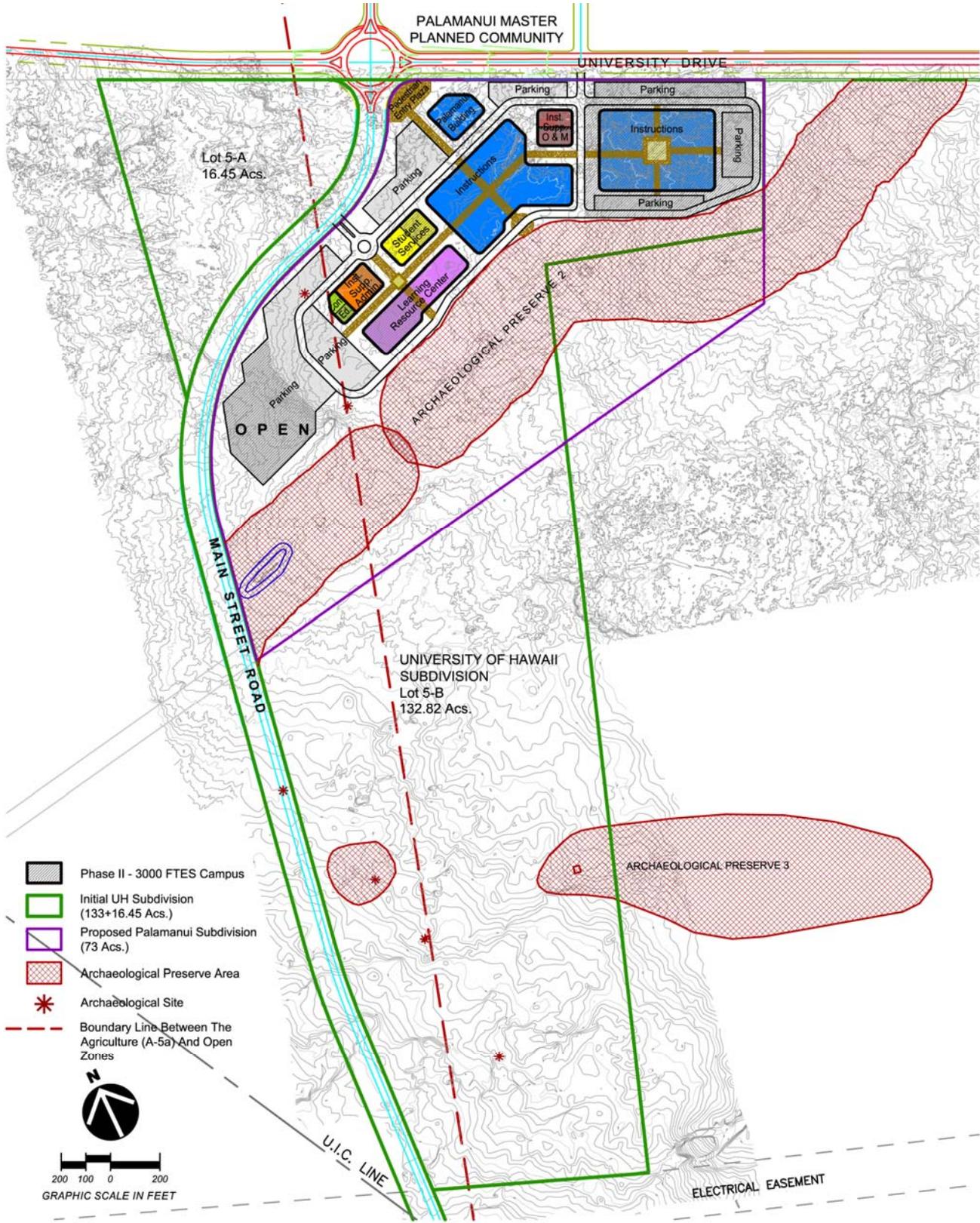
Scheme 3 places the entire UHCWH campus below the Archaeological Preserve 2. It is located in the southwestern portion of the project area and in the same location as the campus core identified in the 1998 LRDP. This location is about 2,800 feet away from the Palamanui Village Center. The 1,500 FTES campus is located in the northern area of the site and covers a land area of about 25 acres. The expansion phase for the 3,000 FTES campus is located south of the 1,500 FTES campus and requires another 16 acres. Perimeter roads encompass both the 1,500 and 3,000 FTES campuses. The 1,500 and 3,000 FTES campus would share the same Academic Support, Student Services, and Institutional Support facilities, which are located in the middle of the campus and expanded from their initial locations. Refer to Figure 19 for a plan of Scheme 3

The 1,500 FTES campus has only one main entrance for all uses, including emergency vehicles. Construction of a second entry is proposed for the 3,000 FTES campus in order to provide convenient access to expanding instructional buildings.



SITE CONSTRAINTS

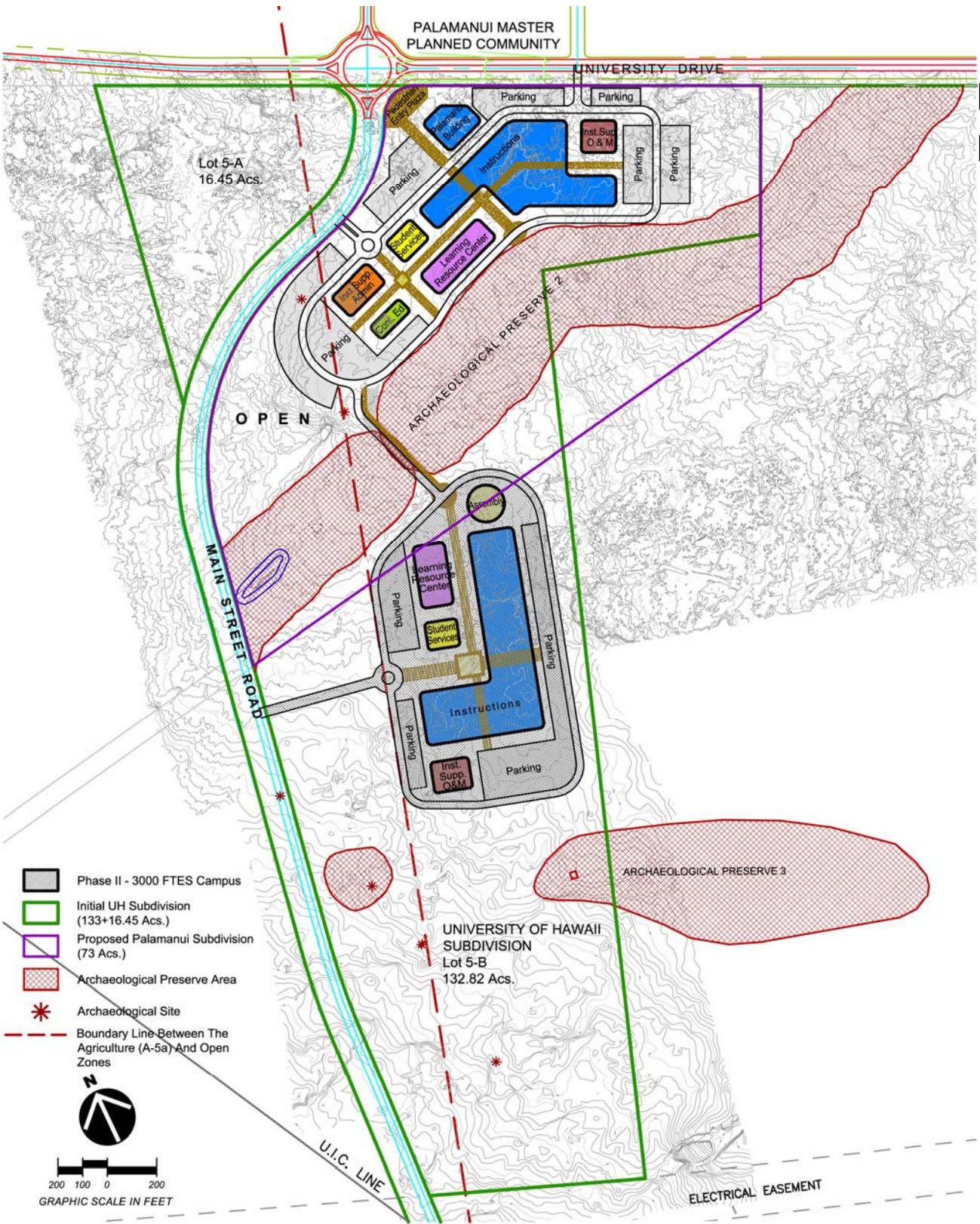
**This Page is Intentionally Blank**



**Note:** Palamanui’s proposed subdivision was adopted by DLNR after the current LRDP effort was underway (refer to Section 5.3). Palamanui’s proposed subdivision is the 73-acre UH subdivision referenced in this document.

SITE UTILIZATION SCHEME 1

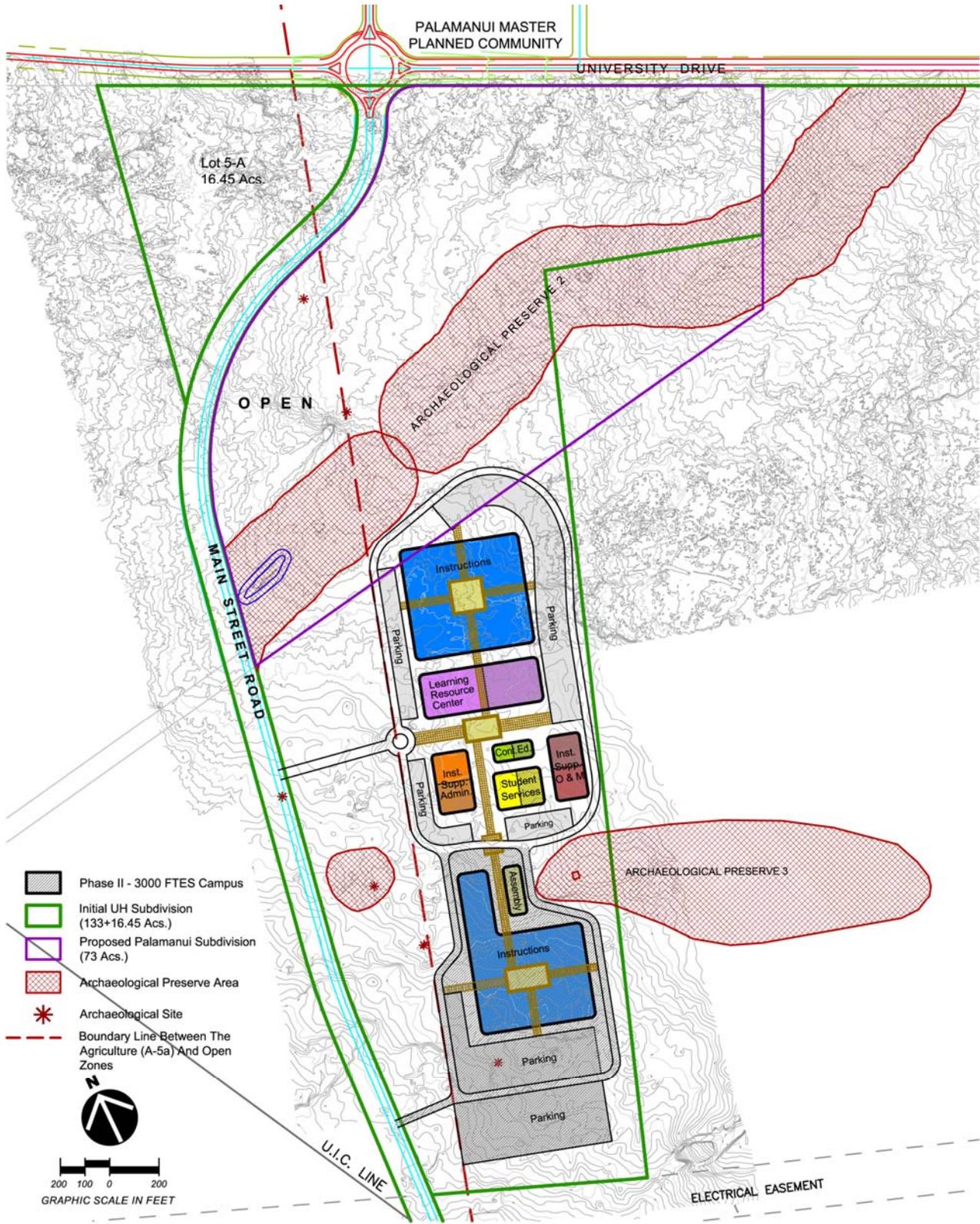
**This Page is Intentionally Blank**



**Note:** Palamanui’s proposed subdivision was adopted by DLNR after the current LRDP effort was underway (refer to Section 5.3). Palamanui’s proposed subdivision is the 73-acre UH subdivision referenced in this document.

SITE UTILIZATION SCHEME 2

**This Page is Intentionally Blank**



**Note:** Palamanui’s proposed subdivision was adopted by DLNR after the current LRDP effort was underway (refer to Section 5.3). Palamanui’s proposed subdivision is the 73-acre UH subdivision referenced in this document.

**SITE UTILIZATION SCHEME 3**

**This Page is Intentionally Blank**

## 5.2 EVALUATION OF SITE UTILIZATION SCHEMES

In evaluating the three (3) alternative site utilization schemes developed above, several factors were considered. They include: educational program and functional requirements, circulation and access, safety and security, compatibility with surrounding land uses, environmental concerns, aesthetic considerations and view planes and incremental development. A summary of the advantages and disadvantages of each scheme follows.

### Scheme 1

#### Advantages

- Close proximity to the Palamanui Master Planned Community provides students and staff ease of access to the commercial and community facilities in the Palamanui Village Town Center.
- The closeness to Palamanui would reduce the length of utility lines (e.g., water, sewer, electrical, and telecommunications) needed to connect with Palamanui's utility systems. As a result, this will substantially reduce the infrastructure costs to develop the campus.

#### Disadvantages

- After deducting the Open-zoned area and archaeological buffers, the site where the entire campus core is located has the smallest developable area (only 28 acres). This limitation leads to inflexibility of the campus's physical development and architectural theme.
- The buildings will be closer together with less open space and landscaping between buildings.
- There is insufficient space for parking in both the 1,500 and 3,000 FTES campuses to satisfy the UH standards.
- This site doesn't allow much room for the expansion phase, so the space requirements for the 3,000 FTES campus cannot be met.
- The small land area may require two-story buildings for some educational functions in order to meet the space requirements indicated in the 2008 Ed Specs.

### Scheme 2

#### Advantages

- The upper campus benefits from its close proximity to the Palamanui Master Planned Community. These benefits include convenient pedestrian access between the campus core and the Palamanui Village Center and lower infrastructure costs.
- Segregating the 3,000 FTES expansion to the lower campus will allow more area for parking as well as more open space between buildings in the upper campus.
- Noisier educational programs such as the Auto Body Repair and Painting, Auto Mechanics Technology or Diesel Mechanics; programs which are projected to be added to the UHCWH upon its expansion to an 3,000 FTES campus, can be located in more isolated areas in the lower campus which has more developable area.

#### Disadvantages of the Preferred Site Utilization Scheme include:

- The campus will be physically split.
- Due to its farther distance from Palamanui, the lower campus will require longer utility lines and would incur higher infrastructure costs.
- The longer distance from the lower campus to the upper campus and the Palamanui Village Center may discourage pedestrian access.

## 5 Site Utilization

---

### Scheme 3

#### Advantages:

- The campus would be developed as one contiguous parcel, which will benefit operations and connections.
- Developing the campus as one contiguous parcel will reduce the overall land area required for the 3,000 FTES campus. Development costs also may be reduced because of the smaller the campus the shorter the perimeter roadway.
- The campus is located on one of the flattest portions of the project area, which would require minimal grading work and subsequently reduce development costs.
- Located in the middle of the project area facing the western or makai side, the entire campus is prominently viewed from outside, especially from the Kona International Airport, which is considered to have the most expansive view of the site.

#### Disadvantages:

- Of the three (3) alternative site utilization schemes, Scheme 3 is the farthest removed from the Palamanui Master Planned Community and will, therefore, incur the highest infrastructure costs of the three (3) schemes (assuming connection to Palamanui's systems). Other infrastructure alternatives would have to be investigated and evaluated.
- The advantages of locating adjacent to the Palamanui Village Center would be lost. The campus will no longer be in comfortable walking distance to the Village Center.

### **5.3 SELECTION OF THE PREFERRED SITE UTILIZATION SCHEME**

Scheme 2 was selected as the Preferred Site Utilization Scheme based on an evaluation of each scheme's conformance to the academic program, existing site conditions, and infrastructure and other development factors. Subsequent to selection of the Preferred Site Utilization Scheme by UH Administration, DLNR approved the 73-acre subdivision proposed by Palamanui for the new UHCWH project site. This subdivision became the boundaries within which the University had to plan the new UHCWH campus. As such, in the transition from the site utilization phase to the site planning phase, the Preferred Site Utilization Scheme required modification so that the entire 3,000 FTES campus could be placed within the subdivision boundaries.

Excluding the Open Zone and the archaeological buffers, the developable area within this 73-acre subdivision is reduced to approximately 37 acres, 28.5 above Preserve 2 and 8.5 acres below (refer to Figure 16, *Site Constraints*). However, due to the 164-foot archaeological buffer, the 8.5 acres below Preserve 2 are inaccessible. Unless access can be gained to the 8.5 acres, the developable area of the 73-acre subdivision is effectively reduced to the 28.5 acres above Preserve 2.

### **5.4 LOCATION OF THE CAMPUS CORE**

The campus core is defined as the area of the UHCWH that will actually be developed with roads, paving, walkways, buildings, landscaping, etc. Other campuses in the UH System are located in more urbanized areas where land is usually at a premium such that the entire site is expected to be developed and utilized. Theoretically, the UHCWH campus should be located at a site that is much larger than what is required to accommodate the anticipated educational facilities. Unfortunately, only 73 acres of the 500-acre University site was eventually assigned

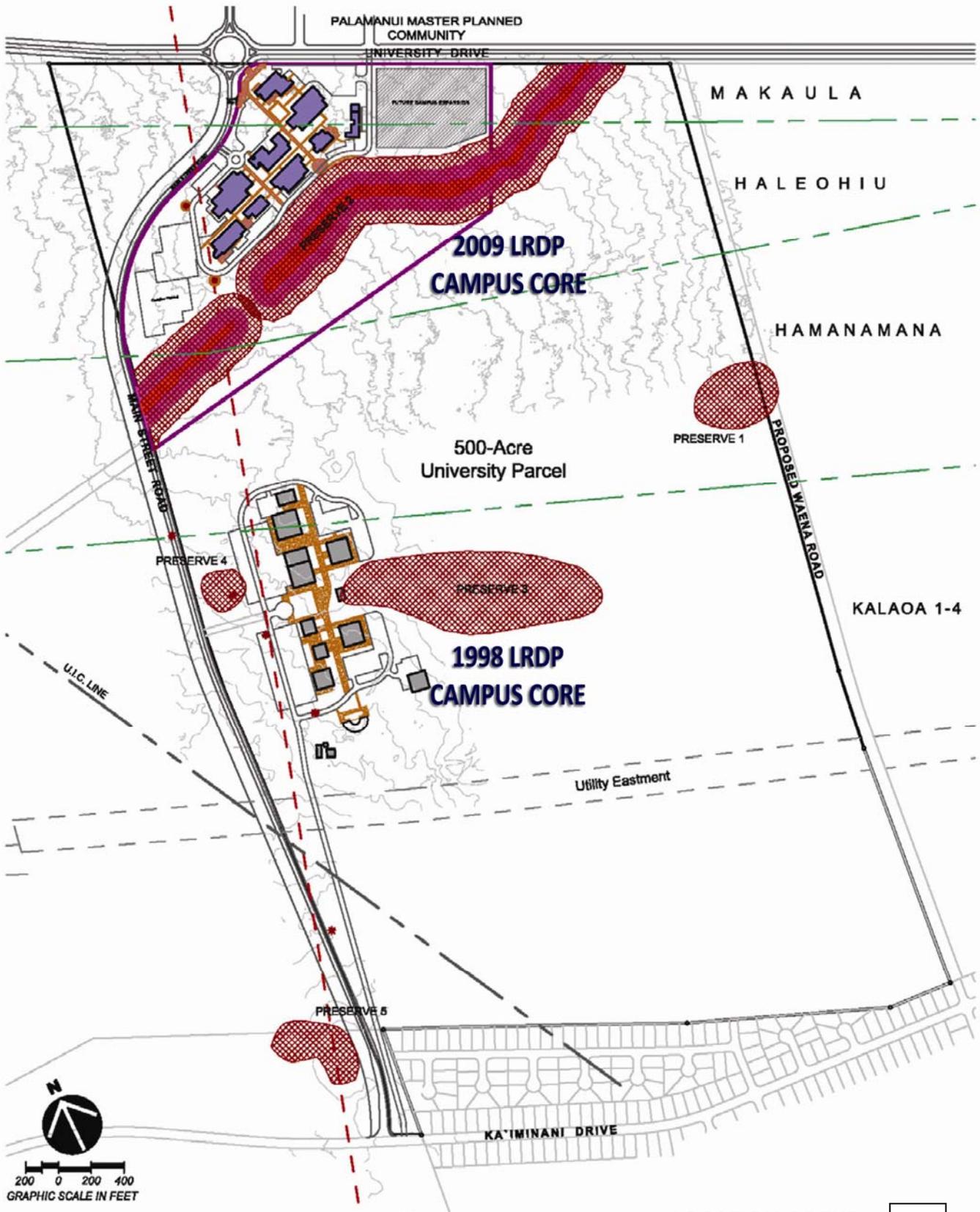
for University use by DLNR's Land Division, which has jurisdiction over all unused state lands that have not yet been subdivided.

The location of the campus core, as determined by the modified Preferred Site Utilization Scheme is located in the northwestern corner of the 500-acre University parcel, proximal to the Palamanui Village Center. Refer to Figure 20 to see the location of the new campus core in relation to the previous campus core as represented in the 1998 LRDP. This location was determined by the assignment of the 73-acre subdivision.

The location in the northwest corner of the 500-acre University site provides:

- proximity to the proposed Main Street Road and University Drives, the two (2) principal access roads linking UHCWH to the rest of the island via Queen Ka'ahumanu Highway;
- proximity to Palamanui creates a synergistic relationship between the two (2) developments and as suggested in the KCDP, serves to create a Regional Center Urban Core; and
- proximity to Palamanui which facilitates tie-ins to Palamanui's infrastructure systems and minimizes infrastructure and development costs for the University.

**This Page is Intentionally Blank**



LOCATION OF THE CAMPUS CORE

**This Page is Intentionally Blank**

**6.0**

---

**Alternative Site Plans**



## 6.1 COMMON DESIGN ELEMENTS

A Preferred Site Utilization Scheme (bubble diagram) was selected based on a thorough examination of the academic program, existing conditions, and infrastructure and development factors. Subsequent to its selection, the Preferred Site Utilization Scheme required modification as discussed in Section 5.3. From the modified preferred scheme, three (3) alternative site plans were derived and drawn to scale. The alternative site schemes include the following elements:

- Proposed building locations, configurations and function;
- Major structures and appurtenances for utilities;
- Major archaeological sites to be preserved;
- Access and roadways;
- Service and emergency access (perimeter roadway and mall);
- Parking lot configurations and capacities;
- Major pedestrian walkways, malls and courtyards; and
- Open spaces and general landscaping.

Being developed from the same site utilization scheme, these three (3) alternative site plans have several common design elements.

First, in the 750 and 1500 FTES campuses, the campus core and its first nine (9) major buildings are situated in roughly the same location within the northern portion of the 73-acre parcel. This location was chosen for its proximity to the Palamanui Master Planned Community, of which the developers are required by the County of Hawai'i to finance the construction of the campus's first building. Most importantly, proximity to Palamanui can reduce the utility runs needed to connect with Palamanui's systems. This will substantially reduce the infrastructure costs to develop the campus. Proximity to Palamanui also provides students and staff easy access to the commercial and community facilities located in the Palamanui Village Town Center.

Second, for development in the upper portion of the proposed site (above the Archeological Preserve 2), all alternatives use the same locations for the primary and secondary vehicular accesses and have a 55-foot radius roundabout at the campus entrance. Primary vehicular access to the campus is off of Main Street Road, which intersects with the roundabout. From this entry point, a view corridor is created to the archaeological preserve area. The secondary or service access is via University Drive.

Third, a large plaza and an amphitheater are sited at the northwestern corner of the proposed site, close to the Palamanui Village Town Center. The 12,000-square-foot plaza serves several important functions including pedestrian access to the campus, a main reception area, and a link between the campus core and the Palamanui Village Town Center. A sculpture could be placed at the center of the plaza to create a landmark or focal point, while a few large trees can provide shade for the paved reception area. The amphitheater would function as a gathering place for performances and outdoor activities. Its location and orientation takes advantage of the site's topography, with the stage located on a lower elevation and the seats tiered to follow the site contours.

Fourth, the same concept for pedestrian circulation is used. Each alternative has two (2) central pedestrian malls running north to south, and a central pedestrian walkway running east to west (mauka-makai), perpendicular to the malls. One mall connects the entry plaza and campus core,

## 6 Alternative Site Plans

---

while the second connects the roundabout/vehicular drop-off to the campus core. These perpendicular pedestrian circulation elements divide the campus core into small sections in which are located the main buildings. This circulation pattern facilitates visual identification of functional areas as ones move through the campus. These pedestrian malls and walkways will be paved and would serve as emergency and maintenance vehicle access.

Fifth, several separate parking areas are provided rather than a large single parking lot. Convenient access to all major building destinations was considered to be an important site planning criteria. All major campus functions are concentrated in the middle of the 73-acre site and are accessible from the separate parking areas. There is no parking between the campus and the Archeological Preserve 2, except for the overflow and small service parking.

Sixth, the same concept for building design and orientation is used in all alternatives. Buildings are configured in a long linear shape with courtyards, and are connected to each other by walkways. The inter-space concept and collaborative learning model is utilized in both architectural design and site planning. Attention is given to the layout of walkways and courtyards as these elements can be used as outdoor classrooms and learning spaces. In all alternatives, buildings are facing in either the northwestern or the northeastern directions to maximize indirect sun exposure (north) and take advantage of prevailing breezes for natural ventilation.

The last common design element is the landscaping concept, which includes the use of dry vegetation and minimal disruption of the sloping lava terrain. Tall palms are proposed for the campus's main vehicular entrance and pedestrian mall to create a sense of welcome and visually relate the importance of the campus in the West Hawai'i region. Coconut palms are placed on the edge of the campus's plaza and reception area to enhance the Hawaiian sense of place. The central east-west pedestrian walkway is shaded by a series of medium canopy trees. The open areas between buildings are left in natural lava and grasses to emphasize the geological origins of the site. Large canopy trees together with small flowering trees, palms and shrubs would be used in the courtyards. Medium canopy trees provide shade and break up the visual monotony of parking areas. Large canopy trees could be planted informally along the Archeological Preserve 2 to form a buffer area. There will be no large expanses of grassed lawns due to the nature of the existing environment and high cost of maintenance.

### 6.2 DEGREE OF COMPATIBILITY TO MAJOR SITE CONSTRAINTS

Each of the alternative site plans were developed on the basis of the varying degrees of compatibility to the three (3) major site constraints. These constraints were discussed previously in Chapter 5: Site Utilization. After deducting the 11 acres in the Open Zone and the 25 acres that constitute the 164-foot (50-meter) archaeological buffer zone, two (2) separate developable areas remain: the 28.5-acre area above (north of) Preserve 2 and the 8.5-acre area below (south of) the Preserve (see Figure 16).

The underlying approach used in developing the alternative site plans is that each scheme would depict a high, moderate, and low degree of compatibility with the site constraints. Alternative 1 has the highest degree of compatibility to major site constraints, as no campus facilities are located within the Open Zone and the 164-foot archeological buffer zone. Alternative 3 has the

lowest degree of compatibility. Not only is the Open Zone used for roadway and landscaped parking, but the archeological buffer is reduced to 82 feet (25 meters).<sup>62</sup> The buffer reduction is necessitated by the need to accommodate the entire 3,000 FTES campus<sup>63</sup> within the 73-acre subdivision, provide access to the 8.5-acre area below Preserve 2, satisfy the UH's parking standards, and comply with UH's desire to keep all buildings to one-story in height. Alternative 2 represents the middle ground between Alternatives 1 and 3. It assumes that certain non-structural site planning elements such as roadways and landscaped parking would be permitted within the Open Zone area; however, no development is proposed within the 164-foot (50-meter) archaeological buffer area. These three alternatives are discussed in further detail under Section 6.3 to 6.5.

### **6.3 ALTERNATIVE SITE PLAN 1**

Alternative Site Plan 1 consists of 26.7 acres of developed land, 10 one-story buildings, and two (2) two-story Buildings.

Site Plan 1 (see Figure 21) is the most restrictive of the three (3) alternatives. The entire campus development is held back from the Open Zone and the 164-foot (50-meter) archaeological buffer. This means the development is only limited on the 28.5-acre site above the Archeological Preserve 2. There is no development within the 8.5-acre buildable site below the Preserve, because it is not accessible from the Main Street Road and the upper portion of the 73-acre subdivision.

The 750 FTES campus covers a land area of 13 acres or about 45.6 percent of the total buildable area. It contains four (4) one-story buildings and three (3) separate parking areas that together provide 380 parking stalls for all students and staffs.

The 1,500 FTES campus requires 23.8 acres or 83.5 percent of the total buildable area for the construction of nine (9) one-story buildings and 756 parking stalls. To increase the number of parking stalls, the western parking area is expanded to twice its initial size and another two (2) parking areas are added to the campus.

The 3,000 FTES campus takes up to 26.7 acres or about 94 percent of the total buildable area. When fully developed, the campus will have 12 buildings and 680 parking stalls.

The vehicular circulation pattern is the major distinctive site planning element between Alternative 1 and the other two alternatives. In Site Plan 1, the perimeter roadway concept was adopted. The internal roadway encircles the major functional facilities except for the Culinary Arts building and the amphitheater. Despite providing a convenient vehicular access to all buildings, the perimeter roadway concept has one critical drawback, which is the disruption of the pedestrian

---

<sup>62</sup> For planning purposes a reduced buffer of 82 feet (25 meters) was used. However, a request is being made to the Hawai'i Island Burial Council to reduce the archaeological buffer from 164 feet (50 meters) to 50 feet (15.24 meters), which would provide additional developable land area.

<sup>63</sup> During the planning process, it became evident that the 3,000 FTES campus facilities would not entirely fit within the allotted 73-acre subdivision. Thus, during preparation of the Ultimate Site Plan the project was adjusted downward to a 1,500 FTES campus. See Section 7.1 for a full explanation of this issue.

## 6 Alternative Site Plans

---

connection between the campus core and the Palamanui Village Center. The perimeter roadway cuts across the pedestrian mall linking the plaza to the campus core and may lead to potential conflicts between vehicles and pedestrians.

Due to the most restrictive site planning criteria, this alternative has two (2) major shortcomings. First, two (2) instruction buildings, located on the eastern end of the campus core, have to be two-stories in order to meet the space requirements identified in the Ed Specs. The construction of a multiple-story building could result in higher costs as compared to a single-story building as an elevator would be required to provide an access to the upper floor for the physically disabled. Second, the number of surface parking stalls provided in the Site Plan 1 does not meet the requirements for the 3,000 FTES campus. Parking is insufficient by 820 stalls based on UH standards.

### 6.4 ALTERNATIVE SITE PLAN 2

Alternative Site Plan 2 consists of 32.5 acres of developed land, and 14 one-story buildings.

Site Plan 2 (see Figure 22) respects the 164-foot (50-meter) archaeological buffer and no development is proposed within that area. Also, maintaining the 164-foot (50-meter) buffer does not permit access to the 8.5-acre land area below Preserve 2, essentially rendering it undevelopable. As such, only the 38.5 acres above Preserve 2, 10 acres of which are in the Open Zone, are available for development.

In order to comply with the University's desire to keep all buildings to one-story in height, Site Plan 2 utilizes the 10-acre Open Zone for roadways and landscaped parking. No buildings would be located in the Open Zone. Use of the Open Zone for roadways and parking allows maximal use of the developable 28.5-acre area for constructing major buildings to satisfy the UHCWH's space requirements. As a result, all 14 buildings can be one-story in height. Implementation of this alternative depends on an approval from the Hawai'i County's Planning Director to use the Open Zone for development of non-structural site elements.

Instead of a perimeter roadway as laid out in Alternative 1, a U-shaped roadway is utilized in Alternative 2 to promote the continuity of pedestrian circulation. This roadway runs counter-clockwise from the main vehicular access and roundabout located at the northwestern corner, to the parking area located on the western end, to the southern portion of the campus core (paralleling the 164-foot (50-meter) archeological preserve buffer), and to the eastern end of the site. The roadway then merges with the secondary vehicular access at University Drive. As a result, the entire interior of the campus core is free from vehicles.

Alternative 2 also shows the incremental development of the 750, 1,500, and 3,000 FTES campuses. The 750 FTES campus requires 13 acres to accommodate four (4) one-story buildings—the Culinary Arts building, the General Education I building, the Health Science building, and the Academic Support I building—and 384 parking stalls. For the 1,500 FTES campus, 24.6 acres of land are needed for five (5) additional one-story buildings (nine [9] total buildings) and 754 parking stalls. When fully developed the 3,000 FTES campus utilizes 32.5 acres and contains a total of 14 one-story buildings and 977 parking stalls, which does not meet

the University's parking requirements. The University's requirement stipulates one (1) stall for every 2 students (i.e., 1,500 stalls for 3,000 FTES).

## **6.5 ALTERNATIVE SITE PLAN 3**

Alternative Site Plan 3 consists of 39.5 acres of developed land and 16 one-story buildings.

Site Plan 3 (see Figure 23) is the least restrictive of the three alternatives. Like Site Plan 2, Site Plan 3 also uses the 10-acre Open Zone for roadway and landscaped parking. The major difference between Site Plans 2 and 3 is that the archaeological buffer in Site Plan 3 is reduced to 82 feet (25 meters) instead of 164 feet (50 meters). Areas between the old 164-foot buffer and the proposed 82-foot buffer are only used for overflow parking and outdoor gathering space, but not for buildings.

The reduced buffer benefits site development in two (2) ways. First, it creates a 100-foot gap between the two lava tube systems. Within this gap, a pedestrian walkway can be constructed to connect the area above (north of) Archeological Preserve 2 and the area below (south of) the Preserve. Second, it provides a 100-foot-wide access from the Main Street Road to the small buildable area below (south of) the archaeological buffer. Having a separate vehicular access, this 8.5-acre area can then be used for the future development of the 3,000 FTES campus. However, the implementation of this alternative requires the consent of the Hawai'i Island Burial Council and the SHPD to reduce the buffer to 82 feet (25 meters).

As depicted in Site Plan 3, the first two (2) phases of development (the 750 FTES and 1,500 FTES campuses) are similar to those of Site Plan 2 in terms of their major site planning components, building and parking locations, size of the campuses, and vehicular and pedestrian circulation patterns. In Alternative 3, the 750 FTES campus covers the land area of 13 acres. It contains four (4) one-story buildings and 380 parking stalls. In the second phase, 26 acres of land are developed and another five (5) one-story buildings and 376 parking stalls are added to the 1,500 FTES campus.

The major difference between Alternatives 2 and 3 clearly emerges when the campus is expanded to serve 3,000 FTES. In Alternative 3, the last phase of campus development takes up a land area of 39.5 acres to house the total of 16 one-story buildings and 1,500 parking stalls. The 3,000 FTES campus is divided into two (2) parts: the upper and lower campuses. Both campuses are connected by a wide pedestrian pathway built within the gap between the two (2) reduced buffers. The upper campus contains twelve (12) buildings and provides about 1,200 parking stalls. Its layout is similar to Site Plan 2 except only two (2), instead of four (4), instruction buildings are added to the western end of the upper campus core. The lower campus accommodates the expanded functional areas including one (1) Student Services building, three (3) Instruction buildings, and 300 parking stalls.

A linear layout is used in organizing the building placement and vehicular circulation system in the lower campus. The lower campus has its own vehicular access from Main Street Road. From this access, the internal two-way road runs parallel to the southern border of the lower campus. There are two (2) main parking areas: one on the western end and another on the eastern end of the site. All four (4) buildings are placed in the middle of the site and face the roadway, so they

## 6 Alternative Site Plans

---

are conveniently accessible from the roadway and parking. At the same time, the inner areas between the roadway and the archeological buffer are free from vehicles. Pedestrians can safely walk between buildings and access the outdoor gathering space provided at the edge of the buffer. A main plaza is placed on the central area between the Student Services building and the Instruction building. It functions as a main outdoor gathering space for the lower campus as well as the link between the two campuses.

There are advantages of the split-campus concept adopted in Site Plan 3. For example, like Alternative 1 and 2, the upper campus will benefit from its close proximity to the Palamanui community. These benefits include convenient pedestrian access between the campus core and the Palamanui Village Center and lower infrastructure development costs. In addition, noisier educational programs such as the Auto Body Repair and Painting, Auto Mechanics Technology or Diesel Mechanics can be located in the more isolated areas within the lower campus.

In spite of the above advantages, Site Plan 3 also has two (2) critical drawbacks. First, due to its farther distance from the Palamanui community, the lower campus will require longer utility lines and will incur higher infrastructure development costs. Second, the longer distance to the upper campus and the Palamanui Village Center may discourage pedestrian access to the lower campus.

### 6.6 THE SELECTION OF THE PREFERRED ALTERNATIVE SITE PLAN

Selection of the Preferred Alternative Site plan was done by considering the following four (4) criteria:

- (1) The proximity to Palamanui Master Planned Community. Because it is intended that the UHCWH will tie into the infrastructure being installed by Palamanui, locating development in the extreme northwestern corner of the project area would result in shorter utility runs and would, therefore, represent a cost savings to UH. In addition, the desired pedestrian-oriented relationship between the UHCWH and the Palamanui Village Town Center could be achieved.
- (2) Compatibility with the 164-foot archaeological buffer.
- (3) The ability to meet the educational program and functional requirements identified in the Ed Specs, and
- (4) All buildings are one-story in height.

Based on the above criteria, Site Plan 2 is more advantageous than Site Plans 1 and 3. All three (3) alternatives satisfy the first criteria, as they demonstrate the closeness to Palamanui. Site Plan 3 was eliminated because it did not meet the second criteria. It would be impossible to complete the layout shown in Site Plan 3, if the Hawai'i Island Burial Council and SHPD do not allow the UHCWH to reduce the buffer from 164 to 82 feet (50 to 25 meters). Site Plan 1 was eliminated because it would require two-story buildings in order to satisfy the space requirements enumerated in the Ed Specs. Therefore, the preferred alternative is Site Plan 2.

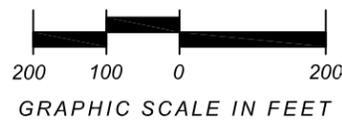
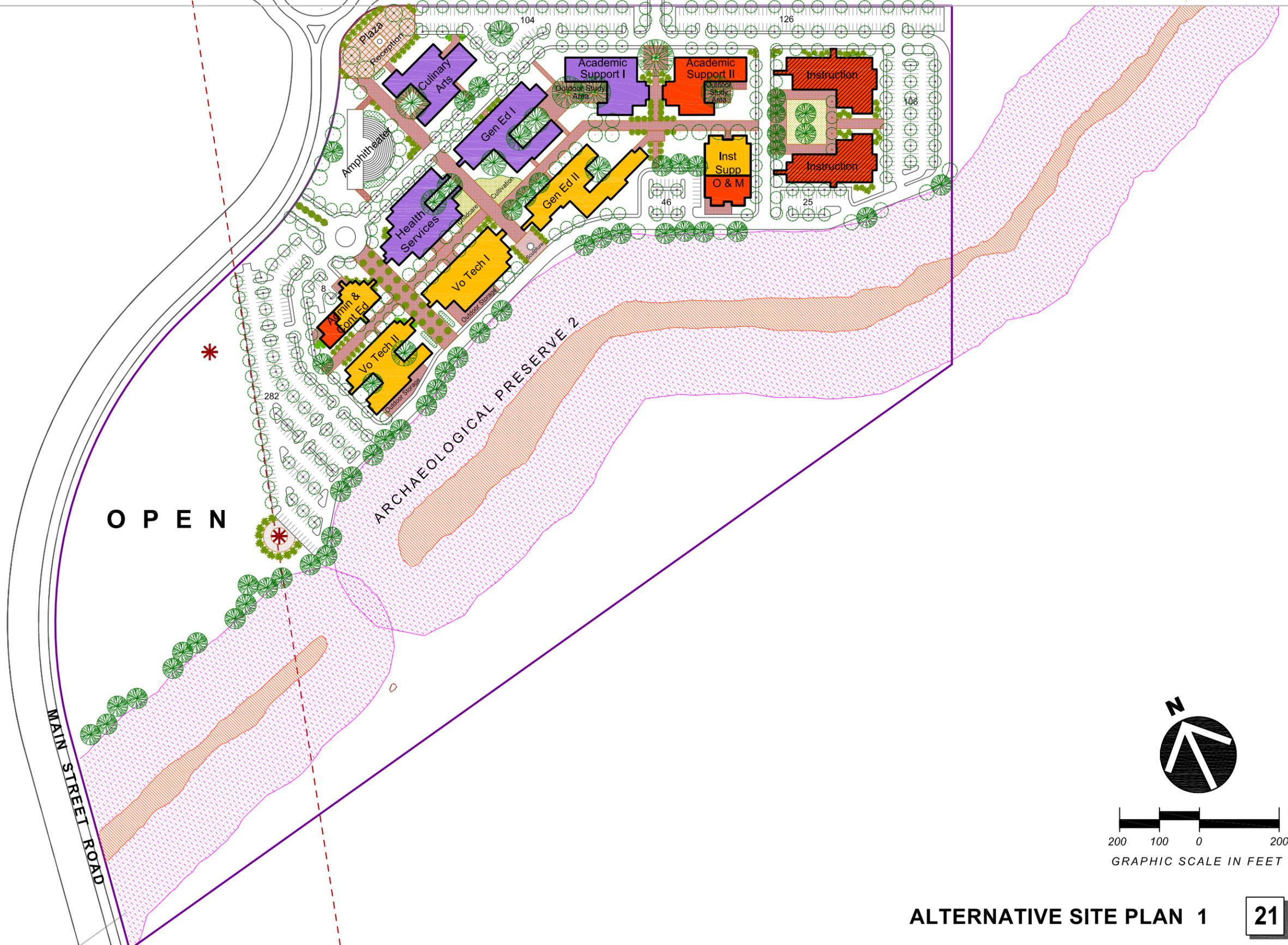
Although Site Plan 2 extends parking into the Open Zone, it does not meet the UH's parking standard and is deficient by approximately 500 parking stalls. In order to satisfy UH's parking standard, some buildings may have to be increased to two-stories in height, which would then allow a reduction in the number of buildings. The reduced number of buildings would provide more land area for parking. Parking requirements could be reduced by applying other

standards that require less parking stalls (i.e., the Hawai'i County Code). These issues will be explored in further detail and the Preferred Campus Site Plan will be modified to address these issues in the next phase of the site planning and design process—development of the Ultimate Campus Site Plan.

**This Page is Intentionally Blank**

**LEGEND**

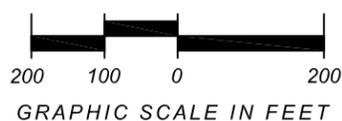
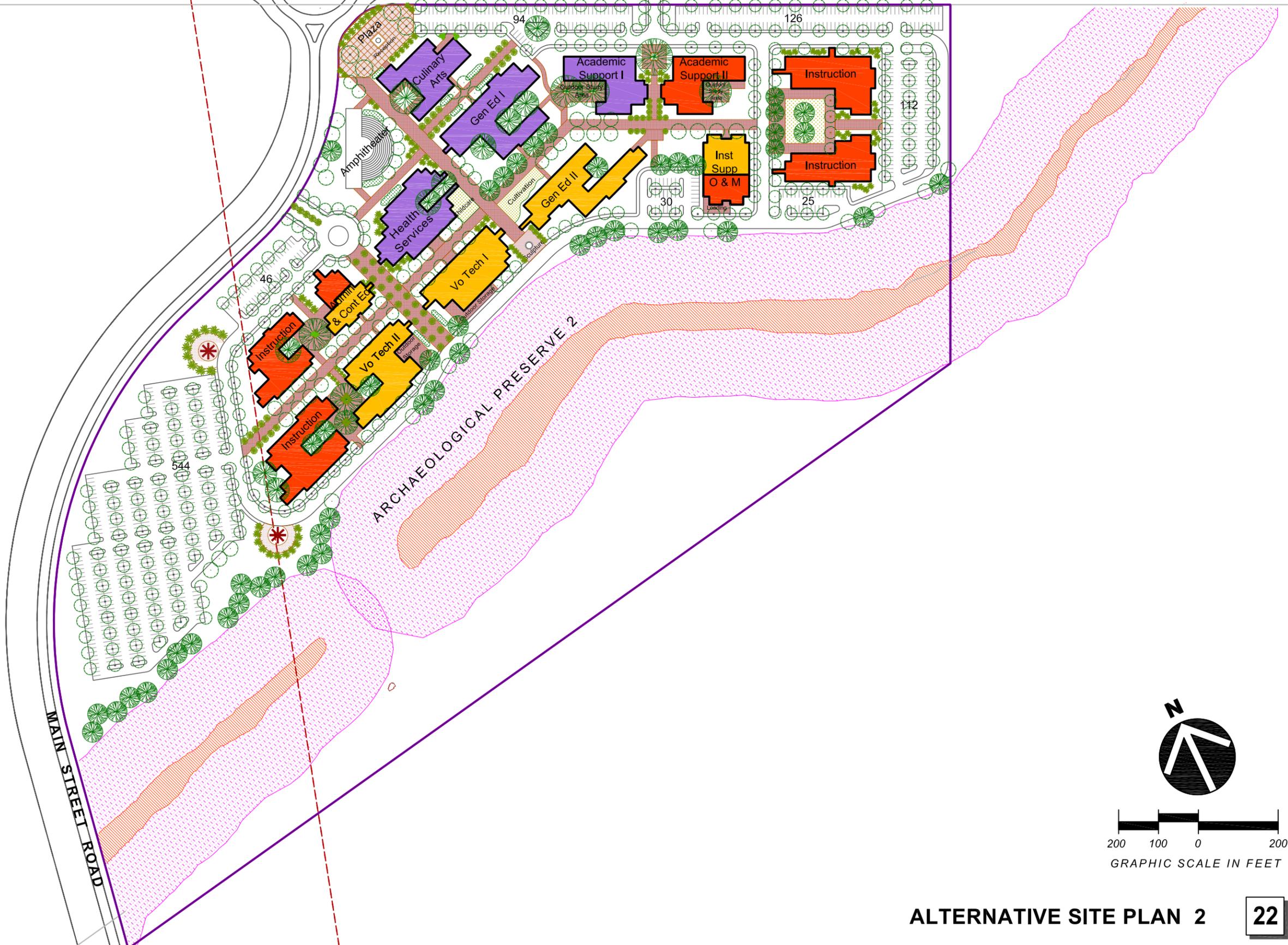
-  73-Acre UH Subdivision
-  750 FTES Campus Building
-  1,500 FTES Campus Building
-  3,000 FTES Campus Building
-  2-Story Building
-  Hardscape
-  Lava Tube Boundary
-  50-Meter Buffer Area
-  Archaeological Site
-  Boundary Line Between The Agriculture (A-5a) and Open Zones



**This Page is Intentionally Blank**

**LEGEND**

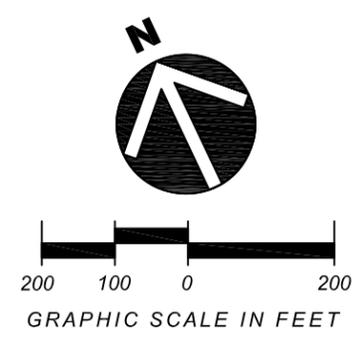
-  73-Acre UH Subdivision
-  750 FTES Campus Building
-  1,500 FTES Campus Building
-  3,000 FTES Campus Building
-  Hardscape
-  Lava Tube Boundary
-  50-Meter Buffer Area
-  Archaeological Site
-  Boundary Line Between The Agriculture (A-5a) and Open Zones



**This Page is Intentionally Blank**

**LEGEND**

-  73-Acre UH Subdivision
-  750 FTES Campus Building
-  1,500 FTES Campus Building
-  3,000 FTES Campus Building
-  Hardscape
-  Lava Tube Boundary
-  25-Meter Buffer Area
-  50-Meter Buffer Line
-  Archaeological Site
-  Boundary Line Between The Agriculture (A-5a) and Open Zones



**This Page is Intentionally Blank**

**7.0**

---

**Ultimate Plans**



## 7.1 ULTIMATE SITE PLAN

Preparation of the Ultimate Site Plan is the final step in the site design process. The Ultimate Site Plan is derived from Alternative Site Plan 2 described in Chapter 6.0, and is a refinement of this plan.

It should be noted that a major change to the site plan was made during preparation of the Ultimate Site Plan. This was the removal of all 3,000 FTES facilities from the Ultimate Site Plan. The decision was made by the project managers, Hawaii Campus Developers, in consultation with UH administration. Thus, the Ultimate Plan reflects the 2008 Ed Specs for the 1,500 FTES level. This change was made for the following reasons:

- 1) Population projections indicate that UHCWH will not reach the 3,000 FTES level for more than 100 years. By that time academic requirements, teaching technology, modes of transportation and building technology are likely to change such that the 2009 plans for the 3,000 FTES campus would be irrelevant.
- 2) The site utilization and alternative site plan studies have shown that the site is too small to comfortably accommodate the 3,000 FTES facilities on the designated 73-acre subdivision. The original vision for the 3,000 FTES campus was based on using a larger portion of the 500-acre University site than the 73-acre subdivision that was granted by DLNR's Land Division. The current subdivision has two (2) major site constraints, the archaeological preserve surrounding the lava tube (containing human burials), which takes up more than half of the total land area, and the 11-acre "Open Zone" on the western end of the subdivision. After deducting the "Open Zone" and Archaeological Preserve, only 37 acres of developable land remains. However, unless access can be gained to the 8.5 acres below Archaeological Preserve 2, the developable land area is effectively reduced to 28.5 acres (see Figure 16, *Site Constraints*).
- 3) There is a large grade differential between the eastern and western ends of the 73-acre subdivision. This presents problems for grading and American with Disabilities Act (ADA) requirements. Portions of the site have severe elevation changes that would require a large amount of retaining walls, stairs and ramps. By removing the 3,000 FTES facilities and just building out to the 1,500 FTES level, there is more room to adjust the placement of the buildings. Avoiding use of the extreme eastern end of the subdivision, which is at a much higher elevation, would then provide more space to arrange all the buildings within the central portion of the project site, which is more level. This would make the overall site plan more workable.

As a result of deleting the 3,000 FTES facilities, additional land area is freed up to arrange the 1,500 FTES facilities in a more functional manner. As such, several changes in building placement were made from the Preferred Alternative Site Plan (See Chapter 6.0). The Academic Support building was moved to the center of the 1,500 FTES campus, closer to the main entrance; the Administration and Continuing Education facilities were combined with the Academic Support building; and the location of the Health Science/Student Services building was switched with the General Education I building so that Culinary Arts and Health Science/Student Services buildings could be developed together. Until the 750 FTES facilities are built, the Culinary Arts and Health Science/Student Services will be the only two (2) buildings on the campus.

Another change that occurred during the transition from the Preferred Alternative Site Plan to the Ultimate Site plan was the location of the amphitheater. In the alternative site plans discussed in

## 7 Ultimate Plans

---

Chapter 6.0, an outdoor amphitheater was shown near the entry plaza and adjacent to Main Street Road. This location was chosen because of the natural bowl-shape of the existing contours. However, during the ultimate site plan phase this location was reconsidered. Since the eventual land use to the west across Main Street Road is unknown at this time, it would be prudent not to locate an outdoor amphitheater there. The noise and bright lights during nighttime events could be disturbing, particularly if the land use is residential. Therefore, in the Ultimate Site Plan it was decided to locate a smaller open stage with amphitheater seating between the Hawaiian Studies building, the O & M building and the cultivation area. This location would not cause any disturbance to neighboring properties.

In addition to the basic site plan, ultimate plans have also been prepared for grading and drainage, water and wastewater systems, landscaping, the power system, lighting, telecommunications/building automation systems, and the mechanical (air conditioning) system. These are described below. These ultimate plans taken together establish a framework and offer practical guidelines for the physical development of the UHCWH. The ultimate plans are intended to aid the architects and engineers and other design professionals who will do the actual design and construction of the UHCWH. The ultimate plans will provide the UHCWH administration with the tools and benchmarks to monitor the development of this important educational facility in West Hawai'i.

The Ultimate Site Plan (refer to Figure 24) is a culmination of site considerations, program planning, planning criteria, site utilization and site plan alternatives described and analyzed in previous sections of this LRDP.

Location. The UHCWH campus core is located on the northwestern corner of the 500-acre site (refer to Figure 20) and covers approximately 23 of the 500 acres. Another approximately seven (7) acres on the eastern side of the campus core are set aside for future expansion in which possible uses include student/transient housing and recreational facilities. The campus core is accessible from both the proposed University Drive and the proposed Main Street Road. After careful analysis of infrastructure needs and development cost factors, the campus core was placed as close as possible to the adjacent Palamanui Master Planned Community. This location minimizes infrastructure costs because the length of utility lines (i.e., water, sewer, electrical, and telecommunications) needed to connect with Palamanui's utility systems will be reduced. It also provides students and staff ease of access to the commercial and community facilities available in the Palamanui Village Town Center. The maximum dimensions of the UHCWH campus core are 1,650 feet from north to south and 1,450 feet from east to west.

Vehicular Circulation. The Ultimate Site Plan has two (2) vehicular accesses. The primary access to the UHCWH is from Main Street Road, close to Palamanui's roundabout. It is a 48-foot wide driveway with an 8-foot wide island defined by a line of tall palm trees. A 55-foot radius roundabout is placed at this main entrance to facilitate traffic flow within the campus core and enhance its grand entry. The secondary or service access is via University Drive. It is a 30-foot wide driveway that is aligned with one of Palamanui's access roads.

The physical limits of the UHCWH campus core and the vehicular circulation systems are circumscribed by the U-shaped roadway. During the alternative site plan phase of the planning process (Chapter 6.0), faculty and staff expressed a preference for the U-shaped roadway because it promotes the pedestrian connection between the campus core and the adjacent Palamanui community. This roadway runs counter-clockwise from the primary vehicular access and the campus's roundabout, to the parking area located on the western

end, to the southern portion of the campus core (paralleling the 50-foot archaeological buffer), and to the eastern end of the site.

**Buildings.** It should be noted that normally an LRDP project provides guidelines for design rather than specifying a specific building design concept. This is because it is expected that the LRDP will be passed on to an architectural design consultant to prepare schematic design studies and then design development, and finally construction drawings. Each of these would be a separate and sequential activity. This current UHCWH project is unusual in that preparation of the LRDP Update, the SEIS, and schematic building design/design development are all being conducted at the same time. The reason for this concurrency of activity is that the University is making every effort to accommodate Palamanui's construction and development schedule, which includes building the first building (Culinary Arts). Therefore, this LRDP Update presents a specific building design concept that will next go into the construction drawing phase to expedite Palamanui's construction schedule.

The building design concept proposed in this document is based on the creation of long linear building modules called "bars" which are arranged on the site to fulfill the functional and square footage requirements set forth in the 2008 Ed Specs. Spaces between the bars become pedestrian ways, which can be covered with roofing or trellises. Building placement maximizes northern and southern exposures. This optimizes the opportunities for natural daylighting. South facing roofs at the appropriate pitch will maximize photovoltaic panel efficiency. Minimizing eastern and western exposures will reduce cooling costs as it is difficult to shade from the sun.

Typical building width will be 30 to 40 feet to maximize the efficiency of natural daylighting and ventilation. All buildings will be single story because one-story buildings are the most efficient for natural daylighting and ventilation. The buildings are being designed so that spaces can be air conditioned during hot weather, but can also take advantage of natural ventilation in cooler weather. Roofs with wide overhangs that provide shading from direct solar gain are recommended. Roofs with photovoltaic collectors will be oriented and angled for optimum performance. This will result in visual interest from the varied roof forms.

A LEED™ Silver level rating is mandated by the state; however, the UHCWH is striving for a higher goal. The massing and orientation of the buildings, as well as other design details are aimed at achieving the LEED™ Platinum level rating for the UHCWH, with an ultimate goal of the campus having net zero energy consumption.

For graphic illustrations of this building design concept, see Section 9.4 Architectural Style and Character and Section 10.4 Transition Plan.

**Parking.** Parking and access for the physically disabled are provided near all buildings for the convenience of students and staff. This is in contrast to many campuses where there is a single large parking lot that requires long walks to buildings on the opposite end of the school grounds. Several medium and small parking areas at the UHCWH campus are served by the U-shaped roadway that affords easy access to any part of the campus, while leaving the central mall and connected interior walkways for use by pedestrians. The number of marked parking stalls and loading spaces is derived by using the Hawai'i County Code parking requirements. For an ultimate enrollment of 1,500 FTES, 463 standard stalls, seventeen (17) accessible stalls, and seventeen (17) loading spaces will be provided. Parking will be sheltered by medium canopy trees at regular intervals. To satisfy the UH parking standard (1 stall for every 2 students), 750 parking stalls are required to serve the 1,500 FTES campus. Therefore, landscaped overflow parking is added to the southwestern

## 7 Ultimate Plans

corner of the site to provide an additional 290 parking spaces for students and staff. The number of parking spaces is shown in Table 5 below.<sup>64</sup>

**Table 5: Summary of the Ultimate Parking Plan**

	Building	Hawai'i County Code			Overflow Parking	UH Standard
		Standard Stalls	Accessible Stalls	Loading Space		
750 FTES Campus	Culinary Arts	49	2	2		
	Health Science & Student Services	47	2	2		
	Admin & Academic Support	50	2	2		
	General Education II	79	2	2		
	O & M	13	1	1		
	<i>Subtotal</i>	238	9	9	140	375
1,500 FTES Campus	General Education I	85	2	2		
	Vocational Technology I	73	2	2		
	Vocational Technology II	30	2	2		
	Hawaiian Studies	37	2	2		
	<i>Subtotal</i>	225	8	8	150	375
	<b>TOTAL</b>	<b>463</b>	<b>17</b>	<b>17</b>	<b>290</b>	<b>750</b>

Pedestrian Entry Plaza. To provide a pedestrian connection between the UHCWH and the adjacent Palamanui community, the 5,000-square-foot pedestrian entry plaza is placed on the northwestern corner of project site, adjacent to Palamanui's roundabout. This plaza functions as the entrance to the campus for those who walk from the Palamanui community and a proposed transit stop. Stairways and ramps will be provided for pedestrians.

Pedestrian Malls and Central Open Space. As mentioned earlier, one of the underlying site planning concepts is to promote safe and pedestrian-friendly circulation within the campus core. The UHCWH campus core is defined by the perpendicular axis of two (2) 20-foot wide north-south pedestrian malls and a 50- to 75-foot wide mauka-makai (or east-west) open space. The first mall starts at the pedestrian entry and continues south through the cultural plaza, while the second one extends from the campus's roundabout to the campus roadway running along the archaeological preserve. Both pedestrian malls also function as an accessway for maintenance and emergency vehicles. Running east to west and perpendicular to the pedestrian malls is a central open space. The width of the open space varies depending on the space between buildings, but a 15-foot wide paved pedestrian pathway runs the entire length of the central open space.

Marae/Piko. A large open space or clearing of approximately 10,000 square feet between the Culinary Arts building and the Student Services/Health Science building is allocated for a marae/piko. The Maori word 'marae' refers to a sacred gathering place that serves both religious and social purposes and was common throughout Polynesia. The Hawaiian form of marae is ma la'e while the term 'piko' means the navel or center of a place. This outdoor gathering and reception space will serve the campus's ceremonial activities. The area between the first two (2) buildings is selected as the location of marae/piko because it is the central and most prominent location within the UHCWH campus core and can be provided during the first phase of construction.

<sup>64</sup> Overflow parking is located within the "Open" district in the western end of the 73-acre subdivision. The County planning rules state that "Public uses, structures and building and community buildings are permitted uses in any district, provided that the director has issued plan approval for such use." (Section 25-4-11 (c))

Cultural Plaza. In the Ultimate Site Plan, a 7,000-square-foot circular cultural plaza is located at the southern end of the pedestrian mall. Approximately one-third of the plaza is shared with the campus roadway. This plaza serves as another gathering space for students as well as a link between the campus core and the archaeological preserve. The Hawaiian Studies building will be located adjacent to the plaza so that it can be used for instructional purposes and ceremonies related to Hawaiian history and culture.

Outdoor Amphitheater. The 4,000-square-foot outdoor amphitheater is placed on the area adjacent to the eastern side of the Hawaiian Studies building. It will be used for student performances such as hula dance. The orientation of seating is designed to take advantage of the existing site topography.

Cultivation Area. An open area of approximately 6,000 square feet between the Health Science/Student Services building and the O & M building is allocated for instructional cultivation purposes, such as growing herbs and greens for the culinary program.

Landscaping. Landscaping will be provided throughout the UHCWH campus. Plantings will be in harmony with the natural lava strewn surroundings. Native Hawaiian species common to the area will be used as much as possible. Large expanses of grassed lawns typical of college campuses will not be provided because they require extensive maintenance and watering. Natural lava rock available at the site will be crushed and used as the main materials for pavement and other landscape elements such as walls, site furniture, and artwork.

Hawaiian Sense of Place. The UHCWH site is on lava lands that have never been developed for modern use. This provides an opportunity to create a unique spirit and Hawaiian sense of place. The existence of numerous cultural resources at Kalaoa provides the backdrop and inspiration for this quality. The goal is to create a balance between the modern needs of education and the traditional elements of Hawaiian culture and teaching.

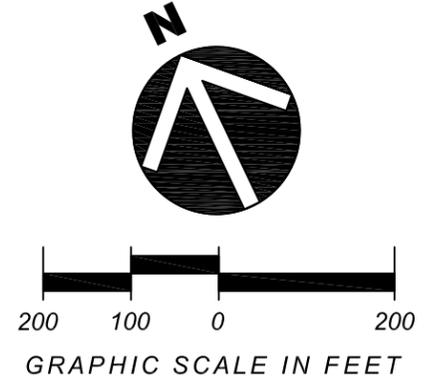
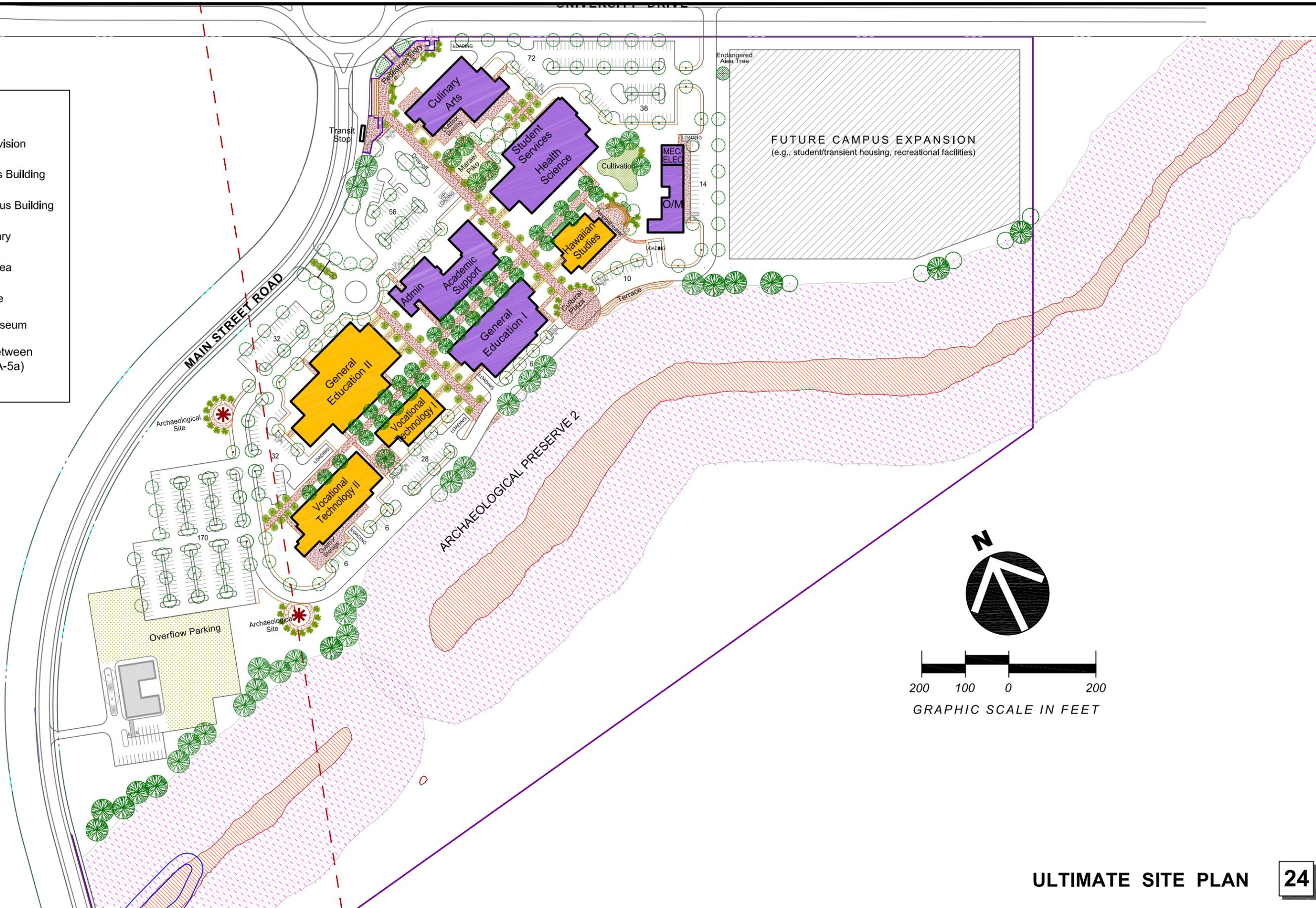
The 73-acre project site has three (3) significant archaeological elements: Archaeological Preserve 2 and two (2) archaeological sites. Archaeological Preserve 2 contains human burials and possible ceremonial areas and should be barricaded or sealed. A 164-foot buffer is used for design purposes to protect the Archaeological Preserve from public access. Because of the site's small size, to accommodate all of the areas defined by the Ed Specs, a 50-foot buffer area will be proposed in the Burial Treatment Plan instead of the 164-foot buffer. Located in the area north of this Preserve are two archaeological sites. Site 15304 (the upper site) is a single petroglyph, while site 15262 (the lower site) is a roughly 13-foot by 10-foot (13' x 10') stone terrace and three (3) adjacent stone mounds.

The connection between the UHCWH campus and these distinctive archaeological resources will be emphasized by using several site planning components. Two (2) north-south pedestrian malls function as visual corridors linking the campus core and the Archaeological Preserve 2. The circular cultural plaza serves as a gathering space where students can also view the lava fields and archaeological preserve. Another important landscape element used to promote the Hawaiian sense of place is a terrace, which can be constructed on the remaining land between the roadway and the 164-foot archaeological buffer line. It will extend eastward from the cultural plaza along the edge of the archaeological buffer. Interpretive signage should be included in the terrace layout to convey the history and significance of the preserve and the Kalaoa area. Likewise, two (2) archaeological sites located on the northwestern portion of the site are also incorporated into the Ultimate Site Plan through the landscape design. Both sites will be fenced off and encircled with a 10-foot wide platform that connects to the campus's pedestrian circulation system, so students and visitors can access them conveniently from the sidewalks.

**This Page is Intentionally Blank**

**LEGEND**

-  73-Acre UH Subdivision
-  750 FTES Campus Building
-  1,500 FTES Campus Building
-  Lava Tube Boundary
-  50-Meter Buffer Area
-  Archaeological Site
-  Possible future Museum
-  Boundary Line Between The Agriculture (A-5a) and Open Zones



**This Page is Intentionally Blank**

## 7.2 ULTIMATE CIVIL PLAN

### 7.2.1 Grading and Drainage

Site grading for the new UHCWH will be limited to the northern portion of the 500-acre University site (see Figure 20, *Location of the Campus Core*). The project site is characterized by gentle sloping terrain with a natural slope between four (4) and eight (8) percent. The lowest point of the project site is at the 400-foot elevation; the highest point is at the 460-foot elevation on the eastern corner of the project site.

Although the project site has a relatively flat sloping terrain, there are localized lava flow mounds and depressions. The site will be graded to a maximum depth of five (5) feet in excavation and in embankment to produce buildable area. The proposed ultimate graded site is approximately 22 acres. The finished parking and internal road grades will be less than five (5) percent.

Although the drainage basin (tributary) towards Hualalai reaches the 5,000-foot elevation, there are no developed drainageways and no signs of flow, not even at Mamalahoa Highway at the 1,800-foot elevation. Mauka lands consist of weathered and/or recent lava flows that are very porous. Most of the rainfall percolates into the weathered lava. The drainage improvements required for the UHCWH development will be minimal. Devices such as field inlets with drywells may be used as needed. A drainage ditch is needed to handle the storm water flowing downhill from the eastern portion of the subdivision. The first option would be a ditch that would run from University Drive down along the southern boundary of the campus bordering the Archaeological Preserve. A second option would be to build a 15-foot wide berm to hold back the water along the same route as the first option. A third option would be to channelize the storm water through the campus under the roadway. The first two options may not be possible because of their proximity to Archaeological Preserve 2, which encompasses a large lava tube system containing human burials and other cultural resources.

Future buildings will be on slightly raised pads to allow any rainwater that is not collected for future use to swale around the structures into drywells (see Figure 25, *Ultimate Grading and Drainage Plan*). The design guidelines in the "Storm Drainage Standards" of the Department of Public Works, County of Hawai'i, were used to evaluate future drainage systems. Potential rainfall at the project site is less than 20 inches per year. The amount of rainfall increases with tributary land elevations to approximately 50 inches at the 4,000-foot elevation. Rainfall gradually decreases to approximately 40 inches per year at the 5,000-foot elevation, which is the highest point in the rainfall tributary system for the UHCWH.

### 7.2.2 Water and Wastewater

Water Supply. Presently the County of Hawai'i water supply system cannot provide adequate potable water to meet the needs of the UHCWH. The pressure of the existing transmission main along the Queen Ka'ahumanu Highway at the 325-foot elevation level is too low to serve the UHCWH site located between the 400- to 600-foot elevations. Instead, potable water will be provided through the Palamanui water supply infrastructure. The University will make its own arrangements with DWS for water quota and service to the Palamanui improvements, which eventually will be transferred to DWS.

Palamanui has two (2) water sources in the upper limits of the Makalei Estates Subdivision. Well #4458-01 (aka Kau Well 1) has been drilled and cased, but not outfitted. Well #4458-02 (aka

## 7 Ultimate Plans

---

Kau Well 2) has been outfitted with a pump house and small reservoir. Both wells are intended to produce 0.8 mgd, each.

The potable water demand for Palamanui is estimated at 1.2 mgd. The UHCWH is allocated 0.4 mgd of the 1.2 mgd. Water demand for a maximum enrollment of 1,500 FTES is estimated to be 60,000 gallons per day (gpd).

Palamanui will provide water to the UHCWH by extending an existing 12-inch pipeline from the Makalei Estates Subdivision. This pipeline will be available for future connection to the two (2) Keahole reservoirs located approximately 1,500 feet east of Queen Ka'ahumanu Highway near the 280-foot elevation. See Figure 26, *Ultimate Water and Wastewater Plan*.

Wastewater. There is presently no municipal WWTP that can accommodate the sewage generated by the UHCWH. The existing WWTP No. 1 is located approximately five (5) miles south of the UHCWH site at Kealakehe. Sewer connection to WWTP No. 1 would be prohibitively expensive due to distance. The county has not yet constructed the proposed WWTP No. 2 for this region. A separate WWTP at Kona International Airport is in the planning/design stage. In future years, if and when WWTP No. 2 is completed, smaller private/public plants including any WWTPs at the UHCWH may be connected to this municipal system. In the immediate future, all UHCWH sewage flows will be piped to Palamanui's proposed a self-contained WWTP. See Figure 26, *Ultimate Water and Wastewater Plan*.

Table 6 below shows the estimated water and sewer demand for the first four (4) buildings of the UHCWH.

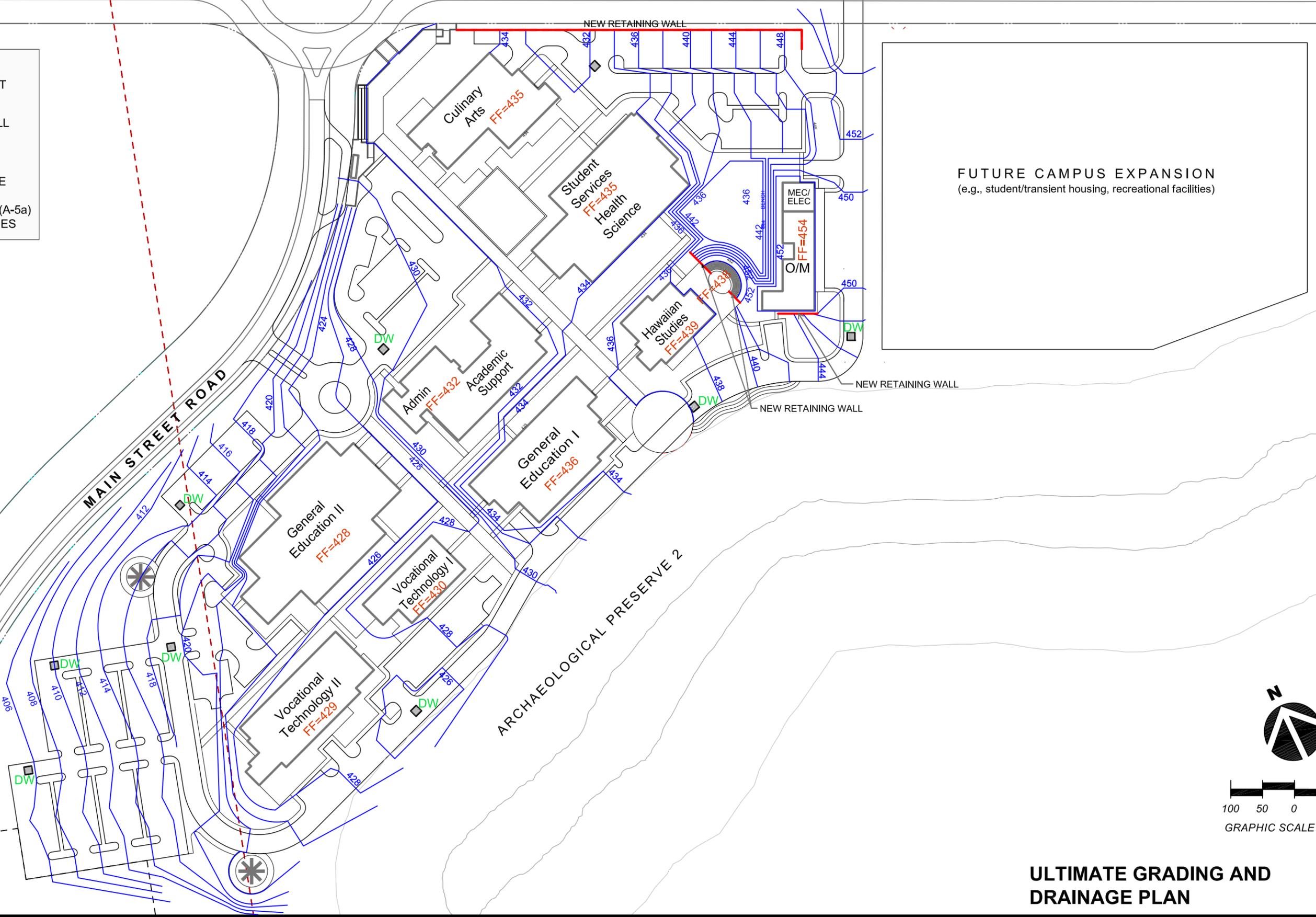
**Table 6. Summary of Domestic Water Demand and Sewage Flows**

No.	Description	Fixture Units	Water Demand (gpd)	Sewer Demand (gpd)
1	Culinary Arts	95.7	3,680	3,680
2	Health Science	51.7	1,269	1,269
3	Academic Support	87.0	1,215	1,215
4	General Education	41.7	2,722	2,722
	<b>Totals</b>	<b>276.1</b>	<b>8,886</b>	<b>8,886</b>

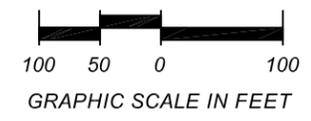
Project designers are investigating the possible use of a Living Machine to service the first two buildings. Living Machine is a trademark and brand name for a biological wastewater treatment system that mimics the cleansing functions of wetlands and does not produce toxic bi-products such as sludge. The bi-products of the wastewater cleaning process are instead converted into biomass.

**LEGEND:**

- DW DRY WELL INLET
- NEW CONTOUR
- RETAINING WALL
- FF = 436 FINISH FLOOR ELEVATION
- BOUNDARY LINE BETWEEN THE AGRICULTURE (A-5a) AND OPEN ZONES



FUTURE CAMPUS EXPANSION  
(e.g., student/transient housing, recreational facilities)



**ULTIMATE GRADING AND DRAINAGE PLAN**

**This Page is Intentionally Blank**

**LEGEND:**

- FH - FIRE HYDRANT
- - WATER PIPE
- W12 - WATER PIPE SIZE
- - SEWER PIPE
- SMH - SEWER MANHOLE
- S8 - SEWER PIPE SIZE
- - - BOUNDARY LINE BETWEEN THE AGRICULTURE (A-5a) AND OPEN ZONES

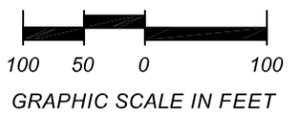
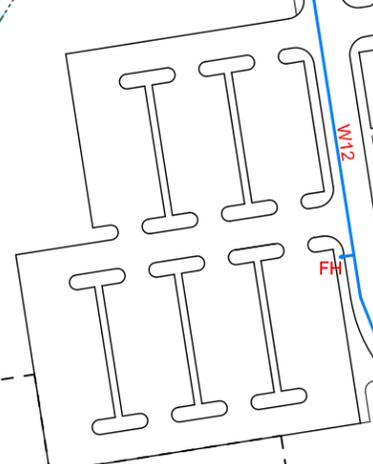
CONNECT TO PALAMANUI EXISTING SEWER LINE

CONNECT TO PALAMANUI EXISTING WATER LINE

MAIN STREET ROAD

ARCHAEOLOGICAL PRESERVE 2

FUTURE CAMPUS EXPANSION  
(e.g., student/transient housing, recreational facilities)



**ULTIMATE WATER AND WASTEWATER PLAN**

**This Page is Intentionally Blank**

### 7.3 ULTIMATE LANDSCAPING PLAN

An ecological and sustainable approach to campus landscape planning should be adopted to create the basics of a unique, site specific, attractive, as well as cost effective campus landscape. The recommended plant materials list and landscape guidelines are based on recognition of the existing site conditions:

- Sloping grassland/lava fields; and
- Hot, dry, windy climate.

The goals of the Ultimate Landscape Plan (see Figure 27) are to provide guidelines for the development of landscaping that is appropriate to the natural and cultural environment. The guidelines will create a sustainable, unique, and cohesive Hawaiian sense of place with enjoyable outdoor spaces for students, faculty and the West Hawai'i community.

Hawaiian Sense of Place. The landscape plant palette should consist primarily of appropriate native Hawaiian and Polynesian-introduced plant species, especially those that are wind and drought tolerant, and well-suited to the site-specific environment. Introduced ornamental plant species suitable to the local environment may also be included.

Interpretive signs listing the botanical and common names of plants and any significant historical or cultural information should be provided to increase knowledge and appreciation of Hawaiian flora and culture.

The use of appropriate Hawaiian plant materials and preservation of the existing grassland and lava fields will contribute to the creation of a unique Hawaiian sense of place. It will also contribute to a sustainable landscape by lowering maintenance costs and by requiring less supplemental irrigation water, fertilizers, and pesticides. The use of lava rock for walls, site furniture, and artwork would also contribute to a Hawaiian sense of place.

Parking Areas. Parking areas should be planted with medium canopy trees (e.g., Kou, Wili Wili, or Autograph trees) at every six (6) to 12 stalls in 3-foot square tree wells or planting strips. The plantings would provide shade, reduce glare and heat from paved surfaces, and screen parking areas from surrounding areas. The perimeters of the parking areas should be planted with shrub hedges to provide screening at eye level. To reduce the amount of impervious cover in the parking areas and promote infiltration, alternative paving materials such as grid pavers will be used in a combination with asphalt. In addition, instead of being paved entirely, parking islands will be left in natural lava and grasses, or placed with bioswales/vegetated filter strips to allow stormwater runoff to naturally filter into the soil and vegetation.

Campus Roadway. Areas along the campus roadway should be graded to transition smoothly into the existing natural grassland/lava fields. Fountain Grass should be allowed to grow naturally on the graded slopes. Occasional informal clusters of small to medium canopy trees (e.g., Manele, Milo, Koa'ia, Kolomona) should be provided.

Pedestrian Entry Plaza. To promote a sense of welcome, small flowering trees and palms (e.g., Plumeria, Beach Heliotrope, Pineapple Guava, Hala, Coconut Palm, and Loulu Palm) should be planted at the front edge of the pedestrian entry plaza, while clusters of Coconut palms can be

## 7 Ultimate Plans

---

placed along its southern edge. Medium canopy trees should be added to the corners of this area to provide shade and to indicate the boundary of the entry space.

Pedestrian Malls. A grove of tall palms (e.g., Coconut Palms) should be planted formally along two north-south pedestrian malls in order to create a strong sense of entry and a visual corridor. Coconut Palms may pose a hazard if the coconuts and dead fronds are not removed regularly and allowed to fall to the ground. Coconut flower clusters need to be removed twice per year, dead or dying fronds should be removed as required. Any palm or tree requires regular maintenance to prevent dead branches, fronds, or fruit from falling and causing potential injury.

Central Open Space. A single species of large canopy trees (e.g., Monkey Pod) should be planted along the east-west open space to provide shade and to reinforce its function as the central pedestrian accessway for the UHCWH. Use of a single tree type will create a strong sense of identity and visually unify the campus.

Marae/Piko. The main concept of the landscape design in marae/piko area is to enhance the Hawaiian sense of place. An important traditional element will be a low lava rock wall, which will surround and define the marae/piko. This open space will be partly paved and partly landscaped. Crushed natural lava rock should be used as the main paving material. A few large canopy trees will be planted at the corners of this area to provide shade and a comfortable atmosphere. Native Hawaiian tree clusters and small flowering trees will be planted along the border of the marae.

Cultural Plaza. Clusters of Coconut Palms will be planted along the northern edge of the 45-foot radius cultural plaza, while the southern edge of this plaza will be left open to maximize viewing opportunities of the lava flows beyond. A sculpture can be placed at the center of the plaza to provide a landmark or visual focal point for the area. Lava rock will also be used as a main material for pavement.

Since the lava flows are higher than the cultural plaza. A low lava rock retaining wall will need to be built around the southern edge of the cultural plaza and will extend through the adjoining terrace. On this retaining wall interpretive signage will be placed to provide information about the natural and cultural resources in the area. The signage will also be used to warn people about the dangers of entering the archaeological preserve and the likelihood of falling through openings in the lava tube or penetrating the thin crust topping the lava tube system. Since the lava tubes are known to contain human burials or “iwi”, entry into the archaeological preserve will be strictly forbidden. A Burial Treatment Plan (BTP) is being prepared for Archaeological Preserve 2. The BTP will need to be approved by the Hawai'i Island Burial Council and the SHPD.

Outdoor Amphitheater. The landscaping design provided for the outdoor amphitheater will aim to promote the Hawaiian sense of place and provide a comfortable environment for seating and student performance activities. Medium canopy trees, Coconut palms, and native Hawaiian tree clusters will be planted along the edge of the seating area. These mature trees will provide shade to the seating area, while Coconut palms and native tree clusters will form the enclosed space and function as a landscaping buffer between the amphitheater and the O & M building.

Archaeological Preserve Buffer. Areas between the campus roadway and the archaeological preserve should be treated as a landscape buffer. Clusters of medium and large canopy trees

will be informally planted along the edge of Archaeological Preserve 2, except for the sections that align with the two (2) pedestrian malls, which should be kept open to allow visual connection to the preserve and the lava fields beyond.

Archaeological Sites. The historical sites identified within the UHCWH campus area will be preserved. Two (2) archaeological sites located on the western side of the campus are incorporated into the Ultimate Landscaping Plan. Each site will be surrounded with a 30-foot radius fence to designate the boundary and protect it from encroachment. A 10-foot wide platform will encircle the sites and will connect to the campus sidewalks. Coconut Palms could be used to line the outer edge of the platform to emphasize the historic significance of these sites. Interpretative signage will be placed on this platform to provide information on the sites to students and visitors.

Building Entrances. Small flowering accent trees and palms (e.g., Plumeria, Beach Heliotrope, Pineapple Guava, Hala, Coconut Palm, and Lulu Palm) should be planted at building entrances. These recommended plant species will help to create a sense of welcome with micro-climates at the main entrance of each building. Use of these plants at specific locations and in small areas will also minimize maintenance and watering.

Foundation Planting. A 5- to 10-foot planting strip immediately adjacent to the bases of buildings should be provided and planted with flowering shrubs and groundcover. These areas could also be used to grow herbs and greens for the culinary program. This will create a noise and visual buffer between building interiors and adjacent pedestrian circulation routes.

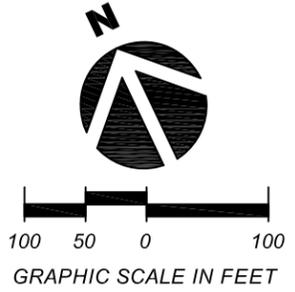
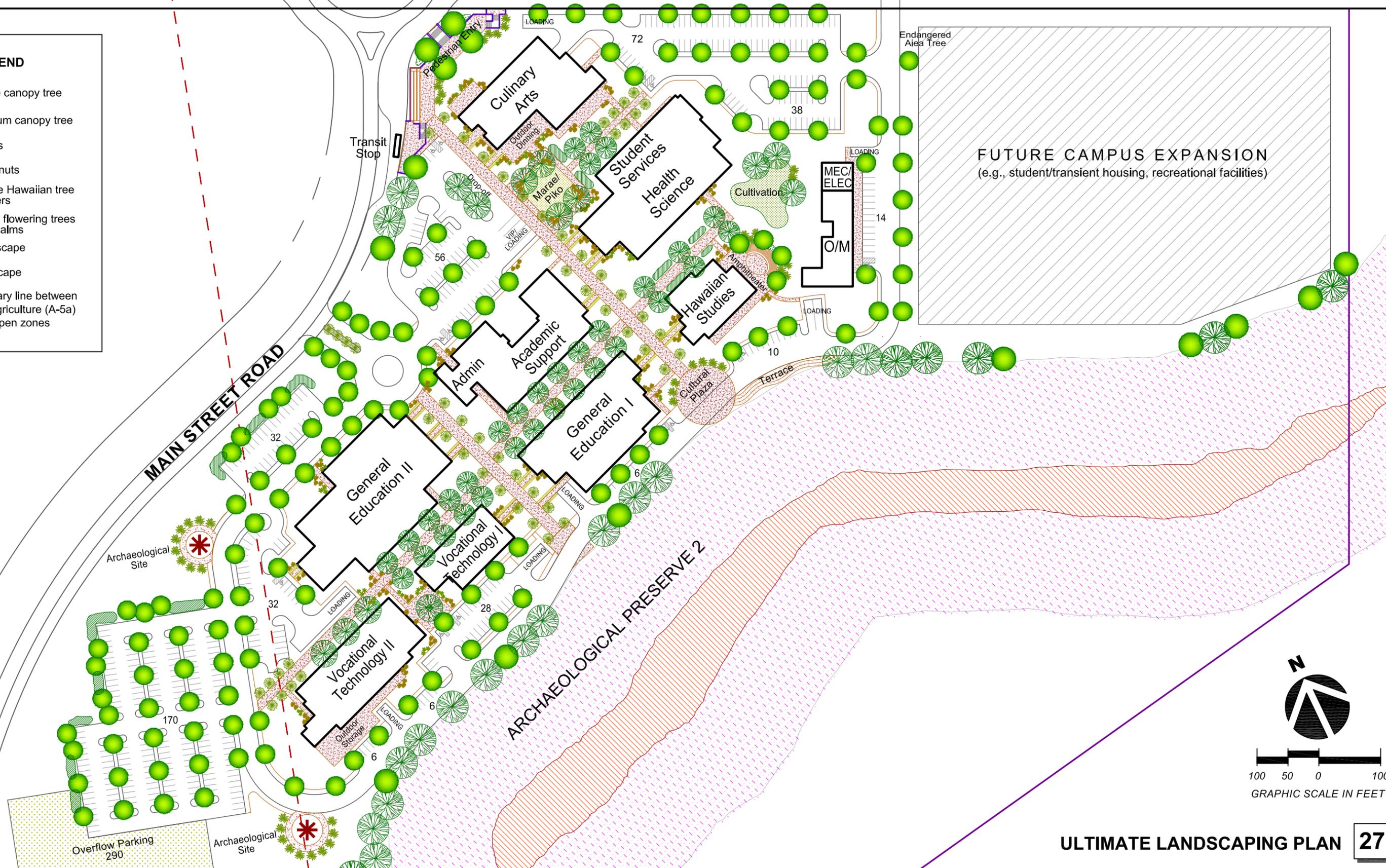
Existing Lava Rock Formations. Where feasible, existing lava rock formations will be preserved and incorporated into landscaped areas to create a unique campus landscape. This will aid in reducing the need to import top soil and other soil amendments, thus reducing landscape development costs.

Automatic Irrigation Systems. An automatic irrigation system should support all landscaped areas. Low volume or drip irrigation should be considered for trees, shrubs and ground cover areas to minimize water loss due to evapotranspiration. A/C condensate will be collected and used to supplement irrigation water thereby reducing the potable water demand for this use. Efforts should be made to study the feasibility of using non-potable or treated effluent as a potential irrigation water source. Currently, the County of Hawai'i has plans to develop a grey water distribution line within the Queen Ka'ahumanu Highway right-of-way into which UHCWH may be able to tap.

**This Page is Intentionally Blank**

**LEGEND**

-  Large canopy tree
-  Medium canopy tree
-  Palms
-  Coconuts
-  Native Hawaiian tree clusters
-  Small flowering trees and palms
-  Hardscape
-  Softscape
-  Boundary line between the agriculture (A-5a) and open zones



**This Page is Intentionally Blank**

## 7.4 ULTIMATE ELECTRICAL AND COMMUNICATION PLAN

### 7.4.1 Power System

The Ultimate Power Plan (See Figure 28, *Ultimate Electrical Plan* and Figure 29, *Ultimate Single Line Diagram*) proposes that the UHCWH electrical system be connected to two (2) 12.47 kV underground HELCO feeders located on University Drive. The two (2) 12.47 kV HELCO circuits will extend to a new primary switchgear station located adjacent to the O & M building. The University is responsible for the design and construction of this new station. The primary switchgear will be housed in a 24-foot by 48-foot (24' x 48') electrical switchgear room. The new UHCWH primary switchgear will consist of two (2) key interlocked incoming circuit breakers, HELCO Metering Section and two (2) circuit breakers for two (2) campus distribution feeders. The ultimate anticipated load for the campus is between 3,000 kilovolt amps (kVA) and 3,500 kVA.

The campus distribution system will be via two (2) 12.47 kV, UH-owned primary circuits to service the transformers located at the various buildings on campus. The primary distribution system for the campus will consist of two (2) 4-inch spare conduits and two (2) 4-inch conduits for the campus distribution feeders with 4-foot by 6-foot (4'x6') electrical primary handholes.

The use of renewable energy sources such as PVs and wind turbines is being considered for the project. These devices may be deployed on roofs, trellises and in parking areas. The project electrical engineer has retained a consultant that specializes in renewable energy systems. The consultant will help the team determine the best and most cost-effective renewable energy system for UHCWH.

### 7.4.2 Lighting

Exterior lighting is required to comply with the Hawai'i County Ordinance 92-01, which requires exterior luminaires to be fully shielded and use low pressure sodium lamps. All roadways and parking lots should be illuminated with pole-mounted area luminaires. All walkways and the pedestrian mall should be illuminated with low pressure sodium area luminaires mounted on short poles of 10 to 12 feet in height and with low pressure sodium landscape bollards. See Figure 30, *Ultimate Lighting Plan*.

Although it is not indicated in the Ultimate Lighting Plan, interior lighting throughout the campus should use the most efficacious source available. Classrooms, offices, support areas and corridors should use fluorescent T-8 lamps with electronic ballasts. Where downlighting is desirable, compact fluorescent type downlights should be incorporated. Rooms that require varying levels of lighting should be equipped with dimmable fluorescent ballasts.

### 7.4.3 Telecommunications/Building Automation System

**Telecommunications.** The UHCWH will be equipped with four (4) 4-inch concrete encased ducts from University Drive with 6-foot by 12-foot (6' x 12') telephone manholes and a 750-square foot switch room (25' x 30') for the telephone equipment. The telephone switch room is located in the Health Science building. Provisions for standby power are recommended. Underground telecommunication cables should be encased in concrete ducts. Manholes and handholes should be provided. Dedicated fiber is expected to run from the telecommunications center to each proposed building. There would be Category 6 multi-pair cables within each proposed building for data and voice services via local LAN (local area network). The telecom will be IP based. See Figure 31, *Ultimate Telecommunications/Building Automation System Plan*.

## 7 Ultimate Plans

---

Cable Television. The Oceanic Time Warner Cablevision system should be extended via underground cables from University Drive for CATV service at the UHCWH site. The CATV system shall be designed using Oceanic Time Warner's specs and guidelines. Distribution of CATV will be via underground ductlines installed along the same route as other telecommunication lines that extend from the telecommunications center. Telecommunication manholes should be provided. The CATV backbone should incorporate dedicated coaxial cable to each building.

HITS. One of the main learning resources for the UHCWH will be its use of HITS. This service will be delivered via fiber service to the telecommunications center for distribution throughout the campus. From the telecommunications center, concrete encased ductlines (designated as "video" on the Ultimate Telecommunications/Building Automation System Plan) should be installed along the same route as other telecommunication equipment. Telecommunication manholes would provide required capability for pulling and connecting cables. The HITS backbone should incorporate dedicated coaxial cable from the media center to each building.

Fire Alarm. There will be a centralized fire alarm that is fully addressable and electrically supervised. Each building would be connected to the central fire alarm panel but would have its own control panel, pull stations, speakers, ADAAG flashers, smoke detectors, heat detectors, duct detectors, and required sprinkler monitors. There would be a separate Fire Alarm ductline system installed throughout the campus to facilitate interconnection of system components.

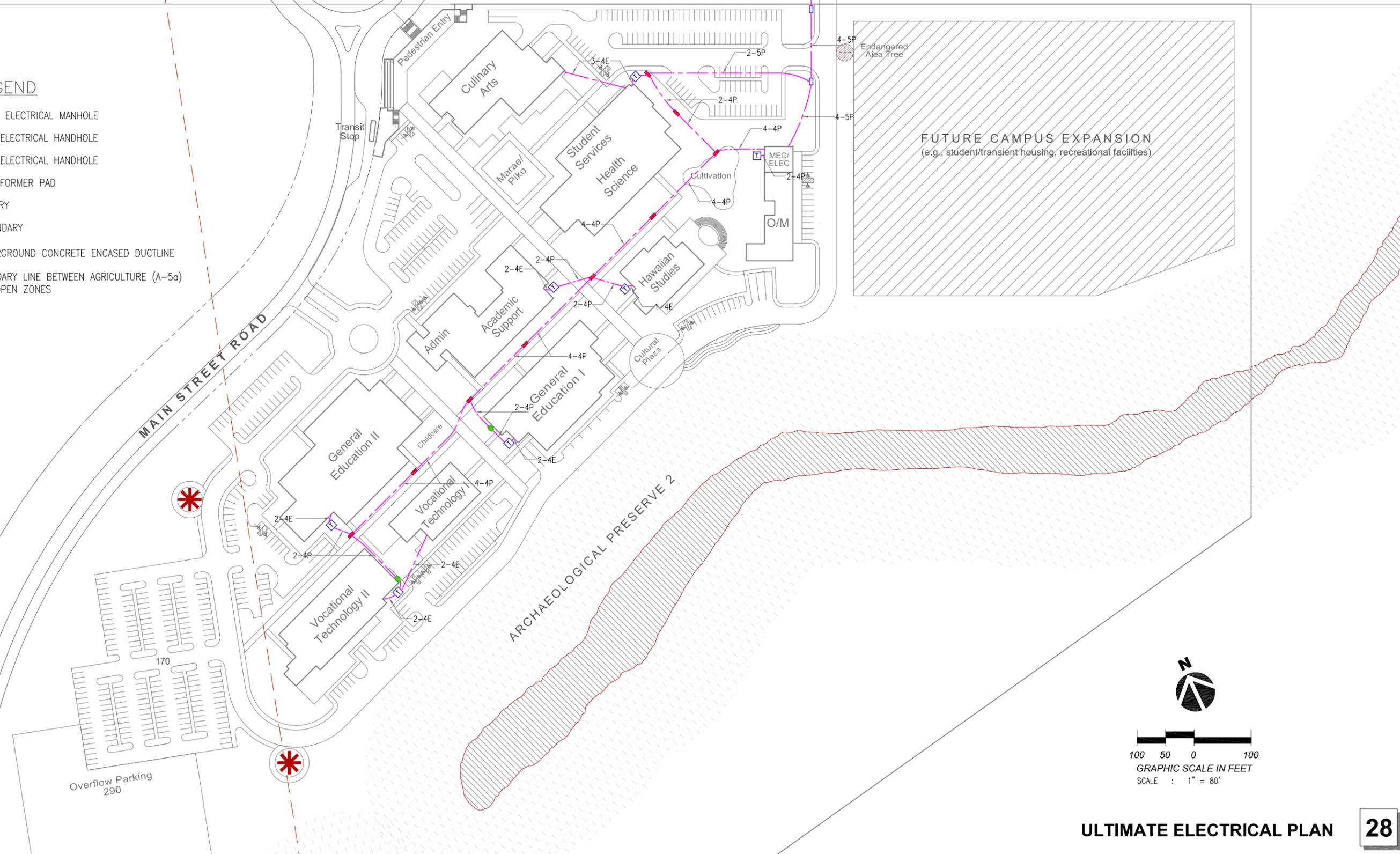
Security Alarm. The UHCWH will have a central security system. The main equipment would be located in the same room as the fire alarm control panel. The security system would provide mass notification features, and monitoring and control of rooms and building entrances. There would be a separate Security ductline system installed throughout the campus to facilitate interconnection of system components.

Building Automation System (BAS). A central BAS or energy management system should be incorporated throughout the UHCWH campus. Main equipment should be located in the same room as the fire alarm control panel and should be similar in design as the fire alarm system. Each building should have a sub-panel(s) that would communicate with the main panel. The BAS should be interfaced with the fire alarm and security alarm systems. The BAS should control and monitor mechanical systems and lighting. There would be a separate BAS ductline system installed throughout the campus to facilitate interconnection of system components.

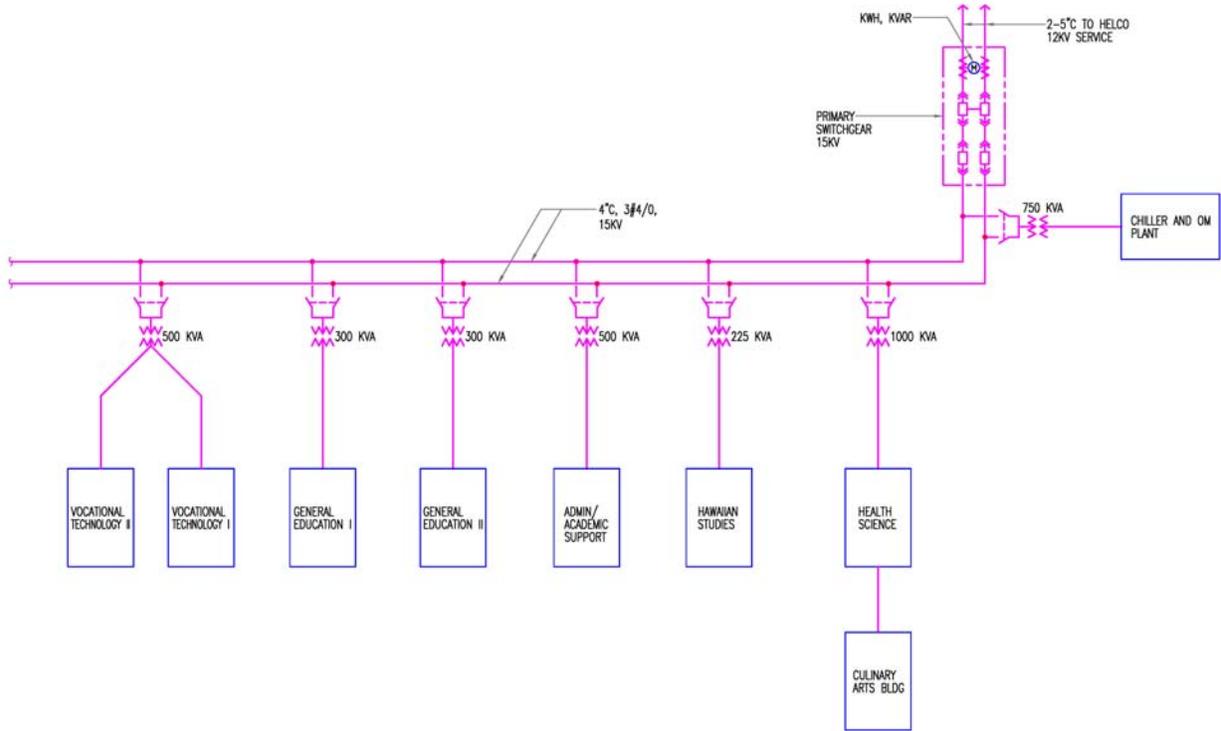
Security Phones. Free standing, clearly marked solar powered security phones should be located in key locations throughout the campus.

LEGEND

-  6'x12' ELECTRICAL MANHOLE
-  4'x6' ELECTRICAL HANDHOLE
-  3'x5' ELECTRICAL HANDHOLE
-  TRANSFORMER PAD
- P PRIMARY
- E SECONDARY
-  UNDERGROUND CONCRETE ENCASED DUCTLINE
-  BOUNDARY LINE BETWEEN AGRICULTURE (A-5a) AND OPEN ZONES



**This Page is Intentionally Blank**



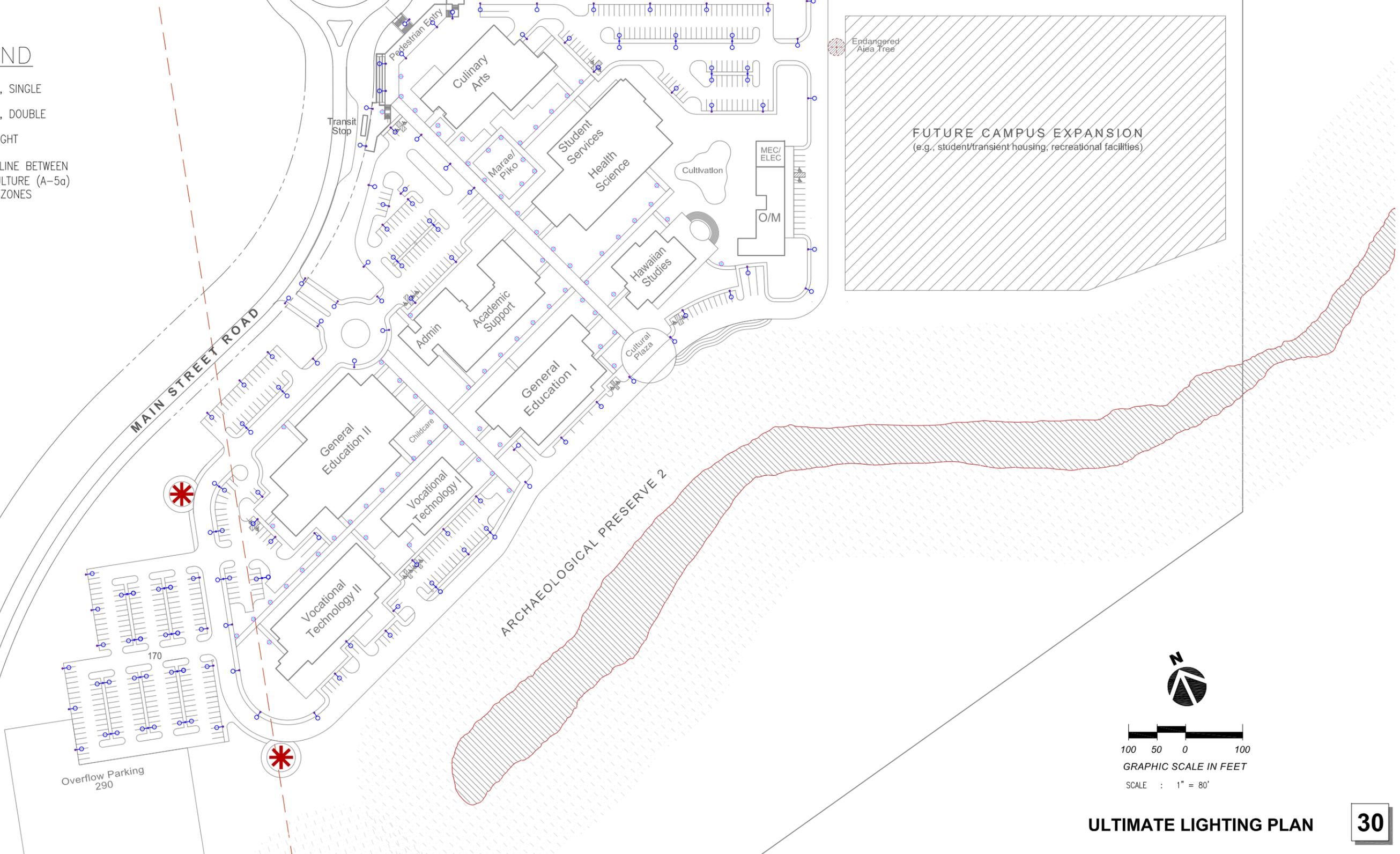
**LEGEND**

- PROVISIONS FOR UTILITY METERING
- CURRENT TRANSFORMERS
- PRIMARY SWITCH, 15KV
- PADMOUNT TRANSFORMER 12.47KV TO 480/277V
- PRIMARY SELECTOR SWITCH, 15KV
- BREAKER
- PROVIDE FOR FUTURE BREAKER

**This Page is Intentionally Blank**

LEGEND

-  POST LIGHT, SINGLE
-  POST LIGHT, DOUBLE
-  WALKWAY LIGHT
-  BOUNDARY LINE BETWEEN THE AGRICULTURE (A-5a) AND OPEN ZONES



GRAPHIC SCALE IN FEET

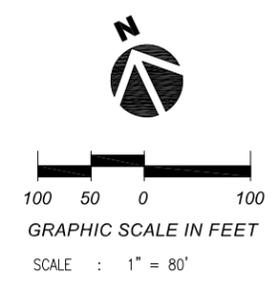
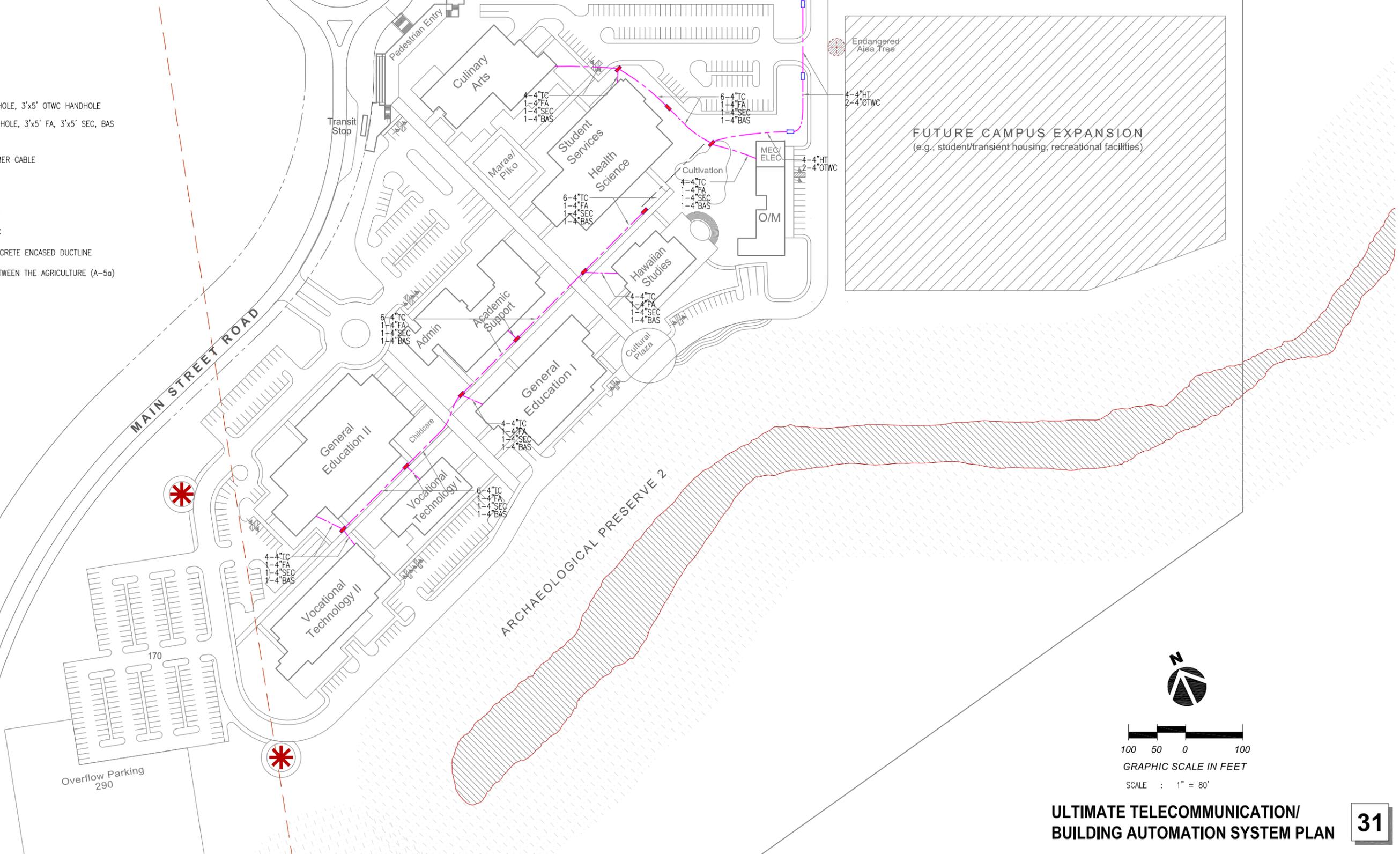
SCALE : 1" = 80'

ULTIMATE LIGHTING PLAN

**This Page is Intentionally Blank**

LEGEND

-  6'x12' HTCOM MANHOLE, 3'x5' OTWC HANDHOLE
-  6'x11' TELCOM MANHOLE, 3'x5' FA, 3'x5' SEC, BAS
- HT HAWAIIAN TELCOM
- OTWC OCEANIC TIME WARMER CABLE
- FA FIRE ALARM
- SEC SECURITY SYSTEM
- TC TELECOMMUNICATION
- BAS BUILDING AUTOMATIC
-  UNDERGROUND CONCRETE ENCASED DUCTLINE
-  BOUNDARY LINE BETWEEN THE AGRICULTURE (A-5a) AND OPEN ZONES



ULTIMATE TELECOMMUNICATION/  
BUILDING AUTOMATION SYSTEM PLAN

**This Page is Intentionally Blank**

**7.5 ULTIMATE MECHANICAL PLAN**

Construction Phasing

The Ultimate Mechanical Plan is proposed to be implemented in phases to coincide with the four (4) development phases of the UHCWH campus and its associated extended construction timeline (refer to Section 10.1). Assuming Phase 1 is completed within five (5) years from present day and Phase 2 is completed within ten (10) years from present, the mechanical system will have operated for over ten (10) years prior to starting Phase 3 construction. Construction of Phase 4 most likely will not be completed until beyond 20 years from present day. The following table gives an overview of the estimated cooling requirements per phase:

**Table 7. Estimated Cooling Requirements**

<b>Phase</b>	<b>Building</b>	<b>AC Cooling Incremental Requirement*</b>
Phase 1	Culinary Arts and 1/3 Health Science buildings	70 tons
Phase 2	2/3 Health Science building	30 tons
Phase 3	General Education 1, Academic Support, & O & M buildings	150 tons
Phase 4	General Education 2, Hawaiian Studies, Vocational Technology I, & Vocational Technology II buildings	150 tons

\* Estimates of AC cooling requirements are based on floor area and expected use.

**7.5.1 Air Conditioning and Ventilation Systems**

Below are three (3) options for consideration to air condition the facilities.

- Option #1 – Variable Refrigerant Volume (VRV) System For all Phases
- Option #2 – Chilled Water Plant with Adjacent Air-Cooled Chiller
- Option #3 – Chilled Water Plant with Remote Air-Cooled Chiller

## 7 Ultimate Plans

The following table discusses the advantages and disadvantage of a VRV system versus a chilled-water system.

**Table 8. Comparison Between a VRV System and a Chilled Water System**

	<b>Advantages</b>	<b>Disadvantages</b>
<b>VRV System</b>	<ul style="list-style-type: none"> <li>▪ Less cost in the initial development phases (1 and 2).</li> <li>▪ Interior floor area for mechanical rooms is greatly reduced.</li> <li>▪ No central plant required.</li> <li>▪ LEED Advantage: Allows facility to operate more energy efficient under "Mixed-Mode."</li> <li>▪ LEED Advantage: Uses non-CFC based refrigerants.</li> <li>▪ LEED Advantage: Has extremely low refrigerant leakage rate for enhanced refrigerant management.</li> <li>▪ LEED Advantage: Re-heat capabilities able to produce free hot water for either domestic or re-heat coil use.</li> </ul>	<ul style="list-style-type: none"> <li>▪ More outdoor floor area is required to house condensing units compared to air-cooled chillers.</li> <li>▪ Less energy efficient after phases 3 and 4 compared to the central chilled water plant.</li> <li>▪ Exposed fan coil units.</li> </ul>
<b>Chilled Water System</b>	<ul style="list-style-type: none"> <li>▪ Higher energy efficiency after phases 3 and 4.</li> <li>▪ Flexible distribution for a large campus.</li> <li>▪ LEED Advantage: Uses non-CFC based refrigerants.</li> <li>▪ LEED Advantage: Re-heat capabilities able to produce free hot water for either domestic or re-heat coil use.</li> <li>▪ Option #3 (as compared to Option #2)               <ul style="list-style-type: none"> <li>➢ Delays purchase of the 2<sup>nd</sup> 200-ton water-cooled chiller until Phase 4.</li> <li>➢ Site infrastructure is placed during the initial phase.</li> <li>➢ Remote placement of air-cooled chillers negates premature abandonment of useful chillers.</li> <li>➢ Space and noise issues associated with air-cooled chiller placement adjacent to Phase 1 and 2 facilities no longer exist.</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>▪ More cost in the initial development phases (1 and 2).</li> <li>▪ Underground pre-insulated piping required to serve all phases.</li> <li>▪ Central plant is required.</li> <li>▪ Increased floor area required for the air handling units.</li> <li>▪ Chilled water fan coil units are noisy compared with ductless split systems.</li> <li>▪ Higher maintenance costs.</li> </ul>

The mechanical system for phases 1 and 2 currently are being designed. Due to budget constraints and the uncertain timeframe for phases 3 and 4, it is preferable to design the mechanical systems for all phases using the Split-Air Conditioning VRV system (option # 1).

The VRV system utilizes a fan-coil air-condition (AC) unit devoted to each interior space that will be air conditioned. Multiple air-cooled condensing units will be installed to serve the interior space fan-coil units (FCU). The air-cooled condensing units will be placed in an equipment yard adjacent to the facilities they are serving. Each FCU will be provided with an internally mounted

condensate drain pump. Due to the increased outside air required to meet LEED accreditation and high occupancy loads, outside air pre-cool units (PCU) will be used to supply outside air to each space.

#### Controls

Each air-conditioned room shall have individual control of its zone FCU(s). All operable windows and doors will be provided with sensor switches. Each zone FCU will be interlocked with its respective zone operable windows and doors. When the windows or doors are opened longer than 60 seconds (adjustable), the zone FCU(s) will shut down. Once windows and doors are shut, zone occupants must manually start the FCU. A direct digital control (DDC) system will be provided. The DDC system will be an operation station placed in a centrally located telecommunications room, (final location to be decided by client). The DDC system shall be web enabled. All FCU's individual zone controllers shall be interlocked with the DDC so unit status can be monitored for override control. PCUs shall be controlled and monitored by the DDC system. The DDC system shall monitor room cooling mode (mechanical or natural), zone carbon dioxide (CO<sub>2</sub>) levels, outdoor air quantities, FCU supply air temperature set points, room air temperature, outside air temperature, supply air static pressure, kitchen exhaust fan status, and energy consumption, in each zone, in kilowatt hours. If CO<sub>2</sub> levels rise 10 percent above the desired set point, the DDC system will alarm. If outdoor air quantities fall below the set minimum, the DDC system will alarm.

#### Ductwork

Insulated galvanized steel ductwork will be used for supply air ductwork. Supply air shall be ducted with exterior wrap insulation. Return air shall be fully ducted. Main supply air ducts are externally insulated. Exposed ducts shall be double walled. Return air ducts shall be lined in classroom and administration areas. Fiberglass ductwork is not allowed. All exposed ductwork and supports shall be painted to match adjacent surfaces.

#### Indoor Design Conditions

This design includes an indoor design temperature of 75°F (dry bulb) 55 percent (relative humidity) for all classrooms, offices, and administrative spaces.

#### Outdoor Design Conditions

Outdoor design temperature: 87°F (dry bulb), 75°F (wet bulb).

#### Ventilation

All restrooms will be naturally ventilated. Window openings shall be provided to comply with the free area of the opening requirements per sanitation code. Buildings and equipment must be in compliance with the *ASHRAE Handbook - HVAC Applications*. Outside air intakes should be located to avoid taking in exhaust air and other sources of potential contamination.

### **7.5.2 Plumbing Systems**

Design of the plumbing system for the UHCWH must be in accordance with the Uniform Plumbing Code (1997) as amended. Potable hot water for each building will be provided by a gas-fired water heater, with a heat recovery system for energy conservation. A circulating pump may be required to keep hot water readily available at remote fixtures.

## **7 Ultimate Plans**

---

### **7.5.3 Fire Sprinkler Systems**

Sprinkler protection must be evaluated at the design stage to account for the use, building configuration and cost-benefit ratios.

### **7.5.4 Propane Gas Systems**

A propane tank should be located adjacent to each building that requires fuel for water heater, kitchen, and laboratory use. Shutoff valves at each laboratory must be provided to allow isolation for repair, maintenance and reconfiguration without affecting the entire system.

**8.0**

---

**Architectural Barrier-Free Program**



The Ultimate Site Plan is designed to ensure accessible and barrier-free routes for pedestrians and vehicles throughout the UHCWH campus core. The Barrier-Free Access Plan is presented in Figure 32.

Accessibility standards for the physically disabled are provided in the ADAAG. The ADAAG is a set of comprehensive guidelines that strive to ensure safe, barrier-free access to all areas of a given facility.

## 8.1 SITE CONSIDERATIONS

Accessible Parking Stalls. Accessible stalls will be provided throughout the various phases of parking lots developed at the UHCWH campus. Each phase will contain sufficient numbers of accessible stalls and access routes for only that particular phase. As each additional phase is constructed, the number of accessible stalls will increase in proportion to the added number of parking stalls. Table 4.1.2(5)a of ADAAG gives the number of accessible stalls for any given number of parking stalls. One (1) of every eight (8) accessible stalls is to be designated “Van Accessible.” A number of drop-off areas for the physically disabled also will be provided.

Accessible Routes. Accessible routes complying with Section 4.3 of ADAAG will be provided throughout the entire UHCWH campus core from parking lots, bus stops and drop-off areas to building entrances. These routes will include any ramps required to negotiate slopes, walkways of sufficient widths and minimum slopes, handrails, curb cuts, surface stripping, and related directional signage. With the exception of ramps, walking paths throughout the UHCWH campus core will generally be designed to about three (3) percent to five (5) percent slope.

## 8.2 BUILDING CONSIDERATIONS

Accessible Buildings. All buildings at the UHCWH will fall under ADAAG section 4.1.3 because all such buildings will be of new construction. The number of access routes to each building is governed by the ADAAG. Building interiors must fully comply with ADAAG guidelines.

Elevators. No elevators will be required to provide vertically accessible transportation since all buildings at the UHCWH will be one-story in height.

Doors, Entries and Hallways. Doors, entries and hallways in all buildings must be of sufficient width and dimensions to meet accessibility standards. Appropriate graphics and directional signs must be provided.

Toilet Facilities and Drinking Fountains. All toilet facilities and 50 percent of the drinking fountains within the campus must be designed to be accessible.

Telephones. All telephones in the UHCWH, including pay phones, must meet ADAAG requirements. Table 4.1.3(17) of the ADAAG provides the extent and number of telephones required to meet accessibility standards.

## 8 Architectural Barrier-Free Program

---

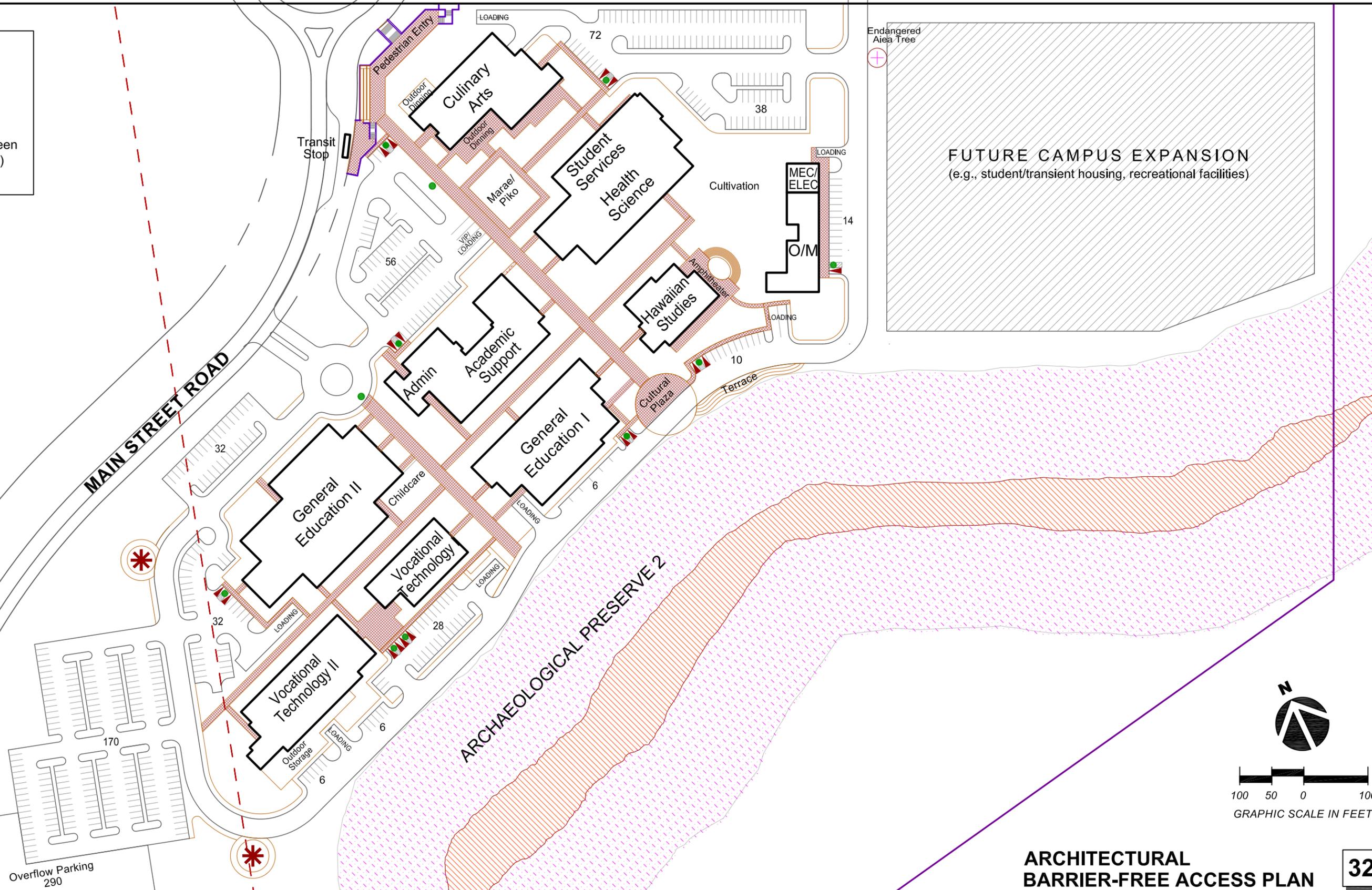
Assembly Areas. Fixed-seat assembly areas will require wheelchair locations according to the total number of provided fixed-seats.

Emergency Egress and Communications. Accessible routes serving any accessible space shall also serve as a means of egress for emergencies or connect to an accessible area of rescue assistance. In general, the area of rescue assistance will not be required because the UHCWH will be designed with only one-story buildings.

Access to Archaeological Sites. (Refer to the discussion in Section 2.12 regarding alternative means of experience for inaccessible venues.)

**LEGEND**

-  Accessible Parking
-  Drop-off Location
-  Accessible Route
-  Boundary Line Between the Agriculture (A-5a) and Open Zones

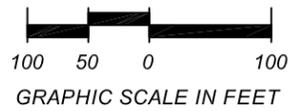


Endangered Aiea Tree

**FUTURE CAMPUS EXPANSION**  
(e.g., student/transient housing, recreational facilities)

**MAIN STREET ROAD**

**ARCHAEOLOGICAL PRESERVE 2**



**ARCHITECTURAL BARRIER-FREE ACCESS PLAN**

**This Page is Intentionally Blank**

**9.0**

---

**Design Considerations and Guidelines**



## **9.1 ARCHITECTURAL DESIGN GUIDELINES**

The following design considerations are intended as suggestions and guidelines for the designers of the UHCWH campus and facilities. These guidelines are based on the unique characteristics of the University site, its climate, geography and the cultural legacy of the West Hawai'i region.

The campus is not only a place where education takes place, but it also serves as a symbol of what education is about. When architecture deals with social, cultural, political, ethical currents in a broader sense, it has the potential to transform the way we view the world and our part in it. It is through these intersections of ideas that the campus and building design will be approached.

First and foremost, Hawai'i itself is a unique location. With its abundance of natural resources and beauty, the design should take advantage of these assets. The University site, too, is unique as there is no existing campus in the world that sits completely on a lava field. The site should be highly respected. Cut and fill should be minimized to preserve the natural landscape.

### **9.1.1 Access, Circulation, Plaza**

The campus should promote a pedestrian-friendly environment. Pedestrians may access the campus via the main entry at the corner of University Drive and Main Street Road. Connecting to the entry plaza is the main campus mall that runs the entire north-south axis to the archaeological preserve. The mall is anchored by the cultural plaza. Connecting to the main campus mall are smaller pathways that lead to the buildings and the spaces between buildings. Other elements linking the buildings and the pathways are plazas. These plazas, covered and uncovered, include but are not limited to: study areas, dining areas, and gathering areas. The main plaza will be the Marae/Piko area in which all formal welcoming ceremonies for distinguished guests will take place.

Because the campus is isolated from other developments in the area, most people will arrive by car, motorcycle/mopeds, bikes or buses. The main vehicular entry will be located along Main Street Road. The campus will have an interior perimeter road for vehicles with consolidated parking lots flanking the two (2) ends of the campus. There will be marked parking stalls per county code and overflow parking to service extended functions. Along the interior road will be parallel parking and smaller parking lots for service and loading purposes.

### **9.1.2 Building Orientation**

Building Orientation impacts overall lighting and cooling costs. Buildings should maximize northern/southern exposures. This will optimize the opportunities for natural daylighting. South facing roofs at the appropriate pitch will maximize photovoltaic panel efficiency. Minimizing eastern and western exposures will reduce cooling cost as it is difficult to shade from the sun.

### **9.1.3 Building Form**

The building form should be largely dictated by the building function/program, environmental and building systems, construction cost, and architectural aesthetics. The typical building width should be 30 feet to 40 feet to maximize the efficiency of natural daylighting and ventilation. Buildings that are single stories are most efficient for natural daylighting and ventilation.

## **9 Design Considerations and Guidelines**

---

### **9.1.4 Building Materials**

It is recommended that the superstructure (foundations, structural columns, beams, load bearing walls) be one or a combination of concrete/masonry, steel and/or glu-lam structural products. The construction labor force is very experienced in working with these materials. Concrete and steel are highly durable and easy to maintain. Infill walls can be lighter materials such as aluminum storefronts, architectural metal screens/panels, wood sidings, cement boards, or similar products. These materials are readily available and are used frequently in the construction of institutional/educational buildings in Hawai'i.

Roofs with wide overhangs that provide shading from direct solar gain are recommended. Light-colored, high-albedo roofs or vegetated roofs are appropriate for the Kalaoa climate with such high insolation. Such roofs help to minimize the heat-island effect. Special coatings and finishes for the roof can be specified to combat corrosion from the salt air. Building roofs with photovoltaic collectors should be oriented and angled for optimum performance. Roof characteristics could be inspired by the regional architecture without compromising effective passive cooling and shading design strategies.

### **9.1.5 Colors**

The colors of architectural elements at the UHCWH should be cool and natural, and be those proven to increase learning. Building walls could be light shades of off-white, beige or gray with accent color walls. Darker tones may be used for accents on windows, doors, wearing surfaces and wainscots in restrooms, kitchens and other wet rooms. Selected walls can be faced with locally available rock for accent and to tie-in with the existing lava terrain. Lighter wall colors are preferable to provide a cool contrast to the hot dark lava rock that dominates the existing landscape. Lighter colors are also preferable for interiors to minimize heat gain. Color variety should match the natural qualities of the building materials, to minimize upkeep and maintenance. Since the UHCWH is the symbol of higher education in the region, colors should be used to accentuate its importance as viewed from the highway and surrounding properties.

### **9.1.6 Peripheral Design Elements**

It is recommended that lava materials be used widely in the design of the campus due to its abundance on the site. Use of lava material will promote a unique Hawaiian sense of place that ties in with the land and its volcanic origins. Ancient Hawaiians used lava rock as a primary building material. Likewise, lava rock should be used as a unifying design element throughout the campus. Terrace retaining walls, building walls, site furniture, and paving material could all be made with lava rock. Large rocks and crushed cinder can be utilized in landscaping and rockscapes. Natural lava outcrops should be preserved and incorporated as part of the open space system of the campus.

## **9.2 LEED™**

Construction, renovations and alterations of any UHCWH campus buildings or site amenities are to conform to the following Sustainable Guidelines. The work shall integrate building materials and methods that promote environmental quality, economic vitality, and social benefit through the construction and operation of the built environment. The resulting project shall meet at a minimum the State of Hawai'i mandated LEED™ Silver rating level, with higher rating levels encouraged. The intent of the LEED™ is to create a built environment that provides the highest level possible of operational efficiency, as well as comfort and support for the users.

In efforts to preserve the natural resources of the State of Hawai'i, buildings should be designed responsibly. New construction and campus renovations should consider efficient management of energy and water resources, management of material resources and waste, protection of environmental quality, protection of health and indoor environmental quality, and reinforcement of natural systems, while integrating the design approach and cultural awareness.

For best results, sustainability should be clearly articulated as a guiding principle for project development, and incorporated into the project from the earliest stages. Sustainable design principles affect all phases of project development, from design, construction, operations and maintenance, and demolition and disposal. Specific to the Kona climate and the UHCWH campus site, buildings should focus their sustainable efforts on conserving water, use of natural daylighting, harvesting sunlight for energy, and—most importantly—passive design cooling and shading strategies. Incorporating these sustainable aspects into the design concepts will help the project achieve the minimum LEED Silver rating level, with higher rating levels encouraged.

LEED™ is an internationally recognized certification system that measures how well a building or community performs across all the metrics that matter most: energy savings, water efficiency, carbon dioxide (CO<sub>2</sub>) emissions reduction, improved indoor environmental quality, and stewardship of resources and sensitivity to their impacts. Developed by the U.S. Green Building Council (USGBC), LEED™ provides building owners and operators a concise framework for identifying and implementing practical and measurable green building design, construction, operations and maintenance solutions.<sup>65</sup>

The LEED™ rating system contains prerequisites and credits in five (5) categories: Sustainable Site Planning, Water Efficiency, Energy Efficiency and Atmosphere, Materials and Resources, and Indoor Environmental Quality. Registered projects can achieve levels of Certified, Silver, Gold, or Platinum. Currently, the State of Hawai'i requires a minimum Silver rating level for public education facilities. All future work should comply with the most current version of the LEED™ rating system and state requirements.

West Hawai'i residents and the staff and faculty at Kealahou strongly support state and local sustainability and renewable energy initiatives. For example, Hawai'i County recently adopted by ordinance, "Mapping Kona's Future: Kona Community Development Plan, Volume 1, September 2008, Final," which includes a goal to, "Establish Kona as a model for sustainability and energy self-sufficiency." As a result, during initial LRDP reviews, the community expressed support for achieving the highest rating, "LEED™ Platinum," and moving the campus to net zero energy consumption along with a goal of minimizing the campus' carbon footprint. There is strong support for this approach among members of the UH Board of Regents, the community college advisory committee and the state's U.S. Congressional delegation.

---

<sup>65</sup> U.S. Green Building Council, 2008.

## **9 Design Considerations and Guidelines**

---

### **9.3 DESIGN CONSIDERATIONS**

#### **9.3.1 Campus Security**

Buildings at the UHCWH should be oriented and sited to create an open campus atmosphere. Building entries must be easily visible for monitoring by security personnel. Hidden or obscure entries and alcoves should be avoided.

Building materials must be sturdy and durable. Flimsy materials that are prone to vandalism and break-ins should be avoided.

Fenestration and openings should be carefully considered in building design. Windows and openings must provide sufficient light, viewing opportunities (from interior to exterior) and should be aesthetically appropriate to the overall building design. Careful placement and sizing of windows will minimize the need for security bars and screens.

Parking should be located to allow easy visual monitoring by security personnel. Whenever possible, parking should be laid out in a large continuous flow rather than isolated pockets. Landscaping and dividing medians can be used to soften the scale of parking lots; however, landscaping should be selected and maintained so that trees and plantings do not obscure security surveillance.

The campus security office should be centrally located for control and to minimize distances for response and patrol time. Alarms for break-in intrusions, fire alarms, smoke detectors, etc. should be included in all buildings and should be connected to a central security control office. This will facilitate security surveillance and control during night hours and weekends when the campus is lightly used. Surveillance cameras can be placed where required throughout the campus, especially in more remote areas.

Security for the campus as a whole can be enhanced by properly designing the entrance to the UHCWH. Minimizing the number of entrances to the campus will facilitate checkpoints for vehicles and pedestrians.

A buffer area between the campus proper and access roads can provide an added degree of security for the UHCWH. The existing terrain is composed of rough and loose lava rock that is overgrown with dense, tall fountain grass. Keeping this area between the road and campus in its natural state may discourage unauthorized entry.

#### **9.3.2 Maintenance**

In addition to function, aesthetics and cultural values, design criteria for buildings must include durability and maintainability. Building materials should be chosen for long-term durability and maintainability rather than short-term cost savings. Consideration should be given to the day-to-day ease of maintenance. To ensure maintainability, materials should be selected that are compatible with the area's climate, weather, terrain and other site-specific characteristics. Mechanical equipment should be located for easy access to facilitate maintenance and repair.

Selected building materials should be readily available to the island of Hawai'i and the State of Hawai'i in general. To facilitate replacement and repairs, parts and repair materials should be

locally and/or readily available. Special-order materials and long-lead items should be minimized.

Building design must take into consideration the location of the UHCWH site in terms of earthquake forces, wind and hurricane forces and other life safety issues as mandated by the International Building Code and any local ordinances pertaining to building design. Careful consideration of these issues in architectural design will contribute to the ease of maintenance in the Kalaoa environment.

### **9.3.3 Safety**

To ensure the safety of students, faculty and staff, buildings and structures at the UHCWH must be designed to meet all applicable life safety codes. These include, but are not limited to, the latest edition of the International Building Code, local County of Hawai'i amendments to this Code, State of Hawai'i Health and Sanitation Standards, State of Hawai'i Department of Occupational Safety and Health (DOSH) Regulations, ADAAG and any other local ordinances that have jurisdiction in the site area.

The main code for building safety is the International Building Code. This Code covers the gamut of life safety issues including building types, occupancy, construction type, material standards, fire resistant standards, exits and egress, structural engineering regulations, and ventilation.

The ADAAG forms the basis for ensuring that buildings and facilities within the proposed campus meet accessibility standards established for physically disabled users of the facility. The State of Hawai'i has established the Commission of Persons with Disabilities to review all state projects to ensure that these projects meet ADAAG standards. All accessible routes, walkways, parking lots, buildings and other facilities within the campus will be subject to review by this Commission.

The Hawai'i Occupational Safety and Health Division (HIOSH), formerly known as DOSH, enforces and oversees the occupational safety and health of the workplace with regulations mirroring that of the Federal Occupational Safety & Health Administration. The UHCWH project will fall under the standards of HIOSH for workplace activities.

### **9.3.4 Operation**

Adherence to the guidelines listed above regarding security, maintenance and safety will contribute greatly to the efficient operation of the UHCWH physical plant. Energy use also needs to be considered.

Three (3) factors would seem to dictate the use of mechanical ventilation and cooling throughout the campus. The first factor is the hot arid climate of the University site. The second factor is the academic goal to emphasize multipurpose telecommunications infrastructure. This implies the use of heat- and moisture-sensitive equipment that requires a controlled environment. Air conditioning will be an integral part of the operation of the UHCWH campus. The third factor is vog or volcanic haze which has become prevalent in the region in the past few years. Vog is now the most significant air pollution source in West Hawai'i and mechanical ventilation and cooling will help to mitigate this pollutant in campus buildings.

The cost of energy in Hawai'i is extremely high. Any attempt to conserve energy above and beyond what is dictated by statutes, ordinances and codes would contribute to the efficient

## 9 Design Considerations and Guidelines

---

operation of the campus. For this reason, campus designers should consider natural cooling and ventilation as an option to air conditioning in specific areas that do not contain sensitive equipment. These areas might include the student lounge(s), traditional classroom(s), and activity and eating area(s) that could be designed to be continuous with outdoor shaded and landscaped areas. These spaces may be air conditioned during extremely hot weather, but could be naturally ventilated during periods of milder weather. Natural ventilation may be an appropriate alternative during the temporary stoppage of air conditioning due to maintenance and repairs, brownouts or blackouts. It is recommended that a life-cycle study be performed to identify the magnitude of savings due to the natural ventilation option.

Additionally, harvesting renewable energy can become a large source of energy cost savings. Due to the abundance of sunlight at the University site, solar energy and solar thermal heating should be considered as sources of energy and natural daylighting. Alternatively, renewable energy sources include, but are not limited to, purchasing energy from the Hamakua Biomass Company, installing microturbines to generate stand-alone power by running on biogas, or geothermal energy.

Lastly, building operations should consider a variety of system controls to reduce building operation energy and water costs. Automatic sensors for lights and water fixtures may help reduce water and energy consumption. Also, controllability of the HVAC systems by zone and time of day may help reduce unnecessary energy usage for cooling loads.

### 9.3.5 Daylighting and Indoor Environment

Energy performance, indoor daylighting, and the indoor environment are very important aspects to a successful, usable, and enjoyable campus design.

As summarized by the Turner Construction Company 2005 Survey of Green Buildings *Plus* Green Building in K-12 and Higher Education:

Large percentages of executives at organizations involved with Green K-12 facilities rated them more highly than traditional facilities on a range of benefits:

- Community image (87%)
- Ability to attract and retain teachers (74%)
- Reduced student absenteeism (72%)
- Student performance (71%)

Similarly, most executives at organizations involved with Green college and university facilities also reported that these facilities generated more benefits relevant to higher education:

- Community image (90%)
- Ability to attract and retain faculty (71%)
- Ability to attract student (70%)
- Student performance (59%)
- Ability to secure research funding (59%)<sup>66</sup>

The added student and faculty health benefits indirectly result from designing sustainable environments with higher indoor air quality, more natural ventilation, and increased daylighting and views. Increasing natural ventilation and minimizing the amounts of toxic, off-gassing

---

<sup>66</sup> Turner Green Buildings, n.d., p. 1

materials will provide a healthier learning environment for students and a healthier working environment for faculty and staff.

According to the LEED™ for New Construction Version 2.2 Reference Guide:

Americans spend on average 90% of their time indoors where U.S. Environmental Protection Agency reports that levels of pollutants may run two to five times – and occasionally more than 100 times – higher than outdoor levels. Similarly, the World Health Organization reported in its Air Quality Guidelines for Europe, Second Edition, that most of an individual's exposure to many air pollutants come through the inhalation of indoor air. Many of these pollutants can cause health reactions ... thus contributing to millions of days absent from school and work.<sup>67</sup>

Additionally, summaries from *Building Momentum: National Trends and Prospects for High-Performance Green Buildings*, prepared for the U.S. Senate Committee on Environment and Public Works by the USGBC have shown that daylighting can contribute to higher test scores for students. More specifically, the document stated that, in a 2001 study by the Heschong Mahone Group, students in California who were testing with the most natural light scored between 20 and 26 percent higher on math and reading tests than students who were testing with the least amount of daylight.<sup>68</sup>

The Turner Construction Company 2005 Survey of Green Buildings also states that:

Green facilities provide a range of significant benefits including better student performance, increased ability to attract and retain teachers, and an improved image in the community. Projects that incorporate Green features also have lower total costs over time due to reduced energy costs and more efficient operations overall.<sup>69</sup>

All of these documents and studies support the need and importance for daylighting and healthy indoor environments in higher education spaces. Overall, campus buildings designed for optimum daylighting, views, and more natural ventilation are highly recommended for the UHCWH campus.

## 9.4 CONCEPTUAL LANDSCAPE DESIGN GUIDELINES

### 9.4.1 Purpose and Location of Landscaped Areas

Landscaping should be used throughout the campus for the following reasons:

- To add color and visual interest to the monotone natural surroundings;
- To provide shade from intense sunlight;
- To provide protection from wind and noise;
- To serve as visual buffers to soften or conceal utility structures and parking;
- To provide a transition between the rugged natural terrain and the more refined developed spaces; and
- To provide comfort and enjoyment for the UHCWH students, faculty, staff, and the West Hawai'i community in general.

---

<sup>67</sup> U.S. Green Building Council, 2006, p. 287.

<sup>68</sup> U.S. Green Building Council, 2003, p. 10.

<sup>69</sup> Turner Green Buildings, n.d. p. 1.

## 9 Design Considerations and Guidelines

Landscaping can be located in the following areas:

- Pedestrian entry, marae/piko, and cultural plaza;
- Building entrances and informal gathering areas between buildings containing flowering and fragrant trees, shrubs, and groundcovers;
- Pathways and malls with informal clusters of small and medium canopy trees;
- Archaeological buffer and sites;
- Parking areas; and
- Open spaces.

Landscaping design should consider the levels of required maintenance and conform to sustainable landscaping guidelines such as the Environmental Protection Agency's Greenscapes program. It should also incorporate features to achieve relevant LEED credits.

### 9.4.2 Planting Types and Sizes

Campus landscaping should emphasize appropriate native Hawaiian and Polynesian introduced plant species that are drought and wind tolerant and that require minimal maintenance. Other introduced species that are associated with the local environment may also be included. Wherever possible, the existing grassland/lava landscape should be preserved and incorporated into the outdoor landscaped areas. The following plants are appropriate to the site and climate.

**Table 9. Plant List**

<i>PLANT LIST</i>		<i>Mature Size</i>	
		<i>Height</i>	<i>Spread</i>
<b>Large Canopy Trees</b>			
Monkeypod	<i>Samanea saman</i>	45'	65'
Kiawe (thornless variety)	<i>Prosopis pallida</i>	45'	50'
<b>Medium Canopy Trees</b>			
Autograph Tree	<i>Clusia rosca</i>	35'	30'
Formosa Koa	<i>Acacia confusa</i>	35'	30'
Gold Tree	<i>Tabebuia donnell-smithii</i>	75'	40'
Hala*	<i>Pandanus odoratissimus</i>	25'	30'
Milo*	<i>Thespesia populnea</i>	30'	30'
Rainbow Shower	<i>Cassia javanica x c. fistula</i>	35'	35'
Royal Poinciana	<i>Delonix regia</i>	35'	40'
Silver Trumpet	<i>Tabebuia argentea</i>	30'	20'
True Kou*	<i>Cordia subcordata</i>	35'	30'
Wili Wili*	<i>Erythrina sandwicensis</i>	30'	30'
Lama	<i>Diospyros sandwicensis</i>	30'	20'
<b>Small Canopy Trees</b>			
Silver Buttonwood	<i>Conocarpus erecta 'seviccus'</i>	15'	12'
Kalamona	<i>Cassia glauca</i>	15'	15'
Plumeria Varieties	<i>Plumeria spp.</i>	20'	20'
Beach Heliotrope*	<i>Messerschmidia argentea</i>	15'	15'
Pineapple Guava	<i>Feijoa sellowiana</i>	15'	15'

**Table 9. Plant List (cont.)**

		Height	Mature Size Spread
<b>Small Canopy Trees (cont.)</b>			
Manele*	<i>Sapinduns saponaria</i>	15'-25'	20'
Koai'a*	<i>Acacia koaia</i>	15'-20'	20'
Naio*	<i>Myoporum sandwicense</i>	20'	15'
'Iliahi	<i>Santalum paniculatum</i>	20'	15'
Noni	<i>Morinda citrifolia</i>	15'	15'
<b>Palms</b>			
Areca	<i>Chrysalidocarpus lutescens</i>	15'	
Coconut*	<i>Cocos nucifera</i>	45'-75'	
Loulu*	<i>Pritchardia martii</i>	25'	
	<i>Pritchardia hillebrandii</i>	25'	
	<i>Pritchardia beccariana</i>	25'	
	<i>Pritchardia affinis</i>	25'	
	<i>Pritchardia remota</i>	25'	
MacArthur	<i>Ptychosperma macarthurii</i>	15'	
Manila	<i>Veitchia merrillii</i>	15'-20'	
<b>Shrubs</b>			
'A'ali'i*	<i>Dodonea viscosa</i>	Hedge/Screen	
Alahe'e*	<i>Canthium odoratum</i>	Hedge/Screen	
Be-Still	<i>Thevetia nerifolia</i>	Hedge/Screen	
Bougainvillea	<i>Bougainvillea spp.</i>	Accent	
Hapuu*	<i>Cibotium spp.</i>	Accent	
Ili'e'e*	<i>Plumbago zcylanica</i>	Foundation	
'Ilima*	<i>Sida fallax</i>	Shrub form	
Kuluj*	<i>Nototrichium sandwicense</i>	Hedge/Shrub	
Ma'o*	<i>Gossypium tomentosum</i>	Hedge/Shrub	
Ma'ohau hele*	<i>Hibiscus brackenridgei</i>	Hedge/Screen	
Naupaka*	<i>Scaevola sericea</i>	Hedge/Screen	
Ohai Alii*	<i>Caesalpinia pulcherrima</i>	Accent	
Ti	<i>Cordyline terminalis</i>	Accent	
Maio pilo	<i>Capparis Sandwichiana</i>	Accent	
'Uhaloa	<i>Walthoria americana</i>	Accent	
<b>Ground Cover</b>			
Akia*	<i>Wikstroemia uva-ursi</i>		
Ilima Papa*	<i>Sida fallax</i>		
Nehe*	<i>Lipochaeta succulenta</i>		
Pa u-o-hi iaka*	<i>Jacquemontia ovalifolia</i>		
Pohinahina*	<i>Vitex rotundifolia</i>		
Trailing Lantana	<i>Lantana montcvidensis</i>		
Dwarf Rhoeo	<i>Rhoeo discolor</i>	Accent	
Ulei*	<i>Osteomeles anthyllidifolia</i>	Accent	
'Ohai	<i>Sesbania Tomentosa</i>	Accent	
Huehue	<i>Cocculus ferrandianus</i>		
Pili	<i>Heteropogon contortus</i>	Grass	

Note: \* = Native or Polynesian-introduced species.

## 9 Design Considerations and Guidelines

---

### 9.4.3 Irrigation System

A design objective should be to provide landscaping that requires minimal maintenance and watering, e.g. xerophytic plants. Where required, an automatic irrigation system should support landscaped areas. Low volume or drip irrigation should be considered for trees, shrubs and groundcover to minimize water loss due to evapotranspiration.

### 9.5 ARCHITECTURAL STYLE AND CHARACTER

The following character sketches, photos of a study model, site sections, building sections and exterior elevations are intended to give the reader a picture of the UHCWH campus. The images convey a visual impression of the general character and atmosphere that this LRDP proposes. See Figures 33 through 43 at the end of this section for illustrations of the building design concept. Also, see Figure 52, *Transition Elevations* in Chapter 10.

A low-rise open environment is desirable to capture the spectacular panoramic views, to relate to the expansive and sprawling terrain, to enhance the natural surroundings and climate, and to create an oasis in the midst of the desert-like surroundings. The design of the UHCWH should strive to bring the outdoors in, not shut it out. Expansive views of Mauna Kea and the Kona coastline should be preserved in the development of the UHCWH. Broad terraces following the existing contours should be created to provide level areas for buildings within the UHCWH campus core. Open spaces and landscaping should be oriented to preserve and enhance the strong vistas in the mauka/makai direction.

It is recommended that all buildings be kept to one (1) story throughout the entire campus core unless there is special need to do otherwise. All future expansion and additions should be required to adhere to this one (1) story guideline. This low profile character will lessen the visual impact of development and facilitate accessibility to all facilities in fulfillment of ADAAG requirements.

Wide roof overhangs, covered walkways and shade trees should be used extensively to shelter pedestrians as they move between various activities on the campus. A series of trellis structures combined with landscape features can be strategically located for effective shading.

The central mall concept will aid in unifying the various activity elements of the campus. The mall will serve as the central pedestrian accessway and gathering place for the UHCWH users. Buildings should be clustered around the mall and grouped so that smaller, more intimate courtyards are created. These courtyards can be micro-climates that are protected from occasional strong winds and shaded from the sun.

Figure 33

Sketch 1. The UHCWH campus site has sweeping views in the mauka (eastern) direction from its prominent location on the slopes of Mt. Hualalai.



Figure 34

Sketch 2. Panoramic views in the makai (western) direction are of the Pacific Ocean. The mauka-makai view corridor should be preserved and enhanced whenever possible in the layout and design of campus facilities.

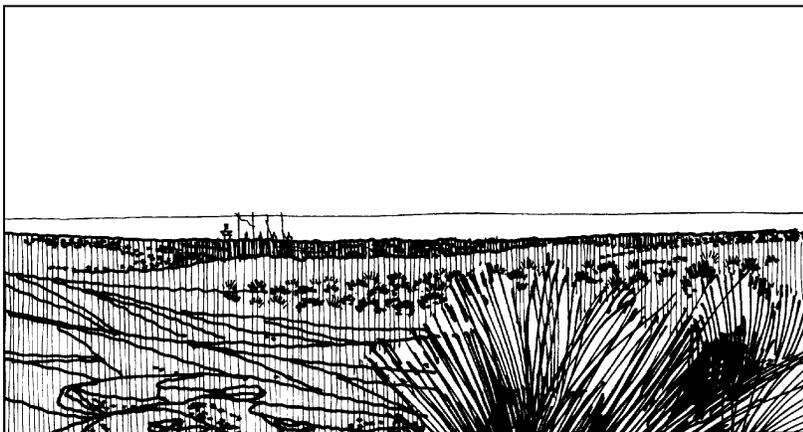


Figure 35

Sketch 3. The Kalaoa campus site is characterized by ancient volcanic flows of hardened pahoehoe and 'a'a lava. The abundance of lava contributes to a dry desert-like appearance. There is very little topsoil and the rocky terrain is interspersed with fountain grass and small dry shrubbery.



**This Page is Intentionally Blank**

Figure 36

Sketch 4. Buried voids or lava tubes were formed as a result of the cooling molten rock and drainage of residual lava from primary flow pathways. Cave-like openings to these lava tubes have been found on the 500-acre UHCWH campus site.

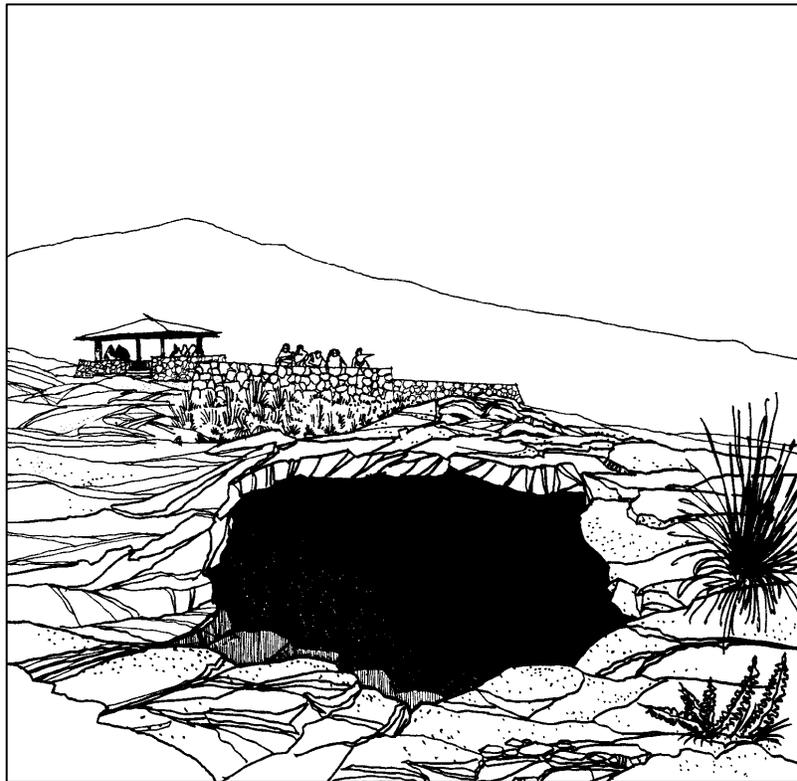
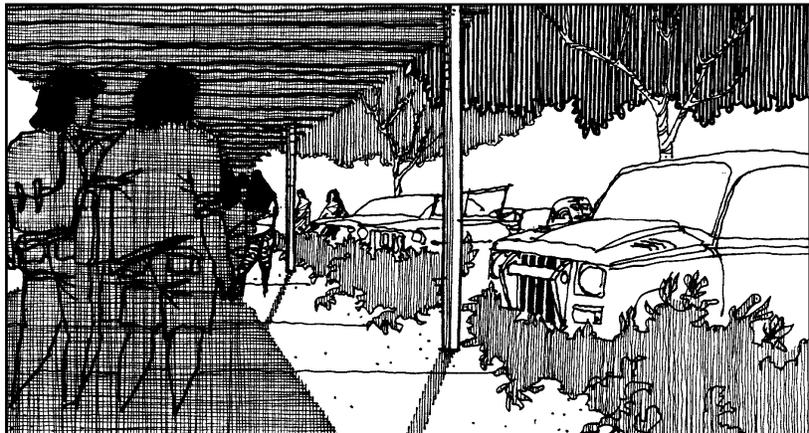


Figure 37

Sketch 5. Parking should be provided close to buildings and broken at intervals with shade trees and shrubbery. Parking can be connected to buildings with covered walkways.



**This Page is Intentionally Blank**

Figure 38

Sketch 6. Buildings should be integrated with the arid lava-strewn surroundings. Creative use of landscaping and architectural design can create a comfortable indoor-outdoor atmosphere that is conducive to student activities.

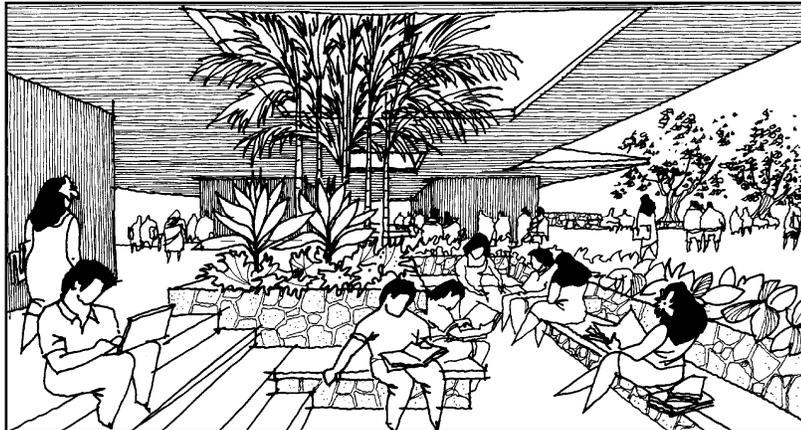


Figure 39

Sketch 7. Large roof overhangs and covered walkways will protect students and staff from the intense sun and sudden rain showers that are typical of the tropical climate at Kalaoa.

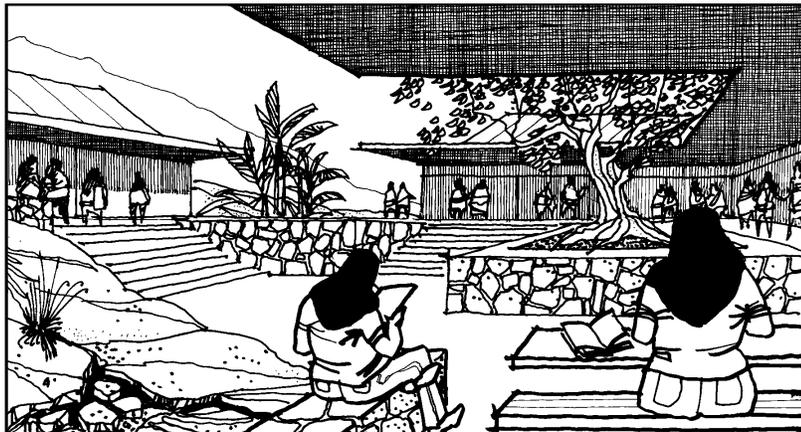
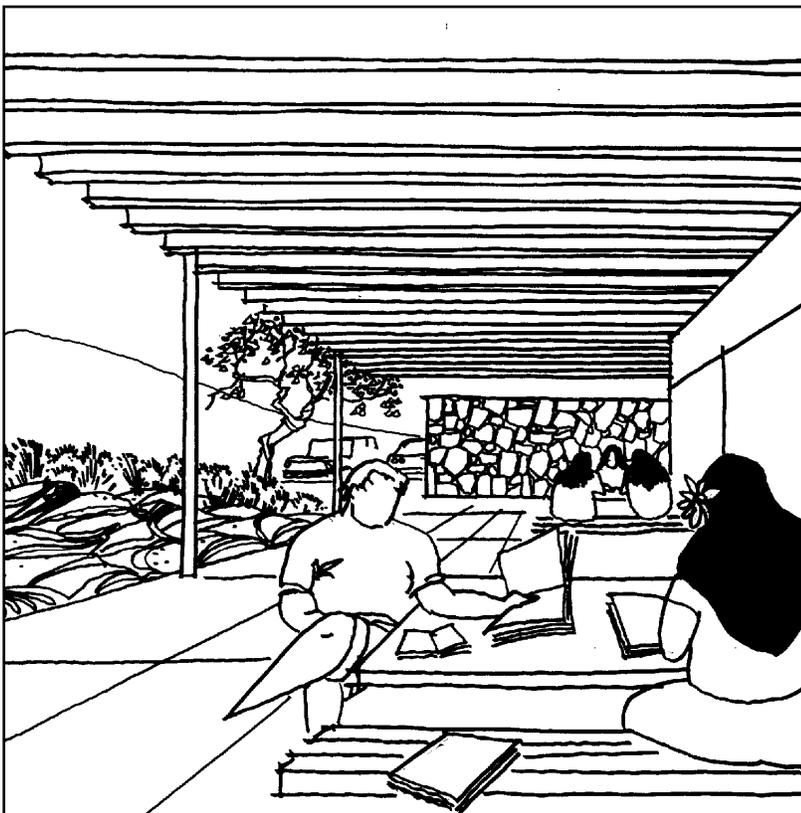


Figure 40

Sketch 8. Smaller pathways and edges of buildings can be shaded with trellises or roofing to create more intimate outdoor areas where students can meet, study or picnic.



**This Page is Intentionally Blank**

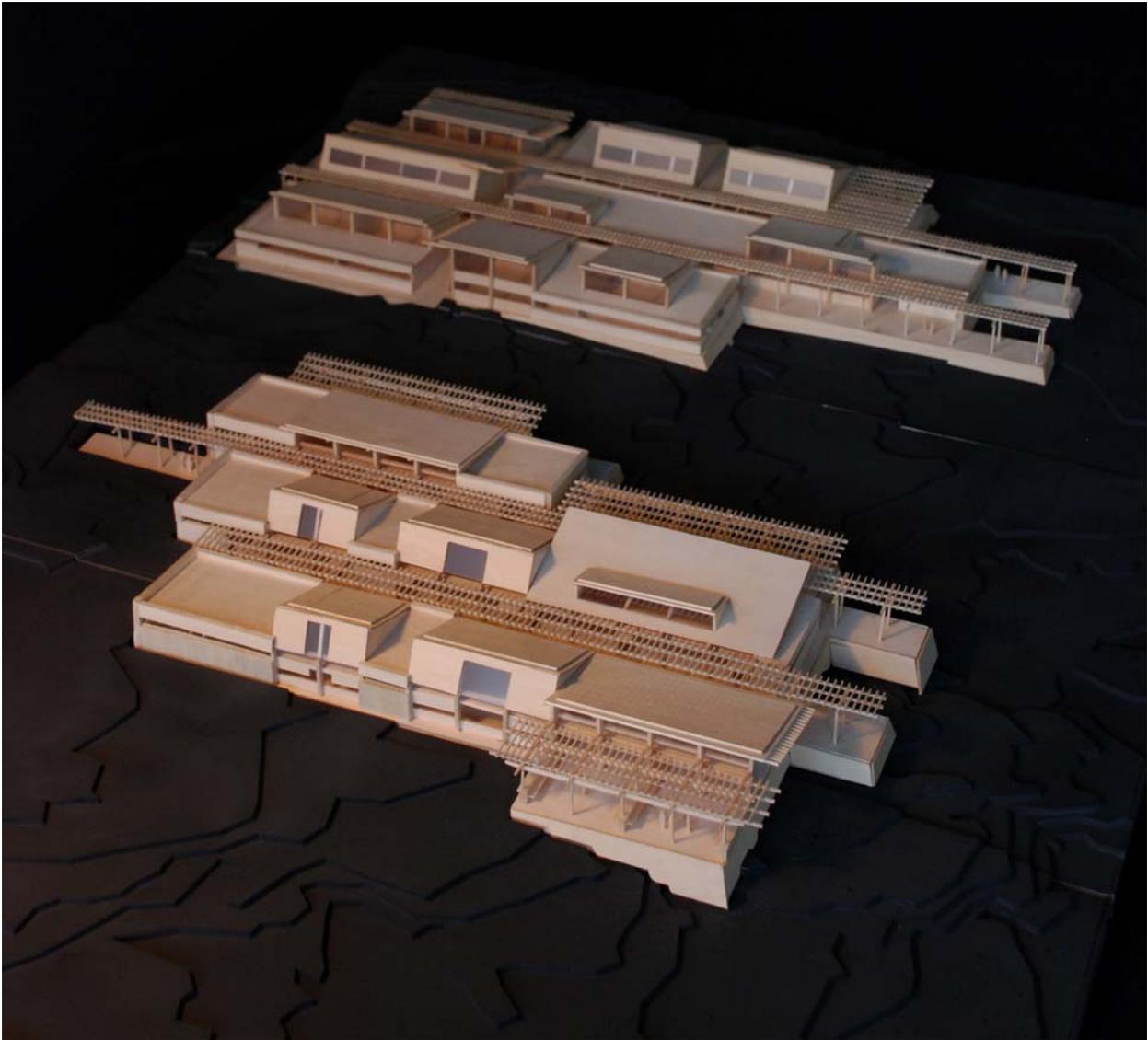


Figure 41  
Model Image 1. Northwest Bird's Eye Perspective View of Culinary Arts and Health Science buildings.

**This Page is Intentionally Blank**

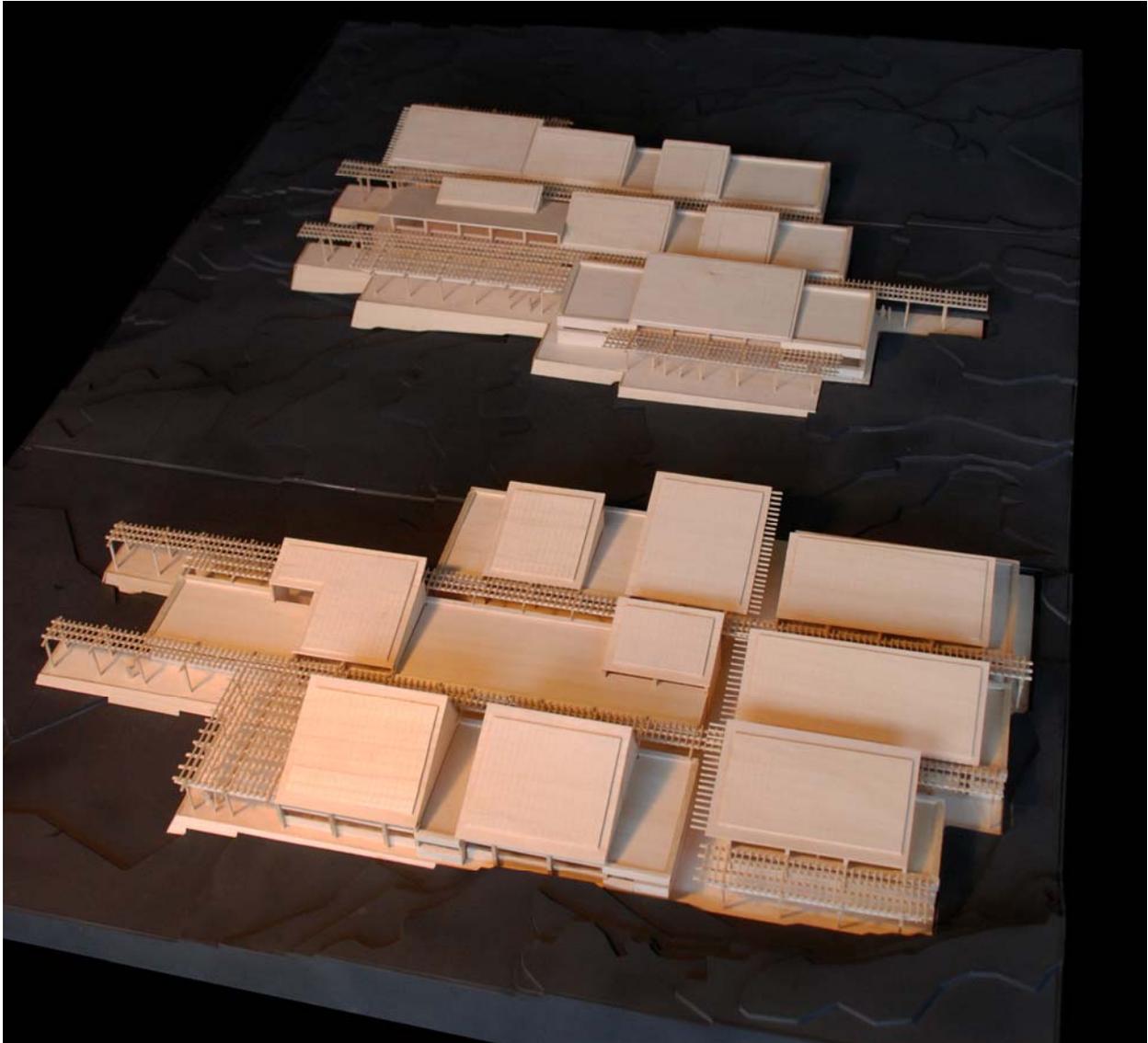


Figure 42  
Model Image 2. Southeast Bird's Eye Perspective View of Culinary Arts and Health Science buildings.

**This Page is Intentionally Blank**

**NORTH ELEVATION - SITE**



**ELEVATION ALONG THE CAMPUS MALL**



**This Page is Intentionally Blank**

**10.0**

---

**Implementation and Transition Plan**



## 10.1 PHASING

A phasing plan that will allow the UHCWH to be developed in a rational and orderly manner was formulated based on the ultimate plans. The phasing plan allows for continuing development of the UHCWH as enrollment and program requirements increase and funding becomes available. The close proximity to the Palamanui Master Planned Community is the main criteria used in the phasing of campus development because it is intended that the UHCWH will tie into Palamanui’s utility systems. This was considered a distinct advantage to the UHCWH and the major reason for moving the campus core from the central portion of the 500-acre University site to the northwest corner of the site. As a result, the initial phase of campus development will be in the northwestern corner of the site. Successive development phases will gradually move farther away from the corner. The incremental development will be divided into four (4) phases. Table 10 below cumulatively summarizes the major site planning components and total built-up area at each phase. For a breakdown of the square footage to be developed in each phase, refer to Table 11. The figures in Table 10 reflect the square footages represented in Section 3.0 Program Requirements and Section 7.0 Ultimate Plans.

**Table 10: Cumulative Summary of Major Site Planning Components at each Phase of Development**

Ultimate Site Plan	# of Bldgs	Building (GSF)	Covered Area (SF)	Roadway & Parking (SF)	Overflow Parking (SF)	Pedestrian Walkways (SF)	Built-up Area (Acres)
Phase 1	2	26,354	15,170	67,300	0	25,200	4.2
Phase 1 & 2	2	38,358	22,160	94,400	0	28,200	6.5
Phase 1 thru 3	5	98,439	31,660	237,600	12,000	66,500	12.3
Phase 1 thru 4	9	165,815	59,380	340,000	95,000	80,000	22.7

### 10.1.1 Phase I

In consultation with the UH administration and Hawai'i Campus Developers who prepared the Ed Specs, it was decided that the first phase would consist of two (2) buildings—the Culinary Arts building and the upper section of the Health Science/Student Services building (see Figure 44, *Development Plan Phase 1*). The Culinary Arts building with approximately 17,792 GSF will be built first. It is located on the northwestern corner of the campus core right across from the Palamanui Master Planned Community. As a condition of obtaining a zone change, Palamanui is being required by the county to fund and construct the first 20,000 sf of building at UHCWH up to a cost of \$5,000,000 with the University paying the balance. In addition to the Culinary Arts building, the upper section of the Health Science/Student Services building with approximately 8,562 GSF would also be built in the first phase. This extra building segment would be necessary to accommodate the transition from the present facility at Kealakekua to the new facility at Kalaoa. These two (2) buildings are large enough to house the present enrollment and programs at Kealakekua. General instruction classrooms and other office and service functions will be initially housed in these buildings.

The UHCWH campus core developed in the first phase will have two (2) vehicular accesses. The primary access is a 30-foot wide driveway connecting Main Street Road to the parking lot located on the western side of the first two (2) buildings. The interior campus roundabout would not be built in this first phase, but a drop-off area will be provided. The secondary service-

## 10 Implementation and Transition Plan

---

vehicle access is via University Drive. It is a 25-foot wide temporary driveway that mainly serves the loading areas required for the main kitchen located in the Culinary Arts building. Full vehicular access is not being provided from University Drive since in this initial phase University Drive will only extend up to the Palamanui Village roundabout and perhaps a short distance east of the roundabout. When University Drive is fully built a second vehicular access can be added for the UHCWH (See Figure 46, *Development Plan Phase 3*).

In this initial phase, only one (1) main parking lot will be provided for campus users. This lot can accommodate 55 standard parking stalls, two (2) accessible stalls, and two (2) loading spaces, all required by Hawai'i County Code. A small parking area is also provided on the northeastern side of the first two (2) buildings to provide an additional 15 parking stalls. This small parking lot is accessible from the temporary service entry.

In the planning process, attention has been given to creating a link between the UHCWH and Palamanui as well as promoting pedestrian circulation within the campus core. As a result, the pedestrian entry plaza and the 20-foot wide north-south pedestrian mall will be constructed at the beginning of campus development. Another two integral site planning elements included in Phase 1 are the marae/piko and the circular cultural plaza.

The area will be graded and surplus excavated material will be deposited in the parking lot and overflow parking area located on the western side of the campus core to be developed in Phase 3. Water and sewer mains will be connected to Palamanui's utility systems in University Drive. Initially power will be provided from a HELCO overhead transmission line running through the southern end of the 500-acre University parcel. Ultimately when a planned electrical substation is completed by Palamanui, the UHCWH will be served from the new substation.

### 10.1.2 Phase 2

In Phase 2, the construction of Health Science/Student Services building will be completed. An additional floor area of approximately 12,004 GSF will be added to the campus. The building mainly includes classrooms, labs, and student services functions.

To accommodate the increase of building space and occupancy, parking would have to be expanded. As shown in Figure 45, *Development Plan Phase 2*, the area of approximately 2,800 square feet south of the main parking lot will be graded and used for this expansion. The surplus excavated material will be deposited in the future Phase 4 area. The total number of standard parking stalls will be 100, plus four (4) accessible stalls and four (4) loading spaces.

### 10.1.3 Phase 3 – Completion of the 750 FTES Campus

This phase will add another three (3) buildings to the campus to support an enrollment capacity of 750 FTES. These buildings are the Admin & Academic Support building, the General Education I building, and the O & M building. See Figure 46, *Development Plan Phase 3*. New buildings will provide more space required to serve five (5) major functions— Institutional Support (Director), Academic Support, Continuing Education, Instruction, and Institutional Support (O & M). Some of the functions (e.g., library and administration) previously located in the first two (2) buildings will be relocated to these new buildings. As a result, the existing Culinary Arts and Health Science/Student Services buildings can then expand to their full capacity as described in the Ed Specs, since they no longer need to house other functions on a temporary basis.

To handle the increase in traffic, the main entrance will be widened and the 55-foot radius roundabout will be added to the campus vehicular circulation. Most importantly, the 30-foot wide interior campus roadway will be constructed to provide convenient access to all major buildings and connect the main entrance on Main Street Road to the secondary access on University Drive.

In Phase 3, more parking areas will have to be built to provide sufficient parking spaces for UHCWH users. Based on the Hawai'i County Code, 238 standard stalls, nine (9) accessible stalls, and nine (9) loading spaces are required for the 750 FTES campus. To meet this requirement, two (2) more parking lots will be added to the campus core; one (1) located on the western side of the Admin & Academic Support building and another located on the northeastern side of the Culinary Arts building. Six (6) parallel parking stalls and two (2) loading spaces will be provided along the campus roadway section south of the General Education I building, while the O & M building will have its own small parking lot. In addition, two overflow parking areas will be provided to add another 140 parking spaces to the campus.

The Phase 3 area will be graded and all other utility mains will be extended. The mechanical and electrical main control rooms will be constructed. They will be attached to the north end of the O & M building.

A possible addition in Phase 3 is an Early Childhood Education program and associated Children's Center. An Early Childhood Education program will provide attitudes, skills, and knowledge for people who work with young children and their families in a variety of early childhood programs. The program will offer certificates and degrees that prepare students for support roles in early childhood programs, to be teachers or lead practitioners.

The Children's Center, similar to the center on the Manono Campus, will provide a setting for early childhood students to gain practical experience with young children. The Center will provide early education and care for children 18 months to 5 years of age and serve children of students, faculty, and staff from the UHCWH. Community children will be accepted on a space available basis. The Center will offer a high quality developmental approach to early education with qualified staff. Early childhood students will work and study in the Center, under the guidance and supervision of early childhood faculty and staff. The Center will be accredited by the National Association for the Education of Young Children.

### **10.1.4 Phase 4 – The 1,500 FTES Campus**

This final development phase will include the construction of the remaining General Instruction classrooms and Division Offices which will be housed in four (4) new buildings: the General Education II, Vocational Technology I, Vocational Technology II, and Hawaiian Studies buildings (see Figure 47, *Development Plan Phase 4*). This completes the physical plant of the UHCWH as described in this LRDP for a total maximum enrollment of 1,500 FTES. The General Education II, Vocational Technology I, and Vocational Technology II buildings will be grouped together and located on the western end of the campus core. These buildings will replace the parking lot and overflow parking built in the previous phase. The Hawaiian Studies building will be separated from the group and placed on the open area adjacent to the cultural plaza, so students can use the plaza for ceremonies and instructional purposes. Attached to the Hawaiian Studies building is the outdoor amphitheater, which also will be built in the last phase.

## 10 Implementation and Transition Plan

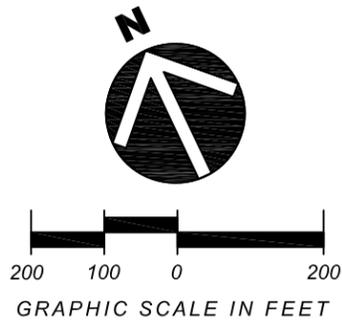
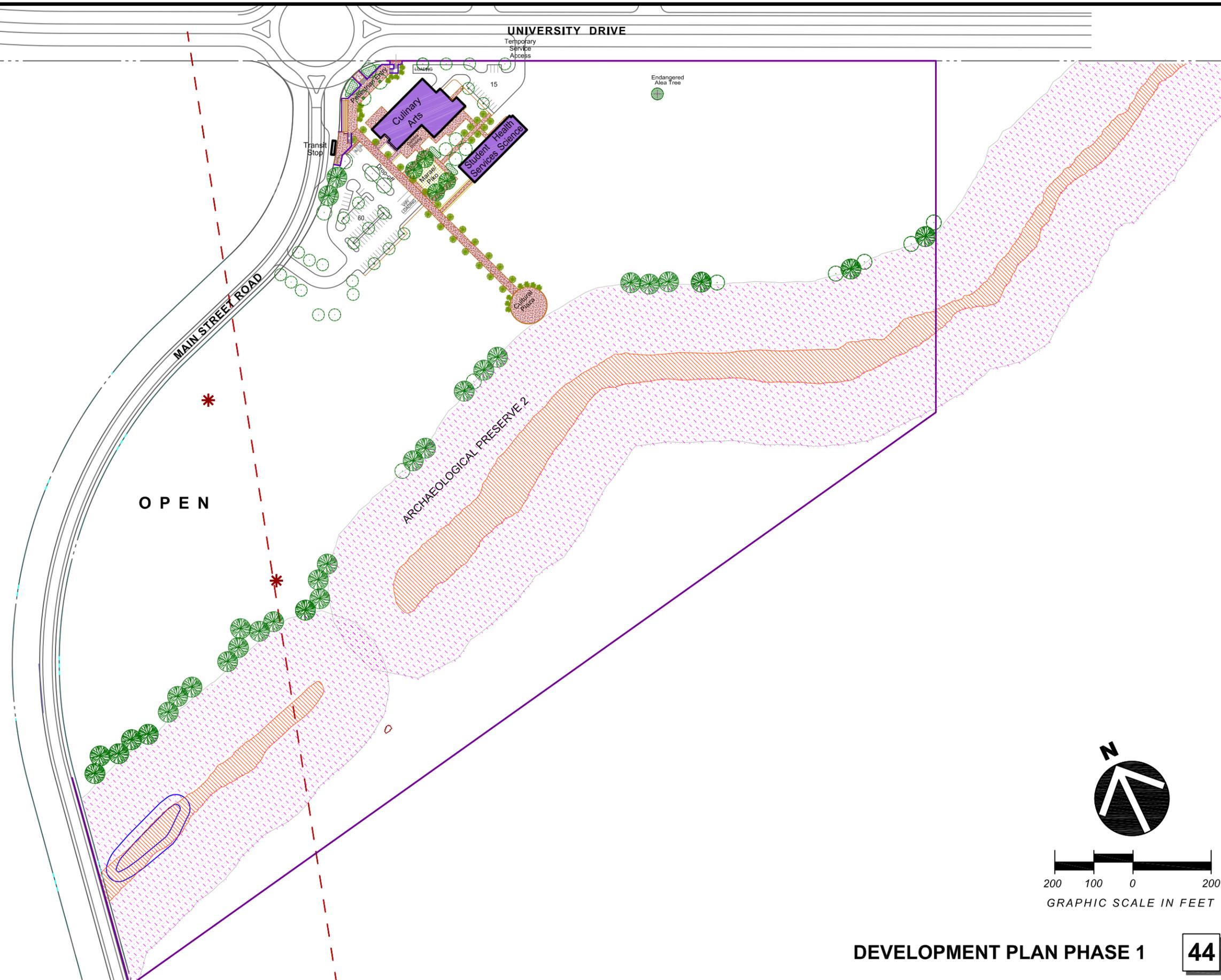
---

In this phase, areas in the Open Zone would have to be used for roadway and parking. The main parking lot located in the Open Zone will cover approximately 76,000 square feet, while the overflow parking will take up another 95,000 square feet. The western section of the campus roadway constructed in the previous phase will be reconfigured to give more space to the buildings. Additional separate small parking areas and loading spaces will also be constructed.

When fully developed, the 1,500 FTES campus will cover about 23 acres of land. It will have nine (9) major buildings, 465 standard parking stalls, 17 accessible stalls, and 17 loading spaces. The overflow parking can accommodate a maximum of 290 more spaces. The open area of approximately seven (7) acres on the eastern portion of the 73-acre subdivision will be set aside for future campus expansion. Possible functions include student/transient housing and recreational facilities.

**LEGEND**

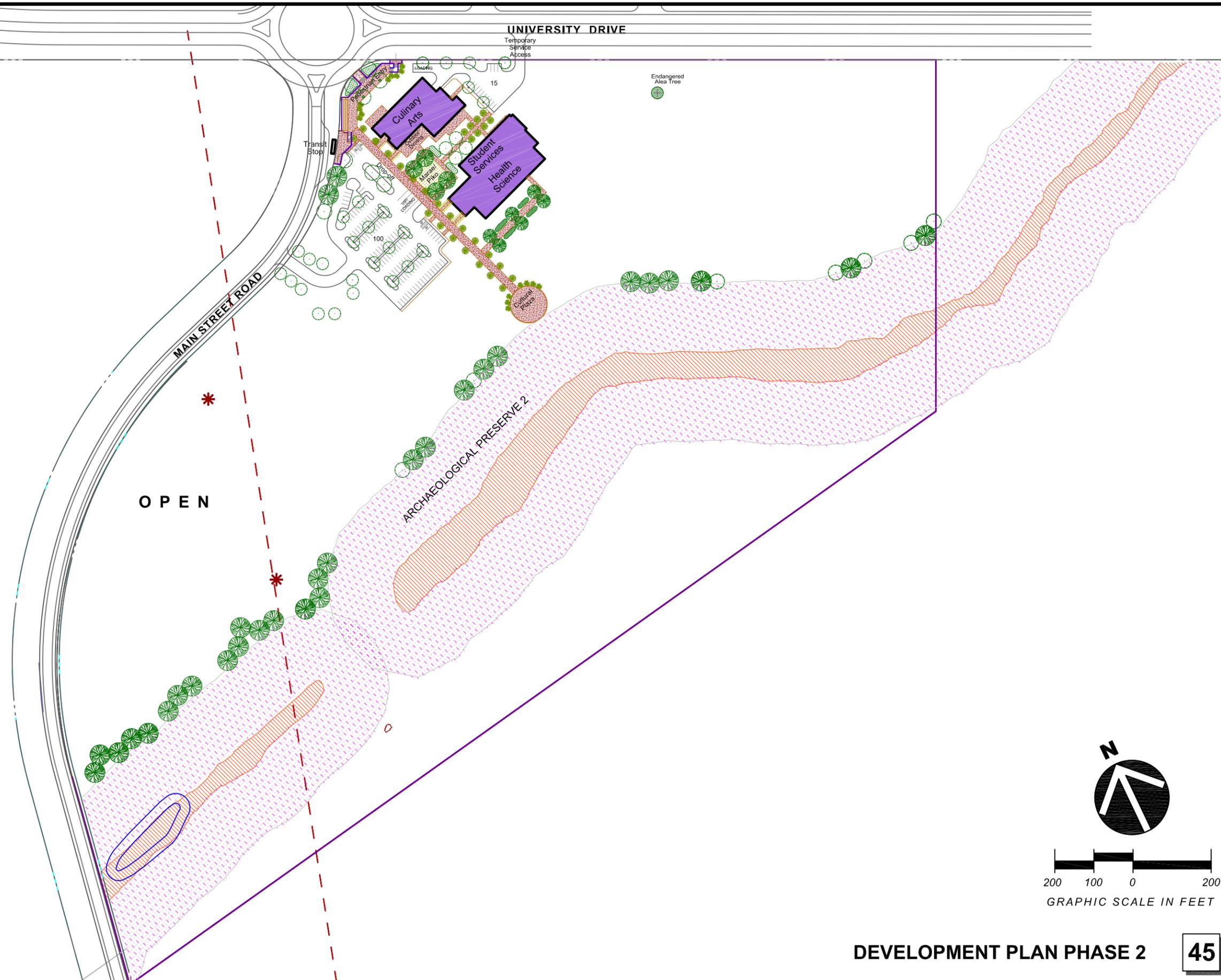
-  73-Acre UH Subdivision
-  750 FTES Campus Building
-  Lava Tube Boundary
-  50-Meter Buffer Area
-  Archaeological Site
-  Boundary Line Between The Agriculture (A-5a) and Open Zones



**This Page is Intentionally Blank**

**LEGEND**

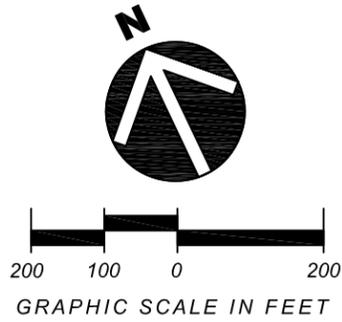
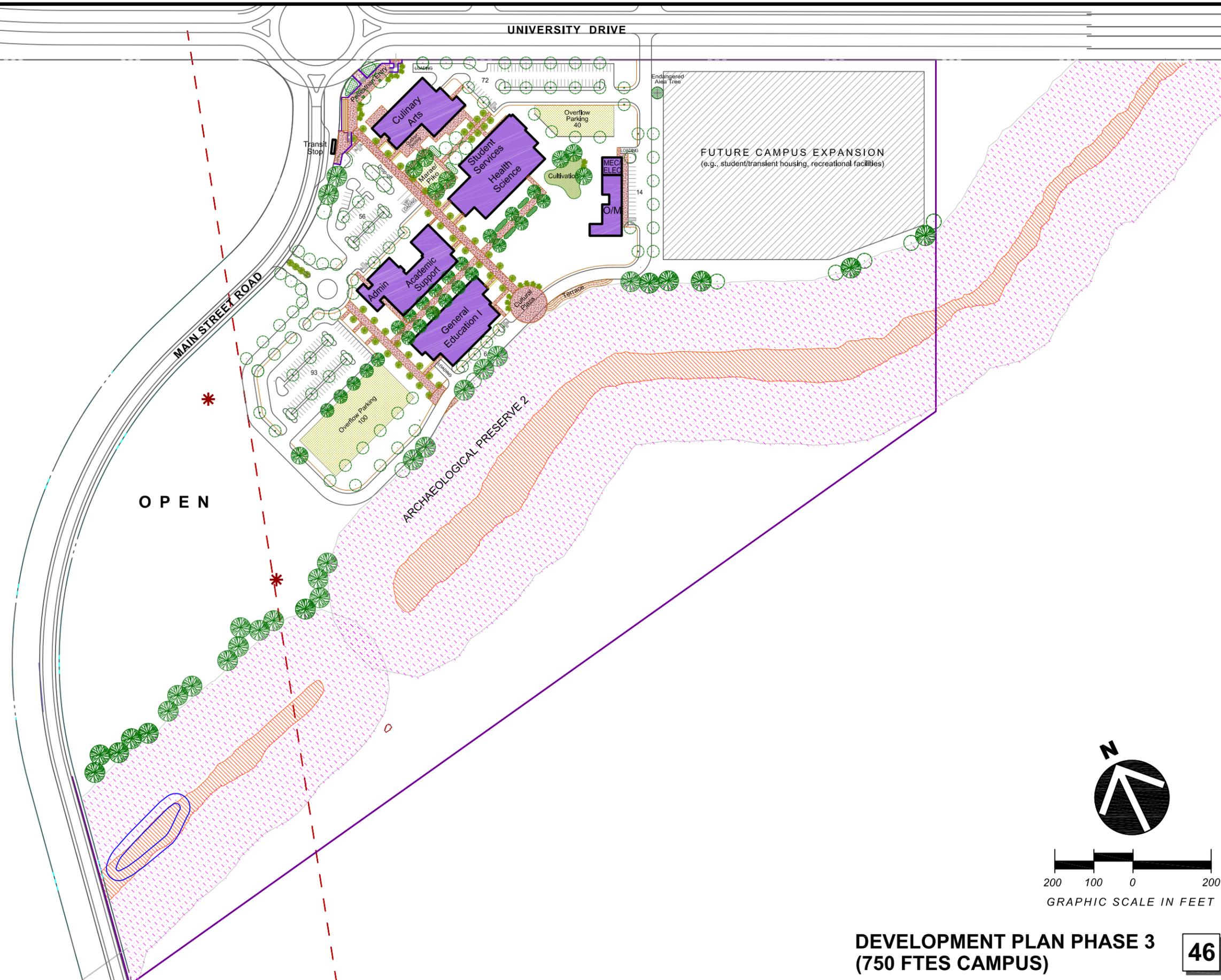
-  73-Acre UH Subdivision
-  750 FTES Campus Building
-  Lava Tube Boundary
-  50-Meter Buffer Area
-  Archaeological Site
-  Boundary Line Between The Agriculture (A-5a) and Open Zones



**This Page is Intentionally Blank**

**LEGEND**

-  73-Acre UH Subdivision
-  750 FTES Campus Building
-  Lava Tube Boundary
-  50-Meter Buffer Area
-  Archaeological Site
-  Boundary Line Between The Agriculture (A-5a) and Open Zones

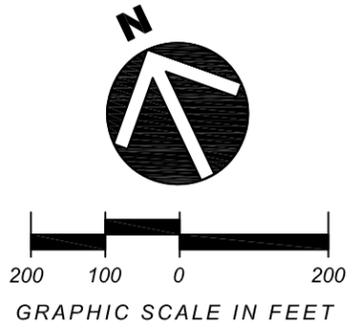
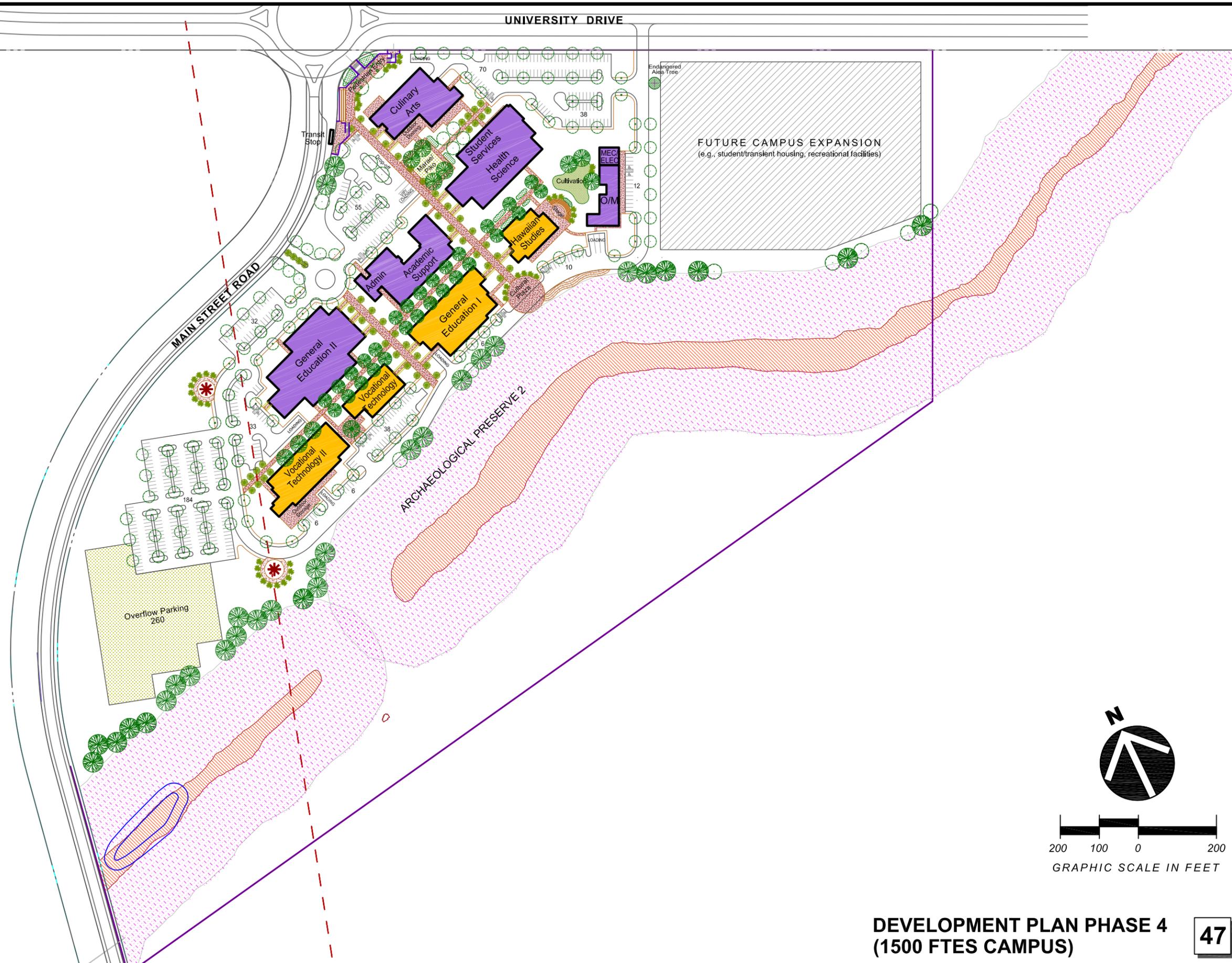


**DEVELOPMENT PLAN PHASE 3  
(750 FTES CAMPUS)**

**This Page is Intentionally Blank**

**LEGEND**

-  73-Acre UH Subdivision
-  750 FTES Campus Building
-  1,500 FTES Campus Building
-  Lava Tube Boundary
-  50-Meter Buffer Area
-  Archaeological Site
-  Boundary Line Between The Agriculture (A-5a) and Open Zones



**DEVELOPMENT PLAN PHASE 4  
(1500 FTES CAMPUS)**

**This Page is Intentionally Blank**

## 10.2 SPACE ALLOCATION

The following space allocation table (Table 11) is derived from the Ed Specs for the UHCWH (as summarized in Section 3.1 of this document), building design, and various criteria developed during the planning process for the UHCWH. The ASF and GSF in Table 11 reflect the square footages represented in Section 3.0 Program Requirements and Section 7.0 Ultimate Plans. The purpose of this section is to present specific space allocation and distribution data to aid in the implementation of the LRDP. The proposed arrangements are tentative and subject to change based on facility needs at the time each phase of the project is implemented.

Table 11 provides a breakdown of the ASF and GSF of the nine (9) buildings that will be constructed within the four-phase timeline (as described in Section 10.1 of this document). The table also indicates the suggested number of stories for each building and whether or not air-conditioning is recommended. Projects are ranked in the proposed order of implementation according to the phasing plan described in section 10.1.

**Table 11: Space Allocation (based on 1,500 FTES)**

Phase	Building	ASF	GSF	Stories	Air-Conditioned
1	Culinary Arts	12,709	17,792	1	Yes
	Health Science & Student Services (Upper Section)	6,115	8,562	1	Yes
2	Health Science & Student Services (Completed)	8,574	12,004	1	Yes
3	Admin & Academic Support	18,906	26,468	1	Yes
	General Education I	16,419	22,987	1	Yes
	O & M	7,590	10,626	1	Partial
4	General Education II	17,580	24,612	1	Yes
	Vocational Technology I	6,632	9,285	1	Yes
	Vocational Technology II	16,226	22,716	1	Yes
	Hawaiian Studies	7,688	10,763	1	Yes
<b>TOTAL*</b>		<b>118,439</b>	<b>165,815</b>		

\*The table reflects the square footage developed in each respective phase. ASF and GSF in this table are derived from the floor plans developed and shown on the Ultimate Site Plan and not the Ed Specs.

## 10.3 IMPLEMENTATION

Ideally it would be desirable to build the UHCWH in the shortest time possible, in one (1) phase. Budgetary constraints require that the long-range development plan be implemented in increments over several years.

To allow the most flexibility for the UHCWH in determining actual increments and scheduling, a ranking of project implementation was derived and is presented in Table 11, *Space Allocation*. In addition to funding, decisions on implementation will be influenced by the actual growth of student enrollment. The LRDP predicts that with the completion of the Phase 3 enrollment capacity

## 10 Implementation and Transition Plan

---

will be 750 FTES. Likewise, the completion of the Phase 4 will bring the enrollment capacity to 1,500 FTES or a head count of approximately 3,000 students.

### 10.4 TRANSITION PLAN

The preceding chapters of this LRDP describe how the ideal or ultimate scenario for physical facilities (for a maximum of 1,500 FTES) evolved during the course of the planning effort. The Ultimate Plan was then divided into four (4) phases for ease of implementation, as described in Sections 10.1 through 10.3. This section discusses how existing facilities and programs located in Kealahou will be moved or transitioned into the Phase 1 development at the new University site (see Figure 48, *Transition Site Plan*).

The UHCWH leases several spaces within the Kealahou Business Plaza—an existing commercial mall complex (See Figure 49, *Existing Center at Kealahou*). The facilities include classrooms, administration and faculty offices, a learning center, library, computer laboratory, bookstore, storage area and parking. The total area leased for educational purposes is approximately 14,400 square feet. The UHCWH currently offers several degree and certificate programs through HawCC, UH Hilo, and UH Manoa. Classes are taught by professors on-site or via distance education technology such as the Internet or HITS. Classes are conducted weekdays, evenings and on weekends.

There are several concerns associated with the existing facilities at Kealahou:

- The location of the facilities is not centralized;
- The present site does not offer the proper image for an institution of higher education;
- The existing space is under-sized, especially the classrooms, and there is a lack of space for meetings and support activities;
- The classrooms are not sound-proof (i.e. some classroom doors cannot be closed during use); and
- Lease rent is being paid because the land is not state owned.

All of these concerns will be mitigated in the transfer to the new Phase I facilities at Kalaoa.

During discussions on phasing for the LRDP, the UHCWH and HawCC administration decided that the transition buildings (the Culinary Arts building and part of the Health Science/Student Services building) should be built in Phase I. Since the programmed area (as formulated in the Ed Specs) for the new Phase I facilities is more than the existing square footage at Kealahou, the transition should accommodate all of the existing UHCWH programs and facilities, as well as provide some room for expansion. During the transition phases, however, the Phase I buildings will initially contain a variety of uses that are not programmed for these buildings in the long-term. See Figures 50, 51, and 52 for plans, sections, and elevations of the transition buildings.

The HawCC and the UHCWH administration have been working with the design architects to decide exactly how the Phase I buildings will be utilized to effect a smooth transition from Kealahou to the new University site. The facility programming proposed in this chapter will accommodate only the transition from Kealahou to the new University site. It is presumed that when permanent facilities are built in subsequent development phases, the initial transition spaces will convert to their long-term usage as programmed in the Ed Specs. These transition spaces are

being designed such that little or no renovation costs would be incurred when it converts to its intended long-term usage.

# 10 Implementation and Transition Plan

---

**This Page is Intentionally Blank**



1 SITE PLAN - PHASE 1



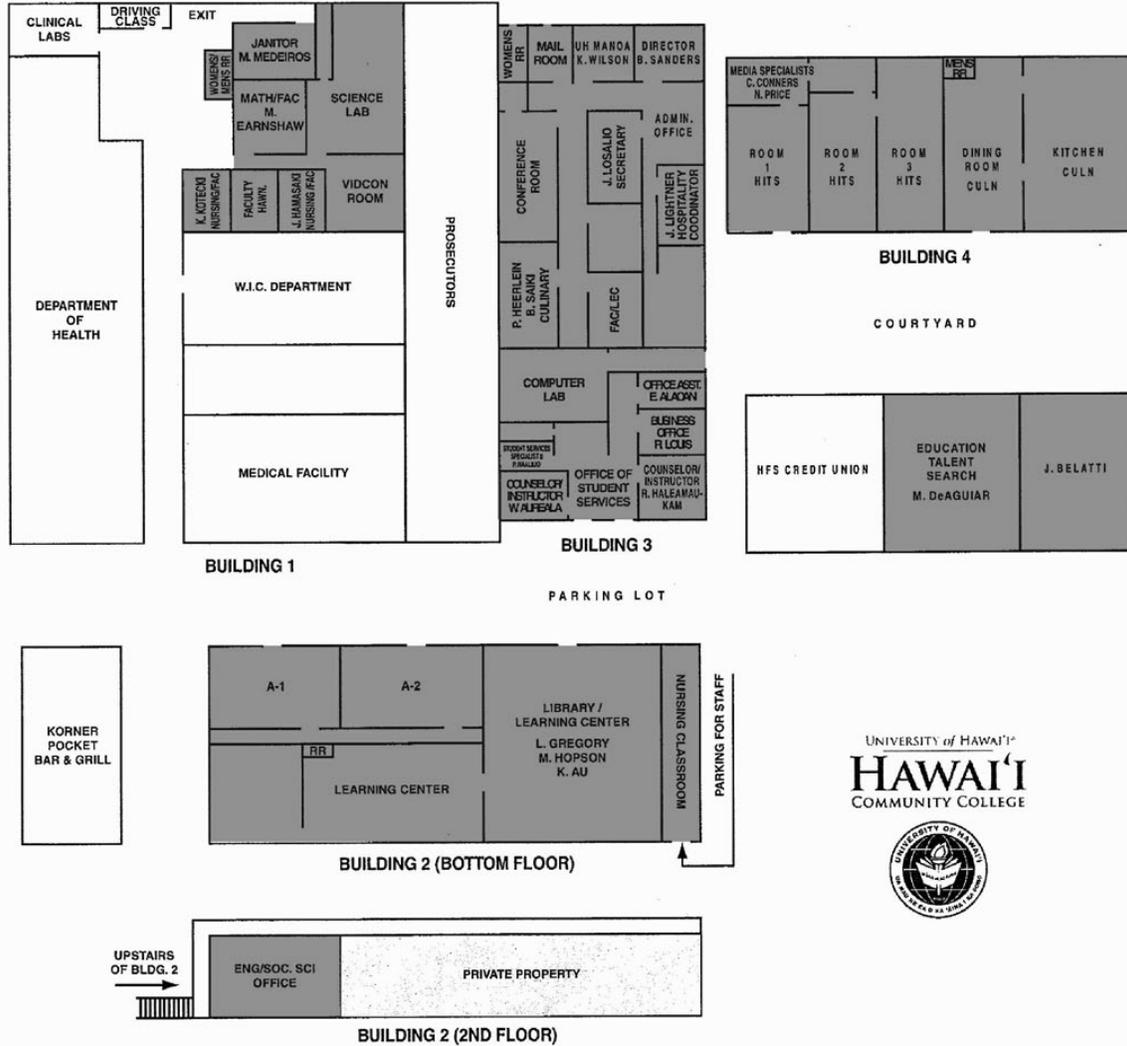
TRANSITION SITE PLAN

48

**This Page is Intentionally Blank**

## University of Hawai'i Center at West Hawai'i

81-964 Haleki'i St. • Kealakekua, Hawai'i 96750  
(808) 322-4850



UNIVERSITY of HAWAII  
**HAWAII**  
COMMUNITY COLLEGE



# 10 Implementation and Transition Plan

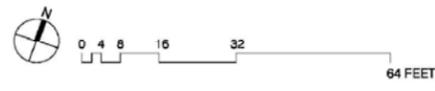
---

**This Page is Intentionally Blank**



**LEGEND**

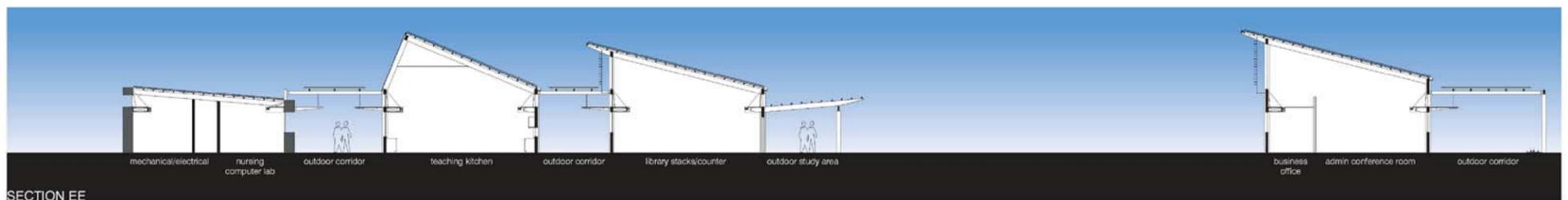
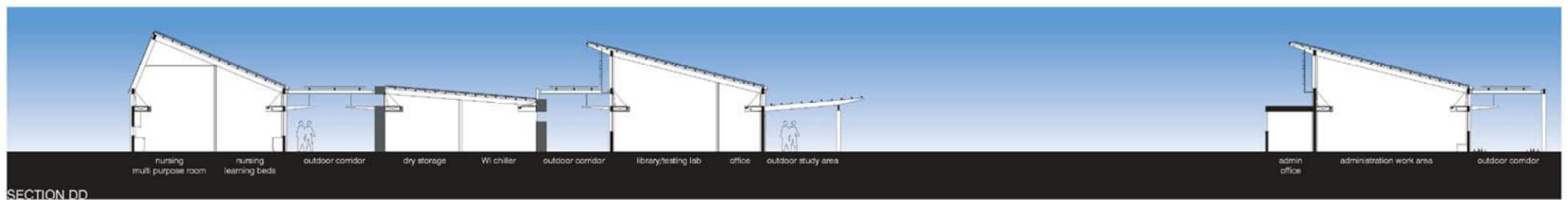
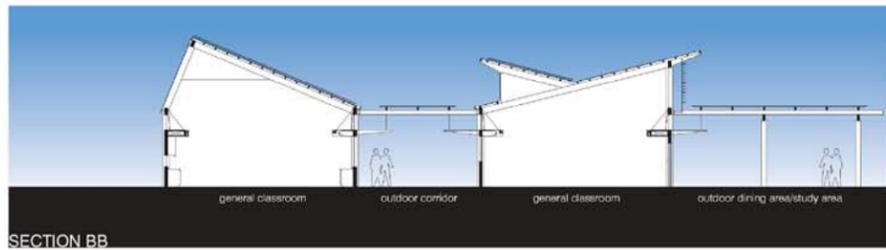
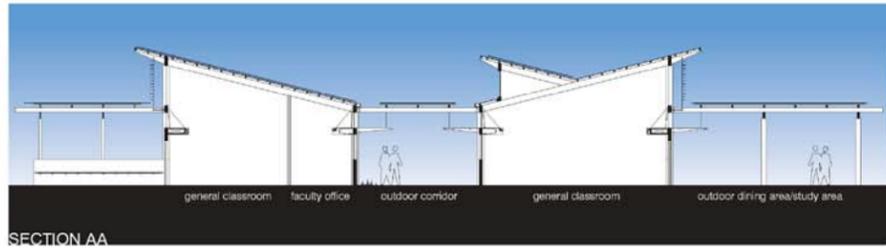
<span style="display:inline-block; width:15px; height:10px; background-color: #FFC0CB; border: 1px solid black;"></span>	GENERAL EDUCATION
<span style="display:inline-block; width:15px; height:10px; background-color: #CCCCFF; border: 1px solid black;"></span>	NURSING SKILLS
<span style="display:inline-block; width:15px; height:10px; background-color: #ADD8E6; border: 1px solid black;"></span>	CULINARY ARTS
<span style="display:inline-block; width:15px; height:10px; background-color: #FFDAB9; border: 1px solid black;"></span>	LIBRARY/LEARNING CENTER
<span style="display:inline-block; width:15px; height:10px; background-color: #90EE90; border: 1px solid black;"></span>	STUDENT SERVICES
<span style="display:inline-block; width:15px; height:10px; background-color: #228B22; border: 1px solid black;"></span>	ADMINISTRATION
<span style="display:inline-block; width:15px; height:10px; background-color: #8B4513; border: 1px solid black;"></span>	BUSINESS
<span style="display:inline-block; width:15px; height:10px; background-color: #FFFF00; border: 1px solid black;"></span>	TALENT SEARCH
<span style="display:inline-block; width:15px; height:10px; background-color: #FFFFFF; border: 1px solid black;"></span>	UTILITY/SUPPORT



1 FLOOR PLAN

**TRANSITION PLAN**

**This Page is Intentionally Blank**



**This Page is Intentionally Blank**



1 WEST ELEVATION



2 EAST ELEVATION



3 NORTH ELEVATION



4 SOUTH ELEVATION @ CULINARY ARTS BUILDING



5 SOUTH ELEVATION @ STUDENT SERVICES BUILDING



TRANSITION ELEVATION

**This Page is Intentionally Blank**

**11.0**

---

**Cost Estimate**



A construction cost estimate (see Table 12 below) was derived based on the ultimate plans. The estimate is separated into the four (4) development phases described in Chapter 10. The cost estimate indicates the total cost magnitude of the UHCWH campus as proposed in this LRDP. These figures will be used by the OCI for phasing and implementation purposes during the actual design and construction of the UHCWH.

The probable construction costs expressed in the estimate are based on historic records of educational facilities designed and recently built in Hawai'i. The costs are based on June, 2009, dollars and include no escalation for inflation. The building areas in square feet were derived from the Ed Specs prepared for the UHCWH and includes a 40 percent factor for circulation and utilities. Actual costs after the design is completed may vary from these initial opinions.

The costs do not include permit, development and legal fees, costs for utility hookups and development of off-site utilities, land acquisition, and architectural and engineering design fees. A 15 percent contingency has been added to cover unforeseen conditions during the construction. This estimate is not intended to cover post contract changes.

Table 12. Construction Cost Estimate

Item	Phase 1		Phase 2	Phase 3	Phase 4	Total
	Phase 1A Food Services Bldg	Phase 1B Health Sciences Bldg (upper sect.)	Phase 1 + Health Sciences Bldg (lower sect.)	Phase 2 + Gen Ed & Academic Support	1500 FTES Campus Ultimate Site Plan	
<b>BUILDINGS</b>						
Culinary Arts	5,087,676		--	--	--	5,087,676
Health Science	--	2,540,024	4,957,300	--	--	7,497,324
Academic Support	--	--	--	7,446,000	--	7,446,000
General Ed II	--	--	--	5,957,000	--	5,957,000
General Ed I	--	--	--	--	8,616,000	8,616,000
Vocational Tech I	--	--	--	--	2,656,000	2,656,000
Vocational Tech II	--	--	--	--	6,217,000	6,217,000
Hawaiian Studies	--	--	--	--	2,592,000	2,592,000
Electric Substation	--	--	--	400,000	--	400,000
Operations & Maintenance	--	--	--	--	2,478,000	2,478,000
<i>Subtotal, Buildings</i>	5,087,676	2,540,024	4,957,300	13,803,000	22,559,000	48,947,000
<i>Contingency (15%)</i>	76,3151	381,004	743,595	2,070,450	3,383,850	7,342,050
<i>Total, Buildings</i>	5,850,827	2,921,028	5,700,895	15,873,450	25,942,850	56,289,050

# 11 Cost Estimate

**Table 12. Construction Cost Estimate (cont.)**

Item	Phase 1		Phase 2	Phase 3	Phase 4	Total
	Phase 1A Food Services Bldg	Phase 1B Health Sciences Bldg (upper sect.)	Phase 1 + Health Sciences Bldg (lower sect.)	Phase 2 + Gen Ed & Academic Support	1,500 FTES Campus Ultimate Site Plan	
<b>EXTERIOR (ON -SITE) IMPROVEMENTS</b>						
Site Grading	114,457	57,143	72,000	496,000	225,600	965,200
Cut & Fill	321,894	160,706	190,400	1,197,800	219,300	2,090,100
Parking	295,114	147,336	204,950	767,300	902,300	2,317,000
Internal Roads	117,559	58,691	--	854,800	184,650	1,215,700
Drainage System	100,050	49,950	--	250,000	200,000	600,000
Water Distribution	161,774	80,766	--	549,400	180,060	972,000
Wastewater System	78,239	39,061	22,700	47,150	--	187,150
Energy Management & Control	333,500	166,500	150,000	300,000	550,000	1,500,000
Archaeological Preservation	166,750	83,250	--	--	100,000	350,000
Landscape	400,200	199,800	150,000	500,000	800,000	2,050,000
Hardscape	200,100	99,900	50,000	150,000	250,000	750,000
Electrical Distribution	707,219	353,079	a	1,725,265	1,362,210	4,147,700
<i>Subtotal, Exterior Improvements</i>	<i>2,996,856</i>	<i>1,496,182</i>	<i>840,050</i>	<i>6,837,715</i>	<i>4,974,120</i>	<i>17,144,923</i>
<i>Contingency (15%)</i>	<i>449,528</i>	<i>224,427</i>	<i>126,008</i>	<i>1,025,657</i>	<i>746,118</i>	<i>2,571,738</i>
<i>Total, Exterior Improvements</i>	<i>3,446,384</i>	<i>1,720,609</i>	<i>966,058</i>	<i>7,863,372</i>	<i>5,720,238</i>	<i>19,716,661</i>
<b>Buildings Total</b>	<b>5,850,827</b>	<b>2,921,028</b>	<b>5,700,895</b>	<b>15,873,450</b>	<b>25,942,850</b>	<b>56,289,050</b>
<b>Exterior Improvements Total</b>	<b>3,446,384</b>	<b>1,720,609</b>	<b>966,058</b>	<b>7,863,372</b>	<b>5,720,238</b>	<b>19,716,661</b>
<b>Total Probable Cost</b>	<b>9,297,211</b>	<b>4,641,637</b>	<b>6,666,953</b>	<b>23,736,822</b>	<b>31,663,088</b>	<b>76,005,711</b>
<b>PROVISIONAL ITEMS</b>						
Outdoor Amphitheatre	--	--	--	--	--	1,000,000
Archaeological Study Areas	--	--	--	--	--	250,000

<sup>a</sup> Electrical infrastructure for Phase 2 will be constructed in Phase 1.

A summary of the estimated total cost for each phase is shown below in Table 13. Design costs were based on DAGS compensation curves for design services. Total design costs are \$4,169,000, of which \$2,454,000 is unfunded. The unfunded amount reflects the design costs above the amount allocated for design under Hawai'i Campus Developer's current contract with UH, which includes updating this LRDP and designing the first three (3) state-funded buildings of

the new UHCWH and the Palamanui-funded building.<sup>70</sup> Construction costs vary widely and are influenced by a number of factors. The costs shown are initial estimates and are subject to change.

**Table 13. Estimated Cost Summary**

	Phase 1		Phase 2	Phase 3	Phase 4
	Phase IA Culinary Arts bldg.	Phase IB Health Science/Student Services bldg. (upper section)	Health Science/Student Services bldg. (completed)	Academic Support and Gen Ed II bldgs.	1,500 FTES Campus
Building Cost	5,850,827	2,921,028	5,700,895	15,873,450	25,942,850
Infrastructure Cost	3,446,384	1,720,609	966,058	7,863,372	5,720,238
<b>Total Construction Cost</b>	<b>9,297,211</b>	<b>4,641,637</b>	<b>6,666,953</b>	<b>23,736,822</b>	<b>31,663,088</b>
Design Cost	383,525	191,475	440,000	854,000	2,300,000
<b>Total Cost</b>	<b>9,680,736</b>	<b>4,833,112</b>	<b>7,106,953</b>	<b>24,590,822</b>	<b>33,963,088</b>
<b>Cumulative Total</b>	<b>9,680,736</b>	<b>14,513,848</b>	<b>21,620,801</b>	<b>46,211,623</b>	<b>80,174,711</b>

It should be noted that a study entitled, “Economic Impact Study for University of Hawaii Center West Hawaii,”<sup>71</sup> was written to support an SEIS being prepared in conjunction with this LRDP update. The economic impact study concludes that construction of an expanded, full-service UH Center at Kalaoa is likely to substantially benefit the economy.

The project will raise productivity of the workforce and enable the supply of critical skills required by private companies, non-profits and government to deliver innovative goods and services. These would include healthcare, education and social services which are currently not available or in short-supply. In the long-run the proposed UH Center in Kalaoa would generate employment, household income and tax revenue and would have an operational impact of increased state expenditures on education and training. In the short-term during construction of the new campus, similar positive economic impacts would be derived. Therefore, the cost of developing the UH Center for West Hawai‘i should be weighed against these positive economic impacts.

Because the economic impact study was prepared before site planning and preliminary building design were completed, the construction cost estimates presented in the study were more conservative and considerably higher than in this LRDP Update. The construction costs presented in this chapter are more accurate and based on more recent information than the economic impact study.

<sup>70</sup> The first UHCWH building (Culinary Arts) is to be designed and constructed (up to \$5,000,000) by Palamanui, LLC per the conditions of their rezoning. This first building, plus the subsequent three (3) state-funded buildings comprise the 750 FTES campus (development phases 1 through 3).

<sup>71</sup> Lucas, 2009.

**This Page is Intentionally Blank**

**12.0**

---

**References**



- AECOS Consultants. 2000. *Faunal Survey of Terrestrial Species within the Proposed University of Hawai'i Center at West Hawai'i Site, North Kona, Hawai'i*. May.
- AECOS Consultants. 2005. *Biological Surveys for the University of Hawaii Center at West Hawaii (UHCWH) Main Street Collector Road, North Kona District, Island of Hawaii*. August.
- AECOS Consultants. 2009. *Biological Surveys for the University of Hawaii Center at West Hawaii (UHCWH), North Kona District, Island of Hawai'i*. July.
- Armstrong, R.W. (ed.). 1983. *Atlas of Hawai'i, Second Edition*.
- B.D. Neal & Associates. 1990. *Air Quality Study for the Proposed O'oma Project, North Kona, Hawai'i*. November. (As referenced in Helber Hastert & Fee, Planners, 1993.)
- Belt Collins Hawai'i, Ltd. 2005. *Hawaii Electric Light Company, Inc. Keahole Generating Station and Airport Substation Urban Reclassification*. January.
- Bruner, Philip L. 1992. *Survey of the Avifauna and Feral Mammals on State-Owned Lands in the Kailua to Keahole Region, North Kona, Hawai'i*. October. (As referenced in Helber Hastert & Fee, Planners, 1993.)
- Char Associates. 1992. *Botanical Survey: West Hawai'i Boundary Review, Kailua to Keahole Region, North Kona, Hawai'i*. September. (As referenced in Helber Hastert & Fee, Planners, 1993.)
- CH2M Hill. 1992. *Draft Environmental Impact Statement: Keahole Generating Station Expansion, North Kona, Hawai'i*. December. (As referenced in Helber Hastert & Fee, Planners, 1993.)
- Cleghorn, Paul L., Ph.D. & Pacific Legacy, Inc. 1998. *Archaeological Investigations for the Proposed University Center at West Hawai'i, North Kona, Hawai'i Island*. May. October.
- Cleghorn, Paul L., Ph.D. & Pacific Legacy, Inc. 2000. *Conceptual Historic Preservation Plan for the Proposed University Center at West Hawai'i, North Kona, Hawai'i Island*. July.
- County of Hawai'i. 2005. *County of Hawai'i General Plan*. February.
- County of Hawai'i. 2009. *County of Hawai'i Integrated Solid Waste Management Plan Update: The Path to Zero Waste (State Review Draft)*. August.
- County of Hawai'i Ordinance No. 06 105. An Ordinance Amending Section 25-8-3 (North Kona Zone Map), Article 8, Chapter 25 (Zoning Code) of the Hawai'i County Code 1983 (2005 Edition), by Changing the District Classification from Agricultural (A-3A) and Open to Project District (PD) at Kau, North Kona, Hawai'i, Covered by Tax map Key 7-2-5:1. Approved July 17, 2006.

## 12 References

---

- David, Reginald E. & E. B. Guinther. 2000. *Faunal Survey of Terrestrial Species within the Proposed University of Hawai'i Center at West Hawai'i Site, North Kona, Hawai'i*. April.
- Department of Business, Economic Development & Tourism, State of Hawaii. 1998. *Fifth Annual Report for LUC Docket No. BR92-685 Office of State Planning/Keahole to Kailua State Lands*. December 31.
- Department of Land and Natural Resources, State of Hawaii. 1993. *Memorandum of Understanding (MOU) for State Water Development and Water System Improvements to Support State Projects, North Kona, Hawaii*.
- DPD Associates. 1992. *University of Hawaii at Hilo, West Hawaii Campus Site Assessment*.
- Fukunaga & Associates, Inc. 1994. *North Kona Water Master Plan (Draft Report)*. November.
- Gagne, W.C. & L.W. Cuddihy. 1990. Vegetation, pp. 45-114 in: W.L. Wagner, D.R. Herbst, and S.H. Sohmer. *Manual of the Flowering Plants of Hawai'i*. Honolulu, HI: University of Hawai'i Press and Bishop Museum Press. Bishop Museum Special Publication 83. (Cited in Herbst, 1998).
- Garcia, Michael. 2004. *Volcanic Hazards at the HELCO Generating Station, North Kona, Hawaii*. Volcano, HI: Geohazards Consultants International, Inc.
- Geolabs-Hawaii. 1998. *Preliminary Geotechnical Engineering Exploration: Proposed University of Hawai'i Center at West Hawai'i, Hawai'i Community College, Long-Range Development Plan, Kalaoa, North Kona, Hawai'i*. June 9.
- Group 70 International, Inc. 2004. *Final Environmental Impact Statement for Palamanui, A Project by Hiluhilu Development, North Kona, Hawaii Tax Map Key: 3-7-2-05:01*. September.
- Hawaii Campus Developers. 2008. *Update 1998 Educational Specifications, Final Report*. September 30.
- Helber Hastert & Fee, Planners. 1993. *Final Environmental Impact Statement: Urban Expansion of State Lands, Keahole to Kailua Region, North Kona, Hawai'i*. July.
- Heliker, C.C. 1990. *Volcanic and Seismic Hazards on the Island of Hawai'i*.
- Herbst, Derral R., Ph.D. 1998. *Botanical Survey for the University of Hawai'i Center at West Hawai'i (UHCWH), Hawai'i Community College Long Range Development Plan (LRDP), Island of Hawai'i, Hawai'i*. March 27.
- Juvik & Juvik. 1998. *Atlas of Hawai'i. Third Edition*. Honolulu, HI: University of Hawai'i Press.
- KPMG Peat Marwick. 1987. *Noise Compatibility Program, Keahole Airport, Hawai'i*. November. (As cited in Helber Hastert & Fee, Planners, 1993.)

- Lucas, Robert L. 2009. *Economic Impact Study for the University of Hawaii Center West Hawaii*. April.
- National Weather Service, Pacific Region, 1982. "Average Annual Rainfall" (in Armstrong, 1983).
- Pacific Legacy, Inc. 2008. *Cultural Resource Identification and Mapping at the University of Hawai'i Center – West Hawai'i, District of North Kona, Island of Hawai'i*. December.
- Paul H. Rosendahl, Ph.D., Inc. 1993. *Archaeological Inventory Survey, Kailua to Keahole Region States Lands, LUC Project-500-Acre University Site*. July.
- Soil Conservation Service (SCS), U.S. Department of Agriculture. 1973. *Soil Survey of Island of Hawai'i, State of Hawai'i*. Washington D.C.: Government Printing Office.
- Turner Green Buildings. n.d. *2005 Survey of Green Buildings Plus Green Building in K - 12 and Higher Education*.
- U.S. Green Building Council. 2003. *Building Momentum: National Trends and Prospects for High Performance Green Buildings*. Prepared for the U.S. Senate Committee on Environment and Public Works. February.
- U.S. Green Building Council. 2006. *New Construction Version 2.2 Reference Guide (3<sup>rd</sup> ed.)*. Washington DC: U.S. Green Building Council.
- U.S. Green Building Council. 2008. "What LEED is." <http://www.usgbc.org/>.
- University of Hawai'i. 1997. "Interim Operational Roles and Responsibilities for University Centers and Originating Campuses." June 19.
- University of Hawai'i, Hawai'i Community College. 1997. *University of Hawai'i Center: West Hawai'i Development Plan, 1998-2007*. September.
- Waimea Water Services, Inc. 2003, June. *Groundwater Resources of Kau, North Kona, Hawaii. A Water Study for Hiluhilu Development, LLC*.
- Wil Chee - Planning, Inc. 1998. *University of Hawai'i Center at West Hawai'i: Educational Specifications*. July.
- Wilson Okamoto Corporation. 2008. *Mapping Kona's Future, Kona Community Development Plan, Volumes 1 and 2*. Prepared for the County of Hawai'i Planning Department. September.
- Wyss and Koyonagi. 2006. *2006 Kiholo Bay, Hawaii Earthquake, a RMS Event Report*.
- Y. Ebisu & Associates. 2005. *Acoustic Study for the Proposed Main Street Collector Road*. June

## 12 References

---

**This Page is Intentionally Blank**

**13.0**

---

**List of Preparers**



---

<b>Company Name</b>	<b>Area of Responsibility</b>
Hawai'i Campus Developers	Educational Specifications Project Management Cost Estimating
Wil Chee - Planning & Environmental	Master Planning Landscape Design Supplemental EIS
Urban Works	Architecture
Pacific Legacy, Inc.	Archaeology Burial Treatment Plan
AECOS, Inc.	Biology
R.M. Towill Corp.	Civil Engineering
Electech Hawaii, Inc.	Electrical Engineering and Communications Systems
Notkin Hawaii, Inc.	Mechanical Engineering

## 13 List of Preparers

---

**This Page is Intentionally Blank**

**14.0**

---

**Glossary of Acronyms**



°F	degrees Fahrenheit
AAQS	Ambient Air Quality Standard
ADAAG	Americans with Disabilities Act Accessibility Guidelines
ALISH	Agricultural Lands of Importance in the State of Hawai'i
ASF	assignable/assigned square feet
ASHRAE	American Society of Heating Refrigerating and Air Conditioning Engineers
BAS	building automation system
BOR	Board of Regents
BTP	Burial Treatment Plan
CATV	cable television
cfm	cubic feet per minute
CO <sub>2</sub>	carbon dioxide
DAGS	(State of Hawai'i) Department of Accounting and General Services
dBA	decibels A-weighted
DDC	direct digital control
DHHL	(State of Hawai'i) Department of Hawaiian Home Lands
DLNR	(State of Hawai'i) Department of Land and Natural Resources
DOH	(State of Hawai'i) Department of Health
DOSH	(State of Hawai'i) Department of Occupational Safety and Health
DOT	(State of Hawai'i) Department of Transportation
DWS	(County of Hawai'i) Department of Water Supply
EA	Environmental Assessment
2008 Ed Specs	Update 1998 Educational Specifications: Final Report (Hawai'i Campus Developers, 2008)
EIS	Environmental Impact Statement
ESA	Endangered Species Act
FCU	fan-coil unit
FHWA	(U.S.) Federal Highways Administration
FTES	Full-time Equivalent Students
FWS	(U.S.) Fish and Wildlife Service
gpd	gallons per day
gpm	gallons per minute
GSF	gross square footage
HawCC	Hawai'i Community College
HELCO	Hawai'i Electric Light Company
HIOSH	Hawai'i Occupational Safety and Health Division
HITS	Hawai'i Interactive Television System
HPP	Historic Preservation Plan
HRS	Hawai'i Revised Statutes
HVAC	Heating Ventilation Air Conditioning
K to K Plan	Keahole to Kailua Development Plan

## 14 Glossary of Acronyms

---

KCDP	Kona Community Development Plan
kV	kilovolt
kVA	kilovolt amps
Ldn	Day-night Average Sound Level in dBA
LEED™	Leadership in Energy and Environmental Design
LRDP	Long Range Development Plan
LUC	(State of Hawai'i) Land Use Commission
MOU	Memorandum of Understanding
msl	mean sea level
NC	Noise Control
NOAA	(U.S. Department of Commerce) National Oceanic and Atmospheric Administration
O & M	operations and maintenance
OCI	University of Hawai'i Office of Capital Improvements
OEQC	Office of Environmental Quality Control
OSP	(State of Hawai'i) Office of State Planning
PCU	pre-cooled handling units
PHRI	Paul H. Rosendahl, Ph.D., Inc.
Project area	500-acre parcel selected in 1991 for University use
Project site	73-acre subdivision within the 500-acre parcel
ppv	public-private venture
psi	pounds per square inch
PVC	polyvinyl chloride
SEIS	Supplemental Environmental Impact Statement
sf	square foot
SHPD	(State of Hawai'i) State Historic Preservation Division
TIAR	Traffic Impact Assessment Report
TMK	Tax Map Key
TND	Traditional Neighborhood Development
TOD	Transit-oriented Development
UH	University of Hawai'i
UH Hilo	University of Hawai'i at Hilo
UHCWH	University of Hawai'i Center at West Hawai'i
UIC	Underground Injection Control
USGBC	U.S. Green Building Council
VRV	variable refrigerant volume
WWTP	wastewater treatment plant

Appendix A  
Archaeological Report

---

Pacific  
Legacy

Incorporated

CULTURAL  
RESOURCES  
CONSULTANTS

CULTURAL RESOURCE  
IDENTIFICATION AND MAPPING  
AT THE  
UNIVERSITY OF HAWAI'I CENTER -  
WEST HAWAI'I,  
DISTRICT OF NORTH KONA  
ISLAND OF HAWAI'I



*Pacific Legacy: Exploring the past, informing the present, enriching the future.*

Hawai'i Offices:  
Kailua, O'ahu  
Wailuku, Maui  
Hilo, Hawai'i

California Offices:  
Santa Cruz  
Berkeley  
Cameron Park  
Chico

CULTURAL RESOURCE  
IDENTIFICATION AND MAPPING  
AT THE  
UNIVERSITY OF HAWAI'I CENTER - WEST HAWAI'I,  
DISTRICT OF NORTH KONA  
ISLAND OF HAWAI'I

*Prepared by:*  
Rowland B. Reeve, M.A.  
and  
Paul L. Cleghorn, Ph.D.  
Pacific Legacy, Inc.

30 Aulike Street, Suite 301  
Kailua, HI 96734  
(808) 263-4800

*Prepared for:*  
Wil Chee Planning & Environmental  
1018 Palm Drive  
Honolulu, HI 96814

December 2008

## ABSTRACT

At the request of Wil Chee-Planning and Environmental, Inc., Pacific Legacy, Inc. conducted archaeological mapping of sites within the newly designated 133 acre University of Hawai'i Center at West Hawai'i project area. The planned University development is located within portions of the seven *ahupua'a* of Maka'ula, Hale'ohi'u, Hamanamana, and Kalaoa 1-4 in the district of North Kona on the leeward side of the island of Hawai'i. The project area is part of a larger parcel that had been the subject of a previous archaeological survey. Pacific Legacy was tasked with determining the extent of archaeological Preserve 2, a lava tube complex that stretches across the project area from southwest to northeast, and recording its location using a geographic positioning system (GPS). Identifying the limits of the tube complex will make it possible to establish appropriate protective buffers around it during campus construction. The positions of a number of other previously identified sites situated within the 133 acre property were also recorded using the GPS.

A total of 16 separate openings were identified along the length of the Preserve 2 lava tube system. These took the form of either skylight openings in the roof of surviving sections of subsurface tubes, or linear depressions formed by the collapse of a section of tube roof. Many of the openings and intact tube sections had previously been found to contain archaeological features, and four separate site numbers had been assigned to different sections of the tube complex.

Evidence of recent damage to the Preserve area was also discovered and documented. A backhoe or some other form of earth moving equipment had been used to break up the *pahoehoe* lava around some of the tube openings. This was most probably done to obtain stone slabs for use in the construction of rock walls. At one opening (Opening #6), the entrance to a subterranean chamber containing several archaeological features, among them a possible ceremonial structure, had been filled in with rubble, sealing up access to the chamber. This damage is relatively recent and similar bulldozing is actively taking place within an adjacent property. There is a strong likelihood that further damage may occur to the tube complex and its associated sites, particularly to petroglyphs carved into the *pahoehoe* slabs that edge the lava tube openings.

The Appendices at the end of this report contain descriptions, measurements, photographs and GPS coordinates for the 16 openings of the Preserve 2 lava tube. They also contain a descriptive list and GPS coordinates for the seven other sites relocated during the present survey, as well as a single newly discovered site. These appendices should be detached prior to the distribution of this report to the general public.



## TABLE OF CONTENTS

1.0 INTRODUCTION.....	1
2.0 PROJECT BACKGROUND .....	3
2.1 Location and Environmental Setting.....	3
2.2 Previous Archaeological Research.....	3
2.1 Archaeological Preserve 2.....	8
3.0 FIELD INVESTIGATIONS.....	11
4.0 FINDINGS .....	12
4.1 Sites 50-10-28-26454 and 50-10-28-15302.....	12
4.1.1 Recent Damage at Site 50-10-28-15302 .....	1
4.2 Site 50-10-28-15298 .....	3
4.3 Site 50-10-28-15266 .....	5
4.3 Sites Outside Preservation Area 2 .....	1
5.0 SUMMARY AND DISCUSSION .....	5
6.0 REFERENCES .....	6
APPENDIX A .....	7
APPENDIX B.....	41



**LIST OF FIGURES**

Figure 1. Location of the University of Hawai'i Center at West Hawai'i project area (base map from Google Earth). ..... 2

Figure 2. Location of the original and present U. of H. Center at West Hawai'i project areas..... 4

Figure 3. Locations of recommended archaeological preserves (after Cleghorn 1998:Figure 10). ..... 6

Figure 4. Location of archaeological sites and preserve areas (after Cleghorn 2000:Figure 3). ..... 7

Figure 5. University of Hawai'i Center at West Hawai'i project area (base map from Google Earth)..... 9

Figure 6. Lava tube openings within archaeological Preserve 2. .... 13

Figure 7. Lava tube openings in the western half of archaeological Preserve 2. .... 14

Figure 8. Skylight of Opening #1 (View Northeast). .... 2

Figure 9. Opening # 6 filled with bulldozed rubble (View West)..... 2

Figure 10. Lava tube openings in the eastern half of archaeological Preserve 2..... 7

Figure 11. Upper tube alignment as mapped during the present project..... 8

Figure 12. Lower tube alignment between Openings #8 and #12 (Head and Rosendahl 1993:Figure 6)..... 8

Figure 13. Archaeological site locations..... 3

Figure 14. Site 50-10-28-26700 (View West). .... 4

Figure 15. Site 50-10-28-26700 petroglyph image. .... 4

Figure 16. Opening #1 (View Northeast)..... 9

Figure 17. Petroglyph site 50-10-28-26454 near Opening #1 (View North). .... 9

Figure 18. Opening #2 (View Northwest). .... 11

Figure 19. Interior of lava tube connecting Openings #1 and #2 (View Northeast). .... 11

Figure 20. Opening #3 at west end of site 50- 10-28-15302 (View Northeast). .... 13

Figure 21. Western end of Opening #3 (View West). .... 13

Figure 22. West end of lava tube connecting Openings #3, #2 and #1 (View Southwest)..... 14

Figure 23. Bulldozing at west end of Opening #3 (View Southwest)..... 14

Figure 24. Opening #4 (View Southwest)..... 16

Figure 25. Opening #5 (View Southeast). .... 16

Figure 26. Bulldozing around entrance to Opening #6 (View East)..... 19

Figure 27. Former entrance to Opening #6 and east end of site 50-10-28-15302 (View West). .... 19

Figure 28. Opening #7 east end of site 50-10-28-15298 (View Northeast)..... 21

Figure 29. Opening #7 (View Southwest)..... 21

Figure 30. Opening #8 (View North)..... 23

Figure 31. Western end of Opening #8 (View Southwest)..... 23

Figure 32. Petroglyph near lip of Opening #8 (View Southwest). .... 24

Figure 33. Another petroglyph near Opening #8 (View Southwest)..... 24

Figure 34. Skylight to lower level tube at west end of Opening #8 (View South)..... 25

Figure 35. Entrance to lower level tube at east end of Opening #8 (View Northeast)..... 25

Figure 36. Opening #9 (View Southwest)..... 27

Figure 37. Skylight to lower tube in Opening #9 (View Southwest). .... 27

Figure 38. Opening #10 (View East)..... 29

Figure 39. Opening #11 (View Northeast)..... 31

Figure 40. Opening #12 (View West). .... 31

Figure 41. Opening #12 (View East)..... 33

Figure 42. Lower tube entrance at west end of Opening #12 (View West). .... 33

Figure 43. Skylight opening to lower tube at Opening #12 (View South). .... 34

Figure 44. Entrance to lower tube near the east end of Opening #12 (View East). .... 34

Figure 45. Opening #13 (View Southwest)..... 36

Figure 46. Opening #14 (View East)..... 36

Figure 47. Opening #15 showing arched passage into Opening #16 (View Northeast)..... 39

Figure 48. Opening #16 (View East)..... 39

Frontispiece: Newly discovered human figure petroglyph at site 50-10-28-26700 (View West).



## 1.0 INTRODUCTION

At the request of Wil Chee-Planning and Environmental, Inc., Pacific Legacy Inc. undertook to map the locations of archaeological sites and preservation areas situated within the c. 133 acre parcel chosen for the development of the University of Hawai'i Center at West Hawai'i (Figure 1). The project area includes portions of the seven *ahupua'a* of Maka'ula, Hale'ohi'u, Hamanamana, and Kalaoa 1-4 in the district of North Kona on the leeward side of the island of Hawai'i. In order to design the placement of campus structures, Wil Chee Planning needed to know the exact location of Preservation Area 2, an extensive lava tube complex containing numerous archaeological features (including human burials and possible ceremonial areas). The planners were also interested in knowing the locations of other preservation areas and archaeological sites within the northern portion of the project area. To accomplish this, Pacific Legacy archaeologists conducted four days of field work, using a geographic positioning system (GPS) to document the limits of the lava tube complex and the locations of individual tube openings. Each tube opening was briefly described and its dimensions were recorded. This information will be useful in planning for the protection and/or sealing of tube entrances both during construction and after completion of the West Hawai'i campus. A GPS was also used to identify the locations of individual archaeological sites within the limits of the proposed project area.

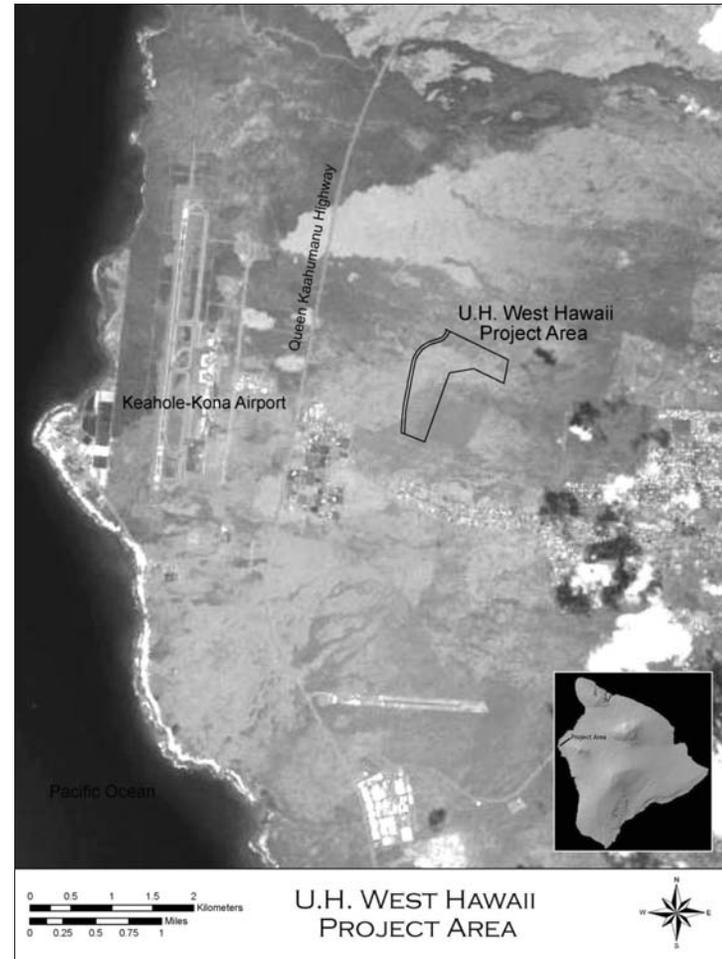


Figure 1. Location of the University of Hawai'i Center at West Hawai'i project area (base map from Google Earth).

## 2.0 PROJECT BACKGROUND

The original site of the future University of Hawai'i Center at West Hawai'i covered an approximately 500 acre parcel located east and upslope of the Keahole-Kona Airport on the leeward side of the island of Hawai'i. This has been scaled back to the current 133 acre area

### 2.1 LOCATION AND ENVIRONMENTAL SETTING

Located within the district of North Kona, this 500 acre property (Tax Map Key parcel (3)-7-3-010:042) includes portions of seven *ahupua'a*: Maka'ula, Hale'ohi'u, Hamanamana, and Kalaoa 1-4. It extends from about the 320 foot (97.5 meter) elevation to the 580 foot (176.7 meter) elevation (Figure 2). The gently east to west sloping terrain of the project area is composed of both 'a'a and *pahoehoe* lava flows. Within these flows are lava tube systems that run primarily *mauka* to *makai* (from the mountains to the shore), which is roughly east to west within the study area. *Pahoehoe* lava flows are the dominant terrain type. These flows can be described as possessing, "a billowy, glassy surface that is relatively smooth ... in some areas, however the surface is rough and broken, and there are hummocks and pressure domes" (Sato et al. 1973:34). Barren stretches of 'a'a lava flow are also encountered within the project area. Sato et al. (1973:34) describe such flows as, "a mass of clinkery, hard, glassy, sharp pieces piled in rumbled heaps."

Located on the leeward side of the island, the project area is relatively arid, receiving 20 to 30 inches (510 to 760 mm) of rainfall annually (Armstrong 1983:63). The mean low annual temperature is 60 to 65 degrees Fahrenheit (15.6 - 18.3° C), and the mean high annual temperature is 80 to 82 degrees Fahrenheit (26.7 - 27.8° C) (Armstrong 1983:64). The primary vegetation within the study area is fountain grass (*Pennisetum setaceurri*). There are also scattered shrubs such as a 'ali 'i (*Dodonaea viscosa*), noni (*Morinda citrifolia*), koa haole (*Leucaena leucocephala*), and Christmas-berry (*Schinus terebinthifolius*).

### 2.2 PREVIOUS ARCHAEOLOGICAL RESEARCH

The entire 500 acre University of Hawai'i Center at West Hawai'i project area was the subject of an archaeological inventory survey conducted by Paul H. Rosendahl Inc. in 1993 (Head and Rosendahl 1993). In their report, Head and Rosendahl provide an extensive review of previous archaeological studies undertaken within the surrounding area (Head and Rosendahl 1993:4-16).

The Head and Rosendahl (1993) survey identified and documented 43 archaeological sites within the 500 acre U. H. West Hawai'i parcel. These sites included temporary habitation shelters, agricultural features, trails, burials, religious sites, and petroglyphs. Based on their findings, Head and Rosendahl concluded that the project area may mark the northern extension of the Kona Field System.

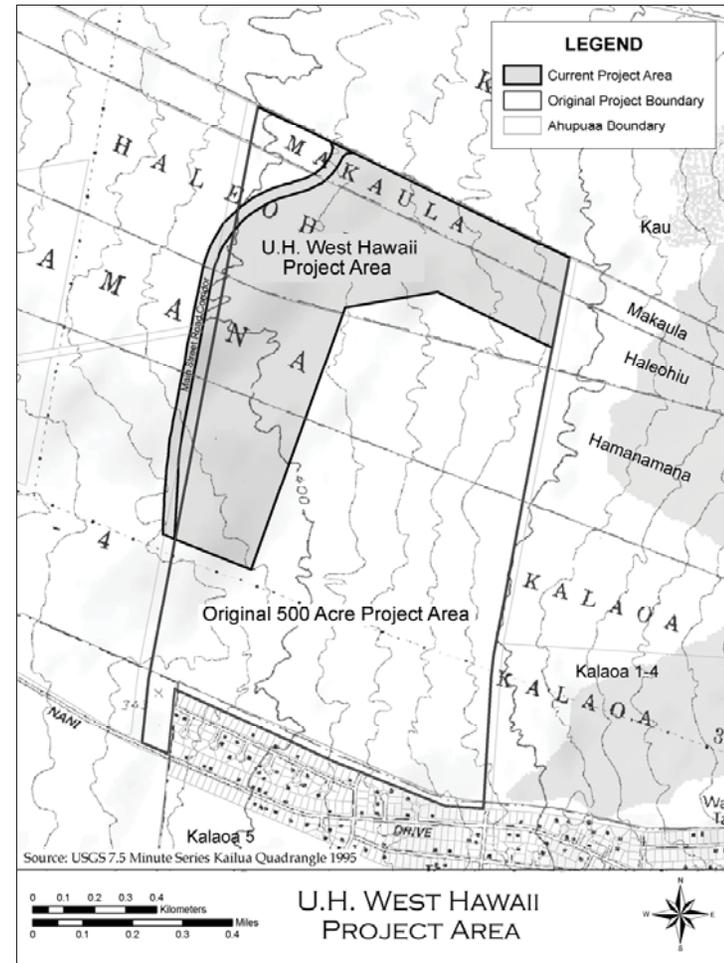


Figure 2. Location of the original and present U. of H. Center at West Hawai'i project areas.

Limited test excavations were conducted by Head and Rosendahl within the 500 acre parcel. These produced five charcoal samples that were submitted for radiocarbon analysis. Based upon these samples, the sites within the area appear to date to the late prehistoric and early historic periods, from around AD 1487 to the late 1800s (Head and Rosendahl 1993: 45-46, 64).

Following the Head and Rosendahl survey, the project area was reduced from 500 to 275 acres. Among the archaeological sites identified and recorded within this 275 acre portion of the study area were shelters and lava tubes that appear to have served as sites of temporary habitation; a possible water catchment inside a lava tube; agricultural features such as mounds, excavations, and clearings; a *papamū* (a stone slab marked with a pattern of shallow circular depressions that was used as a board for the playing of *kōnane*, a game similar to checkers); and an enclosure that may have been used either for habitation or as a religious shrine.

In March of 1998, Pacific Legacy archaeologists were contracted by Will Chee Planning to relocate all of the previously recorded archaeological sites within the 275 acre project area. They were also requested to evaluate the condition of the sites and, if necessary, to revise the original significance assessments and recommendations based upon existing conditions. An additional ca. 900 by 30 meter access road corridor (the Main Street road) running along the western boundary of the property was also surveyed for the presence of surface archaeological remains. The report of this work (Cleghorn 1998) included recommendations regarding the preservation and interpretation of sites within the 275 acre project area. It was recommended that five archaeological preserves be established and maintained (Cleghorn 1998:29-31). The map showing the locations of these preservation areas (Cleghorn 1998:Figure 10) has been reproduced below (Figure 3).

Following on the recommendations made in the 1998 report (Cleghorn 1998:34), a conceptual historic preservation plan was prepared by Pacific Legacy with the input of the University of Hawai'i Center at West Hawai'i Advisory Council on Kalaoa Cultural Site Preservation. This report summarized 18 guidelines which the Advisory Council wanted to be used in shaping all cultural protection activities within the University Center parcel. It also provided procedures for the management of the cultural resources located within the University of Hawai'i Center at West Hawai'i project area (Cleghorn 2000). As part of this report, a map was created showing the previously recorded sites (as adapted from Head and Rosendahl 1993:Figure 3) and their relation to the designated preserve areas (Cleghorn 2000:Figure 3) (Figure 4).

An assessment survey was undertaken by Pacific Legacy in 2005 to relocate previously identified sites within the Main Street road corridor, record their position using a geographic positioning system (GPS), and assess their present condition (Cleghorn and McIntosh 2005). Ten of the 12 previously recorded sites were relocated. Among the recommendations presented in the report of these investigations, it was suggested that the central and northern portions of the roadway be extended west as far as possible to avoid impacting archaeological features within lava tube site of 50-10-28-15302.



Figure 3. Locations of recommended archaeological preserves (after Cleghorn 1998:Figure 10).

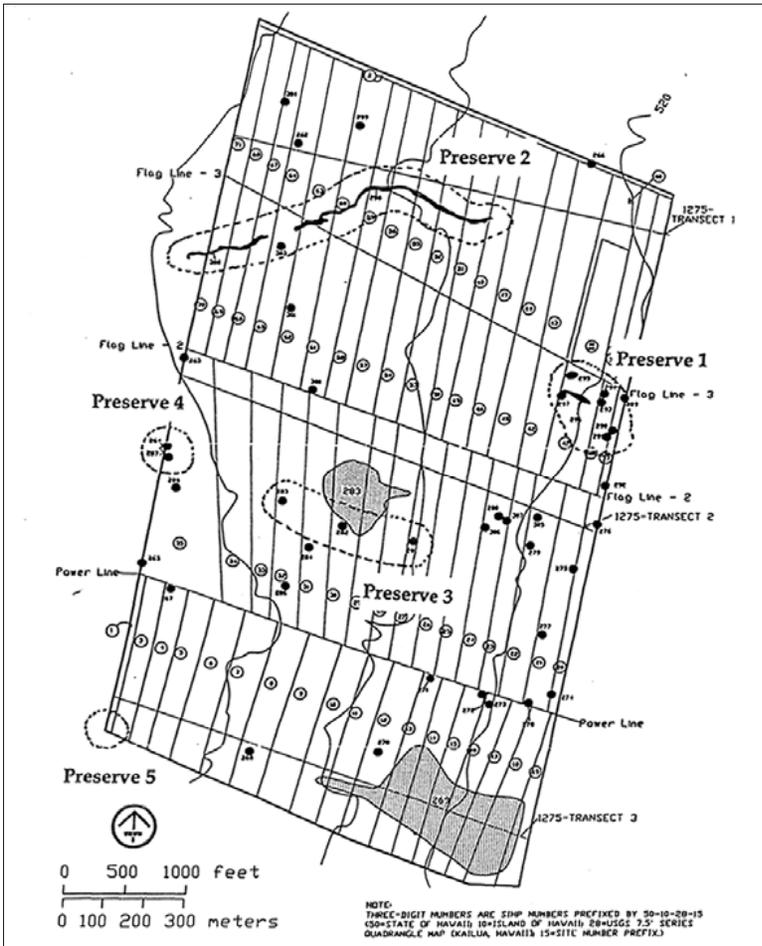


Figure 4. Location of archaeological sites and preserve areas (after Cleghorn 2000:Figure 3).

When the central and northern portions of the road were realigned to the west, this new road corridor passed outside the limits of the original 500 acres into property that had not been the subject of a previous archaeological survey (Tax Map Key parcel (3)-7-3-010:033). During the staking out of this new road alignment, surveyors discovered a petroglyph resting to the southwest (*maka'i*) of site 50-10-28-15302. As a result of this discovery, Pacific Legacy archaeologists were called in to document the petroglyph site (designated site 50-10-28-26454). They were also asked to survey the newly aligned road corridor and the area between it and the original corridor in order to determine whether it might be possible to reroute the road so that it ran between site 50-10-28-15302 and the recently discovered petroglyph.

Site 50-10-28-26454 was found to consist of three petroglyph images pecked into the surface of a roughly 1 by 1.5 meter slab of *pahoehoe* lava (Reeve 2007:1-9). The petroglyphs are situated on the northern lip of a skylight that opens down into a lava tube. This lava tube was discovered to run below the surface in a northeasterly direction and to connect with the western end of site 50-10-28-15302. Four archaeological features (three slightly modified natural terraces and an area of modified roof fall) were found to rest within the lava tube between these two sites. The results of this investigation were included in an archaeological letter report sent to the State Historic Preservation Division (Reeve 2007).

In 2008, the proposed development within the West Hawai'i parcel was shifted to the northern end of the property. This was done to take advantage of utility connections to the recently approved Palamanui Development, located immediately north of the U. H. property. At this time a new, roughly 133 acre project area was established that covered much of the northern and eastern portions of the original 500 acre property (Figures 2 and 5). The northern portion of this new circa 133 acre project area is the subject of the present report.

## 2.1 ARCHAEOLOGICAL PRESERVE 2

One of the most prominent physical features within the U. H. West Hawai'i project area is a large lava tube complex that crosses the northern half of the property from northeast to southwest. While some portions of the lava tube remain intact, along other sections the tube roof has collapsed leaving either a small open skylight or a larger linear depression in the terrain. During Head and Rosendahl's initial 1993 survey this lava tube was found to contain numerous archaeological features. Upon completion of the survey the lava tube complex was assigned two separate Hawaii State Inventory of Historic Properties site numbers. The eastern portion of the tube was given site number 50-10-28-15298, while the western section was designated site 50-10-28-15302 (Figure 6). In Cleghorn's 1998 report this "northern site cluster" was recommended for preservation as archaeological Preserve 2.

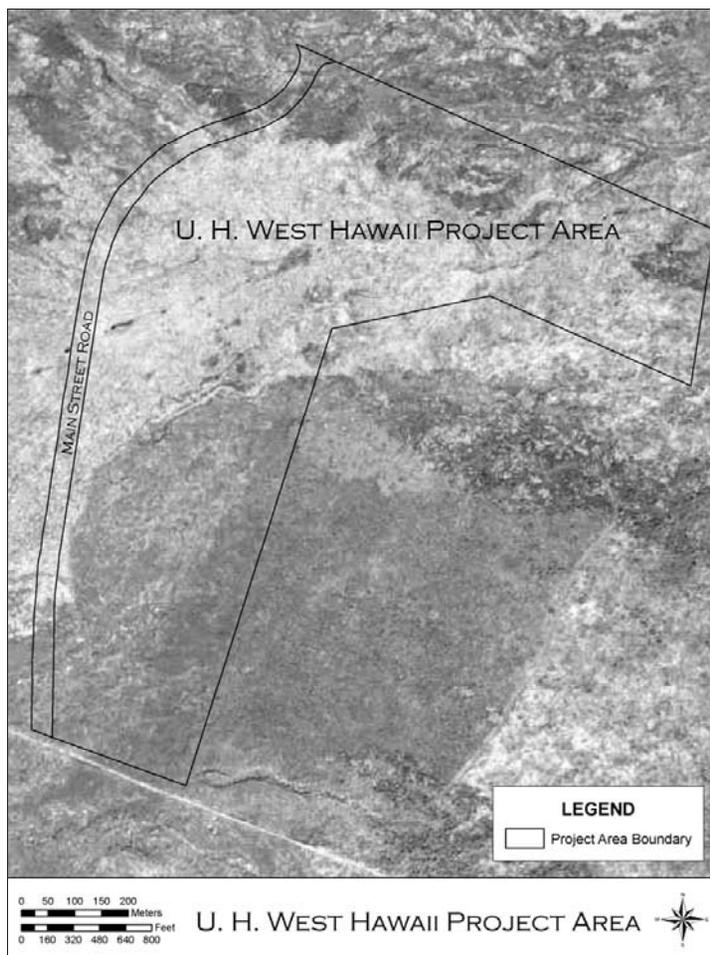


Figure 5. University of Hawai'i Center at West Hawai'i project area (base map from Google Earth).

Site 50-10-28-15302, which covers the western (*makai*) portion of the tube complex, was found to contain over 31 features. These features include ten piles of rock, two stone alignments, five enclosures, three walls, one cairn, eight midden scatters, one modified depression, and one terrace. All of these features probably date to the pre-Contact period and served a variety of functions from habitation to ceremonial (Cleghorn 2000:15). The lava tube consists of two levels. One of the features recorded by Head and Rosendahl (Feature BH) was described as ceremonial due to the presence of a large upright boulder (1.2 x 0.9 x 0.5 meters) which is placed against the N wall of the tube in association with two contiguous enclosures. Shell midden, charcoal, ash, a water worn cobble, and a piece of coral are present in the immediate vicinity of this feature. No human remains were observed within this site (Cleghorn 1998:23).

Site 50-10-28-15298 occupies the eastern (*mauka*) portion of the tube complex. It consists of over 165 features, including at least six human burials (Cleghorn 1998:22). Like site 50-10-28-15302, this tube also consists of two levels. Twelve surface or sink features were found to be associated with the main lava tube, 57 subsurface features were located within a lower level tube, and the remaining ca. 100 features were located on the *pahoehoe* lava surface adjacent to the tube. These features included three pavements, five modified outcrops, six mounds, nine terraces, three cupboards, eleven piles of rock, six enclosures, six petroglyphs and one *papamū*, two pecked stones, one excavated area, ninety midden scatters, nine walls, five alignments, one platform, one stepping stone trail, one cairn, one cleared area, and one modified depression. As with site 50-10-28-15302, these features probably date to the pre-Contact period. Most appear to be associated with habitation or refuge, though human burials are also present (Cleghorn 2000:15).

Both sites were assessed as being culturally significant due to the large number of archaeological features found within them. It was recommended that they be included within an archaeological preserve (Preserve 2), and that a minimum buffer of 50 meters (165 feet) be established around this preserve. Given the culturally sensitive natures of the burials, no access would be allowed into the preserve with the exception of lineal descendants, if any were identified (Cleghorn 200:15).

Although not identified at the time archaeological Preserve 2 was established, the site 50-10-28-26454 petroglyphs were found to be associated with the western end of the lave tube complex and might be considered as belonging within the preserve.

### 3.0 FIELD INVESTIGATIONS

With the shift of development focus to the northern portion of the U. H. West Hawai'i property, it became necessary to identify the exact perimeters of Preservation Area 2 so that the lava tube complex and its associated archaeological features could be properly protected. In order to accomplish this, archaeological field investigations were undertaken by Pacific Legacy archaeologists Rowland B. Reeve, M.A., James McIntosh, B.A., and Kim Mooney, B.A., over a period of four days between 23-26 September 2008. Paul Cleghorn, Ph.D. served as the Principle Investigator for the project.

Field work was first focused on identifying and documenting the limits of the Preservation Area 2 lava tube complex. A hand held Thales Mobile Mapper geographic positioning system (GPS), with a maximum error of plus or minus 3 meters, was used to record the locations of individual tube openings as well as to trace out the approximate boundaries of the intact sections of the lava tube. The various maps of the tube system contained in this report were created using the GPS data obtained during these recordings. Each tube opening was then photographed, measured and described. This detailed information is contained in Appendix A.

The second phase of field work consisted in determining the exact locations of other known sites within the newly established 133 acre project area. This was again accomplished using a Thales Mobile Mapper GPS. A total of 7 sites were located. Their GPS locations, recorded in Universal Transverse Mercator, North American Datum for 1983, Zone 5 (UTM NAD 83 Z5) coordinates, are listed in Appendix B.

### 4.0 FINDINGS

During the GPS mapping of archaeological Preserve 2, a total of 16 separate tube entrances were identified within the University of Hawai'i property (Figure 6). A 17<sup>th</sup> entrance was noted immediately northeast of Opening #16 on the Palamanui property, while additional entrances were also observed to the southwest of Opening #1 outside the property boundary. A detailed description of each opening and its dimensions can be found in Appendix A. Included with these descriptions are photographs of the individual openings. A GPS location, taken at the westernmost point of each opening and recorded in Universal Transverse Mercator, North American Datum for 1983, Zone 5 (UTM NAD 83 Z5) coordinates, is also listed in Appendix A.

#### 4.1 SITES 50-10-28-26454 AND 50-10-28-15302

The western half of the archaeological Preserve 2 lava tube complex includes both sites 50-10-28-15302, originally recorded by Head and Rosendahl (1993), and the more recently recorded site 50-10-28-26454 petroglyph panel (Reeve 2007). This section of the tube extends in a southwest to northeast direction for roughly 325 meters and possesses 6 openings (Figure 7). Its western end is marked by a skylight on the lip of which rest the site 50-10-28-26454 petroglyphs (Opening #1).

##### Opening #1 (Skylight)

Opening #1 is a roughly oval opening in the lava tube roof. Due to the height of the tube at this point, the skylight does not provide easy access into the tube (Figure 8).

##### Tube: Subsurface from Opening #1 to Opening #2

From Opening #1 the lava tube extends below the ground surface in a northeasterly direction for approximately 69 meters (c. 226 feet). It passes beneath the Main Street road corridor before becoming visible again through Opening #2. The tube contains one archaeological feature that has been the subject of a data recovery excavation (Reeve 2008).

##### Opening #2 (Skylight)

Opening #2 is a relatively small, roughly circular skylight. There is no easy access into the tube from this skylight.

##### Tube: Subsurface from Opening #2 to Opening #3

The tube continues subsurface roughly 7.5 meters (c. 24.6 feet) *mauka* of the Opening #2 skylight before ending at the western end of Opening #3. It contains a few very rough archaeological features (Reeve 2007).

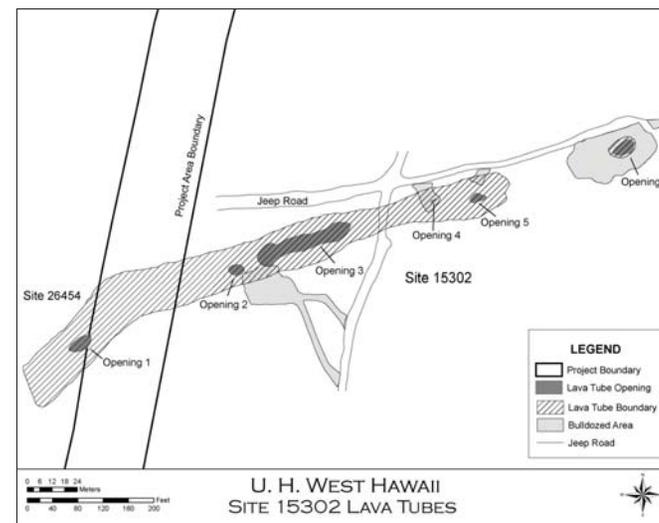
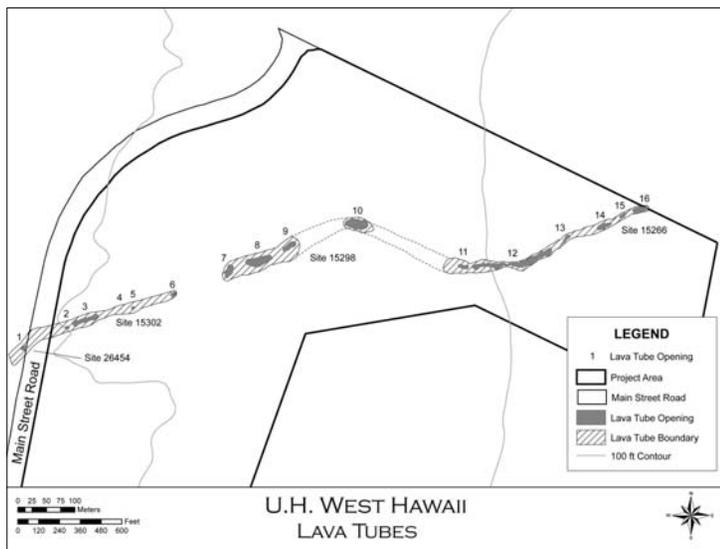


Figure 6. Lava tube openings within archaeological Preserve 2.  
 Archaeological Mapping  
 University of Hawai'i Center - West Hawai'i  
 District of North Kona, Island of Hawai'i  
 December 2008



Figure 7. Lava tube openings in the western half of archaeological Preserve 2.  
 Archaeological Mapping  
 University of Hawai'i Center - West Hawai'i  
 District of North Kona, Island of Hawai'i  
 December 2008



**Opening #3 (Collapsed Tube Section)**

Opening #3 consists of a collapsed section of lava tube that forms a roughly eight meter deep linear depression in the terrain. This depression stretches for approximately 48 meters. Opening #3 marks the beginning of site 50-10-28-15302 as it was originally recorded by Head and Rosendahl (1993). There is no visible subsurface tube between Opening #3 and Opening #5.

**Opening #4 (Lava Bubble)**

Opening #4 consists of a relatively small and shallow lava bubble. The roof of the bubble has been broken open, and the area immediately surrounding it has been bulldozed. Opening #4 does not connect to a subsurface lava tube

**Opening #5 (Skylight)**

Opening #5 is a skylight with no easy access into the subsurface tube that connects it to Opening #6.

**Tube:** Subsurface from Opening # 5 to Opening # 6

A subsurface lava tube runs between Opening #5 and Opening #6. This tube was mapped by Head and Rosendahl during their 1993 survey (Head and Rosendahl 1993:Figure 7). At least nineteen archaeological features were documented as being located within this stretch of tube. Among these is a possible ceremonial structure (Feature BH, Head and Rosendahl 1993:A-73 and A-74).

**Opening #6 (Collapsed Tube Section)**

Opening #6 consists of a shallow collapsed section of lava tube roughly 10 by 5 meters in area. This opening marks the eastern end of site 50-10-27-15302 as recorded by Head and Rosendahl (1993). A map in Head and Rosendahl's 1993 site survey report (Head and Rosendahl 1993:Figure 7) indicates that Opening #6 was once the "Main Entrance" to the subsurface lava tube that connects it with Opening #5. Recent bulldozing has closed off this entrance.

**Tube:** Subsurface for a short distance *mauka* of Opening #6

Head and Rosendahl's map (1993:Figure 7) shows the subterranean tube continuing northeast beyond Opening #6 for at least another 20 meters. At this point the map simply ends with a note that states "passageway continues". It is uncertain how much further northeast the tube runs.

**4.1.1 Recent Damage at Site 50-10-28-15302**

At present a jeep road passes between Opening #3 and Opening #4. This north-south running jeep road connects to a roughly east-west running track located just north of the tube complex (Figure 7).



Figure 8. Skylight of Opening #1 (View Northeast).



Figure 9. Opening # 6 filled with bulldozed rubble (View West)

During the present survey, the archaeological field crew noted evidence of recent ground disturbing activities at the southwestern end of Opening #3, and some rock and soil debris has been pushed into the tube. This disturbance was found to be part of a much larger area of bulldozing that extends off of the nearby jeep road (Figure 7).

Similar areas of bulldozing were visible elsewhere in the western portion of Preserve 2. The bulldozing appears to be concentrated around lava tube openings, such as at Openings #4 and #6 (Figure 7). To the west of the U. of H. property the field crew observed similar damage caused by a backhoe actively tearing up the *pahoehoe* surface to obtain loose slabs of rock. These stones were being removed for use in building stacked stone walls.

It is evident that bulldozing has damaged the archaeological sites within Preserve 2. The ground surface immediately surrounding Opening #6 has been extensively bulldozed, and rubble now fills most of the floor of the opening (Figure 9). It appears that the bulldozing carried out around Opening #6 has covered over the entrance to the subterranean tube that connects it to Opening #5 (Head and Rosendahl 1993:Figure 7). With the Opening #6 entrance now blocked by bulldozer push, the only way to reach the features recorded by Head and Rosendahl would be by descending through the Opening #5 skylight using climbing ropes.

#### 4.2 SITE 50-10-28-15298

There appears to be a gap in the lava tube between Openings #6 and #7. This gap marks the division between site 50-10-27-15302 and site 50-10-27-15298, as recorded by Head and Rosendahl (Figure 6). Site 50-10-28-15298 covers most of the central portion of the archaeological Preserve 2 lava tube complex, including eight openings (Opening #7 to Opening #14) (Figure 10). Most of these openings consist of linear depressions formed by collapsed sections of lava tube.

##### Opening #7 (Collapsed Tube Section)

Opening #7 is a collapsed section of lava tube that marks the western end of site 50-10-27-15298. It forms a 23.8 meters long trench, roughly five meters deep. There is no evidence of a subsurface tube connecting it to Opening #8.

##### Opening #8 (Collapsed Tube Section)

Opening #8 consists of a linear depression roughly 47 meters in length formed by a collapsed section of lava tube. Near the western end of the collapse is a skylight that opens onto a subsurface lava tube. This subsurface tube runs east (*mauka*) as far as Opening #12. The subsurface tube has been mapped by Head and Rosendahl and appears as Figure 6 in their 1993 site survey report (Head and Rosendahl 1993:Figure 6). It contains numerous archaeological sites, including at least five human burials. Three of these burials (B-1, B-2a and B-2b) are located beneath Opening #8. An accessible entrance to this subsurface tube is located at the eastern end of Opening #8.

**Tube:** Subsurface from Opening #8 to Opening #9

The subsurface tube appears to follow roughly the same alignment as the line of surface collapsed tubes. This stretch of tube contains numerous archaeological features.

##### Opening #9 (Collapsed Tube Section)

Opening #9 forms a roughly three meter deep trench running for 26 meters. A skylight at its western end provides access to the subsurface lava tube that is shown in Figure 6 of Head and Rosendahl's 1993 site survey report.

##### **Tube:** Subsurface between Opening #9 and Opening #10

The line of the lava tube complex makes a distinct bend after Opening #9, turning northeast to Opening #10 before curving southeast again to Opening #11. This bend is reflected in Head and Rosendahl's map of the subsurface tube, indicating that the alignments of both the surface openings and the subsurface tube are roughly the same (Figures 11 and 12). Head and Rosendahl's map indicates that several archaeological features, including a subsurface burial (B-3) is located between Openings #9 and #10.

**Opening #10 (Collapsed Tube Section)**

Opening #10 is a very shallow, grass filled depression. It possesses no skylights or other entrances to the subsurface lava tube that runs beneath it.

**Tube:** Subsurface between Opening #10 and Opening #11

Although there are no entrances to the subsurface tube at either Opening #10 or #11, Head and Rosendahl's 1993 map indicates that it does run beneath these openings. A number of archaeological features, including burial B-4, are located within this section of tube.

**Opening #11 (Collapsed Tube Section)**

Opening #11 is a short and shallow depression. There are no skylights or entrances to the lower tube visible from the surface.

**Tube:** Subsurface between Opening #11 and Opening #12

The subsurface lava tube that runs *mauka* from Opening #8, and contains numerous archaeological features, opens into the western end of Opening #12.

**Opening #12 (Collapsed Tube Section)**

Opening #12 is by far the longest of the collapsed lava tube segments within the Preserve 2 complex. It forms a shallow, grass and shrub filled trough that extends for over 138 meters in length. The subsurface tube recorded by Head and Rosendahl emerges at the western end of Opening #12. Several skylights into another subsurface lava tube located east (*mauka*) of the tube recorded by Head and Rosendahl were noted within Opening #12. This tube section does not appear to extend east of Opening #12.

**Opening #13 (Collapsed Tube Section)**

Opening #13 consists of a shallow depression measuring only 22 meters in length. There is no visible evidence of a subsurface lava tube beneath this opening.

**Opening #14 (Collapsed Tube Section)**

Opening #14 is a shallow trench partially covered in grass. At its western end is an opening into a subsurface lava tube that runs 50 to 60 meters west before growing too narrow to be easily investigated. This tube does not connect to Opening #15.

**Opening #15 (Collapsed Tube Section)**

Opening #15 is a relatively small, but steep sided collapsed section of lava tube measuring less than 15 meters in length.

**Tube:** Subsurface between Opening #15 and Opening #16

A roughly 10 meter long arched overhang connects the eastern end of Opening #15 with the western end of Opening #16. Just inside this opening, along the south wall, is a small ash deposit. There are no other signs of human activity, though these may be obscured by roof fall. In amongst this roof fall the Pacific Legacy field crew discovered an old site tag dating from the initial archaeological survey of the project area in 1993. The tag indicates that this portion of the lava tube complex was initially identified as site 50-10-28-15298, but was re-designated as site 50-10-28-15266.

**Opening #16 (Collapsed Tube Section)**

Opening #16 is the easternmost opening within the project area. It consists of a collapsed section of lava tube that measures approximately 27.5 meters in length. Except for the connecting tube into Opening #15, it contains no entrances to subsurface tubes.

**4.3 SITE 50-10-28-15266**

Site 50-10-28-15266 was originally recorded as a pair of habitation terraces located adjacent to the eastern end of Preserve 2 lava tube complex (Head and Rosendahl 1993). These terraces are situated near Openings #15 and #16. The site boundary has been extended to include these two easternmost openings within the University of Hawai'i Center at West Hawai'i project area (Figure 10). As has been mentioned, the lava tube complex continues east (*mauka*) beyond the boundaries of the University of Hawai'i property.



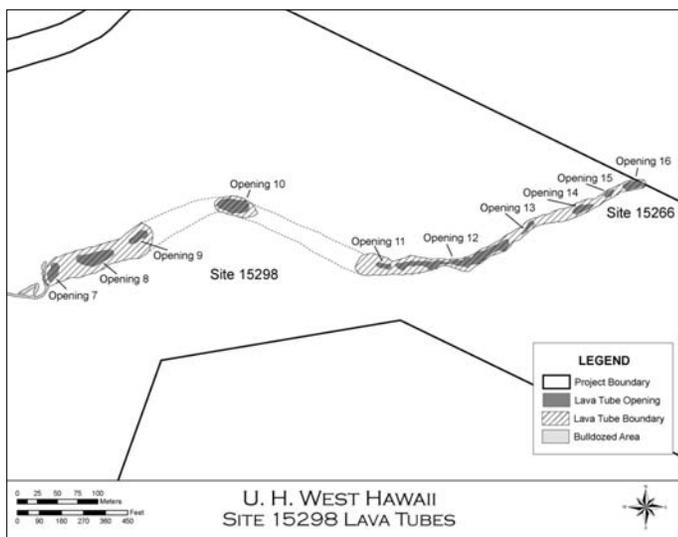


Figure 10. Lava tube openings in the eastern half of archaeological Preserve 2.

Archaeological Mapping  
University of Hawai'i Center - West Hawai'i  
District of North Kona, Island of Hawai'i  
December 2008

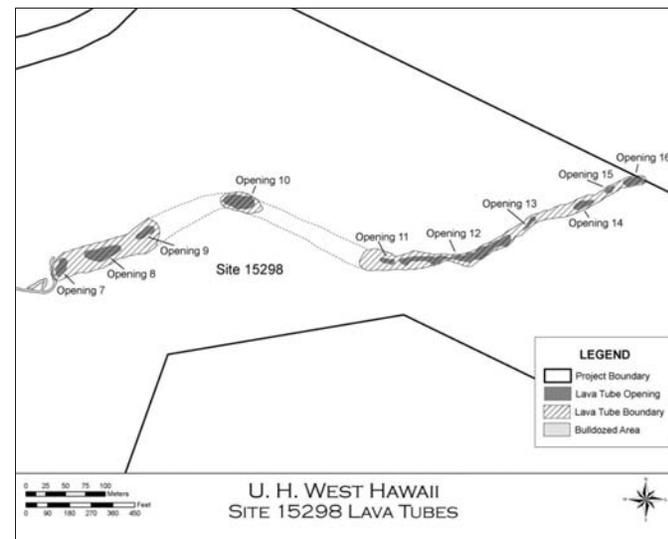


Figure 11. Upper tube alignment as mapped during the present project.

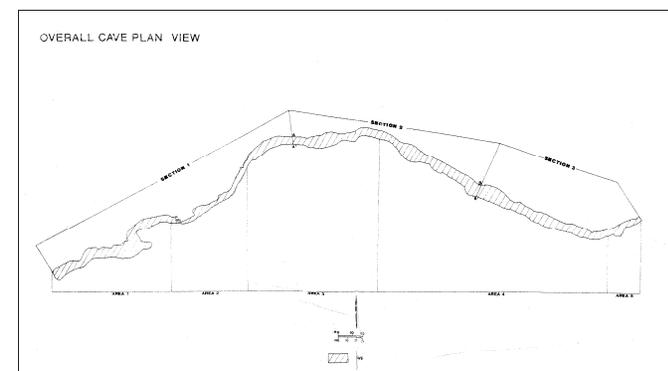


Figure 12. Lower tube alignment between Openings #8 and #12 (Head and Rosendahl 1993:Figure 6).

Archaeological Mapping  
University of Hawai'i Center - West Hawai'i  
District of North Kona, Island of Hawai'i  
December 2008



#### 4.3 SITES OUTSIDE PRESERVATION AREA 2

In addition to locating and describing the openings that lie along the length of the archaeological Preserve 2 lava tube complex, the Pacific Legacy field team also obtained GPS locations for other previously recorded archaeological sites within the newly established 133 acre U. of H. West Hawai'i project area. A total of 7 sites were revisited. A brief descriptive list of these sites is included in Appendix B. Appendix B also contains a table of their GPS locations, recorded in Universal Transverse Mercator, North American Datum for 1983, Zone 5 (UTM NAD 83 Z5) coordinates. Included within this table are the GPS coordinates for two additional sites located north of Preserve 2. The GPS coordinates of these two sites (50-10-28-15262 and 50-10-28-15304), both of which are scheduled for preservation, were recorded by Pacific Legacy archaeologists in 2005 (Cleghorn and McIntosh 2005:30).

Of the three archaeological sites originally identified as being located north of the archaeological Preserve 2 lava tube complex (Head and Rosendahl 1993:Appendix A), two were relocated, recorded and recommended for preservation during the 2005 Main Street Roadway assessment survey (Cleghorn and McIntosh 2005). These are site 50-10-28-15262, a roughly 4 x 3 meter stone terrace with three adjacent stone mounds (Cleghorn and McIntosh 2005:10-11), and site 50-10-28-15304, an isolated X shaped petroglyph (Cleghorn and McIntosh 2005:19). Site 50-10-28-15299, a modified outcrop (Head and Rosendahl 1993:A-70), was not able to be relocated in 2005. GPS locations for both sites 50-10-28-15262 and 50-10-28-15304 were recorded at that time and are listed in the 2005 report (Cleghorn and McIntosh 2005:30). Their coordinates are included in Appendix B.

South of archaeological Preserve 2, the present study obtained GPS locations for seven sites (Figure 13). These include:

Site 50-10-28-15303: A modified overhang shelter that is located southeast of site 50-10-28-15302 and southwest of site 50-10-28-15298. Site 50-10-28-15303 is situated close enough to these two lava tube complex sites to rest within the boundaries of Preserve 2. This site was relocated and described during the 2005 assessment survey (Cleghorn and McIntosh 2005:17-18).

Site 50-10-28-15285: This roughly rectangular enclosure contains a single piece of branch coral outside its eastern wall. It was relocated during the 1998 assessment survey (Cleghorn 1998:19-20) and interpreted as a possible religious shrine. This site forms the western end of Preserve 3.

Site 50-10-28-15283: This agricultural complex of 72 plus features, includes a number of terraces, walls, alignments, mounds and modified outcrops (Cleghorn 1998:18-20). The southern portion of it was included in Preserve 3 (Figure 4). GPS mapping conducted during the present survey reveals that the westernmost fringe of this site complex is located east of and outside the limits of the present project area (Figure 12).

Site 50-10-28-15264: This site consists of a small lava tube and two modified outcrops. It forms part of Preserve 4. The site was relocated and described during the 2005 assessment survey

(Cleghorn and McIntosh 2005:12).

Site 50-10-28-15287: A *papamū* (a natural *pahoehoe* slab marked with a pattern of shallow circular depressions that was used as a board for the playing of *kōnane*, a game similar to checkers); and associated stone alignment that also form part of Preserve 4. This site was relocated and described during the 2005 assessment survey (Cleghorn and McIntosh 2005:13).

Site 50-10-28-15288: This site consists of a partially collapsed stone mound. Though site 50-10-28-15288 is located just south and outside the boundaries of Preserve 4, it was also recommended for preservation (Cleghorn and McIntosh 2005:14).

The boundaries of both archaeological Preserve 3 and 4 had previously been mapped by a licensed surveyor contracted by Wil Chee Planning. Due to their level of accuracy, these mapped boundaries should be used in the planning of any development in the vicinity of the two more southern preserve areas.

The original 1993 survey identified three additional sites located south of Preserve 2 and north of Preserves 3 and 4 (Figure 4). Site 50-10-28-15263, a modified depression (Head and Rosendahl 1993:A-2), was not relocated during the 2005 survey. Site 50-10-28-15300 was described in Head and Rosendahl's 1993 report as a utilized lava tube (Head and Rosendahl 1993:A-71). A lava tube was found during the 2005 survey at the location shown on Head and Rosendahl's site map, but it did not match the description given in their report, nor was any human modification or cultural material noted within the tube. Site 50-10-28-15301 appears on Head and Rosendahl 1993 site maps, but there is no description of the site in the text. It is possible that the feature given this site number was determined not to be a site, but its number was not removed from the site maps. No site was noted in this location during any of the subsequent surveys.

During the present investigations the Pacific Legacy field team discovered a single previously unrecorded feature located roughly 250 meters southwest of site 50-10-28-15285. This site, which has been assigned State Inventory of Historic Properties number 50-10-28-26700, consists of a petroglyph, measuring approximately 51 centimeters in length and 45 centimeters in width, pecked into a roughly 1 by 1 meter slab of *pahoehoe* lava. The *pahoehoe* slab forms part of an uplifted ridge of lava surrounded by fountain grass. The petroglyph is quite large and visible from a distance (Figure 14). The image itself consists of a linear male human figure with uplifted arms (Figure 15). A very faint, possible second image is situated approximately 1 meter to the north of the first figure. This possible second figure appears to be a legless human figure with a reverse triangular torso.

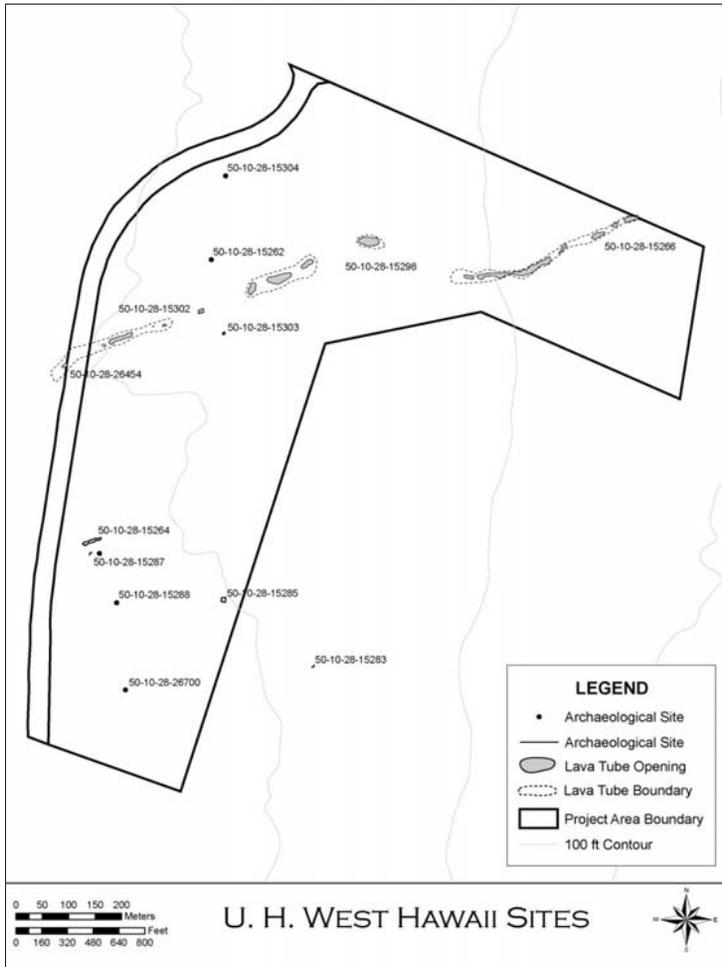


Figure 13. Archaeological site locations.



Figure 14. Site 50-10-28-26700 (View West).

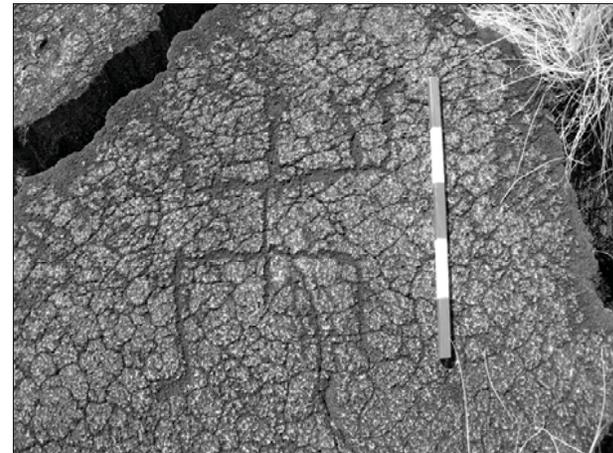


Figure 15. Site 50-10-28-26700 petroglyph image.

## 5.0 SUMMARY AND DISCUSSION

During the present project, Pacific Legacy archaeologist employed a geographic positioning system (GPS) to map the extent of the archaeological Preserve 2 lava tube complex and to identify the locations of its various openings. The GPS was also used to fix the positions of 7 other previously identified sites, all of which were situated within the 133 acre University of Hawai'i Center - West Hawai'i property.

A total of 16 separate openings were identified along the length of the Preserve 2 lava tube. These took the form of both skylights (openings in the roof of surviving sections of subsurface tube) and collapsed tube sections (linear depressions in the terrain formed by the collapse of a portion of tube roof). Different sections of the tube complex were identified as belonging within the three previously recorded archaeological site that make up Preserve 2. Descriptions, measurements, photographs and GPS coordinates for the 16 tube openings can be found in Appendix A at the end of this report. The GPS coordinates of 7 other previously identified sites were also recorded. Appendix B contains a descriptive list and GPS coordinates for these 7 sites. It also contains information and coordinates for a single site that was discovered during the present survey. This site consists of a human figure petroglyph pecked into an outcropping of *pahoehoe* lava. Due to the sensitive nature of these sites, some of which contain human burials, it is important that their exact GPS locations not become common knowledge. For this reason, the appendices should be detached prior to the distribution of this report to the public.

Evidence of recent damage to the Preserve 2 area was also discovered and documented during the course of field operations. The ground surface immediately surrounding some of the tube openings was found to be disturbed by bulldozing. It was apparent that a backhoe or some other form of earth moving equipment had been used to break up the *pahoehoe* lava, most probably to obtain stone slabs for use in the construction of rock walls. At Opening #6, the entrance to a subterranean tube containing several archaeological features, among them a possible ceremonial structure, had been filled in with rubble. This effectively sealed up access to the tube, since the only other possible entrance (Opening #5) is a skylight that can only be accessed using climbing ropes. The bulldozer damage appears to be relatively recent. Similar bulldozing was found to be actively taking place within the property immediately to the west of the U. of H. parcel. There appears to be a strong likelihood that unless steps are taken, further damage may occur to the tube complex and its associated sites. Such bulldozing could easily obliterate surface petroglyphs carved into the *pahoehoe* slabs that edge the lava tube openings. Such petroglyphs have been found at sites 50-10-28-26454 and 50-10-28-15298.

It is recommended that future planning for the University of Hawai'i Center - West Hawai'i campus be conducted in close consultation with the Hawai'i State Historic Preservation Division and the Hawai'i Island Burial Council. This will help to ensure that the cultural properties present within Preserve 2, and at other preserve areas on the U. of H. parcel, will be properly protected.

“

## 6.0 REFERENCES

- Armstrong, R. Warwick  
1983 *Atlas of Hawai'i* (Second Edition). Honolulu. University of Hawai'i Press.
- Cleghorn, Paul L.  
1998 Archaeological Investigations for the Proposed University Center at West Hawai'i, North Kona, Hawai'i Island. On file in the State Historic Preservation Division Library, Kapolei.
- 2000 Conceptual Historic Preservation Plan For the Proposed University Center at West Hawai'i, North Kona, Hawai'i Island. On file in the State Historic Preservation Division Library, Kapolei.
- Cleghorn, Paul L. and James McIntosh  
2005 Archaeological Assessment University of Hawai'i Center at West Hawai'i Main Street Roadway, Island of Hawai'i. On file in the State Historic Preservation Division Library, Kapolei.
- Head, James and Paul H. Rosendahl  
1993 Archaeological Inventory Survey Kailua to Keahole Region State Lands LUC Project - 500-Acre University Site. On file in the State Historic Preservation Division Library, Kapolei.
- Reeve, Rowland  
2007 Letter report dated 11 December, 2007 sent to the Hawai'i State Historic Preservation Division. The letter report documents the recording of site 50-10-27-26454, a set of petroglyphs, as well as other adjacent archaeological features located within the University of Hawai'i Center at West Hawai'i project area. On file at the State Historic Preservation Division office, Hilo.
- 2008 Archaeological Data Recovery Excavations at the University of Hawai'i at West Hawai'i Main Street Road, District of Kona, Island of Hawai'i. On file in the State Historic Preservation Division Library, Kapolei.
- Sato, H. H., W. Ikeda, R. Paeth, R. Smythe, and M Takehiro, Jr.  
1973 *Soil Survey of the Island of Hawai'i, State of Hawai'i*. U.S. Department of Agriculture Soil Conservation Service. Washington D.C. Government Printing Office.

## APPENDIX A

### DESCRIPTIONS OF LAVE TUBE OPENINGS IN PRESERVE 2

#### Opening #1

Skylight  
50-10-28-15302  
Petroglyphs next to opening  
Site 50-10-28-26454

This opening is located at the western end of the project area. It forms the most westerly end of the archaeological Preserve 2 lava tube complex. The opening consists of a roughly oval skylight formed by the collapse of a section of the tube roof (Figure 16). Due to the height of the tube at this point (roughly 6.5 meters - c. 21 feet), it does not provide easy access into the lava tube (ropes would be needed to descend into the tube). From the skylight, the tube can be seen to extend both northeast (*mauka*) into the U. of H. property and southwest (*makai*) out of the project area. To the southwest, the tube closes only a short distance (roughly 30 meters) from the skylight. To the north east, the tube extends at least as far as Opening #3.

Petroglyph site 50-10-28-26454 is situated at the northern lip of the skylight. This site consists of a set of three petroglyph images pecked into the surface of a roughly 1 by 1.5 meter slab of *pahoehoe* lava (Reeve 2007:1-9) (Figure 17). From Opening #1, the lava tube continues for approximately 69 meters (c. 226 feet) below the ground surface in a northeasterly direction. It passes beneath the Main Street road corridor before becoming visible again through the relatively small, roughly circular skylight of Opening #2.

#### Measurements

- c. 12.3 meters long (roughly east to west)
- c. 6.3 meters wide (roughly north to south)
- c. 6.5 meters deep (depth varies somewhat due to rubble)

#### GPS Location (UTM NAD83 Zone 5)

Easting: 183679.4 meters  
Northing: 2185041.1 meters



Figure 16. Opening #1 (View Northeast).



Figure 17. Petroglyph site 50-10-28-26454 near Opening #1 (View North).

## Opening #2

Skylight  
Site 50-10-28-15302

This opening consists of a relatively small, roughly circular skylight formed by the collapse of a section of the tube roof (Figure 18). Like Opening #1, it does not provide easy access into the lava tube. From Opening #2, the tube extends roughly 69 meters (c. 226 feet) underground to the southwest back to Opening #1 (Figure 19). It also extends circa 7.5 meters (c. 24.6 feet) underground to the northeast, connecting with the western end of Opening #3.

### Measurements

- c. 7.2 meters long (roughly east to west)
- c. 5.3 meters wide (roughly north to south)
- c. 6.7 meters deep

### GPS Location (UTM NAD83 Zone 5)

Easting: 183756.3 meters  
Northing: 2185079.3 meters



Figure 18. Opening #2 (View Northwest).



Figure 19. Interior of lava tube connecting Openings #1 and #2 (View Northeast).

### Opening #3

Collapsed section of lava tube  
Site 50-10-28-15302

Opening #3 consists of a collapsed section of lava tube that forms a roughly eight meter deep linear depression in the terrain running southwest to northeast (Figure 20). At the western end of the collapsed section is the entrance to an intact stretch of tube that runs southwest toward skylight Openings #1 and #2 (Figures 21 and 22). There are archaeological features both along the floor of the collapsed section and in the tube extending southwest. Both the floor of the collapsed tube and the entrance to the intact tube are accessible from the sides. This opening marks the beginning of site 50-10-28-15302 as it was originally recorded by Head and Rosendahl (1993, though some minor archaeological features rest within the underground tube that runs between it and Opening #2).

There is no obvious subterranean tube continuing *mauka* from the northeastern end of Opening #3. At present a jeep road passes between it and Opening #4. The archaeological field crew noted evidence of recent ground disturbing activities at the southwestern end of Opening #3, and some rock and soil debris has been pushed into the tube (Figure 23). This disturbance is probably the result of a backhoe tearing up the *pahoehoe* surface to obtain rocks for stacked stone walls.

#### Measurements

- c. 48.0 meters long (roughly east to west)
- c. 7.4 meters wide (roughly north to south)
- c. 8.2 meters deep

#### GPS Location (UTM NAD83 Zone 5)

Easting: 183770.2 meters  
Northing: 2185084.6 meters



Figure 20. Opening #3 at west end of site 50-10-28-15302 (View Northeast).



Figure 21. Western end of Opening #3 (View West).



Figure 22. West end of lava tube connecting Openings #3, #2 and #1 (View Southwest).



Figure 23. Bulldozing at west end of Opening #3 (View Southwest).

#### Opening #4

Lava bubble  
Site 50-10-28-15302

This opening consists of a relatively small and shallow lava bubble. The roof of the bubble has been broken open, and the area immediately surrounding it has been bulldozed (Figure 24). At present there does not appear to be any direct connection between the bubble and any possible subsurface lava tube.

#### Measurements

- c. 3.2 meters long (roughly east to west)
- c. 1.0 meters wide (roughly north to south)
- c. 1.3 meters deep

GPS Location (UTM NAD83 Zone 5)

Easting: 183853.6 meters

Northing: 2185112.2 meters



Figure 24. Opening #4 (View Southwest).



Figure 25. Opening #5 (View Southeast).

## Opening #5

Skylight  
Site 50-10-28-15302

This opening is a skylight formed by the collapse of a section of the lava tube roof. A large *noni* tree is growing up through the opening from inside the tube (Figure 25). There is no easy access from the skylight into the tube that runs beneath it (the only possible means of egress would be through the use of climbing ropes). The tube extends both to the southwest and northeast from the skylight. Because of the lack of access it is difficult to tell how far the tube extends either way.

A "skylight", which appears to be Opening #5, is shown in Figure 7 of Head and Rosendahl's 1993 site survey report. This skylight opens onto a subterranean tube that (according to Head and Rosendahl's map) stretches back toward Opening #6. The subterranean tube that connects Openings #5 with #6 also continues for a little over 30 meters west of the Opening #5 skylight before ending. A lower chamber, however, (entered through an opening just west of Opening #5) continues over 120 meters even further west. Opening 5 may now be the only surviving entrance to these two chambers.

### Measurements

- c. 6.4 meters long (roughly east to west)
- c. 4.1 meters wide (roughly north to south)
- c. 7.0 meters deep

GPS Location (UTM NAD83 Zone 5)  
Easting: 183872.3 meters  
Northing: 2185113.0 meters

## Opening #6

Collapsed section of lava tube  
Site 50-10-28-15302

This collapsed section of lava tube marks the east end of site 50-10-28-15302. Opening #6 appears to match the cave entrance shown in Figure 7 of Head and Rosendahl's 1993 site survey report. This entrance (according to the map) leads down into a subsurface lava tube that runs southwest to Opening #5 and beyond. The tube contains at least nineteen archaeological features. However, the area immediately surrounding Opening #6 has been extensively bulldozed (Figure 26), and rubble now fills most of the floor of the opening (Figure 27). The entrance to the subterranean tube that is shown in Figure 7 has apparently been covered over by bulldozer push.

Head and Rosendahl's map shows the subsurface lava tube continuing northeast beyond Opening #6 for at least another 20 meters. At this point the map simply ends with a note that states "passageway continues". It is uncertain how much further northeast the tube runs.

### Measurements

- c. 10.2 meters long (roughly east to west)
- c. 5.3 meters wide (roughly north to south)
- c. 2.0 meters deep

GPS Location (UTM NAD83 Zone 5)  
Easting: 183941.2 meters  
Northing: 2185136.0 meters



Figure 26. Bulldozing around entrance to Opening #6 (View East).



Figure 27. Former entrance to Opening #6 and east end of site 50-10-28-15302 (View West).

### Opening #7

Collapsed section of lava tube  
Site 50-10-28-15298

This collapsed section of lava tube marks the western end of site 50-10-28-15298. It forms a 23.8 meters long trench, roughly five meter deep, running northeast to southwest (Figure 28). At the western end of the collapse, an intact section of lava tube continues for approximately ten meters to the west before closing out (Figure 29). Within this intact section of tube there is also an entrance to a lower level lava tube. The lower tube runs northeast for about 20 meters. It has a slightly modified entrance and contains a scatter of marine shell midden.

#### Measurements

- c. 23.8 meters long (roughly east to west)
- c. 11.5 meters wide (roughly north to south)
- c. 5.0 meters deep

GPS Location (UTM NAD83 Zone 5)

Easting: 184037.3 meters  
Northing: 2185169.5 meters



Figure 28. Opening #7 east end of site 50-10-28-15298 (View Northeast).



Figure 29. Opening #7 (View Southwest).

### Opening #8

Collapsed section of lava tube  
Site 50-10-28-15298

Opening #8 consists of a linear depression formed by a collapsed section of lava tube (Figure 30). It runs for roughly 47 meters in a west to east direction. At the western end of the collapsed tube is a stacked stone wall that partially shelters the entrance to an intact section of subsurface lava tube (Figure 31). This subsurface tube extends for approximately fifteen meters to the west before closing out. The collapse contains a number of archaeological features, including some petroglyphs carved into the pahoehoe along its outer edges (Figures 32 and 33).

Adjacent to the western end of the collapse is a skylight that opens onto a lower tube (Figure 34). This second, lower level lava tube runs for a short distance to the west before closing out. It also runs east under the collapsed area of Opening #8 and continues until Opening #12. The lower tube has been mapped as Figure 6 of Head and Rosendahl's 1993 site survey report. It appears to follow roughly the same alignment as the upper tube. An accessible entrance to this lower tube is located at the eastern end of Opening #8 (Figure 35).

The lower tube contains numerous archaeological features, including at least five burials. Three of these burials (B-1, B-2a and B-2b) are shown on Head and Rosendahl's map as being located very close to the Opening #8 skylight.

### Measurements

- c. 47.0 meters long (roughly east to west)
- c. 17.7 meters wide (roughly north to south)
- c. 2.5 meters deep

### GPS Location (UTM NAD83 Zone 5)

Easting: 184072.7 meters  
Northing: 2185194.0 meters



Figure 30. Opening #8 (View North).



Figure 31. Western end of Opening #8 (View Southwest).



Figure 32. Petroglyph near lip of Opening #8 (View Southwest).



Figure 33. Another petroglyph near Opening #8 (View Southwest).



Figure 34. Skylight to lower level tube at west end of Opening #8 (View South).



Figure 35. Entrance to lower level tube at east end of Opening #8 (View Northeast).

### Opening #9

Collapsed section of lava tube  
Site 50-10-28-15298

This collapsed section of lava tube forms a roughly three meter deep trench running for 26 meters in a southwest to northeasterly direction (Figure 36). A skylight at its western end provides access to the lower level lava tube that is show in Figure 6 of Head and Rosendahl's 1993 site survey report (Figure 37). On the surface, there is a noticeable gap between Openings #9 and #10, which rests somewhat to the north and east. It is apparent from Head and Rosendahl's map, however, that the lower level lava tube runs between them.

Head and Rosendahl's map indicates that a subsurface burial (B-3) is located between Openings #9 and #10.

#### Measurements

- c. 26.0 meters long (roughly east to west)
- c. 8.5 meters wide (roughly north to south)
- c. 3.5 meters deep
- c. 6.4 meters deep at skylight to lower tube

GPS Location (UTM NAD83 Zone 5)

Easting: 184138.7 meters  
Northing: 2185215.3 meters



Figure 36. Opening #9 (View Southwest).



Figure 37. Skylight to lower tube in Opening #9 (View Southwest).

### Opening #10

Collapsed section of lava tube  
Site 50-10-28-15298

Opening 10 is a very shallow, grass filled depression (Figure 38). No intact tube openings exist at either end of this collapsed section of lava tube. Based upon Head and Rosendahl's 1993 map, the lower level lava tube must run beneath Opening #10. There are, however, no skylights or other entrances into this lower tube. Opening #10 rests north of both Opening #9 and Opening #11, and forms a bend in the line of the tube. This bend is, however, reflected in Head and Rosendahl's map of the lower tube.

#### Measurements

- c. 36.5 meters long (roughly east to west)
- c. 17.0 meters wide (roughly north to south)
- c. 2.0 meters deep

GPS Location (UTM NAD83 Zone 5)

Easting: 184247.8 meters

Northing: 2185261.9 meters



Figure 38. Opening #10 (View East).

#### Opening #11

Collapsed section of lava tube  
Site 50-10-28-15298

This relatively small, collapsed section of lava tube is located some distance to the southeast of Opening #10. According to Figure 6 in Head and Rosendahl's 1993 site survey report, the lower level tube follows the general curve of the upper tube, suggesting that it runs beneath Opening 11. There are, however, no skylights or entrances to the lower tube visible from the surface.

Opening 11 is a short and shallow depression that is hardly visible in the high grass (Figure 39). At its eastern end stands a large bedrock boulder. At the base of this boulder is a small tube opening that does not extend very far.

Burial B-4 is located within the subsurface lava tube that runs between Openings #10 and #11.

#### Measurements

- c. 20.5 meters long (roughly east to west)
- c. 6.5 meters wide (roughly north to south)
- c. 1.0 meters deep

GPS Location (UTM NAD83 Zone 5)

Easting: 184445.9 meters  
Northing: 2185187.5 meters



Figure 39. Opening #11 (View Northeast).



Figure 40. Opening #12 (View West).

#### Opening #12

Collapsed section of lava tube  
Site 50-10-28-15298

Opening #12 is a shallow, grass and shrub filled trough that extends for over 138 meters in length (Figures 40 and 41). It is the longest of the collapsed lava tube segments and contains several openings into the lower level lava tube. At its western end is an opening that appears to mark the eastern end of the lower level lava tube as it was mapped in Figure 6 of Head and Rosendahl's 1993 site survey report (Figure 42). A skylight toward the middle of the collapsed tube opens up onto a continuation of the lower lava tube that extends eastward (Figure 43). There is no access to the lower level lava tube from this skylight. Another skylight exists a little further east with, again, no access into the lower tube. About two thirds of the way along the tube is a fourth opening that appears to provide egress to this portion of the lower tube (Figure 44).

#### Measurements

- c. 138.5 meters long (roughly east to west)
- c. 10.0 meters wide (roughly north to south)
- c. 2.5 meters deep
- c. 3.4 meters deep at skylight to lower tube

#### GPS Location (UTM NAD83 Zone 5)

Easting: 184469.7 meters  
Northing: 2185186.7 meters



Figure 41. Opening #12 (View East).



Figure 42. Lower tube entrance at west end of Opening #12 (View West).



Figure 43. Skylight opening to lower tube at Opening #12 (View South).



Figure 44. Entrance to lower tube near the east end of Opening #12 (View East).

### Opening #13

Collapsed section of lava tube

Opening #13 consists of a shallow depression partially covered in fountain grass (Figure 45). It is much smaller than Opening #12, measuring only 22 meters in length, and is oriented roughly southwest to northeast. There is no visible evidence of an intact lava tube entrance at either end of this opening.

#### Measurements

- c. 22.0 meters long (roughly east to west)
- c. 6.3 meters wide (roughly north to south)
- c. 1.5 meters deep

#### GPS Location (UTM NAD83 Zone 5)

Easting: 184626.7 meters

Northing: 2185225.5 meters



Figure 45. Opening #13 (View Southwest).



Figure 46. Opening #14 (View East).

## Opening #14

Collapsed section of lava tube

Opening #14 is located approximately 50 meters north and east of Opening #13. It consists of a shallow trench partially covered in grass (Figure 46). At the western end of this collapsed section of tube is an opening into a lower level lava tube. Examination of the lower tube revealed a light scattering of charcoal atop ledges that run along both sides of the tube, as well as a great deal of roof collapse. This lower tube runs 50 to 60 meters west before growing too narrow to be easily investigated. There is also a small opening at the eastern end of Opening #14, but it is too small to enter.

### Measurements

- c. 30.0 meters long (roughly east to west)
- c. 6.7 meters wide (roughly north to south)
- c. 2.5 meters deep

### GPS Location (UTM NAD83 Zone 5)

Easting: 184689.7 meters  
Northing: 2185253.1 meters

## Opening #15

Collapsed section of lava tube

Site: 50-10-28-15266

Opening #15 is a relatively small, but steep sided collapsed section of lava tube. There is no opening at its western end, though a small hole is visible, suggesting that an opening may be covered by rock fall. There is a larger opening at the eastern end of Opening #15 which connects it to Opening #16 (Figure 47). Just inside this opening, along the south wall, is a small ash deposit. There are no other signs of human activity within the roughly 10 meter long overhang that connects Openings 15 and 16, though there is a great deal of obscuring roof fall. In amongst this roof fall the Pacific Legacy field crew discovered an old site tag which read:

Site 1298-5\*  
1-27-93  
92-1298  
PHRI J.A.H.  
\*BECOMES SITE 15266

This site tag was obviously left during the initial archaeological survey of the project area in 1993. It suggests that this portion of the lava tube complex was initially identified as site 50-10-28-15298, but was re-designated as site 50-10-28-15266. Head and Rosendahl's 1993 site survey report describes site 50-10-28-15266 as a pair of habitation terraces located adjacent to the lava tube complex. These terraces are situated near Openings #15 and #16.

### Measurements

- c. 14.6 meters long (roughly east to west)
- c. 6.0 meters wide (roughly north to south)
- c. 3.0 meters deep

### GPS Location (UTM NAD83 Zone 5)

Easting: 184729.9 meters  
Northing: 2185272.5 meters



Figure 47. Opening #15 showing arched passage into Opening #16 (View Northeast).



Figure 48. Opening #16 (View East).

### Opening #16

Collapsed section of lava tube  
Site: 50-10-28-15266

Opening #16 is the easternmost opening within the project area. It consists of a collapsed section of lava tube that measures approximately 27.5 meters in length (Figure 48). An arched opening at the western end of Opening #16 connects it to Opening #15. A site tag found within the passageway between these two openings indicates that they form part of site 50-10-28-15266. A very low opening at the eastern end appears too small to enter.

An additional opening is located just outside the project boundary on the Palamanui property. It is also a collapsed section of lava tube. Within the floor of the collapsed tube is a skylight measuring approximately 8 by 4 meters and dropping about 3 plus meters into a lower tube. It is impossible to access this lower tube and therefore it is not known how far it extends in either direction.

#### Measurements

- c. 27.5 meters long (roughly east to west)
- c. 9.5 meters wide (roughly north to south)
- c. 2.7 meters deep

#### GPS Location (UTM NAD83 Zone 5)

Easting: 184752.1 meters  
Northing: 2185284.7

APPENDIX B

DESCRIPTIVE LIST AND GPS COORDINATES FOR ADDITIONAL SITES

Additional Archaeological Sites Investigated

Site Number	Field Number	Site Type	Artifact	Midden	Skeletal Remains	Condition	Possible Age	Possible Function	Narrative
50-10-28-15264		Lava Tube/Bubble	None Observed	Present	None Observed	Good	Traditional	Habitation	
50-10-28-15283		L-Shape Wall	None Observed	None Observed	None Observed	Fair	Traditional	Habitation	Portion of the larger complex
50-10-28-15285		Enclosure	None Observed	None Observed	None Observed	Fair	Traditional	Ceremonial	
50-10-28-15287		Alignment	None Observed	None Observed	None Observed	Poor	Uncertain	Uncertain	Roughly C-shaped
50-10-28-15287		Petroglyph	None Observed	None Observed	None Observed	Fair	Traditional	Recreation	Papamā
50-10-28-15288		Mound	None Observed	None Observed	None Observed	Fair	Traditional	Marker	
50-10-28-15303		Modified Overhang	None Observed	None Observed	None Observed	Fair	Traditional	Habitation	
50-10-28-26700	T-001	Petroglyph	None Observed	None Observed	None Observed	Good	Traditional	Art	Male Human Figure



GPS Coordinates for Archaeological Sites

Site Number	Field Number	GPS Location	Easting	Northing
50-10-28-15262		Center	812849	2185179
50-10-28-15264		West End	183707	2184701.7
50-10-28-15283		West End	184131.9	2184450.6
50-10-28-15285		SW Corner	183964.7	2184582.5
50-10-28-15287		East End	183723.5	2184684.1
50-10-28-15287		Center	183737.6	2184683
50-10-28-15288		Center	183766.9	2184587
50-10-28-15303		West End	183985.4	2185093.5
50-10-28-15304		Center	0812858	2185330
50-10-28-26700	T-001	Center	183777.8	2184419.9

Appendix B  
Biological Report

---

---

---

Biological surveys for the  
University of Hawaii Center at West Hawaii  
(UHCWH), North Kona District,  
Island of Hawai'i

---

---



Fountain grass dominates the landscape at UHCWH

Photo by Eric Guinther

AECOS Consultants  
45-309 Akimala Pl.  
Kāne'ohe, Hawai'i 96744

August 26, 2009

---

---

## Biological surveys for the University of Hawai'i Center at West Hawai'i (UHCWH), North Kona District, Island of Hawai'i<sup>1</sup>

---

---

August 26, 2009

Report No. AC047B

Eric B. Guinther, Reginald David, and Steven L. Montgomery, Ph.D.  
AECOS Consultants  
45-309 Akimala Pl.  
Kāne'ohe, Hawai'i 96744  
Phone: (808) 247-3426 Fax: (808) 236-1782 Email: guinther@hawaii.rr.com

---

---

### Introduction

The purpose of this report prepared by AECOS Consultants is to summarize previous survey efforts and present results of recent biological surveys for the proposed University of Hawai'i Center at West Hawai'i (UHCWH), North Kona District on the Island of Hawai'i (Fig. 1). Previous surveys of the University of Hawai'i (UH) property were undertaken in 1998-9 and 2005 (see Herbst, 1998; David and Guinther, 2000; Guinther, David, & Montgomery, 2005). Revisions to the long-range plans for the proposed facility, including a finalization of the campus subdivision site within the larger property, necessitate preparation of a Supplemental Environmental Impact Statement (WCP, 2009). The 73-ac (29.5-ha) campus site is located along the western side of the state parcel, directly upslope of the proposed Main Street Connector Road and adjacent to the town center being developed for the Palamanui Master Planned Community. The campus site includes parts of Makaula, Haleohiu, and Hamanamana *nā ahupua'a*.

### Survey Methods

**PLANTS** — The 500-ac (202-ha), University of Hawai'i property at Kalaoa (above Keāhole) has been surveyed several times in the past, as have surrounding parcels (Herbst, 1998; Hart, 2003; DOFAW, 2005; Guinther, David, and Montgomery, 2005). The primary purpose of the most recent botanical survey was to locate all trees of the remnant "dry-land forest" known to be present in this area occurring within the campus

---

<sup>1</sup> Report prepared for Wil Chee – Planning, Inc. for the Supplemental EIS and to become part of the public record for the University of Hawai'i Center—West Hawai'i Long Range Development Plan.

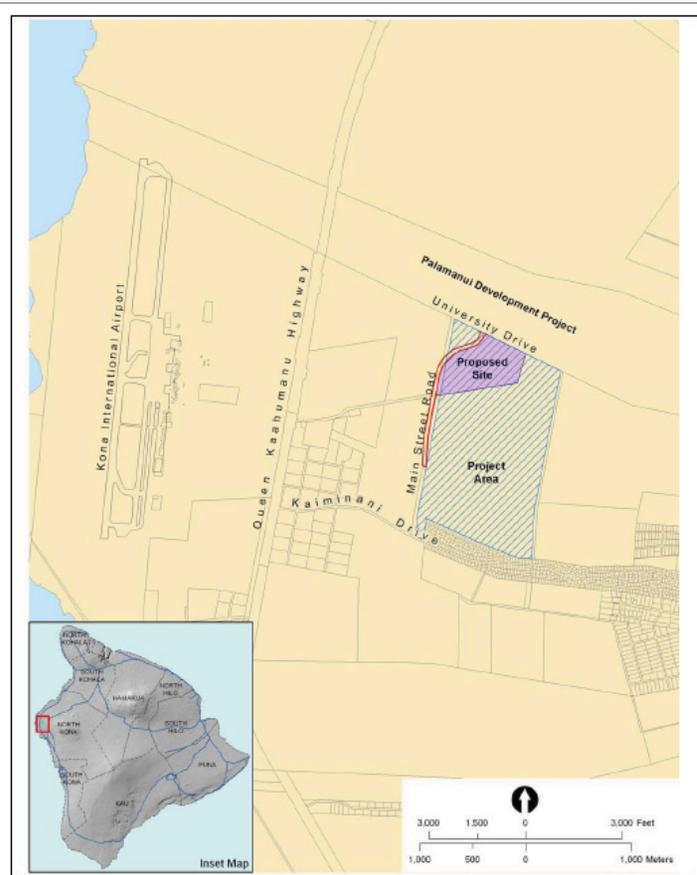


Figure 1. Map showing the project general location on Island of Hawai'i (inset), the 500-acre property ("Project Area"), the 73-acre survey area ("Proposed Site"), and the Main Street Connector Road (red) taken from WCP (2009).

subdivision. This remnant forest does include some federally listed plants. Federal and State of Hawai'i listed species status follows species identified in the following documents (DLNR, 1998, Federal Register, 1999a, 1999b, 2001, 2002, 2004). The botanical survey was undertaken on March 31, 2009 by Eric Guinther under conditions of favorable weather and following a period of average rainfall over preceding months, such that the vegetation was generally healthy and well-developed. Thus, no problems arose with regard to identification of plants encountered either due to there being no flowers or fruit or to not encountering resident plants that would simply not be growing during the dry season (that officially starts in May).

Although all plant species and vegetation types present were noted and estimates of relative abundance (abundant, common, rare, etc.) made, the survey was conducted using a wandering transect that visited each and every tree species (and many of the larger shrubs), recording the position of each with a Trimble GeoXT GPS unit. The survey track was also recorded (Addendum Map).

A plant checklist compiled from observations made by traversing the site in 2005 is included herein, incorporating all new information gained during the March 2009 survey of the campus site. Results of these surveys were compared with a previous survey of the same area (Herbst, 1998) and nearby properties (Char, 1992, 2003; Hart, 2003; DOFAW, 2005). The nomenclature of the higher plants follows that of Wagner, Herbst, and Sohmer (1990, 1999) for both the native and naturalized plants and follows Palmer (2003) for ferns.

**INVERTEBRATES** — Steven L. Montgomery, Ph. D, provided expertise in invertebrate zoology. The primary purpose of the invertebrates survey was to determine if any federally listed endangered, threatened, proposed, or candidate species are extant within the area proposed for UHCWH campus site. Federal and State of Hawaii listed species status follows species identified in DLNR (1998) and Federal Register (1999a, 1999b, 2001, 2002, 2004, 2008b). No attempt was made in this survey to document the many alien species common throughout the lowlands of the Hawaiian Islands. Those mentioned here are important to the health of native invertebrates or humans.

Prior to the field survey, a search was made for publications relating to invertebrates associated with the project area. The review shows no previous native invertebrate surveys in the project area except those done by the present team in prior visits to adjacent UHCWH areas. Searches were made in the electronic catalogs of the Hawaii Public and University of Hawai'i libraries, and electronic and manual catalogs of Bishop Museum Library. The online data bases of Agricola, Google Scholar, Hawaii's Office of Environmental Quality Control, and the NBII Pacific Basic Information Node<sup>2</sup> were

<sup>2</sup> Searches the cataloged specimens of Bishop Museum.

searched. The University of Hawaii's Hawaii Pacific Journal Index which includes listings for the *Proceedings of the Hawaiian Entomological Society* also was searched.

A field survey was conducted at the site in April 15-16, 2009. A general assessment of terrain and habitats was conducted at the start of the survey. Surveying efforts were conducted at various times of day and night, a technique which is vital for a thorough survey. Transects were walked through the property, selecting sampling sites to represent differences in vegetation, and other ecological factors. Special attention was given to known host plants for native invertebrate species which could shelter native invertebrate populations. In addition to host plant searches and visual observation for flying or resting invertebrates, a fine mesh net was swept across plants, leaf litter, rocks, etc. to census any flying, perching, or crawling insects. A light survey was conducted on the night of April 15 using an ultra violet or black light bulb known to be attractive to night active insects. The light survey location is marked on Fig. 2.

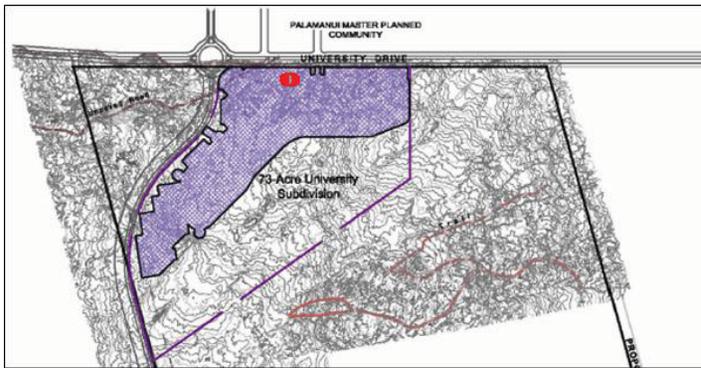


Figure 2. ● = Ultraviolet light study (base map from Figure 3 in UH, 2009).

Invertebrate nomenclature follows *Hawaiian Terrestrial Arthropod Checklist* (HBS2002; Nishida 2002), *Insects of Hawaii* (Zimmerman 1948-80), and *Common Names of Insects & Related Organisms* (HES 1990).

**VERTEBRATES** — Reginald David provided expertise in vertebrate biology. The primary purpose of the zoological surveys was to determine if there were any avian or mammalian species currently listed as endangered, threatened, or proposed for listing under either the federal or the State of Hawaii's endangered species programs on, or within in the immediate vicinity of the proposed development site. Federal and State of

Hawaii's listed species status follows species identified in the following referenced documents (Division of Land and Natural Resources (DLNR) 1998, Federal Register 2005, U. S. Fish & Wildlife Service (USFWS, 2005a, 2008).

Avian phylogenetic order and nomenclature follows *The American Ornithologists' Union Check-list of North American Birds 7<sup>th</sup> Edition* (American Ornithologists' Union 1998), and the 42<sup>nd</sup> through the 49<sup>th</sup> supplements to *Check-list of North American Birds* (American Ornithologists' Union 2000; Banks et al. 2002, 2003, 2004, 2005, 2006, 2007, 2008). Mammal scientific names follow *Mammals in Hawaii* (Tomich 1986). Higher native and naturalized plant names follow *Manual of the Flowering Plants of Hawaii* (Wagner et al. and Wagner and Herbst, 1990, 1999). Place names follow *Place Names of Hawaii* (Pukui et al. 1974).

Eight avian point count stations were placed across the campus project site on March 31, 2009. Stations were evenly spread across the 73-ac site. One eight-minute point count was conducted at each station. Field observations were made using Leitz 10 X 42 binoculars, and by listening for vocalizations. Counts took place between 08:30 a.m. and 10:30 a.m., the peak of daily bird activity. Time not spent conducting point counts was used to search the study site for species and habitats that were not detected during count sessions.

All observations of mammalian species were of an incidental nature. With the exception of the endangered Hawaiian hoary bat (*Lasiurus cinereus semotus*), or 'Ope'ape'a as it is known locally, all terrestrial mammals currently found on the Island of Hawaii are alien species. Most are ubiquitous. No trapping program was proposed or undertaken to quantify the use of the area by alien mammalian species. The survey of mammals was limited to visual and auditory detection, coupled with visual observation of scat, tracks, and other animal sign. A running tally was kept of all vertebrate species observed and heard within the study area.

## Survey Results

The site is located on the western face of Hualalai, upslope from the Keahole Airport (Kona International Airport) between elevations of about 400 to 560 ft (120 and 170 m; Fig. 1). The site is characterized by sloping and undulating ground. The generalized slope map for this area (Hawaii County, 1989) designates the general vicinity as "lowlands" with 5 to 10% slopes. The subdivision (campus) site is a mixture of pahoehoe and 'a'a flows and varies somewhat in ruggedness. At least one large lava tube passes through the campus parcel, evident as a series of depressions and openings where the roof has collapsed. This feature, extending the length of the campus parcel along its southern side, has been designated Archaeological Preserve No. 2.

**VEGETATION** — The vegetation over the 500-ac UH parcel was noted to change distinctly from the southern part of the property to the northern part within the Connector Road corridor. An east-west (*mauka-makai*) gradient is present, as well (Herbst, 1998). The northern sector (campus area) is characterized by a nearly monotypic stand of fountain grass (*Pennisetum setaceum*; Fig. 3) with very widely scattered trees and shrubs (Fig.4), these tending to be a mix of natives and non-natives. Using the classification of Hawaiian plant communities developed by Gagne and Cuddihy (1990), this assemblage represents a Lowland Dry Grassland; specifically, the alien-dominated *Fountain Grass (Pennisetum) Grassland*.



Figure 3. Typical aspect of the lower elevation part of the site near the Main Street Collector Road corridor (photograph taken in 2005).

Nearly all of the herbaceous plants recorded (other than fountain grass) from the Lowland Dry Grassland within the corridor were observed within or on the rocky, stepped margins of collapsed lava tubes or areas disturbed by grading. The upper (higher elevation) part of the campus site shows a transition from a *Fountain Grass (Pennisetum) Grassland* to a Lowland Dry Shrubland, still dominated by fountain grass, but with scattered *koa haole (Leucaena leucocephala)*, Christmas berry (*Schinus terebinthifolius*), 'a'ali'i (*Dodonaea viscosa*), māmane (*Sophora chrysophylla*), and 'alahe'e (*Psidium odoratum*) shrubs present. Widely scattered trees also occur in this area representing the very low elevation limit of the Dry Land Forest developed further

upslope. These trees are mostly *lama (Diospyros sandwicensis)* and *maua (Xylosma hawaiiensis)*, with one 'aiea (*Nothocestrum breviflorum*) and one large silk oak (*Grevillea robusta*) on the campus site (see Addendum Map).



Figure 4. Typical aspect of the upper area of the UH campus site, with very scattered shrubs and trees growing on mixed 'a'a and pahoehoe lava flows dominated by fountain grass (March 2009).

**FLORA** — Table 1 in this report incorporates the most recent survey results with the species listing and abundance estimates from the northern portion of the Connector Road survey undertaken previously (Guinther, David and Montgomery, 2005). The southern sector of the 2005 survey area was noted to differ in a number of respects (see Vegetation, above) from the northern sector and the campus site is entirely within the vegetation area described as the northern sector.

Only 26 species of ferns and flowering plants were recorded in the most recent (March 2009) survey of the campus site. Of these 26 species, 9 (35%) are native species (five are endemics). An additional early Polynesian introduction (*noni* or *Morinda citrifolia*) was recorded.

In the plant survey of April 2005 (Guinther, David, and Montgomery, 2005), a total of 42 different species of plants were recorded as growing in the survey area that extended

Table 1. Listing of plants (flora) for the UHCWH segment of the Main Street Collector Road and the West Hawai'i Campus Center, North Kona District, Hawai'i

Species	Common name	Status	Abundance AREA N	CAMPUS CTR	Notes
<i>FERNS</i>					
PTERIDOPHYTA					
DRYOPTERIDACEAE					
<i>Nephrolepis multiflora</i> (Roxb.) Jarrett ex Morton.	Asian sword fern	Nat	R	R	<1>
THELYPTERIDACEAE					
<i>Christella</i> cf. <i>parasitica</i> (L.) H. Lévy	---	Nat	---	R	<1>
<i>FLOWERING PLANTS</i>					
DICOTYLEDONE					
AMARANTHACEAE					
<i>Amaranthus spinosus</i> L.	spiny amaranth	Nat	R	---	<1>
ANACARDIACEAE					
<i>Schinus terebinthifolius</i> L.	Christmas berry	Nat	---	O	
ASTERACEAE (COMPOSITAE)					
<i>Gamochaeta purpurea</i> (L.) Cabr.	---	Nat	R	R	<1>
<i>Pluchea carolinensis</i> (Jacq.) G. Don	sourbush	Nat	R	---	
CACTACEAE					
<i>Opuntia ficus-indica</i> (L.) Mill.	<i>panini</i>	Nat	R	---	
CAPPARACEAE					
<i>Capparis sandwichiensis</i> DC	<i>maiapilo</i>	<b>End</b>	O	---	
CHENOPODIACEAE					
<i>Chenopodium carinatum</i> R. Br.	---	Nat	R	R	<1>
<i>Chenopodium murale</i> L.	<i>'aheahea</i>	Nat	U	---	<1>
CUCURBITACEAE					
<i>Momordica charantia</i> L.	wild bittermelon	Nat	R	---	<1>
Indet.	?squash	Orn	R	R	<2>
EBENACEAE					
<i>Diospyros sandwicensis</i> (A. DC) Fosb.	<i>lama</i>	<b>End</b>	---	O	
EUPHORBIACEAE					
<i>Chamaesyce hirta</i> (L.) Millsp.	garden spurge	Nat	R	---	
<i>Ricinus communis</i> L.	castor bean	Nat	---	R	<1>
FABACEAE					
<i>Acacia farnesiana</i> (L.) Willd.	<i>klu</i>	Nat	R	R	
<i>Chamaecrista nictitans</i> (L.) Moench	partridge pea	Nat	R	R2	
<i>Indigofera suffruticosa</i> Mill.	indigo	Nat	O	U	
<i>Leucaena leucocephala</i> (Lam.) deWit	<i>koa haole</i>	Nat	O	O	
<i>Sophora chrysophylla</i> (Salisb.) Seem.	<i>māmāne</i>	<b>End</b>	--	U	

Table 1. (continued).

Species	Common name	Status	Abundance AREA N	CAMPUS CTR	Notes
FLACOURTIACEAE					
<i>Xylosma hawaiiensis</i> Seem.	<i>maua</i>	<b>End</b>	R	R	
LAMIACEAE					
<i>Plectranthus parviflorus</i> Willd.	<i>'ala'ala wai nui wahine</i>	<b>Ind</b>	U	---	<1>
MALVACEAE					
<i>Abutilon grandifolium</i> (Willd.) Sweet	hairy abutilon	Nat	R	R	<1>
<i>Sida fallax</i> Walp.	<i>'ilima</i>	<b>Ind</b>	---	---	
MYOPOURACEAE					
<i>Myoporum sandwicense</i> A. Gray	<i>naio</i>	<b>Ind</b>	O	U	
MYRTACEAE					
<i>Metrosideros polymorpha</i> Gaud.	<i>'ōhi'ā lehua</i>	<b>End</b>	R	R	
PHYTOLACCACEAE					
<i>Rivina humilis</i> L.	coral berry	Nat	R	---	<1>
PIPERACEAE					
<i>Peperomia leptostachya</i> Hook & Arnott	<i>'ala'ala wai mui</i>	<b>Ind</b>	U	---	<1>
PORTULACACEAE					
<i>Portulaca oleracea</i> L.	pigweed	Nat	U	R	<1>
<i>Portulaca pilosa</i> L.	---	Nat	U	---	<1>
<i>Talinum fruticosum</i> (L.) Juss.	---	Nat	U	---	<1>
PROTEACEAE					
<i>Grevillea robusta</i> A. Cunn. Ex R. Br.	silk oak	Nat	R	R	
RUBIACEAE					
<i>Morinda citrifolia</i> L.	<i>noni</i> , Indian mulberry	<b>Pol</b>	U	R	<1>
<i>Psydrax odoratum</i> (G. Forster) A.C. Sm. & S. Darwin	<i>alaha'e</i>	<b>Ind</b>	O	O	
SAPINDACEAE					
<i>Dodonaea viscosa</i> Jacq.	<i>'a'ali'i</i>	<b>Ind</b>	O	O	
SOLANACEAE					
<i>Nothocestrum breviflorum</i> A. Gray	<i>'aiea</i>	<b>End</b>	O	O	<3>
STERCULIACEAE					
<i>Waltheria indica</i> L.	<i>'uhaloa</i>	<b>Ind</b>	R	R	
VERBENACEAE					
<i>Lantana camara</i> L.	lantana	Nat.	R	R	
MONOCOTYLEDONES					
COMMELINACEAE					
<i>Commelina benghalensis</i> L.	---	Nat.	R	--	<1>
POACEAE (GRAMINEAE)					
<i>Pennisetum setaceum</i> (Forssk.) Chiov.	fountain grass	Nat.	AA	AA	

Table 1 (continued).

**Legend to Table 1**

Status = distributional status  
**End.** = endemic; native to Hawaii and found naturally nowhere else.  
**Ind.** = indigenous; native to Hawaii, but not unique to the Hawaiian Islands.  
**Nat.** = naturalized, exotic, plant introduced to the Hawaiian Islands since the arrival of Cook Expedition in 1778, and well-established outside of cultivation.  
**Orn.** = exotic, ornamental or cultivated; plant not naturalized (not well-established outside of cultivation).  
**Pol.** = Polynesian introduction before 1778.

Abundance = occurrence ratings for plants in Areas "N" on April 21, 2005 and Campus Center in 2009.  
**R** - Rare - only one or two plants seen.  
**U** - Uncommon - several to perhaps a dozen plants observed.  
**O** - Occasional - found regularly, but not abundant anywhere.  
**C** - Common - considered an important part of the vegetation and observed numerous times.  
**A** - Abundant - found in large numbers; may be locally dominant.  
**AA** - Abundant - abundant and dominant; defining vegetation type.

"AREA N" refers to the northern portion of the Main Street Connector Road corridor surveyed by Guinther, David, and Montgomery (2005).  
 "CAMPUS CTR" lists species and relative abundances for the March 31, 2009 survey.

Notes:  
 <1> Observed only in AREA N in or associated with collapsed lava tubes.  
 <2> Plant lacking fruits or flowers; identification uncertain.  
 <3> Listed species (endangered).

fully across the University of Hawai'i parcel (a survey concentrated on the proposed route for the Connector Road). The entire 500-ac parcel had been surveyed previously for plants by Herbst (1998), who recorded 35 different species. Of the 42 different species found in the 2005 survey, 10 species (23.8%) are recognized as native to the Hawaiian Islands, with three endemic (unique to the Islands) and 7 indigenous (native to Hawai'i, but also found naturally elsewhere in the Pacific Basin) plants. Herbst (1998) found 13 (37%) native species in his survey. Thus, while the majority of species present are alien plants that have become naturalized in this low elevation environment on leeward Hawai'i, the proportion of native species (nearly one-quarter to a third) is moderately high in comparison with most lowland locations in the Islands. Unfortunately, with the exception of *'ilima*, numbers of individuals and total biomass of native species in the road corridor and the campus site are very low in comparison with alien species numbers and biomass.

In Table 1, entries to the listing of plants present in the survey areas are arranged alphabetically under family names (separated by higher taxa, in this case monocots and dicots). Estimated qualitative abundance values are relative to the specified subareas within the survey boundaries. Included are the scientific name, the common name, and status of the species. Separate abundance columns are provided for the present (2009) and previous (2005, northern sector) surveys.

**INVERTEBRATES** — Few native arthropods were observed during the searches, and no telltale species specific feeding damage was found. One abundant, introduced

arthropod was the bigheaded ant (*Pheidole megacephala*) which tends sap-sucking insects, as well as eating most other insects. Also plentiful were longlegged ants (*Anoplolepis longipes*). Table 2 lists invertebrates encountered, including the prominent alien species and the few native arthropods collected or observed.

Table 2. Listing of Invertebrates for the UHCWH segment of the Main Street Collector Road and the West Hawai'i Campus Center, North Kona District, Hawai'i

Species	Common name	Status	Abundance	Notes
<b>INSECTA (INSECTS)</b>				
<b>Coleoptera</b>				
<b>Anobiidae</b>				
<i>Xyletobius euphorbiae</i> Perkins, 1910		End	U	on akoko
<b>Cerambycidae</b>				
<i>Plagithmysus montgomeryi</i> Gressitt & Davis, 1972.?	longhorn borer	End	?	visual only
<b>Scolytidae</b>				
<i>Hypothenemus eruditus</i> (Westwood, 1835)	shot hole borer	Adv	U	on akoko
<b>Diptera: Drosophilidae</b>				
<i>Drosophila melanogaster</i> Meigen, 1830	vinegar gnat	Adv	U	on lama fruits
<b>Lepidoptera:</b>				
<b>Cosmopterigidae</b>				
<i>Hyposmocoma liturata</i> Walsingham, 1907	casebearers	End	C	at light
<i>Hyposmocoma</i> sp. 2		End	C	at light
<b>Crambidae</b>				
<i>Orthomecyna</i> sp. near <i>amphilyca</i>	micro-moths	End	U	at light
<i>Tamsica hyacinthata</i> (Meyrick, 1899)	grass moth	End	R	
<b>Alucitidae</b>				
<i>Alucita objurgatella</i> (Walsingham, 1907)		Adv	U	at light
<b>Xyloryctidae</b>				
<i>Thyrocopa pulverulenta</i> Walsingham, 1907		End	R	at light
<b>Homoptera: Psyllidae</b>				
<i>Trioza hawaiiensis</i> Crawford, 1918		End	U	ohia galls
<b>Hymenoptera</b>				
<b>Anthophoridae</b>				
<i>Ceratina</i> sp.	small carpenter bee	Adv	C	
<b>Apidae</b>				
<i>Apis mellifera</i> Linnaeus, 1758	honey bee	Pur	C	
<b>Formicidae</b>				
<i>Pheidole megacephala</i> (Fabricius, 1793)	bigheaded ant	Adv	O	
<i>Anoplolepis gracilipes</i> (F. Smith, 1857)	longlegged ant	Adv	C	
<b>Vespidae</b>				
<i>Polistes exclamans</i> Viereck, 1906	wasps common paper wasp	Adv	C	

Table 2 (continued).

<b>ARACHNIDA</b>				
<b>Acari: Eriophyidae</b>	broom mites	?	U	galls on <i>lama</i>
<i>Eriophyes</i> sp.				
<b>Araneae: (SPIDERS)</b>				
<b>Araneidae</b>				
<i>Argiope appensa</i> (Walckenaer, 1841)	garden spider	Adv	A	
<b>Pholcidae</b>				
<i>Pholcus phalangiodes</i> (Fuesslins, 1775)	long legged spider	Adv	U	

## Legend to Table2

Status:	
End	endemic to Hawaiian Islands
Ind	indigenous to Hawaiian Islands
Adv	adventive
Pur	purposefully introduced
?	unknown

## Abundance = occurrence ratings:

R	Rare: seen in only one or perhaps two locations
U	Uncommon: seen at most in several locations
O	Occasional: seen with some regularity
C	Common: observed numerous times during survey
A	Abundant: found in large numbers
AA	Very abundant: abundant and dominant

## COLEOPTERA (Beetles)

Cerambycidae: *Plagithmysus* sp. presumed *montgomeryi* Gressitt & David, 1972

*Plagithmysus* is a large group of beetles with many endemic species on Hawai'i Island. The larvae of this native beetle make distinctive feeding galleries. Empty galleries which may have been made by this species were seen in Akoko plants. Habitat and host plants are fairly restricted meaning this is most likely *Plagithmysus montgomeryi*. This genus feeds only on dead, dying, or injured parts of the tree and is not considered a 'pest' (Swezey 1954).

*Hypothenemus eruditus* (Westwood, 1835) was previously described as an endemic, *H. insularis* Perkins (1900), by Swezey (1954), but is now considered 'lumped' with *H. eruditus*, an adventive species.

## LEPIDOPTERA

Cosmopterigidae: *Hyposmocoma*

Two species of adult native *Hyposmocoma* moths came to light, but no caterpillars were seen. Properly called "case bearers," the caterpillars are sometimes misleadingly called "bagworms." Very young caterpillars of case bearers find safety in a hiding place like a leaf curl. When growth forces them out of that protection, they intricately weave a portable shell of their own silk from a lip spinneret. For camouflage, they add bits of

their surroundings to the case using their silk: snips of dry grass or leaves, flakes of bark, maybe a little dirt. The case is then easily mistaken by a predator as another part of the landscape. These bunkers are fitted with a hinged lid (operculum), pulled shut by mini-mandibles to defend them from enemies like beetles and micro wasps. Their relationship to the case is similar to that of a hermit crab to his shell. Although not physically connected to the case as a snail or turtle, they are dependent on it, and die if removed – even if protected from predators and given food. They don't move far, but feed while partly emerged from the case, dragging along their protective armor by their six true legs. (Manning/Montgomery in Liittschwager & Middleton 2001) With over 500 kinds, *Hyposmocoma* micromoths are the greatest assemblage of Hawaiian Island moths, showing astonishing diversity. After writing 630 pages on them, Dr. Elwood Zimmerman lamented the inadequacy of his study. He noted an enormous cluster of species with explosive speciation and diverging radiation (Zimmerman 1978). Much remains to be learned about the life ways of this interesting group of insects now under study by University of Hawaii's Dr. Daniel Rubinoff and colleagues (Rubinoff et al. 2008).

## ARACHINIDA

Acari: *Eriophyes* sp.

Only two species are known from Hawai'i Island: adventive *E. cymodoniensis* (Sayed, 1946) and possible endemic *E. peleae* Keifer, 1973.

**MEDICALLY IMPORTANT INVERTEBRATES** — The large garden spider (*Argiope appensa*) is occasionally found in the area. It is not considered a human health risk. Honey bee colonies, and common paper wasp nests were observed. Many of the alien species of medical importance (centipedes, scorpions, widow spiders) were not observed during this survey, but could be present anywhere in the Hawaiian Islands. Employees should always be alert for their presence. Any of the species may pose a serious risk to specific individuals, and supervisors should be aware of any special allergy by employees. Some individuals can experience anaphylactic reactions to venom and should immediately seek medical assistance.

The stinging nettle caterpillar (*Darna pallivitta*) is known on Hawai'i Island, but not from dry areas such as the project site. This introduced pest is spreading; however the project site is at present unlikely to support this species. After construction, care should be taken. Decorative plantings can create a moister environment more inviting to the pest, or eggs could be brought in on a potted plant. The caterpillar's stinging spines may cause burning and itching sensations on the skin. Swelling and welts can last for several days, then a persistent rash may last for weeks. For any severe symptoms, especially breathing difficulty, seek medical help immediately. (DOA, HEAR)

When moving trash, stones, or piled brush, the use of gloves and long sleeves, covered shoes and long pants will greatly reduce the risk of accidental contact and bites or stings

by any of the mentioned species. Pulling socks up over pant cuffs (socks on outside) reduces the chance of a stinging invertebrate crawling up a pant leg. Please see *What Bit Me?* (Nishida and Tenorio 1993) and *What's Bugging Me* (Tenorio & Nishida, 1995) for photos and discussion of Hawaii's long-standing invertebrate health hazards.

**BIRDS** — A total of 61 individual birds of 10 different species, representing 8 separate families were recorded during station counts (Table 3). One additional species, Barn Owl (*Tyto alba*), was detected as an incidental observation while transiting between count stations. All of the species detected are considered to be alien to the Hawaiian Islands.

Table 3. Avian species detected within the proposed UH Center, West Hawaii campus site.

Common Name	Scientific Name	ST	RA
GALLIFORMES			
PHASIANIDAE - Pheasants & Partridges			
Phasianinae - Pheasants & Allies			
Black Francolin	<i>Francolinus francolinus</i>	A	1.25
COLUMBIFORMES			
COLUMBIDAE - Pigeons & Doves			
Rock Pigeon	<i>Columba livia</i>	A	0.13
Zebra Dove	<i>Geopelia striata</i>	A	0.13
STRIGIFORMES			
TYTONIDAE - BARN OWLS			
Barn Owl	<i>Tyto alba</i>	A	I-1
PASSERIFORMES			
MIMIDAE - Mockingbirds & Thrashers			
Northern Mockingbird	<i>Mimus polyglottos</i>	A	1.38
STURNIDAE - Starlings			
Common Myna	<i>Acridotheres tristis</i>	A	0.63
CARDINALIDAE - Cardinals Saltators & Allies			
Northern Cardinal	<i>Cardinalis cardinalis</i>	A	0.75
FRINGILLIDAE - Fringilline and Cardueline Finches & Allies			
Carduelinae - Carduline Finches			
House Finch	<i>Carpodacus mexicanus</i>	A	1.13
Yellow-fronted Canary	<i>Serinus mozambicus</i>	A	0.50
ESTRILDIDAE - Estrildid Finches			
Estrildinae - Estrildine Finches			
African Silverbill	<i>Lonchura cantans</i>	A	1.63
Java Sparrow	<i>Padda oryzivora</i>	A	0.13

Table 3 (continued).

#### Legend to Table 3

<b>ST</b>	Status:
<b>A</b>	Alien Species
<b>RA</b>	Relative Abundance - Number of birds detected divided by the number of count stations (8)
<b>I-</b>	Incidental observation - A species recorded as an incidental observation followed by the number detected

Avian diversity and densities were exceptionally low, though in keeping with the xeric nature of the habitat present on the project site. Three species, African Silverbill (*Lonchura cantans*), Northern Mockingbird (*Mimus polyglottos*), and Black Francolin (*Francolinus francolinus*), accounted for 56% of the total number of birds recorded. African Silverbills were the most frequently recorded species, accounting for 21% of the total number of birds recorded during the course of this survey.

**MAMMALS** — Four mammalian species were detected during the course of this survey. A number of barking dogs (*Canis f. familiaris*) were heard barking from within the Palisades subdivision. The entire study area was strewn with goat (*Capra h. hircus*) scat. Additionally, skeletal remains of both cattle (*Bos taurus*), and goats were encountered at several locations on the site. All four of the mammalian species detected during the course of this survey are considered to be alien to the Hawaiian Islands.

## Discussion

**PLANT RESOURCES** — Within the general project area, there occurs an elevational shift in the character of the vegetation related to the rainfall gradient: much drier conditions prevail at the coast (median annual rainfall of around 15 in or 380 mm; Taliaferro, 1959; Waimea Water Services, 2003), giving way to annual rainfall medians of 40 to 50 inches (1000-1300 mm) at the 4000-ft (1200-m) elevation. Even wetter conditions prevail around the southwest side of Hualālai above Kailua-Kona, but the increase in rainfall and fog drip received on average above Keāhole Point is sufficient to significantly effect the vegetation. A survey by Hart (2003) of the adjacent Palamanui parcel and covering a wider elevational range than our current survey, described the vegetation patterns thusly:

*Below 500 ft (<150 m) – Pennisetum grassland with scattered native and introduced trees and shrubs.*  
*500 to 650 ft (150 – 200 m) – Pennisetum scrub: shrubs (mostly `a`ali`i, koa-haole, and Christmas berry) co-dominant with fountain grass; occasional native trees such as lama, alahe`e, mamane, iliahi, and wiliwili).*  
*650-900 ft (200-275 m) – Lowland Dryland Forest (Gagne and Cuddihy, 1990) dominated by lama, alahe`e, and iliahi.*

In consideration of the remnant dryland forest containing many rare native trees reported by Hart (2003) for Palamanui (Kau 'ahapua'a), the State of Hawaii conducted its own informal survey of state-owned lands at Pu'ukala, directly adjacent to Kau on the north (DOFAW, 2005). Again, remnants of a native dry land forest were found with a number of listed or rare native tree species. It is clear from both of these surveys, that most of the vegetation having high resource value and/or sensitivity occurs above 600 ft (180 m). The plot of rare trees by Hart (2003) on an aerial photograph of Kau, shows the native trees below 650 ft (200 m) are mostly associated with the more barren lava areas (that is, areas of sparse fountain grass). Possibly, this distribution reflects areas at low (barren) and high (grassy) risk for fires. The campus site is a mix of relatively bare and relative dense growth areas of fountain grass. Scattered occurrences of several native trees occur within the project area, although the remnant trees of this association are very sparsely distributed on the campus site.

A total of 38 plants were logged, although some were large 'a'ali'i, naio, and mamane shrubs. Primary interest was in the 'aiea (1), maua (3), 'ohi'a (1 live, 1 dead), and lama (21) trees on the site (numbers in parentheses represent number of individuals logged). Not logged were several large trees, no longer alive that resembled *kiawe*. As can be seen from the map, the trees are limited mostly to the eastern half of the subdivision parcel and are rather widely spread apart. The area surveyed was entirely covered by fountain grass, which was however sparse in some areas of bare lava. A similar survey conducted by Hart (2003) for the adjacent Palamanui Planned Community development showed a similar scattered growth of maua, 'aiea, uhiuhi, and wiliwili near the boundary separating the Palamanui and UH parcels. In fact, four plants whose positions were recorded by Hart plot to the south side of the Kau/Makaula boundary: two maua (*Xylosma hawaiiense*), one 'aiea (*Nothocestrum breviflorum*), and one wiliwili (*Erythrina sandwicensis*); all but the last species are within the UH campus parcel (see Addendum Map). A maua, lama, and 'aiea growing close together were at one time surrounded by an orange plastic enclosure fence. The fence has since deteriorated and damage by goats to the 'aiea is evident.

One unusual result of the March 2009 survey was the apparent absence of *maiapilo* (*Capparis sandwichiana*; Fig. 5), which although not common in 2005 was listed as an occasional species, particularly towards the north end of the proposed road corridor. It is possible that this plant is still present in the same area, but simply does not occur further up the slope, where the March 2009 survey was conducted (note the dogleg in the road as now proposed eliminated much of the far northern part of the road corridor survey area from the campus site survey; Fig. 1).

In a 1999 report for the UHCWH project, Herbst included a table of listed and rare plant species found or potentially found on the 500-ac property. This table is reproduced and updated here as Table 4. Only species followed by Note <1> are known to be present in the UH campus site.



Figure 5. Shrubby *maiapilo* (*Capparis sandwichiana*), present in the roadway corridor but not seen in the campus site, is a native endemic whose populations are considered vulnerable throughout the state.

Table 4. Listed and rare or vulnerable plants occurring or potentially occurring in the University of Hawai'i 500-ac parcel.

SPECIES (Hawaiian name)	STATUS	NOTE
<i>Bidens micrantha</i> ssp. <i>ctenophylla</i> (ko'oko'olau)	Candidate species	<3>
<i>Caesalpinia kavaensis</i> (uhiuhi)	Listed, endangered	<2>
<i>Capparis sandwichiana</i> (maiapilo)	Rare, vulnerable	<2>
<i>Colubrina oppositifolia</i> (kauila)	Listed, endangered	<3>
<i>Nothocestrum breviflorum</i> ('aiea)	Listed, endangered	<1>
<i>Pleomele hawaiiensis</i> (hala pepe)	Listed, endangered	<2>
Notes:		
<1> Present on the campus parcel in small numbers (see text).		
<2> Reported from on and off the property, but not the campus subdivision site.		
<3> Not reported in recent surveys on or off property; known from leeward Hawai'i.		

INVERTEBRATE RESOURCES — Arthropod life cycles often are keyed to seasonal changes, cyclically altering the species collected. Many arthropods time their emergence and breeding to overlap or follow seasonal weather or to coincide with growth spurts of

an important plant food. This survey came at the end of the winter rains and the vegetation was in good condition to support arthropod populations. Weather was favorable for collecting on both days of the survey. Monitoring at a different time of the year would produce a longer or different arthropod list. At 65% of the disk visible the waning gibbous moon did present some competition to the light survey, but rose after mid-night leaving several moon-free hours for monitoring (USNO). There were no competing streetlights or other distractions, however, and passing clouds reduced interference from time to time. The absence of native invertebrate host plants was a much greater factor in survey findings.

No native arthropods or other invertebrates on the federal or state endangered, threatened, proposed, or candidate lists were seen (Fed. Reg. 2008a). The area provides habitat for only a few native arthropods. Native forest cover accounts for a very small portion of the vegetation and large areas are dominated by fountain grass (*Pennisetum setaceum*). The lack of native host plants is a major factor in the lack of native invertebrates. *Maiapilo* occurs scattered on parts of the larger 73-acre parcel. Its leaves, however, were not chewed by caterpillars of the micromoth in the *Plutella capparidis* complex. Goat feeding damage to all native species is common, and the presence of predatory ant species (*Pheidole megacephala* and *Anoplolepis longipes*) combines to provide a setting unlikely to support high native arthropod levels.

No native snails were located in this survey.

The project location does not provide appropriate habitat for the Hawai'i Island native *Drosophila* species recently listed as threatened or endangered (Fed Reg 2006, 2008).

The survey did not locate any native *Hylaeus* or yellow-faced bees now being considered for Federal protected status (Hon Star-Bull 2009). Examples of the small carpenter bee (*Ceratina* sp.), known from the Kona area, were found in this survey. Both species access similar host plants in similar ways and on first viewing, in field conditions, it is possible to confuse the two bees (Daly & Magnacca 2003) which have similar overall body size & shape. On close examination, however, the two bees are easily distinguished (Fig. 6).

North Kona is known to support larvae of Blackburn's hawk moth (*Manduca blackburni*)—a federally listed species—on host plants in the Family Solanaceae, such as introduced tree tobacco (*Nicotiana glauca*) and native 'aiea (*Nothocestrum* sp.) (USFWS 2005b). None of the introduced hosts suitable for Blackburn's hawk moth caterpillars was seen during the survey. One 'aiea was examined, but no caterpillars, or feeding evidence was seen. The adult moth was not seen.

A few non-native species reasonably expected to occur on the property were not found. Expected would be the adventive sweet potato hawkmoth (*Agrius cingulata*) and white line sphinx (*Hyles lineata*). Either of these species may be misidentified in flight as *Manduca blackburni*. Difficulties in sampling a large area, at only one season, for a

diversity of invertebrates results in the probability some species may elude even the most experienced collector. Not finding a species does not mean it is not present. Missing species might be found with further survey work, in a longer or seasonally different survey of the property.



Figure 6. Comparison of small carpenter bee (left) and yellow faced bee (right). (photos by A. Manning & S. Montgomery)

## Biological Assessments

### Native shrubs and trees

The UHCWH site supports a sparse growth of native trees and shrubs within a non-native *Pennisetum* grassland. Avoiding all of the trees individually will be difficult, but only one has legal status (i.e., is listed as endangered). That specimen is located near the northern edge of the parcel and can be avoided by the proposed campus development. Indeed, the small cluster of 'aiea, lama, and maua (one specimen each) here was once protected by an enclosure fence and this fence needs to be restored. Once construction

begins, this cluster of three trees must be protected from damage; in the end, the health and safety of these trees will benefit from care and oversight that the campus can provide.

All of the native trees and shrubs in this area are vulnerable to fire and depredation by goats. These trees are surviving at the extreme lower elevation end of their extant range on western Hualālai. To whatever extent existing trees can be included in the landscaping should be considered, and these trees flagged to prevent their loss during construction. Mitigation for plants destroyed by the construction of the campus should include funding plantings of the same species on campus and in the archaeological preserve area expected to be established on the UHCWH site.

Special consideration must be given to the single *'aiea* tree located on the campus site. If federal funding (or any federal nexus) is involved, consultation with U.S. Fish and Wildlife (USFWS) will be required under Section 7 of the Endangered Species Act (ESA). Otherwise, the plant remains protected under ESA and cannot be destroyed (considered a "take" under ESA). This tree, located at the northern edge of the campus site—along with two other trees: a *lama* and a *maua*—should be protected temporarily by erecting a fence around the small cluster to exclude goats and keep construction activities away. A design for long term protection could be erecting a low rock wall around the cluster and providing care for the trees. Once construction is completed, depredation by goats should cease. *Lama*, *maua*, and *māmāne* plants elsewhere on the site are not protected by statute, but should be protected from construction damage if these are located in areas not planned for grading. These would also make excellent landscaping species to replace unavoidable losses.

### Cave (Lava tube) Fauna

A lava tube system crosses the campus site as recognized by the Archaeological Preserves (UH 2009). One feature was explored to the extent possible in 2005 (Guinther, David, and Montgomery, 2005) and no native invertebrates, or habitat likely to support native invertebrates, were discovered. However, it remains possible that unknown lava tubes, or inaccessible segments of known lava tubes, could be present and contain native cave fauna. Lava tubes supporting significant biological resources were discovered at adjacent Kau (Palamanui Project) above 500 ft (150 m) elevation and supported by a surface dryland forest with native trees (Howarth, Preston, & James, 2003). At least two and possibly three large lava tubes cross the roadway corridor, their presence evidenced by collapsed sections. It is highly likely lava tubes, which have access outside this portion of the surveyed property, cross under it and that those tubes could support cave fauna.

### Hawaiian Petrel and Newell's Shearwater

The principal potential impact that the construction and operation of the university campus poses to Hawaiian Petrels and Newell's Shearwaters is the increased threat that birds will be downed after becoming disoriented by exterior lighting that may be required in conjunction with the construction and/or subsequent operation of the campus.

To reduce the potential for interactions between nocturnally flying Hawaiian Petrels and Newell's Shearwaters with external lights and man-made structures, it is recommended that any external lighting that is to be used during construction or is being proposed as permanent outdoor lighting, be shielded (Reed et al. 1985, Telfer et al., 1987). This mitigation would serve the dual purpose of minimizing the threat of disorientation and downing of Hawaiian Petrels and Newell's Shearwaters, while at the same time complying with the Hawaii County Code § 14 – 50 et seq. which requires the shielding of exterior lights, so as to lower the ambient glare caused by unshielded lighting to the astronomical observatories located on Mauna Kea.

### Hawaiian hoary bat

The construction and operation of the proposed campus site is not expected to result in any adverse impacts to the endangered Hawaiian hoary bat, the only listed terrestrial mammalian species present in Hawai'i. It is likely that following build-out of the campus, the increased water, and trees that are likely to be installed will attract volant insect, and thus may provide a new foraging resource for bats on a seasonal basis.

### References

- Ainley, D. G, R. Podolsky, L. Deforest, G. Spencer, and N. Nur. 1995. Kauai endangered seabird study. Volume 2: The ecology of Dark-rumped Petrels and Newell's Shearwaters. Final Report TR-105847-V2, Electric Power Research Institute, Palo Alto, California, by PRBO Stinson Beach, CA.
- \_\_\_\_\_. 1997. New insights into the status of the Hawaiian Petrel on Kauai. *Colonial Waterbirds*, 20 (1): 24-30
- \_\_\_\_\_. 2001. The Status and Population Trends of the Newell's Shearwater on Kaua'i: Insights from Modeling, *In: Scott, J. M, S. Conant, and C. Van Riper III (editors) Evolution, Ecology, Conservation, and Management of Hawaiian Birds: A Vanishing Avifauna*. Studies in Avian Biology No. 22. Cooper's Ornithological Society, Allen Press, Lawrence, Kansas., p. 108-123.

- American Ornithologist's Union. 1998. *Check-list of North American Birds*. 7th edition. AOU. Washington D.C. 829 pp.
- \_\_\_\_\_. 2000. Forty-second supplement to the American Ornithologist's Union *Check-list of North American Birds*. *Auk*, 117: 847-858.
- Banks, R. C., C. R. Terry Chesser, C. Cicero, J. L. Dunn, A. W. Kratter, I. J. Lovette, P. C. Rasmussen, J. V. Remsen, Jr., J. D. Rising, and D. F. Stotz. 2007. Forty-eighth supplement to the American Ornithologist Union *Check-list of North American Birds*. *Auk*, 124: 1109-1115.
- \_\_\_\_\_, \_\_\_\_\_, \_\_\_\_\_, \_\_\_\_\_, \_\_\_\_\_, \_\_\_\_\_, and K. Winker. 2008. Forty-ninth supplement to the American Ornithologist Union *Check-list of North American Birds*. *Auk*, 125: 758-768.
- \_\_\_\_\_, C. Cicero, J. L. Dunn, A. W. Kratter, P. C. Rasmussen, J. V. Remsen, Jr., J. D. Rising, D. F. Stotz. 2002. Forty-third supplement to the American Ornithologist's Union *Check-list of North American Birds*. *Auk*, 119: 897-906.
- \_\_\_\_\_, \_\_\_\_\_, \_\_\_\_\_, \_\_\_\_\_, \_\_\_\_\_, \_\_\_\_\_, \_\_\_\_\_, and \_\_\_\_\_. 2003. Forty-fourth supplement to the American Ornithologist's Union *Check-list of North American Birds*. *Auk*, 120: 923-931.
- \_\_\_\_\_, \_\_\_\_\_, \_\_\_\_\_, \_\_\_\_\_, \_\_\_\_\_, \_\_\_\_\_, \_\_\_\_\_, and \_\_\_\_\_. 2004. Forty-fifth supplement to the American Ornithologist's Union *Check-list of North American Birds*. *Auk*, 121: 985-995.
- \_\_\_\_\_, \_\_\_\_\_, \_\_\_\_\_, \_\_\_\_\_, \_\_\_\_\_, \_\_\_\_\_, \_\_\_\_\_, and \_\_\_\_\_. 2005. Forty-sixth supplement to the American Ornithologist's Union *Check-list of North American Birds*. *Auk*, 122: 1031.
- \_\_\_\_\_, \_\_\_\_\_, \_\_\_\_\_, \_\_\_\_\_, \_\_\_\_\_, \_\_\_\_\_, \_\_\_\_\_, and \_\_\_\_\_. 2006. Forty-seventh supplement to the American Ornithologist's Union *Check-list of North American Birds*. *Auk*, 123: 926-936.
- Banko, W. E. 1980a. Population histories-species accounts seabirds: Hawaiian Dark-rumped Petrel ('Ua'u). Cooperative National Park Resources Studies Unit, University of Hawaii at Manoa, Department of Botany, Technical Report #5B.
- Banko, P. C. 1980b. Population histories-species accounts seabirds: Newell's Shearwater ('A'o). Cooperative National Park Resources Studies Unit, University of Hawaii at Manoa, Department of Botany, Technical Report #5A.

- Bruner, P. L. 2003. Avifaunal and feral mammal field survey of Keahole Generating Station, North Kona, Island of Hawaii. Prep. for Belt Collins Hawaii Ltd. 9 pp.
- Char, W. P. 1992. Botanical survey, Keahole Generating Station expansion, North Kona District, Island of Hawaii. Prep. for CH2M Hill by Char & Associates. July 1992.
- \_\_\_\_\_. 2003. Botanical resources assessment study, Keahole Generating Station, North Kona District, Hawaii. Prep. for Belt Collins Hawaii Ltd. 4 pp.
- Cooper, B. A. 1998. Summer behavior and mortality of Dark-rumped Petrels and Newell's Shearwaters at power lines on Kauai. *Colonial Waterbirds*, 21 (1): 11-19
- \_\_\_\_\_. and R. H. Day. 1995. Kauai endangered seabird study. Volume 1: Interactions of Dark-rumped Petrels and Newell's Shearwaters with utility structures on Kauai, Hawaii: Final Report, TR-105847-V1, Electric Power Research Institute, Palo Alto, California.
- Daly, H. V. and K. N. Magnacca. 2003. *Insects of Hawaii. Volume 17. Hawaiian Hylaeus (Nesoprotopis) Bees (Hymenoptera: Apoidea)*. University of Hawaii Press, Honolulu. 234pp.
- David, R. E. 2000a. Faunal survey of avian and mammalian species within the proposed Kaloko-Honokohau Business Park site, Ka-loko, North Kona District, Island of Hawaii. Prep. for William L. Moore Planning & Lanikai Partners, L.P.
- \_\_\_\_\_. 2000b. Faunal survey of avian and mammalian species, Kona International Airport Master Plan update. Keahole, North Kona, Hawaii. Prep. for Edward K. Noda & Associates & Department of Transportation Airports Division (HDOT-AIR).
- \_\_\_\_\_. 2000c. Faunal survey of avian and mammalian species Kaloko Industrial Park, Phases III & IV, Kaloko, North Kona, Hawaii. Prep. for Wilson Okamoto & Associates and TSA International, Ltd.
- \_\_\_\_\_. 2000d. A survey of avian and mammalian species, Papakonane Golf Course at Mauna Lani, South Kohala District, Island of Hawaii, Hawaii. Prep. for Belt Collins Hawaii.
- \_\_\_\_\_. 2001. Faunal survey of avian and mammalian species on the DHHL Kealahou Project site at, North Kona District, Hawaii. Prep. for PBR Hawaii, Inc. and The Department of Hawaiian Homes. 14 pp.

- David, R. E. 2003. A survey of avian and terrestrial mammalian species on the Verizon Hawaii, Inc. Lot TMK: 3/7-4-08:20, at Keahuolū, North Kona District, Hawai'i. Prep. for Blu Croix Ltd., and Verizon Hawaii, Ltd.
- \_\_\_\_\_. 2004a. A survey of avian and terrestrial mammalian Species on TMK: 7-3-08:47, North Kona District, Island of Hawai'i. Prep. for Smith & Collins L.L.C., Dallas, Texas.
- \_\_\_\_\_. 2004b. A survey of avian and terrestrial mammalian species for the Proposed Hina Lani reservoir and transmission line, North Kona District, Island of Hawai'i. Prep. for Wilson Okamoto Corporation & Hawaii County Department of Water Supply.
- \_\_\_\_\_ and E. B. Gunther. 2000. Faunal survey of terrestrial species within the proposed University of Hawaii Center at West Hawai'i site, North Kona, Hawai'i. Prep. for Wil Chee Planning, Honolulu. 13 pp.
- Day, R. H., and B. Cooper. 1997. Patterns of movement of Dark-rumped Petrels and Newell's Shearwaters on Kauai. *The Condor*, 97: 1011-1027.
- \_\_\_\_\_, \_\_\_\_\_, and R. J. Blaha. 2003. Movement patterns of Hawaiian Petrels and Newell's Shearwaters on the Island of Hawai'i. *Pacific Science*, 57, 2:147-159.
- \_\_\_\_\_, \_\_\_\_\_, and T. C. Telfer. 2003. Decline of Townsend's (Newell's Shearwaters (*Puffinus auricularis newelli*) on Kauai, Hawaii. *The Auk*, 120: 669-679.
- Department of Agriculture (DOA). 2001, updated 2005. New Pest Advisory No. 01-03. Nettle Caterpillar, *Darna pallivitta* Moore. Plant Pest Control Branch, Division of Plant Industry, Hawaii Dept. of Agriculture, Honolulu, HI. 2 pp. <http://www.hawaiiag.org/hdoa/npa/npa01-03-netcat.pdf>
- Department of Land and Natural Resources (DLNR). 1998. Indigenous Wildlife, Endangered And Threatened Wildlife And Plants, And Introduced Wild Birds. Department of Land and Natural Resources. State of Hawaii. Administrative Rule §13-134-1 through §13-134-10, dated March 02, 1998.
- Division of Forestry and Wildlife (DOFAW). 2005. Memorandum dated April 5, 2005 to Laura H. Thielen, Director Office of State Planning from Lisa Hadway (DOFAW).
- Federal Register. 1967. Department of the Interior, Fish and Wildlife Service, Endangered and Threatened Wildlife and Plants. Appendix D – United States List of Endangered Native Fish and Wildlife; 32 FR 4001 –March 11, 1967.

- Federal Register. 1975. Department of the Interior, Fish and Wildlife Service, 50 CFR 17. Endangered and Threatened Wildlife. Lists of Endangered and Threatened Fauna. *Federal Register*, 40(77) (Monday, April 21, 1975): 1751-1790.
- \_\_\_\_\_. 1999a. Department of the Interior, Fish and Wildlife Service, Endangered and Threatened Wildlife and Plants. 50CFR 17:11 and 17:12 – December 3, 1999
- \_\_\_\_\_. 1999b. Department of the Interior, Fish and Wildlife Service, 50 CFR 17. Endangered and Threatened Wildlife and Plants. Endangered and Threatened Wildlife and Plants; Review of Plant and Animal Taxa that are Candidates or Proposed for Listing as Endangered or Threatened; Annual Notice of Findings on Recycled Petitions, and Annual Description of Progress on Listing Actions. *Federal Register*, 64(205) (Monday, October 25, 1999): 57534-57547.
- \_\_\_\_\_. 2001. Department of the Interior, Fish and Wildlife Service, 50 CFR 17. Endangered and Threatened Wildlife and Plants. Notice of Findings on Recycled Petitions. *Federal Register*, 66 No. 5 (Monday, January 8, 2001): 1295 – 1300.
- \_\_\_\_\_. 2002. Department of the Interior, Fish and Wildlife Service, 50 CFR 17. Endangered and Threatened Wildlife and Plants. Review of Species That Are Candidate or Proposed for Listing as Endangered or Threatened; Annual Notice of Findings on Recycled Petition; Annual Description of Progress on Listing Actions. *Federal Register*, 67 No. 114 (Thursday, June 13, 2002): 40657-40679.
- \_\_\_\_\_. 2004. Department of the Interior, Fish and Wildlife Service, 50 CFR 17. Endangered and Threatened Wildlife and Plants. Review of Species That Are Candidates or Proposed for Listing as Endangered or Threatened; Annual Notice of Findings on Resubmitted Petition; Annual Description of Progress on Listing Actions. *Federal Register*, 69 No. 86 (Tuesday, May 4, 2004): 24876-24904.
- \_\_\_\_\_. 2006. *Endangered and Threatened Wildlife and Plants; Determination of Status for 12 Species of Picture-Wing Flies From the Hawaiian Islands*. Department of the Interior, Fish and Wildlife Service, Endangered and Threatened Wildlife and Plants. 50CFR 17. *Federal Register*, 71, No. 89 (May 9, 2006): 26835-26852.
- \_\_\_\_\_. 2008a. Department of the Interior, Fish and Wildlife Service, 50 CFR 17. Endangered and Threatened Wildlife and Plants. *Review of Species That Are Candidates or Proposed for Listing as Endangered or Threatened; Annual Notice of Findings on Resubmitted Petition; Annual Description of Progress on Listing Actions*. *Federal Register*, 73 No. 238 (December 10, 2008): 75175-75244.
- \_\_\_\_\_. 2008b. *Endangered and Threatened Wildlife and Plants; Designation of Critical Habitat for 12 Species of Picture-Wing Flies From the Hawaiian Islands*. Department of

- the Interior, Fish and Wildlife Service, Endangered and Threatened Wildlife and Plants. 50CFR 17. Federal Register, 73, No. 234 (December 4, 2008): 73794-73843.
- Gagne, W. C. and L. W. Cuddihy. 1990. Vegetation, pp. 45-114, *In*: Wagner, W.L., D.R. Herbst, and S.H. Sohmer. *Manual of the Flowering Plants of Hawaii*. University of Hawaii Press and B.P. Bishop Museum, Spec. Publ. 83.
- Guinther, E. B., R. David, and S. L. Montgomery. 2005. Biological surveys for the University of Hawaii Center at West Hawaii (UHCWH) Main Street Collector Road, North Kona District, Island of Hawaii. Prep. for Wil Chee – Planning, Inc. AECOS Consultants No. AC047A: 29 pp.
- Hadley, T. H. 1961. Shearwater calamity on Kauai. *Elepaio*, 21: 60.
- Harrison, C. S. 1990. *Seabirds of Hawaii: Natural History and Conservation*. Cornell University Press, Ithica, N.Y. 249 pp.
- Hart, Patrick. 2003. Biological reconnaissance lands of Ka'u, North Kona, Hawaii. Appendix B. Biological Reconnaissance, *In*: Final Environmental Impact Statement, Palamanui, a project by Hiluhilu Development, Tax Map Key: 3-7-2-05:01 (2004). Group 70 International, Inc., Honolulu.
- Hawai'i Biological Survey (HBS). 2002 update. Hawaiian Arthropod Checklist, online authority file of terrestrial arthropod names for the Hawaiian Islands. B. P. Bishop Museum, Honolulu, Hawai'i. [www2.bishopmuseum.org/HBS/checklist/](http://www2.bishopmuseum.org/HBS/checklist/)
- Hawaii County. 1989. Generalized slope map, Keahole to Kailua Development Plan, North Kona District, County of Hawaii. Prep. by R.M. Towill Corp. for the Planning Department, County of Hawaii. September 1989.
- Hawaii Pacific Journal Index. University of Hawaii. Accessed April 2009. [uhmanoa.lib.hawaii.edu/cgi-bin/Pwebrecon.cgi](http://uhmanoa.lib.hawaii.edu/cgi-bin/Pwebrecon.cgi)
- Hawaiian Entomological Society (HES). 1990. *Common Names of Insects & Related Organisms*. Committee on Common Names of Insects. 87 pp.
- Hawaiian Ecosystems at Risk (HEAR). *Darna pallivitta* (Stinging nettle caterpillar) species summary. accessed Oct. 8, 2008. [www.hear.org/species/darna\\_pallivitta/](http://www.hear.org/species/darna_pallivitta/)
- Honolulu Star-Bulletin. 2009, March 24. *Demise of rare isle bees warned*. [www.starbulletin.com/news/20090324\\_Demise\\_of\\_rare\\_isle\\_bees\\_warned.html](http://www.starbulletin.com/news/20090324_Demise_of_rare_isle_bees_warned.html)
- Henshaw, H.W. 1902. *Complete List of Birds of the Hawaiian Possessions with Notes on their Habits*. Thrum, Honolulu. 146 pp.
- Herbst, D. T. 1998. Botanical survey for the University of Hawai'i Center at West Hawai'i (UHCWH), Hawaii Community College Long Range Development Plan (LRDP), Island of Hawai'i, Hawai'i. Prep. for Wil Chee – Planning, Inc. 12 pp.
- Howarth F. G. 1987. Evolutionary ecology of aeolian and subterranean habitats in Hawai'i. *Trends in Evolutionary Ecology*, 2: 220 – 223.
- \_\_\_\_\_, D. J. Preston, and S. A. James. 2003. Final report. Biological assessment of the lava tubes of the Hiluhilu Development Area, Kau, North Kona, Hawai'i. Prep. for Hiluhilu Development, LLC by Hawaii Biological Survey, B.P. Bishop Museum. HBS Cont. No. 2003-023. 36 p.
- Hue, D., C. Glidden, J. Lippert, L. Schnell, J. MacIvor and J. Meisler. 2001. Habitat use and limiting factors in a population of Hawaiian Dark-rumped Petrels on Mauna Loa, Hawai'i. *In*: J. M. Scott, S. Conant, and C. Van Riper III (eds) *Evolution, Ecology, Conservation, and Management of Hawaiian Birds: A Vanishing Avifauna*. Studies in Avian Biology No. 22. Cooper's Ornithological Society, Allen Press, Lawrence, Kansas, pp. 234-242.
- Jacobs, D.S. 1994. Distribution and abundance of the endangered Hawaiian Hoary Bat, *Lasiurus cinereus semotus*, on the Island of Hawai'i. *Pacific Science*, 48(2): 193-200.
- Lucas, G. and H. Sygne. 1978. The IUCN plant red data book. International Union for Conservation of Nature and Natural Resources, Morges, Switzerland. 540 pp.
- Manning, A., S. L. Montgomery, et al. 2001. Accompanying zoological captions in *Remains of a Rainbow*, National Geographic / Environmental Defense Fund. Liittschwager, D. and S. Middleton, photographers.
- National Biological Information Infrastructure (NBII), Pacific Basic Information Node [pbin.nbio.gov/otherinverts/index.asp](http://pbin.nbio.gov/otherinverts/index.asp)
- Nishida, G. M. (ed.). 2002. Hawaiian terrestrial arthropod checklist. Fourth edition. *Bishop Museum Technical Report*, 22, iv + 313 p.
- Nishida, G. M. and J. M. Tenorio. 1993. *What Bit Me? Identifying Hawai'i's Stinging and Biting Insects and Their Kin*. University of Hawaii Press. 72 pp.
- Office of Environmental Quality Control, EA and EIS Online Library. Accessed Mar and Apr 2009. [oeqc.doh.hawaii.gov/Shared%20Documents/Forms/AllItems.aspx](http://oeqc.doh.hawaii.gov/Shared%20Documents/Forms/AllItems.aspx)

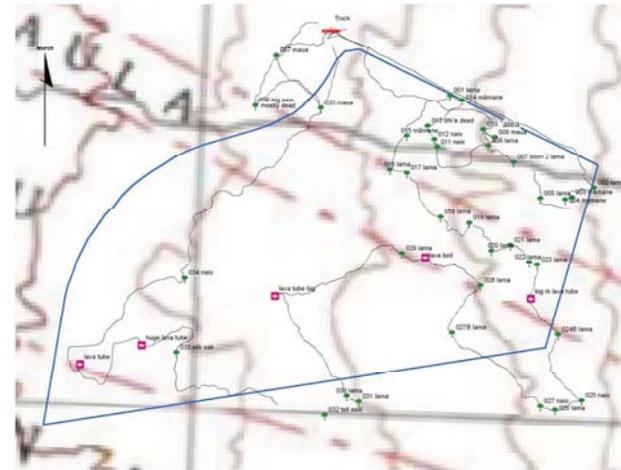
- Palmer, D. D. 2003. *Hawaii's Ferns and Fern Allies*. University of Hawaii Press, Honolulu. 324 pp.
- Perkins, R. C. L. 1913. "Introduction: being a review of the land-fauna of Hawaii," "Vertebrates." In: Sharp, D., ed., *Fauna Hawaiiensis. Vol. 1*. Cambridge University Press, Cambridge, Bishop Museum Special Pub. 6.
- Podolsky, R., D.G. Ainley, G. Spencer, L. de Forest, and N. Nur. 1998. Mortality of Newell's Shearwaters Caused by Collisions with Urban Structures on Kauai. *Colonial Waterbirds*, 21: 20-34.
- Pukui, M. K., S. H. Elbert, and E. T. Mookini. 1976. *Place Names of Hawaii*. University of Hawaii Press. Honolulu, Hawaii. 289 pp.
- Reed, J. R., J. L. Sincock, and J. P. Hailman. 1985. Light attraction in endangered procellariiform birds: Reduction by shielding upward radiation. *Auk*, 102: 377-383.
- Rubinoff, D. et al. 2008. "Molecular systematics & adaptive radiation of Hawaiian endemic moth genus *Hyposmocoma* (Lepidoptera: Cosmopterigidae)". URL: [www.ctahr.hawaii.edu/rubinoff/rubinoff\\_lab/projects/Hyposmocoma/hyposmocoma.htm](http://www.ctahr.hawaii.edu/rubinoff/rubinoff_lab/projects/Hyposmocoma/hyposmocoma.htm)
- Simons, T. R. and C. N. Hodges. 1998. Dark-rumped Petrel (*Pterodroma phaeopygia*). In A. Poole and F. Gill (editors). *The Birds of North America*, No. 345. The Academy of Natural Sciences, Philadelphia, PA. And the American Ornithologists Union, Washington, D.C.
- Swezey, O. H. 1954. *Forest Entomology in Hawaii*. Special Publication 44. B. P. Bishop Museum, Bishop Museum Press, Honolulu, 266 pp.
- Telfer, T. C., J. L. Sincock, G. V. Byrd, and J. R. Reed. 1987. Attraction of Hawaiian seabirds to lights: Conservation efforts and effects of moon phase. *Wildlife Society Bulletin*, 15: 406-413.
- Tenorio, J. M., and G. M. Nishida. 1995. *What's Bugging Me? Identifying and Controlling Household Pests in Hawaii*. University of Hawaii Press. 184 pp.
- Tomich, P.Q. 1986. *Mammals in Hawaii*. Bishop Museum Press. Honolulu, Hawaii. 375 pp.
- U.S. Fish & Wildlife Service (USFWS). 1983. Hawaiian Dark-Rumped Petrel & Newell's Manx Shearwater Recovery Plan. USFWS, Portland, Oregon. February 1983.

- U.S. Fish & Wildlife Service (USFWS). 1998. Recovery Plan for the Hawaiian Hoary Bat. U.S. Fish & Wildlife Service, Portland, Oregon.
- \_\_\_\_\_. 2005a. Endangered and Threatened Wildlife and Plants. 50CFR 17:11 and 17:12 (Tuesday, November 1, 2005).
- \_\_\_\_\_. 2005b. *Recovery Plan for the Blackburn's Sphinx Moth (Manduca blackburni)*. Portland, OR. 125 p.
- \_\_\_\_\_. 2006. USFWS Threatened and Endangered Species System (TESS). Available online at [http://ecos.fws.gov/tess\\_public/StartTESS.do](http://ecos.fws.gov/tess_public/StartTESS.do); last visited on April 2, 2009.
- U.S. Naval Observatory (USNO), Astronomical Applications Department. *Sun and Moon Data*. URL: [www.usno.navy.mil/USNO/astronomical-applications/data-services/rs-one-day-us](http://www.usno.navy.mil/USNO/astronomical-applications/data-services/rs-one-day-us)
- University of Hawaii (UH), Office of Capital Improvements. 2009. Supplemental Environmental Impact Statement Preparation Notice for Revisions and Updates to the University Of Hawaii Center – West Hawaii Long Range Development Plan. (SEISPN). Honolulu, HI. 100 pp.
- Wagner, W. L. and D. R. Herbst. 1999. *Supplement to the Manual of the flowering plants of Hawaii*, pp. 1855-1918. In: Wagner, W.L., D.R. Herbst, and S.H. Sohmer, *Manual of the flowering plants of Hawaii*. Revised edition. 2 vols. University of Hawaii Press and Bishop Museum Press, Honolulu.
- \_\_\_\_\_, \_\_\_\_\_, and S. H. Sohmer 1990. *Manual of the Flowering Plants of Hawaii*. University of Hawaii Press, Honolulu, Hawaii 1854 pp.
- Waimea Water Services, Inc. 2003. Groundwater resources of Kau, North Kona, Hawaii. A water study for Hiluhilu Development, LLC. In: Final Environmental Impact Statement, Palamanui, a project by Hiluhilu Development, Tax Map Key: 3-7-2-05:01 (2004). Appendix J. Group 70 International, Inc., Honolulu.
- Wil Chee Planning (WCP). 2009. Supplemental Environmental Impact Statement preparation notice (SEISPN) for revisions and updates to the University of Hawaii Center—West Hawaii Long Range Development Plan, Kalaoa Hawaii, Hawaii, Tax Map Key (3/7-3-010:042. Prep., for University of Hawaii, Office of Capital Improvements. 100 pp.
- Wilson, S. B., and A. H. Evans. 1890-1899. *Aves Hawaiiensis: The birds of the Sandwich Islands*. R. H. Porter, London.

Zimmerman, E. C. 1948- 80. *Insects of Hawaii*. University of Hawaii Press, Honolulu.

\_\_\_\_\_. 2001. *Insects of Hawai'i. Volume 1: Introduction*. University of Hawai'i Press, Honolulu. xx + 206 pp.

Addendum Map. Project area (survey area outlined in blue; see Figs. 1 and 2 in text) showing track (thin black line) of botanical survey by Guinther and recorded positions of all trees (green) on the property. Background is USGS topographic map. Trees were visible from a distance and the wandering transect purposely visited each one. Many more shrubs of *a'ali'i* in particular exist in this area but shrubs were generally not recorded; the few indicated here are of exceptional stature. Red symbols mark geologic features (e.g., lava tube openings) and vehicle ("truck" at north end) where survey started and ended.



Appendix C  

---

Geotechnical Report



C.W. ASSOCIATES, INC. dba  
**GEOLABS-HAWAII**  
 Geotechnical Engineering, Geology and Environmental Services

June 9, 1998  
 W.O. 3973-00

**Mr. Richard McGerrow**  
**Wil Chee Planning, Inc.**  
 1400 Rycroft Street, Suite 928  
 Honolulu, HI 96814

Dear **Mr. McGerrow**:

Submitted herewith is our report entitled "Preliminary Geotechnical Engineering Exploration, Proposed University of Hawaii Center at West Hawaii, Hawaii Community College, Long-Range Development Plan, Kalaoa, North Kona, Hawaii."

Our work was performed in general accordance with the scope of services outlined in our revised fee proposal of February 17, 1998.

Detailed discussion and recommendations are contained in the body of this report. If there is any point that is not clear, please contact our office.

Very truly yours,

C.W. ASSOCIATES, INC.  
 dba **GEOLABS-HAWAII**

**Robin M. Lim, P.E.**  
 Vice President

RML:ST/SC:mr

(u:\98reports\3973-00.sct-p20)

TABLE OF CONTENTS

	Page
SUMMARY OF FINDINGS AND RECOMMENDATIONS .....	1
INTRODUCTION .....	2
PROJECT CONSIDERATIONS .....	2
PURPOSE AND SCOPE .....	3
Task 1 – Research and Review of Technical Reports and Maps .....	4
Task 2 – Analysis of Aerial Photographs .....	4
Task 3 – Reconnaissance of the Project Site .....	4
Task 4 – Subsurface Exploration of the Project Site .....	4
Task 5 – Engineering Analyses and Report Preparation.....	5
Task 6 – Project Management, Consultation, and Meetings .....	5
REGIONAL GEOLOGY .....	5
SITE DESCRIPTION .....	7
SUBSURFACE CONDITIONS .....	8
DISCUSSION AND PRELIMINARY RECOMMENDATIONS .....	9
Lava Tubes and Voids .....	10
Earthwork .....	11
Excavation .....	14
Site Drainage .....	15
Pavements .....	16
Additional Services .....	18
LIMITATIONS .....	18
PLATES	
Project Location Map .....	Plate 1
Site Plan .....	Plate 2
APPENDIX A	
Boring Log Legend .....	Plate A
Field Exploration and Log of Borings.....	Plates A-1 thru A-4
APPENDIX B	
Injection Testing.....	Plate B-1

(u:\98reports\3973-00.st1-p 21)

PRELIMINARY GEOTECHNICAL ENGINEERING EXPLORATION  
PROPOSED UNIVERSITY OF HAWAII CENTER AT WEST HAWAII

HAWAII COMMUNITY COLLEGE  
LONG-RANGE DEVELOPMENT PLAN

KALAOA, NORTH KONA, HAWAII

W.O. 3973-00 JUNE 9, 1998

SUMMARY OF FINDINGS AND RECOMMENDATIONS

Based on our preliminary site evaluation, we do not believe that there are significant geologic and/or geotechnical constraints which would preclude development of the proposed University of Hawaii Center at West Hawaii Campus at this site. However, there are several geotechnical engineering factors or considerations that should be taken into account in the design and planning for construction of this project.

The proposed site is underlain by variable basalt lava rock formation with little surficial soil cover. Special consideration should be given to reducing the amount of excavation and mass grading in the rock formation to reduce the overall development cost to the project. As a guide, excavations should be kept to less than 15 to 20 feet below the existing ground surface. At these depths of excavations, some blasting of the rock formation will likely be needed to achieve the design grades.

In addition, there is a high potential for encountering significant lava tube or void features during construction at the site. Lava tubes as large as 15 to 20 feet in diameter and several hundred feet or more in length have been encountered during construction of projects in the vicinity. In general, remedial actions consisting of collapsing and backfilling the exposed voids were generally required. In addition, based on our experience on adjacent sites and the preliminary permeability test results, the use of drainage drywells for storm water disposal appears viable at this site.

The text of this report should be referred to for detailed discussion and preliminary recommendations.

GEOTECHNICAL ENGINEERING

INTRODUCTION

This report presents the results of our preliminary geotechnical engineering exploration performed in support of the planning and preliminary engineering for the proposed University of Hawaii Center at West Hawaii project located in the District of North Kona on the Island of Hawaii. The location and vicinity of the proposed site are shown on the Project Location Map, Plate 1.

This report summarizes our findings and preliminary geotechnical engineering recommendations based on our site reconnaissance, field exploration, and literature research performed for the proposed project. These geotechnical findings and preliminary recommendations are intended for general earthwork guidelines, slope stability of cuts and fills, and pavement design for planning and preliminary design purposes only. The findings and preliminary recommendations presented herein are subject to the limitations noted at the end of this report.

PROJECT CONSIDERATIONS

The 500-acre site for the proposed University of Hawaii Center at West Hawaii is located easterly of Keahole Airport and Queen Kaahumanu Highway in Kalaoa in the District of North Kona on the Island of Hawaii. The project site is located within the north central portion of a 2,640-acre parcel owned by the State of Hawaii. The site presently exists as undeveloped land located approximately 1,000 feet northerly of the existing Kaimi Nani Drive mauka-makai roadway serving the Kona Palisades Subdivision. At this time, we understand that it is desired to obtain generalized geotechnical input pertaining to the proposed development of the site for the future University of Hawaii Center at West Hawaii Campus.

The project site currently exists as undeveloped native land. The site is not connected with other improved roadways in the area; therefore, we anticipate that the proposed project will involve development of infrastructure systems including roadways and various utilities to serve the new campus development. We understand that a potable

GEOTECHNICAL ENGINEERING

water source will also need to be developed for this long-range development project. In addition, suitable wastewater systems, potentially including septic tanks with leaching fields and underground injection, would need to be evaluated.

#### PURPOSE AND SCOPE OF WORK

The purpose of our study was to provide preliminary geotechnical engineering recommendations pertinent to the planning of the general earthwork requirements, slope stability of cuts and fills, and structural pavement section for the planning and preliminary design of the proposed campus. Our scope of work generally consisted of the following tasks and work efforts:

1. Research and review of technical reports and maps.
2. Analysis of aerial photographs, where available.
3. Reconnaissance of the project site.
4. Subsurface exploration of the project site.
5. Preparation of preliminary engineering analyses and report.
6. Project management, consultation, and meetings.

Our work efforts were focused on the collection and review of available geologic and geotechnical data. The product of these work efforts is a set of preliminary geotechnical recommendations identifying potential geotechnical engineering constraints that may affect development of this project. Site reconnaissance was conducted to perform a visual ground survey to document other potential geologic hazard areas, in addition to those identified through literature, map, and aerial photographic research and analyses. Furthermore, several test borings were drilled at selected locations near the southern portion of the land parcels to evaluate the general subsurface conditions for storm water run-off disposal.

The near-surface geologic information obtained from our literature study and site reconnaissance, combined with the subsurface information obtained from borings, were used to formulate the preliminary geotechnical engineering recommendations pertaining to

the site selection and planning of the infrastructure at the site. The following tasks summarize the work efforts performed for this phase of the project:

#### Task 1 - Research and Review of Technical Reports and Maps

Available technical reports and maps were collected and the pertinent data was reviewed for use in formulating preliminary geotechnical recommendations for this study. These data included soil types, geotechnical boring information, geologic rock types and structures, and other geomorphic features. The information was obtained from various sources including the project design team, the State of Hawaii – Department of Health Safe Drinking Water Branch, United States Soil Conservation Service, and in-house sources.

#### Task 2 - Analysis of Aerial Photographs

A preliminary review and analysis of limited aerial photographs available was made to evaluate the site with respect to potential geologic hazards. Geologic data obtained from the aerial photographic analysis was further reviewed and confirmed in the field during the field exploration, where possible. The photogeologic information included the location of potential cavities/lava tubes, thick soil deposits, and variation in vegetation, drainage courses, and bedrock exposures.

#### Task 3 - Reconnaissance of the Project Site

A reconnaissance of the site was made to evaluate the features identified on the photogeologic maps. The site reconnaissance also served to identify additional geologic features, which may represent potential hazards or constraints to the proposed development. The information obtained in the field was used to refine and/or modify our understanding of the subsurface conditions for formulation of the preliminary geotechnical recommendations provided herein.

#### Task 4 - Subsurface Exploration of the Project Site

A subsurface exploration was conducted by drilling and sampling four test borings to a depth of about 25 feet below the existing ground surface at selected locations

near the southern portion of the site. The boring data was utilized to evaluate the suitability of the subsurface rock formation for the disposal of storm water runoff at the site. Short-term injection tests were performed in the four borings to evaluate the permeability characteristics of the subsurface materials. Due to the present inaccessibility of the site to vehicular traffic and the presence of significant archaeological features, only a limited boring program was conducted for this preliminary study.

#### Task 5 - Engineering Analyses and Report Preparation

Engineering analyses were performed in support of the formulation of preliminary geotechnical engineering recommendations pertaining to the infrastructure planning and the preparation of guidelines for earthwork specifications governing infrastructure development at the project site.

#### Task 6 - Project Management, Consultation, and Meetings

Meetings and consultation with the project design team to coordinate the work efforts and present our findings and preliminary geotechnical engineering recommendations as the project progresses.

### REGIONAL GEOLOGY

The 500-acre site is located on the southwestern flank of Mount Hualalai. Hualalai is the now dormant shield volcano responsible for the existing geomorphology of the west central portion of the island of Hawaii including the area comprising the subject project site. Hualalai is one of the five sub-aerial volcanoes that formed the island of Hawaii. The other four shield volcanoes include Kohala, Mauna Kea, Mauna Loa, and Kilauea. On-going volcanic activity is occurring at both Mauna Loa and Kilauea volcanoes. Large-scale eruptions of lava from Hualalai are believed to have ceased approximately 130,000 years ago; however, the most recent eruption of lavas occurred relatively recently, in about 1800-1801. These recent lava flows exist northerly of the project site and underlie a portion of the existing Keahole Airport.

In general, the bulk of Hualalai was built during the shield stage of volcanism where voluminous and rapid outpouring of lava flows occurred from the summit and rift zones to form a broad, massive shield extending from below sea-level to near the present day summit elevations. During this period, lava flows from the adjacent volcanoes likely began to coalesce to form the island of Hawaii.

The surface slopes of Hualalai today are generally composed of post-shield stage lava flows consisting of multiple, interbedded pahoehoe and a'a flow types that emanated from the up-slope rift zones of the mountain. Pahoehoe lavas are typical of relatively rapid flowing, more fluid magmas, that pond or spread laterally to form generally smooth or hummocky ground surfaces. The flows are typically vesicular, dense, and layered with generally thin, less competent, and strongly vesicular interbeds of clinker seams.

In contrast, a'a lava or clinker is typical of more viscous, slower flowing lavas and are typified by a ground surface appearance of rubbly, jagged pieces of lava fragments, such as cobbles, boulders or plates of rock material. However, the interior core of a'a lava flows may often be massive, vugular, and very dense rock accumulations surrounded by a surficial and bottom layer of clinker rubble materials.

Both types of lava flows (pahoehoe and a'a) may contain buried voids formed as a result of the cooling of the molten rock and drainage of residual lava from the primary flow pathways. The voids may be expressed as encapsulated pockets or blisters or may be extensive lava tubes or tunnels that at one time carried the bulk of molten lava downslope to the leading edge of the lava flow. It is believed that the larger and more extensive lava tubes are generally found buried within pahoehoe flow types.

Due to the relatively recent age of the volcanics of Hualalai, and much of the island of Hawaii, soil deposits derived from rock weathering are generally rare and thin in extent. Where residual soils are absent, the ground surface may typically consist of a thin brown silty soil representing volcanic ash, which mantles competent rock formation at shallow

depth. Much of the ground surface may be exposed as barren rock with the soil having been deposited within the surface cracks of the rock.

#### SITE DESCRIPTION

A site reconnaissance was conducted to record field observations pertaining to the existing site conditions, soil types, and potential geotechnical hazards at the site. The reconnaissance was performed to confirm preliminary analyses derived from our literature research and aerial photograph review.

The project site encompasses approximately 500 acres within the 2,640-acre land parcel owned by the State of Hawaii. The project site is located approximately 4,500 feet mauka of the existing Queen Kaahumanu Highway. The 500-acre site is bounded by a privately-owned Ka'u Ahupua'a to the north and the Kona Palisades Subdivision to the south. We understand that the eastern boundary will be determined by the boundary of the Urban Land Use Petition, and the western boundary will be dependent on the future mid-level Road alignment.

The project site is situated on the lower southwestern slope of Hualalai with ground surface elevations ranging from about +350 feet Mean Sea Level (MSL) to about +600 feet MSL. The existing ground surface generally slopes down toward the ocean at inclinations of about 5 to 10 percent. The changes in slope appear on a localized scale reflecting the topography of the surface lava flows at the site. Localized mounds and depressions reflect the characteristics of the lava flows as they dispersed and cooled mantling underlying topographic features or met obstructions to flow progress.

The exposed ground surface has been mapped as alkali basalt and trachyte lava flows of 1,500 to 3,000 years (Holocene) in age. The lava flows were observed as both pahoe-hoe and a'a flow types with good distinction between the types. Some volcanic rock features, such as spatter cones and depressions, were observed near the perimeter of the site. The ground surface contained vegetation mainly composed of dry land grasses and scattered shrubs with little surface soil deposits.

GEOLABS HAWAII

An existing Hawaii Electric Light Company transmission line traverses the southern portion of the project site in an east-west direction. We understand that this utility easement has a corridor of approximately 100 to 300 feet in width. An old access road along this transmission line exists, but it is heavily vegetated with wild grasses and small shrubs. No other vehicular access is available to the project site at this time.

A rubbly and fractured ground surface consisting of rock formation was observed, which should provide for good infiltration and permeability at the existing ground surface. Groundwater levels are anticipated to be relatively deep beneath the site and are likely of brackish to saline groundwater quality. The area appears to be situated in an arid to semi-arid climate in the leeward side of Hualalai, which is typified by generally scattered, light intensity, afternoon rain showers.

#### SUBSURFACE CONDITIONS

Our preliminary field exploration at the project site consisted of drilling and sampling four borings, designated as Boring Nos. 1 through 4, extending to a depth of about 25 feet below the existing ground surface. The approximate location of the borings are shown on the Site Plan, Plate 2.

Our field exploration generally encountered a surficial clinker layer consisting of loose to medium dense basalt gravels and cobbles of about 0.5 to 1.5 feet in thickness. The surficial clinkers were generally underlain by slightly to moderately weathered, medium hard to hard basalt formation extending to the maximum depth explored of approximately 25.5 feet below the existing ground surface. In addition, thin layers of loose clinker up to about 2.5 feet in thickness were encountered in Boring Nos. 2 and 3. These thin seams of clinker are typically interbedded in the basalt lava flows.

Although significant cavities and/or voids were not encountered in the four borings drilled, it should be noted that lava tubes, pockets, and blisters are common features found in basalt lava flows. In addition, several prominent lava tube features were observed at northwestern portions of the site during our field reconnaissance. Therefore, a detailed

GEOLABS HAWAII

field exploration should be conducted during the design phase of this project to further evaluate the subsurface conditions throughout the site.

Groundwater was not encountered in the drilled borings at the time of our field exploration. However, it should be noted that groundwater levels are subject to change due to seasonal precipitation, storm water run-off, and other factors. Detailed descriptions of the materials encountered from our field exploration are presented on the Logs of Borings, Plates A-1 through A-4 of Appendix A.

#### **DISCUSSION AND PRELIMINARY RECOMMENDATIONS**

Based on our preliminary broad-scale site evaluation, we do not believe that there are significant geologic and/or geotechnical constraints present at the site, which would preclude development of the proposed University of Hawaii Center at West Hawaii in the area of study. However, there are several geotechnical engineering factors or considerations with regard to the development of the proposed campus that should be addressed in the design and construction of this project including the following:

- Potential for surface and buried lava tubes or voids.
- Mass grading and excavation in rock formation.
- Acceptable subsurface permeability for site drainage.

The potential for surface and buried lava tubes is relatively high at the site considering the numerous lava tubes and/or voids that have been discovered in the vicinity of the site. Presence of the lava tubes should not preclude development at the site as lava tubes are common occurrences on the island of Hawaii. However, provisions should be made in the design and construction of the proposed development to account for the presence of lava tubes in the area of development. These provisions may include proof-rolling of the rock subgrades prior to filling operations and probing and grouting requirements at the foundation locations for the proposed structures at the site.

Based on the subsurface conditions anticipated at the site, we believe that cut slopes may be designed with a slope inclination of 1.5 horizontal to 1 vertical (1.5H:1V) or flatter. Where cut slopes expose dense basalt rock formations, the cut slopes may be steepened to 1H:1V or flatter. Fill slopes constructed of the processed, excavated materials may be designed with a slope inclination of 2H:1V or flatter.

Based on experience with adjacent developments and the results of our permeability tests, the project site is situated on generally permeable ground with subsurface conditions comprising of fractured basalt rock formation. In general, we believe that the use of drywells for the disposal of storm water runoff at this site may be considered favorable from a geotechnical engineering point-of-view.

This preliminary geotechnical engineering evaluation was performed for preliminary assessment of the surface and subsurface conditions at the site only. A design-level geotechnical engineering exploration should be conducted to provide recommendations for design and construction of the campus facilities planned at the site. Detailed discussion of these items and our preliminary geotechnical engineering evaluation are presented in the following sections of this report.

#### **Lava Tubes and Voids**

As previously mentioned, the presence of collapsed and exposed lava tube features of significant size was observed at several locations within the project area during our field exploration. Based on our experience with developments in similar site conditions, we anticipate a high potential for encountering near-surface and shallow buried lava tubes or voids during project construction. The occurrence of large subsurface voids and potential subsequent settlement may adversely impact the performance of foundation systems or pavements, if left undetected. However, it should be noted that the presence of lava tubes and voids should not preclude development of the campus at this site from a geotechnical engineering point-of-view since lava tubes are common occurrences on the island of Hawaii.

Lava tubes as large as 15 to 20 feet in diameter and several hundred feet or more in length have been encountered during construction of projects in the vicinity. Remedial actions, such as collapsing and backfilling of the exposed voids, were required on a case by case basis to progress with the construction of the project. Typically, the smaller, relatively shallow depth lava tubes may be collapsed by the use of heavy construction equipment. Larger lava tubes may require opening of or collapsing the "roof" of the lava tube and backfilling with rock or general fill to backfill the void space.

As a minimum, we believe that proof-rolling the basalt rock subgrades prior to filling and/or construction of improvements on the basalt rock subgrades should be implemented during construction to aid in detecting and collapsing near-surface voids and lava tubes. Proof-rolling should be conducted using heavy construction equipment, such as a Caterpillar D-9 bulldozer or similar heavy equipment. The proof-rolling operations should be conducted under the continuous observation of a qualified geotechnical engineer.

For construction of the proposed structures in support of the campus, we envision that provisions will need to be made for probing and grouting the structure foundation locations to reduce the potential for locating the structure above a lava tube or void. The specific details of the probing and grouting requirements will need to be determined during design following a more detailed field exploration program. Therefore, we recommend that a more detailed reconnaissance and field exploration of the actual site selected for development be performed in an attempt to detect the presence of significant lava tubes.

#### **Earthwork**

In general, the project site slopes gently downward to the ocean at inclinations of about 5 to 10 percent. Localized mounds and depressions are present, reflecting the natural lava flow patterns. Because of the local irregularity of the ground surface, we envision that the mass grading operations will be a significant part of the development of the site in order to provide level areas for construction of the campus structures.

Therefore, we are providing the following general site grading guidelines to be used for preliminary design purposes.

A large portion of the proposed 500-acre site is moderately vegetated with native grasses and small shrubs. At the on-set of earthwork, areas within the contract grading limits should be thoroughly cleared and grubbed. Vegetation growing through cracks in the surface basalt formation was observed in many areas during our site reconnaissance. Due to difficulties associated with grubbing in rocky formations, a screening process may be required to separate excavated fill materials from organic matter. Materials containing excessive amounts of organic matter are not suitable for use as fill materials and should be screened, disposed of off-site, or used in landscape areas, where appropriate.

As previously indicated, lava tube features were observed during our site reconnaissance and should be expected at the site. Therefore, areas designated to receive fill or finished subgrades in cuts should be proof-rolled with a Caterpillar D-9 bulldozer or similar heavy equipment, such as a 20-ton vibratory drum roller, a minimum of six passes to assist in detecting and possibly collapsing near-surface cavities. Soft/loose, weak or yielding areas, or cavities disclosed during site preparation operations should be over-excavated to expose firm ground, and the resulting excavation should be backfilled with general fill material compacted to a minimum of 90 percent relative compaction. The material resulting from the over-excavation should be removed and may be re-used as general fill material provided that the material is processed to meet the requirements of general fill.

Materials to be used as structural fill (6-inch minus fill) should consist of well-graded granular material less than 6 inches in maximum dimension with sufficient fines to prevent the occurrence of voids in the compacted mass. General fill and backfill materials may consist of well-graded granular materials, of which the majority portion is less than 12 inches in size with an absolute maximum dimension of 18 inches. The on-site cut and/or stockpiled material, may be used as structural fill and general fill or backfill materials provided that they are processed to meet the above gradation requirements.

If the excavated materials do not contain sufficient fines to produce a well-graded material, off-site borrow or on-site rock crushing of large-sized rock fragments or boulders may be considered to provide the required gradation and particle sizes to develop a well-graded material.

Structural fill materials should be placed in level lifts not exceeding 12 inches in loose thickness, moisture-conditioned to above the optimum moisture, and compacted to at least 95 percent relative compaction. General fills and backfills should be placed in level lifts not exceeding 12 inches in loose thickness (or equal to the maximum dimension of the fill materials), moisture-conditioned to above the optimum moisture, and compacted to a minimum of 90 percent relative compaction. Relative compaction refers to the in-place dry density of soil expressed as a percentage of the maximum dry density of the same soil established in accordance with ASTM Test Designation D 1557. Optimum moisture is the water content (percentage by weight) corresponding to the maximum dry density. Compaction should be accomplished by sheepsfoot rollers, vibratory rollers, or other types of acceptable compaction equipment.

Boulders, i.e., rock fragments larger than 12 inches in maximum size but less than 5 feet in largest dimension, encountered during site grading may be used as rock fills provided that the following recommendations are followed:

1. Boulders less than 5 feet in largest dimension may be utilized as rock fills provided that the top of the rock fill layer is placed at least 4 feet below the finish subgrades. Boulders larger than 5 feet in maximum dimension should not be used as boulder fill unless reduced in size.
2. Boulders greater than 12 inches in largest dimension should not be exposed at the fill slope face. Boulder placement should be set-back a lateral distance of at least 6 to 8 feet from the edge of the fill slope face.
3. Care must be exercised to avoid placement of boulders in the proposed utility alignment and within the depths of the proposed utility lines to reduce the potential for encountering the boulders during excavation for the utility trenches.

"Rock" fills should be placed in lifts not exceeding the maximum dimension of the rocks. Placement should be by haul-trucks traversing previously placed lifts and dumping at the edge of the currently placed lift. Spreading of the "rock" fill should be by bulldozer to facilitate "seating" of the rock. The rock fill should be watered heavily during placement by water trucks traversing in front of the current rock lift face and spraying water continuously during placement. Compaction equipment (such as a Caterpillar D-9 bulldozer or similar heavy compaction equipment) providing suitable energy to achieve the required compaction should be utilized.

Conventional compaction testing is generally not practicable in fills composed of rocks, boulders, and/or cobbles. Instead, a testing program to evaluate the number of passes by a compactor needed to achieve the desired level of compaction should be conducted at the start of the grading phase of the project. Based on this testing program, the number of passes may then be used as the field criterion for adequate compaction.

For preliminary design purposes, all permanent cut slopes may be designed with a slope inclination of 1.5H:1V or flatter. Cut slopes exposing dense basalt formations may be steepened to 1H:1V or flatter. For fill slopes constructed of the processed, excavated on-site materials, a slope inclination of 2H:1V or flatter may be used in design. Fills placed on slopes with inclinations steeper than 5H:1V should be keyed and benched into the existing slope to provide stability of the new fill against sliding. The filling operations should start at the lowest point and continue up in level horizontal compacted layers in accordance with the above fill placement recommendations. Fill slopes should be constructed by overfilling and cutting back to the design slope ratio to obtain a well-compacted slope face. Water should be diverted away from the tops of slopes, and slope planting should be provided as soon as possible to reduce the potential for erosion of the finished slopes.

#### Excavation

The site is underlain by basalt rock formation at shallow depths with little surface soil cover. Both pahoehoe and a'a lava flows exist within the limits of the project site.

Pahoehoe and a'a lava flows may possess different fracture characteristics that, when subjected to ripping or excavation efforts, produce differing aggregate sizes ranging from predominantly gravel and cobbles with some small boulders to predominantly massive boulder products.

In addition, the basalt rock formation may range from medium hard to very hard with increasing depth. The rippability of the rock formation will also depend on the degree of fracturing and amount of clinker materials contained therein. As a result, variable levels of effort and handling may be necessary during mass grading and excavation work. When siting the campus facilities, it would be advisable to keep excavations into the rock formation to less than 15 to 20 feet of excavation. Even with rock excavations on the order of 15 to 20 feet, some blasting of the rock formation will likely be required in order to excavate the materials to achieve the design grades.

#### Site Drainage

Injection tests were performed in each of the four borings drilled during our field exploration. Each injection test was performed using the constant head method by adjusting the water pumping rate until a steady piezometric head was maintained. Our injection tests indicated that the coefficient of permeability of the underlying basalt formation ranged from about  $2.32 \times 10^{-2}$  to  $1.69 \times 10^{-1}$  centimeters per second. Based on our injection tests, the project site is situated on generally permeable ground with subsurface conditions comprised of fractured rock formation. Based on our experience with similar projects, the use of drywells for the disposal of storm water runoff is the norm and may be considered favorable from a geotechnical engineering point-of-view.

The project site appears to be situated above the State of Hawaii - Department of Health, Underground Injection Control (UIC) line for this portion of the island of Hawaii. As a result, the use of drywells for the disposal of storm water runoff will require the filing for a UIC permit with the State of Hawaii - Department of Health, Safe Drinking Water Branch. The UIC permitting process may include the need to publish a public notice of the intent to utilize drywells at the site for the disposal of storm water run-off. In addition,

engineering reports and geologic inspection may be required to satisfy the conditions to obtain the UIC permit to operate the facility.

#### Pavements

The long-range development plan of the proposed University of Hawaii Center at West Hawaii may involve construction of two-lane and four-lane roadways. Detailed information pertaining to the roadway design and traffic data was not available at the time this report was prepared. In general, the following pavement section is generally required by the County of Hawaii, Department of Public Works:

County of Hawaii Standard Detail R-34

2.0-Inch Asphaltic Concrete  
 4.0-Inch Base Course  
6.0-Inch Select Borrow Subbase  
 12.0-Inch Total Pavement Thickness over Subgrade

In general, the purpose of the subbase course required in the County of Hawaii Standard section is to serve as a foundation or stabilizing course such that the subsequent base and surfacing layers may be constructed on top of an inferior subgrade soil. The standard pavement section does not take into consideration good quality subgrade conditions.

Since the subgrade soils at the project site will generally consist of compacted granular fill material or basalt rock formation, it is our opinion that a subbase course for stabilization/foundation purposes is not necessary due to the high quality of the subgrade materials anticipated at the subject site. If the roadway subgrade exposes near-surface ash soil at the site, we recommend that the ash soils be removed and be replaced with structural fill material (6-inch minus material) compacted to a minimum of 95 percent relative compaction.

If a subbase course is mandatory, we believe that the compacted rock fill or basalt rock formation below the base course layer may be considered as a subbase material since its pavement support characteristics (with CBR value over 60) would be equal to or

better than that of the select borrow subbase course required by the County of Hawaii Standard section. On this basis, the following preliminary pavement designs may be considered for the subject site.

#### Main Roads and Collector Roads

3.0-Inch Asphaltic Concrete  
6.0-Inch Base Course (95 Percent Relative Compaction)  
9.0-Inch Total Pavement Thickness on Compacted Subgrade

#### Minor Streets

2.0-Inch Asphalt Concrete  
6.0-Inch Base Course (95 Percent Relative Compaction)  
8.0-Inch Total Pavement Thickness on Compacted Subgrade

The subgrade soil under the pavement area should be scarified to a minimum depth of 8 inches, moisture-conditioned to above the optimum moisture, and compacted to at least 95 percent relative compaction. CBR tests and/or field observations should be performed on the actual subgrade soils during design and construction to confirm that the above design sections are adequate. The base course should consist of crushed basalt aggregate compacted to a minimum of 95 percent relative compaction.

In general, paved areas should be sloped and drainage gradients maintained to carry surface water to appropriate drainage structures, such as drywells. Surface water ponding should not be allowed anywhere on the site during or after construction. Where concrete curbs are used to isolate landscaping in or adjacent to the pavement areas, we recommend the curbs extend a minimum of 2 inches into the subgrade soil to reduce migration of landscape water into the pavement section. Alternatively, a subdrain system could be constructed to collect excessive water from landscaping irrigation. For long-term performance, we recommend a subdrain system be constructed adjacent to paved/landscaped areas.

#### Additional Services

This preliminary geotechnical engineering exploration report is prepared for the proposed campus planning and preliminary engineering purposes only. It is not intended for use in design and/or preparation of construction documents for the proposed project construction at the site. A design-level geotechnical engineering exploration should be conducted for final design of the project at the site. We recommend that Geolabs-Hawaii be retained for follow-up services on this project.

#### LIMITATIONS

The findings and preliminary recommendations submitted in this report are based upon the information obtained through our site reconnaissance, past project experience, limited field exploration, and literature research for the proposed University of Hawaii Center at West Hawaii project. Variations of subsurface conditions may not become evident until a detailed field exploration program is conducted. If variations then appear evident, it will be necessary to re-evaluate the findings and preliminary recommendations provided in this report.

This report has been prepared for the exclusive use of Wil Chee Planning, Inc., their client, the University of Hawaii, and their subconsultants for specific application to the proposed University of Hawaii Center at West Hawaii, Long Range Development Plan project, in accordance with generally accepted geotechnical engineering principles and practices. No warranty is expressed or implied.

This report has been prepared solely for the purpose of assisting the engineer in the planning and preliminary engineering for the proposed project. Therefore, this report may not contain sufficient data, or the proper information, to serve as the basis for final design and preparation of construction plans and documents. A detailed field exploration program should be implemented to obtain additional information pertaining to the final design of the proposed project.

**PLATES AND APPENDICES**

The following plates and appendices are attached and complete this report:

- Plate 1 - Project Location Map
- Plate 2 - Site Plan
- Appendix A - Field Exploration
- Plate A - Boring Log Legend
- Plates A-1 thru A-4 - Logs of Borings
- Appendix B - Injection Testing

-o0o0o0o0o0o0o0o0o0-

Respectfully submitted,

C.W. ASSOCIATES, INC.  
dba GEOLABS-HAWAII

By   
**Robin M. Lim, P.E.**  
Vice President



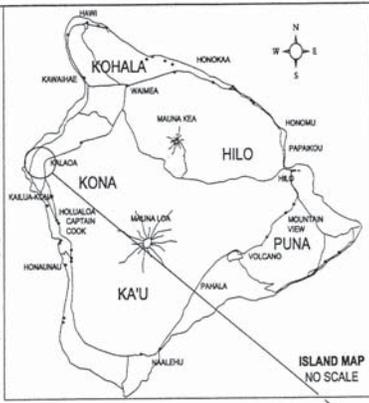
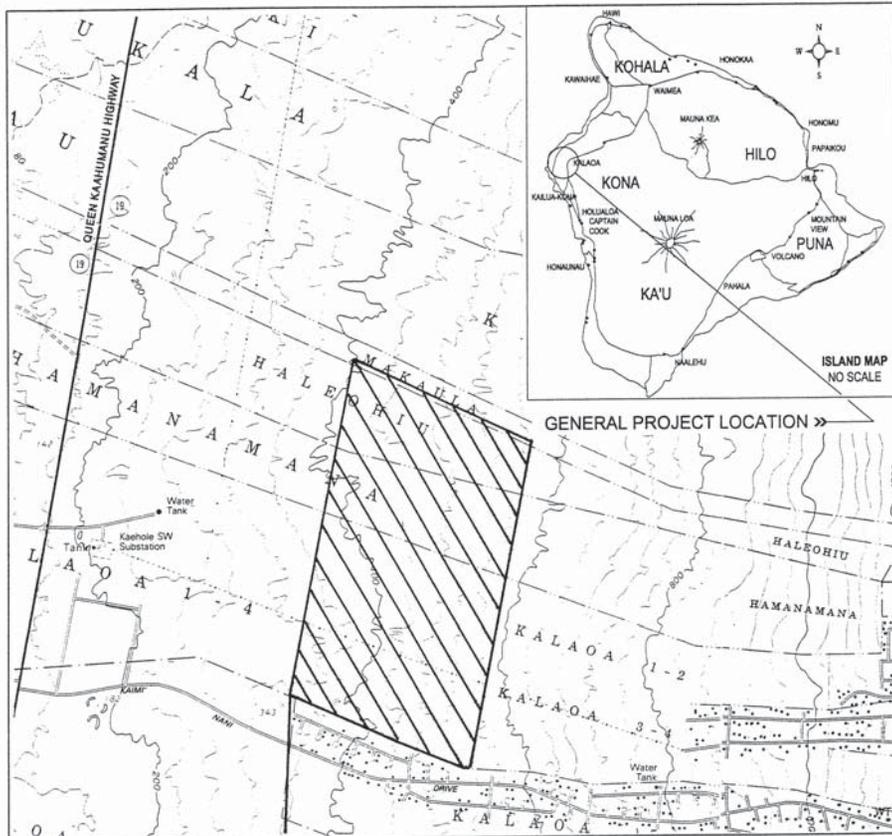
THIS WORK WAS PREPARED BY ME  
OR UNDER MY SUPERVISION.

RML:ST/SC:m  
(u:\98reports\3973-00.st1 -- p19)

---

**PLATES**

---



GENERAL PROJECT LOCATION »

PROJECT LOCATION »

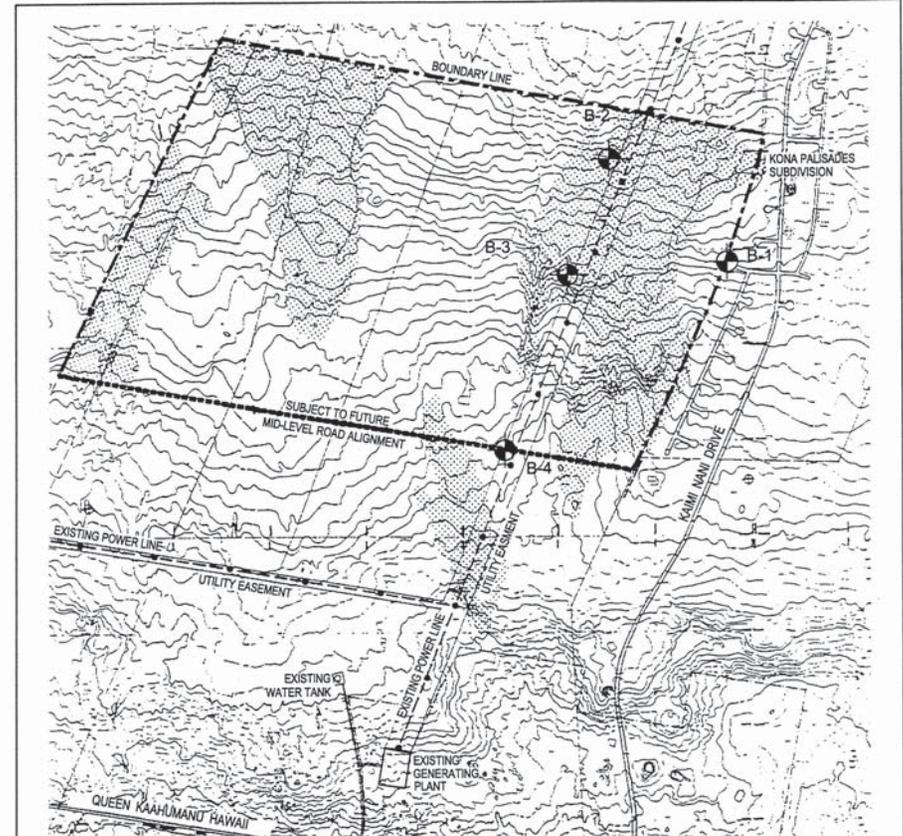


**PROJECT LOCATION MAP**  
 PROPOSED UNIVERSITY OF HAWAII CENTER AT WEST HAWAII  
 HAWAII COMMUNITY COLLEGE  
 LONG-RANGE DEVELOPMENT PLAN  
 KALAOA, NORTH KONA, HAWAII



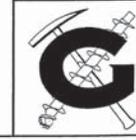
GEOLABS-HAWAII		
Foundation and Soil Engineering - Geology		
DATE	DRAWN BY	PLATE
JUNE 1998	TSK	1
SCALE	W.O.	
1" = 2,000'	3973-00	

REFERENCE: U.S.G.S. QUADRANGLE MAPS; MAKALAWENA, KAILUA, AND KEAHOLE POINT, HAWAII (1982)



**LEGEND:**  
 APPROXIMATE BORING LOCATION

**SITE PLAN**  
 PROPOSED UNIVERSITY OF HAWAII CENTER AT WEST HAWAII  
 HAWAII COMMUNITY COLLEGE  
 LONG-RANGE DEVELOPMENT PLAN  
 KALAOA, NORTH KONA, HAWAII



GEOLABS-HAWAII		
Foundation and Soil Engineering - Geology		
DATE	DRAWN BY	PLATE
JUNE 1998	KHN	2
SCALE	W.O.	
1" = 1,200'	3973-00	

REFERENCE: ARCHAEOLOGICAL AND BIOLOGICAL RESOURCES PLAN FROM LONG RANGE DEVELOPMENT PLAN REPORT BY 818 ASSOCIATES, INC. DATED FEBRUARY 1996.

---

**APPENDIX A**

Field Exploration

---

---

**APPENDIX A**

Field Exploration

---

The subsurface conditions at the site were explored by drilling and sampling four borings to a depth of approximately 25 feet below the existing ground surface. The approximate locations of the borings are shown on the Site Plan, Plate 2. The borings were drilled using truck-mounted drilling equipment, equipped with rock coring tools.

The materials encountered in the borings were classified by visual and textural examination in the field by our Engineer, who monitored the drilling operations on a near-continuous basis. Soils were classified in general conformance with the Unified Soil Classification System as shown on Plate A. Graphic representations of the materials encountered are presented on the Logs of Borings, Plates A-1 through A-4.

Core samples of rock materials encountered at the site were obtained using diamond core drilling techniques in general accordance with ASTM Standard Practice D 2113-83, Diamond Core Drilling for Site Investigation. Core drilling is a rotary drilling method, which uses a hollow bit to cut into the rock formation. The rock material left in the hollow core of the bit is mechanically recovered for examination and description.

Recovery (REC) is used as a subjective guide to the interpretation of the relative quality of rock masses. Recovery is defined as the actual length of material recovered from a coring attempt versus the length of the core attempt. If 3.7 feet of material is recovered from a 5.0-foot core run, the recovery would be 74 percent and would be shown on the Logs of Borings as REC = 74%.

The Rock Quality Designation (RQD) is also a subjective guide to the relative quality of rock masses. RQD is defined as the percentage of the core run that is sound material in excess of 4 inches in length without discontinuities, discounting drilling induced fractures or breaks. If 2.5 feet of sound material is recovered from a 5.0-foot core run, the RQD would be 50 percent and would be shown on the Logs of Borings as RQD = 50%. Generally, the following is used to describe the relative quality of the rock, based on the "Practical Handbook of Physical Properties of Rocks and Minerals."

Appendix A (Continued)  
Field Exploration

Rock Quality	RQD (%)
Very Poor	0 - 25
Poor	25 - 50
Fair	50 - 75
Good	75 - 90
Excellent	90 - 100

The rippability of a rock mass is a function of the relative hardness of the rock, its relative quality, brittleness and fissile characteristics. A dense basalt with a high RQD would be very difficult to rip and would probably require more arduous methods of excavation.

(u:\98reports\3973-00.sc1 - p27)

UNIFIED SOIL CLASSIFICATION SYSTEM (USCS)					
MAJOR DIVISIONS			USCS	TYPICAL DESCRIPTIONS	
COARSE-GRAINED SOILS  MORE THAN 50% OF MATERIAL RETAINED ON NO. 200 SIEVE	GRAVELS  MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	CLEAN GRAVELS LESS THAN 5% FINES	GW	WELL-GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES	
		GRAVELS WITH FINES MORE THAN 12% FINES	GP	POORLY-GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES	
		SANDS  50% OR MORE OF COARSE FRACTION PASSING THROUGH NO. 4 SIEVE	CLEAN SANDS LESS THAN 5% FINES	SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
			SANDS WITH FINES MORE THAN 12% FINES	SP	POORLY-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
	FINE-GRAINED SOILS  50% OR MORE OF MATERIAL PASSING THROUGH NO. 200 SIEVE	SILTS AND CLAYS  LIQUID LIMIT LESS THAN 50		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
				CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
				OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
		SILTS AND CLAYS  LIQUID LIMIT 50 OR MORE		MH	INORGANIC SILT, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS
CH				INORGANIC CLAYS OF HIGH PLASTICITY	
OH				ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS	
HIGHLY ORGANIC SOILS			PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS	

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS

**LEGEND:**

	2-INCH O.D. STANDARD PENETRATION TEST	LL	LIQUID LIMIT
	3-INCH O.D. MODIFIED CALIFORNIA SAMPLE	PI	PLASTICITY INDEX
	SHELBY TUBE SAMPLE	TV	TORVANE SHEAR (tsf)
	CORE SAMPLE	PEN	POCKET PENETROMETER (tsf)
REC	CORE RECOVERY		WATER LEVEL OBSERVED IN BORING
RQD	ROCK QUALITY DESIGNATION		

<b>CW ASSOCIATES, INC. dba GEOLABS - HAWAII</b> Geology Soils and Foundation Engineering	<b>BORING LOG LEGEND</b> PROPOSED UH CENTER AT WEST HAWAII HAWAII COMMUNITY COLLEGE - LRDP. KALAOA, NORTH KONA, HAWAII	PLATE <b>A</b>
WORK ORDER NO. 3973-00	Jun 98	

Date Started: 5/6/98		Drill Rig: Mobile B-53				
Date Completed: 5/6/98		Drilling Method: HQ Coring				
Logged By: V. Bounlangsy		Driving Energy: 140 lb. wt., 30 in. drop				
Total Depth: 25.5 feet						
Depth, ft	FIELD		LABORATORY		Pen, tsf	DESCRIPTION
	Sample Penetra. Resist. Blows/ft	Dry Density pcf	Moisture Content %	Compress. Strength ksf		
	Approximate Surface Elevation (ft): 455*					
0-4						Gray BASALT GRAVEL AND COBBLES with sand and silt (clinker)
4-6					RUN 1 REC=80% RQD=36%	Gray and reddish gray vesicular BASALT, closely to severely fractured, slightly to moderately weathered, medium hard (basalt formation)
6-10					RUN 2 REC=90% RQD=40%	grades to closely fractured
10-15					RUN 3 REC=60% RQD=30%	
15-20					RUN 4 REC=80% RQD=60%	grades to strongly vesicular, closely to moderately fractured
20-25					RUN 5 REC=100% RQD=25%	grades to closely fractured
25	Boring terminated at 25.5 feet					
Groundwater not encountered						
*Elevations estimated from Long Range Development Plan, Existing Topography and Parcel Boundaries (undated) by Wil Chee - Planning, Inc.						
CW ASSOCIATES, INC. dba <b>GEOLABS-HAWAII</b> Geology Soils and Foundation Engineering		<b>LOG OF BORING 1</b> PROPOSED UH CENTER AT WEST HAWAII HAWAII COMMUNITY COLLEGE - LRDP. KALAOA, NORTH KONA, HAWAII			PLATE <b>A-1</b>	
WORK ORDER NO. 3973-00 TSK Jun 98						

Date Started: 5/5/98		Drill Rig: Mobile B-53				
Date Completed: 5/5/98		Drilling Method: HQ Coring				
Logged By: V. Bounlangsy		Driving Energy: 140 lb. wt., 30 in. drop				
Total Depth: 25.5 feet						
Depth, ft	FIELD		LABORATORY		Pen, tsf	DESCRIPTION
	Sample Penetra. Resist. Blows/ft	Dry Density pcf	Moisture Content %	Compress. Strength ksf		
	Approximate Surface Elevation (ft): 533*					
0-4						Gray BASALT GRAVEL AND COBBLES (clinker)
4-6					RUN 1 REC=80% RQD=60%	Gray vesicular BASALT, moderately fractured, slightly weathered, medium hard (basalt formation)
6-10					RUN 2 REC=90% RQD=80%	
10-15					RUN 3 REC=100% RQD=90%	
15-20					RUN 4 REC=50% RQD=30%	grades to closely fractured <b>CLINKER SEAM</b>
20-25					RUN 5 REC=40% RQD=0%	grades to severely fractured
25	Boring terminated at 25.5 feet					
Groundwater not encountered						
CW ASSOCIATES, INC. dba <b>GEOLABS-HAWAII</b> Geology Soils and Foundation Engineering		<b>LOG OF BORING 2</b> PROPOSED UH CENTER AT WEST HAWAII HAWAII COMMUNITY COLLEGE - LRDP. KALAOA, NORTH KONA, HAWAII			PLATE <b>A-2</b>	
WORK ORDER NO. 3973-00 TSK Jun 98						

Date Started: 5/5/98		Drill Rig: Mobile B-53	
Date Completed: 5/5/98		Drilling Method: HQ Coring	
Logged By: V. Bounlangsy		Driving Energy: 140 lb. wt., 30 in. drop	
Total Depth: 25.5 feet			

Depth, ft	FIELD		LABORATORY				Other Data	Pen, tsf	DESCRIPTION
	Sample Penetra. Resist. Blows/ft	Dry Densitypcf	Moisture Content %	Compress. Strength ksf					
								Approximate Surface Elevation (ft): 445*	
5						RUN 1 REC = 100% RQD = 76%		Gray <b>BASALT GRAVEL AND COBBLES</b> Gray vesicular <b>BASALT</b> , moderately fractured, slightly to moderately weathered, medium hard (basalt formation)	
						RUN 2 REC = 16% RQD = 0%		<b>CLINKER SEAM</b>	
10						RUN 3 REC = 45% RQD = 40%		Gray vesicular to vugular <b>BASALT</b> , moderately to slightly fractured, slightly weathered, hard (basalt formation)	
15						RUN 4 REC = 60% RQD = 40%		<b>CLINKER SEAM</b>	
20						RUN 5 REC = 89% RQD = 78%		Gray vugular <b>BASALT</b> , moderately to slightly fractured, slightly weathered, very hard (basalt formation)	
25								Boring terminated at 25.5 feet Groundwater not encountered	
30									
35									

tk	TSK-DV098-F	<b>CW ASSOCIATES, INC. dba GEOLABS - HAWAII</b> Geology Soils and Foundation Engineering	<b>LOG OF BORING 3</b> PROPOSED UH CENTER AT WEST HAWAII HAWAII COMMUNITY COLLEGE - LRDP. KALAOA, NORTH KONA, HAWAII	PLATE <b>A-3</b>
WORK ORDER NO.	3973-00	TSK	Jun 98	

Date Started: 5/4/98		Drill Rig: Mobile B-53	
Date Completed: 5/4/98		Drilling Method: HQ Coring	
Logged By: V. Bounlangsy		Driving Energy: 140 lb. wt., 30 in. drop	
Total Depth: 25.5 feet			

Depth, ft	FIELD		LABORATORY				Other Data	Pen, tsf	DESCRIPTION
	Sample Penetra. Resist. Blows/ft	Dry Densitypcf	Moisture Content %	Compress. Strength ksf					
								Approximate Surface Elevation (ft): 320*	
5						RUN 1 REC = 50% RQD = 30%		Gray <b>BASALT GRAVEL AND COBBLES</b> Gray vugular <b>BASALT</b> , closely to severely fractured, slightly weathered, hard (basalt formation)	
						RUN 2 REC = 30% RQD = 0%		Reddish gray vesicular to scoriaceous <b>BASALT</b> , severely fractured, slightly to moderately weathered, medium hard (basalt formation)	
10						RUN 3 REC = 60% RQD = 30%		grades to closely fractured, slightly weathered	
15						RUN 4 REC = 100% RQD = 70%		grades to moderately fractured, hard	
20						RUN 5 REC = 60% RQD = 20%		grades to severely fractured, medium hard	
25								Boring terminated at 25.5 feet Groundwater not encountered	
30									
35									

tk	TSK-DV098-F	<b>CW ASSOCIATES, INC. dba GEOLABS - HAWAII</b> Geology Soils and Foundation Engineering	<b>LOG OF BORING 4</b> PROPOSED UH CENTER AT WEST HAWAII HAWAII COMMUNITY COLLEGE - LRDP. KALAOA, NORTH KONA, HAWAII	PLATE <b>A-4</b>
WORK ORDER NO.	3973-00	TSK	Jun 98	

**SUMMARY OF CONSTANT HEAD INJECTION TESTS**

Proposed University of Hawaii Center at West Hawaii  
Hawaii Community College  
Long-Range Development Plan  
Kalaoa, North Kona, Hawaii  
-----

Boring No.	Diameter of Boring (in)	Depth of Boring (ft)	Depth of Casing (ft)	Pumping Rate (gal/min)	Constant Piezo. Head (ft)	Coefficient of Permeability (cm/s)
1	4	25.5	18.0	45.0	5.5	5.63E-02
2	4	25.5	18.0	36.0	2.5	1.69E-01
3	4	25.5	18.0	38.0	9.0	2.32E-02
4	4	25.5	18.0	35.0	6.5	3.28E-02

(u:\98reports\3973-00.st1 - p 28)

---

**APPENDIX B**

Injection Testing

---