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KAREN SEDDON
EXECUTIVE DIRECTOR

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STATE OF HAWAII
DEPARTMENT OF BUSINESS, ECONOMIC DEVELOPMENT AND TOURISM
HAWAII HOUSING FINANCE AND DEVELOPMENT CORPORATION
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IN REPLY REFER TO:

13:PEO/41

April 18, 2013

Mr. Gary Gill, Acting Director
Office of Environmental Quality Control
Department of Health, State of Hawai'i
235 Beretania Street, Room 702
Honolulu, Hawaii 96813

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OFC. OF ENVIRONMENTAL QUALITY CONTROL

Dear Mr. Gill:

With this letter, the Hawai'i Housing Finance and Development Corporation (HHFDC) hereby transmits the final environmental assessment and finding of no significant impact (FEA-FONSI) for the Riverside Apartments Improvements project, situated at TMK 2-6-003:009 in the South Hilo District on the island of Hawai'i for publication in the next available edition of the Environmental Notice.

The HHFDC has included copies of public comments and the corresponding responses from the applicant that were received during the 30-day public comment period on the draft environmental assessment and anticipated finding of no significant impact (DEA-AFONSI).

Enclosed is a completed OEQC Publication Form, two copies of the FEA-FONSI, and a CD with a pdf file of the FEA-FONSI and a MS Word file of the publication form.

If there are any questions, please contact Janice Takahashi, Chief Planner, at 587-0639.

Sincerely,

Karen Seddon
Executive Director

Enclosures

c: Urban Housing Communities
Big Island Housing Foundation Riverside Community Based Non-Profit Corporation
Kimura International

APPLICANT ACTIONS
SECTION 343-5(C), HRS
PUBLICATION FORM (JULY 2012 REVISION)

Project Name: Riverside Apartments Improvements: Stream Bank Bluff Protection and Stabilization, Second Slope Scarp and Interior Renovations
Island: Hawai‘i
District: South Hilo
TMK: 2-6-003:009
Permits: SMA Use Permit (SMP), Stream Channel Alteration Permit (SCAP)
Approving Agency: Hawai‘i Housing Finance and Development Corporation (HHFDC)
677 Queen Street , Suite 300
Honolulu, Hawaii 96813
Contact: Janice Takahashi, (808) 587-0639
Applicant: UHC 00382 Hilo L.P., a Hawai‘i Limited Partnership
2000 E. Fourth Street, Suite 205
Santa Ana, CA 92705
Contact: Thomas G. Fischer, (714) 835 3955, x104
Consultant: Kimura International
1600 Kapiolani Boulevard, Suite 1610
Honolulu, HI 96814
Contact: Leslie Kurisaki, (808) 944-8848

Status (check one only):

__DEA-AFNSI	Submit the approving agency notice of determination/transmittal on agency letterhead, a hard copy of DEA, a completed OEQC publication form, along with an electronic word processing summary and a PDF copy (you may send both summary and PDF to oeqchawaii@doh.hawaii.gov; a 30-day comment period ensues upon publication in the periodic bulletin.
_**X**_FEA-FONSI	Submit the approving agency notice of determination/transmittal on agency letterhead, a hard copy of the FEA, an OEQC publication form, along with an electronic word processing summary and a PDF copy (send both summary and PDF to oeqchawaii@doh.hawaii.gov; no comment period ensues upon publication in the periodic bulletin.
__FEA-EISPN	Submit the approving agency notice of determination/transmittal on agency letterhead, a hard copy of the FEA, an OEQC publication form, along with an electronic word processing summary and PDF copy (you may send both summary and PDF to oeqchawaii@doh.hawaii.gov; a 30-day consultation period ensues upon publication in the periodic bulletin.
__Act 172-12 EISPN	Submit the approving agency notice of determination on agency letterhead, an OEQC publication form, and an electronic word processing summary (you may send the summary to oeqchawaii@doh.hawaii.gov. NO environmental assessment is required and a 30-day consultation period upon publication in the periodic bulletin.
__DEIS	The applicant simultaneously transmits to both the OEQC and the approving agency, a hard copy of the DEIS, a completed OEQC publication form, a distribution list, along with an electronic word processing summary and PDF copy of the DEIS (you may send both the summary and PDF to oeqc@doh.hawaii.gov); a 45-day comment period ensues upon publication in the periodic bulletin.
__FEIS	The applicant simultaneously transmits to both the OEQC and the approving agency, a hard copy of the FEIS, a completed OEQC publication form, a distribution list, along with an electronic word processing summary and PDF copy of the FEIS (you may send both the summary and PDF to oeqc@doh.hawaii.gov); no comment period ensues upon publication in the periodic bulletin.
__ Section 11-200-23 Determination	The approving agency simultaneous transmits its determination of acceptance or nonacceptance (pursuant to Section 11-200-23, HAR) of the FEIS to both OEQC and the applicant. No comment period ensues upon publication in the periodic bulletin.
__Statutory hammer Acceptance	The approving agency simultaneously transmits its notice to both the applicant and the OEQC that it failed to timely make a determination on the acceptance or nonacceptance of the applicant's FEIS under Section 343-5(c), HRS, and that the applicant’s FEIS is deemed accepted as a matter of law.
__Section 11-200-27 Determination	The approving agency simultaneously transmits its notice to both the applicant and the OEQC that it has reviewed (pursuant to Section 11-200-27, HAR) the previously accepted FEIS and determines that a supplemental EIS is not required. No EA is required and no comment period ensues upon publication in the periodic bulletin.
__Withdrawal (explain)	

Summary (Provide proposed action and purpose/need in less than 200 words. Please keep the summary brief and on this one page)**:**

The UHC 00382 Hilo L.P., a Hawai‘i Limited Partnership, is proposing improvements to the Riverside Apartments property. The Riverside Apartments is a 74-unit, multi-family affordable rental complex located at 333 Ohai Street in Hilo, Hawai‘i. The proposed action includes 1) interior building renovation; and 2) protection and stabilization of the stream bank bluff behind the apartment building. These are two separate improvement projects that are being implemented independent of each other.

***Interior Building Renovation*.** The Riverside Apartments building has not undergone major improvements since its construction in 1973, and the proposed interior renovation is needed to continue to provide residents with safe and decent living conditions. The modernization will provide new flooring, carpeting, appliances, bathroom and kitchen fixtures, cabinets and paint. Plumbing and electrical repairs will be completed as needed. The building's leaking roof will be replaced and photovoltaic panels installed. Several units will be made ADA-accessible. There will be no new structures or work outside the existing building footprint. The building renovation will be completed in phases over a 12 month period.

Stream Bank Bluff Protection and Stabilization. The proposed stream bank bluff protection and stabilization is considered urgent, and is needed to prevent of failure of the embankment on the property's Second Level terrace. A recent geotechnical investigation found that the steep stream bank behind the apartment building, which overlooks the Wailuku River, is marginally stable and susceptible to slope failure. In this Second Level area, the building is very close to the edge of the embankment, and a slope failure would likely threaten the structural stability of the apartment and possibly the safety of its residents.

In 2008, there was a slope failure on another area of the property, on the adjacent Third Level terrace where the building is also very close to the edge. In the 2008 incident, heavy rains are believed to have contributed to the slope failure. Emergency repairs were completed in 2011 to stabilize and protect the stream bank, and fortunately, there appeared to be no damage to the building.

The currently proposed stream bank bluff protection and stabilization is similar to what was done in 2011 on the adjacent scarp. The project will install a series of soil nails to reinforce the steep embankment slope. An 8- to 10-inch thick layer of reinforced shotcrete (gunite) will be constructed over the slope to protect and stabilize the slope face. The toe of the embankment will be protected against future erosion, scour and undermining by constructing a cutoff wall. A series of micropiles will be installed at the top of the slope adjacent to the building. This is a redundant measure to protect the building in an area where the building footings are very close to the steep stream bank slope. All work will occur outside the waters of the Wailuku River, and best management practices will be used to ensure that dirt and debris does not enter the river.

The federal Department of Housing and Urban Development (HUD), which provides Section 8 rental subsidies to the Riverside Apartments, has required that the stream bank bluff protection and stabilization be completed as a condition of its continued funding. Without the HUD subsidies, the building could not continue to be operated as an affordable housing complex.

The work on the embankment is scheduled to begin in late 2013, and the actual construction work is estimated to take about 4 months.

FINAL
ENVIRONMENTAL ASSESSMENT

RIVERSIDE APARTMENTS IMPROVEMENTS
Stream Bank Bluff Protection and Stabilization
Second Slope Scarp and
Interior Renovations

333 Ohai Street Hilo Hawaii TMK: 2-6-003:009

UHC 00382 Hilo, L.P.,
a Hawaii Limited Partnership

April 2013

FINAL
ENVIRONMENTAL ASSESSMENT

RIVERSIDE APARTMENTS IMPROVEMENTS
Stream Bank Bluff Protection and Stabilization
Second Slope Scarp and
Interior Renovations

333 Ohai Street Hilo Hawaii TMK: 2-6-003:009

Prepared for:

UHC 00382 Hilo, L.P.,
a Hawaii Limited Partnership

Prepared by:

KIMURA INTERNATIONAL

April 2013

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B. Biological Surveys Conducted for the Stream Bank Bluff Protection and Stabilization, Second Slope Scarp at the Riverside Apartments, Reginald E. David, Rana Biological Consulting and Eric Guinther, AECOS Consultants, January 2013

C. Final Archaeological Field Inspection and Literature Review With Subsurface Testing for the Stream Bank Bluff Protection and Stabilization, Second Slope Scarp at Riverside Apartments, Pu‘u‘eo Ahupua‘a, South Hilo District, Hawai‘i Island, Cultural Surveys Hawai‘i, February 2013

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LIST OF ACRONYMS

ADA	Americans with Disabilities Act
BIHF/RS	BIHF Riverside Community Based Non-Profit Corporation (current owner)
BFE	base flood elevation
BMP	Best Management Practices
CDP	Census data place
CSH	Cultural Surveys Hawai‘i
CWA	Clean Water Act
CWRM	Commission on Water Resources Management
CZM	Coastal Zone Management
DLNR	Department of Land & Natural Resources
DA	Department of the Army
DOE	Department of Education
DOH	Department of Health
EA	Environmental Assessment
EDH	EnVision Downtown Hilo
EIS	Environmental Impact Statement
EPA	Environmental Protection Agency
FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Map
FONSI	Finding of No Significant Impact
HAR	Hawai‘i Administrative Rules
HELCO	Hawai‘i Electric Light Company
HHFDC	Hawai‘i Housing Finance and Development Corporation
HRS	Hawai‘i Revised Statutes
HSA	Hawai‘i Stream Assessment
HUD	Department of Housing and Urban Development
LCA	Land Commission Award
LUPAG	Land Use Pattern Allocation Guide
MHW	mean high water
MHHW	mean higher high water
MSL	mean sea level
NAAQS	National Ambient Air Quality Standards
NRCS	Natural Resources Conservation Service

NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
OEQC	Office of Environmental Quality Control
SCAP	Stream Channel Alteration Permit
SHPD	State Historic Preservation Division
SMA	Special Management Area
TMDL	total maximum daily load
TMK	tax map key
UBC	Uniform Building Code
USACE	U.S. Army Corps of Engineers
USGS	United States Geological Survey
USFWS	U.S. Fish and Wildlife Service

Project Summary

Item	Description
Project Name	Riverside Apartments Improvements: Stream Bank Bluff Protection & Stabilization, Second Slope Scarp, and Interior Renovation
Project Proponent	UHC 00382 Hilo, L.P., a Hawaii limited partnership
Approving Agency	State of Hawai‘i, Hawai‘i Housing Finance and Development Corporation (HHFDC)
Determination	Finding of No Significant Impact
Location	333 Ohai Street, Hilo, Hawaii
Tax Map Key	TMK 2-6-003:009
Existing Uses	The Project site is an 1.8-acre parcel occupied by the Riverside Apartments, a 74-unit affordable rental apartment building. The 49,000 SF building includes 12 one-bedroom units, 56 two-bedroom units, and 6 three-bedroom units. The slope area that will be protected and stabilized encompasses 4,810 SF on the Second Level of the property. The project area includes a level area behind the apartment building and a steep, vegetated stream embankment.
Landowner	BIHF Riverside Community Based Non-Profit Corporation (BIHF/RS)
Need for Project	The Riverside Apartments building was constructed in 1973 and has not undergone major improvements since that time. Although the building is structurally sound, interior renovation is badly needed to modernize the property and provide residents with safe and decent living conditions. Stream bank stabilization improvements are urgently needed to prevent a collapse of the embankment behind the Riverside Apartments. In 2008, heavy rains are believed to have caused a slope failure of the stream bank on the Third Level of the Riverside Apartments property. This area underwent emergency repair, which was completed in 2011. A subsequent geotechnical study found that the current project area, the stream embankment on the Second Level of the property, is marginally stable and also susceptible to potential slope failure. Due to the close proximity of the building to the stream bank slope in the Second Level area, a slope failure in this area would likely threaten the structural stability of the Riverside building and possibly jeopardize the safety of its residents.

Item	Description
Project Description	**Interior Renovation**: Renovate the interior of all apartment units and common areas including new flooring, carpeting, painting, fixtures, appliances, and repair and upgrade to plumbing and electrical systems. The building exterior will also be painted, roof will be replaced and photovoltaic panels installed. There will be no new structures or work outside the existing building footprint. **Stream Bank Bluff Protection & Stabilization:** Install a series of soil nails to reinforce the steep embankment slope. Construct an 8 to 10 inch thick layer of reinforced shotcrete (gunite) over the slope to protect and stabilize the slope face. Protect the embankment toe against future erosion, scour and undermining by a cutoff wall. Pave the level area between the upper limits of the shotcrete and the Second Level building face. As a redundant measure to protect the building, install a series of micropiles to underpin the building nearest the stream bank.
Flood Insurance Rate Map	Zone X and Zone A (project areas below 16 ft mean sea level (MSL) elevation) Most of project site, including the apartment building, is within Zone X, area determined to be outside the 1% and 0.2% annual chance floodplains. Portions of the lower stream embankment at or below 16 ft MSL are within flood prone areas of Wailuku River (Flood Zone A, area inundated by 1% annual chance flood, base flood elevation 16 ft MSL).
State Land Use	Urban
Zoning	V-.75 (Resort-Hotel-maximum density of 750 square feet of land for each dwelling unit)
Special Management Area (SMA)	Within SMA

1 PROJECT DESCRIPTION

1.1 INTRODUCTION

The UHC 00382 Hilo, L.P., a Hawai‘i limited partnership, is proposing improvements to the Riverside Apartments property, a 74-unit affordable rental complex in Hilo, Hawai‘i Island. The project proponent is a single purpose entity formed to purchase, own, operate and improve the Riverside Apartments. The BIHF Riverside Community Based Non-Profit Corporation is the current owner of the property. The property is under contract to be sold to UHC 00382 Hilo, L.P.

The proposed action includes interior building renovation and stream bank bluff protection and stabilization. These improvements are being funded by federal and state tax credits, and a $7,984,094 loan from the State of Hawai‘i Housing Finance and Development Corporation’s (HHFDC) Rental Housing Trust Fund. Due to the use of public funds, the HHFDC has determined that an Environmental Assessment (EA) should be prepared in accordance with Hawai‘i Revised Statutes (HRS) Chapter 343 environmental guidelines and requirements.

The building interior renovation work would normally be exempt from Chapter 343 HRS because it involves repair of an existing structure[1]. However, because the building renovation is part of an overall improvement effort (including the stream bank stabilization) which is not exempt from Chapter 343, the renovation is considered to be part of a “single action” subject to Chapter 343 HRS[2] . The scope of this Environmental Assessment (EA) includes both the interior renovation and the proposed stream bank protection and stabilization work.

This EA has been prepared in accordance with Chapter 343, Hawai‘i Revised Statutes (HRS), Act 241, Session Laws of Hawai‘i (SLH) 1992, and Chapter 200 of Title 11, Department of Health (DOH) Administrative rules, “Environmental Impact Statement Rules.” Based on the findings of this document, the HHFDC has determined that the project will not result in any significant environmental impact, and therefore, has issued a Finding of No Significant Impact (FONSI).

1.2 BACKGROUND AND NEED FOR PROJECT

The project site (Figure 1) is a 1.8 acre parcel (TMK 2-6-003:009) located on Ohai Street between Pu‘u‘eo Street and Wainaku Street, and includes the Riverside Apartment complex. The Riverside Apartment complex is a four-story, L-shaped building constructed in 1973. It provides 74 units of subsidized housing to qualified low-income tenants through the support of the U.S Department of Housing and Urban Development (HUD). The building is being purchased by UHC 00382 Hilo, L.P. and the sale is expected to close between July 31 and August 31, 2013.

[1] Section 11-200-8, HAR identifies exempt classes of action such as repairs or maintenance of existing structures involving negligible or no expansion or change of use beyond that previously existing.
[2] Pursuant to 11-200-7, HAR, a group of actions (i.e., building renovation and bank protection/stabilization) shall be treated as a single action when the component actions are phases or increments of a larger total undertaking (Riverside Apartments).

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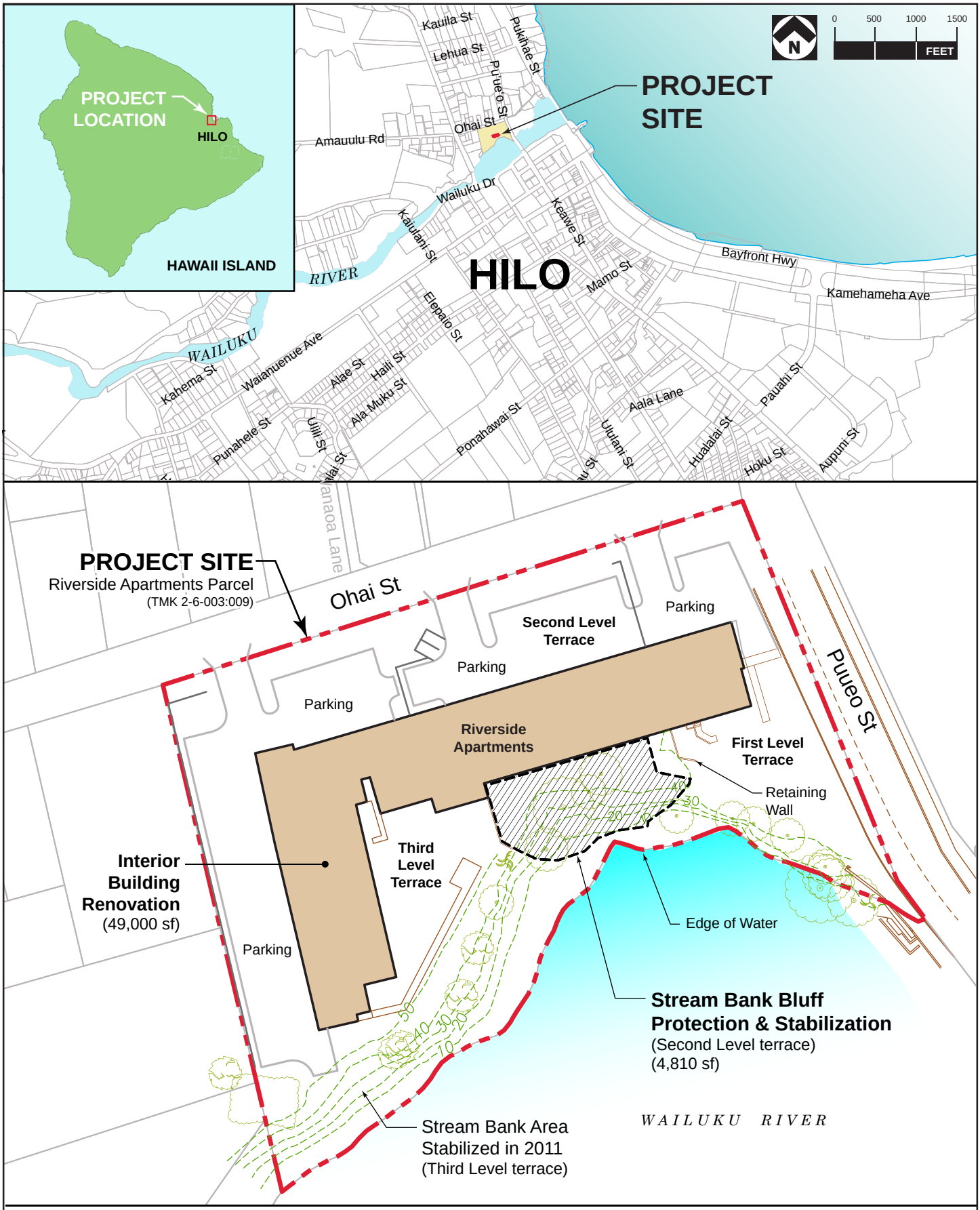


FIGURE 1

LOCATION MAP

Riverside Apartments Improvements

The Riverside Apartments building is situated on a three-level terraced stream bank fronting Ohai Street on the north, and bordered by the Wailuku River on the south, along the rear of the apartment complex. The property sits on a bluff above the river, and is terraced in the east to west direction. The lowest of the three terraces, known as the First Level, is on the easternmost side of the parcel, near Pu‘u‘eo Street. The Third Level, which is situated at the highest elevation, is located on the western most side of the parcel. The proposed stream bank bluff protection and stabilization will be on the Second Level.

1.2.1 Need for Building Renovation

Since its construction in 1973, the Riverside Apartment building has not undergone major improvements other than minor routine maintenance. Although the building is structurally sound, interior modernization and renovation are needed to continue to provide residents with safe and decent living conditions.

At present, the building’s long hallways have vinyl tile floors which are difficult to upkeep and are noisy. Carpet squares are needed to reduce noise levels in the halls. Kitchen appliances are aging and many need to be replaced. Although most kitchen cabinets were replaced in 1996, many are already showing extensive wear, and laminate counter tops are damaged from unreported water leaks. Most bathroom tubs are stained, toilets lack newer flush features, wall tiles are loose, and fiberboard cabinet doors are crumbling. None of the units in the Riverside Apartments are in compliance with the Americans With Disabilities Act (ADA).

The last time the building exterior was painted was 10 years ago, and repainting is needed. The building rooftop is old and moldy and frequently leaks causing problems in the units below.

Photos of Riverside Apartment hallway and interiors.

1.2.2 Need for Stream Bank Bluff Protection and Stabilization

The proposed stream bank bluff protection and stabilization is urgently needed to prevent a failure of the embankment on the Second Level terrace. The edge of the bluff is located very close to the back of the building, in some areas less than ten feet away. In 2008, heavy rains are believed to have caused a slope failure (landslide) of a portion of the Third Level terrace, in an area where the building is also close to the slope. Fortunately, building distress was not observed as a result of the 2008 slope failure. Emergency repairs were completed in July 2011 to protect and stabilize the failed portion of the stream bank. During the design and construction of the previous emergency project, an older slope scarp on the Second Level (the current project area) was also identified. A geotechnical investigation was conducted by Yogi Kwong Engineers (YKE), and included a topographic survey of the stream bank, a reconnaissance of the slope scarp, seven exploratory borings and a three-day geophysical survey. The geotechnical evaluation (see Appendix A) found the stream bank slope in the current project area to be "marginally stable" under unsaturated/static loading conditions. It further concluded that the slope is likely to become unstable under saturated slope or seismic loading conditions; that is, under prolonged heavy rains, stream flooding, or in the event of an earthquake. Because of the close proximity of the apartment building to the steep embankment, a landslide in this area could cause severe structural damage to the apartment building, and possibly endanger its tenants.

The proposed action will stabilize the Second Level terrace in accordance with the recommendations of the geotechnical investigation. The entire project area shown in Figure 1 covers approximately 4,810 square feet in area, and is bounded by two existing retaining walls.

1.3 PROPOSED PROJECT

1.3.1 Building Interior Renovation

Interior improvements include new flooring, new carpeting, appliances, toilets, sinks, cabinets, and repainting. Plumbing and electrical repairs will be completed as needed. The building exterior will be repainted, the leaking roof will be replaced, and photovoltaic panels will be added to the roof. Some units will be made ADA-accessible. There will be no new structures or work outside the existing building footprint. The renovation is described further in Chapter 2.

1.3.2 Stream Bank Bluff Protection and Stabilization

The objective of these improvements is to stabilize the embankment and the Second Level terrace between the two retaining walls, and protect the slope area against future instability, thereby protecting the adjacent building. The proposed improvements will be similar to what was done for the 2011 emergency stabilization at the Third Level. Chapter 2 includes a comparison between the 2011 emergency stabilization and the currently proposed project.

The project will install a series of soil nails at various levels across the slope to reinforce the slope. An 8 to 10 inch thick layer of reinforced shotcrete (gunite) will be constructed over the slope to protect and stabilize the slope face. The toe of the slope will be protected against future erosion, scour and undermining by a cutoff wall. The level area between the upper limits of the shotcrete and the building face will be paved in concrete.

As a redundant measure to protect the building in close proximity to the steep slope, a series of micropiles will be installed along the southern wall of the building to underpin the footings. The micropiles will be approximately 6.5-inches in diameter and installed to approximately 60 feet deep. The micropiles will provide redundant foundation support should the adjacent slope be subject to extreme loading situations.

The proposed work is described in more detail in Chapters 2 and 3. There will be no work or structures placed within the waters of Wailuku River (i.e., below the Mean Higher High Water (MHHW) mark). There will be no construction equipment staged below the MHHW mark. The bank protection and stabilization work will take three to six months to complete.

1.4 POSSIBLE ENVIRONMENTAL PERMITS AND APPROVALS

The following is a summary of environmental approvals and consultations that may be required for the proposed action. Chapter 4 includes a detailed discussion of the project's consistency with federal, State and local land use plans, policies and controls.

Table 1-1: Possible Environmental Permits and Approvals

Approval/Consultation	Agency
State of Hawai‘i	
Chapter 343 Hawai‘i Revised Statutes (*Environmental Assessment)*	Hawai‘i Housing Finance and Development Corporation (HHFDC) (approving agency) Office of Environmental Quality Control
HRS Chapter 6E review (*Historic*)	Department of Land and Natural Resources, State Historic Preservation Division
Stream Channel Alteration Permit (SCAP) *(for stream embankment protection and stabilization)*	Department of Land and Natural Resources, Commission on Water Resource Management
Community noise permit and noise variance	Department of Health
Hawai‘i County	
Special Management Area Use Permit (SMP)	County Planning Department
Building permits for renovation	County of Hawai‘i Public Works-Building Division

1.5 SCHEDULE

The renovation of the Riverside Apartments and the stream bank bluff protection and stabilization are two separate improvement projects that are being implemented independent of each other. The stream bank bluff protection and stabilization is considered urgent and this project is being expedited in order to avoid a slope failure on the Second Level Terrace. Engineering and design efforts are ongoing and work on the slope stabilization will commence as soon as required permits and approvals (EA/Chapter 343, SMP, SCAP) have been obtained. Work on the embankment is currently scheduled to begin in late 2013, and the actual construction work is estimated to extend over a period of about 16 weeks (4 months).

The interior renovation is currently scheduled to be completed in phases over a 12-month period. Renovation plans are currently being developed.

2 ALTERNATIVES INCLUDING THE PROPOSED ACTION

This chapter discusses the alternatives that were considered to the proposed action. The proposed action includes both interior renovation to the Riverside Apartments and the protection and stabilization of the stream bank at the Second Level of the property. The alternatives include 1) No Action; 2) Proposed Action; and 3) Alternative Methods and Materials for Slope Stabilization.

2.1 NO-ACTION ALTERNATIVE

The No-Action alternative would involve no interior renovation to the Riverside Apartments and no work to protect or stabilize the stream bank slope at the Second Level terrace.

2.1.1 No Building Renovation

With no interior renovation, the Riverside Apartments would continue its current operation as an affordable rental complex. Outdated fixtures and furnishings would continue to age and deteriorate, and ongoing maintenance and repair requirements would increase. Outdated appliances and fixtures would become cost prohibitive to repair, and more units would have minimally functional or non-working appliances. Roof leaks, and plumbing problems and leaks throughout the building would occur more frequently, resulting in water and moisture damage which could entail costly and time consuming remediation, and inconvenience to residents. Frequent plumbing repairs will require water shut downs affecting multiple units, causing a hardship to the large number of residents who are at home during the day.

Over time, deferred maintenance could contribute to other health and safety issues including mold and dust, pests, exposure to lead paint, and risk of injury due to unsafe or dilapidated structures or fixtures. Poorly maintained housing could adversely impact both the mental and physical health of residents, including the many young children residing at the complex. From an economic perspective, no action could result in higher building maintenance costs, higher energy costs, and higher health and medical costs over time. It could also result in the eventual loss of federal housing subsidies if the property fails to meet minimum habitability standards. With the no-action alternative, building operation and living conditions would continue unchanged for the short-term. However, over the long term, taking no action is an irresponsible approach to housing management, and will result in undesirable consequences.

2.1.2 No Stream Bank Bluff Protection and Stabilization

The geotechnical evaluation completed for the project area (YKE , 2012) concluded that the embankment in the Second Level area is “marginally stable” under static loading conditions, and is likely to become unstable under saturated slope conditions and seismic loading conditions. A slope collapse could occur after a period of heavy rain, a seismic event, or even without an obvious triggering event. It cannot be predicted when a slope collapse would occur, how large an area would be affected, or how severe the building damage would be. However, the proximity of

the building to the edge of the embankment, the underlying soil conditions, and high level of seismic activity in the Hilo area increase the potential for slope failure and related building distress. A slope failure could undermine the building foundation, resulting in severe damage and significant repair or salvage costs. It could also present a safety risk to building residents.

Moreover, the federal Department of Housing and Urban Development (HUD) has required the project owners to complete the slope stabilization or lose all federal operating subsidies. Currently, the Riverside Apartment complex obtains about $50,000 a month in rental subsidies from HUD. Without the HUD subsidies, the owner could not afford to operate the housing complex, resulting in the loss of 74 units of affordable rental housing and displacement of Riverside tenants.

In summary, if no action were taken, there would be a great risk to property and the physical safety of Riverside residents. Federal housing subsidies would be withdrawn, and the owners would be unable to continue its use as an affordable rental complex. The No Action alternative was determined to be unacceptable.

2.2 PROPOSED ACTION

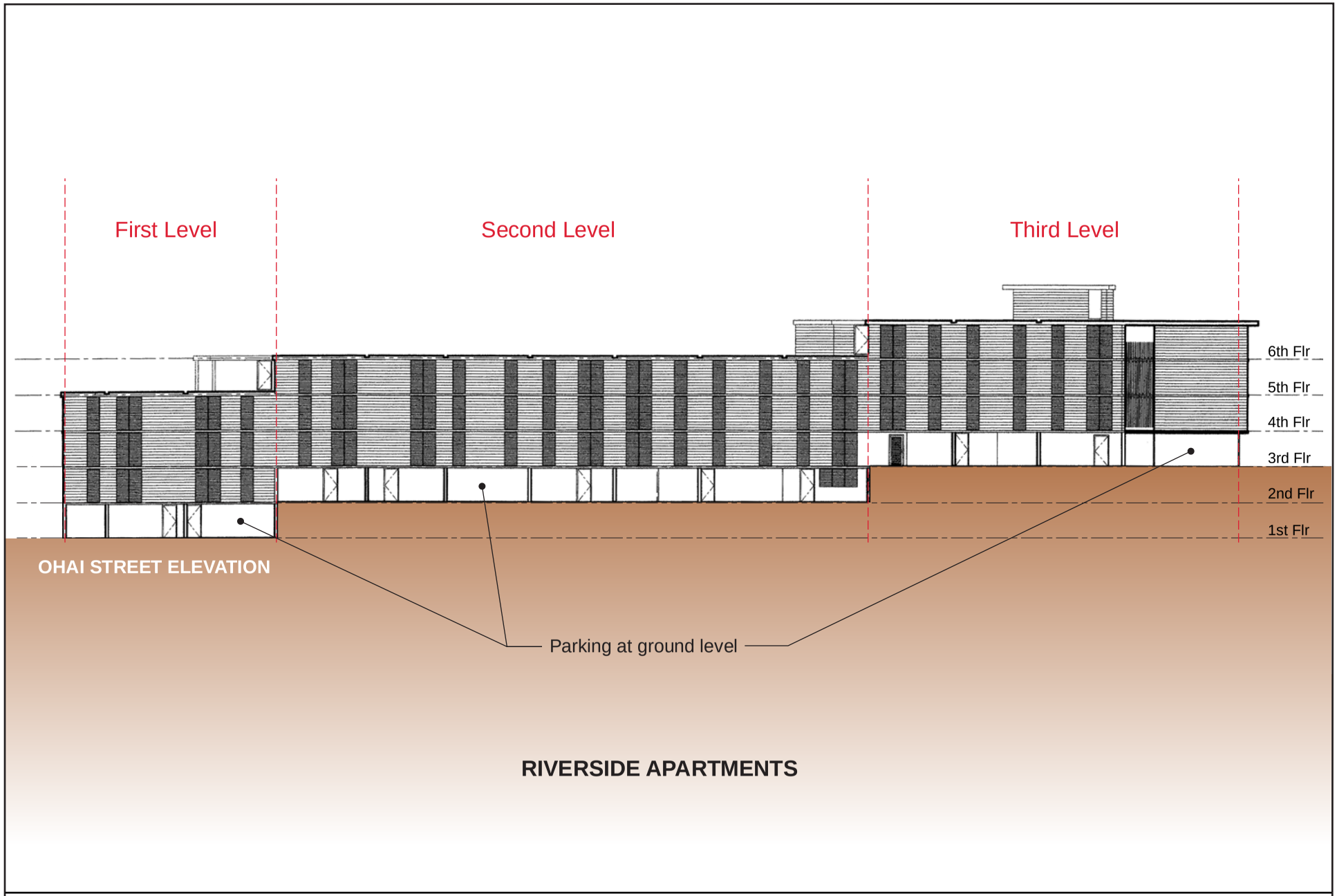
2.2.1 Building Interior Renovation

The proposed modernization will renovate the 74 Riverside Apartment units and common areas, enhancing interior and exterior finishings and amenities. The complex includes 12 one-bedroom units (approximately 559 SF each), 56 two-bedroom units (approximately 660 SF each), and 6 three-bedroom units (approximately 880 SF each). Parking is situated on the ground floor at each of the three terrace levels on the property, with the residential units above.

Because the building is constructed on three terraced levels (Figure 2), there are six “floors” total, although on each terrace level, there are only three floors of apartments above the ground floor parking. Figure 3 shows a typical floor plan for illustrative purposes. The floors consist of a double loaded corridor, or long interior hallway with units on either side.

The proposed improvements include new flooring (carpet, laminate), window treatments, cabinets, counters, appliances (stove, refrigerator), interior plumbing (tubs, faucets, sinks), ceilings, drywall and paint. Repairs will also be made to the building’s common areas including the laundry room, hallways and stairways. Plumbing and electrical systems throughout the building will be repaired as necessary, and the parking lot will be repaired and restriped. Seven of the 74 units will be made Americans With Disabilities Act (ADA)-accessible. The building exterior will be repainted, window awnings or decorative features may be added to the exterior walls, the leaking roof will be replaced, and photovoltaic panels will be added to the roof. No new structures will be built outside the existing building footprint, and all improvements will be to the existing building and grounds.

The renovation will be similar to what was done at the 45-unit E Komo Mai affordable apartment complex on Kinoʻole Street. The modernization of E Komo Mai was completed in January 2012.



Source: Wesley R. Segawa & Associates, 2001

FIGURE 2

BUILDING ELEVATION

Riverside Apartments Improvements

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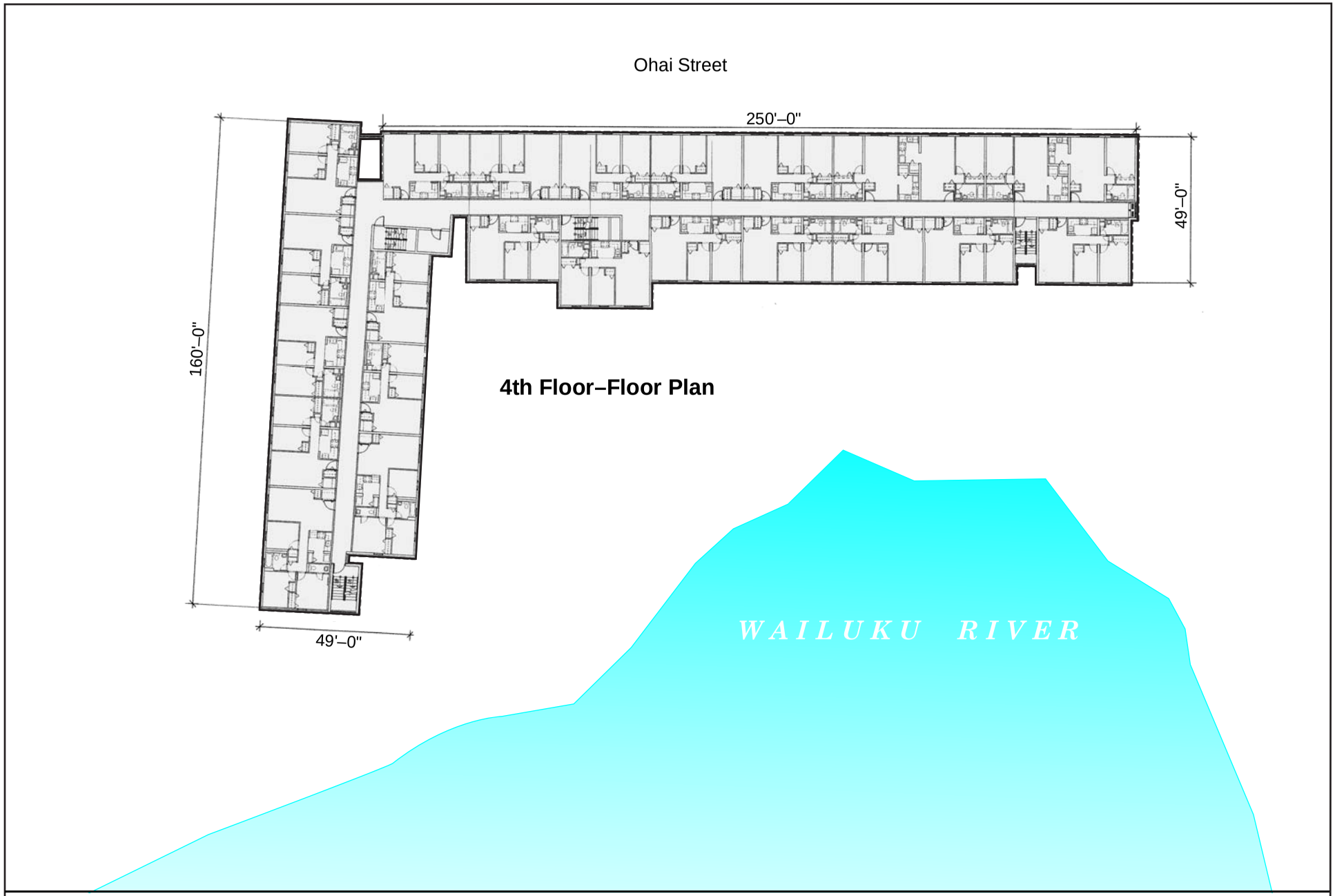

Source: Wesley R. Segawa & Associates, 2001

FIGURE 3

EXISTING TYPICAL BUILDING FLOOR PLAN

Riverside Apartments Improvements

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Before its renovation, the 45-unit E Komo Mai complex looked very similar to the Riverside Apartments.

E Komo Mai following its 2012 renovation.

The renovation was accomplished through a partnership between Urban Housing Communities and Kinoʻole Inc. Financing was provided by Hunt Capital Partners and the Hawaiʻi Housing Finance and Development Corporation (HHFDC)'s Rental Housing Trust Fund. Construction was completed by Hunt Building Company.

Renovated kitchen at E Komo Mai.

The Riverside complex will continue to be occupied while renovation is ongoing, but tenants will be temporarily relocated while their apartments are being improved. All moving costs will be paid for by the project owners. A detailed phasing plan will be developed by the building management in cooperation with the construction contractor. It is estimated that the renovation of the entire complex will take approximately 12 months to complete.

2.2.2 Stream Bank Bluff Protection and Stabilization

The objective of this work is to stabilize the embankment and the Second Level terrace between the two retaining walls, and protect the slope area against future instability, thereby protecting the adjacent building. The proposed improvements will be similar to the emergency stabilization for the Third Level completed in 2011. As shown in Figure 4, the work will have two major components—1) protect and stabilize the embankment in the area where the apartment building is closest to the stream bank, and 2) underpin the building with micropiles to provide redundant protection in the area where the building is closest to the steep slope.

Protect and Stabilize the Embankment

In order to stabilize the stream embankment, a series of soil rock anchors (soil nails) will be drilled into the steep slope face at various angles (see section in Figure 5).

Soil nailing is a common construction technique used as a remedial measure to treat unstable natural slopes. The soil nails generally consist of steel elements (bars or strands) grouted in a drilled hole, to provide lateral or vertical force to resist movement of the slope face. The bars are typically installed into pre-drilled holes and then grouted into place.

A total of seven rows of soil nails will be installed horizontally and at various inclinations across the slope with individual rows spaced at four-foot intervals going up the slope. Soil nails within each row will be spaced approximately three feet apart. It is estimated that approximately 203 soil nails will be required within a 2,710 square foot area of the embankment. Each soil nail will be installed at a depth between 20 and 40 feet. In addition to the soil nails, an 8 to 10 inch thick layer of reinforced shotcrete (gunite) will be installed up and over the stream bank to protect and stabilize the slope face. The shotcrete facing will include a geocomposite subdrain system to relieve groundwater that may collect behind the slope face. A concrete pigment will be added to the shotcrete to color it an earth tone, to blend with the natural rocks, as was done at the Third Level.

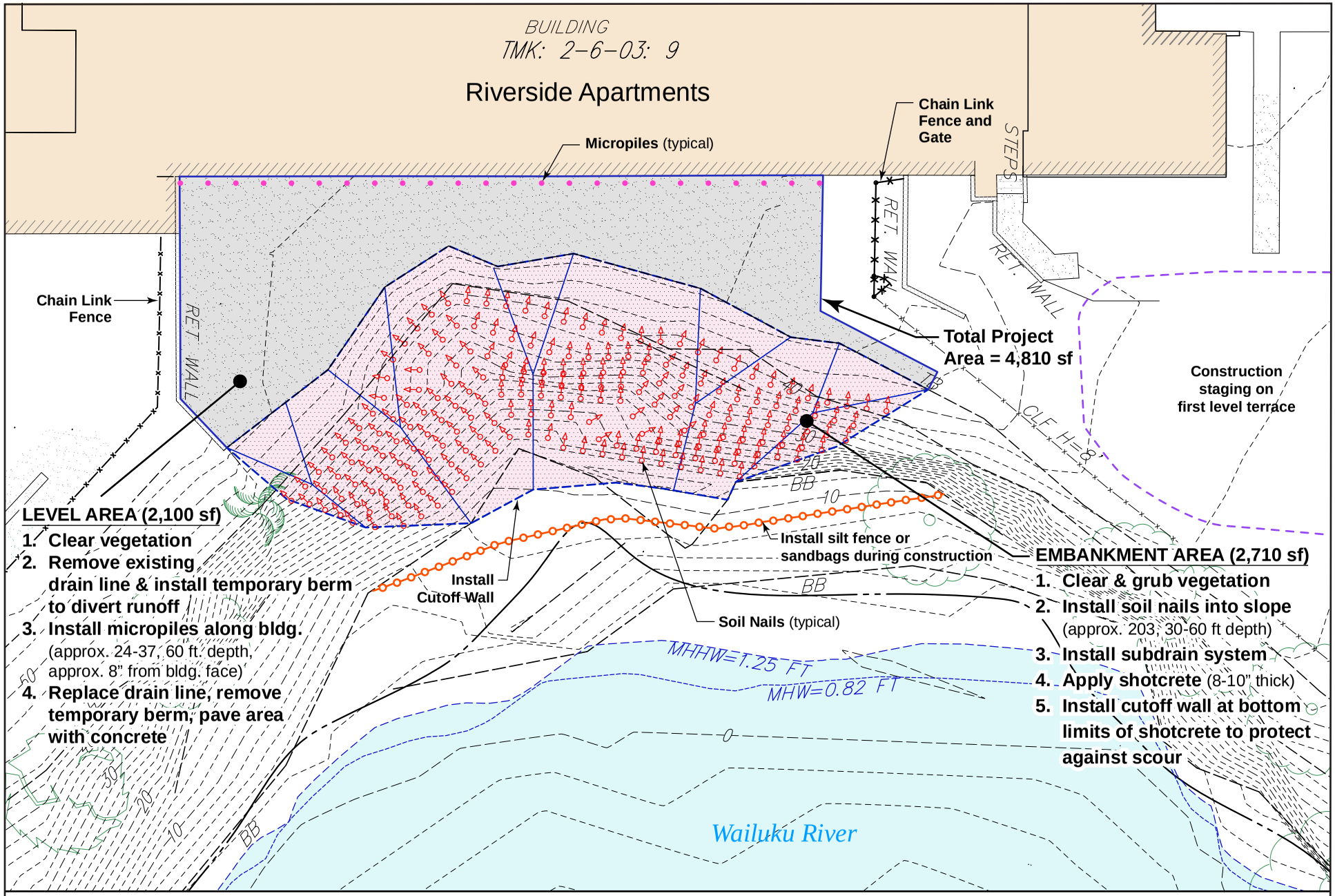

FIGURE 4

SITE PLAN: Stream Bank Bluff Protection & Stabilization

Riverside Apartments Improvements

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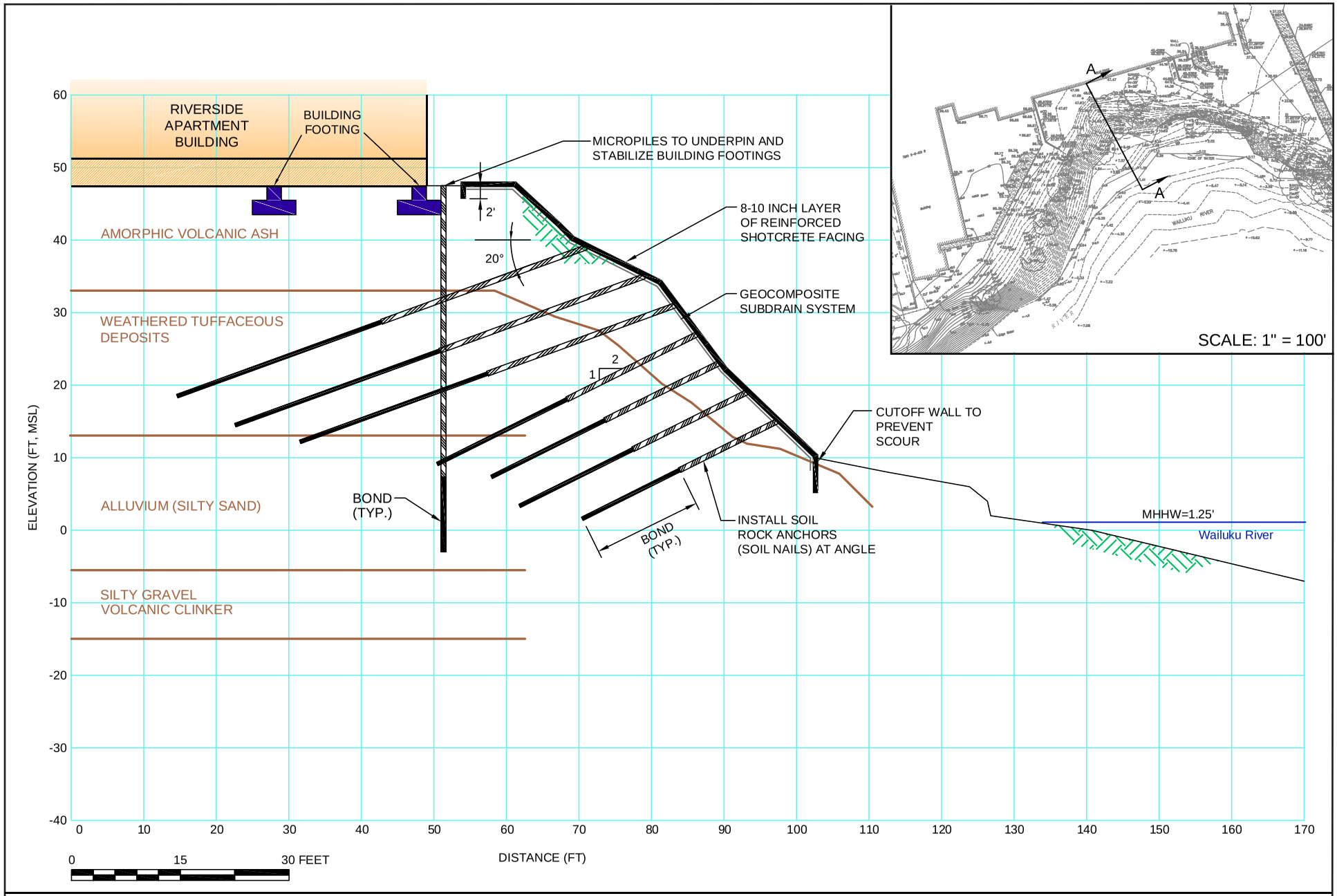

Source: YKE Engineering, 2012

FIGURE 5

PROPOSED SLOPE STABILIZATION AND PROTECTION (SECTION)

Riverside Apartments Improvements

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Examples of soil nail installation.

At the bottom limits of the shotcrete, a cutoff wall will be installed. The wall will be excavated to a depth of five (5) feet or to rock, whichever is less. This will protect against scour caused by turbulent stream flow during heavy rain storms.

Construction for the project is estimated to take approximately three to six months to complete. All work will occur on the stream bank bluff slope and at the top of the bank. No work will be done in or equipment staged below the mean higher high water mark of Wailuku River.

During construction, best management practices will be used to ensure that there are no adverse impacts to the water quality of Wailuku River. Sandbags or a silt fence will be installed during the construction period to prevent rocks, soil, vegetation and other debris from entering the river. The location of the sandbags or silt fence is shown in the site plan. It will be placed below the work area, but above the mean higher high water mark of the river.

Underpin the Building Foundation with Micropiles

In this Second Level area, the building's shallow spread foundations are located as close as 10 to 11 feet from the edge of the embankment. The project will underpin the building's shallow foundations with micropiles in areas where the building is closest to the slope as a means to provide redundant support for the building in event of slope movements due to more extreme events such as very a large earthquake.

The underpinning will be accomplished by installing a series of 24 to 36 micropiles along the edge of the building in the level area at the top of the slope. The micropiles are a high strength central reinforcing bar encased in cement grout within a galvanized steel casing, approximately 6

to 8 inches in outer diameter. The micropiles will be spaced about 4 feet apart and installed along the building wall.

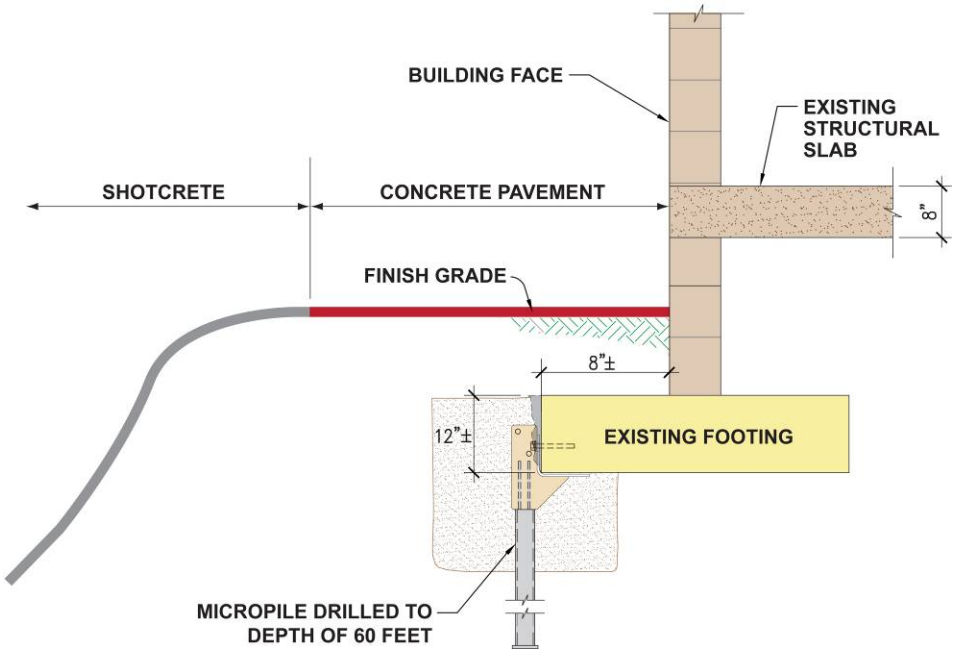

Figure 6. Building Underpinning with Micropiles (Section)

As shown in Figure 6, the micropiles will be structurally connected directly to the continuous wall footings, and installed to a depth of approximately 60 feet in order to support the required load. After installation of the micropiles, the level area at the top of the stream bank will be paved in order to provide additional support and minimize ground saturation which could further destabilize the embankment.

Comparison with 2011 Emergency Stabilization on Third Level

The currently proposed improvements can be compared to the emergency stabilization for the Third Level as follows:

- Both projects involve installation of small diameter soil nails drilled and installed into the slope face to reinforce/improve stability of the slope. Installation of large diameter caissons or piles was deemed less feasible due to the need for relatively heavier equipment compared to the smaller and lighter equipment that can be used for soil nail installation.
- Both projects involve the use of reinforced shotcrete connected to the soil nails to protect and stabilize the slope face.
- Both projects involve installation of micropiles at the top of the stream bank.

- Both projects are located at the two areas of the property where the building is in closest proximity to the edge of the bank.
- Most of the physical difference in scope between the current project and the 2011 project are related to the different subsurface geotechnical conditions at the two areas. For example, depths and locations of bedrock at the Third level and Second Level terraces differ. The unique subsurface conditions affect the placement and depth of soil nails and micropiles, and the extent of shotcrete slope protection.
- The 2011 project did not involve use of public funds, and as such, an Environmental Assessment in accordance with Chapter 343 HRS was not required.

2.3 ALTERNATIVE METHODS AND MATERIALS FOR SLOPE STABILIZATION

Other alternatives for the slope stabilization were considered by the geotechnical engineers. The primary objective of the project is to stabilize and protect the stream bank slope in the Second Level area, generally bound by the two retaining walls.

One alternative considered was to install drilled large diameter concrete caissons to stabilize and protect the slope. This would involve the use of heavy caisson-drilling equipment that would be staged at the top of the embankment behind the building. This alternative was eliminated because of space and access constraints at the top of the bluff, and the marginally stable condition of the existing stream bank. It would also require the use of larger, heavier drill rigs working for long periods of time at the edge of a nearly vertical, unstable bluff. The use of large diameter drilled caissons was determined to be infeasible.

Another option that is commonly used for slope stabilization is construction of a toe buttress, which places rock or other fill material at the toe of the slope. The purpose is to add weight and resistance at the base of the slope to prevent the slope from sliding. There are several reasons why this option was not selected for the Riverside Apartment situation. First, this alternative requires significant space at the toe of the slope to place enough fill material to provide sufficient slope stability. Construction work and placement of fill at the bottom of the slope near Wailuku River would encroach into the area below the mean higher high water mark, which could have impacts on water quality and trigger time-consuming regulatory permits and approvals, delaying the project. Second, the river area is under the jurisdiction of the State of Hawai‘i, and their approval would be needed to place fills and stage equipment on State property. Third, similar to the caisson option, constructing a buttress would require large and heavy equipment working in tight quarters on a steep and marginally stable slope. Access for construction equipment to the bottom of the steep embankment near the river would also be challenging and costly.

These alternative stabilization methods are technically possible. But they entail greater costs, increased risk of destabilizing the embankment, and more time consuming permits and approvals. As such, they were eliminated in favor of the proposed action. Even if feasible, use of concrete caissons or a toe buttress would still not address the need to protect the apartment building in the event that the slope experiences excessive loading conditions.

2.4 COMPARISON OF ALTERNATIVES

Given the unstable condition of the slope face, the limited working and staging area at the top of the stream bank, and the desire to avoid construction near the Wailuku River, the proposed action was determined to be the most feasible alternative. The proposed action would accomplish the project objectives to stabilize the bank as well as provide additional support to the building foundation, within the physical constraints of the site. The geotechnical engineers have determined that the proposed action is the most economical alternative and least disturbing to the environment and existing building. The other alternatives, including the No Action alternative, were eliminated in favor of the proposed action.

3 AFFECTED ENVIRONMENT, IMPACTS AND MITIGATION

3.1 INTRODUCTION

This chapter describes the existing environment, potential project impacts and proposed mitigation. This chapter is organized by resource area, and is generally divided into: 1) physical environment, 2) biological environment, 3) socio-economic environment, 4) utilities and infrastructure, 5) traffic, and 6) public services and facilities.

The discussion of environmental impacts includes both direct and indirect impacts. Direct impacts are those caused by the action and occur at the same place and time. Indirect effects may occur later in time or farther in distance, but are still reasonably foreseeable. The analysis in this chapter also identifies possible cumulative environmental impacts. Cumulative impacts are defined as the results from the incremental impact of the action when added to other past, present and reasonably foreseeable future actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time.

3.2 PHYSICAL ENVIRONMENT

3.2.1 Location and Site Conditions

The Riverside Apartments are located at 333 Ohai Street in Hilo, Hawai‘i, on a 1.8 acre parcel identified as TMK (3) 2-6-003:009. The subject parcel is located at the makai end of the Pu‘u‘eo ahupua‘a, near the mouth of the Wailuku River where it meets Hilo Bay. It is situated near the intersection of Ohai Street with the Pu‘u‘eo Street bridge which crosses the Wailuku River.

The Riverside Apartment complex is comprised of a four-story, L-shaped building constructed in 1973. The terraced site includes parking in an open lot fronting the building, and covered parking on the ground floor of each terrace level. Surrounding land uses are primarily single family residential.

The stream bank bluff protection and stabilization area is located at the rear of the apartment building on the Second Level terrace. The entire Riverside parcel is situated at the top of a steep embankment overlooking the Wailuku River, which borders the entire southern property boundary over a length of approximately 425 feet. In the Second Level area, some portions of the building are situated less than ten feet from the edge of the embankment. The stream embankment is heavily vegetated from the top of the slope down to the river. A section of the embankment at the south end of the Riverside property, on the Third Level, collapsed in 2008, and was subsequently repaired and stabilized.

Top of embankment behind the apartment building on the Second Level.

Note the proximity of the building to the stream embankment, which begins where the vegetation is shown.

3.2.2 Topography and Soils

As discussed previously, the property is terraced into three levels in the east to west direction. The building wing that is situated perpendicular to Ohai Street is known as the "mauka building,"and is on the uppermost terrace (Third Level) of the property. The building wing that runs parallel to Ohai Street extends over the First and Second Levels of the terraced property.

The stream bank bluff protection and stabilization area on the Second Level terrace is bound by two retaining walls. The Second Level is located at an elevation approximately 47 feet above mean sea level (MSL). The First Level, located to the east, is at a slightly lower elevation, approximately 33 feet above MSL. The Third Level, located west of the project area, is at approximately 60 feet above MSL.

Figure 6 illustrates the soil types according to the U.S. Department of Agriculture, Natural Resource Conservation Service soil survey. The predominant soil type within the project area is Hilo Silty Clay Loam (HoC), with slopes of 0 to 10 percent. The Hilo series is characterized by well-drained silty clay loams, which are described as having been "formed in a series of volcanic ash layers that give them a banded appearance. They are gently sloping to steep soils on uplands at an elevation ranging from near sea level to 800 ft," (Foote et al. 1972). This soil type is categorized as receiving between 120 and 180 inches of rainfall a year, with rapid permeability, slow runoff, slight erosion hazard, and good root penetration.

Soil characteristics are discussed further in Section 3.2.3, Geology and Geotechnical below.

3.2.3 Geology and Geotechnical

During the design and permitting of the Third Level slope stabilization project, a second older slope failure was identified at the Second Level terrace. A subsequent geotechnical evaluation was conducted by Yogi Kwong Engineers, LLC (YKE) for this current project area. Its purpose was to explore the subsurface and geotechnical conditions of the current project area, assess the stability of the stream bank, evaluate the impact of potential slope instability to the Riverside Apartment building, and develop recommendations and remediation measures. The resulting *Geotechnical Exploration and Evaluation Report* (YKE 2013) is attached as Appendix A. The discussion below summarizes the findings.

The geotechnical field exploration of the project area was conducted in two stages. A subsurface exploration conducted between April and July 2011 consisted of drilling three (3) exploratory borings and three (3) probe holes, and evaluating the soils in the area. An initial stream bank reconnaissance was also conducted using rappelling gear to access the steep slope in the Second Level area and document the surface conditions. A slope topographic survey was also prepared by R.M. Towill Corporation in support of this project.

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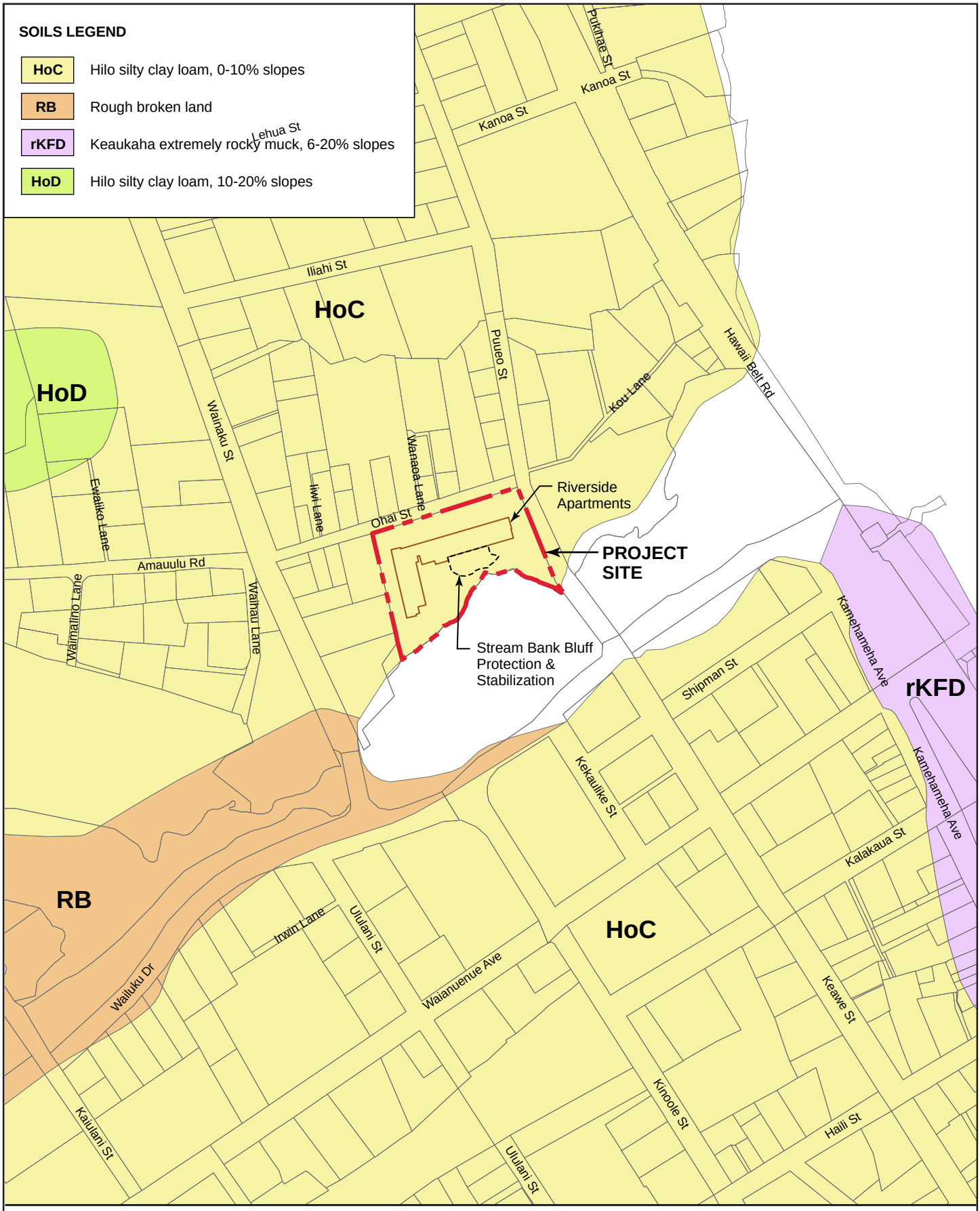


0 100 200 300 FEET

FIGURE 7

SOILS MAP

Riverside Apartments Improvements

A supplemental subsurface exploration was conducted between December 2011 and February 2012 that included a 3-day geophysical reconnaissance and one exploratory boring using a tripod mounted drill in the narrow Second Level terrace area. The approximate locations of the exploratory borings, probe holes and geophysical survey transect locations can be found in Appendix A. Geotechnical laboratory tests were conducted on selected soil samples to evaluate the engineering properties of the encountered soils.

Existing Conditions

Regional Geology

The island of Hawai‘i was formed by the coalescing of five (5) separate volcanoes namely the Kohala, Mauna Kea, Kilauea, Mauna Loa and Hualalai Volcanoes. The town of Hilo generally straddles the southwestern slopes of Mauna Kea and the northwestern slopes of Mauna Loa. Much of the lower southern slopes of Mauna Kea have been buried beneath basalt lava flows from Mauna Loa at the interface between the two volcanoes in the project vicinity (Stearns and Mac Donald, 1946). Wailuku River was generally formed along the intersecting boundary where basalt lava flows and Tephra Deposits of Mauna Loa had overlapped onto older Mauna Kea flows.

Portions of the Hilo town located to the south of Wailuku River are generally underlain by the more recent lava flows of Mauna Loa. Comparatively, portions of Hilo town located in the lower flanks of Mauna Kea and to the north of Wailuku River are generally underlain by older Tephra deposits (also referred to as Pahala Ash).

The name *Pahala Ash* has been generally adopted as the name for fine pyroclastic or tephra ash deposits that originated from Kilauea, Mauna Loa, Mauna Kea and Kohala Volcanoes that have been largely altered by weathering to a mixture of halloysite silt and clay minerals and hydrated oxides of aluminum and iron. The provenance of Pahala Ash on the island of Hawai‘i is believed to be generally related to the proximity of its source and direction of prevailing wind at the time of eruption (Stearns and Mac Donald, 1946 in YKE, 2013).

The Riverside Apartments is located on the northern bank of Wailuku Stream. The geologic units at the Riverside Apartments site generally consist of deeply weathered ash deposits or Tephra (Qt) underlain by basaltic lava flows likely resulting from basalt flows of the Kau Volcanic Series (Qk and Qk1y).

Subsurface Conditions

The YKE geotechnical study characterized subsurface conditions in the project area on the Second Level of the Riverside Apartments property, between the two retaining walls. The findings and conclusions were based on a review of available geologic maps and other published resources, the findings of YKE’s previous geotechnical exploration, the results of the site reconnaissance, and the exploratory borings and probes.

Subsurface conditions at the project area consist primarily of near surface deposits of highly weathered Amorphic Volcanic Ash (Pahala Ash). The Pahala Ash deposits are underlain by Weathered Tuffacous Deposits consisting of predominantly variously welded clinkers and cinder sands with interbedded Pahala Ash deposits. The Weathered Tuffaceous Deposits appear to be generally underlain by slightly to moderately weathered Basalt Lava Flows to the east and west of the project area (i.e., in the First Level and Third Level portions of the property). However, these Basalt Lava Flows were not encountered in the Second Level area of the property between the two existing retaining walls.

In the Second Level project area, the Weathered Tuffaceous Deposits were underlain by Volcanic Clinker Deposits. These are typically the result of the highly vesicular material that rides near the rapidly cooled edges of basalt *a'a* lava flows. As *a'a* flows advance, the outer layers of the flow tend to cool quickly resulting in the fracturing of these outer layers. A thick coating of gravel to boulder sized angular clasts and grindings (or clinker) develop around the inner molten core of the *a'a* flow as it advances. The angular nature of the clinker allows for large voids between clasts, which can be in-filled with the silt and sand sized particles of ground clasts or otherwise in-filled with material from erosional events. The resulting clinker deposits are found to be generally comprised of angular to sub-angular basalt gravel, cobble and boulder sized clinkers suspended in a matrix of weathered sand, silt and clays.

This Clinker Deposit layer appears to contain voids and fissures, which were estimated by measuring the grout intake quantities needed to backfill the exploratory borings. The high quantities of grout material needed indicate the likelihood of voids or fissures in the test areas. Further testing also detected the presence of soft soils and smaller voids in other areas.

The Pahala Ash and Tuffaceous soils were found to have very high natural water contents at various depths near saturation levels at the time of sampling. Additionally, perched groundwater was also encountered in the boring and probes at elevations between 2 and 28 feet mean sea level (msl). The study concluded that localized zones of perched groundwater are prevalent in the study area.

The geotechnical study found an apparent lack of Basalt Lava Flows underlying the near surface Pahala Ash and Weathered Tuffaceous Soils within the study area. From a geotechnical perspective, this means that there is an increased likelihood of slope instability and slope failures in these areas. The study concluded this situation also poses an increased risk to the stability of the apartment building structure, particularly in areas that are closer to the edge of the slope.

Slope Stability Analysis

The YKE geotechnical evaluation included a series of slope stability analyses of the project area. Several different loading conditions were evaluated including the existing *in-situ* condition, potentially fully saturated slope condition, and various seismic conditions that could occur. Slope stability was evaluated for the area between the two retaining walls.

The geotechnical investigation concluded that the stream bank slope within the project area may be prone to future slides under fully saturated conditions, such as after a long period of rain or by perched water, as well as under certain seismic conditions. The project area was characterized as "marginally stable" under current static loading conditions. The study noted that the slope would be prone to instability under saturated slope conditions and certain seismic loading conditions. Due to the close proximity of the building to the stream bank in the Second Level area, failure of the slope would likely undermine the apartment building's foundation capacity.

Impacts and Mitigation

The geotechnical evaluation found the stream bank in the Second Level is vulnerable to further erosion and possible collapse, and recommends that the existing stream bank slope be stabilized and protected. The study also recommended that the toe of the slope be protected from possible scour from the Wailuku River.

As mitigation, the geotechnical evaluation recommended the installation of soil rock anchors (soil nails) placed in seven horizontal rows at various inclinations from the top to the bottom of the slope, with the additional protection of reinforced shotcrete across the slope from top to bottom. In order to stabilize the apartment building, the geotechnical study recommended the installation of micropiles to underpin the shallow building footings. Protection to the toe of the slope will be accomplished by installing a cutoff wall, excavated to a depth of approximately five feet.

The proposed embankment protection and stabilization is based on these geotechnical recommendations. The proposed action is intended to correct the existing unstable embankment and to protect the Riverside Apartment building from potential structural damage. The geotechnical study evaluated slope stability with the recommended improvements, modeling various conditions of slope saturation (i.e., heavy rain) and seismic loading (i.e., earthquakes). It concluded that with the recommended improvements, slope stability would improve and comply with the minimum required factors of safety against slope instability under the various loading conditions considered.

The proposed improvements, which follow the recommendations of the YKE *Geotechnical Exploration and Evaluation Report*, are recommended to mitigate the existing unstable and vulnerable condition of the stream embankment.

3.2.4 Climate and Air Quality

Existing Conditions

Climate

Monthly mean temperatures in Hilo range from 71.4 °Fahrenheit in January to 76.4 °Fahrenheit in August. The average maximum daily temperature at sea level in Hilo is 81.0 degrees Fahrenheit, with an average minimum of 66.7 °. Average annual rainfall recorded at Hilo International Airport between 1981 and 2010 was 127 inches, with 275 days of the year

receiving some rain. According to the National Oceanic Atmospheric Administration (NOAA) website, “Within the city of Hilo, average rainfall varies from about 130 inches a year near the shore to as much as 200 inches upslope,” (NOAA 2009). Extreme rainfall events occur frequently in the Hilo watershed.

The prevailing wind throughout the year is the east northeasterly trade wind. Generally, the trade winds are more persistent in summer than in winter. They range over the open sea near Hawai‘i from a minimum of about 50 percent of the time in January to a maximum of more than 90 percent in July, with an annual frequency of about 70 percent (NRCS 2009).

Air Quality

National Ambient Air Quality Standards (NAAQS) have been established for seven major air pollutants: carbon monoxide (CO), nitrogen oxides (NO_x), ozone (O_3), particulate matter smaller than 10 microns (PM_{10}), particulate matter smaller than 2.5 microns ($PM_{2.5}$), sulfur oxides (SO_x), and lead. Air pollutant levels are monitored by the State Department of Health (DOH) at a network of sampling stations statewide, although there are no sampling stations in windward O‘ahu. Based on ambient air monitoring data, the U.S. Environmental Protection Agency has classified the island of O‘ahu and the entire State of Hawai‘i as being in attainment of the federal standards.

Air pollution in East Hawai‘i is minimal, and is mainly derived from volcanic emissions of sulfur dioxide, which convert into particulate sulfate and produce a volcanic haze (vog) that occasionally blankets the district. The persistent trade winds keep Hilo relatively free of vog for most of the year.

Impacts and Mitigation

Interior Renovation

Both the interior building renovations and the stream bank bluff protection and stabilization action have the potential for adverse air quality impact to building residents. During interior renovation, demolition and construction will generate fugitive dust. There is also the potential for lead-contaminated debris and fibers, and exposure to fumes paint, adhesives, solvents, and new furnishings, and exhaust from construction equipment. Roof renovations and parking lot repair may require application of including coal-tar pitch and asphalt.

Renovations within the building will be phased and tenants within that section of the building will be relocated while work is being done. Renovation areas will be isolated by measures such as sealing the work area, shutting down the ventilation systems, and maintaining good housekeeping practices in the work area. A hazardous materials survey will be completed prior to the renovation and any hazardous materials will be properly handled and disposed.

Stream Bank Bluff Protection and Stabilization

During the slope stabilization, vegetation clearing, drilling, installation of soil nails and micropiles and grouting, and operation of diesel powered construction equipment will increase airborne particles and vehicle emissions. These temporary air quality impacts may be a particular nuisance for the 23 two-bedroom units in the main building which face the river, as the construction work will be conducted in the area immediately outside their back windows.

Dusts screen fabric will be used to cover windows of the nearby apartment units and residents will be instructed to keep windows closed. The contractor will periodically spray the work area with water in order to minimize airborne dust. Because of the proximity of the apartment units and because many of Riverside tenants are at home during the day, residents will be encouraged to temporarily vacate their apartments during work hours. Riverside management will establish designated "refuge areas," such as apartments within the complex or on a nearby property, where residents can go to escape the noise and dust. Currently, the UHC 00382 Hilo, L.P., the project proponent, is looking at acquiring an adjacent property at 375 Ohai Street, next to the Third Level parking lot. If available, the house on the site will be used as a temporary refuge during the embankment work. Several other options, including rental of a nearby church multi-purpose room, are also being investigated for use during the renovation period.

As noted above, tenants will be relocated for the interior renovation work. To the extent possible, the interior renovations will be coordinated with the proposed embankment repair, so that the river-facing units will already be vacant when the embankment work is scheduled.

The construction contractor will be required to employ fugitive dust emission control measures in compliance with provisions of the State DOH Rules and Regulations (Chapter 43, Section 10) and Hawai‘i Administrative Rules (HAR) Chapter 11-60.1, "Air Pollution Control," Section 11-60.1-33 on Fugitive Dust.

Standard best management practices will be utilized during construction, such as spraying water as necessary to control dust. In addition, the following measures will be implemented to minimize dust and air quality impacts:

- Provide an adequate water source at the site prior to start-up of construction activities;
- Pave or revegetate work areas cleared of vegetation as soon as possible to reduce dust;
- Provide adequate dust control measures during weekends, after hours, and prior to daily start-up of construction activities;
- Control dust from debris being hauled away from the project site;
- Move construction equipment to and from the work sites during non-peak traffic periods, to the extent possible, in order to minimize disruption to area traffic.

In summary, air quality impacts will present a nuisance to Riverside Apartment residents during construction, but this will be temporary in duration.

Long-Term Impacts

Once improvements are completed, there will be no long-term effect on air quality.

3.2.5 Natural Hazards

Existing Conditions

Flood

The Riverside Apartments property is situated next to the Wailuku River, at the top of the steep stream bank. As shown in Figure 6, the majority of the property, including the apartment building, is not within a flood prone area, and is designated as Flood Insurance Rate Map (FIRM) Zone X, outside the 1% and 0.2% annual chance floodplain. This was confirmed by the State of Hawai‘i Department of Land and Natural Resources (DLNR) Engineering Division, in a pre-assessment consultation response (see Chapter 7). The Flood Insurance Rate program does not have any regulations for developments within Flood Zone X.

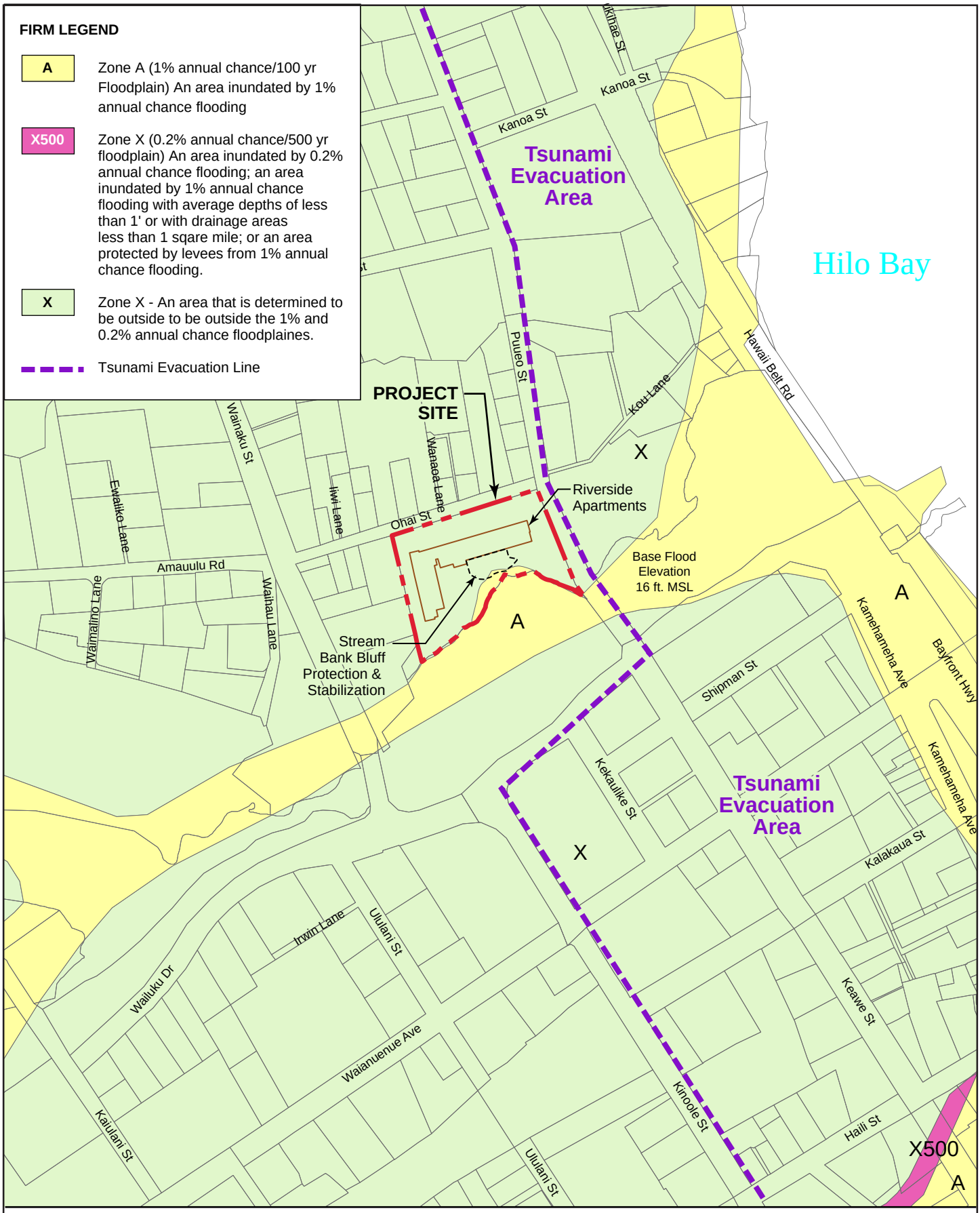
The lower area of the river embankment, including part of the project area, is within the flood zone of the Wailuku River. The FIRM designates this area as Zone A, 1% annual chance of flooding, also referred to as the “100-year” flood or “base flood,” which may occur more or less often than once every 100 years. The base flood elevation (BFE) is 16 feet above mean sea level (MSL). The shotcrete covered area will extend down to $\pm$ 6 feet elevation. Those portions of the project area that are at or below 16 feet MSL are within Zone A.

All project improvements are located above the mean higher high water (MHHW) mark, and no work will occur within or near the river. Because the area within the flood zone is vulnerable to scour, a cutoff wall will be installed at the toe of the shotcrete covered slope. The improvements will not alter the base flood elevation or have adverse impacts on the floodplain.

Tsunami Evacuation

Hilo has a history of being subject to devastating tsunami waves, has experienced greater tsunami-related property damage and loss of human life than any other area in Hawai‘i. Hilo is affected by tsunamis for many reasons, including the local topography and bathymetry. The orientation of the Hawaiian ridge and coastline, with respect to the direction and approach of a tsunami, plays an important role. Also, small funnel-shaped bays, like Hilo Bay, harness the tsunami wave energy and amplify the heights of the waves, leading to greater destruction.

The Hawai‘i County Civil Defense Agency’s tsunami evacuation maps show the Riverside Apartments parcel is not within the tsunami evacuation area. On the north side of Wailuku River, the tsunami evacuation area ends at Pu‘ue‘o Street. Only properties makai of Pu‘ue‘o Street are within the area to be evacuated to higher ground. The nearest evacuation shelter is the Pu‘ue‘o Community Center, located at 145 Wainaku St., Hilo, half a mile north of the project site.



0 100 200 300 FEET

FIGURE 8

FIRM AND TSUNAMI EVACUATION AREA

Riverside Apartments Improvements

Volcanic Hazard

The entire Big Island is subject to geologic hazards, especially lava flows and earthquakes. Volcanic hazard as assessed by the U.S. Geological Survey (USGS) in this area of Hilo is 3 on a scale of ascending risk 9 to 1. The hazard risk is based on the fact that Mauna Loa is an active volcano. Volcanic hazard zone 3 areas have had 1 to 5 percent of their land area covered by lava or ash flows since the year 1800, but are at lower risk than zone 2 areas because of their greater distances from recently active vents and/or because the local topography makes it less likely that flows would cover these areas. (County of Hawai‘i, 2010).

Regional Seismicity

The Island of Hawai‘i is the most seismically active of the Hawaiian Islands, and is located in the highest Uniform Building Code (UBC) Earthquake Zone 4 (1997). The UBC provides the seismic zone factor (Z factor) which is equivalent to the base rock peak horizontal ground acceleration based on earthquake hazards with a 10% probability of being exceeded in 50-years (i.e., roughly corresponding to a 500-year return period seismic event). The UBC seismic zone factor for the Island of Hawai‘i is 0.40 which corresponds to a predicted bedrock acceleration of 0.40g or 0.40 times the force of gravity. Comparatively, the USGS has developed an interactive seismic data base in which a higher base rock ground acceleration of 0.48g is predicted for the project location based on a similar 500-year return period seismic event (USGS, 1996).

While there are a number of parameters that can affect the actual seismic risk at a site such as strength of an earthquake and the epicenter distance, the YKE study noted that the underlying geologic and soil conditions (presence of high moisture Volcanic Ash soils) could amplify the shaking during an earthquake. For example, a higher peak ground acceleration of 1.0g (or 1x the force of gravity) was recorded at the Waimea fire station USGS seismic monitoring station during the M6.7 Kiholo earthquake in October of 2006. Based on available publications, the Waimea fire station is also noted as being underlain with near surface Volcanic Ash soils.

Impacts and Mitigation

The history of relatively frequent seismicity on Hawai‘i Island, the geologic and hydrologic conditions at the Second Level project site area, and the location of the apartment building relative to the steep stream bank in this area increases the risk of instability in the Second Level terrace. The proposed mitigation is to reinforce the slope with closely spaced soil nails connected to a reinforced shotcrete slope facing to protect the face of the slope. The building will be underpinned with small diameter micropiles to provide redundant support for the building where it is in closest proximity to the steep stream bank.

The project is considered critical, given the close proximity of the building to the marginally stable stream bank slope in the Second Level area; high seismic zoning; and the geologic and hydrologic conditions found by the geotechnical study.

3.2.6 Water Resources

Existing Conditions

The project site is located in the Puʻuʻeo *ahupuaʻa*, a section of land that is a major part of the Hilo Bay Watershed. Streams, waterfalls, ponds, and other water features are abundant within the *ahupuaʻa*. The Wailuku River, which borders the property, is 28 miles in length, and is the longest river in Hawaiʻi. It drains a watershed area of 252 square miles. The river's origins along the eastern slope of Mauna Kea are at over 10,000 foot elevation, and from there the river descends steeply, flowing along the divide between the lava flows of Mauna Kea and those of Mauna Loa to the south.

The project area is at the lower reaches of the Wailuku River near its terminus in Hilo Bay. Just upstream of the project site are the popular Rainbow Falls and Wailuku River State Park, as well as the Peʻepeʻe Falls and the turbulent area known as Boiling Pots. The lower reach of the river just mauka (east) of the project site is used for the generation of hydroelectricity. The Hawaiʻi Electric Light Company (HELCO) operates the Waiau and Puʻueʻo hydropower plants, located near Wainaku Street. After passing the Riverside Apartments, the Wailuku River meets Hilo Bay.

Wailuku River is classified as a perennial stream by the 1990 *Hawaiʻi Stream Assessment (HSA*) and assigned a stream code of 8-2-60. The Wailuku River was one of 18 Hawaiʻi streams and tributaries identified in the HSA as eligible for the National Park Service's Wild and Scenic River Status. "Special Areas" known to be present within the Wailuku River included special habitats, wetlands, historic sites and waterfalls. The HSA also ranked aquatic resources based on the presence of various native species and the quality of the aquatic habitat. The six ranking categories included Outstanding, Substantial, Moderate, Limited, Without, and Unknown. Aquatic resources within Wailuku River were rated as "Moderate."

The State of Hawaiʻi Department of Health (DOH) identified Wailuku River as an impaired water body in its *Final 2004 List of Impaired Waters of Hawaiʻi*. The DOH has identified Water Quality Limited Segments (WQLS) around the State, which are water bodies which cannot reasonably be expected to attain or maintain State water quality standards without additional action to control non-point source pollution. Pollutants of concern are identified for each impaired water body, and include nutrients, suspended solids and sediment, turbidity, polychlorinated biphenyls (PCBs), bacteria, and phosphorus.

The DOH identified the primary pollutants of concern for the Wailuku River as nutrients (nitrate/nitrite). As part of its compliance with the federal Clean Water Act, the DOH's Total Maximum Daily Load (TMDL) process will identify activities that may help reduce pollutant loads and improve water quality.

Hilo Bay

The Wailuku River is the largest source of surface water into Hilo Bay. It is one of several tributaries (Waiakea, Alenaio, Wailoa, and Honolii Streams) which feed into Hilo Bay, all of

which have long been on the U.S. Environmental Protection Agency (EPA)'s 303(d) list of impaired waterbodies.

It is estimated that the Wailuku River contributes an average annual flow of one million cubic meters into the bay (M & E Pacific 1980 in Hawai'i County 2010), along with an average of 10 tons of suspended sediments and nutrients each day. Currently, there are efforts by the DOH, USGS, and the University of Hawai'i to quantify and evaluate the input of sediments and nutrients from the Wailuku River into Hilo Bay.

Sediment and nutrients from Wailuku River is among a number of factors that are known to adversely affect water quality of Hilo Bay. A recent assessment and watershed-based plan prepared for the Hilo Bay Watershed Advisory Group (Silvius et al 2005) listed the a number of threats to water quality of Hilo Bay, which included urban flooding; urbanization in flood zones; conservation area flooding and erosion; lack of enforcement of regulations and need for more of appropriate grading regulations; lack of education on best management practices; the left-over impacts of sugar cane industry; the impacts of the Hilo Bay Breakwater on Hilo Bay circulation; an incomplete municipal wastewater system along with a high number of cesspools; and invasive plant and animal species. Additional research into these factors by the State, federal government and private groups is ongoing.

Impacts and Mitigation

The proposed construction activities will occur within or around the building. The stream bluff protection and stabilization will occur on the top of and on the slope of the stream bank above the Wailuku River. All project improvements will be located above the mean higher high water (MHHW) mark of Wailuku River. No work will occur and no equipment will be staged below the MHHW level. Best management practices will be used during construction to prevent runoff and debris from entering the Wailuku River and Hilo Bay.

Construction Period

The construction contractor will follow the requirements of Section 209-Water Pollution and Erosion Control in the 2005 edition of "Hawai'i Standard Specification for Road, Bridge and Public Works Construction" and the Hawai'i County Code, Chapter 10, Erosion and Sediment Control as required by the County Department of Public Works. Chapter 11-55, Water Pollution Control, HAR, Department of Health requires a National Pollutant Discharge Elimination System (NPDES) permit for certain construction activities. An NPDES for discharges of wastewater effluent is not applicable to this project. An NPDES for discharges composed of storm water runoff associated with construction activities (clearing, grubbing) is not required for this project since the disturbance area is less than one (1) acre.

The contractor will utilize best management practices during construction to prevent soil, debris, vegetation from entering the waters of the river. A stilt fence will be installed near the bottom of the embankment, but out of the river waters, to catch debris. These erosion control measures will remain in place throughout the construction period and be properly cleaned and maintained each day. The project plans and specifications include the following statements:

- Prior to construction work temporary erosion control measures, such as sand bags or silt fence, and debris catchment fencing shall be installed.
- Construction work shall be performed incrementally to minimize erosion potential.
- When exposed areas are not to be disturbed for 30 days or more, seed, plant or hydroseed temporary vegetation, unless remaining natural vegetation provides adequate protection.
- Per Hawai‘i State Flood Hazard Assessment Report, the adjacent Wailuku River has a base flood elevation of 16 feet MSL which corresponds to a 100-year flood.
- Non-paved or shotcrete protected surfaces that are denuded during construction shall be grassed.

The construction contractor will also be required to follow standard good housekeeping practices such as proper disposal of waste and hazardous materials, proper storage and use of products, and proper maintenance of construction vehicles and equipment.

Stream Channel Alteration Permit (SCAP)

The State of Hawai‘i Department of Land and Natural Resources, Commission on Water Resource Management (DLNR CWRM) has determined that a Stream Channel Alteration Permit (SCAP) is required for the stream bank bluff protection and stabilization (see pre-assessment consultation comments, Chapter 7).

A SCAP is required for any temporary or permanent activity within the stream bed or banks that may: 1) Obstruct, diminish, destroy, modify, or relocate a stream channel; 2) Change the direction of the flow of water in a stream channel; or 3) Remove any material or structure from a stream channel. The project involves stabilization of the stream bank and therefore is subject to SCAP. However, no work will occur within the stream bed and the improvements will have a negligible effect on the flow of the Wailuku River. No equipment will be staged or placed below the MHHW mark of the stream.

The SCAP application will be submitted to the DLNR CWRM following completion of the Environmental Assessment.

Operational Period

By stabilizing and protecting an extremely vulnerable stream bank, the project will have a long-term positive impact on the water quality of the Wailuku River. The improvements will not affect the carrying capacity, flow or direction of the river. The improvements protect against scour and ongoing erosion that occurs during periods of heavy rainfall. Most importantly, the improvements will avoid a major slope failure that could contribute large quantities of sediment, debris, rocks, boulders and vegetation into the river.

3.2.7 Noise

Existing Conditions

Noise levels in the vicinity of the project site are relatively low, consistent with the character of the residential neighborhood. The primary source of noise at the project site generated by residents in the apartment building (talking, children playing, television, radio, etc.), operation of landscape and maintenance equipment (lawnmower, hedge trimmers, etc.) and traffic on nearby Ohai Street and Pu‘ue‘o Street.

Impacts and Mitigation

Construction Period

During interior renovation, there will be noise associated with demolition, construction, and the operation of machinery and equipment. Impacts to residents will be minimized by relocating residents from the renovation areas, and sealing off the work area, for example with plywood partitions or similar methods, to alleviate both dust and noise.

The embankment work will include clearing vegetation, felling trees, removal of an existing drainline, and drilling associated with installation of micropiles and soil rock anchors. The noise from these activities will especially impact residents occupying the river-facing units. Noise impacts will be exacerbated and difficult to mitigate due of the proximity of the embankment work area to the building. For example, approximately 24 to 36 micropiles, 6 to 8 inches in diameter, will be drilled into the top of the slope using a hydraulic drill rig less than one foot away from the existing building wall. This work will be done immediately outside the windows of the 23 units in the main building that face the Wailuku River.

The installation of approximately 203 soil nails into the face of the embankment will also involve noise associated with drilling. This work area on the embankment is as close as 20 feet from the nearest apartment units. Noisy work includes drilling to install the 3.5 inch diameter rods and application of a layer of shotcrete through high velocity pneumatic pumps and hoses.

The total construction period for the embankment work is expected to last approximately four months. Noisy work will generally occur on and off throughout the construction period, with clearing, drilling and shotcrete application generally spanning from start to finish. The work and anticipated noise will be similar to what was experienced during the repair to the Third Level scarp (see photos).

The following types of equipment will likely be used during construction:

- Chainsaw for cutting trees
- Chipping machine for consolidating tree cuttings
- Excavators
- Fork lift
- Trucks and Semi-Truck for material/equipment delivery and disposal
- Boom Truck
- Concrete truck
- Concrete pump truck (likely with boom) and air compressor for Shotcrete application.
- Drill types:
  - Pneumatic air-track drill with diesel power pack compressor
  - Diesel powered tracked drill
  - Diesel powered spider excavator
  - Percussive attachments for drilling for drilling through rock (which would increase the noise level)

Some standard noise mitigations that are recommended include:

- Construct noise barriers such as temporary walls between noisy activities and noise-sensitive receivers
- Site equipment as far away from noise-sensitive site as possible
- Combine noisy operations to occur in the same time period
- Avoid night time work
- Use quieted equipment such as quieted and enclosed air compressors, mufflers on all engines

Residents will be notified in advance of the construction schedule and the timing and duration of the noisiest activities. The river-facing units will probably already be vacated for the interior renovation when the embankment work is planned. Residents who remain in their units will be strongly encouraged to vacate during the day when these high noise activities are planned.

During the period when work is being done on the embankment, Riverside management will provide a "refuge area" where residents can stay during construction hours. The project owner is currently pursuing acquisition of a house next door on Ohai Street. If the acquisition is successful, the house can be used as a temporary refuge during the embankment work. The house would be furnished with tables, televisions, and computers to allow tenants the opportunity to leave their units during the day. Riverside management is also investigating other spaces nearby which could be rented for this purpose, including a church multi-purpose room. If the temporary refuge space is farther than a few blocks from Riverside, transportation will be provided for the tenants. Riverside management is committed to working closely with the construction contractor and the residents to communicate information about planned construction activities, so residents can also make other arrangements in advance.

All construction activities will comply with the Hawai‘i Department of Health (DOH) Administrative Rules Chapter 11-46 on Community Noise Control. The Riverside Apartments parcel is considered a Class B zoning district, which includes all areas zoned for multi-family dwellings, apartment, business, commercial, hotel, resort or similar type. Maximum permissible sound levels by stationary sources and construction equipment in a Class B district during Daytime (7:00 AM to 10:00 PM) is 60 dB). These noise levels apply to the areas within the Riverside property, and any point beyond the property line.

In cases where construction noise exceeds, or is expected to exceed the DOH's "maximum permissible" noise levels at the property line (for a non-exempt activity) a permit will be obtained from the DOH to operate vehicles, construction equipment, power tools, etc. that emit noise levels in excess of "maximum permissible" levels. The regulations allow an exemption for "Construction and remedial activities related to the emergency repair of damage caused by natural disasters, including but not limited to tsunamis and hurricanes…" [§ 11-46-5 (6)], and the proposed action may qualify for this exemption.

The DOH currently regulates construction noise under a permit system. Under current procedures, noisy construction activities are restricted to hours between 7:00 AM and 6:00 PM, Monday through Friday, excluding certain holidays, and 9:00 AM and 6:00 PM on Saturdays. Construction is not permitted on Sundays. All construction work will be performed during the day to ensure minimal nighttime noise impacts on residents.

Operational Noise

Once the improvements are completed, there will not be any long-term increase in noise.

3.2.8 Solid and Hazardous Wastes

Interior renovation may involve the removal of lead based paint and asbestos containing material. A hazardous materials survey will need to be conducted prior to renovation. All tenants and their possessions will be relocated from the renovation area, and the work area will be isolated and contained through the use of heavy plastic sheeting, including on the floor and other surfaces. Ventilation systems within the work area will be closed and sealed to avoid dust from getting into vents and moving to other parts of the building. Construction areas will be secured, and tenants will not be allowed into the areas of the building where work is ongoing. Units will be thoroughly cleaned and free of any hazardous materials before tenants move back in.

The construction contractor will be required to dispose of waste material subject to the requirements of Chapter 20-Refuse of the Hawai‘i County Code and may require a landfill disposal permit from the Department of Environmental Management, Solid Waste Division. All waste materials will be collected and properly disposed.

An existing drain line that will be removed is known to have asbestos containing material. This and other hazardous materials that may be encountered or generated will be disposed in accordance with local and State regulations. No construction waste materials will be buried or disposed on site.

Once completed, the proposed renovation and bank stabilization will not impact the quantity or type of waste generated at the Riverside Apartment complex.

3.2.9 Visual Impact

Existing Conditions

The Riverside Apartment building is outdated and has not had a major upgrade since its construction in 1973. The existing setting provides for basic housing needs, but does not present an attractive living environment. The physical appearance of the complex does not foster a sense of community pride or a desire among the residents to upkeep the premises.

Seen from behind the Riverside Apartments, the stream bank area is a heavily vegetated area, with tall trees and thick growth nearly completely obstructing any view of the river. The stream bank itself is not visible. Viewed from across the Wailuku River, the stream bank is obscured by dense vegetation, and the Riverside Apartment building is barely visible over the top of the trees.

Project area as it currently appears from across the Wailuku River.

Impacts and Mitigation

The interior renovation is expected to dramatically improve the visual and aesthetic environment for Riverside residents, in addition to improving livability, health and safety. The renovation of the E Komo Mai apartments, which at one time closely resembled Riverside, illustrates the visual improvement that is anticipated. Although there are currently no design plans for the Riverside renovation, the modernization will be similar in scope. The overwhelmingly positive reaction of E Komo Mai tenants to the physical improvements are also anticipated when the Riverside Apartments renovation is complete.

The bank protection and stabilization work will also modify the visual environment. The removal of vegetation on the Second Level scarp will alter the appearance and ambiance of the immediate project area. For the tenants of the river-facing apartment units, the existing view out their window of dense vegetation will dramatically change, and the river will be clearly visible from their apartments. The river-facing units will also be exposed to more natural sunlight, heat and wind flow.

From across Wailuku River, the newly hardened area will appear stark and bare in comparison to current conditions and the surrounding stream bank. The Second Level scarp will have a rocky appearance, similar to the section of the Third Level slope that was repaired in 2011. Vegetation on the adjacent First Level and Third Level scarps will remain unchanged.

Shotcrete surface will look similar to this area near the top of the Third Level scarp.

No replacement landscaping is included as part of the stream bank bluff protection and stabilization work. The installation of new landscaping in this area could be counter productive to the stabilization efforts. For example, large trees growing on a slope can contribute destabilizing forces due to their weight and the force of wind against the trees. Tree roots can loosen soil and rock-joints, or crack the shotcrete, reducing its effectiveness. . Decaying roots of dead/dying trees can leave voids and cavities in the ground.

The existing dense vegetation behind the building has become a breeding ground for mosquitoes, causing an ongoing maintenance problem and a nuisance for residents. Reducing the vegetation will improve air circulation, reduce dampness, and help control the mosquito population.

Concerns about the visual appearance of the stabilized area will be addressed by adding earth-toned pigment to the shotcrete covering the slope to blend in with the surrounding rock. Eventually, vegetation from the surrounding areas will visually soften the stark edges of the shotcrete, providing a more natural appearance.

3.3 BIOLOGICAL ENVIRONMENT

Biological surveys of the project were conducted by Rana Biological Consulting, Inc. and AECOS Consultants in January 2013 (see Appendix B). The surveys included botanical, avian and mammalian surveys. The primary purpose w to determine of there are any botanical, avian or mammalian specie currently listed, or proposed for listing under either federal or State of Hawai‘i endangered species statues within or adjacent to the study area.

3.3.1 Botanical Resources

Existing Conditions

The front and west sides of the Riverside Apartment building are largely paved and used as a driveway and parking lot, with a narrow grassy strip fronting the Ohai Street fence. On the east side of the building near Pu‘u‘eo Street, there is a flat grassy area with a few landscaped plants. Behind the building, all three levels are grassed. All vegetation in these areas is introduced,

ornamental plants. There are no native plants or threatened or endangered species in this landscaped area.

The biological surveys focused on the embankment area at the Second Level terrace. The site is a high, extremely steep bank on loose soil material and only accessible parts of the site could be traversed on foot. Inaccessible parts were viewed from the top of the bank, from within where possible to access, and from the river (looking upstream from the Pu‘u‘eo Street bridge).

The vegetation in the project area is a dense forest of bamboo and various large trees on a very steep bank of Wailuku River. Various ornamentals are mixed into this vegetation in the vicinity of the Riverside Apartments. At the very top of the steep bank near the Riverside Apartment building, plants are mostly landscape ornamentals. Down the slope, a forest of large trees and bamboo creates dense shade, somewhat limiting understory growth. However, small ferns, shrubs, and vines climbing into trees contribute to the lush vegetation.

A total of 6 ferns and 47 flowering plants were recorded from the site and immediately adjacent areas along the river. A table listing the plants recorded is found in Table 1 of the biological report in Appendix B. Of the 533 species recorded, only two (3.7%) are plants native to the Hawaiian Islands; however another five (9.4%) are early Polynesian introductions (so called “canoe plants”). The two native plants are *neleua* (*Rhus sandwicensis*) and *hau* (*Hibiscus tiliaceus*). Neither are rare in the Hilo area. The early Polynesian introductions—*kukui* (*Aleurites moluccana*), *‘ulu* (*Artocarpus altilis*), *‘ihi‘ai* (*Oxalis corniculata*), *ki* (*Cordyline fruticosa*), and *‘ohe* (*Schizostachyum glaucifolium*)—are also common species in Hawai‘i. A total of 12 species (22.6%) of those recorded are considered ornamentals; plants placed or spreading from landscaping efforts of species not considered naturalized in the Hawaiian Islands.

Impacts and Mitigation

The building renovation will not impact botanical resources on the site.

In order to install the micropiles adjacent to the building, a drain line and the existing landscaping next to the building will be removed. The entire stream embankment within the project area will be cleared and grubbed, and several large trees will be removed.

The removal of the dense vegetation on the stream embankment will modify the natural environment and change the appearance and ambiance of the area. However, none of the botanical species within the project site are considered important from resource or cultural perspectives. No species within the site are currently listed or proposed for listing under either federal or State of Hawai‘i endangered species statutes.

Landscaping behind the building will be reestablished when the project improvements are complete.

3.3.2 Avifauna

Existing Conditions

One avian count station was sited within the study area. A single 8-minute avian point count was made at the count station, and the count and subsequent search of the site were conducted between 8:00 AM and 10:00 AM.

A total of 35 individual birds of six species, representing five separate families, were recorded during the station count. All of the avian species recorded during the course of this survey are alien to the Hawaiian Islands. No species currently protected or proposed for protection under either the federal or State of Hawai‘i endangered species programs were detected during the course of this survey.

Avian diversity and densities were low, though in keeping with the location and vegetation present on the site. Japanese White-eye (*Zosterops japonicus*) were the most frequently recorded species, accounting for 31 percent of the total number of birds recorded at the station count. Table 2 in the biological report provides a listing of all observed avian species.

The findings of the avian survey are consistent with the location of the site. All species recorded are alien to the Hawaiian Islands.

Potential Impacts to and Mitigation for Protected Species

Although no seabirds were detected during the survey, it is possible that both the endangered Hawaiian Petrel (*Pterodroma sandwichensis*) and the threatened endemic sub-species of the Newell’s Shearwater (*Puffinus auricularis newelli*) overfly the project area in small numbers between April and the middle of December each year. Both species have been recorded flying to and from their nesting colonies over the greater Hilo area. Both of these pelagic seabird species nest high in the mountains in burrows excavated under thick vegetation, especially *‘uluhe* (*Dicranopteris lineraris*) fern. Although there is a large amount of *‘uluhe* on the site, the site is not suitable nesting habitat for either of these seabird species.

The primary cause of mortality in these two seabird species is thought to be predation by alien mammalian species at the nesting colonies. Collision with man-made structures is considered to be the second most significant cause of mortality. Nocturnally flying seabirds, especially fledglings on their way to sea in the summer and fall, can become disoriented by exterior lighting. When disoriented, seabirds often collide with manmade structures, and if they are not killed outright, the dazed or injured birds are easy targets of opportunity for feral mammals.

The principal potential impact that the construction poses to protected seabirds is the increased threat that birds will be downed after becoming disoriented during the nesting season by lights associated with the project. If there is night time construction activity, outdoor lighting could pose a threat to these nocturnally flying seabirds.

There are no plans to do any nighttime construction or install any lighting as part of the project. Therefore, the construction of the project improvements are not expected to impact any listed seabirds. However, if nighttime construction activity or equipment maintenance is proposed during the construction phases of the project, all associated lights should be shielded. When large flood/work lights are used, they should be placed on poles that are high enough to allow the lights to be pointed directly at the ground.

3.3.3 Mammalian Resources

Existing Conditions

With the exception of the Hawaiian hoary bat (*Lasiurus cinereus semotus*), or ‘ope‘ape‘a as it is known locally, all terrestrial mammals currently found on the Island of Hawai‘i are alien species, and most are ubiquitous. The survey of mammals was limited to visual and auditory detection, coupled with visual observations of scat, tracks, and other animal sign.

No mammalian species were detected during the course of the survey. No mammalian species currently protected or proposed for protection under either the federal or Hawai‘i endangered species programs were detected during the survey.

Discussion of Findings

The findings of the mammalian survey are consistent with the location of the site. Although no rodents were detected, it is likely that the four established species in Hawai‘i, the roof rat (*Rattus r. rattus*), Norway rat (*Rattus norvegicus*), European house mouse (*Mus domesticus*) and possibly Polynesian rats (*Rattus exulans hawaiiensis*) are present within the project area

No Hawaiian hoary bats were detected during the course of this survey. Hawaiian hoary bats are widely distributed within the greater Hilo area and are present in most areas that still have trees and dense shrubs.

Potential Impacts to and Mitigation for Protected Species

During the construction period, there is a potential for impact to the Hawaiian hoary bat during the clearing and grubbing phases of the embankment work. The removal of vegetation along the stream embankment may temporarily displace individual bats which may use the vegetation as a roosting location. As bats use multiple roosts within their home territories, the potential disturbance is likely to be minimal. However, during the pupping season, females carrying their pups may be less able to rapidly vacate a roost site as the vegetation is cleared. Additionally, adult female bats sometimes leave their pups in the roost tree while they forage. Very small pups may be unable to flee a tree that is being felled.

Potential adverse effects from such a disturbance can be avoided or minimized by not clearing woody vegetation taller than 4.6 meters (15 feet) between June 1 and September 15, the period in which bats are potentially at risk from vegetation clearing.

3.3.4 Threatened and Endangered Species

During the pre-assessment consultation period, the U.S. Fish and Wildlife Service (USFWS), Pacific Island Field Office provided comments via email dated November 15, 2012 (see Chapter 7). The comments stated:

> *…Proposed slope stabilization work will occur only on the bluff above the stream, and no work will take place below the mean high water mark of the Wailuku River. The construction contractor will take ameliorative steps, including the installation of silt fencing, debris catchment fences, and the placement of sandbags along the stream bank to prevent debris from falling into the river during construction…*
>
> *Based on information you provided and pertinent information in our files, including data compiled by the Hawai'i Biodiversity and Mapping Program, there is no designated critical habitat or observed populations of species within the proposed project's construction footprint protected by the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. 1531 et seq).*

This information provided by the USFWS is consistent with the findings of the biological field surveys conducted in January 2013.

For other projects, the USFWS has also recommended that no barbed wire fences be installed. No barbed wire fencing is proposed either during construction or as a permanent feature. As noted above, the following mitigations will be included in the construction specifications to avoid potential adverse impact on protected species:

1. It is recommended that woody vegetation taller than 4.6 meters (15 feet) not be cleared between June 1 and September 15, the period in which bats are potentially at risk from vegetation clearing.
2. If nighttime construction activity or equipment maintenance is proposed during the construction phases of the project, all associated lights should be shielded, and when large flood/work lights are used, they should be placed on poles that are high enough to allow the lights to be pointed directly at the ground.

3.4 SOCIO-ECONOMIC ENVIRONMENT

3.4.1 Demographic Characteristics

Existing Conditions

According to the 2010 U.S. Census, the Hilo Census Data Place (CDP) had a total population of 43,263 persons. Of these, 21.3% are below the age of 18, 6.0% under the age of 5, and 18.0% aged 65 and older. Ethnic breakdown for the Hilo CDP was approximately 17.6% white, 34.3% Asian, 14.2% Native Hawaiian or other Pacific Islander, and 32.5% persons of two or more

races. Average household size was 2.73 and median household income was $53,058. (U.S. Census Bureau Quick Facts, http://quickfacts.census.gov/qfd/states/15/1514650.html).

The project improvements will occur within the property occupied by the Riverside Apartments, a multi-family affordable housing complex. The Riverside Apartments has a total of 74 rental units, including 12 one-bedroom/one-bath units, 56 two-bedroom/one-bath units, and, six three-bedroom/one and one-half-bath units. Sixty-nine (69) of the units are Section 8 assisted, and two others are used an on-site manager's office on the ground floor. The building occupancy rate is currently 91%.

According to BIHF Riverside profile data, there are currently 66 occupied units (excluding the resident manager's and office), with a total of 178 residents. Of these 66 households, 53 (80.3%) have a female head of household. Of the female-headed households, over half (29 or 54.7%) are single females, with a total of 48 children under the age of 18.

Compared to the Hilo CDP, the entire Riverside resident population has a greater percentage of Native Hawaiian and Pacific Islanders (47.8%), a slightly larger average household size (2.86 persons), and a greater percentage of children below the age of 18 (45.0%). Many of these children are below the age of 5.

Of the current households, 58 families (87.9%) have incomes below 30% of the area median income; 6 families (9.1%) are below 40% of the area median income, and only two families (3.0%) are below 50% of the area median income. Over one-fourth of the heads of households are considered to have "special status," e.g., disabled, elderly, etc. (BIHF Riverside, Summary Statistics Report, 1/13/2013).

Impacts and Mitigation

The renovation of the building will have an extremely positive impact on the living conditions, health and safety of current and future Riverside Apartment residents. The proposed stabilization of the stream embankment will ensure the continuation of federal housing subsidies, allowing the project to continue operating. All improvements will ensure that the Riverside Apartment building is a pleasant, healthy, and safe place to live. This represents a positive socio-economic impact to the Hilo community and to the Riverside residents.

There will be some short-term disruption and inconvenience to Riverside residents due to the need to relocate prior to interior renovations. Tenants will be relocated while their units are being renovated. Relocation plans are still being developed, and will be finalized when more is known about the phasing of the interior renovation. Building management has indicated their intent to move tenants from their existing units to other non-renovated units first, have the units renovated, and then moving the tenants back in. If there are not enough vacant units at Riverside, apartments will be rented at the Val Halla Apartments (about 2 blocks from Riverside) and/or other buildings. A major objective is to minimize the disturbance to tenants resulting from having to pack and move.

All moving costs will be borne by the new Riverside owner (UHC 00382 Hilo L.P.), and services provided will include supplying moving boxes, paying for professional movers to transport boxes and furniture (tenants will need to pack their own boxes and inventory what is in each box if they need to) both to another unit and back if necessary. Box lunches will be provided for tenants on moving day, as all their food and kitchen equipment will be packed up. If there are change fees for moving landlines and cable, tenants will be reimbursed for this cost as well.

Construction noise and dust will also be a major inconvenience to residents. Tenant relocation will be done for the interior renovation, but not specifically for the embankment work. As discussed previously in Section 3.2.7, the work on the river-facing units will be scheduled to occur simultaneously with the embankment work, to the extent possible. During the embankment work, a temporary refuge will be available off-site so residents can vacate during the day while construction is ongoing.

In general, a large percentage of Riverside tenants are mothers with young children who remain at home during the day. This at-home population will be most affected by construction period dust and noise. The river-facing units closest to the Second Level embankment are all two-bedroom units and occupied by families of three or more persons, including children of preschool age. Many residents do not have cars, and be less able to leave the property during the day. Given the demographic profile and the large number of mothers with young children who will be at home during construction hours, it will be particularly important to provide accessible refuge areas where residents can escape the noise and dust.

The project improvements will have no long-term impact on population or demographics within the building or surrounding community.

3.4.2 Archaeological, Historic, and Cultural Resources

An *Archaeological Field Inspection and Literature Review* (February 2013) for the project was completed by Cultural Surveys Hawai‘i (CSH) and is included as Appendix C. The area subject to the field inspection was a 0.065-acre (2,831 SF) area on the steep slope within the larger 1.8-acre Riverside Apartments property.

Historical research conducted included a study of archival sources, historic maps, Land Commission Awards (LCA), and previous archaeological reports to construct a history of land use and to determine if archaeological sites have been recorded on or near this property. A summary of the historical research is discussed below in the Cultural Impact section. Limited field inspection of the project area was also conducted to identify any surface archaeological features.

Existing Conditions

Background Research

The background research conducted as part of the *Archaeological Field Inspection and Literature Review* includes the myths and legends about the vicinity, traditional and historic

accounts of the area, and a summary of previous archaeological research. The project site is located within the Pu‘u‘eo *ahupua‘a*. on the northwest shore of Hilo Bay. The Wailuku River is the most substantial waterway within this ahupua‘a, and this perennial stream is an integral part of the Hilo Watershed system. The study notes that in times of heavy rain, this river becomes a raging, destructive force, hence its name: Wailuku literally means “water of destruction” (Pukui et al. 1974 in CSH 2013).

Historical and legendary accounts indicate that the immediate project area had a long history as a crossing area across the Wailuku River, including as a simple ford in the pre-Contact and early post-Contact period, to the early plank cross-bridges, to later concrete and steel bridges. Mid-nineteenth century land documents indicate that the coastal Pu‘u‘eo area was used for habitation. Although the steep banks of the Wailuku River in this area were probably not used for irrigated taro agriculture, the land at the top of the scarp may have been used for dryland sweet potato crops. In the mid-nineteenth century to the late twentieth century, the focus of agriculture switched to sugar cane cultivation. There were several camps for the new immigrant sugar plantation workers along the coast and in the uplands.

In the late nineteenth century, Pu‘u‘eo became a favored residential section, separated from the commercial section of Hilo by several bridges across the Wailuku River. However, there were a few shops in the Pu‘u‘eo area, including the Serrao store, once on the northeast corner of the subject parcel. In the later twentieth century, the residents, tenements, and stores in the subject parcel were demolished to make way for the new Riverside Apartments.

Results of Field Work

The fieldwork component of the archaeological literature review and field inspection consisted of a pedestrian survey in October 2012 conducted by two CSH archaeologists. The archaeologists completed a 100 percent pedestrian coverage of the project area, including the area from the top of the scarp to the base of the scarp and along the edge of the Wailuku River.

A scattering of modern trash was observed along the edge of the high water mark on the streambed and on the slope. The trash consisted of plastic, wood, metal and ceramic objects, all broken, discarded pieces. They were not buried in the soil, and likely were tossed down the slope as trash. The deposition appeared to be contemporary. The items were not collected. No historic properties were identified during the survey.

Impacts and Mitigation

The background information presented in the CSH study indicates that the project area had a rich history of habitation and agricultural use from the pre-Contact period to the present, However, the proposed stream bank stabilization work will affect only the steep scarp on the south side of the Riversides Apartment study area, which is a portion of the north bank of the Wailuku River upstream of the Keawe/Pu‘u‘eo Street Bridge. Early photographs indicate that the project area was always a steep slope. The easiest place to cross, across a natural ford over several large rocks, seems to have been upstream of the present project area near Make Falls near present Wainaku Street. The first bridge near the project area, along the Pu‘u‘eo Street/Keawe Street

alignment (once known as "Bridge Street") to the southeast, was built in 1859. It was replaced by three other bridges over the years. A railroad bridge was also built *makai* of the project area, first in 1909. The history of these bridges illustrates one of the reasons the Wailuku River was named for the Hawaiian phrase "dangerous waters." Several earthquakes, tsunamis, and floods damaged and destroyed several bridges. It is likely that the scarp in the project area has been scoured by the rising waters of the Wailuku River many times including several flood and tsunami events.

The interior renovation work will occur within the existing building footprint. No new structures will be built and no new areas will be excavated.

The *Archaeological Field Inspection and Literature Review* concluded that it is unlikely that the steep slope that will be stabilized was ever used for habitation or agriculture. It noted that if there were any evidence of this use, it is likely that it would have been swept downstream during the turbulent history of the Wailuku River in Hilo. CSH recommended no additional background research, subsurface testing, or any monitoring during stream bank stabilization.

No further work is recommended. However, if at any time during construction subsurface features (including lava tubes) or deposits are encountered, construction activities should cease and the State Historic Preservation Division (SHPD) should be contacted immediately.

Cultural Impact

As summarized above and discussed in detail in the *Archaeological Field Inspection and Literature Review* (Appendix C), the immediate project area had a long history as a crossing area across the Wailuku River. The coastal area within the Puʻuʻeo *ahupuaʻa* was used for habitation, and this area had a rich history of habitation and agricultural use from the pre-Contact period to the present. However, as noted previously, the steep banks of the Wailuku River, where the proposed stabilization will occur, were probably not used for irrigated taro agriculture. The study notes that land at the top of the bank, where the apartment building sits, may have been used for dryland sweet potato crops.

No archaeological or historic resources were identified during the field inspection or a follow-up test pit dug at the request of the SHPD. There are no non-physical traditional cultural properties or practices within the subject parcel. No adverse cultural impact is anticipated. No further background research, subsurface testing, or monitoring during construction was recommended by the project archaeologists.

HRS Chapter 6E Consultation

A Draft *Archaeological Field Inspection and Literature Review* was submitted to the SHPD on November 18, 2012, requesting historic preservation review in accordance with HRS Chapter 6E-42. The SHPD responded with a letter dated December 17, 2012 (see Chapter 7) to project consultant Kimura International, which stated:

> *On November 18, 2012 we received a draft report describing an archaeological field inspection and a literature review in connection with the proposed project (Hammatt et. al 2012) We have reviewed this report and at this time; cannot concur with the recommendation*

of no further work for this project (2012.3284, 1212SN07). The project area is located along the lower reaches of the Wailuku Stream, within an area that was an important political center and densely populated prior to and following western contact. Although this project area has been impacted by modern development, previous surface disturbance may not have fully destroyed the subsurface remains of archaeological and natural history deposits or human skeletal remains that could potentially be preserved in subsurface deposits within this project area.

We request more information to assess the possible impact this project might have on historic properties that may be present along the bank. We request that you provide more detailed information describing how the proposed stabilization efforts will directly impact the bank slope.

As requested, more detailed information on the number of rock nail anchors and micropilings was provided to SHPD. After further consultation between the SHPD and CSH archaeologists, a test excavation was conducted to provide additional information regarding the potential for subsurface resources. The excavation was carried out by two CSH archaeologists in January 2013. The location of the excavation, near the edge of the escarpment, was discussed with the SHPD. One test unit, approximately one square meter (3 ft by 3 ft) in size was excavated to a depth of 120 cm below the surface (47 inches). No cultural materials were present, and the findings were reported to the SHPD. The *Archaeological Field Inspection and Literature Review* report was revised to incorporate the findings of the January 2013 test pit. The updated report, dated January 2013, included in Appendix C, was resubmitted to SHPD in January 2013 in accordance with Chapter 6E-42, HRS.

In a letter dated February 4, 2013, the SHPD concurred with the recommendation of no further work and that no historic properties will be affected by the project. The letter is included in Appendix C, and states:

We appreciate the effort made to satisfy our concerns relating to the potential for subsurface historic properties within or near the proposed project area, as noted in our letter dated December 17th, 2012…an excavation was conducted to further determine the presence or absence of subsurface resources. Information regarding the location and findings of a 1.0 m by 1.0 m hand excavation unit was added to the report. Two soil layers, both of which were determined to be culturally sterile, were identified in the test unit. Due to safety concerns, the excavation was terminated at 120 cmbs. Based on this information, we concur with your recommendation of no further work for this location; and we believe that there will be no historic properties affected by the project.

The SHPD also provided a letter dated March 28, 2013 commenting on the Draft EA and concluding:

Based on current information, we believe that no historic properties will be affected. However, we would like to be informed in the event that historic resources, including human skeletal remains, structural remains, sand deposits, midden deposits, or lava tubes are identified during construction activities.

3.5 UTILITIES AND INFRASTRUCTURE

3.5.1 Existing Conditions

Domestic water connection to the municipal system is at Ohai Street. Consumption is monitored by a meter fronting the property. The 4-inch water line continues straight into the building from Ohai Street where it branches into the building's plumbing system. There are no on-site fire hydrants. There is a municipal fire hydrant at the corner of Ohukai Street and Pu‘u‘eo Street. There is a standpipe system with hose cabinets to supply water for fire suppression.

Sanitary sewage is collected on site by six and eight inch lines along the front and side of the Riverside Apartment buildings. The sewage discharges into the municipal system via a lateral on Pu‘u‘eo Street. Electrical service is provided to the property by Hawaiian Electric Light Company. There are also gas lines and a gas meter fronting the property.

Storm water runoff generated on the Riverside Apartment's parking lot and building roof top is collected by drain inlets and roof drains, respectively. The collected runoff is conveyed below grade and discharged at the stream bank where it outfalls to the Wailuku River. Storm runoff generated on the backside of the building along the top of the stream bank sheet flows toward the river.

3.5.2 Impacts and Mitigation

No change in water, electrical, or sewer demand is anticipated as a result of the interior renovation. There will be no change in the number of residential units and no new land uses on the property. The project will not impact water, electrical, gas or sewer lines or service to the Riverside Apartment building. More detailed information on plumbing and electrical improvements will be available during the upcoming design phase for the building renovation. Renovation architects and engineers will coordinate their plans with and obtain approval of the applicable utility providers.

A portion of an existing drain line running parallel to the backside of the apartment building will be temporarily removed as part of the stream bank stabilization, because it is located in the area where the proposed micropiles will be installed. During the construction period, temporary bypass drain lines will be used to continue the existing drainage pattern during rainfall events. The drain line will be replaced in the same location after installation of the micropiles, and before the area is paved.

During construction, stormwater runoff generated on the top bank fronting the proposed work will not be allowed to sheet flow down the bank of the exposed slope face. Sandbags will be placed along the top bank to divert this stormwater runoff during a rainfall event.

The project improvements will result in a negligible increase in stormwater runoff from the Riverside Apartments property, due to an increase in impermeable surface on the property. The flat level area behind the building which is currently grassed and dirt will be covered with

concrete in order to provide more stability and minimize infiltration into the embankment which could contribute to future instability. The formerly natural, vegetated embankment will be covered by shotcrete, resulting in a slight and negligible increase in the quantity of stormwater runoff leaving the property and entering the river. Stormwater runoff will sheet flow to the vegetated area at the bottom of the shotcrete cutoff wall before entering the river.

3.6 TRAFFIC

3.6.1 Existing Conditions

The Riverside Apartments are located in a residential neighborhood on Ohai Street, between Pu‘u‘eo Street and Wainaku Street. Parking for the building is located in an open lot fronting Ohai Street and under cover on the ground floor of the complex.

3.6.2 Impacts and Mitigation

The renovation of the building will not increase the number of residential units, tenants, or parking spaces. No long-term impact on traffic is anticipated.

During building renovation and embankment repair, large equipment and materials will be transported to the site, and construction waste and debris will be transported from the site. This will have minor and temporary traffic impacts on the property and in the immediate vicinity. The type and number of vehicles and equipment needed will depend on the construction contractor and on the work that is ongoing.

For the stream bank bluff protection and stabilization, standard earthmoving equipment, trailer mounted drill rigs or spider excavators with drill head attachment are some of the large equipment that will be transported to the site.

The micropiles and soil nails will need to be transported to the site on a flatbed truck or lowboy trailer, and mobilized on site with a fork lift or boom truck. The soil nails can also be delivered in shorter segments and connected in the field with couplers.

Construction equipment and vehicles will enter and exit the property through the First Level terrace driveway. The First Level parking area will be used for equipment/vehicle staging in addition to the adjacent First Level lawn area. At the present time the Riverside Apartments have 81 stalls less 8 (used for other purposes), or 73 stalls available. According to the Riverside management, tenants use only 40 stalls and staff use 3 or 4, providing sufficient area for vehicle and equipment access, and staging without the need to displace tenants or staff parking. Plans for construction period parking and staging will be developed by the construction contractor in consultation with the Riverside management.

The movement of project vehicles and equipment will not block access on Ohai Street or surrounding streets. Construction equipment and materials will be mobilized to and from the property during non-peak traffic hours during the day. The vehicle access way, staging and construction areas will be coned and fenced off for safety.

The County of Hawai‘i Police Department, in a November 8, 2012 early consultation letter (see Chapter 7) stated that they do not anticipate any significant impact to traffic and/or public safety concerns. The contractor will coordinate the movement of construction equipment and vehicles with the Riverside Apartment management, and with the County of Hawai‘i Police Department. Once construction is completed, there will be no long-term impacts on traffic.

4 CONSISTENCY WITH EXISTING PLANS, POLICIES AND CONTROLS

4.1 FEDERAL

4.1.1 Section 404, Clean Water Act

Section 404 of the Clean Water Act (CWA) defines requirements for discharges of dredged or fill materials in waters of the United States and sets limits on such discharges. The U.S. Army Corps of Engineers (USACE) administers the permit.

4.1.2 Section 10, Rivers and Harbors Act

The Rivers and Harbors Act of 1899 gives the USACE regulatory authority over virtually any construction, excavation or fill activities that has potential to impact navigable waters of the United States. Section 10 requires that a Department of the Army (DA) permit be obtained from the USACE prior to undertaking any construction, dredging, or other activity occurring in, over, or under or affecting navigable waters of the U.S.

4.1.3 Determination of No Permit Required

The Wailuku River is a navigable water of the U.S. subject to U.S. Army Corps of Engineers jurisdiction. The USACE has completed a review of the proposed stream bank bluff protection and stabilization, and determined that it is not subject to Section 10 of the Rivers and Harbors Act or Section 404 of the Clean Water Act. The proposed project does not involve dredging or filling activities. All work will occur landward of the Mean Higher High Water Mark (MHHWM) of the Wailuku River. No equipment or material will be placed below the MHHWM. The USACE letter dated November 16, 2012 confirming “No Permit Required” is included in Chapter 7.

4.2 STATE OF HAWAI‘I

4.2.1 Hawai‘i State Plan

The 1996 Hawai‘i State Plan (Chapter 226, HRS) is the umbrella document in the statewide planning system. It serves as a written guide for the future long-range development of the state by describing a desired future for the residents of Hawai‘i and providing a set of goals, objectives, and policies that are intended to shape the general direction of public and private development.

By repairing an unstable slope which presents a physical danger to existing life and property, the project is consistent with the State Plan objectives and policies for the **physical environment—land, air and water quality**:

> “(b) To achieve the land, air and water quality objectives, it shall be the policy of the State to…(5) Reduce the threat to life and property from erosion, flooding, tsunamis,

> hurricanes, earthquakes, volcanic eruptions, and other natural or man-induced hazards and disasters." (Section 226-13, HRS)

The federal Department of Housing and Urban Development (HUD) has required that the proposed stream bank protection and stabilization be completed as a condition of its continued housing subsidies to the Riverside Apartments. The interior renovation will repair an aging, and deteriorated affordable housing complex. Both the renovation and the stream bank protection will allow the project owners to continue to provide safe, sanitary and affordable housing to low income residents. As such, the proposed action furthers the following objective and policy for **socio-cultural advancement—housing:**

> "(b) To achieve the housing objectives, it shall be the policy of this State to:…(4) Promote appropriate improvements, rehabilitation, and maintenance of existing housing units and residential areas…" (Section 226-19, HRS).

4.2.2 State Land Use Classification

The State Land Use Commission, pursuant to Chapter 205 and 205A, HRS and Chapter 15-15, Hawai‘i Administrative Rules, is empowered to classify all lands in the State into one of four land use districts: urban, rural, agricultural and conservation. The entire Riverside Apartments property and surrounding areas are located within the Urban district (Figure 9). Activities or uses within the Urban district are regulated by the County of Hawai‘i.

4.2.3 Coastal Zone Management

The State's Coastal Zone Management ("CZM") objectives and policies (Section 205A-2, HRS) and the County of Hawai‘i Planning Commission Rules of Practice and Procedure, Rule 9, Special Management Areas, have been developed to preserve, protect, and where possible, to restore the natural resources of the coastal zone of Hawai‘i. All lands in the State of Hawai‘i and the area extending seaward from the shoreline are classified as valuable coastal resources within the State's CZM area.

The Special Management Area (SMA) permitting system is part of the CZM Program approved by the federal and state governments, and is administered by the counties. Each County designates its Special Management Area, and is tasked with ensuring that uses and activities within its SMA is carried out in compliance with the CZM objectives and policies, and SMA guidelines. The project area is located within the County of Hawai‘i's SMA, as shown in Figure 9 and discussed in Section 4.3.4.

Both the interior renovation and the proposed stream bank bluff protection and stabilization are consistent with the objectives and policies of Chapter 205A HRS, Coastal Zone Management:

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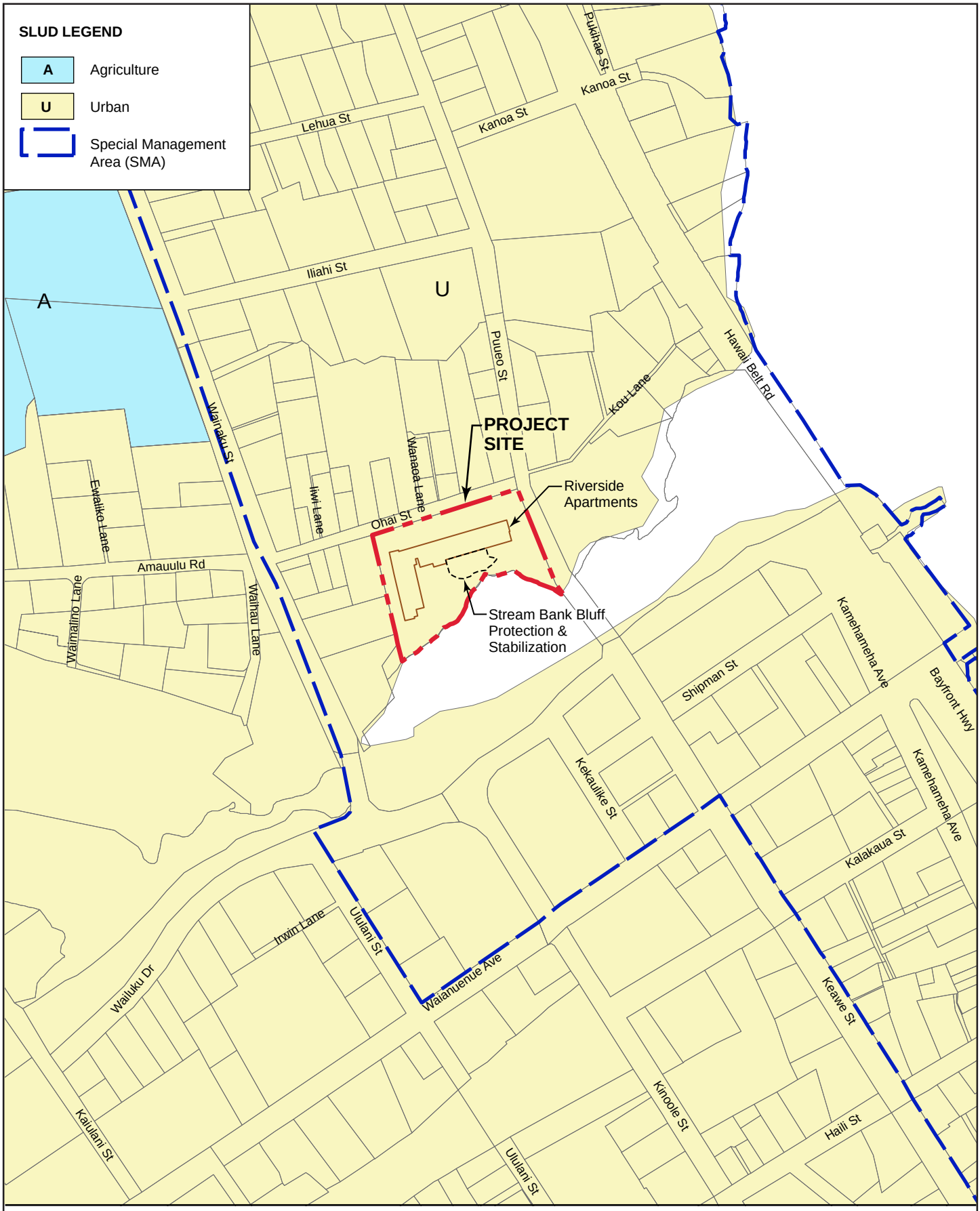

FIGURE 9

STATE LAND USE AND SMA

Riverside Apartments Improvements

Recreational resources

CZM Objective: *Provide coastal recreational opportunities accessible to the public.*

Discussion: The proposed action will not impact coastal recreational opportunities available to the public. Both the building renovation and stream bank bluff protection and stabilization will be limited to the Riverside Apartment property and the stream bank bluff behind the building. There is no coastal recreation or access in this area.

Historic resources

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

Discussion: The proposed action will not impact historic resources. The Riverside Apartment building does not meet the criteria for a historic structure. An archaeological literature review and field inspection and subsequent test excavation conducted for the embankment stabilization found no historic properties. The general area was used as a crossing area across the Wailuku River and was used for habitation and agriculture from the pre-contact period to the present. However, it is unlikely that the steep stream bank scarp was ever used for habitation or agriculture, and the archaeologists recommended no further testing or monitoring.

Scenic and open space resources

CZM Objective: *Protect, preserve, and, where desirable, restore or improve the quality of coastal scenic and open space resources.*

Discussion: The proposed action will not impact coastal scenic and open space resources. The stream bank stabilization will require the removal of existing vegetation along the unstable slope and the installation of soil rock anchors and a shotcrete surface. This will change the physical appearance of the stream embankment as seen from across the Wailuku River. A concrete pigment will be added to the shotcrete so that it blends into the natural surrounding rocks.

Coastal ecosystems

CZM Objective*: Protect valuable coastal ecosystems, including reefs, from disruption and minimize adverse impacts on all coastal ecosystems.*

Discussion: The proposed action will not impact coastal ecosystems. The building renovation is limited to the existing building. Protection and stabilization work will be limited to the stream bank. No work will occur in the waters of Wailuku River. Best management practices such as silt screens will be used to ensure that project debris does not enter the waters of Wailuku River or Hilo Bay.

Economic uses

CZM Objective: *Provide public or private facilities and improvements important to the State's economy in suitable locations.*

> **Discussion:** The project will take place within private property occupied by the Riverside Apartments, a federally subsidized housing project providing affordable rental housing for Hilo residents. The provision of affordable housing is important to the State's economy. The interior renovation ensures that the rental housing will be safe and sanitary and that it will remain a healthy and desirable place to live. The embankment protection and stabilization will address existing geological conditions which threaten the continued operation of this housing facility. If the stream bank bluff protection and stabilization is not implemented, the federal Department of Housing and Urban Development will not continue to provide housing subsidies, and the owners will be unable to operate. Without the project, a slope failure could occur at any time, threatening both the apartment building and jeopardizing the safety of its residents. This is a critical, urgently needed emergency repair important to the State's economy.

Coastal Hazards

CZM Objective: *Reduce hazard to life and property from tsunami, storm waves, stream flooding, erosion, subsidence, and pollution.*

> **Discussion:** The Project will repair an unstable stream bank that presents an ongoing hazard to life and property. Without the project, it is only a matter of time before the stream bank fails, undermining the structural stability of the apartment building and risking the safety of its residents. The proposed improvements will reduce this existing hazard to life and property.

Managing development

CZM Objective: *Improve the development review process, communication, and public participation in the management of coastal resources and hazards.*

> **Discussion:** The project proponents are seeking a SMA Emergency Permit from the County of Hawai‘i for the embankment protection and stabilization. The granting of an Emergency Permit will allow the remediation of a potentially hazardous situation in a timely manner.

Public participation

CZM Objective*: Stimulate public awareness, education, and participation in coastal management.*

> **Discussion:** This objective is not applicable to the proposed action.

Beach protection

CZM Objective: *Protect beaches for public use and recreation.*

Discussion: This objective is not applicable to the proposed action. There are no public recreational beaches adjacent to the project area.

Marine Resources

CZM Objective: *Promote the protection, use, and development of marine and coastal resources to assure their sustainability.*

Discussion: Wailuku River empties into Hilo Harbor. The project will not increase siltation or debris from Wailuku River into marine and coastal areas. The proposed best management practices during construction will ensure that debris from the stream bank bluff protection and stabilization does not enter the river or Hilo Bay.

4.3 COUNTY OF HAWAI‘I

4.3.1 County General Plan

The Hawai‘i County General Plan’s Land Use Pattern Allocation Guide (LUPAG) Map designates the entire Riverside Apartments parcel as Medium Density Urban. The existing use of the site, as a residential complex, is consistent with that designation. No change in land use is proposed.

4.3.2 County Zoning

The project area, as well as the entire Riverside Apartments parcel, is zoned V-.75 (Resort-Hotel-maximum density of 750 square feet of land for each dwelling unit) by the County. The existing apartment complex is consistent with the county zoning. No change to this land use is proposed. The proposed stream bank stabilization and repair is an action that is allowed under the existing zoning.

4.3.3 Special Management Area

The project site is located within the County’s designated Special Management Area (SMA). Although it is in the SMA, the project is not located in a “shoreline area” as defined by Section 205A-41, HRS.

Pursuant to Hawai‘i Revised Statutes (HRS) §§205A-22 and 205A-23, and Rule 9, Special Management Area, County of Hawai‘i Planning Commission Rules of Practice and Procedure, the County of Hawai‘i Planning Commission is authorized to designate the county special management areas. The SMA is governed at the County level by Rule 9, Special Management Area, County of Hawai‘i Planning Commission Rules of Practice and Procedure.

According to Chapter 205A-22, HRS and Planning Commission Rule 9-4(e)(1)(A), “Development” includes *“Placement or erection of any solid material or any gaseous, liquid, solid or thermal waste.”* Therefore, the proposed stream bank bluff protection measures are considered “development,” requiring a Special Management Area Use Permit (SMP).

Rule 9-4(e)(2)(F) of the same document states "development" does not include *"Repair, maintenance or interior alterations to existing structures or relating to existing uses."* Therefore, the County Planning Department determined that the building renovation project is exempt from the definition of "development" and from further review against SMA rules and regulations (see letter from Planning Department in Chapter 7).

Because of the urgent nature of the slope stabilization work and the imminent threat to life and property, the project proponent will be seeking a "Special Management Area Emergency Permit," pursuant to Planning Commission Rule 9-14(a), which states:

> *A Special Management Area Emergency Permit may be issued for emergency repairs to existing public utilities including but not limited to water, sewer, gas, and electric transmission lines and highways, or similar emergencies, which may otherwise not be exempt from the Special Management Area permit requirements…*

A Draft EA comment letter from the County Planning Department dated April 3, 2013 (see Chapter 7) stated:

> *…on April 12, 2011, our office issued an SMA Emergency Permit, subject to compliance with several conditions, for the emergency stabilization of a portion of the Wailuku stream bank on the subject property…It is anticipated that the proposed stream bank bluff protection and stabilization of the second slope scarp on the subject property would go through similar SMA Emergency Permit review. However, the SMA determination for the proposed project cannot be made until a completed SMA Use Permit Application is submitted to our office.*

A SMA Use Permit Application for the stream bank bluff protection and stabilization project will be submitted to the Planning Department upon completion of this Final Environmental Assessment.

4.3.4 Other Community Planning Efforts

Hilo Bayfront Trails Master Plan

The Hilo Bayfront Trails is a County of Hawai‘i three-phase project to plan, design, and construct a path system from the Wailuku River at Reed's Island to Hilo Harbor's cruise ship terminal so that residents and visitors can better enjoy the beautiful shoreline features along Hilo Bay by walking, biking, or using other non-vehicular modes of travel. The project was conceived as a system of paths to connect existing recreational sites along the Hilo Bayfront area, both *mauka* and *makai* of Kamehameha Avenue. The Riverside Apartments are near the western most end of the Hilo Bayfront Trails master plan area. However, no improvements are proposed for the Riverside Apartments property. The proposed stream bank stablilization will have no effect on the Hilo Bayfront Trails plans.

EnVision Downtown Hilo 2025

In 2004-2005, a volunteer group called the Friends of Downtown Hilo Steering Committee facilitated a community-based planning process to create a vision and living action plan designed to preserve and promote downtown Hilo's unique character. The resulting document, *EnVision Downtown Hilo (EDH) 2025: A Community-Based Vision and Living Action Plan* was adopted by the Hawai‘i County Council in 2005. EDH 2025 contains a long-range vision achieved through implementation of strategies and actions in six vision focus areas: creating economic vitality; preserving our environment; strengthening and sustaining our community; enhancing education, culture, and the arts; promoting health and safety; and managing growth.

In 2010, the plan was updated and adopted by the County Council in November 2010. Today, the EDH 2025 plan continues to serve as a guide for planning in downtown Hilo. The project site is located across the Wailuku River from the primary downtown Hilo core, but is within the designated "Pu‘u‘eo Sub-Area" of the EDH 2025 plan. The proposed stream bank stabilization will have no effect on any EDH 2025 proposals or plans.

4.4 OTHER CONSIDERATIONS

4.4.1 Unavoidable Adverse Effects

All potential environmental impacts discussed in Chapter 3 can either be avoided or mitigated to an extent that they would not be significant.

4.4.2 Energy Requirements and Conservation Potential of Various Alternatives and Mitigation Measures

The proposed repair and stabilization of the stream bank bluff at the Riverside Apartments property will entail the use of energy, personnel and equipment. If the project were not done, there is a high risk of slope failure, which could threaten the structural integrity of the apartment building, jeopardize the health and safety of its residents, and lead to severe erosion and runoff into Wailuku River. Therefore, the project represents sound long-term management of the environment and ensures continued operation of the Riverside Apartments, avoiding major repairs before an emergency occurs.

4.4.3 Relationship of Short-Term uses and Long-Term Productivity

In the short-term, the project will have temporary construction-related impacts such as noise and dust on the surrounding area, and especially the residents of the Riverside Apartment building. The slope stabilization improvements will require a commitment of public funds. However, to do nothing would lead to the loss of federal housing subsidies, without which the owners would be unable to operate. This would remove 74 rental units from Hilo's affordable rental housing inventory. If the slope were to fail, it would also lead to more severe and costly damage to the Riverside Apartment building in the long term. The repairs ensure that the apartments can continue their long-term use and productivity in providing affordable rental housing to eligible local families.

4.4.4 Irretrievable and Irreversible Resource Commitments

Resources that are committed irreversibly or irretrievably are those that cannot be recovered if the project is implemented. The proposed project will involve the commitment of capital, labor, materials, fuel and equipment. The proposed slope stabilization improvements are needed to maintain the efficient and safe operation of the Riverside Apartments, and irretrievable resource commitments are minor.

5 DETERMINATION, FINDINGS AND REASONS SUPPORTING THE CHAPTER 343 HRS DETERMINATION

5.1 CHAPTER 343 HRS DETERMINATION

Based on the information and analysis in this Environmental Assessment, the Hawai‘i Housing Finance and Development Corporation (HHFDC) has concluded that the proposed interior renovation and the stream bank bluff protection and stabilization will not have a significant impact on the environment. As such, the HHFDC is issuing a Finding of No Significant Impact (FONSI), pursuant to the State of Hawai‘i HRS Chapter 343, and an Environmental Impact Statement (EIS) is not required.

5.2 CHAPTER 343 HAWAI‘I REVISED STATUTES (HRS) SIGNIFICANCE CRITERIA

In determining whether an action may have significant impact on the environment, the applicant or agency must consider all phases of the project, its expected consequences both primary and secondary, its cumulative impact with other projects, and its short and long-term effects. The State of Hawai‘i Department of Health Rules Section 11-200-12 (Hawai‘i Administrative Rules, revised 1996) establish 13 “Significance Criteria” to be used as a basis for identifying whether significant environmental impact will occur.

An agency will determine an action may have a significant impact on the environment if it meets any of the following criteria:

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

The project will not result in an irrevocable commitment to loss or destruction of any natural or cultural resources. There are no significant biological resources or habitats within the project area. No night time work or lighting is planned which could have an adverse impact on threatened and endangered sea birds that overfly the project area in small numbers between April and mid-December each year.

During the clearing and grubbing of the site, there is a potential for impact to the Hawaiian hoary bat. Potential adverse effects from such a disturbance can be avoided or minimized by not clearing woody vegetation taller than 15 feet between June 1 and September 15, the pupping season in which young and female bats are potentially at risk from vegetation clearing.

Although the project vicinity has a history of habitation and agricultural use from pre-contact to the present, the archeologists concluded it is unlikely that the steep slope area was ever used for habitation or agriculture. Any evidence of this use would likely have been swept downstream by the turbulent Wailuku River. A field survey of the project area and a test excavation at the top of the scarp did not find any historic properties and no additional archaeological work is recommended.

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

The proposed project does not curtail the range of beneficial uses of the environment. The improvements will allow the continued beneficial use of the property, providing up to 74 units of affordable rental housing to low income families. The renovation will modernize a property which has not had major improvements since its construction 40 years ago. The improvements to the stream bank bluff will remedy a hazardous condition that presents an immediate threat to the structural integrity of the existing building and could endanger its residents. Without the project, the embankment is vulnerable to a slope failure. Rather than curtailing use of the environment, the project preserves the beneficial use of the environment and ensures its continuation.

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

The proposed project is consistent with the environmental policies in Chapter 344, HRS, which establishes a state policy to encourage productive and enjoyable harmony between people and their environment, promotes efforts to prevent or eliminate damage to the environment and stimulate community health and welfare, and enriches the understanding of the ecological systems and natural resources important to the people of Hawai‘i.

The primary purpose of the renovation is to modernize an aging, deteriorated housing facility which is consistent with the policy to "foster safe, sanitary and decent housing" [§344-4 (8)(C)]. The purpose of the embankment stabilization project is to protect and stabilize an unstable stream embankment in danger of slope failure. A collapse of the stream embankment would result in extensive and costly damage to the Riverside Apartment building, and possibly endanger the safety of its residents. As such, the proposed action is encouraging *"productive and enjoyable harmony between people and their environment,"* and is consistent with the guideline regarding "land, water, mineral, visual, air and other natural resources" *to "encourage management practices which conserve and fully utilize all natural resources"* [§344-4 (2)(A)].

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

The proposed project will have a positive effect on the economic and social welfare of the community and State. The purpose of the building renovation is to provide safe and sanitary conditions in an existing affordable rental housing complex. The project will also remedy an environmental threat which is jeopardizing the structural integrity and safety of the Riverside Apartments. The stabilization of the stream embankment will allow the Riverside Apartments to continue to provide 74 units of safe, affordable rental housing to eligible Hawai‘i Island residents. It will ensure that the federal HUD subsidies to the apartment complex will continue.

During construction, there will be some adverse air quality and noise impacts on the complex residents, many of whom are home during the day. These are temporary impacts that will be mitigated to the extent possible, including relocation of tenants during interior renovation, use of

dust screens and window covers, notifying residents in advance and encouraging them to vacate, and the provision of "refuge areas" nearby for those residents who are unable to leave the property. The short-term impacts are far outweighed by the need to modernize this aging property, and the urgency of the bank stabilization to the continued viability and safety of this low-income housing project.

Neither the interior building renovation nor the stream bank stabilization will impact any ongoing cultural practices. There are no traditional cultural properties or practices on or near the steep stream bank.

5. Substantially affects public health;

The proposed improvements will not substantially affect public health. The temporary construction-period noise and dust impacts will be short-term, and in the larger picture, are insignificant when weighed against the urgency of the repairs and the long-term benefit of continuing to provide affordable rental housing at the Riverside Apartments. The improvements will ensure that the apartment building is structurally sound and safe for occupancy. This is a positive benefit to public health and welfare.

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

The proposed project will not result in any substantial secondary impacts such as population changes or effect on other public facilities.

7. Involves a substantial degradation of environmental quality;

Construction period noise and dust will temporarily degrade the immediate environment for Riverside residents. These short-term impacts will be mitigated through equipment noise attenuation, dust screens, and other measures. Construction best management practices will be used to contain debris that could enter the Wailuku River and impact its water quality. No work will occur in or near Wailuku River. The improvements are intended to avoid a major slope failure, which pose a greater threat of degradation to environmental quality than the project itself.

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

The proposed project is limited to stream bank stabilization and repair at the Riverside Apartments property. It is similar to another emergency stabilization project that was completed in 2011 after a slope failure. However, it does not have a cumulative effect or commitment for larger action.

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

The project will not substantially affect any rare, threatened, or endangered species or its habitat. A field survey found no threatened or endangered species or their habitats within the project

area. No night work or lighting is proposed which could adversely impact overflying seabirds. There will be no removal of woody vegetation above 15 feet in height between June 1 and September 15 in order to avoid potential impacts to Hawaiian hoary bats.

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

The project will result in short-term construction period increases in fugitive dust and noise that will inconvenience residents of the Riverside Apartment complex. These impacts will be temporary and short-term, and construction activity limited to day time. Refuge areas away from the construction will be made available to residents who are unable to leave the property during the day. Best management practices, including use of a silt screen, will be utilized to prevent construction debris from entering the Wailuku River. There will be no long term impacts to air or water quality or noise.

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

The project area is outside the designated floodway of Wailuku River. No work will be done below the mean higher high water mark of the river. The project area is outside the tsunami evacuation zone. The Hilo area is considered an earthquake prone area, and a major objective of the proposed installation of micropiles is to stabilize the building footings and prevent major structural damage in case of a seismic event.

A geotechnical study of subsurface conditions found that the project area is marginally stable under static loading conditions but is likely to become unstable under certain saturated and seismic conditions. The proposed action is intended to remedy this geologically hazardous condition.

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

The project will not impact scenic vistas or viewplanes identified in county or state plans or studies. The placement of shotcrete over the stream embankment will alter its appearance from a heavily vegetated stream bank to a bare, exposed, solid surface. The embankment area will be visible from the opposite side of the Wailuku River, and the change in appearance may present a stark change from present conditions. The shotcrete will be a natural rock color to blend into the surroundings as much as possible. Over time, the growth of the surrounding vegetation will restore a more natural and less man-made appearance, although the area will remain a hardened surface.

13. Requires substantial energy consumption.

The project will not require substantial energy consumption. Some energy resources will be consumed during project construction.

6 REFERENCES

Cultural Surveys Hawai‘i, Inc. *Final Archaeological Field Inspection and Literature Review for the Stream Bank Bluff Protection and Stabilization, Second Slope Scarp at the Riversides Apartments, Pu‘u‘eo Ahupua‘a, South Hilo District, Hawai‘i Island,* TMK (3) 2-6-003:009. February 2013

David, Reginald E., Rana Biological Services and Eric Guinther, AECOS Consulting. *Biological Surveys Conducted for the Stream Bank Bluff Protection and Stabilization, Second Slope Scarp at the Riverside Apartments*. January 2013

State of Hawai‘i, Commission on Water Resource Management and the National Parks Service. *Hawai‘i Stream Assessment, A Preliminary Appraisal of Hawai‘i’s Stream Resources.* December 1990.

State of Hawai‘i, Department of Business, Economic Development and Tourism*. State Data Book 2011. http://hawaii.gov/dbedt/info/economic/databook/db2011/*

State of Hawai‘i, Office of the Governor, Office of State Planning. The *Hawaii State Plan*, Chapter 226, Hawai‘i Revised Statutes, 1991.

State of Hawai‘i, Department of Health, Environmental Planning Office. Final 2004 List of Impaired Waters in Hawai‘i, Prepared under Clean Water Act §303(d). June 16, 2004.

County of Hawaii Planning Department, *EnVision Downtown Hilo 2025: A Community-Based Vision and Living Action Plan, 5-year Action Plan Update.* Prepared by S.Gagorik et al., November 2010

County of Hawaii Department of Research and Development, *Hilo Bayfront Trails Master Plan*, Prepared by Helber Hastert & Fee, Planners. June 2009

_____. *Final Environmental Assessment, Hilo Bayfront Trails*, Hilo, County of Hawai‘i, State of Hawai‘i. April 2010

“New hydro generator in Hilo”, Pacific Business News, “Jul 19, 2005, http://www.bizjournals.com/pacific/stories/2005/07/18/daily21.html?page=all

United States Department of Agriculture, Natural Resource Conservation Service, Hilo Rapid Watershed Assessment, March 2009. http://www.pia.nrcs.usda.gov/technical/rwa.html.

Yogi Kwong Engineers, LLC, *Final Submittal, Geotechnical Exploration and Evaluation Report, Stream Bank Bluff Protection and Stabilization of a Second Erosion Scarp, Second Level of the Riverside Apartments Property at 333 Ohai Street, Hilo, Hawaii.* April 2013.

7 PERSONS AND AGENCIES INVOLVED IN THE PREPARATION OF THE ENVIRONMENTAL ASSESSMENT

7.1 AGENCIES AND ORGANIZATIONS CONSULTED

The following agencies and organizations were contacted during the pre-assessment consultation and Draft EA review periods. The comments received are summarized in Sections 7.2 and 7.3 and copies of the letters are included at the end of this chapter.

Federal

U.S. Department of Housing and Urban Development, Hawai‘i Field Office
U.S. Department of the Interior, Fish and Wildlife Service
Army Engineer Division
- Civil Works Technical Branch
- Regulatory Branch

State

Department of Accounting and General Services
Department of Agriculture
Department of Business, Economic Development & Tourism, Office of Planning
Department of Hawaiian Home Lands
Department of Land and Natural Resources
- Land Division
- State Historic Preservation Division
- Office of Conservation and Coastal Lands

Department of Health
- Environmental Planning Office

Office of Environmental Quality Control
Office of Hawaiian Affairs
University of Hawaii Environmental Center
Department of Public Safety
Department of Transportation
University of Hawai‘i Environmental Center

County of Hawai‘i

Department of Finance
Fire Department
Department of Environmental Management
Department of Parks and Recreation
Department of Public Works
Planning Department

Office of Housing and Community Development
Department of Water Supply
Police Department
Department of Research and Development

Mass Transit Agency

Other Organizations

Hawaiian Telcom
Hawaii Gas
Hawaii Electric Light Company, inc.
Big Island Housing Foundation (BIHF) Riverside Community Based Non-Profit Corporation
Urban Housing Communities LLC

Elected Officials

Mayor Billy Kenoi
State Representative Mark Nakashima, State House of Representatives, District 1
State Representative Clift Tsuji, State House of Representatives, District 2
Senator Gilbert Kahale, State Senate District 1
County Councilmember Valerie Poindexter, District 1
County Councilmember J Yoshimoto, District 2
County Councilmember Dennis Onishi, District 3

7.2 COMMENTS RECEIVED DURING PRE-ASSESSMENT CONSULTATION

Letters soliciting comments were sent to the agencies and organizations listed above in November 2012, and a total of 15 written responses were received. A summary of the comments is included in the table below, and copies of the letters are included at the end of this chapter.

Table 7-1: Summary of Comments Received During Pre-Assessment Consultation

Agency or Individual	Format/Date/Reference	Comments	Action/Response
Federal			
Department of the Army	Letter dated November 21, 2012	DA permit not required	None required
U.S. Fish and Wildlife Service, Pacific Islands field Office, Ecological Services, Consultations & HCP	Email dated November 15, 2012	Based on information, information in our files including data compiled by Hawaii Biodiversity and Mapping Program, there is no designated critical habitat or observed populations of species within proposed construction footprint protected by the Endangered Species Act of 1973, as amended.	

Agency or Individual	Format/Date/Reference	Comments	Action/Response
State of Hawai‘i			
Department of Business, Economic Development & Tourism, Office of Planning	Letter dated November 2, 2012	1. DEA should include discussion of project’s consistency with objectives and policies in HRS Section 205A-2 (Coastal Zone management) 2. Review Chapter 5 Hawaii Watershed Guidance	Included in EA.
Department of Health	Letter dated November 7, 2012 Letter dated October 22, 2012	1. Army Corps of Engineers should be contacted. 2. May require submittal of individual permit or NOI for general permit coverage under NPDES. 3. Applicant for NPDES permit required to submit to State Historic Preservation Division. 4. Any discharges with or without Section 401WQC or NPDES shall comply with applicable state water quality standards.	Corps of Engineers determined no permit required. Project will comply with all applicable permit requirements and water quality standards.
Historic Preservation Division, Department of Land and Natural Resources	Letter dated December 17, 2012, LOG NO: 2012.3046, DOC NO: 1212SN04 Letter dated February 4, 2013, LOG NO: 2013.0555, DOC NO: 1302SN01	We received draft archaeological field inspection and literature review on November 18, 2012. We cannot concur with recommendation for no further work. Request more information to assess possible impact this project might have on historic properties. Subsequent excavation conducted by CSH at SHPD request. Excavation was terminated at 120 cmbs due to safety concerns. Ask that excavated soil layers be identified as fill to better define existing landscape in project area. Based on this information, SHPD concurs with recommendation for no further work and we believe no historic properties affected.	In response to December 17, 2012 letter, additional information provided to SHPD. Follow up discussion between archaeologist and SHPD led to test excavation, terminated at 120 cmbs for safety reasons. No historic properties were identified. Revised archaeology report submitted to SHPD on January 25, 2013, with SHPD concurrence on February 4, 2013.
Department of Land and Natural Resources, Land Division	Letter dated November 14, 2012	**Division of Aquatic Resources**—waiting for draft EIS **Hawaii District Land Office**—no comments **Commission on Water Resource Management**—Stream Channel Alteration Permit is required. **Engineering Division**—Project is located in Flood Zone X.	Draft Environmental Assessment will be provided to DLNR. Stream Channel Alteration Permit application to be submitted after completion of EA.
Department of Public Safety	Letter dated October 23, 2012	No preliminary comments at this time.	None required.

Agency or Individual	Format/Date/Reference	Comments	Action/Response
Department of Transportation	Letter dated November 14, 2012	DOT does not anticipate significant adverse impact to State transportation facilities.	None required.
University of Hawai‘i at Mānoa, Water Resources Research Center, Environmental Center	Letter dated November 5, 2012	No comment at this time due to resource constraints; look forward to receiving Draft EA	Draft EA will be provided.
County of Hawai‘i			
Department of Environmental Management, Wastewater Division	Letter dated October 23, 2012 transmitting Memo dated October 22, 2012	Property is currently served by the County sewer system connected via Pu‘u‘eo Street. Although project does not seem to affect County sewer lateral, location and routing of private sewer lines within property are unknown and should be identified prior to any excavation work.	Comment forwarded to project engineer.
Fire Department	Letter dated October 29, 2012	No comments to offer at this time.	None required.
Planning Department	Letter dated November 14, 2012	Property is zoned V-.75, Resort-Hotel max density 750 SF for each dwelling unit. Designated urban by State Land Use Commission. Hawaii County General Plan LUPAG designates parcels as Medium Density Urban. On April 12, 2011, Planning Dept. issued SMA Emergency Permit for portion of Wailuku Streambank. It is anticipated that proposed project on second slope scarp would go through similar SMA Emergency Permit review. Determination cannot be made until completed SMA Use Permit application is submitted.	SMA Use Permit application will be submitted after completion of the EA.
Police Department	Letter dated November 8, 2012	Staff, upon reviewing provided documents and visiting proposed site does not anticipate any significant impact to traffic and/or public safety concerns.	None required.
Department of Water Supply	Letter dated November 15, 2012	No Department of Water Supply facilities within the proposed project area. Water for construction can be made available from a fire hydrant fronting the subject parcel on Ohai Street.	None required.

7.3 COMMENTS RECEIVED DURING DRAFT EA COMMENT PERIOD

The Draft EA was completed and notice of availability was published in the March 8, 2013 edition of the Office of Environmental Quality Control (OEQC) *The Environmental Notice*. This commenced a 30-day public comment period which ended on April 8, 2013.

The Draft EA was sent to the agencies and organizations listed above, and hard copies were made available for general public review at the Hilo Library and the Hawai‘i State Library in Honolulu. The Draft EA could also be accessed and downloaded from the OEQC web site. The following comments were received during the public commend period:

Table 7-2: Summary of Comments Received During Draft EA Comment Period

Agency or Individual	Format/Date/Reference	Comments	Action/Response
State of Hawai‘i			
Dept. of Hawaiian Home Lands	Letter dated March 21, 2013	No comment to offer at this time.	None required.
Department of Health, Environmental Planning Office	Letter dated March 8, 2013	Review standard comments at www.hawaii.gov/health/epo Examine info on sustainable design, encourage application of sustainability strategies and principles.	Project will comply with all applicable permit requirements and water quality standards.
Department of Health, Clean Water Branch	Letter dated March 27, 2013	1. Project must meet antidegradation policy, designated uses for water classification, water quality criteria. 2. May be required to obtain NPDES. 3. Recommend contact Army Corps of Engineers, Regulatory Branch regarding permitting requirements. 4. All construction or operational discharges must comply with State Water Quality Standards.	Project will comply with all applicable water quality criteria and standards. No NPDES permit is anticipated, because project area is less than 1 acre in size. No Department of the Army permit is required.
Department of Health, Indoor and Radiological Health Branch	Letter dated April 4, 2013	Project activities must comply with cited administrative rules.	Project will comply.
DLNR, Commission on Water Resource Management	Letter dated March 19, 2013	Stream Channel Alteration Permit required for the proposed project. Stream bank stabilization and protection will impact Wailuku River stream bank.	SCAP application will be submitted after completion of Final EA/FONSI.
Historic Preservation Division, Department of Land and Natural Resources	Letter dated March 28, 2013 (LOG NO: 2013.2189, DOC NO: 1303SN15 Archaeology)	Based on current information, we believe that no historic properties will be affected. In the event that historic resources are identified during construction, cease work in vicinity, protect find and contact the SHPD.	Project will comply.

Agency or Individual	Format/Date/Reference	Comments	Action/Response
Office of Planning	Letter dated March 18, 2013	1. FEA should provided detailed comparison between 2011 emergency stabilization and proposed project. 2. Correct statement as noted. 3. Correct reference as noted. 4. FEA should provide landscaping plan and address mitigation measures. 5. FEA should correct statement as noted.	1. Information will be provided in Chapter 2 of FEA. 2. Statement to be corrected. 3. Reference to be corrected. 4. No additional landscaping proposed as part of stream bank work. Landscaping may be counter productive to bank stabilization. Visual concerns minimized by earth-toned pigment to shotcrete to provide more natural look. 5. Statement .to be corrected.
Department of Public Safety	Letter dated March 14, 2013	No comments at this time.	None required.
Department of Transportation	Letter dated Marc h 28, 2013	DOT does not anticipate significant adverse impact to State transportation facilities.	None required.
University of Hawai‘i at Mānoa, Water Resources Research Center, Environmental Center	Letter dated April 5, 2013	No comment at this time due to resource constraints; look forward to reading Final EA	None required.
County of Hawai‘i			
Department of Environmental Management, Wastewater Division	Letter dated March 12, 2013.	No further comments. .	None required.
Fire Department	Letter dated March 7, 2013	No comments to offer at this time.	None required.
Planning Department	Letter dated April 3, 2013	Property is zoned V-.75, Resort-Hotel max density 750 SF for each dwelling unit. Designated urban by State Land Use Commission. Hawaii County General Plan LUPAG designates parcels as Medium Density Urban. On April 12, 2011, Planning Dept. issued SMA Emergency Permit for portion of Wailuku Streambank. Anticipated that proposed project would go through similar SMA Emergency Permit review.	SMA Use Permit application will be submitted after completion of the Final EA/FONSI.

Agency or Individual	Format/Date/Reference	Comments	Action/Response
		Determination cannot be made until completed SMA Use Permit application is submitted.	
Hawai‘i Gas	Email from Russell Goya dated March 26, 2013	Proposed work should not impact gas lines servicing the apartment complex.	None required.

Comments Received During Pre-Assessment Consultation

DEPARTMENT OF THE ARMY
U.S. ARMY ENGINEER DISTRICT, HONOLULU
FORT SHAFTER, HAWAII 96858-5440

REPLY TO
ATTENTION OF:

November 16, 2012

Regulatory Branch

File Number POH-2011-00061

Kimura International, Inc.
Attention: Leslie Kurisaki
1600 Kapiolani Boulevard, Suite 1610
Honolulu, Hawaii 96814

RECEIVED NOV 21 2012

NO PERMIT REQUIRED

Dear Mr. Sandefur:

We have received your letter dated November 13, 2012 requesting Department of the Army (DA) review for jurisdictional determination of permit requirements on the proposed Emergency Second Slope Scarp Streambank Stabilization of the Wailuku Stream adjacent to the Riverside Apartments at 333 Ohai Street, TMK (3) 2-6-003:009, Hilo, Hawaii Island, Hawaii. We have assigned the project the reference number **POH-2011-00061**. Please cite the reference number in any future correspondence concerning this project.

We have completed our review of the submitted document pursuant to Section 10 of the Rivers and Harbors Act of 1899 (Section 10) and Section 404 of the Clean Water Act (Section 404) and have determined the submitted documents accurately identify a navigable water of the U.S., subject to U.S. Army Corps of Engineers (Corps) jurisdiction.

Based on the information you submitted, the proposed streambank stabilization, involving installation of a series of inclined soil anchors into the streambank scarp slope will occur landward of the Mean High Water Mark (Section 10 limit of Corps jurisdiction) of the Wailuku Stream. Additionally, the proposed installation of an 8 to 10-inch thick layer of schtcrete will be discharde landward of the Mean Higher High Water Mark (Section 404 limit of jurisdiction) of the Wailuku Stream. Accordingly, a **DA permit will not be required**. This determination does not relieve you of the responsibility to obtain any other permits, licenses, or approvals that may be required under County, State, or Federal law for your proposed work.

Thank you for contacting us regarding this project and providing us with the opportunity to comment. Should you have any questions, please contact Ms. Jessie Pa'ahana at *808.835.4107* or via e-mail at *Jessie.K.Paahana@usace.army.mil*. You are encouraged to provide comments on your experience with the Honolulu District Regulatory Branch by accessing our web-based customer survey form at *http://per2.nwp.usace.army.mil/survey.html*.

Sincerely,

George P. Young, P.E.
Chief, Regulatory Branch

US Fish & Wildlife Service

Leslie Kurisaki

From: Ian_Bordenave@fws.gov

Sent: Thursday, November 15, 2012 12:22 PM

To: lkurisaki@kimurainternational.com

Subject: RE: Service File 2013-TA-0030 Stream Bank Bluff Protection and Stabilization at the Riverside Apartments, Hawaii

Aloha Lisa,

The U.S. Fish and Wildlife Service (Service) received your letter on October 19, 2012, requesting our comments on the proposed stream bank and bluff stabilization project at the Riverside Apartments in Hilo, Hawaii. In 2008, heavy rains contributed to the failure of portions of the terraced stream bank below the Riverside Apartments. After emergency repairs were made to stabilize sections of the upper terrace, subsequent geotechnical investigations have determined that additional portions of a lower terrace are susceptible to slope failure. Such a slope failure could seriously threaten structural integrity of the Riverside Apartments building. Proposed slope stabilization work will occur only on the bluff above the stream, and no work will take place below the mean high water mark of the Wailuku River. The construction contractor will take ameliorative steps, including the installation of silt fencing, debris catchment fences, and the placement of sandbags along the stream bank to prevent debris from falling into the river during construction.

Based on information you provided and pertinent information in our files, including data compiled by the Hawaii Biodiversity and Mapping Program, there is no designated critical habitat or observed populations of species within the proposed project's construction footprint protected by the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. 1531 *et seq.*). If you have any further questions concerning the proposed project please feel free to contact me and refer to Service File 2013-TA-0030.

Mahalo,

Ian Bordenave
Biologist
U.S. Fish and Wildlife Service
Pacific Islands Field Office
Ecological Services, Consultations & HCP
300 Ala Moana Blvd., Suite 3-122
Honolulu, HI. 96850
Phone: (808) 792-9453
E-Mail: ian_bordenave@fws.gov

NEIL ABERCROMBIE
GOVERNOR
RICHARD C. LIM
DIRECTOR
MARY ALICE EVANS
DEPUTY DIRECTOR
JESSE K. SOUKI
DIRECTOR
OFFICE OF PLANNING

DEPARTMENT OF BUSINESS, ECONOMIC DEVELOPMENT & TOURISM

OFFICE OF PLANNING
235 South Beretania Street, 6th Floor, Honolulu, Hawaii 96813
Mailing Address: P.O. Box 2359, Honolulu, Hawaii 96804

Telephone: (808) 587-2846
Fax: (808) 587-2824

Ref. No. P-13771

November 2, 2012

RECEIVED NOV 05 2012

Mr. Glenn T. Kimura, President
Kimura International, Inc.
1600 Kapiolani Boulevard, Suite 1610
Honolulu, Hawaii 96814

Dear Mr. Kimura:

Subject: Stream Bank Bluff Protection & Stabilization - Second Slope Scarp
Riverside Apartments, Hilo, Hawaii, TMK: (3) 2-6-003: 009
Environmental Assessment - Early Consultation

Thank you for the opportunity to provide comments on the Environmental Assessment - Early Consultation for the subject project. It is our understanding that the Big Island Housing Foundation Riverside Community-Based Non-Profit Corporation (BIHF Riverside) is proposing a stream bank bluff stabilization project at the Riverside Apartments, located on a parcel identified as TMK: (3) 2-6-003:009. The project is intended to stabilize the second terrace level area in accordance with the recommendations of a geotechnical investigation completed in approximately July 2011. The current project area covers approximately 3,320 square feet and is bounded by two retaining walls. All work will occur on the stream bank bluff slope and at the top of the bank.

The Office of Planning (OP) has reviewed the information provided in your letter dated October 19, 2012, and has the following comments to offer:

1. The entire state is defined to be within the Coastal Zone Management Area (Hawaii Revised Statutes (HRS) Section 205A-1 - definition of "coastal zone management area"). The Draft Environmental Assessment should include a discussion of the proposed project's consistency with the objectives and policies set forth in HRS Section 205A-2.

2. Because of the project area's proximity to Wailuku Stream and Hilo Bay, and the potential for the unstabilized stream bank as a coastal nonpoint pollution impact, we invite the BIHF Riverside to review Chapter 5 of the Hawaii Watershed Guidance, specifically the section on management measures for stream bank and shoreline

erosion. The Guidance provides a summary of management measures and resources that may be implemented to minimize coastal nonpoint pollution impact.

The Hawaii Watershed Guidance can be found on-line at http://hawaii.gov/dbedt/czm/initiative/nonpoint/HI Watershed Guidance Final.pdf.

Thank you for the opportunity to comment on the Environmental Assessment-Early Consultation for the proposed project.

Should you have questions or require clarification, please do not hesitate to contact Leo Asuncion, Coastal Zone Management Program Manager, at 587-2875.

Sincerely,

Mary Ann Kobayashi for

Jesse K. Souki
Director

NEIL ABERCROMBIE
GOVERNOR

LORETTA J. FUDDY, A.C.S.W., M.P.H.
Director of Health

STATE OF HAWAII
DEPARTMENT OF HEALTH
P.O. BOX 916
HILO, HAWAII 96721-0916

RECEIVED NOV 0 9 2012

November 7, 2012

Glenn K. Kimura, President
Kimura International Inc.
1600 Kapiolani Blvd., Suite 1610
Honolulu, HI 96814

Dear Mr. Kimura:

Subject: Environmental Assessment-Early Consultation
Stream Bank Bluff Protection & Stabilization
Second Slope Scarp at the Riverside Apartments
Hilo, Hawaii
TMK: 2-6-003:009

The Department of Health (DOH), Clean Water Branch (CWB), acknowledges receipt of the subject document on November 7, 2012. The CWB has reviewed the limited information contained in the subject document and offers the following comments:

1. The Army Corps of Engineers should be contacted at (808) 438-9258 for this project. Pursuant to Federal Water Pollution Control Act (commonly known as the "Clean Water Act" (CWA)), Paragraph 401(a)(1), a Section 401 Water Quality Certification (WQC) is required for "[a]ny applicant for Federal license or permit to conduct any activity including, but not limited to, the construction or operation of facilities, which may result in any discharge into the navigable waters…". The term "discharge" is defined in CWA, Subsections 502(16), 502(12), and 502(6); Title 40, Code of Federal Regulations, Section 122.2, and Hawaii Administrative Rules (HAR), Chapter 11-54.

2. In accordance with HAR, Sections 11-55-04 and 11-55-34.05, the Director of Health may require the submittal of an individual permit application or a Notice of Intent (NOI) for general permit coverage authorized under the National Pollutant Discharge Elimination System (NPDES).

   a. An application for an NPDES individual permit is to be submitted at least 180 days before the commencement of the respective activities. The NPDES application forms may also be picked up at our office or downloaded from our website at: http://www.hawaii.gov/health/environmental/water/cleanwater/forms/indiv-index.html.

3. In accordance with HAR, Section 11-55-38, the applicant for an NPDES permit is required to either submit a copy of the new NOI or NPDES permit application to the State Department of Land and Natural Resources, State Historic Preservation Division (SHPD), or demonstrate to the satisfaction of the DOH that the project, activity, or site covered by the NOI or application has been or is being reviewed by SHPD. If applicable, please submit a copy of the request for review by SHPD or SHPD's determination letter for the project.

4. Any discharges related to project construction or operation activities, with or without a Section 401 WQC or NPDES permit coverage, shall comply with the applicable State Water Quality Standards as specified in HAR, Chapter 11-54.

Hawaii Revised Statutes, Subsection 342D-50(a) requires that "[n]o person, including any public body, shall discharge any water pollutants into state waters, or cause or allow any water pollutant to enter state waters except in compliance with this chapter, rules adopted pursuant to this chapter, or a permit or variance issued by the director."

If you have any questions, please contact Mr. Alec Wong, Supervisor of the Engineering Section, CWB, at (808) 586-4309.

Sincerely,

Newton Inouye
District Environmental Health Program Chief
Hawaii District

c: Environmental Planning Office
WORD:EA-Riverside Apartments.my

NEIL ABERCROMBIE
GOVERNOR OF HAWAII

LORETTA J. FUDDY, A.C.S.W., M.P.H.
DIRECTOR OF HEALTH

STATE OF HAWAII
DEPARTMENT OF HEALTH
P. O. BOX 3378
HONOLULU, HI 96801-3378

In reply, please refer to:
File:

12-194
Riverside Apts.

October 22, 2012

RECEIVED NOV 05 2012

Mr. Glenn T. Kimura, President
Kimura International Inc.
1600 Kapiolani Blvd., Suite 1610
Honolulu, Hawaii 96814

Dear Mr. Kimura:

SUBJECT: Environmental Assessment-Early Consultation
Stream Bank Bluff Protection & Stabilization, Second Slope Scarp at the Riverside Apartments, Hilo, Hawaii, TMK: 2-6-003: 009

The Department of Health (DOH), Environmental Planning Office (EPO), acknowledges receipt of your letter, dated October 19, 2012. Thank you for allowing us to review and comment on the subject document. The document was routed to the various branches of the Environmental Health Administration. We have no comments at this time, but reserve the right to future comments. We strongly recommend that you review all of the Standard Comments on our website: www.hawaii.gov/health/environmental/env-planning/landuse/landuse.html. Any comments specifically applicable to this application should be adhered to.

The United States Environmental Protection Agency (EPA) provides a wealth of information on their website including strategies to help protect our natural environment and build sustainable communities at: http://water.epa.gov/infrastructure/sustain/ . The DOH encourages State and county planning departments, developers, planners, engineers and other interested parties to apply these strategies and environment principles whenever they plan or review new developments or redevelopments projects. We also ask you to share this information with others to increase community awareness on healthy, sustainable community design. If there are any questions about these comments please contact me.

Sincerely,

Laura Leialoha Phillips McIntyre, AICP
Environmental Planning Office Manager
Environmental Health Administration
Department of Heath
919 Ala Moana Blvd., Ste. 312
Honolulu, Hawaii 96814
Phone: 586-4337
laura.mcintyre@doh.hawaii.gov

NEIL ABERCROMBIE
GOVERNOR OF HAWAII

HISTORIC PRESERVATION DIVISION
DEPARTMENT OF LAND AND NATURAL RESOURCES

601 Kamokila Boulevard, Suite 555
Kapolei, HI 96806

WILLIAM J. AILA, JR.
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

ESTHER KIA'AINA
FIRST DEPUTY

WILLIAM M. TAM
DEPUTY DIRECTOR - WATER

AQUATIC RESOURCES
BOATING AND OCEAN RECREATION
BUREAU OF CONVEYANCES
COMMISSION ON WATER RESOURCE MANAGEMENT
CONSERVATION AND COASTAL LANDS
CONSERVATION AND RESOURCES ENFORCEMENT
ENGINEERING
FORESTRY AND WILDLIFE
HISTORIC PRESERVATION
KAHOOLAWE ISLAND RESERVE COMMISSION
LAND
STATE PARKS

December 17, 2012

Mr. Glenn T. Kimura
Kimura International, Inc.
1600 Kapiolani Blvd. Suite 1610
Honolulu, Hawai`i 96814
Attn. Leslie Kurisaki

LOG NO: 2012.3046
DOC NO: 1212SN04
Archaeology

Dear Mr. Kimura:

SUBJECT: **Chapter 6E-42 Historic Preservation Review –**
Environmental Assessment Early Consultation, Stream Bank Protection and Stabilization
Second Slope Scarp at the Riverside Apartments
Pu'u'eo Ahupua'a, South Hilo District, Island of Hawai'i
TMK: (3) 2-6-003:009

Thank you for the opportunity to provide comments for the proposed project. We received your submittal October 26, 2012; we apologize for the delayed review and thank you for your patience. According to your letter, a 3,320 sq. ft. area will be stabilized along the stream bank to support the building footings nearest the stream bank. The project plans to install a series of micopiles and to construct a series of soil anchors in the stream bank slope with an 8-10 inch layer of reinforced shotcrete (gunite) to facilitate the stabilization of the stream bank slope face.

On November 18, 2012 we received a draft report describing an archaeological field inspection and a literature review in connection with the proposed project (Hammatt et. al 2012) We have reviewed this report and at this time; cannot concur with the recommendation of no further work for this project (2012.3284, 1212SN07). The project area is located along the lower reaches of the Wailuku Stream, within an area that was an important political center and densely populated prior to and following western contact. Although this project area has been impacted by modern development, previous surface disturbance may not have fully destroyed the subsurface remains of archaeological and natural history deposits or human skeletal remains that could potentially be preserved in subsurface deposits within this project area.

We request more information to assess the possible impact this project might have on historic properties that may be present along the bank. We request that you provide more detailed information describing how the proposed stabilization efforts will directly impact the bank slope. Please contact Sean Nāleimaile at (808) 933-7651 or Sean.P.Naleimaile@Hawaii.gov if you have any questions or concerns regarding this letter.

Aloha,

Theresa K. Donham
Archaeology Branch Chief

NEIL ABERCROMBIE
GOVERNOR OF HAWAII

WILLIAM J. AILA, JR.
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
LAND DIVISION

POST OFFICE BOX 621
HONOLULU, HAWAII 96809

November 14, 2012

Kimura International Inc.
Attention: Ms. Leslie Kurisaki
1600 Kapiolani Boulevard, #1610
Honolulu, HI 96814

via email: lkurisaki@kimurainternational.com

Dear Ms. Kurisaki:

SUBJECT: Environmental Assessment-Early Consultation Stream Bank Bluff Protection & Stabilization Second Slope Scarp at the Riverside Apartments, Kimura International Inc. for Big Island Housing Foundation Riverside Community-Based Non Project Corporation, Applicant, South Hilo, Hawaii; TMK: (3) 2-6-003:009

Thank you for the opportunity to review and comment on the subject matter. The Department of Land and Natural Resources' (DLNR) Land Division distributed or made available a copy of your report pertaining to the subject matter to DLNR Divisions for their review and comments.

At this time, enclosed are comments from (i) the Division of Aquatic Resources, (ii) the Hawaii District Land Office, (iii) the Commission on Water Resource Management, and (iv) the Engineering Division on the subject matter. Should you have any questions, please feel free to call Kevin Moore at (808) 587-0426. Thank you.

Sincerely,

Russell Y. Tsuji
Land Administrator

Enclosure(s)

NEIL ABERCROMBIE
GOVERNOR OF HAWAII

WILLIAM J. AILA, JR.
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

AMV
RN

DAR 4511

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
LAND DIVISION

POST OFFICE BOX 621
HONOLULU, HAWAII 96809

RECEIVED
LAND DIVISION
2012 NOV -9 A 10: 16
DEPT. OF LAND & NATURAL RESOURCES STATE OF HAWAII

RECEIVED
2012 OCT 31 PM 2: 10
DIV OF AQUATIC RESOURCES HILO, HAWAII

October 25, 2012

MEMORANDUM

TO: **DLNR Agencies:**
X Div. of Aquatic Resources
__Div. of Boating & Ocean Recreation
X Engineering Division
__Div. of Forestry & Wildlife
__Div. of State Parks
X Commission on Water Resource Management
X Office of Conservation & Coastal Lands
X Land Division – Hawaii District
X Historic Preservation

FROM: Russell Y. Tsuji, Land Administrator
SUBJECT: Environmental Assessment-Early Consultation Stream Bank Bluff Protection & Stabilization Second Slope Scarp at the Riverside Apartments
LOCATION: South Hilo, Hawaii; TMK: (3) 2-6-003:009
APPLICANT: Kimura International Inc. for Big Island Housing Foundation Riverside Community-Based Non Project Corporation

Transmitted for your review and comment on the above referenced document. We would appreciate your comments on this document. Please submit any comments by November 13, 2012.

If no response is received by this date, we will assume your agency has no comments. If you have any questions about this request, please contact Kevin Moore at 587-0426. Thank you.

Attachments

( ) We have no objections.
( ) We have no comments.
( ) Comments are attached.

waiting for draft EIS

Signed: [signature]
Print name: Robert N. Shimoto
Date: 07 NOV 2012

cc: Central Files

RECEIVED
DAR 10/29/12

NEIL ABERCROMBIE
GOVERNOR OF HAWAII

WILLIAM J. AILA, JR.
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

2012 OCT 29 P 4:16

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LAND DIVISION
HILO, HAWAII

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
LAND DIVISION

POST OFFICE BOX 621
HONOLULU, HAWAII 96809

October 25, 2012

MEMORANDUM

TO: **DLNR Agencies:**
X Div. of Aquatic Resources
__Div. of Boating & Ocean Recreation
X Engineering Division
__Div. of Forestry & Wildlife
__Div. of State Parks
X Commission on Water Resource Management
X Office of Conservation & Coastal Lands
~~X Land Division – Hawaii District~~
X Historic Preservation

RECEIVED
LAND DIVISION
2012 NOV 13 A 10:24
DEPT. OF LAND & NATURAL RESOURCES
STATE OF HAWAII

FROM: Russell Y. Tsuji, Land Administrator
SUBJECT: Environmental Assessment-Early Consultation Stream Bank Bluff Protection & Stabilization Second Slope Scarp at the Riverside Apartments
LOCATION: South Hilo, Hawaii; TMK: (3) 2-6-003:009
APPLICANT: Kimura International Inc. for Big Island Housing Foundation Riverside Community-Based Non Project Corporation

Transmitted for your review and comment on the above referenced document. We would appreciate your comments on this document. Please submit any comments by November 13, 2012.

If no response is received by this date, we will assume your agency has no comments. If you have any questions about this request, please contact Kevin Moore at 587-0426. Thank you.

Attachments

( ) We have no objections.
(✓) We have no comments.
( ) Comments are attached.

Signed: _____

Print name: GORDON C. HEU
Date: 11/8/12

cc: Central Files

NEIL ABERCROMBIE
GOVERNOR OF HAWAII

WILLIAM J. AILA, JR.
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
LAND DIVISION

POST OFFICE BOX 621
HONOLULU, HAWAII 96809

October 25, 2012

MEMORANDUM

2012 OCT 26 PM 2:17

TO: **DLNR Agencies:**
X Div. of Aquatic Resources
__Div. of Boating & Ocean Recreation
X Engineering Division
__Div. of Forestry & Wildlife
__Div. of State Parks
X Commission on Water Resource Management
X Office of Conservation & Coastal Lands
X Land Division – Hawaii District
X Historic Preservation

FROM: Russell Y. Tsuji, Land Administrator
SUBJECT: Environmental Assessment-Early Consultation Stream Bank Bluff Protection & Stabilization Second Slope Scarp at the Riverside Apartments
LOCATION: South Hilo, Hawaii; TMK: (3) 2-6-003:009
APPLICANT: Kimura International Inc. for Big Island Housing Foundation Riverside Community-Based Non Project Corporation

Transmitted for your review and comment on the above referenced document. We would appreciate your comments on this document. Please submit any comments by November 13, 2012.

If no response is received by this date, we will assume your agency has no comments. If you have any questions about this request, please contact Kevin Moore at 587-0426. Thank you.

Attachments

( ) We have no objections.
( ) We have no comments.
(✓) Comments are attached.

Stream Channel Alteration Permit is required.

Signed: RKChang

Print name: R.K. CHANG
Date: 10/26/12

cc: Central Files

FILE ID: RFD. 3477.8
DOC ID: 10333 / 10343

NEIL ABERCROMBIE
GOVERNOR OF HAWAII

WILLIAM J. AILA, JR.
CHAIRPERSON

WILLIAM D. BALFOUR, JR.
SUMNER ERDMAN
LORETTA J. FUDDY, A.C.S.W., M.P.H.
NEAL S. FUJIWARA
JONATHAN STARR
TED YAMAMURA

WILLIAM M. TAM
DEPUTY DIRECTOR

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT
P.O. BOX 621
HONOLULU, HAWAII 96809

October 29, 2012

REF: RFD.3477.8

TO: Russell Tsuji, Administrator
Land Division

FROM: William M. Tam, Deputy Director
Commission on Water Resource Management

SUBJECT: Environmental Assessment-Early Consultation Stream Bank Bluff Protection & Stabilization Second Slope Scarp at the Riverside Apartments

FILE NO.: n/a
TMK NO.: (3) 2-6-003:009

RECEIVED
LAND DIVISION
2012 OCT 30 P 3:57
DEPT. OF LAND & NATURAL RESOURCES
STATE OF HAWAII

Thank you for the opportunity to review the subject document. The Commission on Water Resource Management (CWRM) is the agency responsible for administering the State Water Code (Code). Under the Code, all waters of the State are held in trust for the benefit of the citizens of the State, therefore, all water use is subject to legally protected water rights. CWRM strongly promotes the efficient use of Hawaii's water resources through conservation measures and appropriate resource management. For more information, please refer to the State Water Code, Chapter 174C, Hawaii Revised Statutes, and Hawaii Administrative Rules, Chapters 13-167 to 13-171. These documents are available via the Internet at http://www.hawaii.gov/dlnr/cwrm.

Our comments related to water resources are checked off below.

☐ 1. We recommend coordination with the county to incorporate this project into the county's Water Use and Development Plan. Please contact the respective Planning Department and/or Department of Water Supply for further information.

☐ 2. We recommend coordination with the Engineering Division of the State Department of Land and Natural Resources to incorporate this project into the State Water Projects Plan.

☐ 3. We recommend coordination with the Hawaii Department of Agriculture (HDOA) to incorporate the reclassification of agricultural zoned land and the redistribution of agricultural resources into the State's Agricultural Water Use and Development Plan (AWUDP). Please contact the HDOA for more information.

☐ 4. We recommend that water efficient fixtures be installed and water efficient practices implemented throughout the development to reduce the increased demand on the area's freshwater resources. Reducing the water usage of a home or building may earn credit towards Leadership in Energy and Environmental Design (LEED) certification. More information on LEED certification is available at http://www.usgbc.org/leed. A listing of fixtures certified by the EPA as having high water efficiency can be found at http://www.epa.gov/watersense/pp/index.htm.

☐ 5. We recommend the use of best management practices (BMP) for stormwater management to minimize the impact of the project to the existing area's hydrology while maintaining on-site infiltration and preventing polluted runoff from storm events. Stormwater management BMPs may earn credit toward LEED certification. More information on stormwater BMPs can be found at http://hawaii.gov/dbedt/czm/initiative/lid.php.

☐ 6. We recommend the use of alternative water sources, wherever practicable.

☐ 7. There may be the potential for ground or surface water degradation/contamination and recommend that approvals for this project be conditioned upon a review by the State Department of Health and the developer's acceptance of any resulting requirements related to water quality.

Permits required by CWRM:

Additional information and forms are available at http://hawaii.gov/dlnr/cwrm/resources_permits.htm.

☐ 8. The proposed water supply source for the project is located in a designated water management area, and a Water Use Permit is required prior to use of water. The Water Use Permit may be conditioned on the requirement to use dual line water supply systems for new industrial and commercial developments.

☐ 9. A Well Construction Permit(s) is (are) required before any well construction work begins.

☐ 10. A Pump Installation Permit(s) is (are) required before ground water is developed as a source of supply for the project.

☐ 11. There is (are) well(s) located on or adjacent to this project. If wells are not planned to be used and will be affected by any new construction, they must be properly abandoned and sealed. A permit for well abandonment must be obtained.

☐ 12. Ground water withdrawals from this project may affect streamflows, which may require an instream flow standard amendment.

☒ 13. A Stream Channel Alteration Permit(s) is (are) required before any alteration(s) can be made to the bed and/or banks of a stream channel.

☐ 14. A Stream Diversion Works Permit(s) is (are) required before any stream diversion works is (are) constructed or altered.

☐ 15. A Petition to Amend the Interim Instream Flow Standard is required for any new or expanded diversion(s) of surface water.

☐ 16. The planned source of water for this project has not been identified in this report. Therefore, we cannot determine what permits or petitions are required from our office, or whether there are potential impacts to water resources.

☐ OTHER:

If there are any questions, please contact Robert Chong at 587-0266.

NEIL ABERCROMBIE
GOVERNOR OF HAWAII

'12 OCT 26 AM 9 :23 ENGINEERING

WILLIAM J. AILA, JR.
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
LAND DIVISION

POST OFFICE BOX 621
HONOLULU, HAWAII 96809

October 25, 2012

MEMORANDUM

RECEIVED
LAND DIVISION
2012 NOV 14 P 3: 30
DEPT. OF LAND &
NATURAL RESOURCES
STATE OF HAWAII

TO: **DLNR Agencies:**
X Div. of Aquatic Resources
__Div. of Boating & Ocean Recreation
X Engineering Division
__Div. of Forestry & Wildlife
__Div. of State Parks
X Commission on Water Resource Management
X Office of Conservation & Coastal Lands
X Land Division – Hawaii District
X Historic Preservation

FROM: Russell Y. Tsuji, Land Administrator
SUBJECT: Environmental Assessment-Early Consultation Stream Bank Bluff Protection & Stabilization Second Slope Scarp at the Riverside Apartments
LOCATION: South Hilo, Hawaii; TMK: (3) 2-6-003:009
APPLICANT: Kimura International Inc. for Big Island Housing Foundation Riverside Community-Based Non Project Corporation

Transmitted for your review and comment on the above referenced document. We would appreciate your comments on this document. Please submit any comments by November 13, 2012.

If no response is received by this date, we will assume your agency has no comments. If you have any questions about this request, please contact Kevin Moore at 587-0426. Thank you.

Attachments

( ) We have no objections.
( ) We have no comments.
(X) Comments are attached.

Signed: _____

Print name: Carty S. Chang, Chief Engineer
Date: 11/14/12

cc: Central Files

DEPARTMENT OF LAND AND NATURAL RESOURCES
ENGINEERING DIVISION

LD/KevinMoore
RE:EAEarly ConsultationStreamBankBluffProtection
Hawaii.587

COMMENTS

( ) We confirm that the project site, according to the Flood Insurance Rate Map (FIRM), is located in Flood Zone ___.

(X) **Please take note that the project site, according to the Flood Insurance Rate Map (FIRM), is located in Flood Zone X. The Flood Insurance Program does not have any regulations for developments within Flood Zone X.**

( ) Please note that the correct Flood Zone Designation for the project site according to the Flood Insurance Rate Map (FIRM) is ___.

( ) Please note that the project must comply with the rules and regulations of the National Flood Insurance Program (NFIP) presented in Title 44 of the Code of Federal Regulations (44CFR), whenever development within a Special Flood Hazard Area is undertaken. If there are any questions, please contact the State NFIP Coordinator, Ms. Carol Tyau-Beam, of the Department of Land and Natural Resources, Engineering Division at (808) 587-0267.

Please be advised that 44CFR indicates the minimum standards set forth by the NFIP. Your Community's local flood ordinance may prove to be more restrictive and thus take precedence over the minimum NFIP standards. If there are questions regarding the local flood ordinances, please contact the applicable County NFIP Coordinators below:

( ) Mr. Mario Siu Li at (808) 768-8098 or Ms. Ardis Shaw-Kim at (808) 768-8296 of t he City and County of Honolulu, Department of Planning and Permitting.

( ) Mr. Frank DeMarco at (808) 961-8042 of the County of Hawaii, Department of Public Works.

( ) Mr. Francis Cerizo at (808) 270-7771 of the County of Maui, Department of Planning.

( ) Mr. Wynne Ushigome at (808) 241-4890 of the County of Kauai, Department of Public Works.

( ) The applicant should include water demands and infrastructure required to meet project needs. Please note that projects within State lands requiring water service from the Honolulu Board of Water Supply system will be required to pay a resource development charge, in addition to Water Facilities Charges for transmission and daily storage.

( ) The applicant should provide the water demands and calculations to the Engineering Division so it can be included in the State Water Projects Plan Update.

( ) Additional Comments: _____

( ) Other: _____

Should you have any questions, please call Ms. Suzie S. Agraan of the Planning Branch at 587-0258.

Signed: _____
CARTY S. CHANG, CHIEF ENGINEER

Date: 11/14/12

NEAL ABERCROMBIE
GOVERNOR

TED SAKAI
DIRECTOR

MARTHA TORNEY
Deputy Director
Administration

Deputy Director
Corrections

KEITH KAMITA
Deputy Director
Law Enforcement

STATE OF HAWAII
DEPARTMENT OF PUBLIC SAFETY
919 Ala Moana Boulevard, 4th Floor
Honolulu, Hawaii 96814

No. 2012-1899

October 23, 2012

RECEIVED OCT 26 2012

Mr. Glenn T. Kimura
President
Kimura International, Inc.
1600 Kapiolani Blvd., Suite 1610
Honolulu, Hi. 96814

Dear Mr. Kimura,

Subject: Environmental Assessment-Early Consultation
Stream Bank Bluff Protection & Stabilization
Second Slope Scarp at the Riverside Apartments
Hilo, Hawaii
TMK 2-6-003:009

I am in receipt of your letter dated Oct. 19, 2012, subject as above, stating that your firm is preparing an Environmental Assessment (EA) on behalf of Big Island Housing Foundation Riverside Community-Based Non Profit Corporation (BIHF-Riverside).

The Department of Public Safety does not have any preliminary comment at this time. We do anticipate receiving a copy of the Draft EA in the near future and may take the opportunity to make comments after reviewing the draft documents.

Thank you for notifying us of this project.

Sincerely,

Ted Sakai, Interim Director
Department of Public Safety

NEIL ABERCROMBIE
GOVERNOR

GLENN M. OKIMOTO
DIRECTOR

Deputy Directors
JADE T. BUTAY
FORD N. FUCHIGAMI
RANDY GRUNE
JADINE URASAKI

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
869 PUNCHBOWL STREET
HONOLULU, HAWAII 96813-5097

IN REPLY REFER TO:

STP 8.1037

November 14, 2012

RECEIVED NOV 23 2012

Mr. Glenn T. Kimura
President
Kimura International, Inc
1600 Kapiolani Boulevard, Suite 1610
Honolulu, Hawaii 96814

Dear Mr. Kimura:

Subject: Riverside Apartments Stream Bank Bluff Protection and Stabilization
Early Consultation for Environmental Assessment
TMK: 2-6-003:009

Thank you for requesting the State Department of Transportation's (DOT) review of the subject project. DOT understands that the applicant proposes to install a series of micropiles to underpin the building footings near the stream bank and construct a series of soil anchors in the stream bank scarp slope to protect and stabilize the stream bank slope face.

Given the location and the nature of the project, DOT does not anticipate any significant adverse impacts to the State transportation facilities.

DOT appreciates the opportunity to provide comments. If there are any other questions, please contact Mr. Garrett Smith of the DOT Statewide Transportation Planning Office at telephone number (808) 831-7976.

Very truly yours,

GLENN M. OKIMOTO, Ph.D.
Director of Transportation

Water Resources Research Center
Environmental Center

UNIVERSITY of HAWAI'I®
MĀNOA

November 5, 2012
NC: 2012-10-19

Mr. Glenn T. Kimura, President
Kimura International, Inc.
1600 Kapiolani Blvd., Suite 1610
Honolulu, HI 96814

RECEIVED NOV 14 2012

Dear Mr. Kimura:

Environmental Assessment- Early Consultation
Stream Bank Bluff Protection & Stabilization, Second Slope Scarp at the Riverside Apartments, Hilo, Hawaii TMK 2-6-003:009

Thank you for your letter dated October 19, 2012 inviting the Environmental Center to consult on the preparation of the Draft Environmental Assessment for the proposed stream bank bluff stabilization project at the Riverside Apartments in Hilo. We will not comment at this time due to resource constraints; however we look forward to reviewing the Draft Environmental Assessment when it becomes available.

Sincerely,

David Penn
Assistant Specialist

copy: Sara Bolduc, Environmental Center

2500 Dole Street, Krauss Annex 19 Honolulu, Hawai'i 96822
Telephone: (808) 956-7361 Fax: (808) 956-3980
An Equal Opportunity/Affirmative Action Institution

William P. Kenoi
Mayor

William T. Takaba
Managing Director

Dora Beck, P.E.
Acting Director

County of Hawai'i
DEPARTMENT OF ENVIRONMENTAL MANAGEMENT
25 Aupuni Street • Hilo, Hawai'i 96720
(808) 961-8083 · Fax (808) 961-8086
http://co.hawaii.hi.us/directory/dir_envmng.htm

RECEIVED OCT 24 2012

October 23, 2012

Mr. Glenn T. Kimura
President
Kimura International Inc.
1600 Kapi'olani Blvd, Suite 1610
Honolulu, HI 96814

RE: Environmental Assessment-Early Consultation
Stream Bank Bluff Protection & Stabilization
Second Slope Scarp at the Riverside Apartments
Hilo, HI
TMK: 2-6-003:009

Dear Mr. Kimura,

Please find enclosed comments from our Wastewater Division on the subject project.

Thank you for allowing us to review and comment.

Sincerely,

Dora Beck

Dora Beck, P.E.
ACTING DIRECTOR

County of Hawai'i is an Equal Opportunity Provider and Employer.

DEPARTMENT OF ENVIRONMENTAL MANAGEMENT
WASTEWATER DIVISION

COUNTY OF HAWAII –108 RAILROAD AVENUE – HILO, HI 96720
HILO (808) 961-8338 FAX (808) 961-8644

MEMORANDUM

RECEIVED OCT 24 2012

Date: October 22, 2012

To: Dora Beck, P.E., Acting Director

From: Lyle Hirota, Acting Division Chief Lyle Hirota

Digitally signed by Lyle Hirota
DN: cn=Lyle Hirota, o=Wastewater Division, ou=COH, email=lhirota@co.hawaii.hi.us, c=US
Date: 2012.10.22 08:37:05 -10'00'

Subject: TMK 2-6-003:009
Environmental Assessment – Early Consultation
Riverside Apartments

The property is currently served by the County Sewer System connected via Puueo Street.

While the Current Project Area as identified in the letter from Kimura International, Inc. does not seem to affect the County sewer lateral, the location and routing of private sewer lines within the property is unknown and should be identified prior to any excavation work.

cc: Rizalino Mangaoang, P.E., Acting WWD Deputy Division Chief
Toni Nakatani, EST III

William P. Kenoi
Mayor

Darren J. Rosario
Fire Chief

Renwick J. Victorino
Deputy Fire Chief

County of Hawai'i
HAWAI'I FIRE DEPARTMENT
25 Aupuni Street • Room 2501 • Hilo, Hawai'i 96720
(808) 932-2900 • Fax (808) 932-2928

RECEIVED NOV 0 2 2012

October 29, 2012

Mr. Glenn T. Kimura
Kimura International Inc.
1600 Kapiolani Blvd.
STE 1610
Honolulu, HI 96814

Dear Mr. Kimura,

SUBJECT: ENVIRONMENTAL ASSESSMENT –EARLY CONSULTATION
STREAM BANK BLUFF PROTECTION & STABLIZATION SECOND SLOPE SCARP AT THE RIVERSIDE APARTMENTS
TMK: 2-6-003:009

The Hawai'i Fire Department does not have any comments to offer at this time regarding the above-referenced draft Environmental Assessment – Early Consultation.

Thank you for the opportunity to comment.

Sincerely,

DARREN J. ROSARIO
Fire Chief

KT:lc

William P. Kenoi
Mayor

BJ Leithead Todd
Director

Margaret K. Masunaga
Deputy

West Hawai'i Office
74-5044 Ane Keohokalole Hwy
Kailua-Kona, Hawai'i 96740
Phone (808) 323-4770
Fax (808) 327-3563

County of Hawai'i

PLANNING DEPARTMENT

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

November 14, 2012

RECEIVED NOV 15 2012

Ms. Leslie Kurisaki
Kimura International
1600 Kapiolani Blvd, Suite 1610
Honolulu, HI 96814

Dear Ms. Kurisaki:

Subject: **Pre-Consultation for Draft Environmental Assessment**
Project: Stream Bank Bluff Protection and Stabilization
TMK: (3) 2-6-003:009; Pu'ueo, South Hilo, Hawai'i

Thank you for your letter dated October 19, 2012, requesting comments from this office regarding the preparation of a Draft Environmental Assessment (DEA) for the subject project.

The subject property consists of 1.848 acres and is zoned V-.75 (Resort- Hotel-maximum density of 750 square feet of land area for each dwelling unit) by the County of Hawai'i and designated Urban by the State Land Use Commission. The Hawai'i County General Plan Land Use Pattern Allocation Guide (LUPAG) Map designates the parcels as Medium Density Urban. In addition, the entire property is located within the Special Management Area (SMA) and subject to review against SMA rules and regulations. Although it is in the Special Management Area, it is not located in a "shoreline area" as defined by Section 205A-41, Hawai'i Revised Statutes (HRS).

On April 12, 2011, our office issued an SMA Emergency Permit, subject to compliance with several conditions, for the emergency stabilization of a portion of the Wailuku stream bank on the subject property. On October 4, 2011, our office received the project completion photos and as-built construction plans for the project. It is anticipated that the proposed stream bank bluff protection and stabilization of the second slope scarp on the subject property would go through a similar SMA Emergency Permit review. However, that determination cannot be made until a completed SMA Use Permit Assessment Application is submitted to our office.

We have no further comments to offer, at this time. However, please provide our department with a copy of the Draft Environmental Assessment for our review and comment.

If you have any questions or if you need further assistance, please feel free to contact Bethany Morrison of this office at 961-8138.

Sincerely,

for BJ LEITHEAD TODD
Planning Director

BJM:cs
P:\wpwin60\Bethany\EA-EIS Review\preconsultdraftea Stream Bank Bluff Protection Riverside Apartments.doc

cc: Ms. Delene K. Osorio, Executive Director
BIHF Riverside Community Based Nonprofit Corp.
688 Kinoole #212
Hilo, HI 96720

William P. Kenoi
Mayor

Harry S. Kubojiri
Police Chief

Paul K. Ferreira
Deputy Police Chief

County of Hawai'i
POLICE DEPARTMENT
349 Kapiolani Street • Hilo, Hawai'i 96720-3998
(808) 935-3311 • Fax (808) 961-8865

November 8, 2012

RECEIVED NOV 14 2012

Mr. Glenn T. Kimura, President
Kimura International, Inc.
1600 Kapiolani Blvd., Suite 1610
Honolulu, HI 96814

Dear Mr. Kimura:

Subject: Environmental Assessment-Early Consultation, Stream Bank Bluff Protection & Stabilization Second Slope Scarp at the Riverside Apartments, Hilo, Hawaii; TMK: 2-6-003:009

Staff, upon reviewing the provided documents and visiting the proposed site, does not anticipate any significant impact to traffic and/or public safety concerns.

Thank you for allowing us the opportunity to comment.

If you have any questions, please contact Captain Robert Wagner of our S. Hilo Patrol Division at 961-2214.

Sincerely,

HENRY J. TAVARES, JR.
ASSISTANT POLICE CHIEF
AREA I OPERATIONS BUREAU

RW:lli
120641

DEPARTMENT OF WATER SUPPLY • COUNTY OF HAWAI'I
345 KEKŪANAŌ'A STREET, SUITE 20 • HILO, HAWAI'I 96720
TELEPHONE (808) 961-8050 • FAX (808) 961-8657

November 15, 2012

RECEIVED NOV 17 2012

Mr. Glenn T. Kimura
Kimura International, Inc.
1600 Kapiolani Boulevard, Suite 1610
Honolulu, HI 96814

PRE-ENVIRONMENTAL ASSESSMENT CONSULTATION
STREAM BANK BLUFF PROTECTION AND STABILIZATION
SECOND SLOPE SCARP AT THE RIVERSIDE APARTMENTS
TAX MAP KEY 2-6-003:009

This is in response to your letter dated October 19, 2012.

Please be informed that there are no Department of Water Supply facilities within the proposed project area. Water for construction can be made available from a fire hydrant fronting the subject parcel on Ohai Street.

Should there be any questions, please contact Mr. Ryan Quitoriano of our Water Resources and Planning Branch at 961-8070, extension 256.

Sincerely yours,

Quirino Antonio, Jr., P.E.
Manager-Chief Engineer

RQ:sco

Comments Received During Draft EA Comment Period

NEIL ABERCROMBIE
GOVERNOR
STATE OF HAWAII

JOBIE M. K. MASAGATANI
CHAIRMAN
HAWAIIAN HOMES COMMISSION

STATE OF HAWAII
DEPARTMENT OF HAWAIIAN HOME LANDS
P. O. BOX 1879
HONOLULU, HAWAII 96805

RECEIVED APR 04 2013

March 21, 2013

Ms. Leslie Kurisaki
Kimura International, Inc.
1600 Kapi'olani Blvd, Suite 1610
Honolulu, Hawai'i 96814

Dear Ms. Kurisaki:

Subject: Draft Environmental Assessment Riverside Apartments Improvements: Stream Bank Bluff Protection and Stabilization, Second Slope Scarp and Interior Renovations

Thank you for the opportunity to review the subject Draft Environmental Assessment. The Department of Hawaiian Home Lands has no comment to offer at this time.

If you have any questions, please contact our Planning Office at 620-9480.

Aloha,

Darrell C. Yagodich,
Planning Program Manager

KIMURA INTERNATIONAL INC.

April 8, 2013

Mr. Darrell C. Yagodich, Planning Program Manager
State of Hawaii
Department of Hawaiian Home Lands
P.O. Box 1879
Honolulu, HI 96805

Dear Mr. Yagodich:

Subject: Draft Environmental Assessment
Riverside Apartments Improvements: Stream Bank Bluff Protection and Stabilization, Second Slope Scarp, and Interior Renovations, TMK (3) 2-6-003:009, Hilo, Hawaii

Thank you for your comment letter dated March 21, 2013, indicating that the Department of Hawaiian Home Lands has no comments to offer at this time.

If you have future comments or questions, please feel free to call Leslie Kurisaki at (808) 944-8848, x2213.

Sincerely,

KIMURA INTERNATIONAL, Inc.

Glenn T. Kimura, President

1600 Kapiolani Blvd., Suite 1610
Honolulu, HI 96814
Tel: 808 944-8848 ● Fax: 808 941-8999

NEIL ABERCROMBIE
GOVERNOR OF HAWAII

Received
MAR 14 2013
By

STATE OF HAWAII
DEPARTMENT OF HEALTH
P. O. BOX 3378
HONOLULU, HI 96801-3378

LORETTA J. FUDDY, A.C.S.W., M.P.H.
DIRECTOR OF HEALTH

In reply, please refer to:
File:

13-054
Riverside Apts.

March 8, 2013

Mr. Thomas G. Fischer
UHC 00382 Hilo, L.P. a Hawaii Limited Partnership
2000 E. Fourth Street, Suite 205
Santa Ana, CA 92705

Dear Mr. Fischer:

SUBJECT: Riverside Apartments Improvements: Stream Bank Bluff Protection and Stabilization, Second Slope Scarp and Interior Renovations

The Department of Health (DOH), Environmental Planning Office (EPO), acknowledges receipt of your letter dated March 5, 2013. Thank you for allowing us to review and comment on the subject document. Your document was routed to the Clean Water and Indoor & Radiological Branches. They will provide specific comments to you if necessary. EPO recommends that you review the Standard Comments (www.hawaii.gov/health/epo under the land use tab). You are required to adhere to all Standard Comments specifically applicable to this application.

EPO suggests that you examine the many sources available on strategies to support the sustainable design of communities, including the:
U.S. Environmental Protection Agency's sustainability programs: www.epa.gov/sustainability
U.S. Green Building Council's LEED program: www.new.usgbc.org/leed

The DOH encourages everyone to apply these sustainability strategies and principles early in the planning and review of projects. We also request that for future projects you consider conducting a Health Impact Assessment (HIA). More information is available at www.cdc.gov/healthyplaces/hia.htm. We request you share all of this information with others to increase community awareness on sustainable, innovative, inspirational, and healthy community design.

We request a written response confirming receipt of this letter and any other letters you receive from DOH in regards to this submission. You may mail your response to 919 Ala Moana Blvd., Ste. 312, Honolulu, Hawaii 96814. However, we would prefer an email submission to epo@doh.hawaii.gov. We anticipate that our letter(s) and your response(s) will be included in the final document. If you have any questions, please contact me at (808) 586-4337.

Mahalo,

Laura Leialoha Phillips McIntyre, AICP
Manager, Environmental Planning Office

c: Ms. Leslie Kurisaki

KIMURA INTERNATIONAL INC.

April 10, 2013

Ms. Laura Leialoha Phillips McIntyre
Manager, Environmental Planning Office
State of Hawaii
Department of Health
P.O. Box 3378
Honolulu, HI 96801-3378

Dear Ms. Phillips McIntyre,

Subject: Draft Environmental Assessment
Riverside Apartments Improvements: Stream Bank Bluff Protection and Stabilization, Second Slope Scarp, and Interior Renovations, TMK (3) 2-6-003:009, Hilo, Hawaii

Thank you for your comment letter dated March 8, 2013. The project will comply with all applicable Standard Comments, and sustainability strategies and principles wherever possible.

If you have future comments or questions, please feel free to call Leslie Kurisaki at (808) 944-8848, x2213.

Sincerely,

KIMURA INTERNATIONAL, Inc.

Glenn T. Kimura, President

1600 Kapiolani Blvd., Suite 1610
Honolulu, HI 96814
Tel: 808 944-8848 ● Fax: 808 941-8999

NEIL ABERCROMBIE
GOVERNOR OF HAWAII

LORETTA J. FUDDY, A.C.S.W., M.P.H.
DIRECTOR OF HEALTH

STATE OF HAWAII
DEPARTMENT OF HEALTH
P. O. BOX 3378
HONOLULU, HI 96801-3378

In reply, please refer to:
EMD/CWB

03095PST.13

March 27, 2013

RECEIVED
APR 0 3 2013

Mr. Thomas G. Fischer
UHC 00382 Hilo, L.P. a Hawaii Limited Partnership
2000 E. Fourth Street, Suite 205
Santa Ana, CA 92705

Dear Mr. Fischer:

SUBJECT: Comments on the Draft Environmental Assessment for the Riverside Apartments Improvements: Stream Bank Bluff Protection and Stabilization, Second Slope Scarp and Interior Renovations South Hilo, Island of Hawaii, Hawaii

The Department of Health (DOH), Clean Water Branch (CWB), acknowledges receipt of your letter, dated March 5, 2013, requesting comments on your project. The DOH-CWB has reviewed the subject document and offers these comments. Please note that our review is based solely on the information provided in the subject document and its compliance with the Hawaii Administrative Rules (HAR), Chapters 11-54 and 11-55. You may be responsible for fulfilling additional requirements related to our program. We recommend that you also read our standard comments on our website at: http://www.hawaii.gov/health/environmental/env-planning/landuse/CWB-standardcomment.pdf.

1. Any project and its potential impacts to State waters must meet the following criteria:

   a. Antidegradation policy (HAR, Section 11-54-1.1), which requires that the existing uses and the level of water quality necessary to protect the existing uses of the receiving State water be maintained and protected.

   b. Designated uses (HAR, Section 11-54-3), as determined by the classification of the receiving State waters.

   c. Water quality criteria (HAR, Sections 11-54-4 through 11-54-8).

2. You may be required to obtain a National Pollutant Discharge Elimination System (NPDES) permit for discharges of wastewater, including storm water runoff, into State surface waters (HAR, Chapter 11-55). An application for an NPDES individual permit must be submitted at least 180 calendar days before the commencement of the discharge. To request NPDES permit coverage, you must submit the CWB Individual NPDES Form through the e-Permitting Portal and the hard copy

certification statement with $1,000 filing fee. Please open the e-Permitting Portal website at: https://eha-cloud.doh.hawaii.gov/epermit/View/home.aspx. You will be asked to do a one-time registration to obtain your login and password. After you register, click on the Application Finder tool and locate the "CWB Individual NPDES Form." Follow the instructions to complete and submit this form.

3. If your project involves work in, over, or under waters of the United States, it is highly recommend that you contact the Army Corp of Engineers, Regulatory Branch (Tel: 438-9258) regarding their permitting requirements.

   Pursuant to Federal Water Pollution Control Act [commonly known as the "Clean Water Act" (CWA)], Paragraph 401(a)(1), a Section 401 Water Quality Certification (WQC) is required for "[a]ny applicant for Federal license or permit to conduct any activity including, but not limited to, the construction or operation of facilities, which may **result** in any discharge into the navigable waters..." (emphasis added). The term "discharge" is defined in CWA, Subsections 502(16), 502(12), and 502(6); Title 40 of the Code of Federal Regulations, Section 122.2; and Hawaii Administrative Rules (HAR), Chapter 11-54.

4. Please note that all discharges related to the project construction or operation activities, whether or not NPDES permit coverage and/or Section 401 WQC are required, must comply with the State's Water Quality Standards. Noncompliance with water quality requirements contained in HAR, Chapter 11-54, and/or permitting requirements, specified in HAR, Chapter 11-55, may be subject to penalties of $25,000 per day per violation.

If you have any questions, please visit our website at: http://www.hawaii.gov/health/environmental/water/cleanwater/index.html, or contact the Engineering Section, CWB, at (808) 586-4309.

Sincerely,

Alec Wong

ALEC WONG, P.E., CHIEF
Clean Water Branch

ST:rh

c: DOH-EPO #13-054 [via email only]
Ms. Leslie Kurisaki, Kimura International, Inc.

KIMURA INTERNATIONAL INC.

April 10, 2013

Mr. Alec Wong, P.E., Chief
Clean Water Branch
State of Hawaii
Department of Health
P.O. Box 3378
Honolulu, HI 96801-3378

Dear Mr. Wong:

Subject: Draft Environmental Assessment
Riverside Apartments Improvements: Stream Bank Bluff Protection and Stabilization, Second Slope Scarp, and Interior Renovations, TMK (3) 2-6-003:009, Hilo, Hawaii

Thank you for your comment letter dated March 27, 2013. We offer the following responses:

1. The project will meet DOH criteria related to impacts to State waters (anti-degradation, designated uses, water quality).

2. A National Pollutant Discharge Elimination System (NPDES) permit for discharges of wastewater effluent is not applicable to this project. An NPDES for discharges composed of storm water runoff associated with construction activities (clearing, grubbing) is not required for this project since the disturbance area is less than one (1) acre.

3. The Army Corps of Engineers have issued a No Permit Required letter dated November 16, 2012. All project improvements will occur landward of the Mean High Water Mark of Wailuku Stream. The letter is included in Chapter 7 of the Final EA.

4. All discharges related to construction or project operation will comply with State Water Quality Standards. A copy of your letter will be provided to the design and construction teams for both the stream bank stabilization work and the building interior renovation.

If you have further comments or questions, please feel free to call Leslie Kurisaki at (808) 944-8848, x2213.

Sincerely,

KIMURA INTERNATIONAL, Inc.

Glenn T. Kimura, President

1600 Kapiolani Blvd., Suite 1610
Honolulu, HI 96814
Tel: 808 944-8848 ● Fax: 808 941-8999

NEIL ABERCROMBIE
GOVERNOR OF HAWAII

LORETTA J. FUDDY, A.C.S.W., M.P.H.
DIRECTOR OF HEALTH

STATE OF HAWAII
DEPARTMENT OF HEALTH
P. O. BOX 3378
HONOLULU, HI 96801-3378

In reply, please refer to:
File:

April 4, 2013

RECEIVED APR 09 2013

Mr. Thomas G. Fischer
UHC 00382 Hilo, L.P. a Hawaii Limited Partnership
2000 E. Fourth Street, Suite 205
Santa Ana, CA 92705

Dear Mr. Fischer:

This correspondence is in response to your request for comments to the Draft Environmental Assessment (DEA) for Riverside Apartments Improvements: Stream Bank Bluff Protection and Stabilization, Second Slope Scarp and Interior Renovations, South Hilo District, Island of Hawaii.

Project activities shall comply with the following Administrative Rules of the Department of Health:

- Chapter 11-41 Lead-Based Paint Activities
- Chapter 11-501 Asbestos Requirements
- Chapter 11-503 Fees for Asbestos Removal & Certification
- Chapter 11-504 Asbestos Abatement Certification Program

Should you have any questions, please contact me at (808) 586-4701.

Sincerely,

Jeffrey M. Eckerd
Program Manager
Indoor and Radiological Health Branch

C: Leslie Kurisaki, Kimura International, Inc.

KIMURA INTERNATIONAL INC.

April 10, 2013

Mr. Jeffrey M. Eckerd, Program Manager
Indoor and Radiological Health Branch
State of Hawaii
Department of Health
P.O. Box 3378
Honolulu, HI 96801-3378

Dear Mr. Eckerd,

Subject: Draft Environmental Assessment
Riverside Apartments Improvements: Stream Bank Bluff Protection and Stabilization, Second Slope Scarp, and Interior Renovations, TMK (3) 2-6-003:009, Hilo, Hawaii

Thank you for your comment letter dated April 4, 2013. The project will comply with the DOH Administrative Rules you have cited, pertaining to Lead-Based Paint and Asbestos.

If you have future comments or questions, please feel free to call Leslie Kurisaki at (808) 944-8848, x2213.

Sincerely,

KIMURA INTERNATIONAL, Inc.

Glenn T. Kimura, President

1600 Kapiolani Blvd., Suite 1610
Honolulu, HI 96814
Tel: 808 944-8848 ● Fax: 808 941-8999

NEIL ABERCROMBIE
GOVERNOR OF HAWAII

WILLIAM J. AILA, JR.
CHAIRPERSON

WILLIAM D. BALFOUR, JR.
SUMNER ERDMAN
LORETTA J. FUDDY, A.C.S.W., M.P.H.
NEAL S. FUJIWARA
JONATHAN STARR
TED YAMAMURA

WILLIAM M. TAM
DEPUTY DIRECTOR

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT
P.O. BOX 621
HONOLULU, HAWAII 96809

RECEIVED MAR 21 2013

March 19, 2013

Ref.: RFD.3477.8

Mr. Thomas G. Fischer
UHC 00382 Hilo, L.P. a Hawaii Limited Partnership
2000 E. Fourth Street, Suite 205
Santa Ana, CA 92705

Dear Mr. Thomas Fischer:

Request for Determination
Riverside Apartment Improvements, Island of Hawaii, TMK: Various 3-2-6-003:009

We are responding to your March 7, 2013 letter, regarding a request for determination concerning riverside apartment improvements that include stream bank protection and stabilization, second slope scarp and interior renovations.

The Commission on Water Resource Management (Commission), Stream Protection and Management Branch, has the responsibility to protect stream channels from alteration whenever practicable to provide for fishery, wildlife, recreational, aesthetic, scenic, and other beneficial instream uses in the State of Hawaii under the authorization of the State Water Code (Code), Hawaii Revised Statutes (HRS) Chapter 174C, and Hawaii Administrative Rules (HAR) Chapter 13-169 (Protection of Instream Uses of Water).

Pursuant to the Code, §174C-71(3)(A), the Commission "shall require persons to obtain a permit from the Commission prior to undertaking a stream channel alteration." The term "stream channel" is defined in the Code, §174C-3, as a "watercourse with a definite bed and banks which periodically or continuously contains flowing water." Furthermore, the Code defines "stream" as any "natural watercourse in which water usually flows in a defined bed or channel."

Based on the information that you provided, the Commission requires a Stream Channel Alteration Permit (SCAP) Application to be submitted for the proposed project. Stream bank stabilization and protection work associated with riverside apartment improvements will impact Wailuku River stream bank. Work performed without appropriate permits or authorizations may be subject to fines and/or remedial actions.

Please be advised that the project may require other agency approvals regarding wetlands, water quality, grading, stockpiling, and floodways. This letter should not be used for other regulatory jurisdictions or used to imply compliance with other federal, state, or county rules.

Enclosed is a Stream Channel Alteration Permit Application Form. Additional forms may be picked up at our office or downloaded from our website at: http://www.hawaii.gov/dlnr/cwrm/forms.htm

Should you have any questions, please contact Denise Tu of the Stream Protection and Management Branch at (808)587-0234.

Very truly yours,

WILLIAM M. TAM
Deputy Director

DST:ky

c: Ms. Leslie Kurisaki

KIMURA INTERNATIONAL INC.

April 10, 2013

Mr. William M. Tam, Deputy Director
Commission on Water Resource Management
Department of Land and Natural Resources
State of Hawaii
P.O. Box 621
Honolulu, HI 96809

Dear Mr. Tam:

Subject: Request for Determination, RFD.3477.8
Riverside Apartments Improvements: Stream Bank Bluff Protection and Stabilization, Second Slope Scarp, and Interior Renovations, TMK (3) 2-6-003:009, Hilo, Hawaii

Thank you for your letter dated March 19, 2013, which determined that a Stream Channel Alteration Permit is required for the proposed project. We have been in contact with Mr. Dean Uyeno of your staff, and a permit application will be submitted shortly.

If you have additional comments or questions, please feel free to call Leslie Kurisaki at 944-8848, x2213.

Sincerely,

KIMURA INTERNATIONAL, Inc.

Glenn T. Kimura, President

1600 Kapiolani Blvd., Suite 1610
Honolulu, HI 96814
Tel: 808 944-8848 ● Fax: 808 941-8999

NEIL ABERCROMBIE
GOVERNOR OF HAWAII

WILLIAM J. AILA, JR.
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

ESTHER KIA'AINA
FIRST DEPUTY

WILLIAM M. TAM
DEPUTY DIRECTOR - WATER

AQUATIC RESOURCES
BOATING AND OCEAN RECREATION
BUREAU OF CONVEYANCES
COMMISSION ON WATER RESOURCE MANAGEMENT
CONSERVATION AND COASTAL LANDS
CONSERVATION AND RESOURCES ENFORCEMENT
ENGINEERING
FORESTRY AND WILDLIFE
HISTORIC PRESERVATION
KAHOOLAWE ISLAND RESERVE COMMISSION
LAND
STATE PARKS

HISTORIC PRESERVATION DIVISION
DEPARTMENT OF LAND AND NATURAL RESOURCES

601 Kamokila Boulevard, Suite 555
Kapolei, HI 96806

March 28, 2013

Mr. Glenn T. Kimura
Kimura International, Inc.
1600 Kapiolani Blvd. Suite 1610
Honolulu, Hawai`i 96814
Attn. Leslie Kurisaki

LOG NO: 2013.2189
DOC NO: 1303SN15
Archaeology

RECEIVED APR 13 2013

Dear Mr. Kimura:

SUBJECT: **Chapter 6E-42 Historic Preservation Review –**
Draft Environmental Assessment for Riverside Apartments Improvements: Stream Bank Protection and Stabilization, Second Slope Scarp and Interior Renovations
Pu'u'eo Ahupua'a, South Hilo District, Island of Hawai'i
TMK: (3) 2-6-003:009

Thank you for the opportunity to provide comments for the draft environmental assessment. We received your submittal March 7, 2013. The proposed project will stabilize the slope along the stream bank to support building footings nearest the stream bank and include interior renovations of the existing building. Both the building renovations and stream bank stabilization are considered a "single action" of an overall improvement effort subject to Chapter 343 HRS. The Riverside Apartment Complex was built in 1973; the inerior renovations are therefore not subject to historic preservation review at this time. According to your letter, a 3,320 sq. ft. area will be stabilized along the stream bank to support the building footings nearest the stream bank. The project plans to install a series of micopiles and to construct a series of soil anchors in the stream bank slope with a 8-10 inch layer of reinforced shotcrete (gunite) to facilitate the stabilization of the stream bank slope face.

The the lower reaches of the Wailuku Stream is within an area that was an important political center and was densely populated prior to and following western contact. Although the aforementioned project area has been impacted by modern development, previous surface disturbance may not have fully destroyed the subsurface remains of archaeological and natural history deposits or human skeletal remains that could potentially be preserved in subsurface deposits within this project area. Our office reviewed a draft report titled *Draft Archaeological Field Inspection and Literature Review for the Stream Bank Bluff Protection and Stabilization, Second Slope Scarp at the Riverside Apartments, Pu'u'eo Ahupua'a, South Hilo District, Island of Hawai'i TMK: (3) 2-6-003:009* (C. O'Hara, D. Shideler, and H. Hammatt 2012) and requested subsurface testing to address concerns that unidentified subsurface deposits might be present (letter dated December 17, 2012, *Log 2012.3284, Doc. 1212SN07*). Additional fieldwork was conducted within the project area and a revised report was approved by our office in a letter dated February 4, 2013 (*Log 2013.0555, Doc. 1302SN01*). No evidence of subsurface deposits or features was identified.

Based on current information, we believe that **no historic properties will be affected**. However, we would like to be informed in the event that historic resources, including human skeletal remains, structural remains, sand deposits, midden doposis, or lava tubes are identified during construction activities. If any of these are identified, please cease work in the immediate vicinity, protect the find from additional disturbance, and contact the State Historic Preservation Division at (808 933-7651. Please contact Sean Nāleimaile at (808) 933-7651 or Sean.P.Naleimaile@Hawaii.gov if you have any questions or concerns regarding this letter.

Aloha,

Theresa K. Donham
Archaeology Branch Chief

KIMURA INTERNATIONAL INC.

April 15, 2013

Ms. Theresa Donham, Archaeology Branch Chief
Historic Preservation Division
Department of Land and Natural Resources
601 Kamokila Boulevard, Suite 555
Kapolei, HI 96806

Dear Ms. Donham:

Subject: Chapter 6E-42 Historic Preservation Review—Draft Environmental Assessment Riverside Apartments Improvements: Stream Bank Bluff Protection and Stabilization, Second Slope Scarp, and Interior Renovations, TMK (3) 2-6-003:009, Hilo, Hawaii

Thank you for your letter dated March 28, 2013 (LOG NO: 2013.2189, DOC NO: 1303SN15) providing comment on the draft Environmental Assessment and indicating that based on current information, SHPD believes that no historic properties will be affected.

Your office will be informed in the event that historic resources, including human skeletal remains, structural remains, sand deposits, midden deposits or lava tubes are identified during construction activities.

If you have additional comments or questions, please feel free to call Leslie Kurisaki at (808) 944-8848, x2213.

Sincerely,

KIMURA INTERNATIONAL, Inc.

Glenn T. Kimura, President

1600 Kapiolani Blvd., Suite 1610
Honolulu, HI 96814
Tel: 808 944-8848 ● Fax: 808 941-8999

OFFICE OF PLANNING
STATE OF HAWAII

235 South Beretania Street, 6th Floor, Honolulu, Hawaii 96813
Mailing Address: P.O. Box 2359, Honolulu, Hawaii 96804

NEIL ABERCROMBIE
GOVERNOR

JESSE K. SOUKI
DIRECTOR
OFFICE OF PLANNING

Telephone: (808) 587-2846
Fax: (808) 587-2824
Web: http://hawaii.gov/dbedt/op/

Ref. No. P-13921

March 18, 2013

RECEIVED MAR 20 2013

Mr. Thomas G. Fischer
UHC 00382 Hilo, L.P., a Hawaii Limited Partnership
2000 E. Fourth Street, Suite 205
Santa Ana, California 92705

Dear Mr. Fischer:

Subject: Draft Environmental Assessment for Riverside Apartments Improvements: Stream Bank Bluff Protection and Stabilization, Second Slope Scarp, and Interior Renovations, Tax Map Key: (3)2-6-003:009, Hilo, Hawaii

Thank you for the opportunity to provide comments on the Draft Environmental Assessment (Draft EA) for the Riverside Apartments Improvements: stream bank bluff protection and stabilization, second slope scarp, and interior renovations.

The Office of Planning has reviewed the subject Draft EA and has the following comments to offer:

1. On page 1-8, the Draft EA states that "[t]he proposed improvements will be similar to what was done for the 2011 emergency stabilization at the Third Level." On page 4-5, the project proponents are seeking a special management area (SMA) emergency permit from the County of Hawaii for the embankment protection and stabilization. The Final EA should provide a detailed comparison between the 2011 emergency stabilization and the proposed stream bank bluff protection and stabilization, with an assessment about their similarities.

2. On page 2-2, the Draft EA states that "the federal Department of Housing and Urban Development (HUD) has required the project owners to complete the slope stabilization or lose all federal operating subsidies." The Final EA should correct the contradictory statement, page 4-5, that "If the stream bank bluff protection and stabilization is implemented, the federal Department of Housing and Urban Development will not continue to provide housing subsidies."

3. The project area is located within the County of Hawaii's SMA. The Final EA should replace "as shown in Figure 7" on page 4-2, with "as shown in Figure 9." In the Draft EA, Figure 7 is entitled "Soils Map" while Figure 9 is "State Land Use and SMA."

4. Section 3.2.9 Visual Impact, on page 3-20, and Section 3.3.1 Botanical Resources, on page 3-22, state that the bank protection and stabilization work will modify the visual environment, and the existing landscaping next to the building will be removed. The Final EA should provide a landscaping plan with mitigation measures about how landscaping behind the building will be reestablished when the project improvements are complete.

5. Pursuant to Hawaii Revised Statutes (HRS) §§205A-22 and 205A-23, and Rule 9, Special Management Area, County of Hawaii Planning Commission Rules of Practice and Procedure, the County of Hawaii Planning Commission is the authority to designate the county special management areas. The Final EA should correct the statement on page 4-6 that special management areas were designated by the Hawaii County Council under the provisions of HRS Chapter 205A.

In the future, in order to ensure a timely response from the Office of Planning, please address your letter requests to the Director of the Office of Planning. The Office of Planning is a semi-autonomous agency that reports directly to the Governor. It is attached to the Department of Business, Economic Development & Tourism for administrative purposes.

If you have any questions regarding this comment letter, please contact Leo Asuncion, Coastal Zone Management Program Manager, at (808) 587-2875.

Sincerely,

Jesse K. Souki
Director

c: Ms. Leslie Kurisaki, Kimura International, Inc.

KIMURA INTERNATIONAL INC.

April 8, 2013

Mr. Jesse K. Souki, Director
Office of Planning
State of Hawaii
P.O. Box 2359
Honolulu, HI 96804

Dear Mr. Souki:

Subject: Draft Environmental Assessment
Riverside Apartments Improvements: Stream Bank Bluff Protection and Stabilization, Second Slope Scarp, and Interior Renovations, TMK (3) 2-6-003:009, Hilo, Hawaii

Thank you for your comment letter dated March 18, 2013. We provide the following responses to your comments:

1. The Final EA (Chapter 2, Alternatives) will include a comparison between the 2011 emergency stabilization and the proposed project, including the following points:

- Both projects involve installation of small diameter soil nails drilled and installed into the slope face to reinforce/improve stability of the slope. Installation of large diameter caissons or piles was deemed less feasible due to the need for relatively heavier equipment compared to the smaller and lighter equipment that can be used for soil nail installation.
- Both projects involve the use of reinforced shotcrete connected to the soil nails to protect and stabilize the slope face.
- Both projects involve installation of micropiles at the top of the stream bank.
- Both projects are located at the two areas of the property where the building is in closest proximity to the edge of the bank.
- Most of the physical difference in scope between the current project and the 2011 project are related to the different subsurface geotechnical conditions at the two areas. For example, depths and locations of bedrock at the Third level and Second Level terraces differ. The unique subsurface conditions affect the placement and depth of soil nails and micropiles and extent of shotcrete slope protection.
- The 2011 project did not involve use of public funds, and as such, an Environmental Assessment in accordance with Chapter 343 HRS was not required.

1600 Kapiolani Blvd., Suite 1610
Honolulu, HI 96814
Tel: 808 944-8848 ● Fax: 808 941-8999

2. The statement on page 4-5 will be corrected to state that "If the stream bank bluff protection and stabilization is not implemented, the federal Department of Housing and Urban Development will not continue to provide housing subsidies."

3. Reference to Figure 9 will be revised as noted.

4. No landscaping is included as part of the proposed project. The intent of the project is to stabilize the stream bank slope by covering it with reinforced shotcrete. The flat terrace behind the building will be protected with concrete to reduce the potential for slope saturation caused by water infiltration from the top of the bank. These improvements were recommended by the geotechnical study.

The installation of new landscaping in this area could be counter productive to the stabilization efforts. For example, large trees growing on a slope can contribute destabilizing forces due to their weight and the force of wind against the trees. Tree roots can loosen soil and rock-joints, or crack the shotcrete, reducing its effectiveness. . Decaying roots of dead/dying trees can leave voids and cavities in the ground.

In addition, the existing heavy vegetation behind the building is a breeding ground for mosquitoes, causing an ongoing maintenance problem and a nuisance to residents. Reducing the vegetation in this area will allow for better air circulation and mosquito control.

We are aware that there are concerns about the visual appearance of the stabilized area. Earth-toned pigment will be added to the shotcrete covering the slope to blend in with the surrounding rock. Eventually, vegetation from the surrounding areas will visually soften the stark edges of the shotcrete, providing a more natural appearance.

5. Statement will be corrected as noted.

If you have additional comments or questions, please feel free to call Leslie Kurisaki at 944-8848, x2213.

Sincerely,

KIMURA INTERNATIONAL, Inc.

Glenn T. Kimura, President

NEIL ABERCROMBIE
GOVERNOR

STATE OF HAWAII
DEPARTMENT OF PUBLIC SAFETY
919 Ala Moana Boulevard, 4th Floor
Honolulu, Hawaii 96814

TED SAKAI
DIRECTOR

Martha Torney
Deputy Director
Administration

Max Otani
Deputy Director
Corrections

Keith Kamita
Deputy Director
Law Enforcement

No. 2013-418

March 14, 2013

RECEIVED MAR 19 2013

Glenn T. Kimura, President
Kimura International, Inc.
1600 Kapi'olani Blvd., Suite 1610
Honolulu, Hawaii 96814

Dear Mr. Kimura:

Subject: TMK: Various (3) 2-6-003:009
South Hilo District, Island of Hawaii
Stream Bank Bluff Protection & Stabilization
Second Slope Scarp & Interior Renovations

Thank you for providing a copy of your Draft Environmental Assessment (DEA) for the abovementioned project. The Department of Public Safety has reviewed the DEA and has no comments at this time.

Sincerely,

Ted Sakai
Director

KIMURA INTERNATIONAL INC.

April 10, 2013

Mr. Ted Sakai, Director
State of Hawaii
Department of Public Safety
919 Ala Moana Boulevard, 4th Floor
Honolulu, HI 96814

Dear Mr. Sakai:

Subject: Draft Environmental Assessment
Riverside Apartments Improvements: Stream Bank Bluff Protection and Stabilization, Second Slope Scarp, and Interior Renovations, TMK (3) 2-6-003:009, Hilo, Hawaii

Thank you for your comment letter dated March 14, 2013, indicating that the Department of Public Safety has no comments to offer at this time.

If you have future comments or questions, please feel free to call Leslie Kurisaki at (808) 944-8848, x2213.

Sincerely,

KIMURA INTERNATIONAL, Inc.

Glenn T. Kimura, President

1600 Kapiolani Blvd., Suite 1610
Honolulu, HI 96814
Tel: 808 944-8848 ● Fax: 808 941-8999

NEIL ABERCROMBIE
GOVERNOR

GLENN M. OKIMOTO
DIRECTOR

Deputy Directors
JADE T. BUTAY
FORD N. FUCHIGAMI
RANDY GRUNE
JADINE URASAKI

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
869 PUNCHBOWL STREET
HONOLULU, HAWAII 96813-5097

IN REPLY REFER TO:
STP 8.1156

March 28, 2013

RECEIVED APR 0 6 2013

Mr. Thomas G. Fischer
UHC 00382 Hilo, L.P. a Hawaii Limited Partnership
2000 East Fourth Street, Suite 205
Santa Ana, California 92705

Dear Mr. Fischer:

Subject: Riverside Apartments Stream Bank Bluff Protection and Stabilization Second Slope Scarp
Draft Environmental Assessment (DEA)
TMK: 2-6-003:009

The State Department of Transportation (DOT) previously commented on the DEA for the subject project in its letter STP 8.1037 dated November 14, 2012 (see Section 7.2 of the DEA).

Given the location and the nature of the project, DOT does not anticipate any significant adverse impacts to the State transportation facilities.

DOT appreciates the opportunity to provide comments. If there are any other questions, please contact Mr. Garrett Smith of the DOT Statewide Transportation Planning Office at telephone number (808) 831-7976.

Very truly yours,

GLENN M. OKIMOTO, Ph.D.
Director of Transportation

c: Leslie Kurisaki, Kimura International, Inc.

KIMURA INTERNATIONAL INC.

April 10, 2013

Dr. Glenn M. Okimoto, Ph.D., Director of Transportation
State of Hawaii
Department of Transportation
869 Punchbowl Street
Honolulu, HI 96813-5097

Dear Dr. Okimoto:

Subject: Draft Environmental Assessment
Riverside Apartments Improvements: Stream Bank Bluff Protection and Stabilization, Second Slope Scarp, and Interior Renovations, TMK (3) 2-6-003:009, Hilo, Hawaii

Thank you for your comment letter dated March 28 referencing your previous comments dated November 14, 2012. We note that DOT does not anticipate any significant adverse impacts to State transportation facilities.

If you have additional comments or questions, please feel free to call Leslie Kurisaki at (808) 944-8848, x2213.

Sincerely,

KIMURA INTERNATIONAL, Inc.

Glenn T. Kimura, President

1600 Kapiolani Blvd., Suite 1610
Honolulu, HI 96814
Tel: 808 944-8848 ● Fax: 808 941-8999

Water Resources Research Center
Environmental Center

UNIVERSITY of HAWAI'I
MĀNOA

April 5, 2013
NC- EA- 2013-03-08-01

Mr. Thomas G. Fisher
UHC 00882 Hilo, L.P.
2000 E. Fourth Street, Suite 205
Santa Ana, CA 92705
VIA FAX TO: (714) 835-3275

Ms. Leslie Kurisaki
1600 Kapiolani Blvd., Suite 1610
Honolulu, HI 96814
VIA FAX TO : (808) 941-8999

Dear Mr. Fisher and Ms. Kurisaki,

Draft Environmental Assessment
Riverside Apartments Improvements: Stream Bank Bluff Protection and Stabilization, Second Slope Scarp and Interior Renovations
Hilo, Hawaii

Thank you for your letter dated March 5, 2013 requesting the Environmental Center to comment on the Draft Environmental Assessment for the proposed Riverside Apartments Improvements project in Hilo, Hawaii. We will not comment at this time due to resource constraints; however we look forward to reading the Final Environmental Assessment and using it to support our review of future permit applications for stream channel alterations.

Sincerely,

David Penn
Assistant Specialist

copy: Sara Bolduc, Environmental Center

2500 Dole Street, Krauss Annex 19 Honolulu, Hawai'i 96822
Telephone: (808) 956-7361 Fax: (808) 956-3980
An Equal Opportunity/Affirmative Action Institution

KIMURA INTERNATIONAL INC.

April 10, 2013

Mr. David Penn, Assistant Specialist
University of Hawaii at Manoa
Water Resources Research Center
Environmental Center
2500 Dole Street, Krauss Annex 19
Honolulu, HI 96822

Dear Mr. Penn:

Subject: NC-EA-2013-03-08-01
Draft Environmental Assessment
Riverside Apartments Improvements: Stream Bank Bluff Protection and Stabilization, Second Slope Scarp, and Interior Renovations, TMK (3) 2-6-003:009, Hilo, Hawaii

Thank you for your comment letter dated April 5, 2013, indicating that the Environmental Center will not comment at this time due to resource constraints.

If you have future comments or questions, please feel free to call Leslie Kurisaki at (808) 944-8848, x2213.

Sincerely,

KIMURA INTERNATIONAL, Inc.

Glenn T. Kimura, President

1600 Kapiolani Blvd., Suite 1610
Honolulu, HI 96814
Tel: 808 944-8848 ● Fax: 808 941-8999

William P. Kenoi
Mayor

Dora Beck, P.E.
Acting Director

County of Hawai'i
DEPARTMENT OF ENVIRONMENTAL MANAGEMENT
25 Aupuni Street • Hilo, Hawai'i 96720
(808) 961-8083 · Fax (808) 961-8086
http://co.hawaii.hi.us/directory/dir_envmng.htm

RECEIVED MAR 16 2013

March 12, 2013

Mr. Glenn T. Kimura
President
Kimura International Inc.
1600 Kapi'olani Blvd, Suite 1610
Honolulu, HI 96814

RE: Riverside Apartments Improvements: Stream Bank Bluff Protection and Stabilization
Second Slope Scarp and Interior Renovations
Hilo, HI
TMK: 2-6-003:009

Dear Mr. Kimura,

We have no further comments to offer on the subject project.

Thank you for allowing us to review and comment.

Sincerely,

Dora Beck

Dora Beck, P.E.
ACTING DIRECTOR

KIMURA INTERNATIONAL INC.

April 10, 2013

Ms. Dora Beck, P.E., Acting Director
County of Hawaii
Department of Environmental Management
25 Aupuni Street
Hilo, HI 96720

Dear Ms. Beck:

Subject: Draft Environmental Assessment
Riverside Apartments Improvements: Stream Bank Bluff Protection and Stabilization, Second Slope Scarp, and Interior Renovations, TMK (3) 2-6-003:009, Hilo, Hawaii

Thank you for your comment letter dated March 12, 2013 indicating that your department has no further comments to offer on the project.

If you have future comments or questions, please feel free to call Leslie Kurisaki at (808) 944-8848, x2213.

Sincerely,

KIMURA INTERNATIONAL, Inc.

Glenn T. Kimura, President

1600 Kapiolani Blvd., Suite 1610
Honolulu, HI 96814
Tel: 808 944-8848 ● Fax: 808 941-8999

William P. Kenoi
Mayor

Received
MAR 14 2013
By_____

Darren J. Rosario
Fire Chief

Renwick J. Victorino
Deputy Fire Chief

County of Hawai'i

HAWAI'I FIRE DEPARTMENT
25 Aupuni Street • Room 2501 • Hilo, Hawai'i 96720
(808) 932-2900 • Fax (808) 932-2928

March 7, 2013

Mr. Thomas Fischer
UHC 00382 Hilo, L.P
2000 E. Fourth Street, Suite 205
Santa Ana, CA 92705

Dear Mr. Fischer,

SUBJECT: Draft Environmental Assessment
Riverside Apartments Improvements: Stream Bank Bluff Projection and Stabilization, Second Slope Scarp and Interior Renovations
TMK: (3) 2-6-003-:009

The Hawai'i Fire Department does not have any comments to offer at this time regarding the above-referenced early Draft Environmental Assessment.

Thank you for the opportunity to comment.

Sincerely,

DARREN J. ROSARIO
Fire Chief

GA:lc

CC: Ms. Leslie Kurisaki, Kimura International

KIMURA INTERNATIONAL INC.

April 10, 2013

Chief Darren J. Rosario, Fire Chief
County of Hawaii
Fire Department
25 Aupuni Street, Room 2501
Hilo, HI 96720

Dear Chief Rosario:

Subject: Draft Environmental Assessment
Riverside Apartments Improvements: Stream Bank Bluff Protection and Stabilization, Second Slope Scarp, and Interior Renovations, TMK (3) 2-6-003:009, Hilo, Hawaii

Thank you for your letter dated March 7, 2013, indicating the Hawaii Fire Department has no comments to offer at this time.

If you have future comments or questions, please feel free to call Leslie Kurisaki at (808) 944-8848, x2213.

Sincerely,

KIMURA INTERNATIONAL, Inc.

Glenn T. Kimura, President

1600 Kapiolani Blvd., Suite 1610
Honolulu, HI 96814
Tel: 808 944-8848 ● Fax: 808 941-8999

William P. Kenoi
Mayor

BJ Leithead Todd
Director

Margaret K. Masunaga
Deputy

West Hawai'i Office
74-5044 Ane Keohokalole Hwy
Kailua-Kona, Hawai'i 96740
Phone (808) 323-4770
Fax (808) 327-3563

County of Hawai'i

PLANNING DEPARTMENT

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

April 3, 2013

RECEIVED APR 04 2013

Mr. Thomas G. Fischer
UHC 00382 Hilo, L.P.
2000 E. Fourth Street, Suite 205
Santa Ana, CA 92705

Dear Mr. Fischer:

Subject: **Draft Environmental Assessment**
Project: Riverside Apartments Improvements: Stream Bank Bluff Protection and Stabilization, Second Scarp and Interior Renovations
TMK: (3) 2-6-003:009; Pu'ueo, South Hilo, Hawai'i

Thank you for your letter received on March 6, 2013, requesting comments from this office regarding the Draft Environmental Assessment (DEA) for the Riverside Apartments Improvement project.

The applicant is proposing to renovate the interior of all apartment units and common areas including new flooring, carpeting, painting, fixtures, appliances, and repair and upgrade to plumbing and electrical systems. The building exterior will also be painted, the roof will be replaced, and photovoltaic panels will be installed. There will be no new structures or work outside the existing building footprint.

In addition, the applicant proposes stream bank bluff protection and stabilization. The project will install a series of soil nails to reinforce the steep embankment slope, construct an 8 to 10 inch thick layer of reinforced shotcrete (gunite) over the slope to protect and stabilize the slope face, protect the embankment toe against future erosion, scouring, and undermining by a cutoff wall, and pave the level area between the upper limits of the shotcrete and the Second Level building face. As a redundant measure to protect the building, the applicant proposes to install a series of micropiles to underpin the building nearest the stream bank.

The subject property consists of 1.848 acres and is zoned V-.75 (Resort- Hotel-maximum density of 750 square feet of land area for each dwelling unit) by the County of Hawai'i and designated Urban by the State Land Use Commission. The Hawai'i County General Plan Land Use Pattern

Allocation Guide (LUPAG) Map designates the parcels as Medium Density Urban. In addition, the entire property is located within the Special Management Area (SMA) and subject to review against SMA rules and regulations.

According to Chapter 205A-22, Hawai'i Revised Statutes (HRS), and Planning Commission (PC) Rule No. 9-4 (e) (2) (F) states, "development" does not include *"Repair, maintenance, or interior alterations to existing structures or relating to existing uses."* Therefore, the renovation project may be determined to be exempt from the definition of "development" and from further review against SMA rules and regulations. In addition, on April 12, 2011, our office issued an SMA Emergency Permit, subject to compliance with several conditions, for the emergency stabilization of a portion of the Wailuku stream bank on the subject property.

It is anticipated that the proposed stream bank bluff protection and stabilization of the second slope scarp on the subject property would go through a similar SMA Emergency Permit review. However, the SMA determination for the proposed project cannot be made until a completed SMA Use Permit Assessment Application is submitted to our office. Please note that pursuant to PC Rule 9-10 (i), the interior renovations may qualify for the SMA Short Form Assessment Application. Both applications may be downloaded from our website at: http://records.co.hawaii.hi.us/weblink/Browse.aspx?dbid=1&startid=55628.

We have no further comments to offer, at this time. If you have any questions or if you need further assistance, please feel free to contact Bethany Morrison of this office at (808) 961-8138.

Sincerely,

for BJ LEITHEAD TODD
Planning Director

BJM:cs
P:\wpwin60\Bethany\EA-EIS Review\draftea Riverside Apartments.doc

cc: Ms. Leslie Kurisaki
Kimura International, Inc.
1600 Kapiolani Blvd., Suite 1610
Honolulu, HI 96814

KIMURA INTERNATIONAL INC.

April 10, 2013

Ms. B.J. Leithaed Todd, Planning Director
County of Hawaii
Planning Department
101 Pauahi Street, Suite 3
Hilo, HI 96720

Dear Ms. Leithead Todd:

Subject: Draft Environmental Assessment
Riverside Apartments Improvements: Stream Bank Bluff Protection and Stabilization, Second Slope Scarp, and Interior Renovations, TMK (3) 2-6-003:009, Hilo, Hawaii

Thank you for your comment letter dated April 3, 2013, and for confirming the zoning and land use information in the Draft EA. We note that the Riverside Apartments interior renovation project may be determined to be exempt from the definition of development, and from further review against Special Management Area rules and regulations.

We also note that the proposed stream bank bluff protection and stabilization is anticipated to go through a SMA Emergency Permit review, similar to the SMA Emergency permit issued in 2011 for stabilization on the same property. We have been in contact with Ms. Bethany Morrison, and will be submitting a SMA permit application shortly.

If you have additional comments or questions, please feel free to call Leslie Kurisaki at (808) 944-8848, x2213.

Sincerely,

KIMURA INTERNATIONAL, Inc.

Glenn T. Kimura, President

1600 Kapiolani Blvd., Suite 1610
Honolulu, HI 96814
Tel: 808 944-8848 ● Fax: 808 941-8999

Leslie Kurisaki

From: Goya, Russell
Sent: Tuesday, March 26, 2013 6:20 AM
To: 'tfischer@uhcllc.net'; 'lkurisaki@kimurainternational.com'
Cc: Min, Marvin
Subject: Riverside Apartment Improvements

Mr. Fischer, Ms. Kurisaki:

After reviewing the DEA for the Riverside Apartment Improvements project, the proposed work should not impact the gas lines servicing the apartment complex. Please contact Hawai'i Gas if circumstances require you to perform work not noted in the DEA.

Regards,

Russell Goya
Hawai'i Gas
East Hawaii Operations
Phone: 808-935-0021
Fax: 808-969-9134
E-mail: rgoya@hawaiigas.com
IMPORTANT/CONFIDENTIAL: Unless otherwise indicated, this message is intended only for the personal and confidential use of the designated recipient(s) named above and may be subject to privilege. If you are not the intended recipient of this message you are hereby notified that any review, dissemination, distribution or copying of this message is strictly prohibited. This communication is for information purposes only and should not be regarded as an official statement of the entity sending this message. Email transmission cannot be guaranteed to be secure or error-free. Therefore, we do not represent that this information is complete or accurate and it should not be relied upon as such. All information is subject to change without notice.

Leslie Kurisaki

From: Leslie Kurisaki
Sent: Monday, April 08, 2013 9:32 AM
To: 'Goya, Russell'; 'tfischer@uhcllc.net'
Cc: 'Min, Marvin'; 'Delene Osorio'
Subject: RE: Riverside Apartment Improvements

Dear Mr. Goya,

Thank you for your emailed comments below noting that the Riverside Apartment improvement project should not impact gas lines servicing the complex. Hawaii Gas will be notified if additional work not covered in the Draft EA is to be performed.

A copy of your email and this response will be included in the Final Environmental Assessment.

Thank you,

Leslie Kurisaki

Leslie Kurisaki
Kimura International, Inc.
1600 Kapiolani Blvd., Suite 1610
Honolulu, Hawaii 96814
Phone (808) 944-8848, ext. 2213
Fax (808) 941-8999

From: Goya, Russell [mailto:rgoya@hawaiigas.com]
Sent: Tuesday, March 26, 2013 6:20 AM
To: 'tfischer@uhcllc.net'; 'lkurisaki@kimurainternational.com'
Cc: Min, Marvin
Subject: Riverside Apartment Improvements

Mr. Fischer, Ms. Kurisaki:

After reviewing the DEA for the Riverside Apartment Improvements project, the proposed work should not impact the gas lines servicing the apartment complex. Please contact Hawai'i Gas if circumstances require you to perform work not noted in the DEA.

Regards,

Russell Goya
Hawai'i Gas
East Hawaii Operations
Phone: 808-935-0021
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Appendix A

Final Submittal, Geotechnical Exploration and Evaluation Report

Yogi Kwong Engineers, LLC
April 2013

FINAL SUBMITTAL

Geotechnical

Exploration and Evaluation Report

Stream Bank Bluff Protection and Stabilization of a Second Erosion Scarp Second Level of the Riverside Apartments Property at

333 Ohai Street, Hilo, Hawaii
(TMK 2-6-003:009)

Prepared for:

Big Island Housing Foundation
Riverside Community Based Non-Profit Corporation
688 Kinoole Street, Suite 212
Hilo, HI 96720

April 2013

Prepared by:

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YKE Project No. 11011

Yogi Kwong Engineers, LLC

April 17, 2013

Mrs. Delene K. Osorio
Executive Director
Big Island Housing Foundation
Riverside Community Based Non Profit Corporation
688 Kinoole Street, Suite 212
Hilo, HI 96720

Subject: **Final Submittal Geotechnical Exploration and Evaluation Report Stream Bank Bluff Protection and Stabilization of a Second Erosion Scarp Second Level of the Riverside Apartments Property at 333 Ohai Street, Hilo, Hawaii (TMK 2-6-003:009)**

Dear Mrs. Osorio:

Yogi Kwong Engineers, LLC is pleased to submit this final submittal of our Geotechnical Exploration and Evaluation Report for protection and stabilization of a second erosion scarp on the stream bank bluff towards the downstream end (Second Level) of the subject Riverside Apartments property site located at 333 Ohai Street, Hilo Hawaii (TMK 2-6-003:009) for your review and use. Our geotechnical engineering services were performed in general accordance with our original March 22, 2011 proposal and our October 3, 2011 proposal for contract amendment to Big Island Housing Foundation Riverside Community Based Non-Profit Corporation (BIHF Riverside CBNPC).

We appreciate the opportunity to provide these services to BIHF Riverside CBNPC. If you have any questions regarding this letter and the attached Geotechnical Report, please do not hesitate to contact us.

Yours truly,
Yogi Kwong Engineers, LLC

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LIST OF ABBREVIATIONS

ACE	Ace Land Surveyors, LLC
ALTA	American Land Title Association
ASCM	American Congress of Surveying and Mapping
ASTM	American Society of Testing and Materials
bgs	Below ground surface
BIHF	Big Island Housing Foundation
CBNPC	Community Based Non-Profit Corporation
CMU	Concrete masonry unit
DCP	Dynamic Cone Penetration
DLNR	Department of Land and Natural Resources
ERT	Electrical Resistivity Tomography
fps	Feet per Second (Feet/Sec)
g	Gravitational Force
GG	Global Geophysics
ips	Inches per Second (inch/sec)
MSL	Mean Sea Level
MHHWM	Mean Higher High Water Mark
PCF	Pounds per Cubic Feet (lbs/ft^3)
PGA	Peak Ground Acceleration
PSI	Pounds per Square Inch (lbs/in^2)
REC	Core recovery ratios
RMTC	R.M. Towill Corporation
RQD	Rock quality designation
SN	Soil Nail
SPT	Standard Penetration Test
TMK	Tam Map Key
TXCU	Triaxial Consolidated Undrained
UCS	Unconfined Compressive Strength
UHC	Urban Housing Communities, LLC
USCS	Unified Soil Classification System
UBC	Uniform Building Code
USGS	U.S. Geological Society
YKE	Yogi Kwong Engineers, LLC

This report presents the results of our geotechnical assessment, including a field exploration and slope stability analyses, of an existing bank along the Wailuku River fronting the southeast portion of the subject Riverside Apartments property located at 333 Ohai Street, Hilo, Hawaii (TMK 2-6-003:009). Also presented are the geotechnical design concepts of our recommended slope stabilization measures at the portion of the bank with a probable historic erosion scarp on the slope. The project location is shown in Figure 1.

At the time of this report, we understand that Big Island Housing Foundation Riverside Community Based Non-Profit Corporation (BIHF Riverside CBNPC) is currently in the process of selling the subject low income housing property to Urban Housing Communities, LLC (UHC).

1.1 Previous Stream Bank Slope Investigation and Stabilization

The site of the Riverside Apartments is bordered by Wailuku River over a length of approximately 425 feet along its southern and southeastern property boundary. Based on available information, we understand that a portion of the stream/river bank fronting the south corner of the property experienced a slope failure in February 2008. YKE was previously contracted by UHC to perform a limited scope of geotechnical reconnaissance and subsurface exploration to evaluate this portion of the stream bank that had experienced a slope failure towards the upstream/southern end of the property. As part of the previous investigation, UHC also contracted Ace Land Surveyors, LLC (ACE) to perform a limited topographic survey for that failed portion of the stream bank. In general, the previously performed survey by ACE provided topographic information over an approximate 200-foot portion of the stream bank along the upstream/southern boundary of the property.

The findings and recommendations for stabilization and protection of the failed stream bank towards the upstream end of the property were presented in the final submittal of our geotechnical report titled *Emergency Stream Bank Bluff Protection and Stabilization* (YKE, 2011). YKE was subsequently contracted by BIHF Riverside CBNPC to prepare the construction plans and applications for as-needed permits. The construction plans for installing a system of micropiles, soil-rock anchors and reinforced shotcrete slope protection were issued in May 2011 and construction was completed in late July 2011 by Janod, Inc. under a separate contract with BIHF. The approximate limits of the installed shotcrete slope protection and stabilizing micropiles have been superimposed onto Figure 2 for ease of reference.

Refer to the previously issued Geotechnical Report (YKE, February 2011) and Construction Plans (YKE, May 2011) for more information.

1.2 PURPOSE AND SCOPE OF WORK

BIHF Riverside CBNPC has requested YKE to perform the subject geotechnical investigation and slope stability evaluation in support of geotechnical recommendations for the stabilization of a second portion of the stream bank bluff located towards the downstream end of the property generally bound between two (2) existing retaining walls that span between the building and the stream bank. The purpose of this current project is to explore the subsurface conditions of the subject portion of the stream bank bluff, assess the stability of this portion of the stream bank, evaluate the impacts of potential slope instability to the adjacent Riverside Apartments building, and develop geotechnical design recommendations for appropriate remediation measures.

The portion of stream bank under the current study is located downstream of the portion of stream bank which was reported to have experienced a slope failure in February 2008. Construction for the emergency protection and stabilization of the February 2008 slope failure was completed prior to this report.

The following scope of services was performed during our geotechnical exploration and evaluation of the subject stream bank in general accordance with the original scope of work in our March 22, 2011 fee proposal:

- Reviewed pertinent available record drawings and geotechnical information;
- Reviewed available historic aerial photographs to obtain pertinent supplemental site surface condition information;
- Subcontracted RMTC to continue a topographic survey of the Wailuku River bank along the southern property boundary that was previously initiated by ACE;
- Drilled three (3) geotechnical exploratory borings and one (1) geotechnical probe hole in areas accessible to a truck mounted drill rig outside of the narrow 2nd level stream bank bluff bound by the two retaining walls. Obtained both disturbed and relatively undisturbed soil samples in the borings for characterization of the geotechnical subsurface conditions;
- Drilled two (2) geotechnical probe holes between the above geotechnical borings using a light-weight trailer mounted air-track drill to obtain supplemental subsurface information within the narrow 2nd level stream bank bluff bound by the two retaining walls;
- Performed geotechnical laboratory tests on collected samples, including moisture content, wet and dry density, grain size distribution, Atterberg Limits (Plasticity Index),

consolidation, one-dimensional ring swell, direct shear and consolidated undrained triaxial shear (TXCU) strength tests;

- Performed a geotechnical slope reconnaissance by rappelling with ropes and ladders to observe and document the stream bank slope surface conditions along the stream bank bluff.

Upon completion of the above described scope of services it was found that the basalt lava flows, which were observed and encountered to be generally underlying the stream bank on either sides of the two (2) retaining walls, was not encountered in the probe holes conducted in the narrow stream bank bluff located between the two (2) retaining walls. As a result, YKE submitted a proposal to BIHF Riverside CBNPC for contract amendment (dated October 3, 2011) to conduct additional exploration in support of our evaluation.

The following scope of services was performed during our supplemental geotechnical exploration and evaluation in general accordance with our October 3, 2011 Proposal for Contract Amendment (Amendment Work):

- Subcontracted Global Geophysics to conduct a three-day geophysical survey of the subject stream bank using Electrical Resistivity Tomography (ERT) and Seismic Refraction Methods;
- Drilled one (1) geotechnical exploratory boring within the narrow 2nd level stream bank bluff bound by the two retaining walls using a light-weight tri-pod mounted concore drill rig to obtain both disturbed and relatively undisturbed soil samples for characterization of the geotechnical subsurface conditions;
- Performed supplemental geotechnical laboratory tests on collected samples, including moisture content, wet and dry density, and TXCU strength tests;
- Evaluated the stream bank slope stability in the vicinity generally bound by the two (2) existing retaining walls towards the southeastern end of the property and develop recommendations for slope stabilization measures;
- Conducted an in-house quality assurance review of the geotechnical evaluations and considerations by a principal engineer of our firm;
- Submitted a draft submittal geotechnical report for project team review and comment;
- Prepared this final submittal geotechnical report summarizing the findings of our evaluations and our geotechnical recommendations and design concepts for project team review and use.

The scope of our services presented herein does not include application for permits, such as USCOE Section 10/Section 401/NWP, DOH NPDES, County Grading/Building, DLNR SCAP, or other permits not required to conduct exploratory borings; nor does it include civil or structural engineering evaluations or design, and any environmental, hazardous waste, and/or hydrological assessments of the site.

2.1 PREVIOUS INVESTIGATION CONDUCTED BY YKE

A previous nearby field exploration was conducted as part of our evaluation of the February 2008 slope failure that occurred towards the upstream end of the stream bank along the property's southern boundary. The previous field exploration for the now completed stabilization project was conducted between September and October of 2008. The previous field exploration included a slope reconnaissance of the slide scarp and drilling of two (2) exploratory borings (B1-1 and B1-2) in the vicinity of the previous slope failure. Approximate locations of Borings B1-1 and B1-2 are shown on Figure 2.

Geotechnical laboratory tests were also conducted as part of the previous investigation. Previous laboratory tests included moisture content and dry density determination, grain size distribution by sieve analyses, TXCU and direct shear strength tests as well as pH, resistivity, sulfate and chloride tests.

For ease of reference, the logs of the previous borings and records of the previous laboratory test results reviewed as part of the regional geology considerations for this current project are included in Appendix F of this report.

2.2 SUBSURFACE GEOTECHNICAL EXPLORATION AND GEOPHYSICAL RECONNAISSANCE

The field exploration for this current project was conducted in two (2) stages: a) following the initial authorization of our original scope of work and b) subsequent to approval of our supplemental scope of work for this project.

The subsurface exploration performed under the original scope of work included the drilling of three (3) exploratory borings (B2-1, B2-1A and B2-2) and three (3) probe holes (P2-1, P2-2 and P2-3) conducted between April 20 and July 08, 2011. An initial stream bank geotechnical reconnaissance using rappelling gear to document the surface soils and rocks conditions along the steep stream bank bluff slope was also conducted as part of the original scope of work.

A supplemental subsurface exploration was conducted between December 16, 2011 and February 01, 2012 that included a 3-day geophysical reconnaissance and one (1) exploratory boring (B2-3).

Four (4) Dynamic Cone Penetration (DCP) probes were performed on January 22, 2013 to supplement the geophysical data at the toe of the slope.

The approximate locations of the exploratory borings, probe holes, DCP probes and geophysical survey transects conducted as part of this project are shown in Figure 2. A detailed description of the procedures used to perform the exploratory borings, probe boreholes and DCP probes along with the logs of borings, probe boreholes and DCP probes

are provided in Appendix A. A letter report entitled *Report on Geophysical Surveys at 333 Ohai Street, Hilo Hawaii* (dated February 11, 2012), discussing the geophysical survey methods employed and the findings, is presented in Appendix A.

Select photographs taken during the site slope reconnaissance are presented in Appendix C, and select photographs of soil samples obtained in our borings and probe holes are presented in Appendix D.

2.3 LABORATORY TESTING

Laboratory tests were conducted on selected soil samples recovered from the field exploration program to evaluate the engineering properties of the encountered soils. The conducted laboratory tests included moisture content and dry density, grain size distribution by sieve analyses, one-dimensional ring swell, consolidation, TXCU, direct shear strength, pH analysis, resistivity, sulfate analysis, chloride analysis, and bicarbonates analysis tests. The laboratory tests were performed by GeoTesting Express in Boxborough, MA, V&A Consulting Engineers laboratory in Oakland, CA, Construction Engineering Labs in Pearl City, HI, Food Quality Lab in Honolulu, HI, and YKE's geotechnical test laboratory in Honolulu, HI. The laboratory test results along with a description of the test methods that were employed are presented in Appendix B. Photographs of select soil samples are presented in Appendix D.

3.1 GENERAL SITE SURFACE CONDITIONS

In general, the Riverside Apartments complex is comprised of an L-shaped, four (4) story multi-family low-income apartment building. The available record drawings and reports indicate that the existing structure is constructed mainly of CMU walls supported primarily on shallow wall footings with post-tensioned floor slabs spanning between the footings.

Available topographic surveys of the Riverside Apartments property include an ALTA/ASCM land title survey prepared by Walter R. Thompson (December, 2007) and a survey of a limited portion of the stream bank towards the upstream end of the property prepared by ACE (November, 2008). RMTC was contracted by YKE as part of this current study to continue the topographic survey downstream of the stream bank survey which was initiated by ACE.

Based on the available topographic information, the Riverside Apartments property is bordered by Wailuku River over an approximate length of 425 feet along its southern property boundary. A steep stream bank bluff is generally located within the boundary of the Riverside Apartment property. The top of the stream bank resides at elevations ranging from about 60 feet MSL at the southwest (upstream) end of the property to about 32 feet MSL at the southeast (downstream) end of the property.

The courtyard between the building and the stream bank bluff is terraced from upstream to downstream direction with two retaining walls providing grade breaks between the 1st, 2nd, and 3rd levels of the property. The 2nd level is located between the two retaining walls that span between the building's south wall and the edge of the stream bank bluff. The very steep stream bank bluff gets as close as about 10 feet of the building in the 2nd level portion of the property.

Construction of the previous *Emergency Stream Bank Bluff Slope Protection and Stabilization* project was completed in July of 2011. This project included the installation of a series of vertical and battered micropiles along the crest of the 3rd level stream bank bluff combined with the application of reinforced shotcrete and the installation soil-rock anchors to protect and stabilize the slope located near the southwest (upstream) end of the property.

Very dense and tall vegetation was observed along a majority of the property's stream bank. The observed vegetation growth on the stream bank included tall grasses, shrubs, dense and tall bamboo, and numerous small and large diameter trees. Based on a review of the available historic aerial photographs, it appears that significant growth of vegetation along the stream bank bluff had occurred sometime between 1960 and 2000, as shown in Figures 3 through 5.

Based on the available topographic plans, a 10-inch storm drain line runs underground between the existing building and the crest of the stream bank. During construction of the emergency stream bank bluff slope protection and stabilization project, the contractor reported that the existing drain line is comprised of asbestos pipes that may warrant special handling when removed.

3.2 REGIONAL GEOLOGY

The island of Hawaii was formed by the coalescing of five (5) separate volcanoes, namely the Kohala, Mauna Kea, Kilauea, Mauna Loa and Hualalai Volcanoes. The town of Hilo generally straddles the southwestern slopes of Mauna Kea and the northwestern slopes of Mauna Loa. Much of the lower southern slopes of Mauna Kea have been buried beneath basalt lava flows from Mauna Loa at the interface between the two volcanoes in the project vicinity (Stearns and Mac Donald, 1946). Wailuku River generally formed along the intersecting boundary where basalt lava flows and Tephra Deposits of Mauna Loa had overlapped onto older Mauna Kea flows.

Portions of the Hilo town located to the south of Wailuku River are generally underlain by the more recent lava flows of Mauna Loa. Comparatively, portions of Hilo town located in the lower flanks of Mauna Kea and to the north of Wailuku River are generally underlain by older Tephra deposits (also referred to as Pahala Ash).

The name ‘Pahala’ ash has been generally adopted as the name for fine pyroclastic or tephra ash deposits that originated from Kilauea, Mauna Loa, Mauna Kea and Kohala Volcanoes that have been largely altered by weathering to a mixture of clay minerals and hydrated oxides of aluminum and iron. The provenance of Pahala Ash on the island of Hawaii is believed to be generally related to the proximity of its source and direction of prevailing wind at the time of eruption (Stearns and Mac Donald, 1946).

The Riverside Apartments property is located on the northern bank of Wailuku River. The geologic units at the Riverside Apartments site generally consist of deeply weathered ash deposits or Tephra (Qt) underlain by basalt lava flows likely resulting from basalt flows of the Kau Volcanic Series (Qk and Qk1y) as shown on Figure 6. The geology of the site is highly complex due to the overlapping lava flows from both Mauna Loa and Mauna Kea, and the erosion and interbedding of sediments from the Wailuku River during and after the lava flows

3.3 REGIONAL SEISMICITY

The island of Hawaii is the most seismically active of the Hawaiian Islands and is located in the highest UBC Earthquake Zone 4 (1997). UBC provides the seismic zone factor which is equivalent to the base rock peak horizontal ground acceleration based on earthquake hazards

with a 10% probability of exceedance in 50 years (10%/50 years) roughly corresponding to a 500-year return period event. The UBC seismic zone factor for the island of Hawaii is 0.40 with a base rock PGA corresponding to 0.40g.

The USGS interactive website also provides select de-aggregated earthquake parameters at different risk levels. Based on the 1998 USGS interactive seismic hazard de-aggregation mapping database, a 10%/50-year seismic event at this site on the island of Hawaii corresponds to a slightly lower predicted base rock PGA of 0.345 g (Site Class B). Similarly, a less probable 2%/50-year seismic event with a corresponding 2,475 year return period occurring at the project site is predicted to have a higher base rock PGA equivalent to 0.588 g (Site Class B).

It should be noted that a higher PGA of 1.0g was recorded at the Waimea Fire Station during the October 2006 magnitude 6.7 earthquake off the west shore of Hawaii. Based on the area geology and study done by Munson and Thurber (1997), it is our understanding that the Waimea Fire Station is directly underlain by Pahala Ash in turn underlain by basalt lava flows at a relatively shallow depth. It appears that the higher accelerations are possibly related to high frequency amplification that is reported by Munson and Thurber (1997) to be characteristic of shallow ash deposits.

The evaluation of potential seismic loading on the stability of the subject stream bank is discussed in Section 4 of this report.

3.4 SUBSURFACE CONDITIONS

Interpretations of the subsurface conditions presented in this report are based on a review of the available geologic maps and other published resources, the findings of YKE's previous geotechnical exploration, the results and findings of our geotechnical field reconnaissance, the exploratory borings, probes, and geophysical surveys completed for this project as well as YKE's general experience in this area.

The available subsurface and regional geologic data indicates that the subsurface conditions at the project location to the explored depths primarily consist of near surface deposits of highly weathered Amorphic Volcanic Ash (Pahala Ash) underlain by Weathered Tuffaceous Deposits with interbedded Pahala Ash deposits. The Weathered Tuffaceous Deposits appear to be generally underlain by slightly to moderately weathered Basalt Lava Flows immediately to the east and west of the area bound by the two retaining walls. However, Basalt Lava Flows were not encountered underlying the Weathered Tuffaceous Deposits in the area of the stream bank generally bound between the two (2) existing retaining walls.

More detailed descriptions of the subsurface conditions encountered during our field exploration are presented in the boring logs and the geophysical survey report (Appendix A). The results of geotechnical laboratory tests are included in Appendix B, and the logs of previous borings and results of previous laboratory testing are included in Appendix F of this report. Due to the highly variable nature of volcanic deposits and weathering of volcanic ash and lava flow deposits, subsurface conditions between the borings may vary significantly from those indicated in this report.

Based on our exploratory boring and geophysical reconnaissance findings, a generalized subsurface profile along the stream bank is presented in Figure 7 and a discussion of the local geologic units is presented in the following subsections.

3.4.1 Amorphic Volcanic Ash (Pahala Ash)

Based on the field exploration findings, the project site is generally underlain by near surface Amorphic Volcanic Ash or Pahala Ash deposits. In extensive deposits, Pahala Ash may vary greatly from soil-like to soft and friable rock-like in texture, and it can also vary greatly in chemical and mineralogical compositions. Erupted volcanic ash matter may be firmly fused by adhesion of the hot ash fragments. Extensive deposits of Pahala Ash will typically contain varying amounts of volcanic bomb matter that may be cobble- to boulder-sized and may vary in consistency from dense to moderately or highly scoriaceous or friable cinder-like.

The Amorphic Volcanic Ash Deposits encountered in the borings conducted at the Riverside Apartments property site typically consisted of mottled brown, light brown and dark brown tuffaceous silts, sands and gravels that have resulted from chemical weathering or decomposition of Volcanic Ash and dust resulting in a fine- to coarse-grained soil-like consistency. Based on USCS, the Amorphic Volcanic Ash Deposits are primarily classified as elastic silts (MH) with the soil matrix ranging from very soft to medium stiff in consistency. Based on the seismic refraction transects performed as part of the geophysical survey for this project, the Amorphic Volcanic Ash has a typical seismic P-wave velocity between 440 fps to 550 fps along the tested transects.

The range of field sampling blow counts and the results of selected laboratory tests performed on samples of the weathered Volcanic Ash deposits encountered in the borings are summarized in Table 1 below.

Table 1: Summary of Field Sampling Blow Counts and Laboratory Test Results of Encountered Amorphic Volcanic Ash Deposits

Field Sampling Blow Counts and Laboratory Test Results	Range	Average
SPT blows per foot, N	1 to 4	2.3
D&M Type 'U' blows per foot, Nu	1 to 8	3.8
Moisture content, %	59 to 204	150
Dry Density, lb/ft3	25 to 62	33
Moist Density, lb/ft3	69 to 82	76
Liquid Limit, % Plasticity Index, %	225 111	NA

3.4.2 Weathered Tuffaceous Deposits

In general, the near-surface Pahala Ash deposits are found to be underlain by Weathered Tuffaceous Deposits. Tuff is a term used to describe a relatively soft, friable rock that is usually formed by the consolidation and fusing or welding of volcanic clinkers, cinder sand, ash and/or dust. In extensive deposits, weathered tuff may vary greatly in texture from soil-like to soft friable rock-like. Similarly, tuff can also vary greatly in chemical and mineralogical compositions laterally and vertically. Erupted tuffaceous matter may be firmly fused by adhesion of the hot ash fragments. Extensive deposits of weathered tuff may contain varying amounts of volcanic bomb matter that can be cobble- to boulder-sized and vary in consistency from dense to moderately or highly scoriaceous or friable cinder-like. Sparsely to densely spaced cobble and boulder-sized volcanic bomb matter was observed entrained within the weathered volcanic ash soil matrix along the exposed stream bank slope surface during our field reconnaissance.

The soil matrix portion of the Weathered Tuffaceous Deposits encountered in the borings and observed along the stream bank typically consisted of mottled brown, light brown and olivine tuffaceous sands, silts and gravels that have resulted from chemical weathering or decomposition with the resulting generally soil-like consistency ranging from very soft to very stiff. Based on the seismic refraction performed as part of the geophysical survey for this project, the Weathered Tuffaceous Deposits were found to have a typical seismic P-wave velocity ranging from 2,140 fps to 4,520 fps along the geophysical transects.

The range of field sampling blow counts and the results of selected laboratory tests performed on the samples of the Weathered Tuffaceous Deposits encountered in the borings are summarized in Table 2 below.

Table 2: Summary of Field Sampling Blow Counts and Laboratory Test Results of Encountered Weathered Tuffaceous Deposits

Field Sampling Blow Counts and Laboratory Test Results	Range	Average
SPT blows per foot, N	1 to 3	2.2
D&M Type 'U' blows per foot, N_u	2 to 22	9.4
Moisture content, %	42 to 167	75
Dry Density, lb/ft^3	31 to 73	59
Moist Density, lb/ft^3	81 to 107	97
Soil Gradation % Gravel % Sand % Fines	0 to 30 16 to 59 24 to 84	17 37 53
Liquid Limit, % Plasticity Index, %	57 and 199 14 and 110	NA

3.4.3 Volcanic Clinker Deposits

Volcanic Clinker Deposits are typically the result of the loose material that rides near the rapidly cooled edges of basalt a'a flows. As a'a flows advance, the outer layers of the flow tend to cool quickly resulting in the fracturing of these outer layers. A thick coating of gravel- to boulder-sized angular clasts and grindings (or clinker) develop around the inner molten core of the a'a flow as it advances. The angular nature of the clinker allows for large voids between clasts, which can be in-filled with the silt and sand-sized particles of ground clasts or otherwise in-filled with material from erosional events. The resulting clinker deposits are found to typically include angular to sub-angular basalt gravel, cobble and boulder-sized clinkers suspended in a matrix of weathered sand, silt and clays.

The Weathered Tuffaceous Deposits encountered in B2-1 were underlain by Volcanic Clinker Deposits. At the transition between the overlying Weathered Tuffaceous Deposits and the Volcanic Clinker Deposits, intermixing of the two volcanic deposits were observed in the samples retrieved.

During sampling in Boring B2-1, quick sampler penetrations of approximately 36 and 42 inches with one blow of the hammer were recorded at the approximate depths of 14.5 and 25 feet bgs, respectively. It appears to indicate the probable presence of voids or fissures within the deposits of Volcanic Clinkers. To assess the size of the voids or fissures in B2-1, YKE has measured the grout intake quantities required to backfill Borings B2-1 and B2-2.

Approximately 22 gallons (3 cubic feet) of grout loss was measured when backfilling Boring B2-1 which was drilled to a depth of 39 feet bgs. Comparatively, an estimated 9 gallons of grout loss was measured when backfilling Boring B2-2 which did not encounter significant voids or fissures while drilling to an approximate depth of 52.5 feet bgs. Although some degree of grout loss is likely related to the open graded structure of the Volcanic Clinker Deposits, the higher grout loss encountered when backfilling B2-1 seems to support the likelihood that voids or fissures were encountered in the borings.

To further evaluate the extent of possible voids or fissures in the vicinity of B2-1, YKE drilled supplemental Boring B2-1A at an offset of 8 feet to the west of B2-1 and supplemental probe hole P2-1 at an offset of 2 feet to the east of B2-1. Based on the sampler resistance encountered in B2-1A and P2-1 it appears that soft soils and possible smaller voids may exist in the Volcanic Clinker Deposits in the vicinity of B2-1.

3.4.4 Alluvium

Alluvium typically consists of soils derived from paleo upslope erosion and deposition of eroded upslope soils and variously weathered basalt rocks. The alluvium encountered at the Riverside Apartments consisted primarily of bedded deposits of soft to medium stiff elastic silts and loose to medium dense silty sands with variable amounts of gravel. The older alluvial soils were encountered below the Weathered Tuffaceous Deposits from approximately 34 feet bgs to 43 feet bgs in B2-3 whereas older alluvial soils were encountered below Basalt Lava Flows from approximately 35 feet bgs through the explored depth of 52.5 feet bgs in Boring B2-2.

The range of field sampling blow counts and the results of selected laboratory tests performed on the samples of the Older Alluvial Deposits encountered in the borings are summarized in Table 3 below.

Table 3: Summary of Field Sampling Blow Counts and Laboratory Test Results of Alluvium

Field Sampling Blow Counts and Laboratory Test Results	Range	Average
SPT blows per foot, N	5 to 12	7.7
D&M Type 'U' blows per foot, N_u	21 and 28	24.5
California Modified Sampler, N_{cm}	35	NA
Moisture content, %	55 and 70	63
Soil Gradation % Gravel	4 and 12	8
Soil Gradation % Sand	33 and 40	37
Soil Gradation % Fines	48 and 64	56

3.4.5 Basalt Lava Flows

As shown on the Logs of Borings (Appendix A), Basalt Lava Flows were encountered underlying the Weathered Tuffaceous Deposits in Borings B2-1 and B2-2 which were drilled to the west of the upper retaining wall and to the east of the lower retaining wall, respectively. Basalt Lava Flow were not encountered through the explored depth of 60 feet bgs at B2-3 which was drilled in the bluff area located between the two retaining walls and between Borings B2-1 and B2-2.

The geophysical survey results appear to collaborate with the findings of B2-3 where Basalt Lava Flow was not encountered to the explored depth in the stream bank area between the two (2) existing retaining walls. Rock outcrops were observed at the toe of the slope towards the upstream and downstream end of the 2nd level area. Rock was not observed at the toe of the slope in the center portion of the 2nd level terrace. The approximate edge of the rock outcrops at the toe of the slope in the 2nd level area is identified in Figure 2. Based on our exploratory boring and geophysical reconnaissance findings, a generalized subsurface profile along the stream bank is presented in Figure 7.

The basaltic rocks encountered in Boring B2-2 comprised primarily of hard slightly weathered to closely fractured to crushed basalt with local zones of soft friable rock to soil like extremely weathered basalt. The examined rock outcrops in the 2nd level project area ranged from slightly to extremely weathered, hard to friable and massive to closely fractured basalt.

The ranges of core recovery ratios (REC), rock quality designation (RQD) values of the samples of Basalt Lava Flows encountered in the borings are summarized in Table 4 below.

Table 4: Summary of Field Core REC and RQD of Encountered Basalt Lava Flows

Core REC and RQD	Range	Average
REC (%)	21 to 75	54.8
RQD values (%)	0 to 35	17.5

Based on the seismic refraction survey performed as part of the geophysical survey for this project, the Basalt Lava Flows were found to have a typical seismic P-wave velocity of about 7,830 fps along the geophysical transects as further discussed in Appendix A.

3.4.6 Groundwater

Perched groundwater is typical of deposits that contain stratified layers of fine- and coarse-grained soil as encountered in the Pahala Ash, Weathered Tuffaceous and Clinker Deposits which may be intermittently underlain by Basalt Lava Flows as discussed above. The Pahala Ash and Tuffaceous soils were found to have very high natural water contents at various depths near saturation levels at the time of sampling. Additionally, perched groundwater was also encountered in the boring and probes explored as part of this study.

Due to the high variability of deposition and stratigraphy of Ash and Tuffaceous soils and Basalt Lava Flows, it is anticipated that localized zones of perched groundwater are prevalent in the study area. A summary of the recorded perched groundwater levels is presented in Table 5 below.

Table 5: Summary of Recorded Groundwater Levels

Boring/Probe Identification	Groundwater Level (Elevation, feet MSL)
B2-1	28
B2-2	16
B2-3	13.8 and 12.5
P2-1	None Encountered
P2-2	13.6
P2-3	2

As discussed in Section 3, there appears to be a probable gap in the Basalt Lava Flows that underlay the near-surface Pahala Ash and Weathered Tuffaceous soils along the stream bank in the vicinity of the 2nd level area of the property between the two retaining walls. The lack of Basalt Lava Flows underlying the Pahala Ash and Weathered Tuffaceous soils contributes to an increased likelihood of slope instability and failures in those stream bank slope areas which may lead to potential building distress depending on magnitude of the slope failure and proximity or setback of the building relative to the slope.

Since the stability of the entire existing stream bank slope bordering the southern property line of the Riverside Apartments cannot be properly evaluated without extensive site clearing, slope reconnaissance and field exploration efforts that are beyond the scope of this study, this geotechnical assessment focuses only on evaluation of the existing stream bank generally bound by the two retaining walls in the 2nd level terrace of the property. Geotechnical design concepts and recommendations for protection and stabilization of this section of the stream bank and building are discussed herein. The analyses were performed to evaluate the slope stability of the local stream bank bluff between the two retaining walls, based on the available geotechnical information.

4.1 Slope Stability Analyses

YKE has performed a series of slope stability analyses of the existing stream bank in the study area under various loading conditions including the existing *in-situ* condition, potentially fully saturated slope condition, and various seismic conditions that could probably occur based on the regional and local seismicity considerations discussed in Subection 3.2 and Subsection 4.2.1 below, respectively.

The slope stability analyses were performed by using the Morgenstern-Price Method with the aid of a limit equilibrium slope stability program, SLOPE/W (2004). SLOPE/W is a frequently used and widely accepted computer program for the general solution of slope stability problems by using two-dimensional limiting equilibrium methods such as the Morgenstern-Price method. The results of our laboratory soil tests were used to characterize the engineering properties of the soils encountered in the borings that may exist under various loading conditions (or stress states) for use as inputs into SLOPE/W.

YKE has evaluated the stream bank slope stability in the second erosion scarp area between the two retaining walls along three cross-sections, A-A, B-B, and C-C, respectively, on the western side, in the middle, and on the eastern side as shown in Figure 2. Based on the slope stability analysis results, it appears that the existing stream bank slope in the vicinity of the second erosion scarp area bound by the two retaining walls may be prone to future slides under the evaluated fully saturated slope and seismic conditions as discussed below.

4.1.1 Psuedo-Static Seismic Stability Analyses

The seismic stability of the existing stream bank slope during an earthquake event was evaluated by using a *pseudo-static* procedure. In the pseudo-static procedure, the effect of earthquake ground motions are represented by constant horizontal and vertical inertial forces imposed on the soil mass and the stability is assessed in terms of Factor of Safety following standard limit equilibrium principles. The horizontal and vertical seismic inertial forces (F_h and F_v) are equal to the weight of the failed sliding mass (W) multiplied by the dimensionless pseudo-static coefficients k_h and k_v. The horizontal (F_h) and vertical (F_v) inertial forces imposed on the slope in a pseudo-static analysis are therefore summarized as follows:

$$F_h = k_h * W \quad \text{and} \quad F_v = k_v * W$$

Although the seismic coefficient is assumed to be related to the earthquake's peak ground acceleration, the seismic force F_{have} is considered to only act in one direction in the pseudo-static stability analysis. Comparatively, earthquake acceleration forces are imposed in several directions over the duration of the earthquake due to the induced three-dimensional random shaking motion of an earthquake. Therefore it is commonly believed that in the absence of dramatic loss of strength (such as liquefaction), using the earthquake PGA coefficient as the seismic coefficient in the in pseudo-static analysis yields excessively conservative results since the peak acceleration acts only momentarily in one direction.

It is our understanding that the use of a seismic coefficient ranging between 50 and 67 percent of the earthquake's PGA coefficient is commonly recommended and adopted among practitioners based on available published information. The Hawaii State Department of Land and Natural Resources (DLNR) *Hawaii Dam Safety Guidelines: Seismic Analysis & Post-Earthquake Inspections, Circular C131* recommends the use of a simplistic seismic coefficient of minimum 0.20 for pseudo-static seismic stability analyses of earth dams on the island of Hawaii in the lack of site-specific seismic analyses. However, as discussed in Subsection 3.2, a much higher de-aggregated base-rock peak ground acceleration of 0.48g is predicted for the project location based on a 10%/50-year seismic event (USGS, 1996), which roughly corresponds to a 500-year return period.

Peak ground accelerations at the ground surface will vary depending on such factors as distance from the earthquake epicenter, depth of bedrock, and the influence of soils above the bedrock. In a study conducted by Munson and Thurber (1997), it was observed that "Accelerations at ash sites along the Hamakua coast are dramatically enhanced at high frequencies compared to nearby lava sites". It was found that the amplification of high frequency, strong ground motions generally increased at sites with surface weathered ash deposits, which are therefore susceptible to enhanced ground motions.

The Munson and Thurber (1997) findings may be further supported by the higher peak ground acceleration readings of 1.0g recorded at the Waimea Fire Station seismograph during the October 16, 2006 earthquake near the Big Island. The Waimea Fire Station seismograph is known to be underlain by Pahala Ash. Based on previous mapping done by the U.S. Soil Conservation Service (1973), it appears that the ash deposits in the vicinity of the Waimea area may be at least five (5) feet thick and underlain by Basalt Lava Flows. Therefore, it is likely that ground accelerations higher than 0.48g may occur at the Riverside Apartments stream bank due to the presence of the near-surface deposits of soft and low density Pahala Ash and Tuffaceous deposits.

Based on these local seismicity considerations, horizontal seismic coefficients ranging from 0.2 to 0.67 were therefore used in the seismic slope stability analyses of the existing stream bank in concern as discussed above. k_{have}=0.20 is corresponding to the seismic coefficient recommended by Hawaii State DLNR for dams on the island of Hawaii, and k_{have}=0.67 is corresponding to a seismic coefficient equal to 66 percent of the maximum PGA measured at the Waimea Fire Station during the recent earthquake on October 16, 2006.

4.1.2 Soil Engineering Properties used in Slope Stability Analyses

Based on the laboratory test results and our previous experience with Weathered Volcanic Ash and Tuffaceous deposits, the soil properties and strength parameters summarized in Table 6 below were derived and used in our slope stability analysis:

Table 6: Summary of Soil Properties and Strength Parameters Used in Slope Stability Analyses

SOIL PROPERTY		PAHALA ASH	WEATHERED TUFFACEOUS DEPOSITS	OLDER ALLUVIUM (SILTY SAND)	VOLCANIC CLINKERS
Bulk Unit Weight (γ_m, lb/ft^3)		76	95	95	95
Total Strength	Cohesion	344 psf	73 psf	725 psf	0 psf
	Friction	13.2˚	28.9˚	16.0˚	45.0˚
Effective Strength	Cohesion	230 psf	91 psf	683 psf	0 psf
	Friction	29.1˚	34.7˚	35.3˚	45.0˚
80% Effective Strength	Cohesion	184 psf	73 psf	547 psf	0 psf
	Friction	24.0˚	28.9˚	29.5˚	45.0˚

The total strength parameters presented in Table 6 were used to evaluate the slope stability under static loading conditions assuming the slope becomes fully saturated after a long period of rain or by perched water. The effective strength parameters were used to evaluate the slope stability under static loading with assumed groundwater conditions modeled based on depths encountered in the borings at the time of exploration. To account for loss of soil strength when subject to earthquake cyclic loading, the 80% effective strength parameters were used to evaluate the slope stability under pseudo-static loading with assumed groundwater levels modeled based on depths encountered in the borings at the time of exploration.

4.1.3 Stability of Existing Stream Bank Slope in Vicinity of Second Erosion Scarp

Three existing stream bank slope cross sections A-A, B-B and C-C were evaluated under the various loading conditions as discussed above. As shown in Figure 2, Section A-A is located by the upper level retaining wall. A rock outcrop feature was mapped at the toe of the slope during our field reconnaissance. Section C-C is located by the lower level retaining wall. A rock outcrop was similarly mapped at the toe of the slope in the vicinity of the cross-section. Section B-B is located in the approximate middle between the two retaining walls and in close proximity to Seismic Line 5 and Boring B2-3. The slope profile used for stability analyses was developed based on the boring data, geophysical surveys and geotechnical field mapping conducted as part of this project as presented in Figure 8. The calculated slope stability Factors of Safety of the existing stream bank along Sections A-A, B-B and C-C are summarized in Table 7 below.

Table 7: Summary of Calculated Slope Stability Factors of Safety of Existing Stream Bank

	Static Conditions		**Pseudo-Static / Seismic Conditions**			
	Saturated	**Existing**	k_{have} **= 0.2**	k_{have} **= 0.32**	k_{have} **= 0.5**	k_{have} **= 0.67**
Section A-A	5.39	5.39	N.E.*	N.E.*	N.E.*	1.27
Section B-B	1	1.42	<1	<1	<1	<1
Section C-C	1.87	1.64	<1	<1	<1	<1

Results of the slope stability analyses are presented in Appendix E.
N.E.*: Not Evaluated.

Based on the evaluated slope profile, it appears that the 2nd level stream bank slope above the upper rock outcrop represented by Section A-A is relatively stable under evaluated existing (in-situ) loading conditions. However, the stream bank slope in the building vicinity bound between the two rock outcrops within the bound of two retaining walls, represented by Section B-B, is marginally stable under saturated slope conditions. Furthermore, it appears that the slope between the two rock outcrops area, represented by Section B-B, and the slope

over the lower rock outcrop, represented by Section C-C, will likely become unstable under the evaluated seismic loading conditions, and failure of the adjacent stream bank slope may undermine the Riverside Apartments building.

Therefore we recommend that, as a minimum, the existing stream bank slope in the vicinity between the two retaining walls be stabilized and protected against future potential slope failures, erosions, and also be protected from potential river scour that may undermine the slope as discussed in the following subsections of the report.

4.2 SLOPE STABILIZATION RECOMMENDATIONS

It is recommended that the portion of stream bank slope between the two retaining walls be stabilized and protected against future instability, erosion, and also be protected against river/stream scour at the toe of the stream bank slope to prevent potential slope failures that may undermine the Riverside Apartments building behind the slope.

The potential use of a row of closely spaced reinforced concrete caissons could stabilize and protect the slope and has been considered during our evaluation. However, due to space constraints at the top of the bluff and the current marginally stable condition of the stream bank slope, the use of heavy caisson-drilling equipment may not be practical and may impose excessive surcharge on the near vertical bluff. Therefore, large diameter drilled caissons are not considered for use in the following proposed stabilization measures.

Because of the site constraints, we have evaluated the use of small diameter retaining elements such as soil nails (SNs) and rock bolt anchors that could be installed within tight work space and on an existing slope to different design angles to stabilize the slope as discussed in the following subsection.

4.2.1 Slope Stabilization with Soil Nails, Rock Bolt Anchors, and Reinforced Shotcrete Slope Protection

As previously discussed, Basalt Lava Flows were not encountered underlying the Pahala Ash and Tuffaceous soils in the marginally stable to potentially unstable stream bank slope towards the center of the 2nd level area..

To improve the stability of the slope, seven (7) rows of soil nails are recommended to be installed into the 2nd level between the two rock outcrop features at the upstream and downstream toes. Based on the marginal calculated slope stability Factor of Safety at Section C-C, two (2) rows of soil nails are recommended to be installed above the rock outcrop as shown in Figure 9. Soil nails should be spaced 4 feet on-center along each horizontal row. At a minimum, the upper four (4) rows and the lower three (3) rows of soil

nails in the area between the two rock outcrops should have an allowable pull out capacity of 18.5 kips and 20.5 kips, respectively, and the soil nails installed above the rock crop at the downstream end of the 2nd level area should have an allowable pull out capacity of 13.5 kips with a minimum Factor of Safety of 2.0. The pullout capacity should be verified by performing pile load test on 10% of the installed soil nails in accordance with ASTM D3689.

Based on our slope stability analyses, the potential slip planes in the center portion of the 2nd level terrace may be deep seated, potentially nearly the full depth of the stream bank slope from top to near the bottom. Therefore, we recommended that the slope section in concern be additionally protected and stabilized with a suitably reinforced shotcrete slope facing in conjunction with the use of the proposed soil nail system. The reinforced shotcrete facing should be constructed up and over the protected stream bank and structurally connected to the soil nails so as to mobilize the pullout capacity of the soil nails and hold the shotcrete slope facing in place.

Although the slope stability analysis indicates that the slope above the western side rock outcrop is considered stable under evaluated loading conditions, the exposed slope appears prone to potential surface scour from run-off water. Therefore, we recommend to also protect this portion of the slope from potential erosions with shotcrete slope protection.

To help key the shotcrete into the relatively less erodible basalt rock, we recommend that the shotcrete be extended to overlap the rock outcrop at the upstream and downstream edges of the 2nd level terrace area. We also recommend that ten (10) foot long rock anchor bolts be installed into the rock outcrop to help lock the shotcrete in with the Basalt Lava Flows.

The soil nail/rock anchor bolts should comprise of encapsulated nail bar such as the Double Corrosion Protection (DCP) nail bar manufactured by Dywidag-Systems International (DSI), or Class III Multiple Corrosion Protection (MCP) nail bar manufactured by Williams Form Engineering Corp.

In the interest of performing a timely repair to the subject stream bank section in concern, it is important that the proposed slope stabilization work be performed by an experienced and qualified shotcrete and soil nail/rock nail contractor to furnish and install the shotcrete facing, soil nails and rock bolt anchors. All shotcrete, soil nails, and rock bolt anchors should be designed by a structural engineer licensed in the state of Hawaii.

4.2.2 Improved Slope Stability Factors of Safety

By incorporating the above recommended slope stabilization and protection measures into our analyses, we have calculated the following slope stability safety factors for the stream bank slope in concern. The slope stability analyses were performed with the limit

equilibrium slope stability program SLOPE/W under the various loading conditions considered, as shown in Appendix E and also summarized in Table 8 below:

Table 8: Summary of Calculated Slope Stability Factors of Safety with Proposed Stabilization and Protection Measures

	Static Conditions		Pseudo-Static / Seismic Conditions			
	Saturated	**Existing**	k_{have} = 0.2	k_{have} = 0.32	k_{have} = 0.5	k_{have} = 0.67
Section B-B	1.5	3.3	1.9	1.6	1.3	1.1
Section C-C	3.8	4.7	2.3	2.0	1.5	1.1

Results of the slope stability analyses are presented in Appendix E.
Factor of safety of 1.1 for pseudo-static seismic loading conditions based on DLNR C131.
Factor of safety of 1.2 and 1.5 for saturated and existing conditions respectively based on DLNR R92.

It is noted that the improved slope stability Factors of Safety will comply with the minimum required Factors of Safety against slope instability under the various loading conditions considered.

4.2.3 Drainage and Scour Protection

The above slope stability analyses assume that significant perched groundwater conditions will not develop behind the slip scarp under seismic loading conditions. It is therefore recommended that the shotcrete facing also be designed to allow adequate drainage of potential ground seepage through the soil and rock layers on the slope and relieve potential buildup of perched groundwater from behind the slope face protection.

After the clearing of trash and other debris and the removal of vegetation and loose soil from the slope face, we recommend that suitable free draining geo-composite drainage sheets minimum 1-foot wide and spaced approximately 4 feet on center should be placed along the cleared slope face and the reinforced shotcrete facing in near vertical columns from the top of the bluff down to the lower limit of the shotcrete slope protection at the toe of the slope. The geo-composite drain sheets should be connected at the toe with a properly designed drainage system in accordance with the manufacturer's recommendations to remove the collected seepage water from behind the slope to be covered with the shotcrete facing.

It is also recommended that the toe of the slope be adequately protected against future erosion, scour and undermining. The scour potential of the soils at the toe of the stream bank slope in concern should be evaluated by a civil engineer licensed in the state of Hawaii and experienced in evaluation and design of stream bank toe revetments.

4.3 SURFACE DRAINAGE

It was observed that the roof gutter downspout pipes were not connected to the collector pipe. All roof drains should be repaired and connected to a pipe discharging away from the slope. Also surface runoff overflow from the upper terrace can flow into this area. Therefore it is recommended to minimize the possibility of the remaining unprotected slopes, the drainage pattern at the top of the slope be analyzed so that the majority of rain fall runoff is diverted from flowing over the face of the slope.

4.4 UNDERPINNING OF THE BUILDING WITH MICROPILES

In addition to the above recommended slope stabilization measures, we also believe that the existing shallow footings supporting the Riverside Apartment building's 2nd level, where it is closest to the stream bank in concern, should be underpinned with a row of micropiles to provide redundant foundation support during extreme seismic events. Due to the close proximity of the steep stream bank underlain by deep soil deposits to the 2nd level building in a seismically active area of the state, we feel that the micropile underpinning could provide redundant support for the building's spread foundations in this area should more extreme slope loading conditions (such as very large earthquakes) develop, which are beyond those evaluated in this report based on historical earthquake records.

However, the precautionary underpinning should be designed and installed to avoid significant effects on potential building soil-structure interaction in the event of extreme seismic event.

For preliminary planning purposes, we recommend that 6.5-inch diameter micropiles could be used for underpinning purposes. Each micropile should consist of a high strength central reinforcing bar encased in minimum 4,000 psi cement grout within a minimum 6.5-inch outer diameter galvanized steel casing to reduce the potential for corrosion, as shown in Figure 10. Since soft/loose ash and tuffaceous soils are prone to caving into the drilled holes during the micropile installation process, the use of steel casings is recommended to keep the boreholes clear for grouting as well as to provide additional pile shear and bending stiffness over the design life of the micropiles.

We recommend 45-foot length micropiles with the lower 25-foot length being uncased could be installed to develop 10 tons of allowable axial loads per micropile.

The location, spacing of each micropile, and existing footing to micropile contact should be designed by a licensed structural engineer. An experienced micropile Subcontractor or Contractor should be retained to install the micropile underpinning.

4.5 SITE GRADING

Based on the subsurface conditions at the project site, any excavations into the existing steep stream bank bluff could readily cave-in, particularly during rainy periods and/or due to vibrations from construction loadings or other human activities nearby. Construction safety and stability of any temporary excavations must be closely monitored and is the sole responsibility of the contractor, who must comply with all applicable government safety regulations.

The geotechnical recommendations and conclusions presented in this report are based on the assumption that the scope of the designed and constructed project as described does not change appreciably, and that significant variations in soil properties from those encountered by our exploration do not occur. This report presents our opinion of the subsurface conditions and the properties of the materials anticipated to be encountered during construction. To accomplish this, it was necessary to interpolate between exploratory borings and data points, and extrapolate the data to estimate the site subsurface conditions. While the properties of the materials encountered in the field are expected to be within the ranges discussed, the actual distribution of materials encountered will likely vary from those discussed in this report.

The descriptions and discussions of anticipated subsurface conditions presented in this report are intended for BIHF Riverside CBNPC and their designated sub-consultants in design considerations and preparation of construction bid documents. If any conditions notably differ from those described herein are encountered during construction, YKE should be immediately notified in writing and be allowed reasonable time to review, analyze and respond to the unforeseen conditions.

This report was prepared for BIHF Riverside CBNPC and their designated design consultants in accordance with generally accepted geotechnical engineering practices. The geotechnical opinions and recommendations given in this report are based on our evaluation of the data collected for this project. This study excludes civil, hydrological and structural engineering evaluations. Additive conclusions or recommendations made from this data by others for other uses are their responsibility.

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APPENDIX A FIELD EXPLORATION

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APPENDIX A FIELD EXPLORATION

This appendix summarizes the results of site geotechnical reconnaissance, field explorations, and soil sampling performed by YKE as well as the topographic survey performed by R.M. Towill Corporation and geophysical survey conducted by Global Geophysics in support of the Stream Bank Stability at the Second Erosion Scarp Area at the 2nd level of the Riverside Apartments at 333 Ohai Street in Hilo, Hawaii.

The location of the project site is shown on Figure 1 and the approximate boring, probe, DCP test and geophysical transect locations are shown on Figure 2.

A.1 SLOPE GEOTECHNICAL RECONNAISSANCE

YKE performed a slope reconnaissance during our field exploration phase of the study. YKE used rappelling ropes and climbing rope ladders to traverse the very steep stream bank bluff. Photographs taken during the geotechnical slope and site reconnaissance are presented in Appendix C and part of graph observed surface rock out crops and erosion scarp are shown on Figure 2.

A.2 EXPLORATORY BORINGS AND PROBES

Field explorations for the stream bank assessment consisted of drilling four (4) exploratory borings B2-1, B2-1A, B2-2 and B2-3 and three (3) probe holes, P2-1, P2-2 and P2-3 between April 20 and July 08, 2011 and December 16, 2011 and February 01, 2012. The approximate locations of the borings and probe holes are shown on Figure 2.

The borings were drilled by Hawaii Test Boring, Inc. using a truck mounted SIMCO drill rig with 4-inch solid-stem, continuous flight augers, wash boring and coring. A tri-pod mounted concore drill rig with 4-inch solid-stem, continuous flight augers was used to explore Boring B2-3 in the narrow 2nd level area. A portable air-track “drag-and-drill” was used to conduct the two probe holes in the 2nd level area between the two existing retaining walls by Janod, Inc. The Logs of Borings are presented on Figures A-4 through A-10.

A.3 SOIL SAMPLING

Soil sampling was conducted under the observation of YKE engineering personnel, who logged the materials encountered in each boring and obtained samples for further examination and laboratory testing.

Relatively undisturbed and disturbed soil samples were obtained using either a Standard Penetration Test (SPT) sampler, Dames & Moore type “U” sampler or Modified California Drive Sampler. All samplers were driven into the ground by successive blows of a 140-

pound hammer falling 30 inches. The sampler was driven for a typical total distance of 18 inches, and blow counts for each 6 inches of penetration were recorded. Where the SPT sampler was used, the procedure followed the ASTM D1586 standard for determining the "standard penetration resistance" of soil. Generally, the standard penetration resistance or sampling resistance is quantified as the sum of blow counts for the second and third 6–inch interval of penetration as noted on the Logs of Borings unless otherwise indicated.

Soil samples recovered from the field were initially classified according to the American Society of Testing and Materials (ASTM) D2488 standard and the Unified Soil Classification System, shown on Figure A-1. These classifications were later refined according to ASTM D2487 based on the results of laboratory tests performed on selected samples. Samples recovered during the field exploration program were transported to our office in Honolulu for further examination and laboratory testing. The borings were backfilled using ready mix cement for dry boreholes or tremie grout cement backfilling boreholes where groundwater was encountered.

A.4 Dynamic Cone Penetration Probing

Four (4) Dynamic Cone Penetration (DCP) probes were performed on January 22, 2013 by YKE personnel. The DCP probes consisted of driving a cone tip into the ground by successive blows of a 15-pound hammer falling 20 inches. The DCP cone was advanced and resistance values for each increment of 1.75 inches were recorded. Approximate locations of the DCP probes are shown on Figure 2. The Logs of DCP Probing are presented on Figure A-11

A.5 Report on the Geophysical Surveys at 333 Ohai Street, Hilo Hawaii

A three (3) day geophysical survey was conducted by Global Geophysics. The letter report prepared by Global Geophysics (2012) is included in Appendix A.

SOIL CLASSIFICATION CHART

	Major Divisions		Symbol	Typical Names	Other Criteria
COARSE GRAINED SOILS More than 50% of material larger than No. 200 sieve size	**Gravels** More than 50% of coarse fraction retained on No. 4 sieve	**Clean Gravel** Little or no fines (<5%)	GW	Well-graded gravels, gravel-sand mixtures, little or no fines	Cu>4 and 1<=Cc=3
			GP	Poorly graded gravels, gravel-sand mixtures, little or no fines	Not meeting Cu and Cc criteria for GW
		Gravels with Fines Appreciable amount of fines (>12%)	GM	Silty gravels, gravel-sand-silt mixtures	Atterberg limit below A-line or PI<4
			GC	Clayey gravels, gravel-sand-silt mixtures	Atterberg limit above A-line with PI>7
	Sands More than 50% of coarse fraction passing No. 4 sieve	**Clean Sands** Little or no fines (<5%)	SW	Well-graded sands, gravelly sands, little or no fines	Cu>6 and 1<=Cc=3
			SP	Poorly graded sands, gravelly sands, little or no fines	Not meeting Cu and Cc criteria for SW
		Sands with Fines Appreciable amount of fines (>12%)	SM	Silty sands, sand-silt mixture	Atterberg limit below A-line or PI<4
			SC	Clayey sands, sand-clay mixture	Atterberg limit above A-line with PI>7
FINE GRAINED SOILS More than 50% of material smaller than No. 200 sieve size	**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	Atterberg limit below A-line
			CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, lean clay	Atterberg limit above A-line
			OL	Organic silts and organic silty clays flow plasticity	Atterberg limit below A-line
	Silts and Clays Liquid limit larger than 50%		MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts	Atterberg limit below A-line
			CH	Inorganic clays of high plasticity, fat clays	Atterberg limit above A-line
			OH	Organic clays of high plasticity, organic silts	Atterberg limit below A-line
HIGHLY ORGANIC SOILS			Pt	Peat and other highly organic soils	

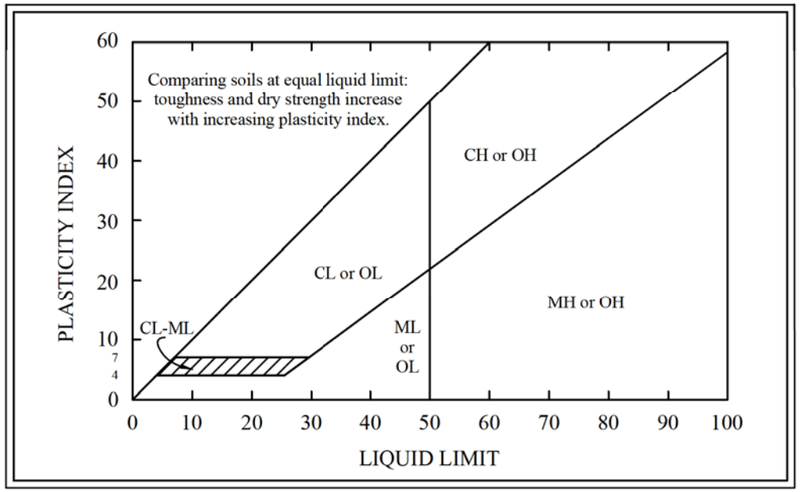
Notes: 1. Cu = D60/D10, Cc = (D30)^2/(D60 x D10) where D60, D30 and D10 are diameters associated with 60%, 30% and 10% smaller in gradation curves.
2. Dual symbols are used to indicate borderline classifications such as GP/SP.

GRADATION CHART

Soil Fraction		Size Range			
		Lower Limit		Upper Limit	
		Millimeters	Sieve	Millimeters	Sieve
Boulders		304.8	12*	914.4	36*
Cobbles		76.2	3*	304.8	12*
Gravel		4.76	4**	76.2	3*
Sand	Coarse	2	10**	4.76	4**
	Medium	0.42	40**	2	10**
	Fine	0.074	200**	0.42	40**
Fines				0.074	200**

* U.S. standard sieve opening in inches
** U.S. standard sieve number

PLASTICITY CHART



UNIFIED SOIL CLASSIFICATION
GEOTECHNICAL EXPLORATION AND ASSESSMENT
Stream Bank Bluff Protection and Stabilization
of a Second Erosion Scarp
Second Level of the Riverside Apartments Property
333 Ohai Street, Hilo, Hawaii (TMK 2-6-003:009)

YOGI KWONG ENGINEERS, LLC
PROJECT NO. 11011

FIGURE A-1

DESCRIPTION OF ROCK MATERIALS

A. DEGREE OF WEATHERING

The following terms were used to describe the chemical weathering of rock:

Extremely Weathered: The original minerals of the rock have been almost entirely altered to secondary minerals, even though the original fabric may be intact.

Highly Weathered: The rock is weakened to such an extent that a 2-inch diameter core can be broken readily by hand across the rock fabric.

Moderately Weathered: Rock is discolored and noticeably weakened, but a 2-inch diameter core cannot usually be broken by hand, across the rock fabric.

Slightly Weathered: Rock is slightly discolored, but not noticeably lower in strength than fresh rock.

Unweathered: Rock shows no discoloration, loss of strength, or any other effect of weathering.

B. HARDNESS

The following terms were used to describe the hardness of rock and soil (per ASTM D4879-08 Standard Guide for Geotechnical Mapping of Large Underground Opening in Rock):

Very Soft or Hard, Soil-like Material (Friable): Scratched with fingernail. Slight indention produced by light blow of point of geologic pick. Requires power tools for excavation. Peels with pocket knife.

Soft Rock: Hand-held specimen crumbles under firm blows with point of geologic pick.

Moderately Soft Rock: Shallow indention (1-3mm) produced by light blows with point of geologic pick. Peels with pocket knife with difficulty.

Moderately Hard Rock: Cannot be scraped or peeled with pocket knife. Intact hand held specimen breaks with single blow of geologic hammer. Can be distinctly scratched with 20d common steel nail.

Hard Rock: Intact held specimen requires more than one hammer blow to break it. Can be faintly scratched with 20d common steel nail.

Very Hard Rock: Intact specimen breaks only by repeated, heavy blows with geologic hammer. Cannot be scratched with 20d common steel nail.

C. ROCK FRACTURE CHARACTERISTICS

The general fracture spacing is described in the boring log according to the following criteria:

Crushed: Less than 5 microns (mechanical clay) to 0.1 foot.

Intensely Fractured: 0.05 to 0.1 foot (contain no clay).

Closely Fractured: 0.1 to 0.5 feet.

Moderately Fractured: 1.0 to 3.0 feet.

Very Widely Fractured: Over 3 feet.

STREAM BANK BLUFF PROTECTION AND STABILIZATION SECOND LEVEL OF THE RIVERSIDE APARTMENTS PROPERTY

LOG OF BORING KEY

LOCATION: 333 OHAI STREET, HILO, HAWAII (TMK 2-6-003:009)
DATE(S) DRILLED:
GROUND SURFACE ELEVATION:
LOGGED BY:
CHECKED BY:
GROUNDWATER LEVEL / DATE:
HAMMER TYPE:
HAMMER WEIGHT/DROP:
CONTRACTOR:
DRILLING METHOD:
DRILL EQUIP:
BOREHOLE BACKFILL:

ELE. (FT, MSL)	DEPTH (FT)	SAMPLE TYPE	SAMPLE NO.	SAMPLING RESISTANCE	RECOVERY, %	RQD, %	GRAPHIC LOG	DESCRIPTION	WATER CONTENT, %	DRY UNIT WEIGHT, pcf	GRAVEL	SAND	FINES	OTHER TESTS AND REMARKS
0	0							STRATA SYMBOLS						
								Asphalt Concrete						
								Elastic silt (MH)						
								Silty Gravel (GM)						
								Basalt Rock						
-5	5							Well-graded gravel (GW)						
								Cobbles						
								Boulders						
								SAMPLER SYMBOLS						
								Standard Penetration Test (SPT) sampler						
-10	10							Dames and Moore (D&M) sampler						
				10				Modified California (MC) sampler						
								Number of blows to advance sampler 12 inches, or distance indicated						
-15	15							ABBREVIATIONS FOR TESTS						
								Gravel = % of sampler passing through 76.2 mm sieve and retained on #4 sieve						
								Sand = % of sample passing through #4 sieve and retained on #200 sieve						
								Fines = % of sample passing through #200 sieve						
-20	20							TXCU = Triaxial Shear Consolidated Undrained Test						
								DS = Direct Shear Test						
								FV = Field Vane Shear, tsf						CWR = Complete Water Return
								PP = Pocket Penetrometer Test, tsf						
								TV = Pocket Torvane Test, tsf						PWR = Partial Water Return
-25	25							PI = Plastic Index (% moisture)						
								LL = Liquid Limit (% moisture)						
								CON = One-Dimensional Consolidation Test						
								Swell = One-Dimensional Swell Potential Test						
-30	30													

YOGI KWONG ENGINEERS, LLC

Date Printed:9/18/2012 **FIGURE A-3**

STREAM BANK BLUFF PROTECTION AND STABILIZATION SECOND LEVEL OF THE RIVERSIDE APARTMENTS PROPERTY

LOG OF BORING B2-1

LOCATION: 333 OHAI STREET, HILO, HAWAII (TMK 2-6-003:009)
DATE(S) DRILLED: 4-19-11
GROUND SURFACE ELEVATION: +/- 56.0 FT MSL
LOGGED BY: D. GANDY
CHECKED BY: K. SANDEFUR
GROUNDWATER LEVEL / DATE: +28.0 FT MSL / 4-19-11
HAMMER TYPE: SAFETY
HAMMER WEIGHT/DROP: 140 LB / 30 IN
CONTRACTOR: HAWAII TEST BORINGS, INC.
DRILLING METHOD: 4" SOLID STEM AUGER, NX CORE SYSTEM, WASH BORE
DRILL EQUIP: SIMCO 2400 SK-1
BOREHOLE BACKFILL: CUTTINGS, GRAVEL, CEMENT GROUT (TREMIE)

ELE. (FT, MSL)	DEPTH (FT)	SAMPLE TYPE	SAMPLE NO.	SAMPLING RESISTANCE	RECOVERY, %	RQD, %	GRAPHIC LOG	DESCRIPTION	WATER CONTENT, %	DRY UNIT WEIGHT, pcf	GRAVEL	SAND	FINES	OTHER TESTS AND REMARKS
	0							AMORPHIC VOLCANIC ASH						
55			1	8	67			Brown with reddish brown elastic silt with sand and roots (MH), medium stiff, moist to wet	168.3	25.9				PP = 0.5 tsf Swell
			2	4	83			grades to soft to medium stiff, without roots	171.2					PP = 0.63 tsf TV = 0.25 tsf LL = 225 PI = 111
	5		3	3	100			grades to reddish brown, very soft to soft	158.4	31.0				PP=0.63 tsf TV = 0.44 tsf CON
50			4	5	100			grades with trace sand, soft	165.2	27.5				
			5	4	67									
	10		6	6	100			WEATHERED TUFFACEOUS DEPOSITS Dark gray elastic silt with highly weathered gravel and sand (MH), soft, moist to wet grades with orangish brown, soft to medium stiff, more gravelly						PP = 0.25 tsf
45			7	2	100			becomes dark brown, more sandy with less gravel, very soft to soft	60.3					PP = 0.38 tsf TV = 0.38 tsf LL = 57 PI = 14
									68.9	52.5				PP = 0.25 tsf
	15							Probable void, fissure, or soft/loose zone						
40			8	1/54"	16.7									
			9	2	67			becomes very soft	55.9	65.0				PP = 0.63 tsf TV = 0.25 tsf TXCU
	20		10	3	56			Mottled dark brown silty gravel with sand and roots (GM), very loose, moist to wet	49.4	71.9	30	27	43	TXCU
35			11	17/8"	64			PROBABLE BASALT CLINKERS Dark brown silty gravel, cobbles, and boulders (GM), dense	64.3	64.0				Sampler Refusal 15 blows for final 2 inches and auger grinding 21.5' to 23' bgs
			12	107	6									
	25							Probable void, fissure, or soft/loose zone						14" basalt cobble recovered in NX barrel
30			13	1/36"	0									
														Install casing
								Mottled brown sandy elastic silt (MH), stiff						
			14	12	100			Mottled brown and dark gray silty sand with gravel (SM), very dense, wet						
	30		15	30/2"	100									

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Date Printed:9/18/2012 **FIGURE A-4**

STREAM BANK BLUFF PROTECTION AND STABILIZATION SECOND LEVEL OF THE RIVERSIDE APARTMENTS PROPERTY

LOG OF BORING B2-1

LOCATION: 333 OHAI STREET, HILO, HAWAII (TMK 2-6-003:009)
DATE(S) DRILLED: 4-19-11
GROUND SURFACE ELEVATION: +/- 56.0 FT MSL
LOGGED BY: D. GANDY
CHECKED BY: K. SANDEFUR
GROUNDWATER LEVEL / DATE: +28.0 FT MSL / 4-19-11
HAMMER TYPE: SAFETY
HAMMER WEIGHT/DROP: 140 LB / 30 IN
CONTRACTOR: HAWAII TEST BORINGS, INC.
DRILLING METHOD: 4" SOLID STEM AUGER, NX CORE SYSTEM, WASH BORE
DRILL EQUIP: SIMCO 2400 SK-1
BOREHOLE BACKFILL: CUTTINGS, GRAVEL, CEMENT GROUT (TREMIE)

ELE. (FT, MSL)	DEPTH (FT)	SAMPLE TYPE	SAMPLE NO.	SAMPLING RESISTANCE	RECOVERY, %	RQD, %	GRAPHIC LOG	DESCRIPTION	WATER CONTENT, %	DRY UNIT WEIGHT, pcf	GRAVEL	SAND	FINES	OTHER TESTS AND REMARKS
	30							Dark bluish gray with brown slightly to extremely weathered basalt, friable to hard, closely to intensely fractured with silt and sand infilling						Sampler refusal
25			NX-1		21	0								Alternating gray and brown CWR
	35		16	75/9"	40									Sampler refusal 50 blows for final 3 inches
20			NX-2		75	35		BASALT LAVA FLOWS Dark bluish gray with brown basalt, unweathered to highly weathered, hard to soft, moderately to intensely fractured						Partial gray to clear CWR
								PROBABLE BASALT CLINKER Dark Brown and gray silty gravel and cobbles (GM)						
	40							Boring completed at 39.0 feet below existing ground surface on 4/19/2011.						
15								Borehole backfilled with tremie grout. 23 gallons using #90 cement and #25 bentonite.						
	45													
10														
	50													
5														
	55													
0														
	60													

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Date Printed:9/18/2012 **FIGURE A-4**

STREAM BANK BLUFF PROTECTION AND STABILIZATION SECOND LEVEL OF THE RIVERSIDE APARTMENTS PROPERTY

LOG OF BORING B2-1A

LOCATION: 333 OHAI STREET, HILO, HAWAII (TMK 2-6-003:009)
DATE(S) DRILLED: 4-20-11
GROUND SURFACE ELEVATION: +/- 56.0 FT MSL
LOGGED BY: D. GANDY
CHECKED BY: K. SANDEFUR
GROUNDWATER LEVEL / DATE: NONE ENCOUNTERED
HAMMER TYPE: SAFETY
HAMMER WEIGHT/DROP: 140 LB / 30 IN
CONTRACTOR: HAWAII TEST BORINGS, INC.
DRILLING METHOD: 4" SOLID STEM AUGER
DRILL EQUIP: SIMCO 2400 SK-1
BOREHOLE BACKFILL: CUTTINGS, GRAVEL, CEMENT GROUT (TREMIE)

ELE. (FT, MSL)	DEPTH (FT)	SAMPLE TYPE	SAMPLE NO.	SAMPLING RESISTANCE	RECOVERY, %	RQD, %	GRAPHIC LOG	DESCRIPTION	WATER CONTENT, %	DRY UNIT WEIGHT, pcf	GRAVEL	SAND	FINES	OTHER TESTS AND REMARKS
	0							AMORPHIC VOLCANIC ASH Brown with reddish brown elastic silt with sand (MH), moist to wet						Auger to 10' bgs
55														
	5													
50														
	10							becomes brown, soft to medium stiff, moist to wet						PP = 0.38 tsf TV = 0.5 tsf
45			1	3	100				204.4	24.9				
			2	3	54			WEATHERED TUFFACEOUS DEPOSITS Dark gray elastic silt with highly weathered gravel, sand and roots (MH), soft, moist	75.1					PP = 0.5 tsf TV = 0.5 tsf
	15		3	3	100			becomes mottled brown, more sandy with no gravel, very soft to soft, moist	59.3	60.7	0	16	84	TXCU PP = 0.38 tsf TV = 0.31 tsf
40			4	3	100			grades to soft	59.6					PP = 0.33 tsf TV = 0.25 tsf
								Boring completed at 17.5 feet below existing ground surface on 4/20/2011. Borehole backfilled with tremie grout. 11 gallons using #90 cement and #25 bentonite.						
	20													
35														
	25													
30														
	30													

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Date Printed:9/18/2012 **FIGURE A-5**

STREAM BANK BLUFF PROTECTION AND STABILIZATION SECOND LEVEL OF THE RIVERSIDE APARTMENTS PROPERTY

LOG OF BORING B2-2

LOCATION: 333 OHAI STREET, HILO, HAWAII (TMK 2-6-003:009)
DATE(S) DRILLED: 4-20-11 to 4-21-11
GROUND SURFACE ELEVATION: +/- 38.0 FT MSL
LOGGED BY: D. GANDY
CHECKED BY: K. SANDEFUR
GROUNDWATER LEVEL / DATE: +22.0 FT MSL / 4-21-11
HAMMER TYPE: SAFETY
HAMMER WEIGHT/DROP: 140 LB / 30 IN
CONTRACTOR: HAWAII TEST BORINGS, INC.
DRILLING METHOD: 4" SOLID STEM AUGER, NX CORE SYSTEM, WASH BORE
DRILL EQUIP: SIMCO 2400 SK-1
BOREHOLE BACKFILL: CUTTINGS, GRAVEL, CEMENT GROUT (TREMIE)

ELE. (FT, MSL)	DEPTH (FT)	SAMPLE TYPE	SAMPLE NO.	SAMPLING RESISTANCE	RECOVERY, %	RQD, %	GRAPHIC LOG	DESCRIPTION	WATER CONTENT, %	DRY UNIT WEIGHT, pcf	GRAVEL	SAND	FINES	OTHER TESTS AND REMARKS
	0							AMORPHIC VOLCANIC ASH Reddish brown sandy elastic silt (MH), soft, moist to wet						
			1	5	100				166.0	28.4				PP = 0.5 tsf TV = 0.38 tsf Swell
35			2	1	94			becomes very soft						
	5		3	2	100				186.3	27.6				
			4	1	100									TV = 0.25 tsf
30			5	2	100									
			6	1	22			grades with roots	165.5	28.5				
	10		7	2	100				135.2	34.7				
			8	3	100			becomes soft to very soft	166.6	30.5				
25			9	3	100			ALLUVIUM Interbedded seams and layers of mottled dark gray silty sand and sandy elastic silt with gravel (SM/MH), very soft to very loose, moist to wet	87.1	49.5			70	TXCU
	15		10	1	100				166.5					LL = 199 PI = 110
			11	5	100			becomes soft to very loose	103.9	44.8	16	59	24	TXCU
20			12	7	56			grades with cobbles	60.2	59.6				DS
	20		13	17	100			grades to mottled brown, soft to loose, with more gravel	41.9	73.2	25	37	38	TXCU
			14	4	56			becomes soft to very loose, wet	63.0	61.8			71	TXCU
15			15	19	100			grades with more gravel, soft to loose, wet	54.5	69.3	15	48	38	
			16	22	33			grades with less gravel	61.0	55.5				Large basalt gravel in shoe
	25		17	25/11"	100			becomes medium stiff to medium dense	59.9	66.1				
								BASALT LAVA FLOWS Dark bluish gray slightly vesicular slightly weathered basalt, hard, closely fractured to crushed with soft rock-like to soil-like, extremely weathered, contains sandy silt infilling in fractures						Install casing
10			NX-1		71	29								Brown PWR
	30							contains extremely weathered zone						

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Date Printed:4/17/2013 **FIGURE A-6**

STREAM BANK BLUFF PROTECTION AND STABILIZATION SECOND LEVEL OF THE RIVERSIDE APARTMENTS PROPERTY

LOG OF BORING B2-2

LOCATION: 333 OHAI STREET, HILO, HAWAII (TMK 2-6-003:009)
DATE(S) DRILLED: 4-20-11 to 4-21-11
GROUND SURFACE ELEVATION: +/- 38.0 FT MSL
LOGGED BY: D. GANDY
CHECKED BY: K. SANDEFUR
GROUNDWATER LEVEL / DATE: +22.0 FT MSL / 4-21-11
HAMMER TYPE: SAFETY
HAMMER WEIGHT/DROP: 140 LB / 30 IN
CONTRACTOR: HAWAII TEST BORINGS, INC.
DRILLING METHOD: 4" SOLID STEM AUGER, NX CORE SYSTEM, WASH BORE
DRILL EQUIP: SIMCO 2400 SK-1
BOREHOLE BACKFILL: CUTTINGS, GRAVEL, CEMENT GROUT (TREMIE)

ELE. (FT, MSL)	DEPTH (FT)	SAMPLE TYPE	SAMPLE NO.	SAMPLING RESISTANCE	RECOVERY, %	RQD, %	GRAPHIC LOG	DESCRIPTION	WATER CONTENT, %	DRY UNIT WEIGHT, pcf	GRAVEL	SAND	FINES	OTHER TESTS AND REMARKS
	30							Dark bluish gray slightly vesicular slightly weathered basalt, hard, closely fractured to crushed with extremely weathered sandy silt zones, soft rock-like						Pause drilling 4-20-11 Resume drilling 4-21-11
5			NX-2		52	6								Brown PWR
	35							WEATHERED TUFFACEOUS DEPOSITS Mottled brown sandy elastic silt (MH), medium stiff, wet						Softer core resistance
			18	6	78				70.3		4	33	63	Drill using wash boring methods
0								grades with interbedded seams and layers of silty sand (SM), medium stiff to medium dense, wet						
	40													
			19	12	50			grades with gravel						
-5														
	45													
			20	5	71			becomes medium stiff to loose	55.3		12	40	48	PP = 1.2 tsf
-10														
	50													
			21	27	50			becomes dark gray and brown, medium dense						
-15								Boring completed at 52.5 feet below existing ground surface on 4/21/2011. Borehole backfilled with tremie grout. 34 gallons using #90 cement and #25 bentonite.						
	55													
-20														
	60													

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Date Printed:4/17/2013 **FIGURE A-6**

STREAM BANK BLUFF PROTECTION AND STABILIZATION SECOND LEVEL OF THE RIVERSIDE APARTMENTS PROPERTY

LOG OF BORING B2-3

LOCATION: 333 OHAI STREET, HILO, HAWAII (TMK 2-6-003:009)
DATE(S) DRILLED: 1-31-12 TO 2-1-12
GROUND SURFACE ELEVATION: +/- 47.0 FT MSL
LOGGED BY: J. SPRINGS
CHECKED BY: K. SANDEFUR
GROUNDWATER LEVEL / DATE: SEE END OF LOG
HAMMER TYPE: SAFETY
HAMMER WEIGHT/DROP: 140 LB / 30 IN
CONTRACTOR: HAWAII TEST BORINGS, INC.
DRILLING METHOD: 4" SOLID STEM AUGER
DRILL EQUIP: CONCORE
BOREHOLE BACKFILL: CUTTINGS, GRAVEL, CEMENT GROUT (TREMIE)

ELE. (FT, MSL)	DEPTH (FT)	SAMPLE TYPE	SAMPLE NO.	SAMPLING RESISTANCE	RECOVERY, %	RQD, %	GRAPHIC LOG	DESCRIPTION	WATER CONTENT, %	DRY UNIT WEIGHT, pcf	GRAVEL	SAND	FINES	OTHER TESTS AND REMARKS
	0							PROBABLE FILL Brown elastic silt (MH), moist						Pothole to 3' with hand auger
45								AMORPHIC VOLCANIC ASH Brownish red elastic silt with sand and trace roots (MH), moist to wet						
	5		1	6	100			becomes mottled reddish brown, soft to medium stiff	101.8	34.7				FV = 0.9 tsf PP = 1.1 tsf TV = 0.3 tsf
40			2	5	78									PP = 1.1 tsf TV = 0.4 tsf
	10		3	5	89			becomes brown	116.0	34.5				
35			4	5	100			grades with grayish red and yellow mottling, with voids	59.2	62.0				
	15		5	13	89			WEATHERED TUFFACEOUS DEPOSITS Mottled yellowish brown elastic silt with cinder sand and trace gravel (MH), stiff, moist						
30			6	5	100			becomes mottled dark gray, with friable extremely weathered gravel, soft	57.5	66.9				TXCU
	20		7	10	100			becomes medium stiff	68.6	57.8				TXCU
25			8	7	100			becomes mottled brown	71.4	59.9				PP = 2.3 tsf
	25		9	18	100			becomes stiff						PP = 1.1 tsf
20			10	14	100									
	30													

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Date Printed:9/18/2012 **FIGURE A-7**

STREAM BANK BLUFF PROTECTION AND STABILIZATION SECOND LEVEL OF THE RIVERSIDE APARTMENTS PROPERTY

LOG OF BORING B2-3

LOCATION: 333 OHAI STREET, HILO, HAWAII (TMK 2-6-003:009)
DATE(S) DRILLED: 1-31-12 TO 2-1-12
GROUND SURFACE ELEVATION: +/- 47.0 FT MSL
LOGGED BY: J. SPRINGS
CHECKED BY: K. SANDEFUR
GROUNDWATER LEVEL / DATE: SEE END OF LOG
HAMMER TYPE: SAFETY
HAMMER WEIGHT/DROP: 140 LB / 30 IN
CONTRACTOR: HAWAII TEST BORINGS, INC.
DRILLING METHOD: 4" SOLID STEM AUGER
DRILL EQUIP: CONCORE
BOREHOLE BACKFILL: CUTTINGS, GRAVEL, CEMENT GROUT (TREMIE)

ELE. (FT, MSL)	DEPTH (FT)	SAMPLE TYPE	SAMPLE NO.	SAMPLING RESISTANCE	RECOVERY, %	RQD, %	GRAPHIC LOG	DESCRIPTION	WATER CONTENT, %	DRY UNIT WEIGHT, pcf	GRAVEL	SAND	FINES	OTHER TESTS AND REMARKS
	30		11	22	0			Mottled brown elastic silt with cinder sand and trace friable extremely weathered gravel, stiff, moist to wet	71.0					Resample to obtain undisturbed sample
15			12	8	100			becomes red, medium stiff	76.0	54.3				TXCU
								becomes wet						
								ALLUVIUM						
	35		13	28	100			Brown silty sand with highly weathered gravel (SM), medium dense, wet						
10			14	35	0									
														Pause drilling 1/31/12 Resume drilling 2/1/12
	40		15	21	100			becomes brown to orangish brown, loose						sampler refusal and bouncing (34 blows for first 6-inches)
5			16	44/10"	100			Orangish brown highly to moderately weathered silty gravel with sand (GM), medium dense to dense, wet						
								contains probable cobbles and boulders						
	45		17	75/5"	100			grades to grayish brown, very dense contains probable cobbles and boulders						sampler refusal
0			18	82	83									auger chatter, slow advance, ground vibrations while augering to 53' bgs
	50		19	65/3"	100			becomes brown, with probable cobbles and boulders						
			20	34	100			becomes dense						
-5														
								with less cobbles and boulders						no auger chatter
								Dark gray highly weathered subangular poorly graded gravel with silt (GP), with seams of brown silty sand, medium dense, wet						
	55		21	29	100									
-10														
								contains probable cobbles and boulders						auger grinding 59' to 60' bgs
	60													

YOGI KWONG ENGINEERS, LLC

Date Printed:9/18/2012 **FIGURE A-7**

STREAM BANK BLUFF PROTECTION AND STABILIZATION SECOND LEVEL OF THE RIVERSIDE APARTMENTS PROPERTY

LOG OF BORING B2-3

LOCATION: 333 OHAI STREET, HILO, HAWAII (TMK 2-6-003:009)
DATE(S) DRILLED: 1-31-12 TO 2-1-12
GROUND SURFACE ELEVATION: +/- 47.0 FT MSL
LOGGED BY: J. SPRINGS
CHECKED BY: K. SANDEFUR
GROUNDWATER LEVEL / DATE: SEE END OF LOG
HAMMER TYPE: SAFETY
HAMMER WEIGHT/DROP: 140 LB / 30 IN
CONTRACTOR: HAWAII TEST BORINGS, INC.
DRILLING METHOD: 4" SOLID STEM AUGER
DRILL EQUIP: CONCORE
BOREHOLE BACKFILL: CUTTINGS, GRAVEL, CEMENT GROUT (TREMIE)

ELE. (FT, MSL)	DEPTH (FT)	SAMPLE TYPE	SAMPLE NO.	SAMPLING RESISTANCE	RECOVERY, %	RQD, %	GRAPHIC LOG	DESCRIPTION	WATER CONTENT, %	DRY UNIT WEIGHT, pcf	GRAVEL	SAND	FINES	OTHER TESTS AND REMARKS
	60		22	85/10"	100			Dark brown to gray highly to moderately weathered gravel with silt (GP), dense, wet						
-15								Boring completed at 61.3 feet below existing ground surface on 2/1/2012.						
								Summary of Groundwater Measurements: Date (ft, bgs) (ft, msl) 2-1-12 (8:40 AM) 33.25' 13.75' 2-2-12 (9:00 AM) 34.5' 12.5'						
	65							Borehole backfilled with tremie grout. 60 gallons using #90 cement and #50 bentonite						
-20														
	70													
-25														
	75													
-30														
	80													
-35														
	85													
-40														
	90													

YKE
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Date Printed:9/18/2012 **FIGURE A-7**

STREAM BANK BLUFF PROTECTION AND STABILIZATION SECOND LEVEL OF THE RIVERSIDE APARTMENTS PROPERTY

LOG OF PROBE P2-1

LOCATION: 333 OHAI STREET, HILO, HAWAII (TMK 2-6-003:009)
DATE(S) DRILLED: 4-21-11
GROUND SURFACE ELEVATION: +/- 56.0 FT MSL
LOGGED BY: D. GANDY
CHECKED BY: K. SANDEFUR
GROUNDWATER LEVEL / DATE: NONE ENCOUNTERED
HAMMER TYPE: SAFETY
HAMMER WEIGHT/DROP: 140 LB / 30 IN
CONTRACTOR: HAWAII TEST BORINGS, INC.
DRILLING METHOD: 4" SOLID STEM AUGER
DRILL EQUIP: SIMCO 2400 SK-1
BOREHOLE BACKFILL: CUTTINGS, GRAVEL, CEMENT GROUT (TREMIE)

ELE. (FT, MSL)	DEPTH (FT)	SAMPLE TYPE	SAMPLE NO.	SAMPLING RESISTANCE	RECOVERY, %	RQD, %	GRAPHIC LOG	DESCRIPTION	WATER CONTENT, %	DRY UNIT WEIGHT, pcf	GRAVEL	SAND	FINES	OTHER TESTS AND REMARKS
	0							AMORPHIC VOLCANIC ASH Brown with reddish brown elastic silt with sand (MH), moist						Description of sampled soil from auger cuttings
55														
	5													
50														
	10							WEATHERED TUFFACEOUS DEPOSITS						Approximate interpreted Geologic Interface based on adjacent Boring B2-1
45														
	15		1	1/12" 1/6" 1/6" 1/6" 1/6" 1/6" 1/6"	NA			Brown mottled with black and reddish brown specks sandy elastic silt (MH), very soft, moist	70.3					PP = 0.13 tsf TV = 0.13 tsf SPT sampler full with soil
40														
	20							Probe completed at 18.0 feet below existing ground surface on 4/21/2011. Borehole backfilled with tremie grout. 11 gallons using #90 cement and #25 bentonite.						
35														
	25													
30														
	30													

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Date Printed:4/11/2013 **FIGURE A-8**

STREAM BANK BLUFF PROTECTION AND STABILIZATION SECOND LEVEL OF THE RIVERSIDE APARTMENTS PROPERTY

LOG OF PROBE P2-2

LOCATION: 333 OHAI STREET, HILO, HAWAII (TMK 2-6-003:009)
DATE(S) DRILLED: 5-11-11
GROUND SURFACE ELEVATION: +/- 47.6 FT MSL
LOGGED BY: D. LIM
CHECKED BY: K. SANDEFUR
GROUNDWATER LEVEL / DATE: + 34.0 FT MSL
HAMMER TYPE: N/A
HAMMER WEIGHT/DROP: N/A
CONTRACTOR: JANOD, INC.
DRILLING METHOD: PERCUSSIVE ROCK BIT
DRILL EQUIP: DRAG AND DRILL AIR TRACK
BOREHOLE BACKFILL: TREMIE GROUT

ELE. (FT, MSL)	DEPTH (FT)	SAMPLE TYPE	SAMPLE NO.	SAMPLING RESISTANCE	RECOVERY, %	RQD, %	GRAPHIC LOG	DESCRIPTION	WATER CONTENT, %	DRY UNIT WEIGHT, pcf	GRAVEL	SAND	FINES	OTHER TESTS AND REMARKS
	0							Brown elastic silt (MH)						
45														
	5													
40														
	10													
35														
	15													
30														
	20													
25								Brown elastic silt (MH), moist						Description of sampled soil from probe cuttings
	25							Brown elastic silt (MH), moist						
20								Brown elastic silt (MH), moist						
	30													

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Date Printed:4/11/2013 **FIGURE A-9**

STREAM BANK BLUFF PROTECTION AND STABILIZATION SECOND LEVEL OF THE RIVERSIDE APARTMENTS PROPERTY

LOG OF PROBE P2-2

LOCATION: 333 OHAI STREET, HILO, HAWAII (TMK 2-6-003:009)
DATE(S) DRILLED: 5-11-11
GROUND SURFACE ELEVATION: +/- 47.6 FT MSL
LOGGED BY: D. LIM
CHECKED BY: K. SANDEFUR
GROUNDWATER LEVEL / DATE: + 34.0 FT MSL
HAMMER TYPE: N/A
HAMMER WEIGHT/DROP: N/A
CONTRACTOR: JANOD, INC.
DRILLING METHOD: PERCUSSIVE ROCK BIT
DRILL EQUIP: DRAG AND DRILL AIR TRACK
BOREHOLE BACKFILL: TREMIE GROUT

ELE. (FT, MSL)	DEPTH (FT)	SAMPLE TYPE	SAMPLE NO.	SAMPLING RESISTANCE	RECOVERY, %	RQD, %	GRAPHIC LOG	DESCRIPTION	WATER CONTENT, %	DRY UNIT WEIGHT, pcf	GRAVEL	SAND	FINES	OTHER TESTS AND REMARKS
	30													Description of sampled soil from probe cuttings
			30					Brown elastic silt (MH), moist						
			30					Clear water mist						
15														
			15					Brown elastic silt (MH), wet						
	35													
10														
			15					Brown elastic silt (MH), wet						
								End probe						
	40		15					Probe completed at 40.0 feet below existing ground surface on 5/11/2011.						
								Borehole backfilled with tremie grout.						
5														
	45													
0														
	50													
-5														
	55													
-10														
	60													

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Date Printed:4/11/2013 **FIGURE A-9**

STREAM BANK BLUFF PROTECTION AND STABILIZATION SECOND LEVEL OF THE RIVERSIDE APARTMENTS PROPERTY

LOG OF PROBE P2-3

LOCATION: 333 OHAI STREET, HILO, HAWAII (TMK 2-6-003:009)
DATE(S) DRILLED: 5-11-11
GROUND SURFACE ELEVATION: N/A
LOGGED BY: D. LIM
CHECKED BY: K. SANDEFUR
GROUNDWATER LEVEL / DATE: NONE ENCOUNTERED
HAMMER TYPE: N/A
HAMMER WEIGHT/DROP: N/A
CONTRACTOR: JANOD, INC.
DRILLING METHOD: PERCUSSIVE ROCK BIT
DRILL EQUIP: DRAG AND DRILL AIR TRACK
BOREHOLE BACKFILL: TREMIE GROUT

ELE. (FT, MSL)	DEPTH (FT)	SAMPLE TYPE	SAMPLE NO.	SAMPLING RESISTANCE	RECOVERY, %	RQD, %	GRAPHIC LOG	DESCRIPTION	WATER CONTENT, %	DRY UNIT WEIGHT, pcf	GRAVEL	SAND	FINES	OTHER TESTS AND REMARKS
0	0							Brown elastic silt (MH) Gravel-to cobble-sized basalt						
			20					Probe completed at 1.5 feet below existing ground surface on 5/11/2011. Borehole backfilled with tremie grout.						Probe stopped due to excessive mud splash
-5	5													
-10	10													
-15	15													
-20	20													
-25	25													
-30	30													

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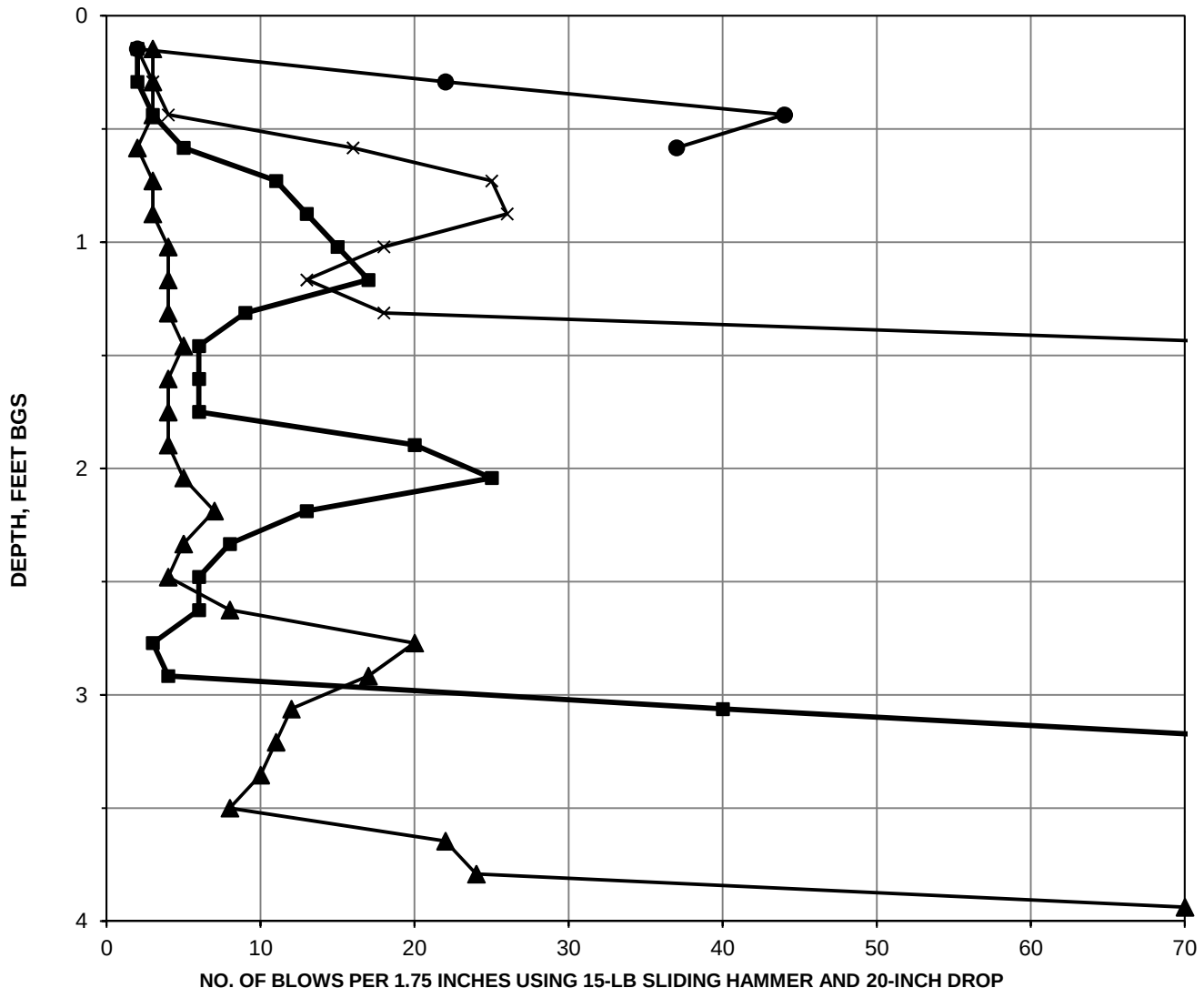
Date Printed:4/11/2013 **FIGURE A-10**



Legend	DCP No.	Date	Approximate Ground Surface Elevation (feet, MSL)	Notes
●	DCP-1	1/22/2013	10	
■	DCP-2	1/22/2013	12	Refusal at approximately 3.2 feet bgs
▲	DCP-3	1/22/2013	9	Refusal at approximately 3.9 feet bgs
x	DCP-4	1/22/2013	10	Refusal at approximately 1.5 feet bgs.
○				

Project: Stream Bank Bluff Protection and Stabilization

Second Level of the Riverside Apartments Property

DYNAMIC CONE PENETROMETER LOG

Location: 333 Ohai Street, Hilo, HI (TMK 2-6-003:009)

Project Number: 11011

FIGURE A-11

Yogi Kwong Engineers, LLC

Global Geophysics

16651 White Mountain Road SE
Monroe, WA 98272
Tel: 425-890-4321
Fax: 360-805-0259

February 11, 2012 Our Ref.: 101-0926.000

Yogi Kwong Engineers, LLC
1357 Kapiolani Blvd., Suite 1450
Honolulu, HI, 96814

Attention: Mr. Kealohi Sandefur

RE: REPORT ON THE GEOPHYSICAL SURVEYS AT 333 OHAI STREET, HILO, HAWAII

Dear Mr. Sandefur:

Global Geophysics conducted electrical resistivity tomography (ERT) and seismic refraction surveys at 333 Ohai Street, Hilo, Hawaii in December 2011. The proposed objectives of the geophysical investigations are to assist in obtaining subsurface conditions in support of the Riverside Apartments Stream Bank evaluation.

METHODOLOGY AND INSTRUMENTATION

Electrical resistivity tomography and seismic refraction were used for this study. The following paragraphs describe the methods and field procedures.

Electrical Resistivity Tomography (ERT)

The electrical resistivity tomography technique maps differences in the electrical properties of geologic materials. These differences can result from variations in lithology, water content, and pore-water chemistry. The method involves transmitting an electric current into the ground between two electrodes and measuring the voltage between two other electrodes. The direct measurement is an apparent resistivity of the area beneath the electrodes that includes deeper layers as the electrode spacing is increased. Recent advances in technology permit rapid collection of multiple soundings, using up to 56 electrodes for each spread. The data are modeled to create a 2-D geo-electric cross-section that is useful for mapping both vertical and horizontal variations of the subsurface strata.

The data were acquired with an AGI SuperSting R8 using up to 56 electrodes spaced at a 5 feet interval. Once the electrode array was installed in the ground, multiple soundings were automatically carried out by the control unit. Downloading and routine modeling of the data was done on-site to provide preliminary analysis and QA/QC of the data. These results were

displayed on a color monitor as cross-section that highlight changes in resistivity with depths along the transects.

Seismic refraction

Seismic refraction is the traditional method for determining the rock velocity for rock rippability using a controlled energy source to generate a seismic signal. The seismic signals are received by a series of geophones (24, for example) that are connected to a seismic cable laid on the ground surface in a linear manner. The geophones, evenly spaced along the geophone cable, are placed on the ground surface. The seismic energy source is discharged at several places along the array and off both ends.

The seismic wavelets travel through the earth to the geophones that convert the acoustic energy in the ground to an electric signal in the geophone cable. The seismograph detects the arriving electric signals with respect to time and stores the records for future data processing. The seismic data is processed to determine the seismic velocity of the earth material through which the energy has traveled and to model the subsurface geology. This geophysical model depicts the earth in cross-section showing the velocity and thickness of the subsurface layers below the seismic line

The seismic refraction survey was conducted using a Geometrics Geode 24-channel digital seismograph. The sensors were Mark Products 4.5-Hz vertical geophones and the seismic energy sources were a 20 lb sledge hammer. The typical field procedure consisted of laying out the cables and planting the geophones at 5 ft intervals. The sledge hammer was pounded at seven locations along the geophone array. Data was collected and saved in digital format and a field record was produced on the computer screen to QA/QC the data in real time.

RESULTS

The ERT data was collected along 2 transects, and seismic refraction data was collected along 5 transects. The locations of these lines are shown in Figure 1. The interpreted resistivity profiles are shown in Figure 2. Interpreted seismic refraction profiles are presented in Figure 3. The results are summarized as follows:

1. Interpreted basalt lava flow only is only present on the east side of the survey area (seismic lines 1 and 3, ERT line 2); lava flow may be present on the southwest of the area on ERT line 1. A rock outcrop was observed on the stream bank bluff to the east of the 'probable historic erosion' (generally areas with very steep or vertical slope contours). The rock outcrop observed at the stream bank bluff appears consistent with the 7,830 ft/sec p-wave velocity picked up in seismic lines 1 and 3.
2. The saturated sandy and gravelly soils in the area of possible historic erosion is present on ERT line 1 and 2.
3. The p-wave velocity of the amorphic volcanic ash ranges between 440 ft/s and 550 ft/s.
4. The p-wave velocity of the weathered tuffaceous deposit ranges between 2140 ft/s and 4520 ft/s.
5. The p-wave velocity of the basalt lava flow is 7830 ft/s.

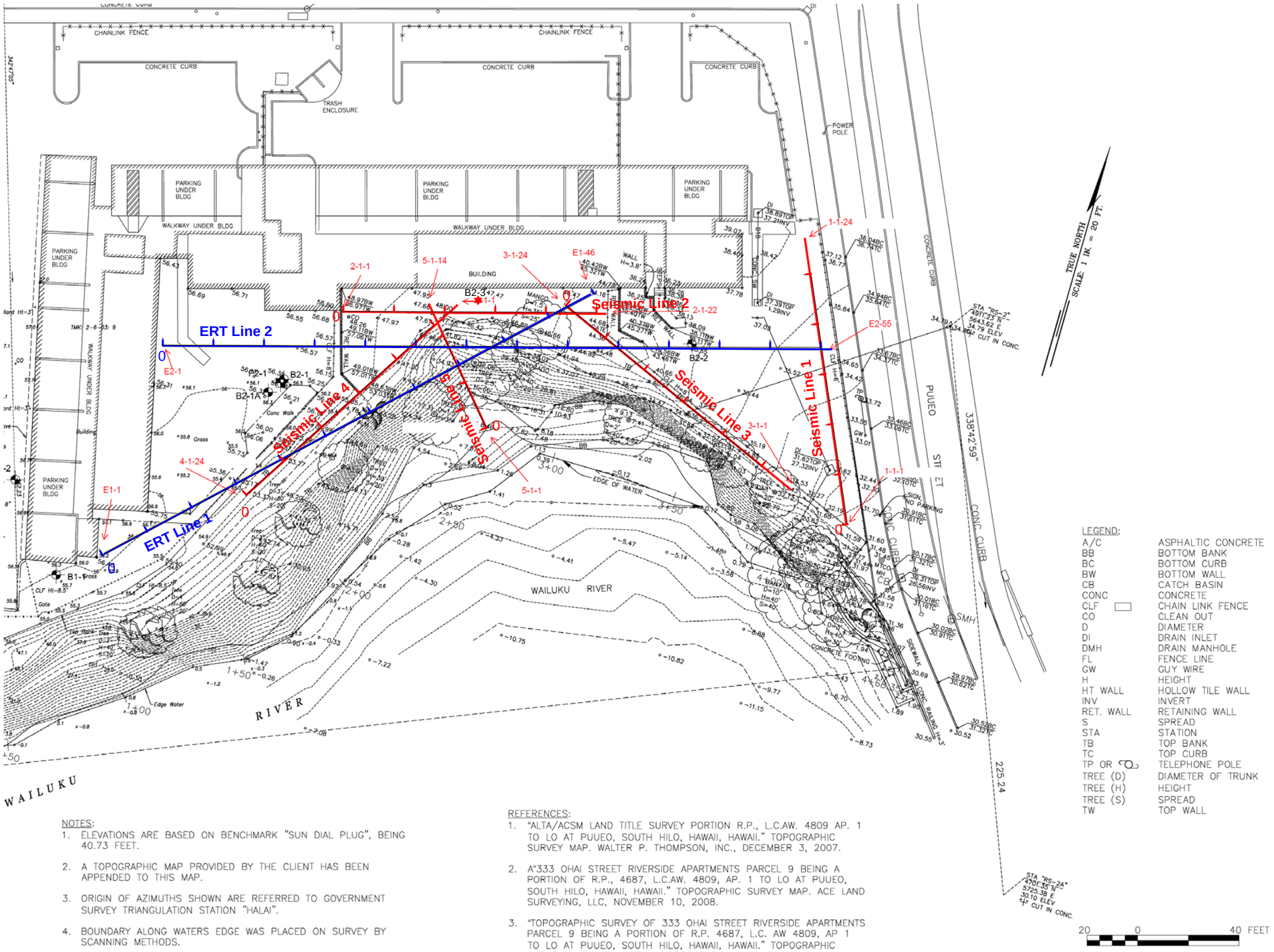
LIMITATIONS OF THE GEOPHYSICAL METHOD

Global geophysics services are conducted in a manner consistent with the level of care and skill ordinarily exercised by other members of the geophysical community currently practicing under similar conditions subject to the time limits and financial and physical constraints applicable to the services. ERI and refraction are remote sensing geophysical methods that may not detect all subsurface conditions due to the limitations of the methods, soil conditions, size of the features and their depths.

Sincerely,

Global Geophysics

John Liu, Ph.D., R.G.
Principal Geophysicist



LEGEND:

A/C	ASPHALTIC CONCRETE
BB	BOTTOM BANK
BC	BOTTOM CURB
BW	BOTTOM WALL
CB	CATCH BASIN
CONC	CONCRETE
CLF	CHAIN LINK FENCE
CO	CLEAN OUT
D	DIAMETER
DI	DRAIN INLET
DMH	DRAIN MANHOLE
FL	FENCE LINE
GW	GUY WIRE
H	HEIGHT
HT WALL	HOLLOW TILE WALL
INV	INVERT
RET. WALL	RETAINING WALL
S	SPREAD
STA	STATION
TB	TOP BANK
TC	TOP CURB
TP OR	TELEPHONE POLE
TREE (D)	DIAMETER OF TRUNK
TREE (H)	HEIGHT
TREE (S)	SPREAD
TW	TOP WALL

NOTES:

1. ELEVATIONS ARE BASED ON BENCHMARK "SUN DIAL PLUG", BEING 40.73 FEET.
2. A TOPOGRAPHIC MAP PROVIDED BY THE CLIENT HAS BEEN APPENDED TO THIS MAP.
3. ORIGIN OF AZIMUTHS SHOWN ARE REFERRED TO GOVERNMENT SURVEY TRIANGULATION STATION "HALAI".
4. BOUNDARY ALONG WATERS EDGE WAS PLACED ON SURVEY BY SCANNING METHODS.

REFERENCES:

1. "ALTA/ACSM LAND TITLE SURVEY PORTION R.P., L.C.AW. 4809 AP. 1 TO LO AT PUUEO, SOUTH HILO, HAWAII, HAWAII." TOPOGRAPHIC SURVEY MAP. WALTER P. THOMPSON, INC., DECEMBER 3, 2007.
2. A"333 OHAI STREET RIVERSIDE APARTMENTS PARCEL 9 BEING A PORTION OF R.P., 4687, L.C.AW. 4809, AP. 1 TO LO AT PUUEO, SOUTH HILO, HAWAII, HAWAII." TOPOGRAPHIC SURVEY MAP. ACE LAND SURVEYING, LLC, NOVEMBER 10, 2008.
3. "TOPOGRAPHIC SURVEY OF 333 OHAI STREET RIVERSIDE APARTMENTS PARCEL 9 BEING A PORTION OF R.P. 4687, L.C. AW 4809, AP 1 TO LO AT PUUEO, SOUTH HILO, HAWAII, HAWAII." TOPOGRAPHIC SURVEY MAP. R.M. TOWILL CORPORATION, AUGUST 2011.

PROJECT

RIVERSIDE APARTMENT STREAM BANK EVALUATION HILO, HAWAII

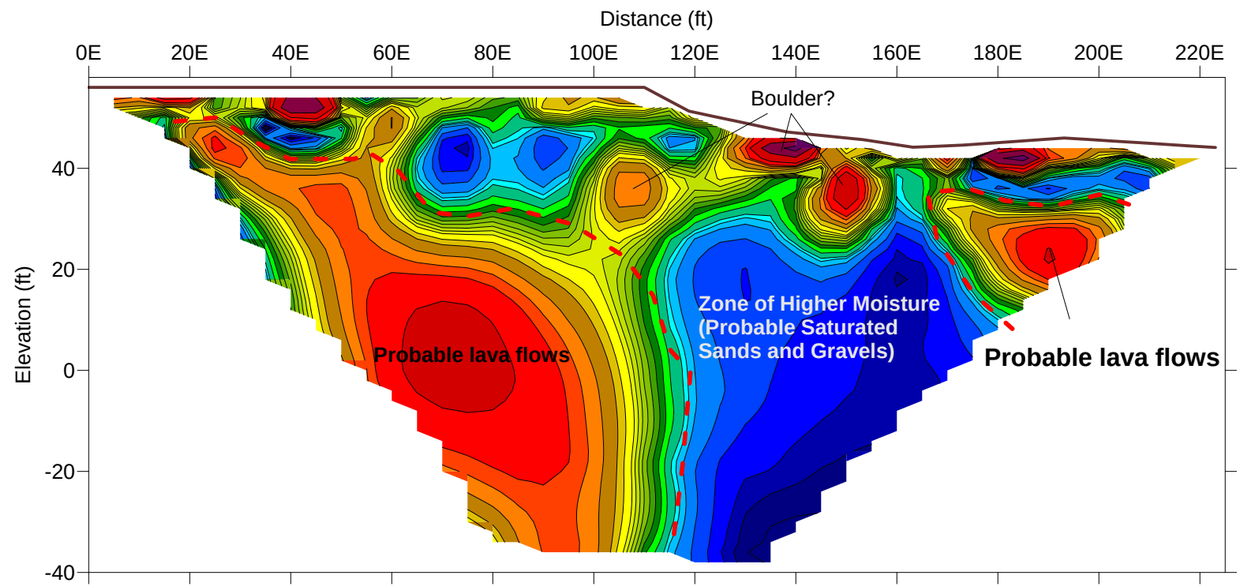
TITLE

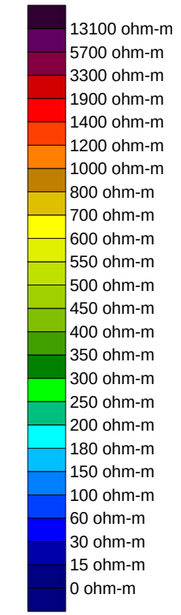
GEOPHYSICAL TRANSECT LOCATIONS

Global Geophysics
16651 White Mountain Road SE
Monroe, WA, 98272
Tel: 425-890-4321

PROJECT NO.: 101-0925.000		FILE No.
DESIGN	--	SCALE AS SHOWN / REV.
CADD	JL	**FIGURE 1**
CHECK	JL	
REVIEW	--	

ERT Line 1





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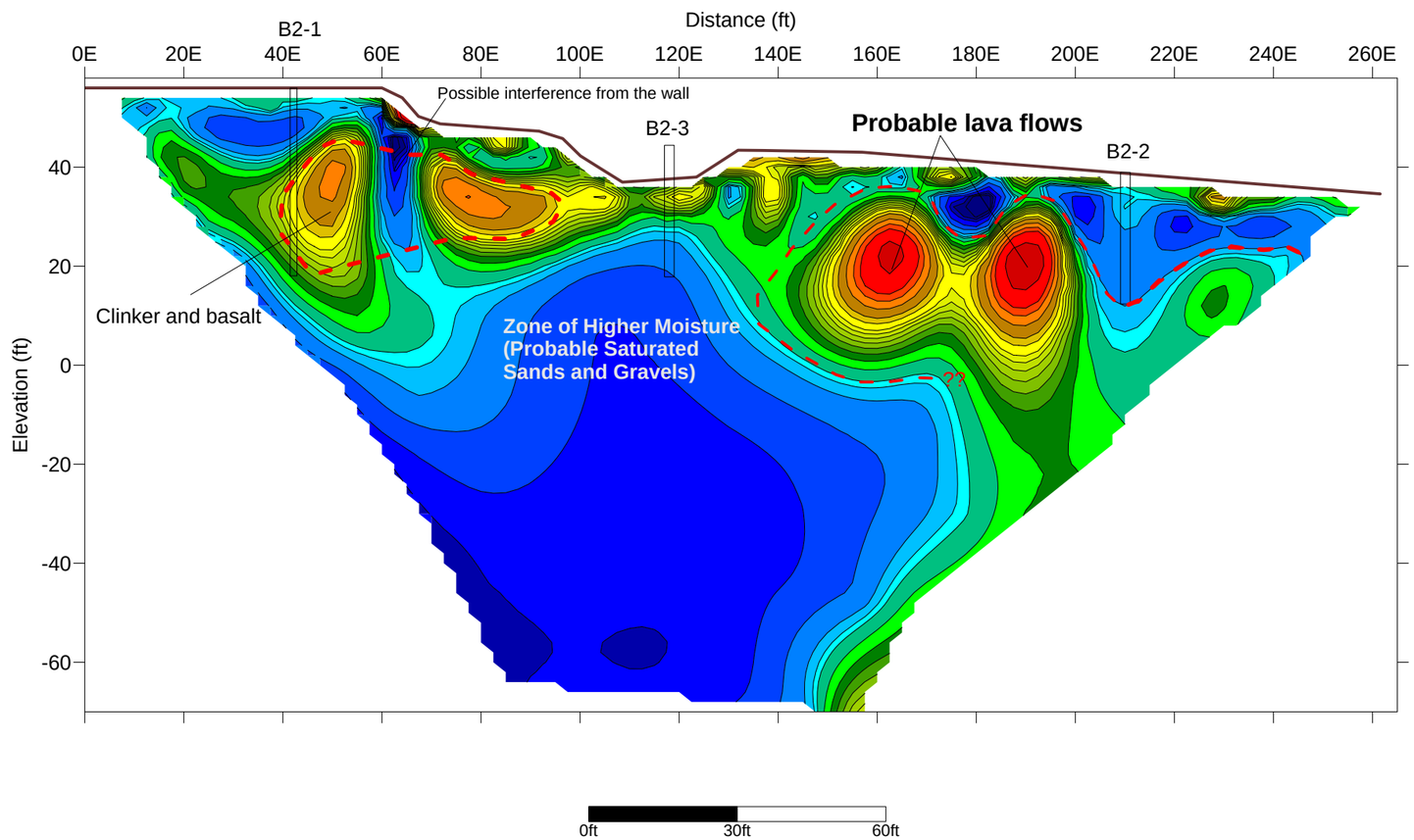


LEGEND:

Ground surface

Basalt Flow?

PROJECT

RIVERSIDE APARTMENT STREAM BANK EVALUATION
HILO, HAWAII

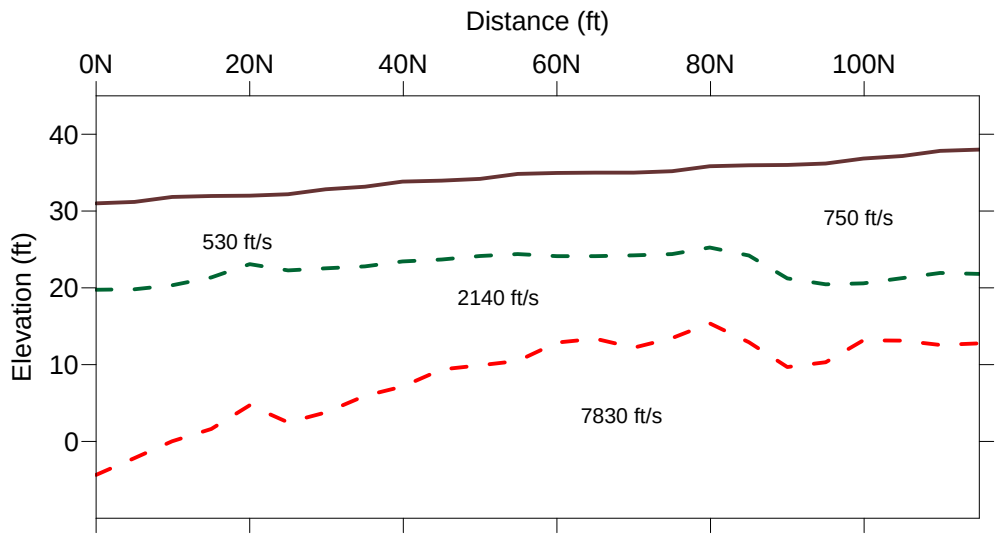
TITLE

INVERTED RESISTIVITY PROFILES

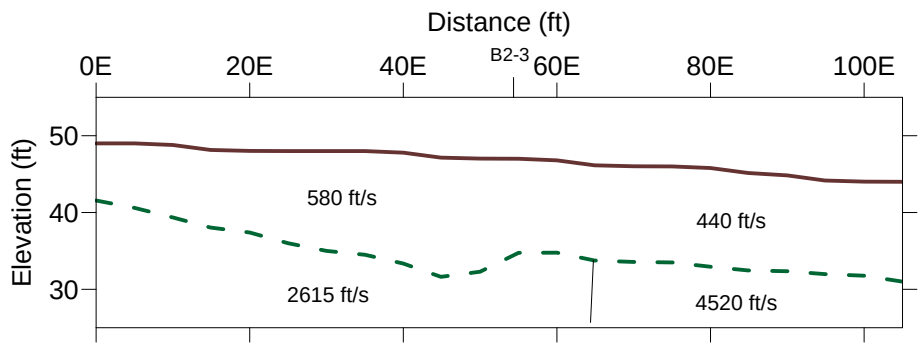
Global Geophysics
16651 White Mountain Road SE
Monroe, WA, 98272
Tel: 425-890-4321

PROJECT NO.: 101-0925.000		FILE No.
DESIGN	--	SCALE AS SHOWN / REV.
CADD	JL	FIGURE 2
CHECK	JL	
REVIEW	--	

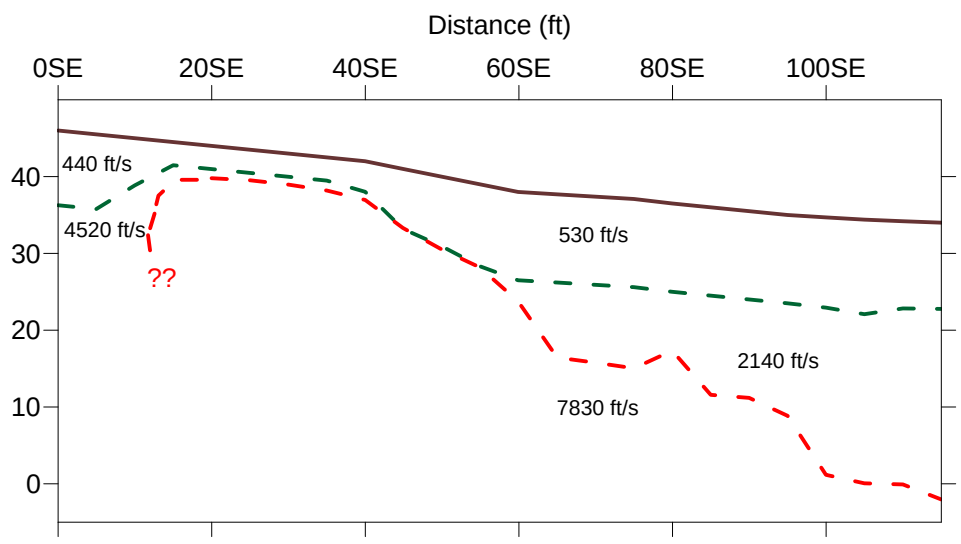
Line 1



Line 2



Line 3



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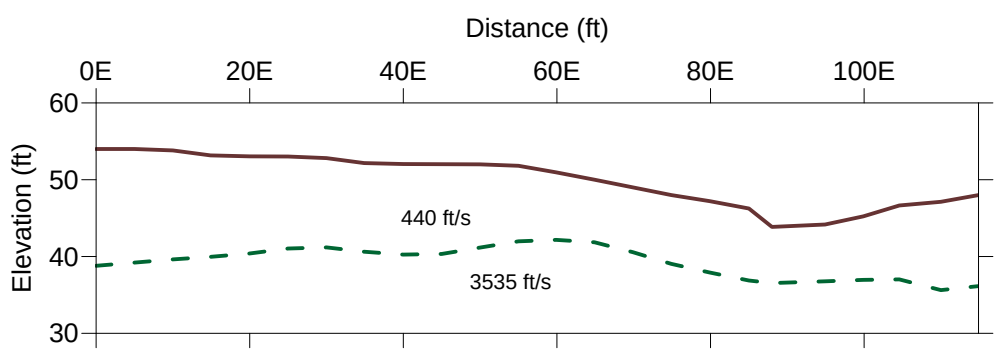

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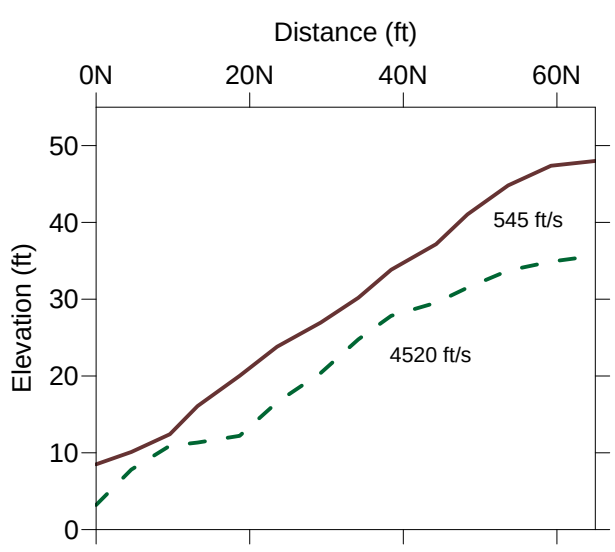
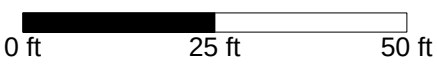




Note: The velocity of the soil/rock is p-wave velocity

Legend

- Ground surface
- Weathered Tuffaceous Deposit
- Bedrock?

PROJECT

RIVERSIDE APARTMENT STREAM BANK EVALUATION
HILO, HAWAII

TITLE

INTERPRETED SEISMIC PROFILES

Global Geophysics
16651 White Mountain Road SE
Monroe, WA, 98272
Tel: 425-890-4321

PROJECT NO.: 101-0925.000		FILE No.
DESIGN	--	SCALE AS SHOWN / REV.
CADD	JL	FIGURE 3
CHECK	JL	
REVIEW	--	

APPENDIX B LABORATORY TESTING

To verify field soil sample descriptions and classifications, selected soil samples obtained during the field exploration were laboratory tested for moisture content, grain size distribution by sieve analyses, Atterberg Limits, one-dimensional consolidation test, one-dimensional swell potential test, and consolidated undrained triaxial shear and direct shear strength. The tests and results are described in the following paragraphs.

B.1 MOISTURE CONTENT AND DRY DENSITY

Selected relatively undisturbed soil samples were tested to measure their moisture contents and dry densities. The tests were performed in accordance with American Society for Testing and Materials (ASTM) Method D2216. Results of the moisture contents and dry densities are presented on the Log of Borings at the appropriate sample depths.

B.2 GRADATION ANALYSES

Gradation analyses were performed on selected samples using the sieve method to evaluate grain size distribution. Gradation analysis tests were performed in accordance with ASTM D422 (3/4-inch through #200 sieve) or ASTM D1140 (#200 sieve only). Results of sieve tests are presented on Figure B-1 and on the Logs of Borings at the appropriate sample depths.

B.3 ATTERBERG LIMITS (PLASTICITY INDEX)

To assist in classifying the soils, Plasticity Index tests were performed on selected samples. These tests were performed in accordance with ASTM D4318. Results of the Atterberg Limits tests are presented on Figure B-2 and on the Logs of Borings at the appropriate sample depths.

B.4 ONE-DIMENSIONAL CONSOLIDATION TEST

The compressibility of relatively undisturbed soil samples was determined by the performance of the one-dimensional consolidation test in accordance with ASTM D2435. Results of these tests are presented on Figure B-3.

B.5 SWELL POTENTIAL TEST

Swell potential tests were performed on selected samples that were saturated by water in accordance with ASTM D4546 Method A. The amount of swell was measured until the time rate of swell slowed. The test results are presented in Table B-1 below.

Table B-1: Summary of One-Dimensional Swell Potential Test Results

Location	Depth (ft)	Initial		Air Dry		Final		Load (psf)	Recorded Swell Potential (%)
		Water Content (%)	Dry Density (pcf)	Water Content (%)	Dry Density (pcf)	Water Content (%)	Dry Density (pcf)		
B2-1	1.0	168.3	25.9	N/A	N/A	193.5	25.5	20	1.20
B2-2	1.0	166.0	28.4	N/A	N/A	178.4	28.3	100	0.40

B.6 CONSOLIDATED UNDRAINED (CU) TRIAXIAL

Ten (10) triaxial consolidated, undrained (CU) compression tests were conducted on relatively undisturbed samples from the borings to evaluate soil strength properties. All CU triaxial tests were performed in accordance with ASTM D4767 except four (4) which were sheared with drain valves open during compression phase. Results of the four (4) triaxial tests with drain valves open are presented in Figure B-4 and the results of the other six (6) tests are presented in Figures B-5 and B-6.

B.7 DIRECT SHEAR

The direct shear test was performed to determine the consolidated drained shear strength of a soil material in direct shear. The test was performed by deforming a specimen at a controlled strain rate on or near a single shear plane determined by the configuration of the apparatus. Four (4) specimens were tested, each under a different normal load, to determine the effects upon shear resistance and displacement, and strength properties, such as Mohr strength envelopes. These tests were performed in accordance with ASTM D3080. The results are presented in Figure B-7.

B.8 pH, RESISTIVITY, SULFATE, CHLORIDE, AND BICARBONATES TESTS

pH analysis tests were performed using test method SM 4500-H+B. Sulfate analysis tests were performed using the EPA 375.4 test method. Chloride analysis tests were performed using the SM 4500-CI C test method. Bicarbonates analysis tests were performed using SM 2320 B test method. Resistivity tests were performed in accordance with ASTM G57 for samples B2-3 at 6.5 feet and B2-3 at 21.0 feet. Resistivity tests were performed in accordance with USDA Handbook 60, Chapter 6 for Sample B2-3 at 45.5 feet. Results of these tests are summarized in Table B-2.

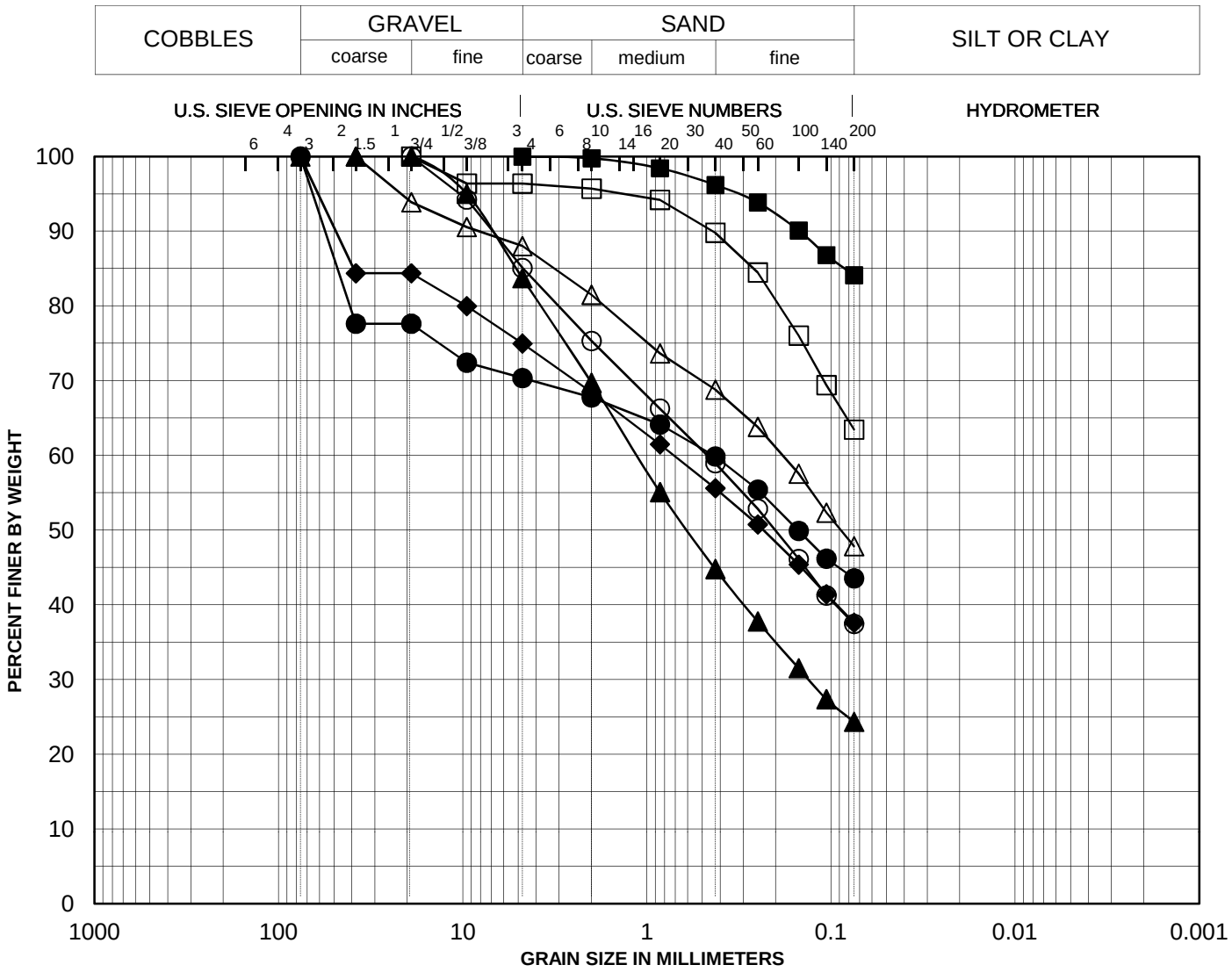
Table B-2: Summary of pH, Resistivity, Sulfates, Chloride, and Bicarbonates Test Results

Boring	Depth (feet)*	pH	Resistivity (OHM-cm)		Sulfates (ppm)	Chloride (ppm)	Bicarbonates (mg/L as CaCO3)
			As Received	Saturated			
B2-2	7.0	7.15			143.85	1.58	2301.3
B2-3	6.5			>20,000[1]			
B2-3	21.0			>20,000[1]			
B2-3	35	5.77			92.54	8.76	271.2
B2-3	45.5		10,225[2]	5,219[2]			
B2-3	50.3	6.86			1395	18.32	229.1

* Below ground surface

[1] Tested in accordance with ASTM G57.

[2] Tested in accordance with the method specified in USDA Handbook 60, Chapter 6.



Boring		Depth (ft)	Description	Gravel %	Sand %	Fines %
●	B2-1	20.0	WEATHERED TUFF, Silty gravel with sand (GM)	29.7	26.8	43.6
■	B2-1A	14.0	WEATHERED TUFF, Elastic silt with sand (MH)	0.0	15.9	84.1
☆	B2-2	13.5	WEATHERED TUFF, Elastic silt with sand (ML)	NA	NA	70.4
▲	B2-2	16.0	WEATHERED TUFF, Silty sand with gravel (SM)	16.3	59.4	24.3
◆	B2-2	19.0	WEATHERED TUFF, Silty sand with gravel (SM)	25.0	37.4	37.6
☆	B2-2	20.5	WEATHERED TUFF, Elastic silt with sand (ML)	NA	NA	70.6
○	B2-2	22.0	WEATHERED TUFF, Silty sand (SM)	14.9	47.6	37.5
□	B2-2	35.5	WEATHERED TUFF, Sandy elastic silt (MH)	3.6	32.9	63.5
△	B2-2	45.5	WEATHERED TUFF, Silty sand (SM)	12.0	40.2	47.8

☆ Note: Samples tested #200 only

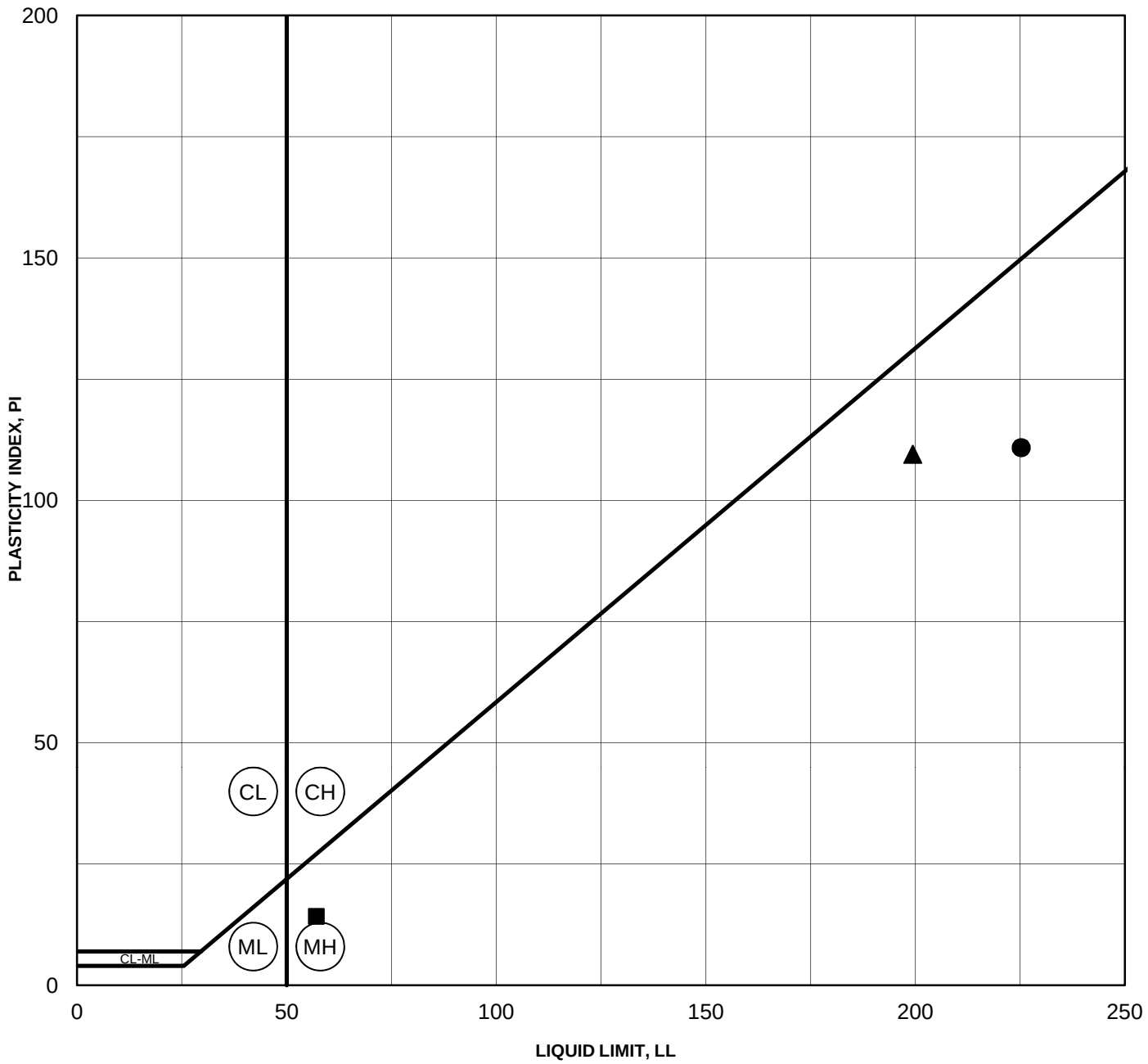
Project: Stream Bank Bluff Protection and Stabilization of a Second Erosion Scarp
Second Level of the Riverside Apartments Property

Location: 333 Ohai Street, Hilo, HI (TMK 2-6-003:009)

GRAIN SIZE DISTRIBUTION

Project Number: 11011

FIGURE B-1



Boring		Depth (ft)	LL %	PL %	PI %	Classification
●	B2-1	2.5	225	114	111	Elastic Silt (MH)
■	B2-1	11.5	57	43	14	Elastic Silt (MH)
▲	B2-2	14.5	199	90	110	Elastic Silt (MH)

Project: Stream Bank Bluff Protection and Stabilization of a Second Erosion Scarp
Second Level of the Riverside Apartments Property

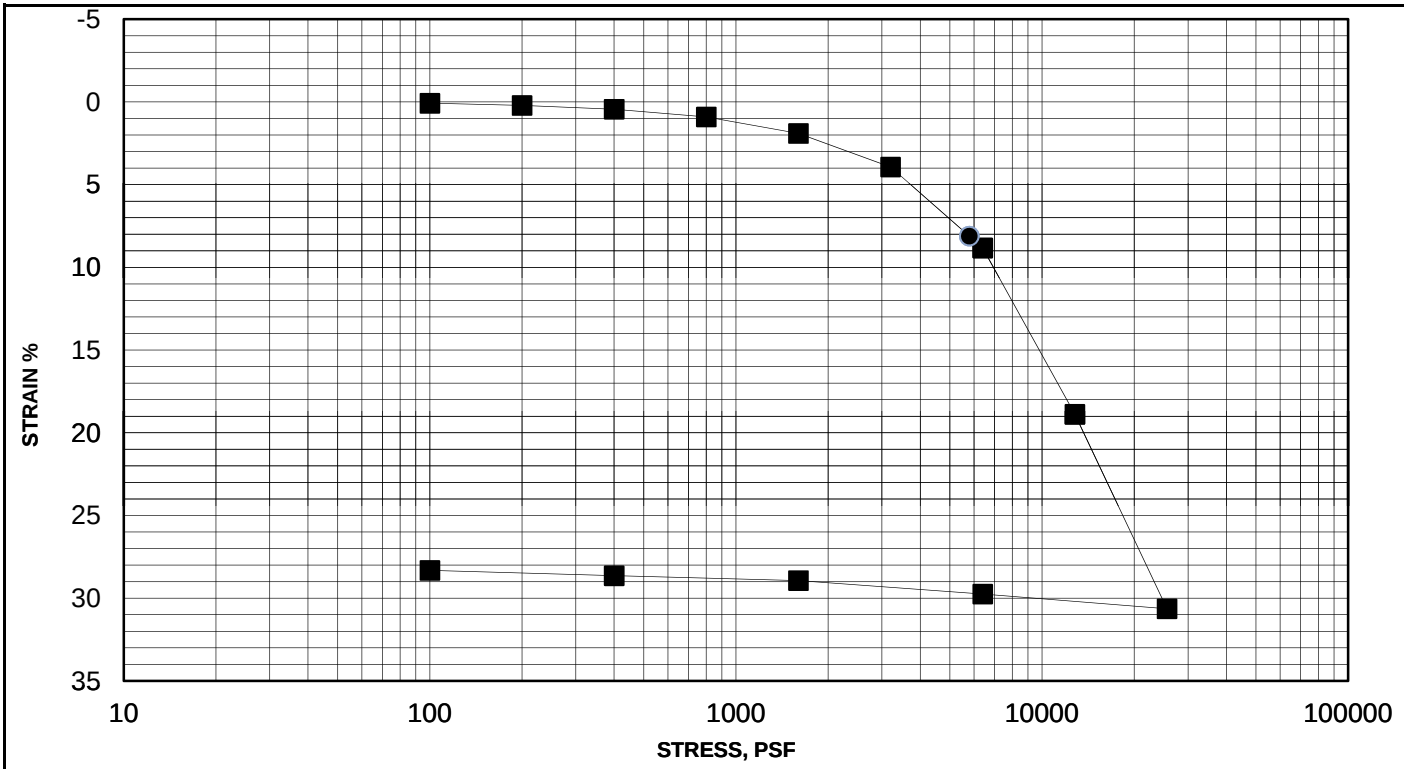
Location: 333 Ohai Street, Hilo, HI (TMK 2-6-003:009)

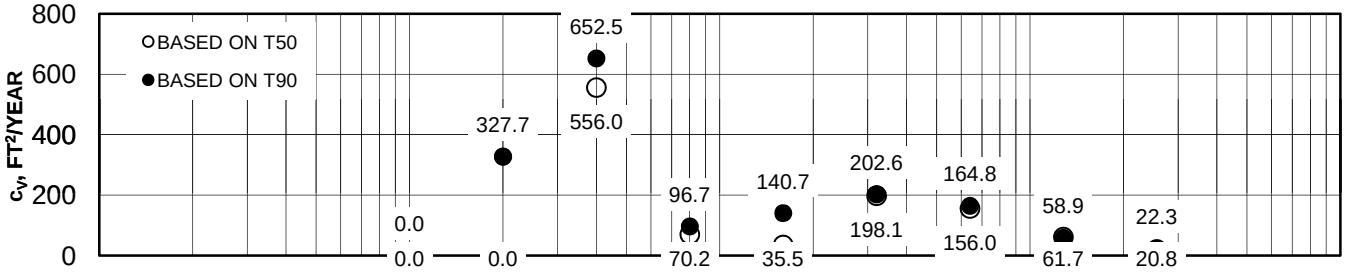
PLASTICITY CHART

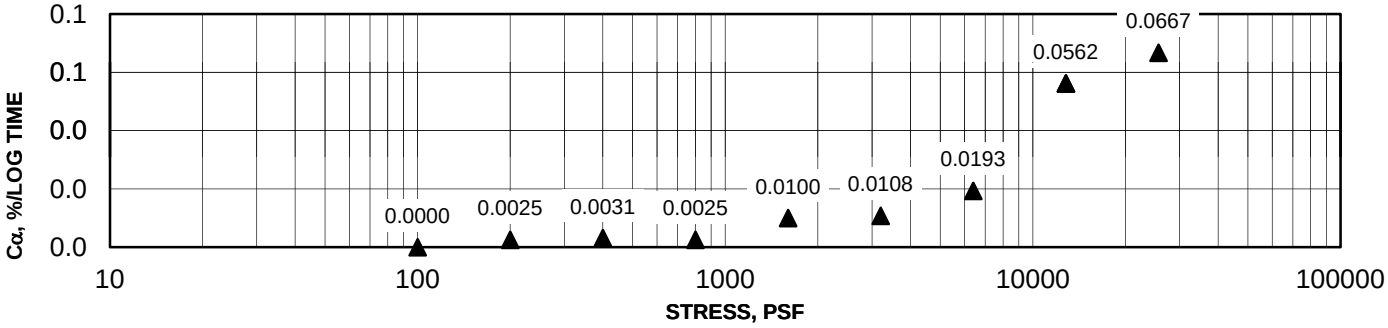
Project Number: 11011

FIGURE B-2

Yogi Kwong Engineers, LLC







Boring	Depth (ft)	Description	Initial		Final		p_o (psf)	$C\varepsilon_c$ (*)	$C\varepsilon_r$ (*)
			w_o (%)	γ_d (pcf)	w_o (%)	γ_d (pcf)			
B2-1	4.5	Elastic silt	158.4	31.0	112.6	43.2	5784	39.1	1.1

* %Vertical Strain / Log Stress

Project: Stream Bank Bluff Protection and Stabilization of a Second Erosion Scarp
Second Level of the Riverside Apartments Property

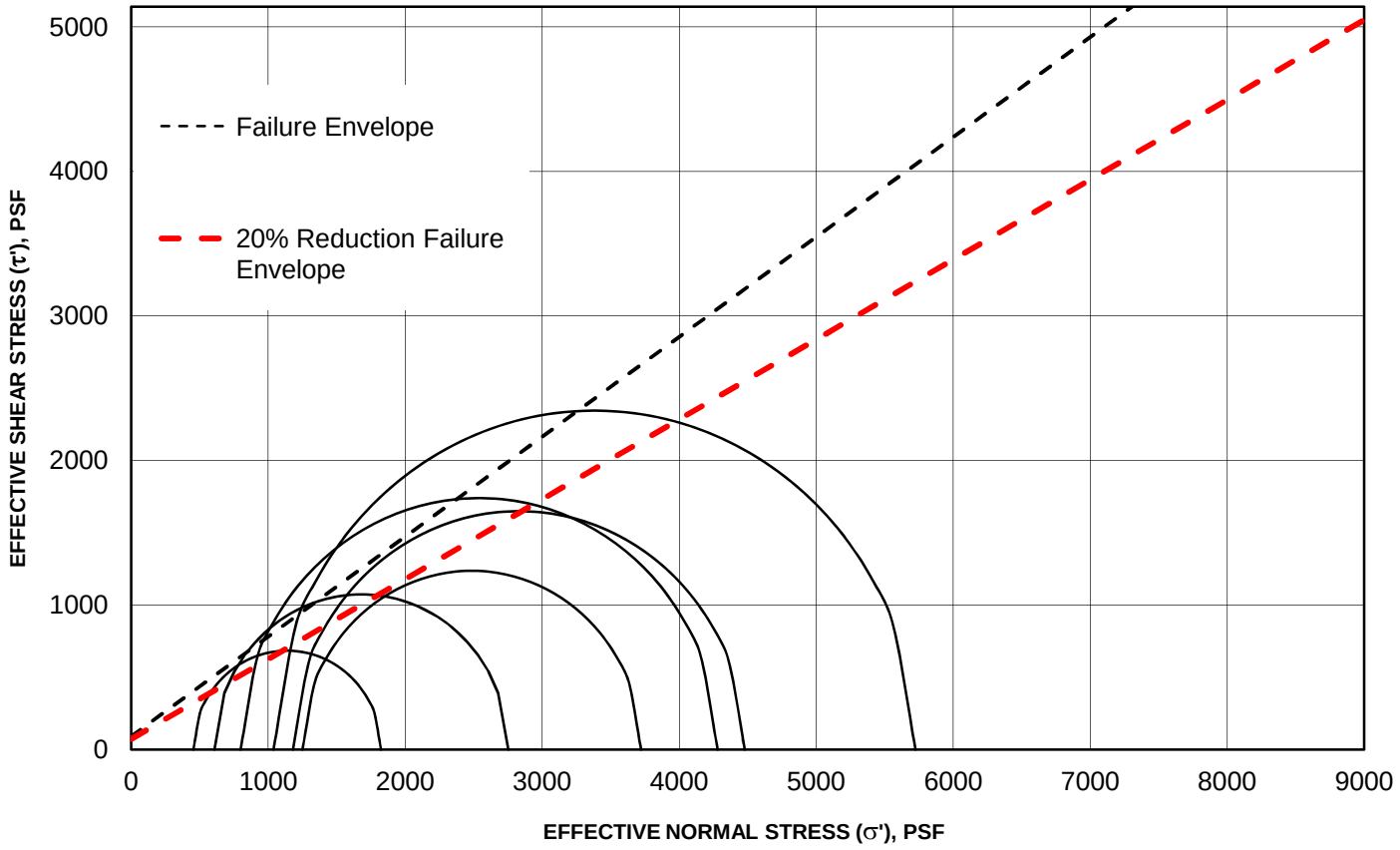
Location: 333 Ohai Street, Hilo, HI (TMK 2-6-003:009)

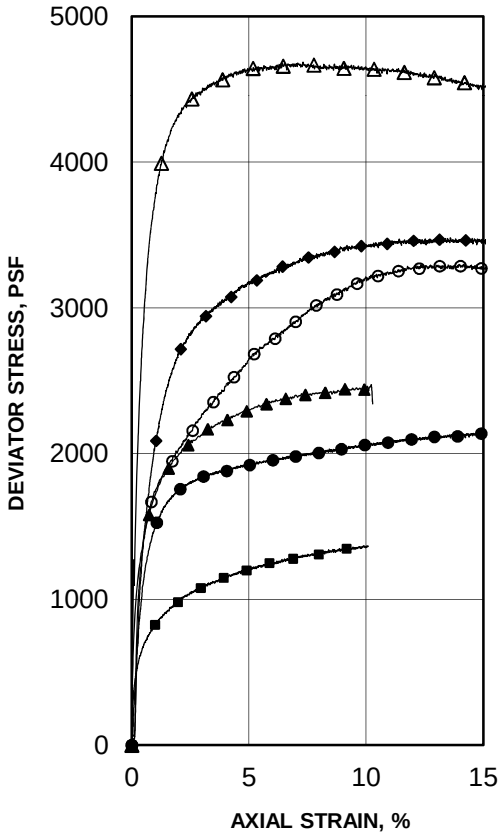
Project Number: 11011

Yogi Kwong Engineers, LLC

CONSOLIDATION TEST

FIGURE B-3





Boring	B2-1	B2-2	B2-2	B2-3	B2-3	B2-3		
Depth (ft)	18.5	13.0	20.5	16.5	20.0	31.5'		
Legend	●	■	▲	◆	○	△		
γ_d (pcf)	65	50	62	67	58	54		
w_o (%)	56%	87%	63%	57%	69%	76%		
σ'_{1f} (psf)	2753	1823	3721	4281	4478	5725		
σ_{3f} (psf)	1500	1000	2500	1500	2500	4000		
σ_{df} (psf)	2146	1369	2471	3481	3298	4687		
u_f (psf)	893	546	1250	700	1320	2962		
NOTES:								

EFFECTIVE STRESS FAILURE ENVELOPE

Peak Failure Envelope	20% Reduction Failure Envelope
ϕ' = 34.7 Degree	**ϕ' = 28.9 Degree**
C'= 91 psf	**C'= 73 psf**

Sample Description:

Weathered Tuffaceous Deposit

Project: Stream Bank Bluff Protection and Stabilization of a Second Erosion Scarp
Second Level of the Riverside Apartments Property

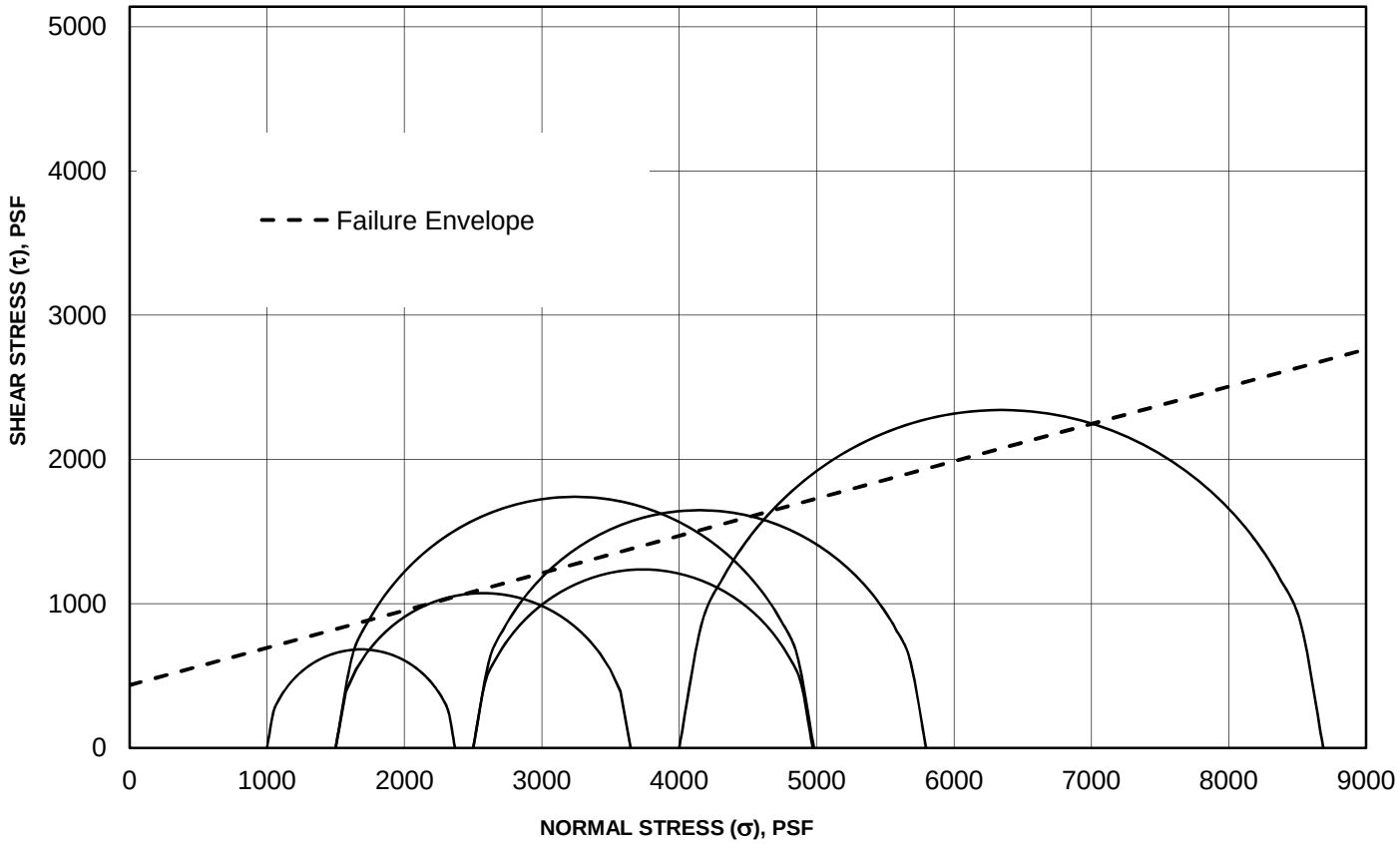
CU TRIAXIAL: EFFECTIVE STRESS

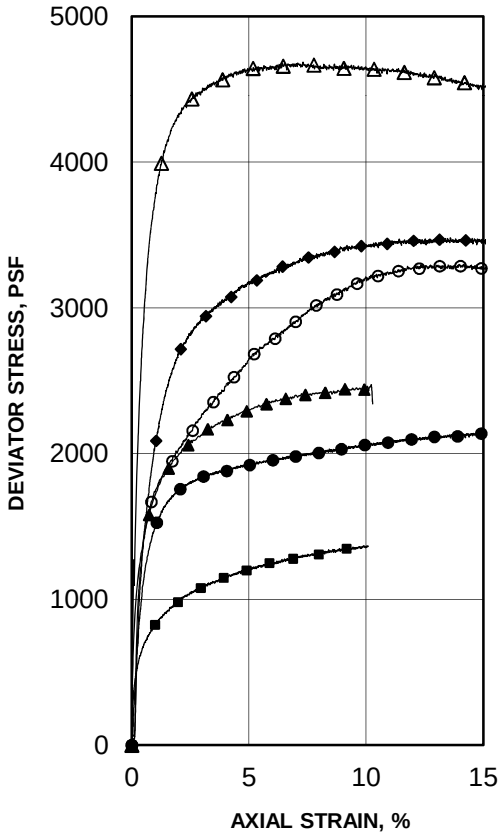
Location:333 Ohai Street, Hilo, HI (TMK 2-6-003:009)

Project Number: 11011

Yogi Kwong Engineers,LLC

FIGURE B-4





Boring	B2-1	B2-2	B2-2	B2-3	B2-3	B2-3		
Depth (ft)	18.5	13.0	20.5	16.5	20.0	31.5'		
Legend	●	■	▲	◆	○	△		
γ_d (pcf)	65	50	62	67	58	54		
w_o (%)	56%	87%	63%	57%	69%	76%		
σ_{1f} (psf)	3646	2369	4971	4981	5798	8687		
σ_{3f} (psf)	1500	1000	2500	1500	2500	4000		
σ_{df} (psf)	2146	1369	2471	3481	3298	4687		
u_f (psf)	893	546	1250	700	1320	2962		

NOTES:

TOTAL STRESS FAILURE ENVELOPE

Peak Failure Envelope

ϕ = 14.5 Degree

C= 435 psf

Sample Description:

Weathered Tuffaceous Deposit

Project: Stream Bank Bluff Protection and Stabilization of a Second Erosion Scarp
Second Level of the Riverside Apartments Property

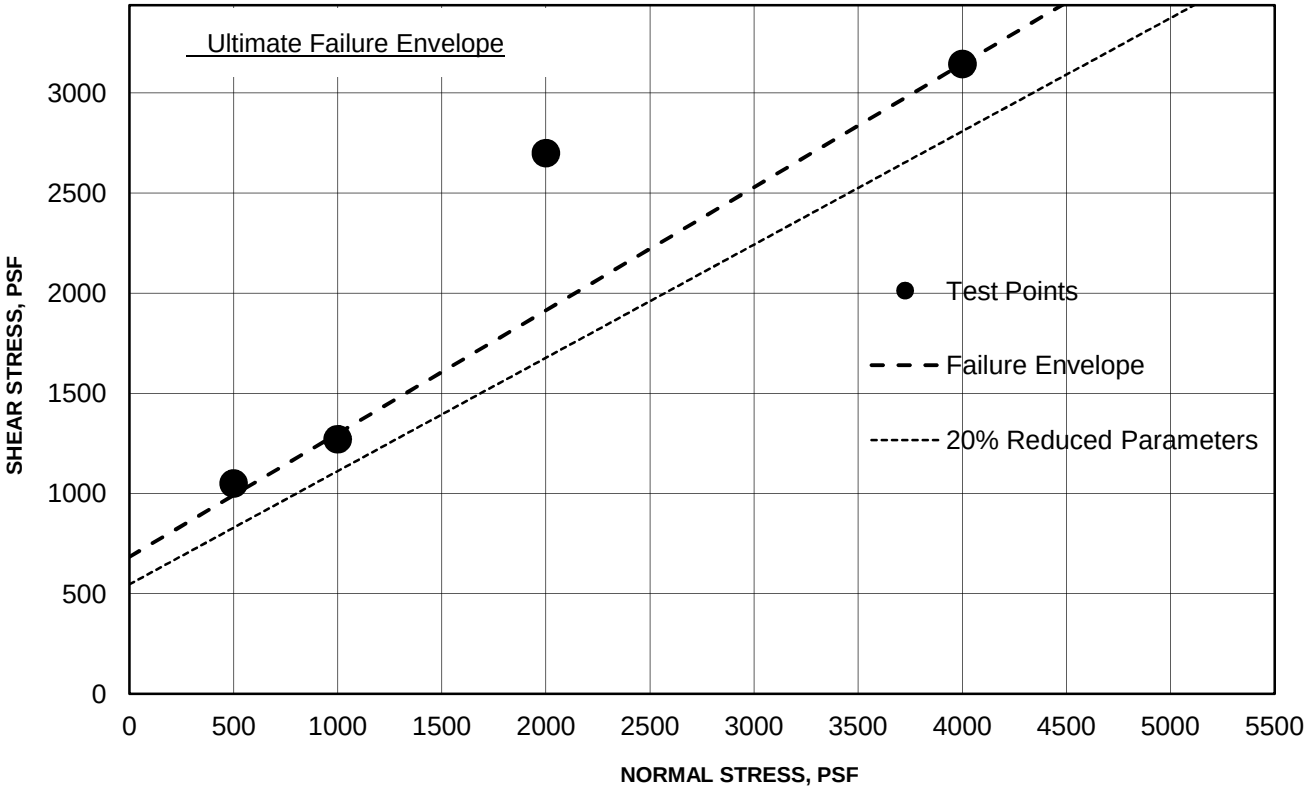
CU TRIAXIAL: TOTAL STRESS

Location:333 Ohai Street, Hilo, HI (TMK 2-6-003:009)

Project Number: 11011

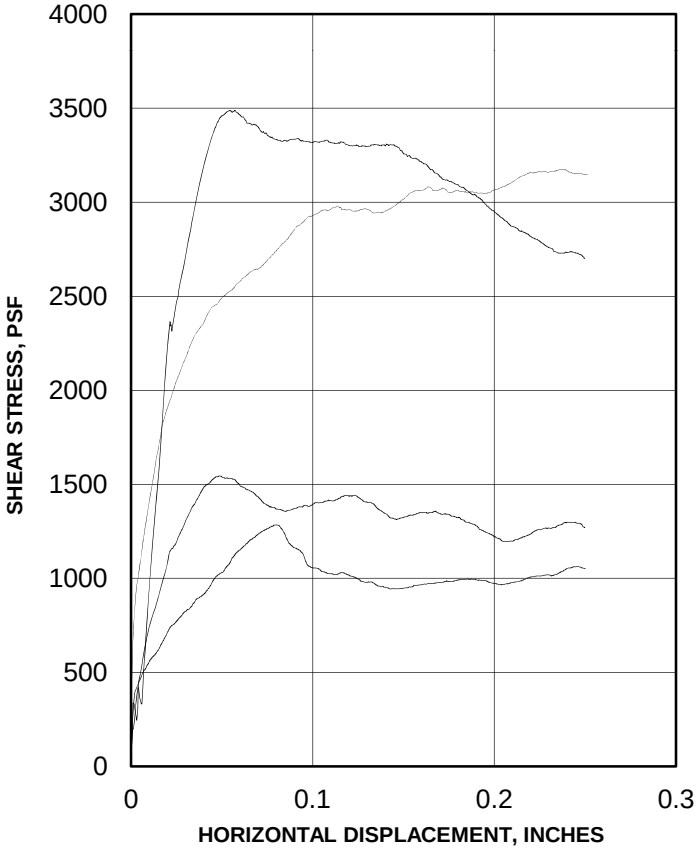
Yogi Kwong Engineers, LLC

FIGURE B-5



Ultimate Failure Envelope:	**c'=**	**683 psf**
	ϕ'=	**35.3 degree**

20% Reduction Failure Envelope:	**c'=**	**547 psf**
	ϕ'=	**29.5 degree**



Boring		B2-2	**Depth**	17.5 ft	
Description		**WEAHTERED TUFFACEOUS DEPOSITS:** Dark gray mottled with reddish brown silty sand (SM) with gravel N_u=7			
Sample No.		1	2	3	4
Initial	Water Content, %	65.5	70.2	52.7	52.5
	Dry Density, pcf	58.4	55.4	65.7	58.7
	Diameter, inches	2	2	2	2.0
	Height, inches	1.0	1.0	1.0	1.0
Final	Water Content, %	77.0	70.2	61.2	71.7
	Dry Density, pcf	59.3	57.0	66.6	65.1
	Diameter, inches	2	2	2	2.0
	Height, inches				
Strain Rate, in./minute		0.0005	0.0005	0.0005	0.0005
Normal Stress, psf		**499**	**999**	**1999**	**4000**
Peak Stress, psf		**1285**	**1546**	**3488**	**3176**
Displacement, in.		0.080	0.049	0.054	0.238
Ultimate Stress, psf		**1051**	**1272**	**2700**	**3145**
Displacement, in.		0.250	0.250	0.250	0.251

Project: Stream Bank Bluff Protection and Stabilization of a Second Erosion Scarp
Second Level of the Riverside Apartments Property

DIRECT SHEAR TEST

Location: 333 Ohai Street, Hilo, HI (TMK 2-6-003:009)

Project Number: 11011

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FIGURE B-6

APPENDIX C

PHOTOGRAPHS OF SLOPE AND SITE RECONNAISSANCE

View of west slope, transect B at the elevation 0'.

View of south down slope, transect B.

View of south down slope, transect B.

West slope along 13' down the bluff, transect B.

West slope along 13', transect B.

West slope along 13', transect B.

SLOPE AND SITE RECONNAISSANCE PHOTOS

Project Name: Stream Bank Bluff Protection and Stabilization of a Second Erosion Scarp Second Level of the Riverside Apartments Property

Location: 333 Ohai St., Hilo, Hawaii, HI (TMK 2-6-003:009) **Project No**. 11011

Yogi Kwong Engineers, LLC

FIGURE C-1

West slope along 19', transect B.

West slope along 19', transect B, Residual soil.

West slope along 19', transect B, Residual soil.

West slope along 19', transect B, Residual soil.

West slope along 25', transect B, Residual soil.

West slope along 25', transect B, Residual soil.

SLOPE AND SITE RECONNAISSANCE PHOTOS

Project Name: Stream Bank Bluff Protection and Stabilization of a Second Erosion Scarp Second Level of the Riverside Apartments Property

Location: 333 Ohai St., Hilo, Hawaii, HI (TMK 2-6-003:009) **Project No**. 11011

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FIGURE C-2

West slope along 25', transect B, Residual soil.

West slope along 30', transect B, Residual soil.

West slope along 30', transect B, Residual soil.

West slope along 30', transect B, Residual soil.

West slope along 30', transect B, Residual soil.

West slope along 29', transect B, Tuff layer.

SLOPE AND SITE RECONNAISSANCE PHOTOS

Project Name: Stream Bank Bluff Protection and Stabilization of a Second Erosion Scarp Second Level of the Riverside Apartments Property

Location: 333 Ohai St., Hilo, Hawaii, HI (TMK 2-6-003:009) **Project No**. 11011

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FIGURE C-3

West slope along 29', transect B, Tuff layer.

West slope along 29', transect B, Tuff layer.

West slope along 35', transect B, Tuff layer.

West slope along 35', transect B, Tuff layer.

West slope along 35', transect B, Tuff layer. Highly weathered soft and entrained boulder.

West slope along 42', transect B, Tuff layer.

SLOPE AND SITE RECONNAISSANCE PHOTOS

Project Name: Stream Bank Bluff Protection and Stabilization of a Second Erosion Scarp Second Level of the Riverside Apartments Property

Location: 333 Ohai St., Hilo, Hawaii, HI (TMK 2-6-003:009) **Project No**. 11011

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FIGURE C-4

West slope along 42', transect B, Tuff layer.

West slope along 42', transect B, Rock face at tuff layer.

West slope along 42', transect B, Rock face at tuff layer.

West slope, transect B, View of rappelling work.

West slope along 47', transect B, Exposed boulder retained in the tuff layer.

West slope along 57', transect B, Tuff layer.

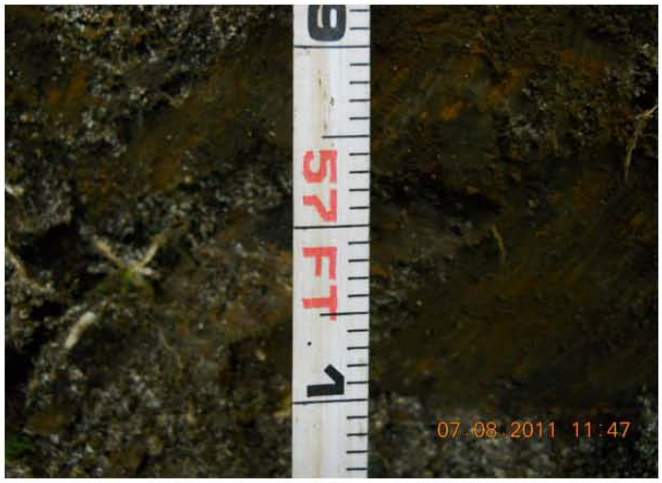
SLOPE AND SITE RECONNAISSANCE PHOTOS

Project Name: Stream Bank Bluff Protection and Stabilization of a Second Erosion Scarp Second Level of the Riverside Apartments Property

Location: 333 Ohai St., Hilo, Hawaii, HI (TMK 2-6-003:009) **Project No**. 11011

Yogi Kwong Engineers, LLC

FIGURE C-5



West slope along 57', transect B, Tuff layer.

View of south slope toe.

View of west along rock outcrop at slope toe, 40' east of slope transect B.

View along rock outcrop to up slope, 40' east of slope transect B.

View of east along rock outcrop slope material, 50' east of slope transect B.

View along rock outcrop to up slope, 40' east of slope transect B.

SLOPE AND SITE RECONNAISSANCE PHOTOS

Project Name: Stream Bank Bluff Protection and Stabilization of a Second Erosion Scarp Second Level of the Riverside Apartments Property

Location: 333 Ohai St., Hilo, Hawaii, HI (TMK 2-6-003:009) **Project No**. 11011

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FIGURE C-6

View along rock outcrop to up slope, 40' east of slope transect B.

View of Southwest Wailuku river from slope toe.

View of Southeast Wailuku river along slope toe.

View along rock outcrop to up slope, 50' east of slope transect B.

View of East 30' slope material at toe, transect C, Highly weathered tuff.

View of up slope from toe. 60 feet east of slope transect B.

SLOPE AND SITE RECONNAISSANCE PHOTOS

Project Name: Stream Bank Bluff Protection and Stabilization of a Second Erosion Scarp Second Level of the Riverside Apartments Property

Location: 333 Ohai St., Hilo, Hawaii, HI (TMK 2-6-003:009) **Project No**. 11011

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FIGURE C-7

View of up slope from toe. 60 feet east of slope transect B.

View of east slope toe. 60' east from slope transect B.

SLOPE AND SITE RECONNAISSANCE PHOTOS

Project Name: Stream Bank Bluff Protection and Stabilization of a Second Erosion Scarp Second Level of the Riverside Apartments Property

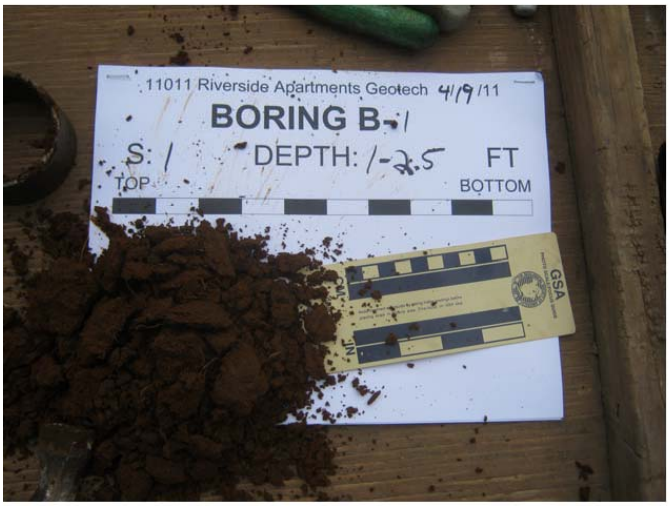
Location: 333 Ohai St., Hilo, Hawaii, HI (TMK 2-6-003:009) **Project No**. 11011

Yogi Kwong Engineers, LLC

FIGURE C-8

APPENDIX D

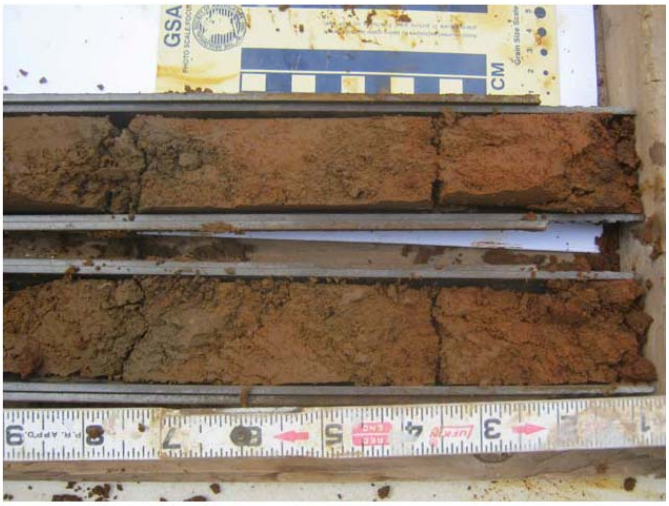
PHOTOGRAPHS OF SELECT SOIL SAMPLES



Boring B2-1, Sample 1, Depth 1' to 2.5'

Boring B2-1, Sample 1, Depth 1' to 2.5'

Boring B2-1, Sample 2, Depth 2.5' to 4'



Boring B2-1, Sample 2, Depth 2.5' to 4'

Boring B2-1, Sample 2, Depth 2.5' to 4'

Boring B2-1, Sample 3, Depth 4.5' to 6'

BORING B2-1 SAMPLE PHOTOS

Project Name: Stream Bank Bluff Protection and Stabilization of a Second Erosion Scarp Second Level of the Riverside Apartments Property

Location: 333 Ohai St., Hilo, Hawaii, HI (TMK 2-6-003:009) **Project No**. 11011

Yogi Kwong Engineers, LLC

FIGURE D-1

Boring B2-1, Sample 3, Depth 4.5' to 6'

Boring B2-1, Sample 4, Depth 6.5' to 8'

Boring B2-1, Sample 4, Depth 6.5' to 8'

Boring B2-1, Sample 5, Depth 8' to 9.5'

Boring B2-1, Sample 5, Depth 8' to 9.5'

Boring B2-1, Sample 6, Depth 10' to 11.5'

BORING B2-1 SAMPLE PHOTOS

Project Name: Stream Bank Bluff Protection and Stabilization of a Second Erosion Scarp Second Level of the Riverside Apartments Property

Location: 333 Ohai St., Hilo, Hawaii, HI (TMK 2-6-003:009) **Project No**. 11011

Yogi Kwong Engineers, LLC

FIGURE D-2

Boring B2-1, Sample 6, Depth 10' to 11.5'

Boring B2-1, Sample 7, Depth 11.5' to 13'

Boring B2-1, Sample 7, Depth 11.5' to 13'

Boring B2-1, Sample 7, Depth 11.5' to 13'

Boring B2-1, Sample 8, Depth 13.5' to 18.5'

Boring B2-1, Sample 8, Depth 13.5' to 18.5'

BORING B2-1 SAMPLE PHOTOS

Project Name: Stream Bank Bluff Protection and Stabilization of a Second Erosion Scarp Second Level of the Riverside Apartments Property

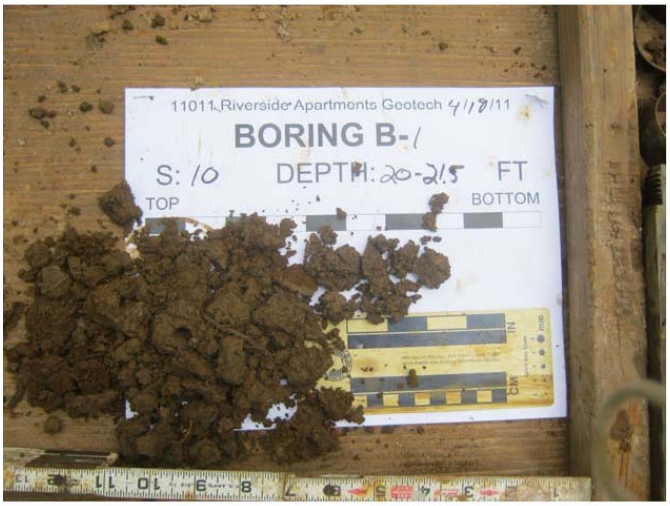
Location: 333 Ohai St., Hilo, Hawaii, HI (TMK 2-6-003:009) **Project No**. 11011

Yogi Kwong Engineers, LLC

FIGURE D-3

Boring B2-1, Sample 9, Depth 18.5' to 20'

Boring B2-1, Sample 9, Depth 18.5' to 20'



Boring B2-1, Sample 10, Depth 20' to 21.5'

Boring B2-1, Sample 10, Depth 20' to 21.5'

Boring B2-1, Sample 11, Depth 21.5' to 22.7'

Boring B2-1, Sample 11, Depth 21.5' to 22.7'

BORING B2-1 SAMPLE PHOTOS

Project Name: Stream Bank Bluff Protection and Stabilization of a Second Erosion Scarp Second Level of the Riverside Apartments Property

Location: 333 Ohai St., Hilo, Hawaii, HI (TMK 2-6-003:009) **Project No**. 11011

Yogi Kwong Engineers, LLC

FIGURE D-4

Boring B2-1, Sample 12, Depth 23.5' to 25'

Boring B2-1, Sample 12, Depth 23.5' to 25'

Boring B2-1, Recovery in core barrel while cleaning out borehole, Depth 25' to 28'

Boring B2-1, Recovery in core barrel while cleaning out borehole, Depth 25' to 28'

Boring B2-1, Recovery in core barrel while cleaning out borehole, Depth 25' to 28'

Boring B2-1, Sample 14, Depth 28' to 29.5'

BORING B2-1 SAMPLE PHOTOS

Project Name: Stream Bank Bluff Protection and Stabilization of a Second Erosion Scarp Second Level of the Riverside Apartments Property

Location: 333 Ohai St., Hilo, Hawaii, HI (TMK 2-6-003:009) **Project No**. 11011

Yogi Kwong Engineers, LLC

FIGURE D-5

Boring B2-1, Sample 14, Depth 28' to 29.5'

Boring B2-1, Sample 14, Depth 28' to 29.5'

Boring B2-1, Sample 15, Depth 29.5' to 30.2'

Boring B2-1, Sample 15, Depth 29.5' to 30.2'

Boring B2-1, Sample NX-1, Depth 30.2' to 34'

Boring B2-1, Sample NX-1, Depth 30.2' to 34'

BORING B2-1 SAMPLE PHOTOS

Project Name: Stream Bank Bluff Protection and Stabilization of a Second Erosion Scarp Second Level of the Riverside Apartments Property

Location: 333 Ohai St., Hilo, Hawaii, HI (TMK 2-6-003:009) **Project No**. 11011

Yogi Kwong Engineers, LLC

FIGURE D-6

Boring B2-1, Sample NX-1, Depth 30.2' to 34'

Boring B2-1, Sample 16, Depth 34' to 35.2'

Boring B2-1, Sample 16, Depth 34' to 35.2'

Boring B2-1, Sample NX-3, Depth 35.25' to 39'

Boring B2-1, Sample NX-3, Depth 35.25' to 39'

Boring B2-1, Sample NX-3, Depth 35.25' to 39'

BORING B2-1 SAMPLE PHOTOS

Project Name: Stream Bank Bluff Protection and Stabilization of a Second Erosion Scarp Second Level of the Riverside Apartments Property

Location: 333 Ohai St., Hilo, Hawaii, HI (TMK 2-6-003:009) **Project No**. 11011

Yogi Kwong Engineers, LLC

FIGURE D-7

Boring B2-1A, Sample 1, Depth 10' to 11.5'

Boring B2-1A, Sample 1, Depth 10' to 11.5'

Boring B2-1A, Sample 2, Depth 11.5' to 13.5'

Boring B2-1A, Sample 2, Depth 11.5' to 13.5'

Boring B2-1A, Sample 2, Depth 11.5' to 13.5'

Boring B2-1A, Sample 3, Depth 14' to 15.5'

BORING B2-1A SAMPLE PHOTOS

Project Name: Stream Bank Bluff Protection and Stabilization of a Second Erosion Scarp Second Level of the Riverside Apartments Property

Location: 333 Ohai St., Hilo, Hawaii, HI (TMK 2-6-003:009) **Project No**. 11011

Yogi Kwong Engineers, LLC

FIGURE D-8

Boring B2-1A, Sample 3, Depth 14' to 15.5'

Boring B2-1A, Sample 4, Depth 15.5' to 17.5'

Boring B2-1A, Sample 4, Depth 15.5' to 17.5'

Boring B2-1A, Sample 4, Depth 15.5' to 17.5'

Boring B2-1A, Sample 4, Depth 15.5' to 17.5'

BORING B2-1A SAMPLE PHOTOS

Project Name: Stream Bank Bluff Protection and Stabilization of a Second Erosion Scarp Second Level of the Riverside Apartments Property

Location: 333 Ohai St., Hilo, Hawaii, HI (TMK 2-6-003:009) **Project No**. 11011

Yogi Kwong Engineers, LLC

FIGURE D-9

Boring B2-2, Sample 1, Depth 1' to 2.5'

Boring B2-2, Sample 1, Depth 1' to 2.5'

Boring B2-2, Sample 2, Depth 2.5' to 4'

Boring B2-2, Sample 2, Depth 2.5' to 4'

Boring B2-2, Sample 2, Depth 2.5' to 4'

Boring B2-2, Sample 3, Depth 4' to 5.5'

BORING B2-2 SAMPLE PHOTOS

Project Name: Stream Bank Bluff Protection and Stabilization of a Second Erosion Scarp Second Level of the Riverside Apartments Property

Location: 333 Ohai St., Hilo, Hawaii, HI (TMK 2-6-003:009) **Project No**. 11011

Yogi Kwong Engineers, LLC

FIGURE D-10

Boring B2-2, Sample 3, Depth 4' to 5.5'

Boring B2-2, Sample 4, Depth 5.5' to 7'

Boring B2-2, Sample 4, Depth 5.5' to 7'

Boring B2-2, Sample 4, Depth 5.5' to 7'

Boring B2-2, Sample 5, Depth 7' to 8.5'

Boring B2-2, Sample 5, Depth 7' to 8.5'

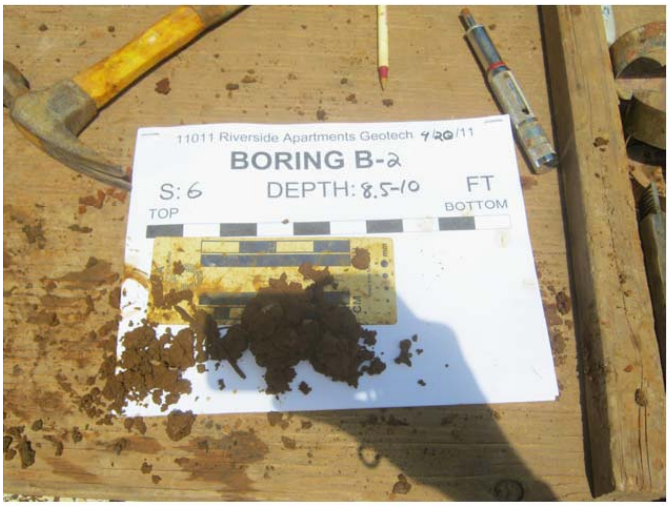
BORING B2-2 SAMPLE PHOTOS

Project Name: Stream Bank Bluff Protection and Stabilization of a Second Erosion Scarp Second Level of the Riverside Apartments Property

Location: 333 Ohai St., Hilo, Hawaii, HI (TMK 2-6-003:009) **Project No**. 11011

Yogi Kwong Engineers, LLC

FIGURE D-11



Boring B2-2, Sample 6, Depth 8.5' to 10'

Boring B2-2, Sample 6, Depth 8.5' to 10'

Boring B2-2, Sample 7, Depth 10' to 11.5'

Boring B2-2, Sample 7, Depth 10' to 11.5'

Boring B2-2, Sample 8, Depth 11.5' to 13'

Boring B2-2, Sample 8, Depth 11.5' to 13'

BORING B2-2 SAMPLE PHOTOS

Project Name: Stream Bank Bluff Protection and Stabilization of a Second Erosion Scarp Second Level of the Riverside Apartments Property

Location: 333 Ohai St., Hilo, Hawaii, HI (TMK 2-6-003:009) **Project No**. 11011

Yogi Kwong Engineers, LLC

FIGURE D-12

Boring B2-2, Sample 9, Depth 13' to 14.5'

Boring B2-2, Sample 9, Depth 13' to 14.5'

Boring B2-2, Sample 10, Depth 14.5' to 16'

Boring B2-2, Sample 10, Depth 14.5' to 16'

Boring B2-2, Sample 10, Depth 14.5' to 16'

Boring B2-2, Sample 11, Depth 16' to 17.5'

BORING B2-2 SAMPLE PHOTOS

Project Name: Stream Bank Bluff Protection and Stabilization of a Second Erosion Scarp Second Level of the Riverside Apartments Property

Location: 333 Ohai St., Hilo, Hawaii, HI (TMK 2-6-003:009) **Project No**. 11011

Yogi Kwong Engineers, LLC

FIGURE D-13

Boring B2-2, Sample 11, Depth 16' to 17.5'

Boring B2-2, Sample 12, Depth 17.5' to 19'

Boring B2-2, Sample 12, Depth 17.5' to 19'

Boring B2-2, Sample 13, Depth 19' to 20.5'

Boring B2-2, Sample 13, Depth 19' to 20.5'

Boring B2-2, Sample 14, Depth 20.5' to 22'

BORING B2-2 SAMPLE PHOTOS

Project Name: Stream Bank Bluff Protection and Stabilization of a Second Erosion Scarp Second Level of the Riverside Apartments Property

Location: 333 Ohai St., Hilo, Hawaii, HI (TMK 2-6-003:009) **Project No**. 11011

Yogi Kwong Engineers, LLC

FIGURE D-14

Boring B2-2, Sample 14, Depth 20.5' to 22'

Boring B2-2, Sample 15, Depth 22' to 23.5'

Boring B2-2, Sample 15, Depth 22' to 23.5'

Boring B2-2, Sample 16, Depth 23.5' to 25'

Boring B2-2, Sample 16, Depth 23.5' to 25'

Boring B2-2, Sample 17, Depth 25' to 26.4'

BORING B2-2 SAMPLE PHOTOS

Project Name: Stream Bank Bluff Protection and Stabilization of a Second Erosion Scarp Second Level of the Riverside Apartments Property

Location: 333 Ohai St., Hilo, Hawaii, HI (TMK 2-6-003:009) **Project No**. 11011

Yogi Kwong Engineers, LLC

FIGURE D-15

Boring B2-2, Sample 17, Depth 25' to 26.4'

Boring B2-2, Sample NX-1 and NX-2, Depth 26.4' to 35.5'

Boring B2-2, Sample NX-1 and NX-2, Depth 26.4' to 35.5'

Boring B2-2, Sample NX-1 and NX-2, Depth 26.4' to 35.5'

Boring B2-2, Sample NX-1 and NX-2, Depth 26.4' to 35.5'

Boring B2-2, Sample NX-1 and NX-2, Depth 26.4' to 35.5'

BORING B2-2 SAMPLE PHOTOS

Project Name: Stream Bank Bluff Protection and Stabilization of a Second Erosion Scarp Second Level of the Riverside Apartments Property

Location: 333 Ohai St., Hilo, Hawaii, HI (TMK 2-6-003:009) **Project No**. 11011

Yogi Kwong Engineers, LLC

FIGURE D-16

Boring B2-2, Sample NX-1 and NX-2, Depth 26.4' to 35.5'

Boring B2-2, Sample NX-1 and NX-2, Depth 26.4' to 35.5'

Boring B2-2, Sample 18, Depth 35.5' to 37'

Boring B2-2, Sample 18, Depth 35.5' to 37'

Boring B2-2, Sample 18, Depth 35.5' to 37'

Boring B2-2, Sample 19, Depth 40.5' to 42.5'

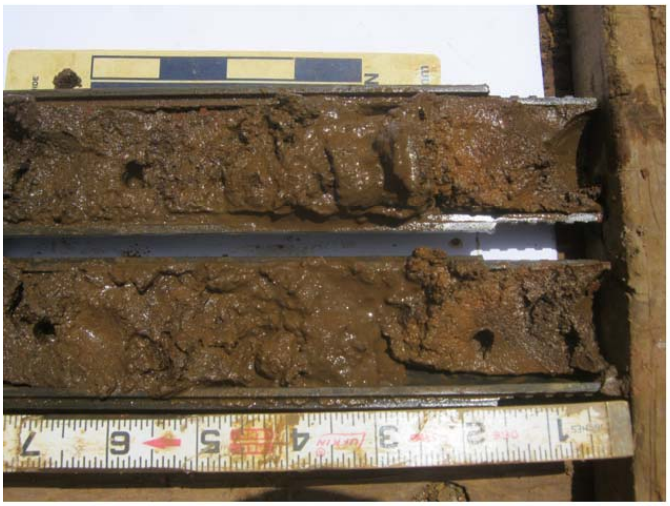
BORING B2-2 SAMPLE PHOTOS

Project Name: Stream Bank Bluff Protection and Stabilization of a Second Erosion Scarp Second Level of the Riverside Apartments Property

Location: 333 Ohai St., Hilo, Hawaii, HI (TMK 2-6-003:009) **Project No**. 11011

Yogi Kwong Engineers, LLC

FIGURE D-17



Boring B2-2, Sample 19, Depth 40.5' to 42.5'

Boring B2-2, Sample 19, Depth 40.5' to 42.5'

Boring B2-2, Sample 20, Depth 45.5' to 47.5'

Boring B2-2, Sample 20, Depth 45.5' to 47.5'

Boring B2-2, Sample 20, Depth 45.5' to 47.5'

Boring B2-2, Sample 21, Depth 50.5' to 52.5'

BORING B2-2 SAMPLE PHOTOS

Project Name: Stream Bank Bluff Protection and Stabilization of a Second Erosion Scarp Second Level of the Riverside Apartments Property

Location: 333 Ohai St., Hilo, Hawaii, HI (TMK 2-6-003:009) **Project No**. 11011

Yogi Kwong Engineers, LLC

FIGURE D-18

Boring B2-2, Sample 21, Depth 50.5' to 52.5'

Boring B2-2, Sample 21, Depth 50.5' to 52.5'

BORING B2-2 SAMPLE PHOTOS

Project Name: Stream Bank Bluff Protection and Stabilization of a Second Erosion Scarp Second Level of the Riverside Apartments Property

Location: 333 Ohai St., Hilo, Hawaii, HI (TMK 2-6-003:009) **Project No**. 11011

Yogi Kwong Engineers, LLC

FIGURE D-19

Boring B2-3, Sample 1, Depth 5' to 6.5'

Boring B2-3, Sample 1, Depth 5' to 6.5'

Boring B2-3, Sample 2, Depth 6.5' to 8'

Boring B2-3, Sample 2, Depth 6.5' to 8'

Boring B2-3, Sample 2, Depth 6.5' to 8'

Boring B2-3, Sample 3, Depth 10' to 11.5'

BORING B2-3 SAMPLE PHOTOS

Project Name: Stream Bank Bluff Protection and Stabilization of a Second Erosion Scarp Second Level of the Riverside Apartments Property

Location: 333 Ohai St., Hilo, Hawaii, HI (TMK 2-6-003:009) **Project No**. 11011

Yogi Kwong Engineers, LLC

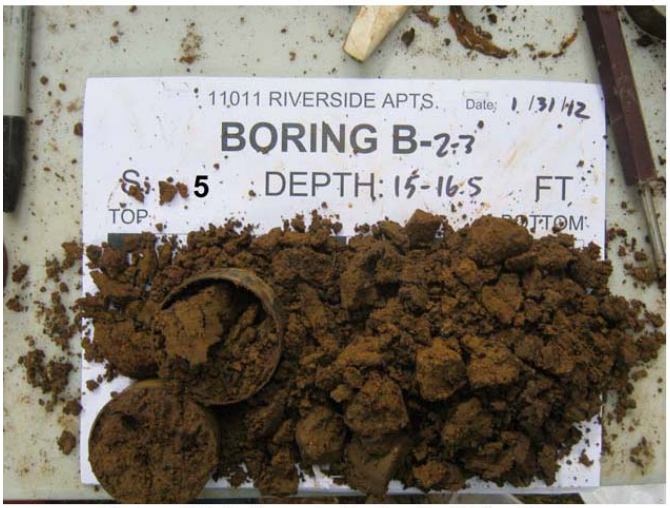
FIGURE D-20

Boring B2-3, Sample 3, Depth 10' to 11.5'

Boring B2-3, Sample 4, Depth 11.5' to 13'

Boring B2-3, Sample 4, Depth 11.5' to 13'

Boring B2-3, Sample 4, Depth 11.5' to 13'



Boring B2-3, Sample 5, Depth 15' to 16.5'

Boring B2-3, Sample 5, Depth 15' to 16.5'

BORING B2-3 SAMPLE PHOTOS

Project Name: Stream Bank Bluff Protection and Stabilization of a Second Erosion Scarp Second Level of the Riverside Apartments Property

Location: 333 Ohai St., Hilo, Hawaii, HI (TMK 2-6-003:009) **Project No**. 11011

Yogi Kwong Engineers, LLC

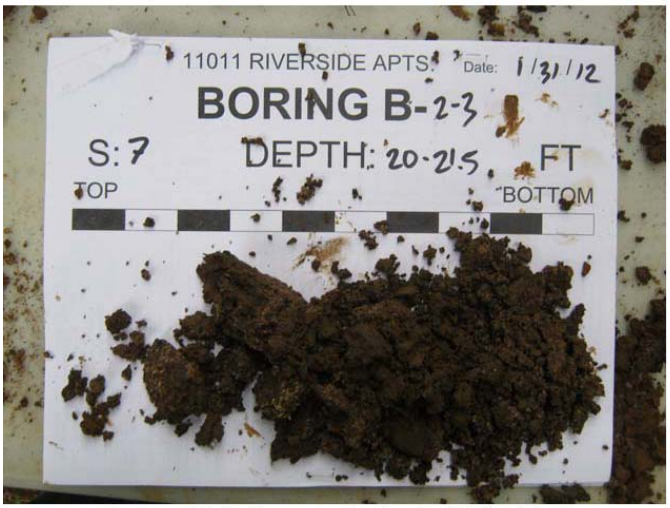
FIGURE D-21

Boring B2-3, Sample 5, Depth 15' to 16.5'

Boring B2-3, Sample 6, Depth 16.5' to 18'

Boring B2-3, Sample 6, Depth 16.5' to 18'

Boring B2-3, Sample 6, Depth 16.5' to 18'



Boring B2-3, Sample 7, Depth 20' to 21.5'

Boring B2-3, Sample 7, Depth 20' to 21.5'

BORING B2-3 SAMPLE PHOTOS

Project Name: Stream Bank Bluff Protection and Stabilization of a Second Erosion Scarp Second Level of the Riverside Apartments Property

Location: 333 Ohai St., Hilo, Hawaii, HI (TMK 2-6-003:009) **Project No**. 11011

Yogi Kwong Engineers, LLC

FIGURE D-22

Boring B2-3, Sample 8, Depth 21.5' to 23'

Boring B2-3, Sample 8, Depth 21.5' to 23'

Boring B2-3, Sample 8, Depth 21.5' to 23'

Boring B2-3, Sample 9, Depth 25' to 26.5'

Boring B2-3, Sample 9, Depth 25' to 26.5'

Boring B2-3, Sample 9, Depth 25' to 26.5'

BORING B2-3 SAMPLE PHOTOS

Project Name: Stream Bank Bluff Protection and Stabilization of a Second Erosion Scarp Second Level of the Riverside Apartments Property

Location: 333 Ohai St., Hilo, Hawaii, HI (TMK 2-6-003:009) **Project No**. 11011

Yogi Kwong Engineers, LLC

FIGURE D-23

Boring B2-3, Sample 10, Depth 26.5' to 28'

Boring B2-3, Sample 11, Depth 30' to 31.5' (disturbed sample)

Boring B2-3, Sample 11, Depth 30' to 31.5' (disturbed sample)

Boring B2-3, Sample 11, Depth 30' to 31.5' (disturbed sample)

Boring B2-3, Sample 12, Depth 31.5' to 33'

Boring B2-3, Sample 12, Depth 31.5' to 33'

BORING B2-3 SAMPLE PHOTOS

Project Name: Stream Bank Bluff Protection and Stabilization of a Second Erosion Scarp Second Level of the Riverside Apartments Property

Location: 333 Ohai St., Hilo, Hawaii, HI (TMK 2-6-003:009) **Project No**. 11011

Yogi Kwong Engineers, LLC

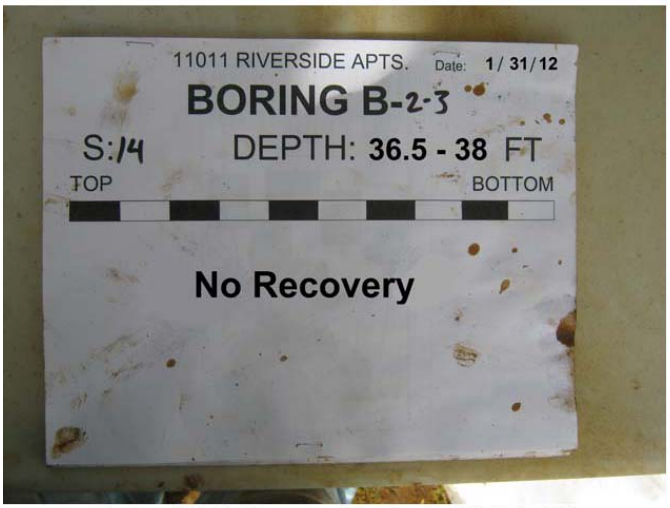
FIGURE D-24

Boring B2-3, Sample 12, Depth 31.5' to 33'

Boring B2-3, Sample 13, Depth 35' to 36.5'

Boring B2-3, Sample 13, Depth 35' to 36.5'

Boring B2-3, Sample 13, Depth 35' to 36.5'



Boring B2-3, Sample 14, Depth 36.5' to 38'

Boring B2-3, Sample 15, Depth 40' to 41.5'

BORING B2-3 SAMPLE PHOTOS

Project Name: Stream Bank Bluff Protection and Stabilization of a Second Erosion Scarp Second Level of the Riverside Apartments Property

Location: 333 Ohai St., Hilo, Hawaii, HI (TMK 2-6-003:009) **Project No**. 11011

Yogi Kwong Engineers, LLC

FIGURE D-25

Boring B2-3, Sample 15, Depth 40' to 41.5'

Boring B2-3, Sample 16, Depth 41.5' to 42.8'

Boring B2-3, Sample 16, Depth 41.5' to 42.8'

Boring B2-3, Sample 17, Depth 45' to 45.4'

Boring B2-3, Sample 17, Depth 45' to 45.4'

Boring B2-3, Sample 18, Depth 45.4' to 46.9'

BORING B2-3 SAMPLE PHOTOS

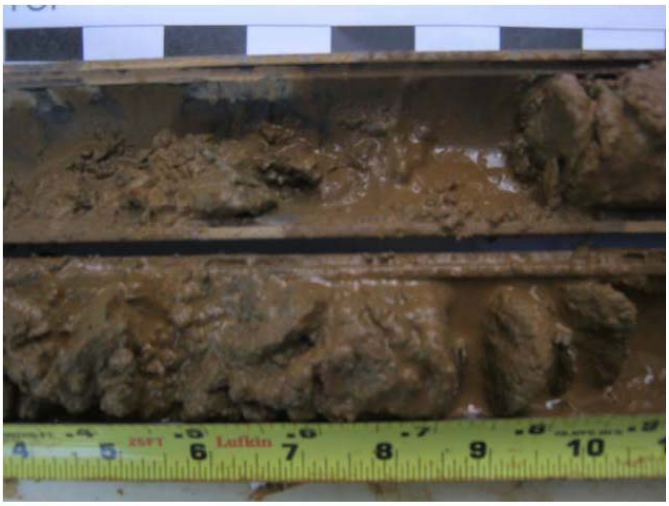
Project Name: Stream Bank Bluff Protection and Stabilization of a Second Erosion Scarp Second Level of the Riverside Apartments Property

Location: 333 Ohai St., Hilo, Hawaii, HI (TMK 2-6-003:009) **Project No**. 11011

Yogi Kwong Engineers, LLC

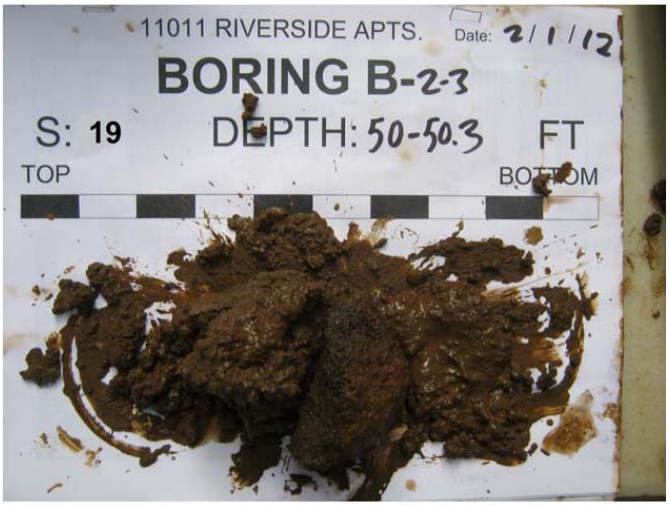
FIGURE D-26

Boring B2-3, Sample 18, Depth 45.4' to 46.9'



Boring B2-3, Sample 18, Depth 45.4' to 46.9'

Boring B2-3, Sample 18, Depth 45.4' to 46.9'



Boring B2-3, Sample 19, Depth 50' to 50.3'

Boring B2-3, Sample 19, Depth 50' to 50.3'

Boring B2-3, Sample 20, Depth 50.3' to 51.8'

BORING B2-3 SAMPLE PHOTOS

Project Name: Stream Bank Bluff Protection and Stabilization of a Second Erosion Scarp Second Level of the Riverside Apartments Property

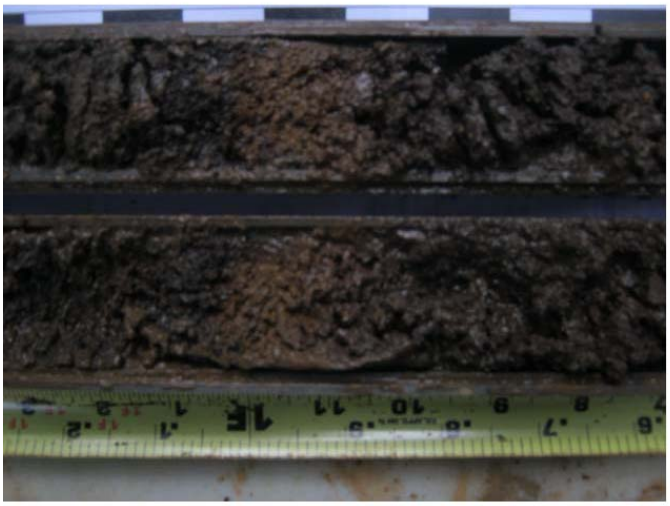
Location: 333 Ohai St., Hilo, Hawaii, HI (TMK 2-6-003:009) **Project No**. 11011

Yogi Kwong Engineers, LLC

FIGURE D-27

Boring B2-3, Sample 21, Depth 55' to 56.5'

Boring B2-3, Sample 21, Depth 55' to 56.5'



Boring B2-3, Sample 21, Depth 55' to 56.5'

Boring B2-3, Sample 21, Depth 55' to 56.5'

Boring B2-3, Sample 22, Depth 60' to 61.5'

Boring B2-3, Sample 22, Depth 60' to 61.5'

BORING B2-3 SAMPLE PHOTOS

Project Name: Stream Bank Bluff Protection and Stabilization of a Second Erosion Scarp Second Level of the Riverside Apartments Property

Location: 333 Ohai St., Hilo, Hawaii, HI (TMK 2-6-003:009) **Project No**. 11011

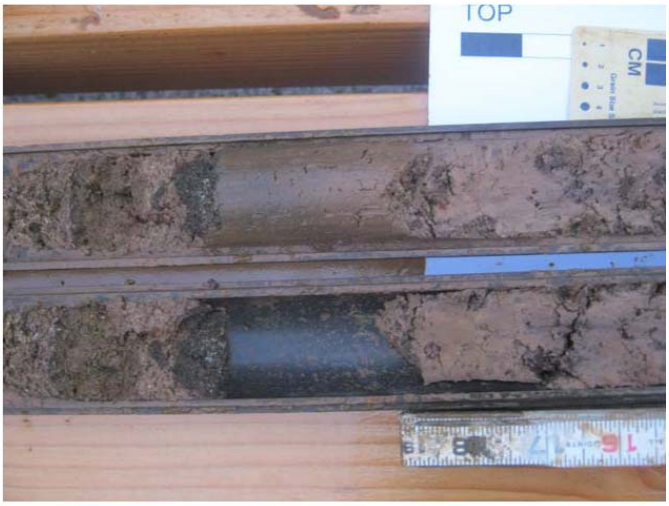
Yogi Kwong Engineers, LLC

FIGURE D-28

Probe P2-1, Sample 1, Depth 14' to 18'

Probe P2-1, Sample 1, Depth 14' to 18'

Probe P2-1, Sample 1, Depth 14' to 18'



Probe P2-1, Sample 1, Depth 14' to 18'

PROBE P2-1 SAMPLE PHOTOS

Project Name: Stream Bank Bluff Protection and Stabilization of a Second Erosion Scarp Second Level of the Riverside Apartments Property

Location: 333 Ohai St., Hilo, Hawaii, HI (TMK 2-6-003:009) **Project No**. 11011

Yogi Kwong Engineers, LLC

FIGURE D-29

APPENDIX E

SLOPE STABILITY ANALYSES

Project: Steam Bank Bluff Protection and Stabilization of a Second Erosion Scarp

Location: Second Level of the Riverside Apartments Property at 333 Ohai Street, Hilo, Hawaii (TMK 2-6-003:009)

Project Number: 11011

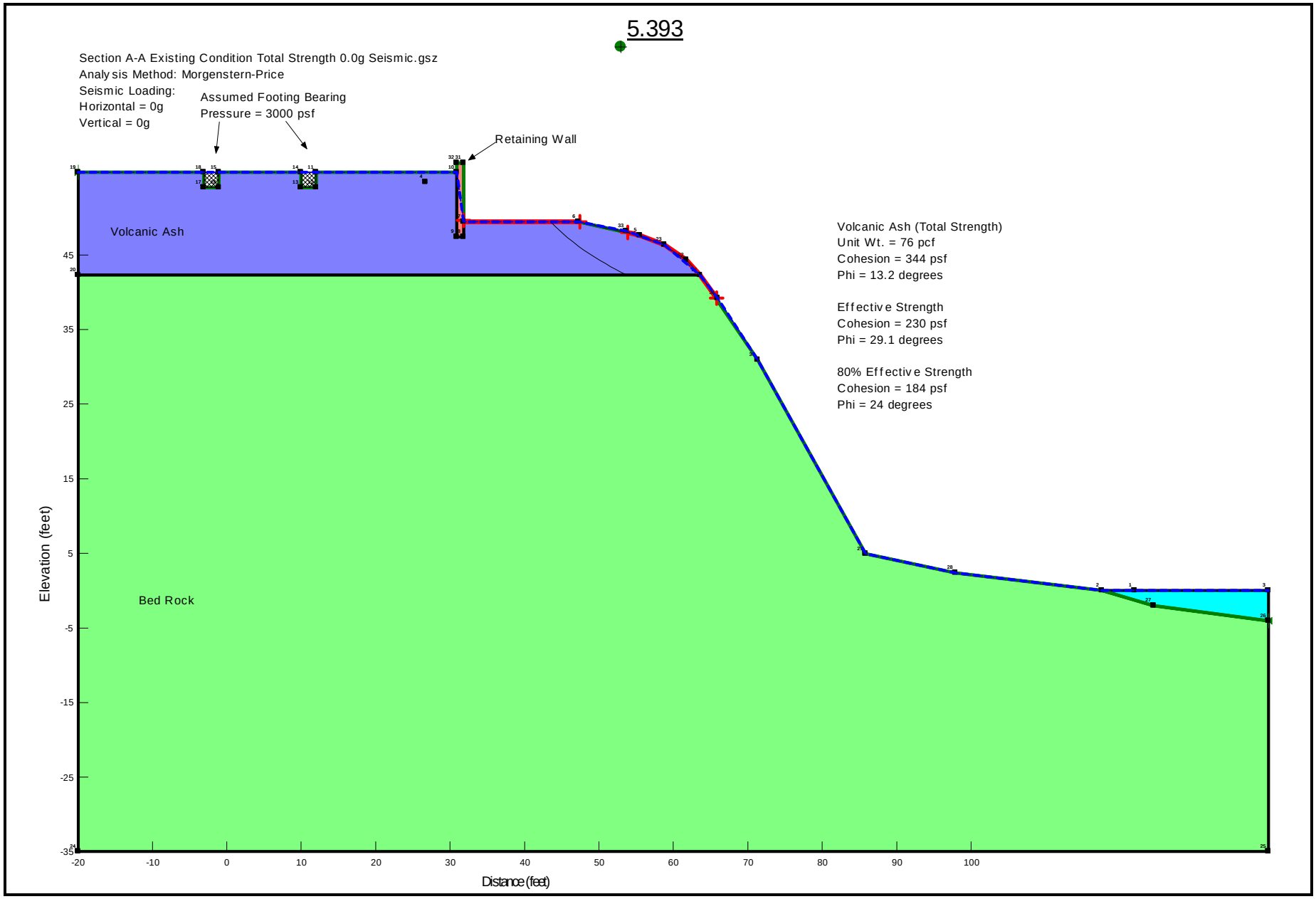
By: SW

Date: 3/13/2013

Soil Properties							
	Unit Weight	Total strenth		Effective Strength			
				100% strength		80% effective strength	
	γ	ϕ	c	ϕ	c	ϕ	c
	pcf	(^{0})	psf	(^{0})	psf	(^{0})	psf
Amorphic Volcanic Ash	76	08029 TXCU		08029 TXCU			
		13.2	344	29.1	230	24.0	184
Weathered Tuffaceous Deposit	95	11011 TXCU		11011 TXCU rest results			
		14.5	435	34.7	91	28.9	73
Silty Sand	95	08029 Estimated		11011 Direct Shear test results N=7			
		16	725	35.3	683	29.5	547
Silty Gravel	95	Estimated		Estimated			
		45	0	45	0	39.0	0

Factor of Safety							
		Total Strength	100% Effective Strength	80% Effective Strength			
Section		Saturated	0.0 g	0.2g	0.32g	0.5g	0.67g
A-A	Existing Condition	5.39	5.39				1.27
	Figure No.	E-2	E-3				E-4
B-B	Existing Condition	1	1.42	0.82	0.69	0.54	0.44
	Figure No.	E-5	E-6	E-7	E-8	E-9	E-10
	Soil Nail and Shotcrete	1.52	3.28	1.93	1.6	1.27	1.06
	Figure No.	E-11	E-12	E-13	E-14	E-15	E-16
C-C	Existing Condition	1.87	1.64	0.95	0.8	0.64	0.54
	Figure No.	E-17	E-18	E-19	E-20	E-21	E-22
	Soil Nail and Shotcrete	3.77	4.65	2.31	1.95	1.54	1.12
	Figure No.	E-23	E-24	E-25	E-26	E-27	E-28

Soil Nail and Shotcrete Summary (Factor of Safety of Soil Nail Capacity = 1.5 in Slope Stability Analysis)								
	Row Number	Ultimate Capacity (kips)	Elevation (feet)	Spacing (feet)	Inclination (Degrees)	Minimum Length (feet)	Estimated Anchor Number	Estimated Total Length
Section B-B	1	37	39	4	26.5	40		
	2	37	35	4	26.5	40		
	3	37	31	4	26.5	40		
	4	37	27	4	26.5	40		
	5	41	23	4	26.5	30		
	6	41	19	4	26.5	30		
	7	41	15	4	26.5	30		
Section C-C	1	27	39	4	26.5	25		
	2	27	35	4	26.5	20		
Note:	Ultimate Capacity of rebar is calculated for 1-inch Grade 60 rebar.							



SLOPE STABILITY ANALYSIS: SECTION A-A EXISTING CONDITION

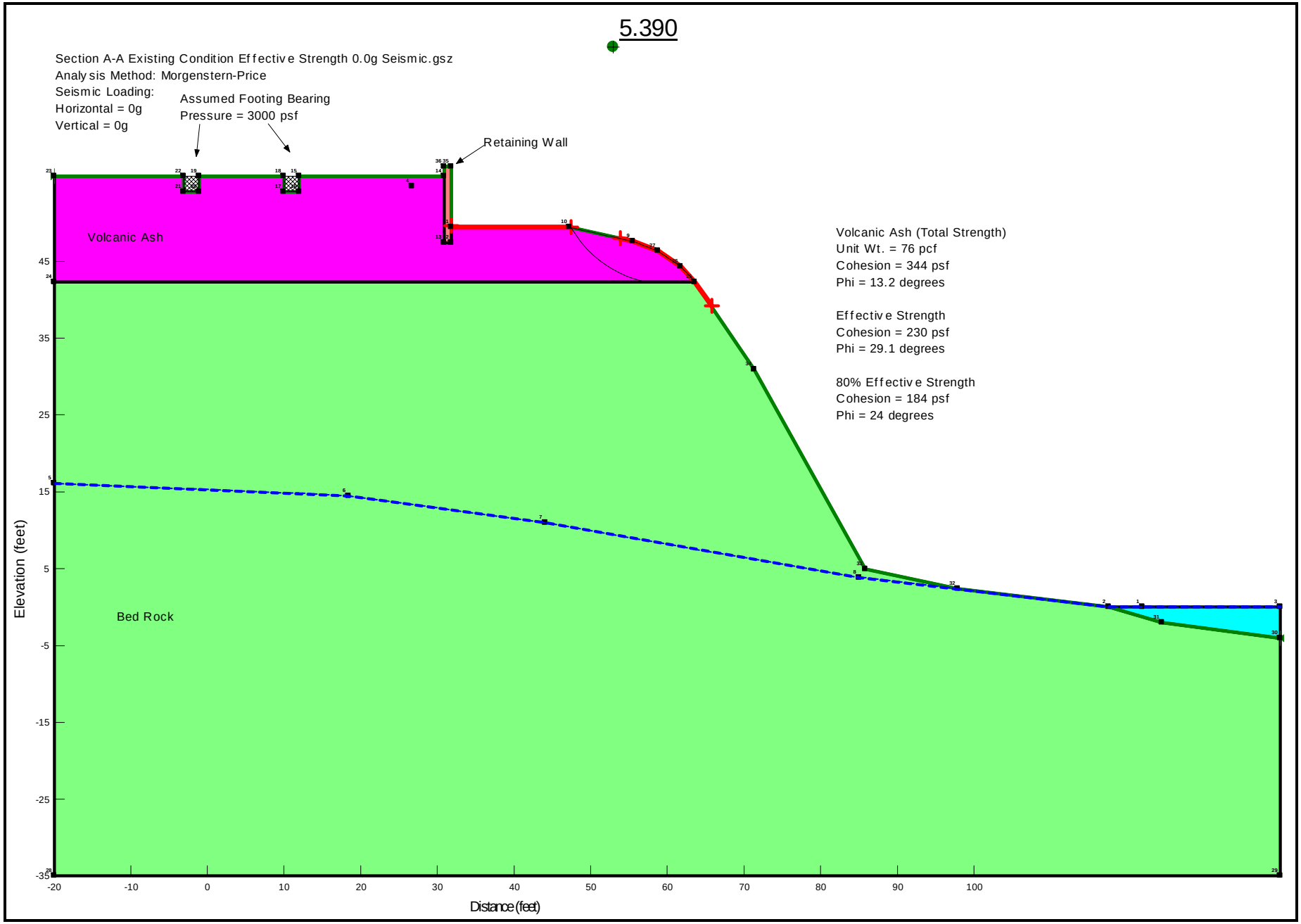
FULLY SATURATED SLOPE CONDITION

Steam Bank Bluff Protection and Stabilization of a Second Erosion Scarp

Second Level of the Riverside Apartments Property at 333 Ohai Street, Hilo, Hawaii (TMK 2-6-003:009) Project No. 12014

Yogi Kwong Engineers, LLC

APPENDIX E-2



SLOPE STABILITY ANALYSIS: SECTION A-A EXISTING CONDITION

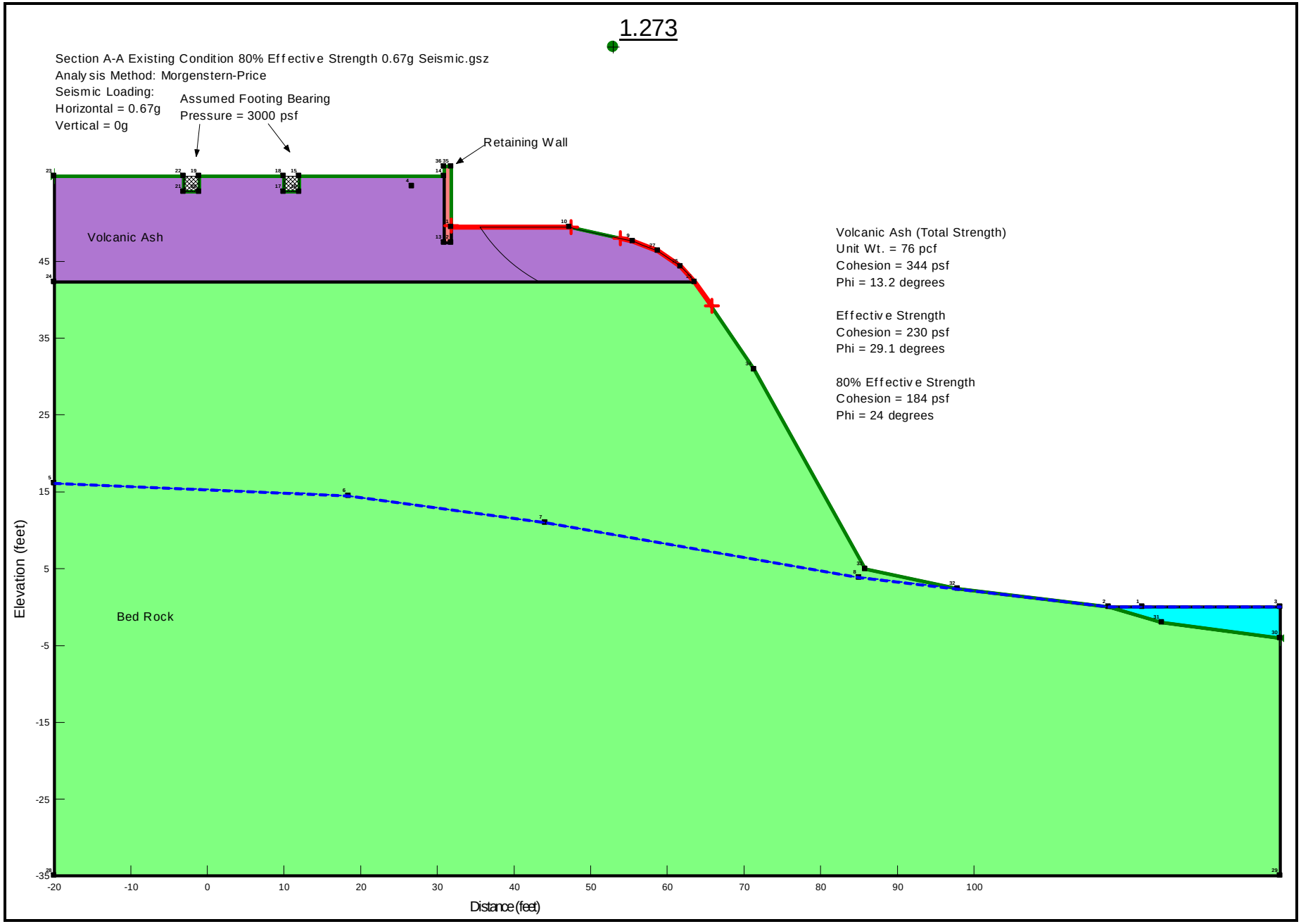
STATIC LOADING

Steam Bank Bluff Protection and Stabilization of a Second Erosion Scarp

Second Level of the Riverside Apartments Property at 333 Ohai Street, Hilo, Hawaii (TMK 2-6-003:009) Project No. 12014

Yogi Kwong Engineers, LLC

APPENDIX E-3



SLOPE STABILITY ANALYSIS: SECTION A-A EXISTING CONDITION

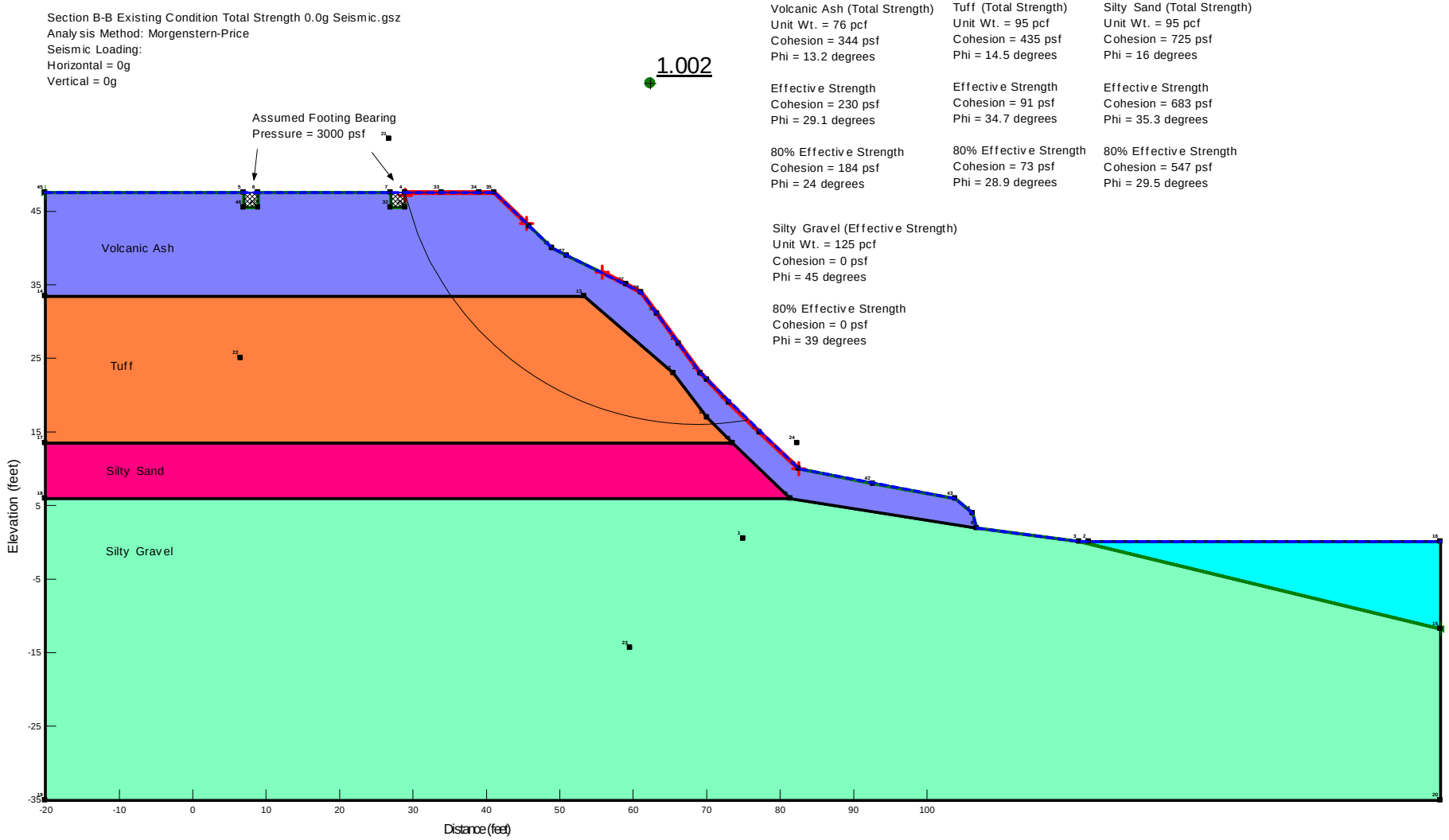
0.67G PSEUDOSTATIC SEISMIC LOADING

Steam Bank Bluff Protection and Stabilization of a Second Erosion Scarp

Second Level of the Riverside Apartments Property at 333 Ohai Street, Hilo, Hawaii (TMK 2-6-003:009) Project No. 12014

Yogi Kwong Engineers, LLC

APPENDIX E-4



SLOPE STABILITY ANALYSIS: SECTION B-B EXISTING CONDITION

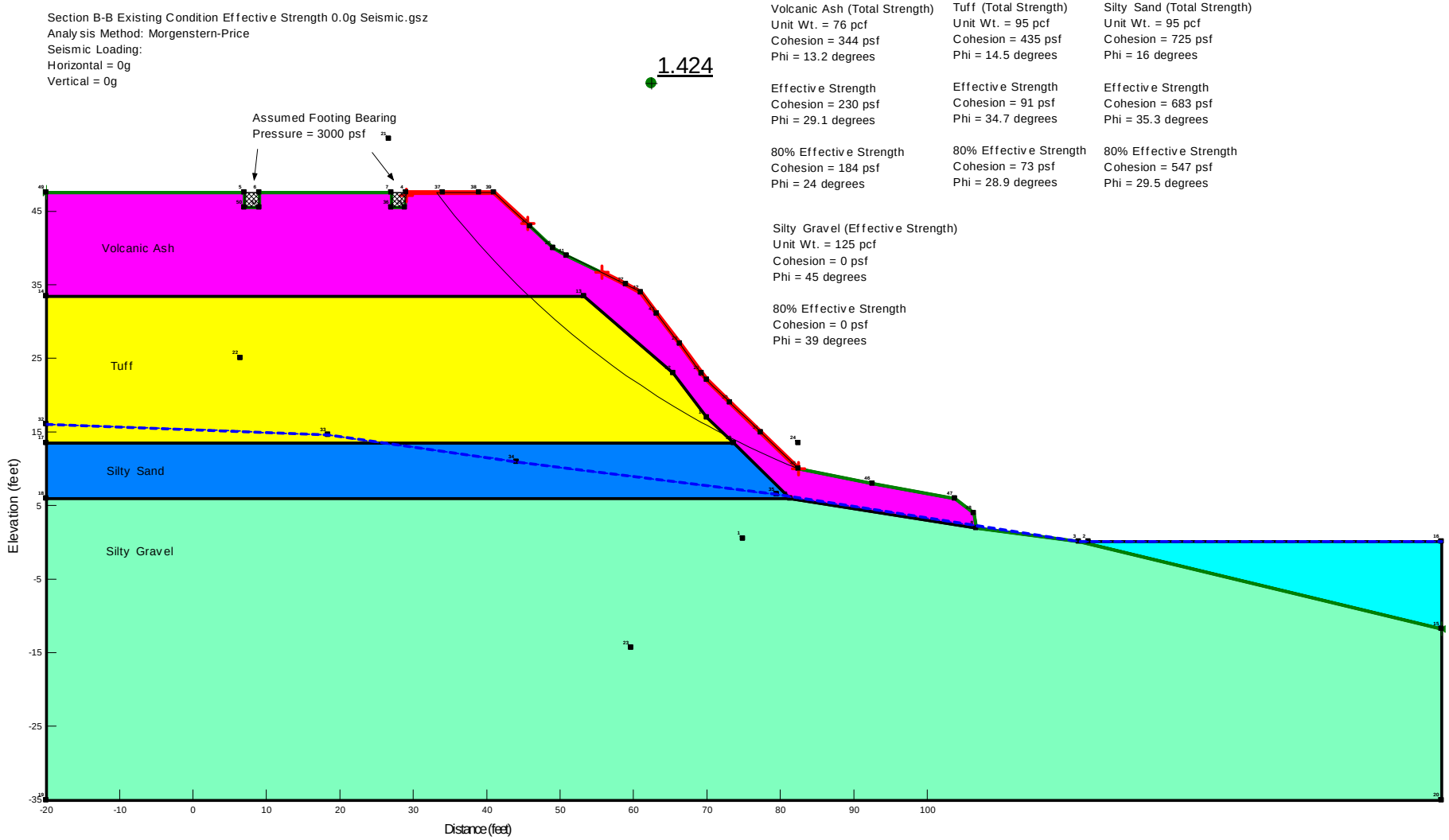
FULLY SATURATED SLOPE CONDITION

Steam Bank Bluff Protection and Stabilization of a Second Erosion Scarp

Second Level of the Riverside Apartments Property at 333 Ohai Street, Hilo, Hawaii (TMK 2-6-003:009) Project No. 12014

Yogi Kwong Engineers, LLC

APPENDIX E-5



SLOPE STABILITY ANALYSIS: SECTION B-B EXISTING CONDITION

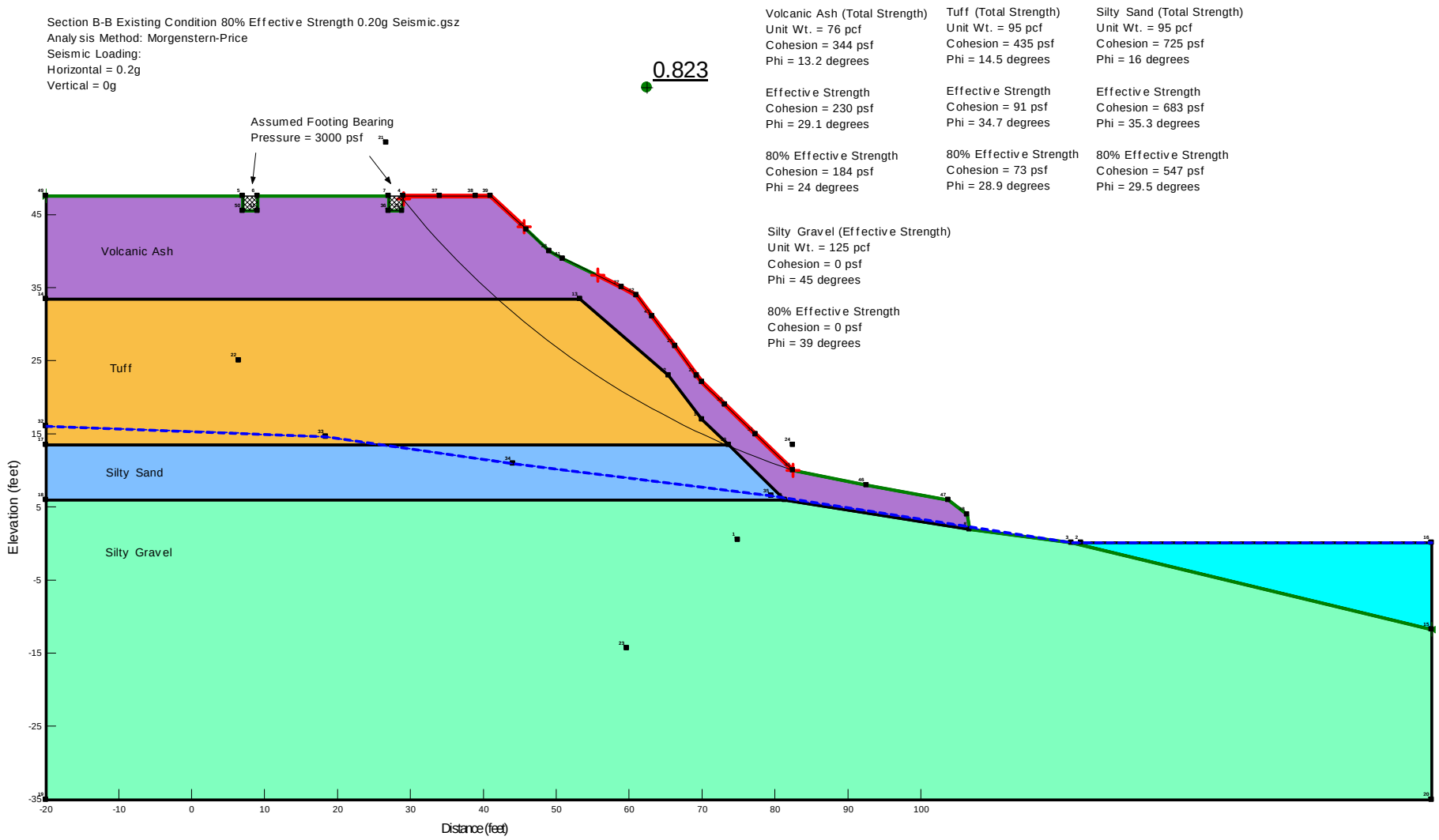
STATIC LOADING

Steam Bank Bluff Protection and Stabilization of a Second Erosion Scarp

Second Level of the Riverside Apartments Property at 333 Ohai Street, Hilo, Hawaii (TMK 2-6-003:009) Project No. 12014

Yogi Kwong Engineers, LLC

APPENDIX E-6



SLOPE STABILITY ANALYSIS: SECTION B-B EXISTING CONDITION

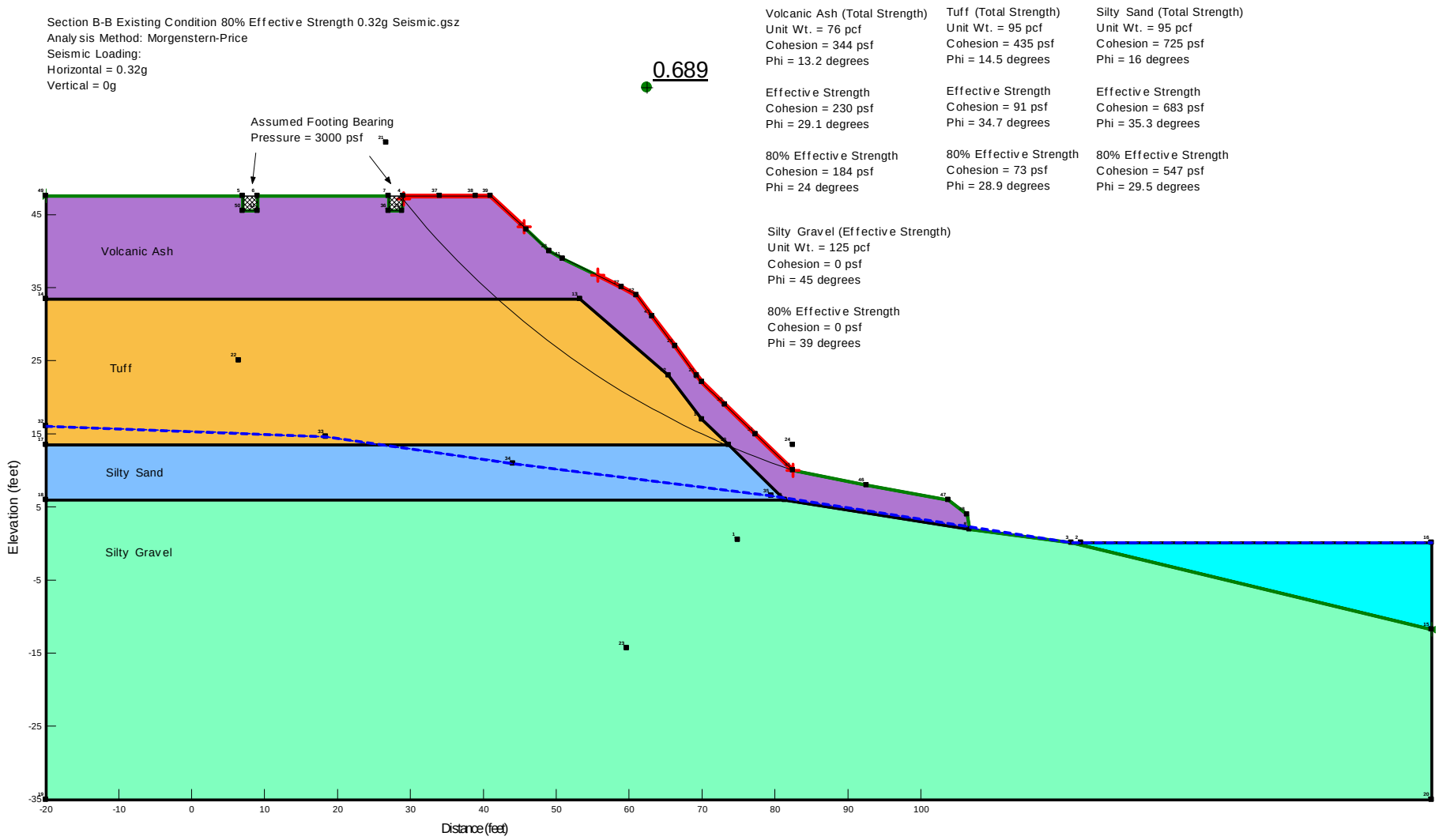
0.2G PSEUDOSTATIC SEISMIC LOADING

Steam Bank Bluff Protection and Stabilization of a Second Erosion Scarp

Second Level of the Riverside Apartments Property at 333 Ohai Street, Hilo, Hawaii (TMK 2-6-003:009) Project No. 12014

Yogi Kwong Engineers, LLC

APPENDIX E-7



SLOPE STABILITY ANALYSIS: SECTION B-B EXISTING CONDITION

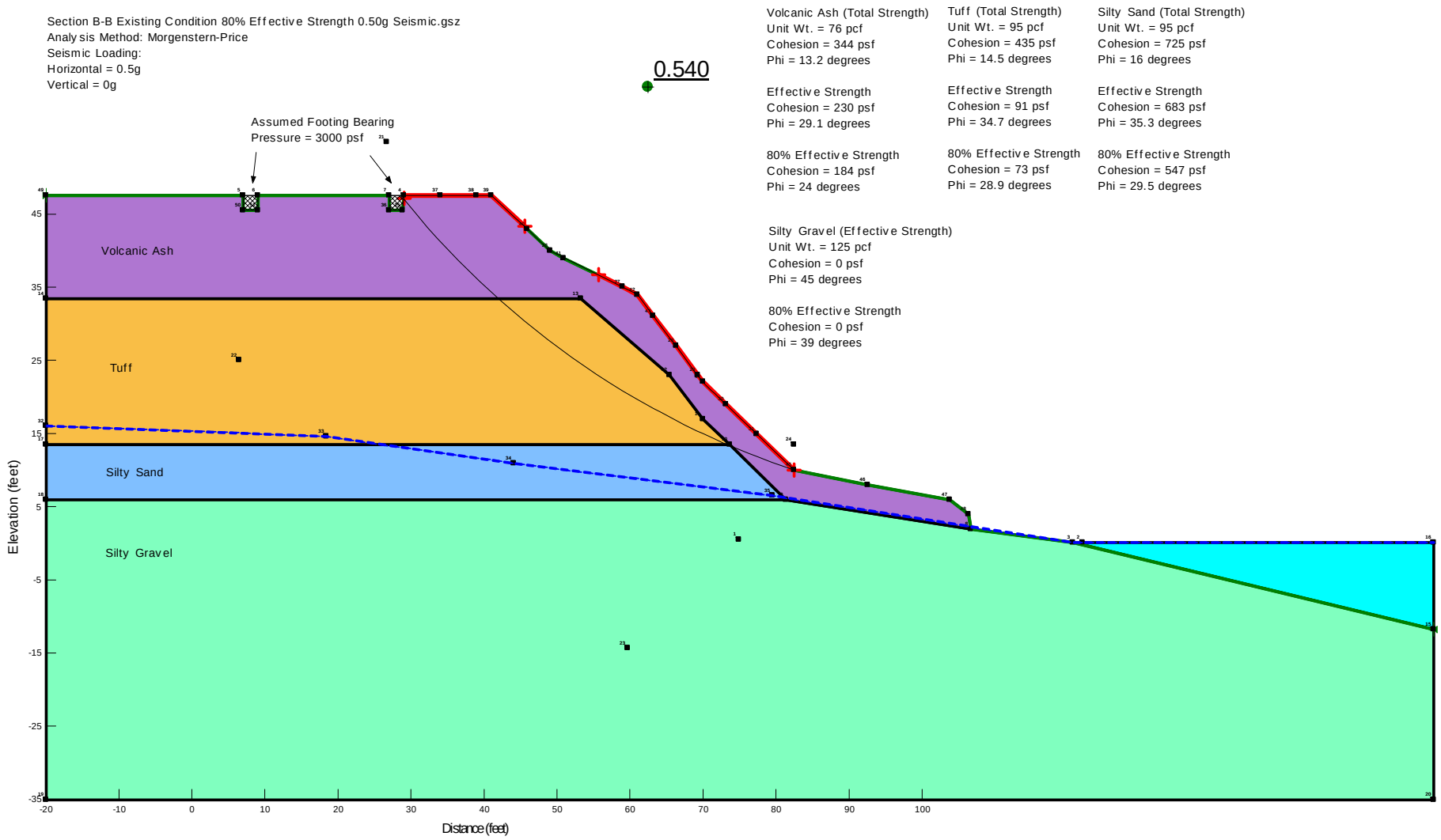
0.32G PSEUDOSTATIC SEISMIC LOADING

Steam Bank Bluff Protection and Stabilization of a Second Erosion Scarp

Second Level of the Riverside Apartments Property at 333 Ohai Street, Hilo, Hawaii (TMK 2-6-003:009) Project No. 12014

Yogi Kwong Engineers, LLC

APPENDIX E-8



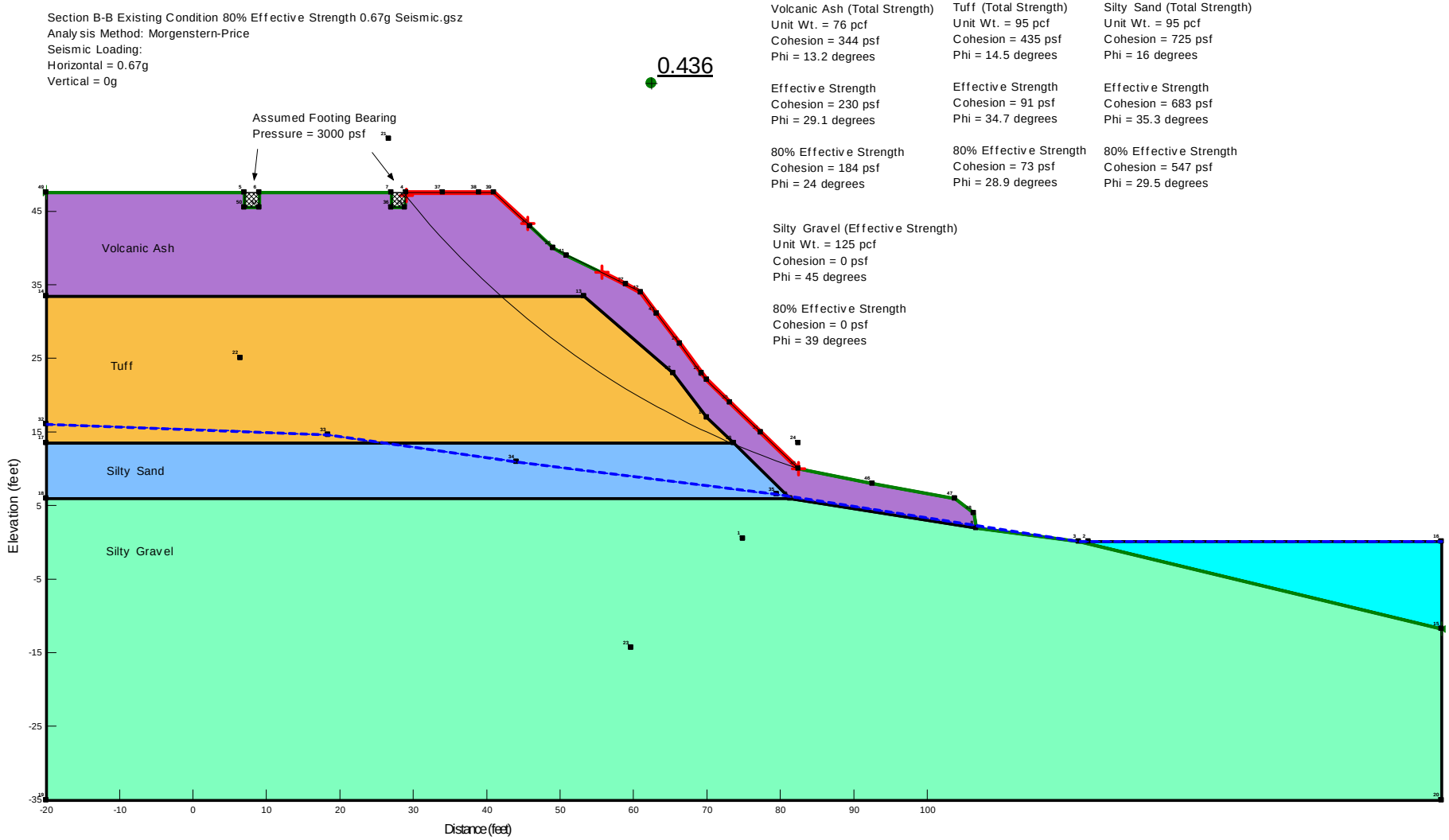
SLOPE STABILITY ANALYSIS: SECTION B-B EXISTING CONDITION

0.50G PSEUDOSTATIC SEISMIC LOADING

Steam Bank Bluff Protection and Stabilization of a Second Erosion Scarp
Second Level of the Riverside Apartments Property at 333 Ohai Street, Hilo, Hawaii (TMK 2-6-003:009) Project No. 12014

Yogi Kwong Engineers, LLC

APPENDIX E-9



SLOPE STABILITY ANALYSIS: SECTION B-B EXISTING CONDITION

0.67G PSEUDOSTATIC SEISMIC LOADING

Steam Bank Bluff Protection and Stabilization of a Second Erosion Scarp

Second Level of the Riverside Apartments Property at 333 Ohai Street, Hilo, Hawaii (TMK 2-6-003:009) Project No. 12014

Yogi Kwong Engineers, LLC

APPENDIX E-10

Section B-B Soil Nail & Micropile Total Strength 0.00g Seismic.gsz
Analysis Method: Morgenstern-Price
Seismic Loading:
Horizontal = 0g
Vertical = 0g

1.516

Volcanic Ash (Total Strength)
Unit Wt. = 76 pcf
Cohesion = 344 psf
Phi = 13.2 degrees

Effective Strength
Cohesion = 230 psf
Phi = 29.1 degrees

80% Effective Strength
Cohesion = 184 psf
Phi = 24 degrees

Tuff (Total Strength)
Unit Wt. = 95 pcf
Cohesion = 435 psf
Phi = 14.5 degrees

Effective Strength
Cohesion = 91 psf
Phi = 34.7 degrees

80% Effective Strength
Cohesion = 73 psf
Phi = 28.9 degrees

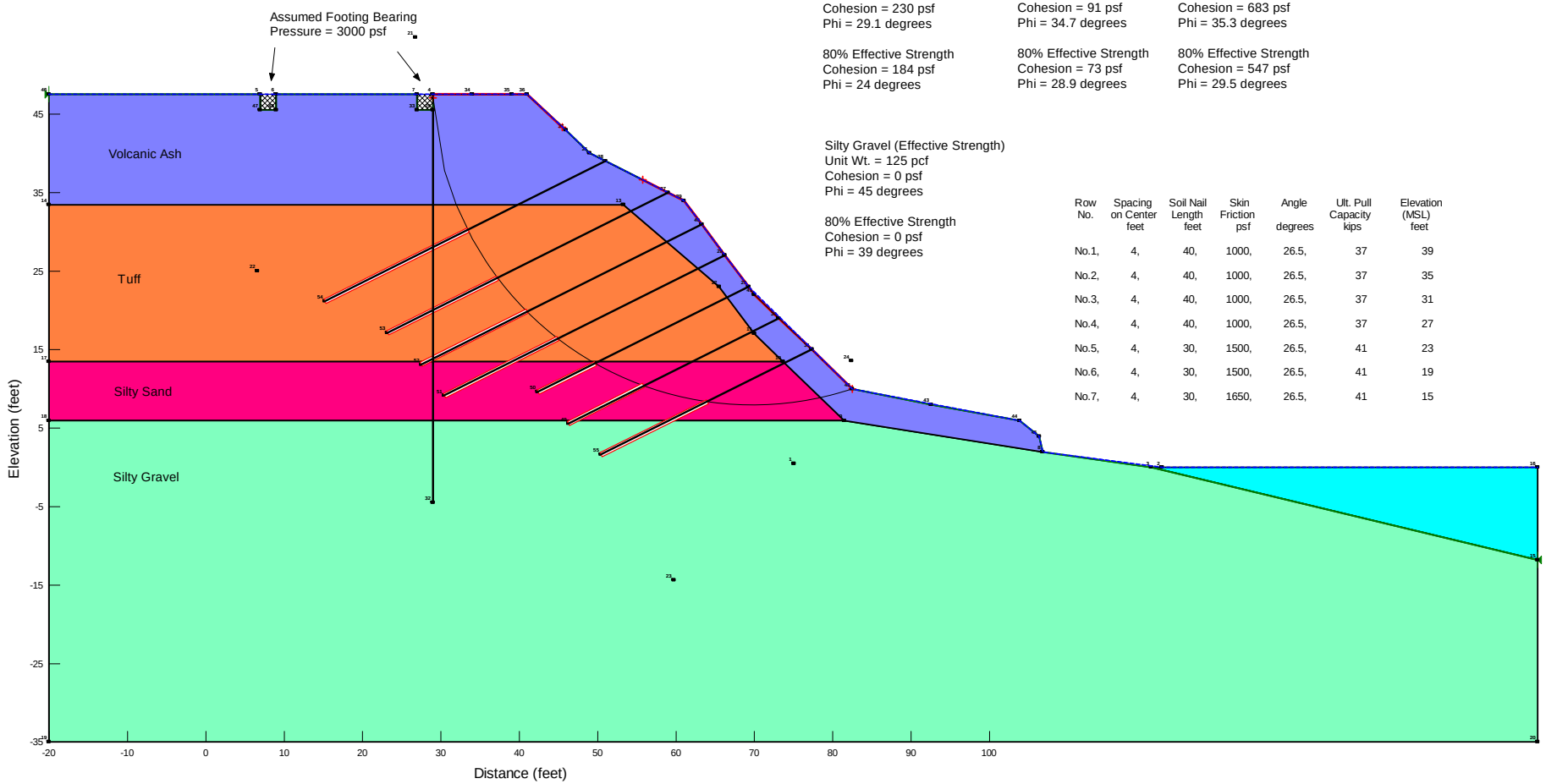
Silty Sand (Total Strength)
Unit Wt. = 95 pcf
Cohesion = 725 psf
Phi = 16 degrees

Effective Strength
Cohesion = 683 psf
Phi = 35.3 degrees

80% Effective Strength
Cohesion = 547 psf
Phi = 29.5 degrees

Silty Gravel (Effective Strength)
Unit Wt. = 125 pcf
Cohesion = 0 psf
Phi = 45 degrees

80% Effective Strength
Cohesion = 0 psf
Phi = 39 degrees



Row No.	Spacing on Center feet	Soil Nail Length feet	Skin Friction psf	Angle degrees	Ult. Pull Capacity kips	Elevation (MSL) feet
No.1,	4,	40,	1000,	26.5,	37	39
No.2,	4,	40,	1000,	26.5,	37	35
No.3,	4,	40,	1000,	26.5,	37	31
No.4,	4,	40,	1000,	26.5,	37	27
No.5,	4,	30,	1500,	26.5,	41	23
No.6,	4,	30,	1500,	26.5,	41	19
No.7,	4,	30,	1650,	26.5,	41	15

SLOPE STABILITY ANALYSIS: SECTION B-B SOIL NAILS AND SHOTCRETE

FULLY SATURATED SLOPE CONDITION

Steam Bank Bluff Protection and Stabilization of a Second Erosion Scarp

Second Level of the Riverside Apartments Property at 333 Ohai Street, Hilo, Hawaii (TMK 2-6-003:009) Project No. 12014

Yogi Kwong Engineers, LLC

APPENDIX E-11

Section B-B Soil Nail & Micropile Effective Strength 0.00g Seismic.gsz
Analysis Method: Morgenstern-Price
Seismic Loading:
Horizontal = 0g
Vertical = 0g

3.279

Volcanic Ash (Total Strength)
Unit Wt. = 76 pcf
Cohesion = 344 psf
Phi = 13.2 degrees

Effective Strength
Cohesion = 230 psf
Phi = 29.1 degrees

80% Effective Strength
Cohesion = 184 psf
Phi = 24 degrees

Tuff (Total Strength)
Unit Wt. = 95 pcf
Cohesion = 435 psf
Phi = 14.5 degrees

Effective Strength
Cohesion = 91 psf
Phi = 34.7 degrees

80% Effective Strength
Cohesion = 73 psf
Phi = 28.9 degrees

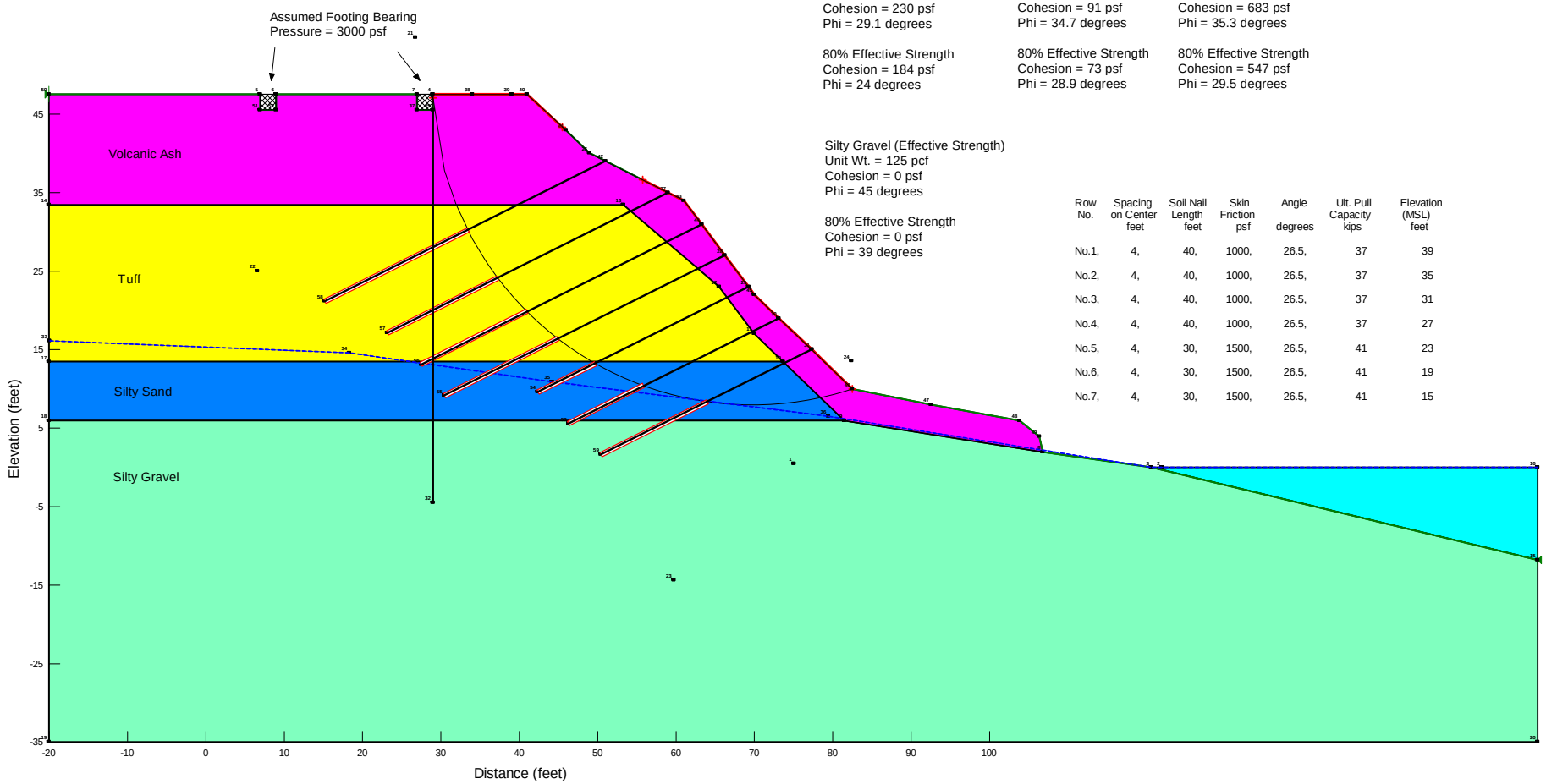
Silty Sand (Total Strength)
Unit Wt. = 95 pcf
Cohesion = 725 psf
Phi = 16 degrees

Effective Strength
Cohesion = 683 psf
Phi = 35.3 degrees

80% Effective Strength
Cohesion = 547 psf
Phi = 29.5 degrees

Silty Gravel (Effective Strength)
Unit Wt. = 125 pcf
Cohesion = 0 psf
Phi = 45 degrees

80% Effective Strength
Cohesion = 0 psf
Phi = 39 degrees



Row No.	Spacing on Center feet	Soil Nail Length feet	Skin Friction psf	Angle degrees	Ult. Pull Capacity kips	Elevation (MSL) feet
No.1,	4,	40,	1000,	26.5,	37	39
No.2,	4,	40,	1000,	26.5,	37	35
No.3,	4,	40,	1000,	26.5,	37	31
No.4,	4,	40,	1000,	26.5,	37	27
No.5,	4,	30,	1500,	26.5,	41	23
No.6,	4,	30,	1500,	26.5,	41	19
No.7,	4,	30,	1500,	26.5,	41	15

SLOPE STABILITY ANALYSIS: SECTION B-B SOIL NAILS AND SHOTCRETE

STATIC LOADING

Steam Bank Bluff Protection and Stabilization of a Second Erosion Scarp
Second Level of the Riverside Apartments Property at 333 Ohai Street, Hilo, Hawaii (TMK 2-6-003:009) Project No. 12014

Yogi Kwong Engineers, LLC

APPENDIX E-12

Section B-B Soil Nail & Micropile 80% Effective Strength 0.20g Seismic.gsz
Analysis Method: Morgenstern-Price
Seismic Loading:
Horizontal = 0.2g
Vertical = 0g

1.926

Volcanic Ash (Total Strength)
Unit Wt. = 76 pcf
Cohesion = 344 psf
Phi = 13.2 degrees

Effective Strength
Cohesion = 230 psf
Phi = 29.1 degrees

80% Effective Strength
Cohesion = 184 psf
Phi = 24 degrees

Tuff (Total Strength)
Unit Wt. = 95 pcf
Cohesion = 435 psf
Phi = 14.5 degrees

Effective Strength
Cohesion = 91 psf
Phi = 34.7 degrees

80% Effective Strength
Cohesion = 73 psf
Phi = 28.9 degrees

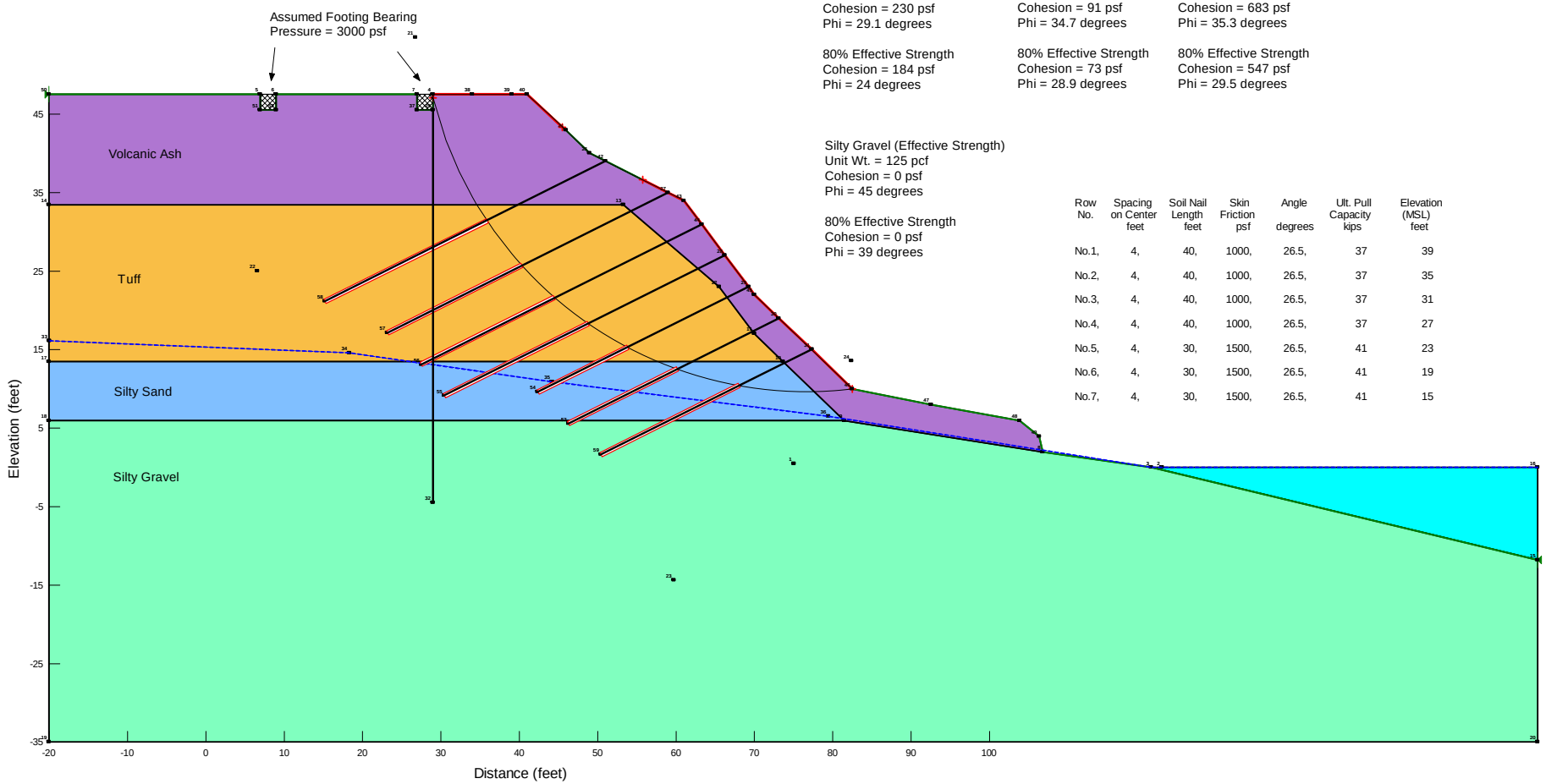
Silty Sand (Total Strength)
Unit Wt. = 95 pcf
Cohesion = 725 psf
Phi = 16 degrees

Effective Strength
Cohesion = 683 psf
Phi = 35.3 degrees

80% Effective Strength
Cohesion = 547 psf
Phi = 29.5 degrees

Silty Gravel (Effective Strength)
Unit Wt. = 125 pcf
Cohesion = 0 psf
Phi = 45 degrees

80% Effective Strength
Cohesion = 0 psf
Phi = 39 degrees



Row No.	Spacing on Center feet	Soil Nail Length feet	Skin Friction psf	Angle degrees	Ult. Pull Capacity kips	Elevation (MSL) feet
No.1,	4,	40,	1000,	26.5,	37	39
No.2,	4,	40,	1000,	26.5,	37	35
No.3,	4,	40,	1000,	26.5,	37	31
No.4,	4,	40,	1000,	26.5,	37	27
No.5,	4,	30,	1500,	26.5,	41	23
No.6,	4,	30,	1500,	26.5,	41	19
No.7,	4,	30,	1500,	26.5,	41	15

SLOPE STABILITY ANALYSIS: SECTION B-B SOIL NAILS AND SHOTCRETE

0.2G PSEUDOSTATIC SEISMIC LOADING

Steam Bank Bluff Protection and Stabilization of a Second Erosion Scarp
Second Level of the Riverside Apartments Property at 333 Ohai Street, Hilo, Hawaii (TMK 2-6-003:009) Project No. 12014

Yogi Kwong Engineers, LLC

APPENDIX E-13

Section B-B Soil Nail & Micropile 80% Effective Strength 0.32g Seismic.gsz
Analysis Method: Morgenstern-Price
Seismic Loading:
Horizontal = 0.32g
Vertical = 0g

1.603

Volcanic Ash (Total Strength)
Unit Wt. = 76 pcf
Cohesion = 344 psf
Phi = 13.2 degrees

Effective Strength
Cohesion = 230 psf
Phi = 29.1 degrees

80% Effective Strength
Cohesion = 184 psf
Phi = 24 degrees

Tuff (Total Strength)
Unit Wt. = 95 pcf
Cohesion = 435 psf
Phi = 14.5 degrees

Effective Strength
Cohesion = 91 psf
Phi = 34.7 degrees

80% Effective Strength
Cohesion = 73 psf
Phi = 28.9 degrees

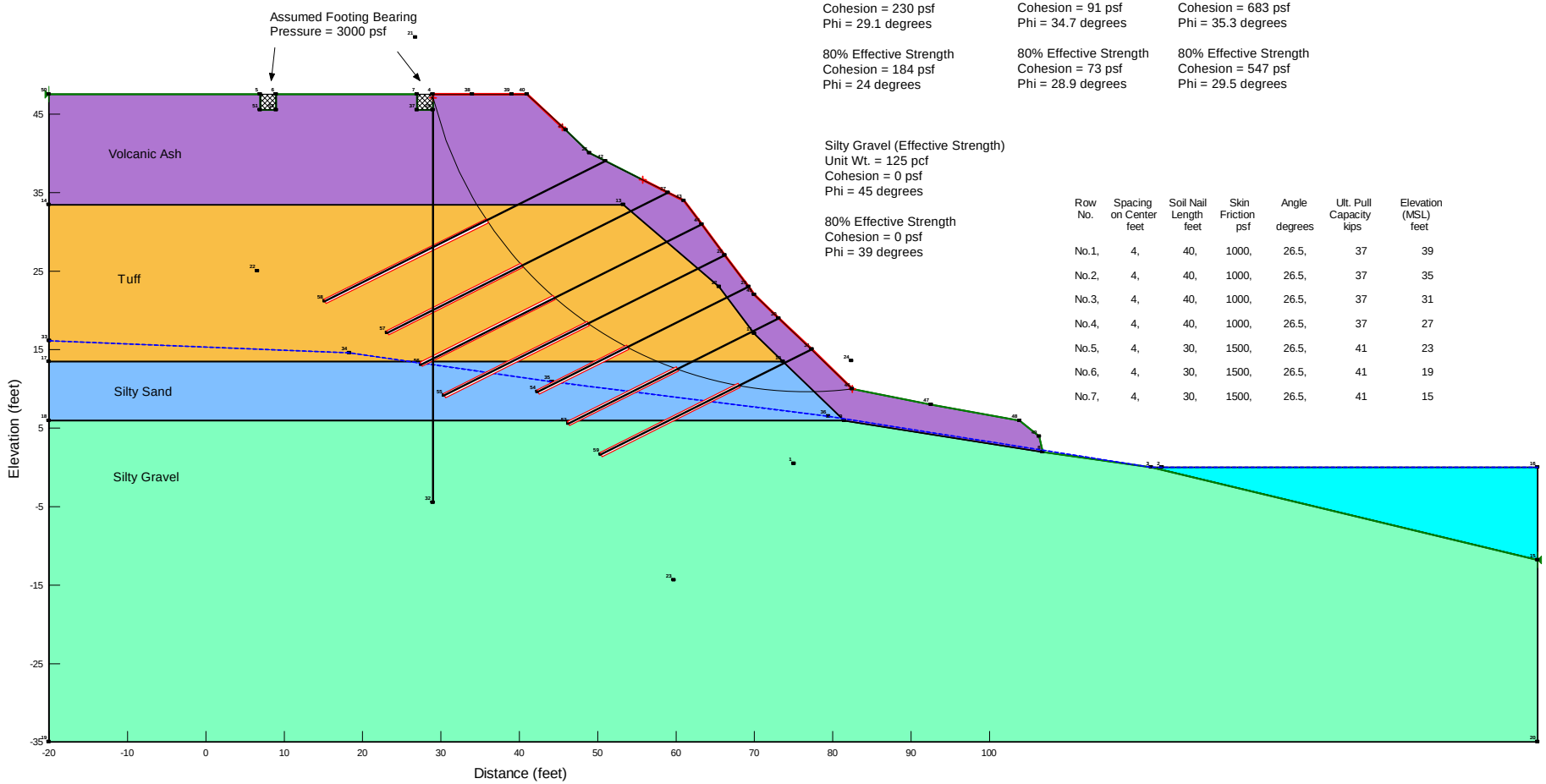
Silty Sand (Total Strength)
Unit Wt. = 95 pcf
Cohesion = 725 psf
Phi = 16 degrees

Effective Strength
Cohesion = 683 psf
Phi = 35.3 degrees

80% Effective Strength
Cohesion = 547 psf
Phi = 29.5 degrees

Silty Gravel (Effective Strength)
Unit Wt. = 125 pcf
Cohesion = 0 psf
Phi = 45 degrees

80% Effective Strength
Cohesion = 0 psf
Phi = 39 degrees



Row No.	Spacing on Center feet	Soil Nail Length feet	Skin Friction psf	Angle degrees	Ult. Pull Capacity kips	Elevation (MSL) feet
No.1,	4,	40,	1000,	26.5,	37	39
No.2,	4,	40,	1000,	26.5,	37	35
No.3,	4,	40,	1000,	26.5,	37	31
No.4,	4,	40,	1000,	26.5,	37	27
No.5,	4,	30,	1500,	26.5,	41	23
No.6,	4,	30,	1500,	26.5,	41	19
No.7,	4,	30,	1500,	26.5,	41	15

SLOPE STABILITY ANALYSIS: SECTION B-B SOIL NAILS AND SHOTCRETE

0.32G PSEUDOSTATIC SEISMIC LOADING

Steam Bank Bluff Protection and Stabilization of a Second Erosion Scarp
Second Level of the Riverside Apartments Property at 333 Ohai Street, Hilo, Hawaii (TMK 2-6-003:009) Project No. 12014

Yogi Kwong Engineers, LLC

APPENDIX E-14

Section B-B Soil Nail & Micropile 80% Effective Strength 0.50g Seismic.gsz
Analysis Method: Morgenstern-Price
Seismic Loading:
Horizontal = 0.5g
Vertical = 0g

1.273

Volcanic Ash (Total Strength)
Unit Wt. = 76 pcf
Cohesion = 344 psf
Phi = 13.2 degrees

Effective Strength
Cohesion = 230 psf
Phi = 29.1 degrees

80% Effective Strength
Cohesion = 184 psf
Phi = 24 degrees

Tuff (Total Strength)
Unit Wt. = 95 pcf
Cohesion = 435 psf
Phi = 14.5 degrees

Effective Strength
Cohesion = 91 psf
Phi = 34.7 degrees

80% Effective Strength
Cohesion = 73 psf
Phi = 28.9 degrees

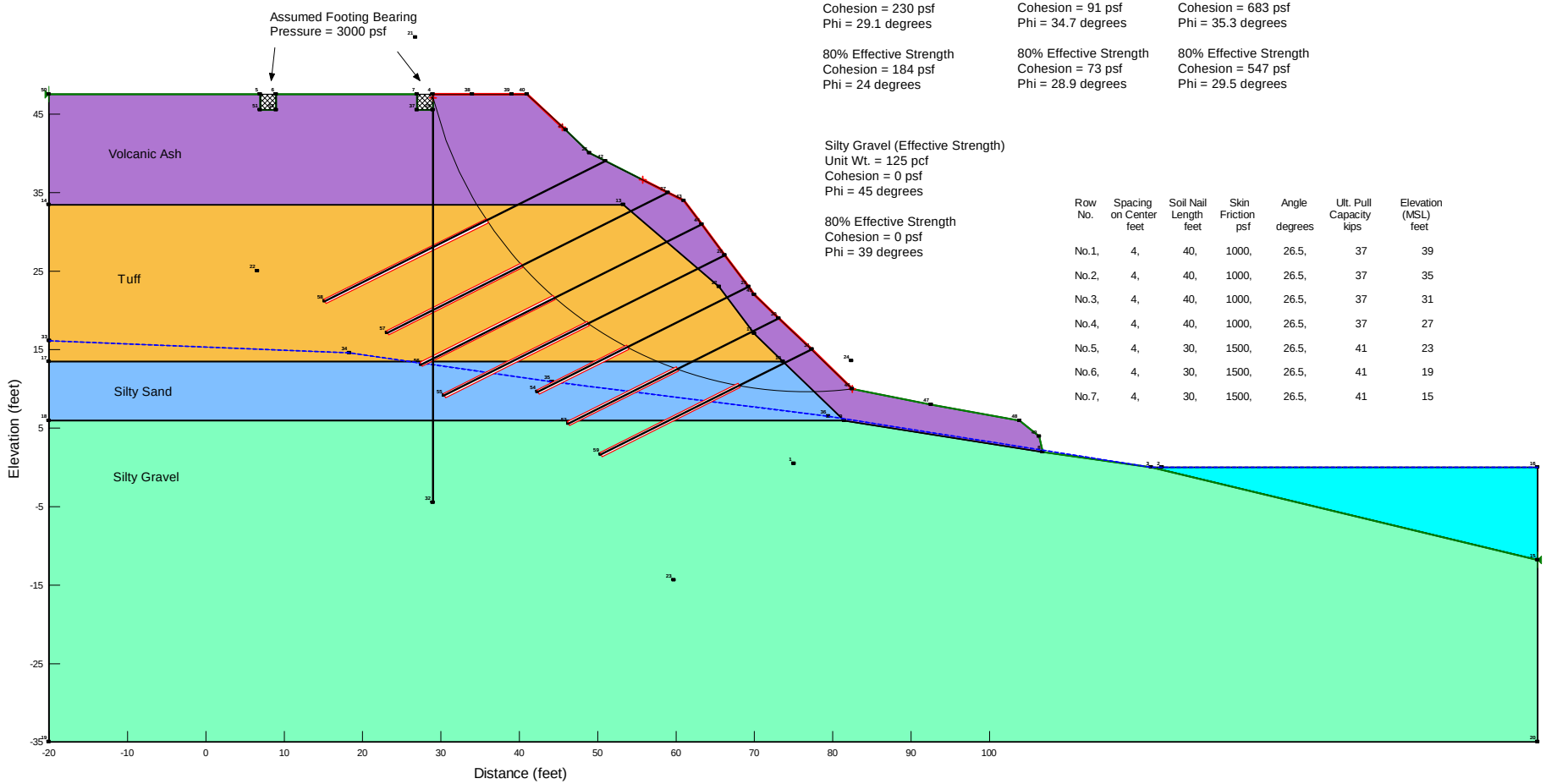
Silty Sand (Total Strength)
Unit Wt. = 95 pcf
Cohesion = 725 psf
Phi = 16 degrees

Effective Strength
Cohesion = 683 psf
Phi = 35.3 degrees

80% Effective Strength
Cohesion = 547 psf
Phi = 29.5 degrees

Silty Gravel (Effective Strength)
Unit Wt. = 125 pcf
Cohesion = 0 psf
Phi = 45 degrees

80% Effective Strength
Cohesion = 0 psf
Phi = 39 degrees



Row No.	Spacing on Center feet	Soil Nail Length feet	Skin Friction psf	Angle degrees	Ult. Pull Capacity kips	Elevation (MSL) feet
No.1,	4,	40,	1000,	26.5,	37	39
No.2,	4,	40,	1000,	26.5,	37	35
No.3,	4,	40,	1000,	26.5,	37	31
No.4,	4,	40,	1000,	26.5,	37	27
No.5,	4,	30,	1500,	26.5,	41	23
No.6,	4,	30,	1500,	26.5,	41	19
No.7,	4,	30,	1500,	26.5,	41	15

SLOPE STABILITY ANALYSIS: SECTION B-B SOIL NAILS AND SHOTCRETE

0.5G PSEUDOSTATIC SEISMIC LOADING

Steam Bank Bluff Protection and Stabilization of a Second Erosion Scarp
Second Level of the Riverside Apartments Property at 333 Ohai Street, Hilo, Hawaii (TMK 2-6-003:009) Project No. 12014

Yogi Kwong Engineers, LLC

APPENDIX E-15

Section B-B Soil Nail & Micropile 80% Effective Strength 0.67g Seismic.gsz
Analysis Method: Morgenstern-Price
Seismic Loading:
Horizontal = 0.67g
Vertical = 0g

1.061

Volcanic Ash (Total Strength)
Unit Wt. = 76 pcf
Cohesion = 344 psf
Phi = 13.2 degrees

Effective Strength
Cohesion = 230 psf
Phi = 29.1 degrees

80% Effective Strength
Cohesion = 184 psf
Phi = 24 degrees

Tuff (Total Strength)
Unit Wt. = 95 pcf
Cohesion = 435 psf
Phi = 14.5 degrees

Effective Strength
Cohesion = 91 psf
Phi = 34.7 degrees

80% Effective Strength
Cohesion = 73 psf
Phi = 28.9 degrees

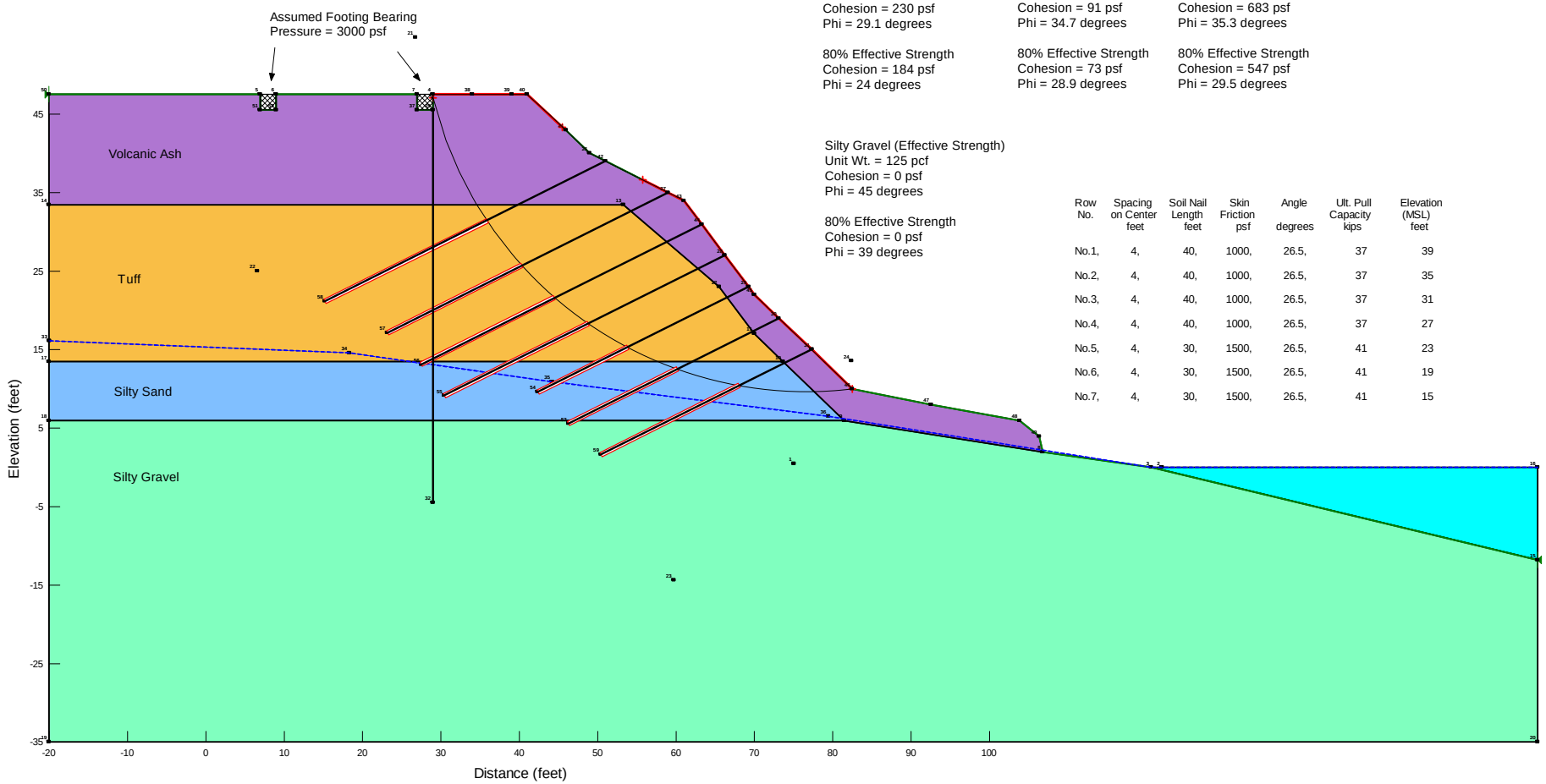
Silty Sand (Total Strength)
Unit Wt. = 95 pcf
Cohesion = 725 psf
Phi = 16 degrees

Effective Strength
Cohesion = 683 psf
Phi = 35.3 degrees

80% Effective Strength
Cohesion = 547 psf
Phi = 29.5 degrees

Silty Gravel (Effective Strength)
Unit Wt. = 125 pcf
Cohesion = 0 psf
Phi = 45 degrees

80% Effective Strength
Cohesion = 0 psf
Phi = 39 degrees



Row No.	Spacing on Center feet	Soil Nail Length feet	Skin Friction psf	Angle degrees	Ult. Pull Capacity kips	Elevation (MSL) feet
No.1,	4,	40,	1000,	26.5,	37	39
No.2,	4,	40,	1000,	26.5,	37	35
No.3,	4,	40,	1000,	26.5,	37	31
No.4,	4,	40,	1000,	26.5,	37	27
No.5,	4,	30,	1500,	26.5,	41	23
No.6,	4,	30,	1500,	26.5,	41	19
No.7,	4,	30,	1500,	26.5,	41	15

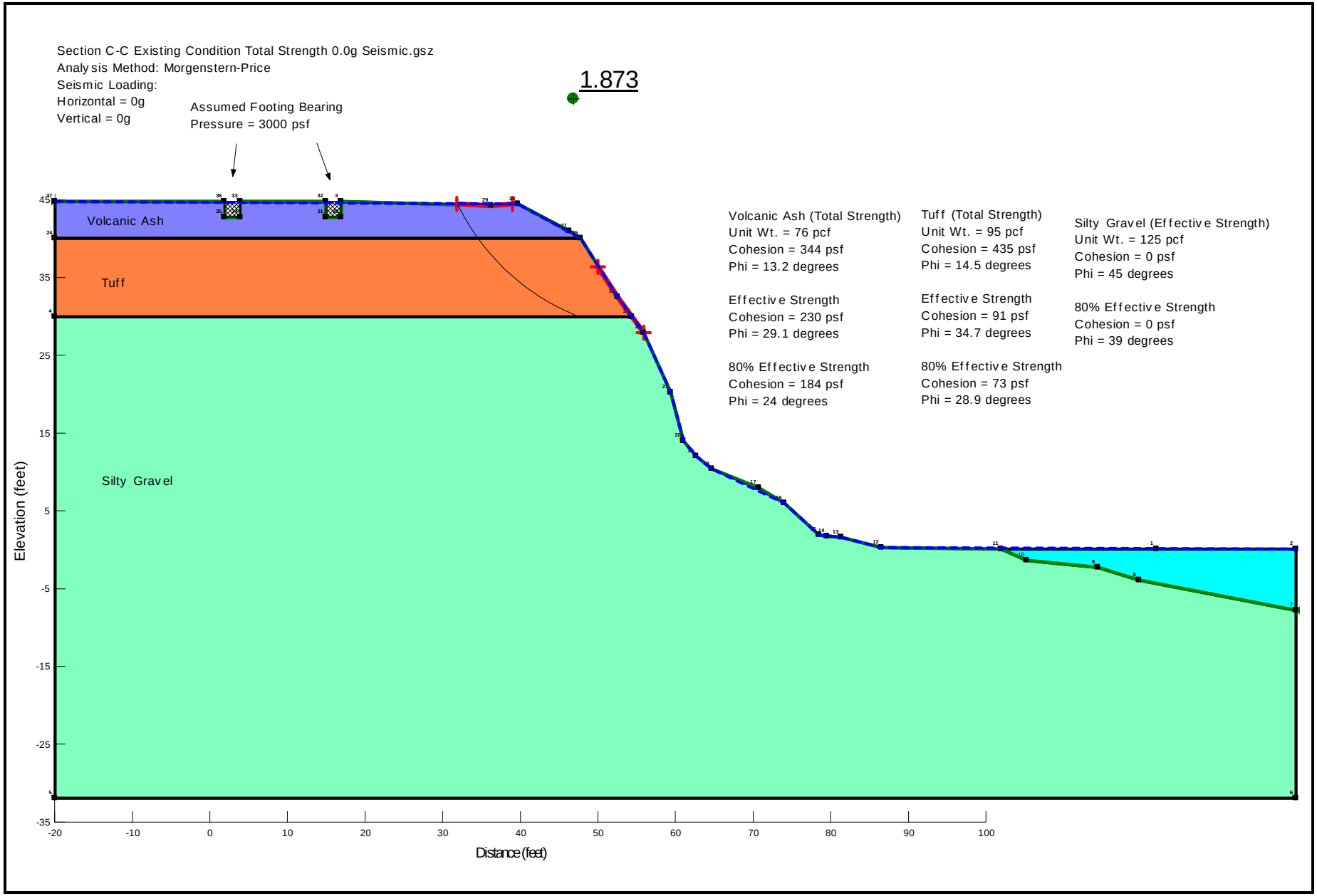
SLOPE STABILITY ANALYSIS: SECTION B-B SOIL NAILS AND SHOTCRETE

0.67G PSEUDOSTATIC SEISMIC LOADING

Steam Bank Bluff Protection and Stabilization of a Second Erosion Scarp
Second Level of the Riverside Apartments Property at 333 Ohai Street, Hilo, Hawaii (TMK 2-6-003:009) Project No. 12014

Yogi Kwong Engineers, LLC

APPENDIX E-16



SLOPE STABILITY ANALYSIS: SECTION C-C EXISTING CONDITION

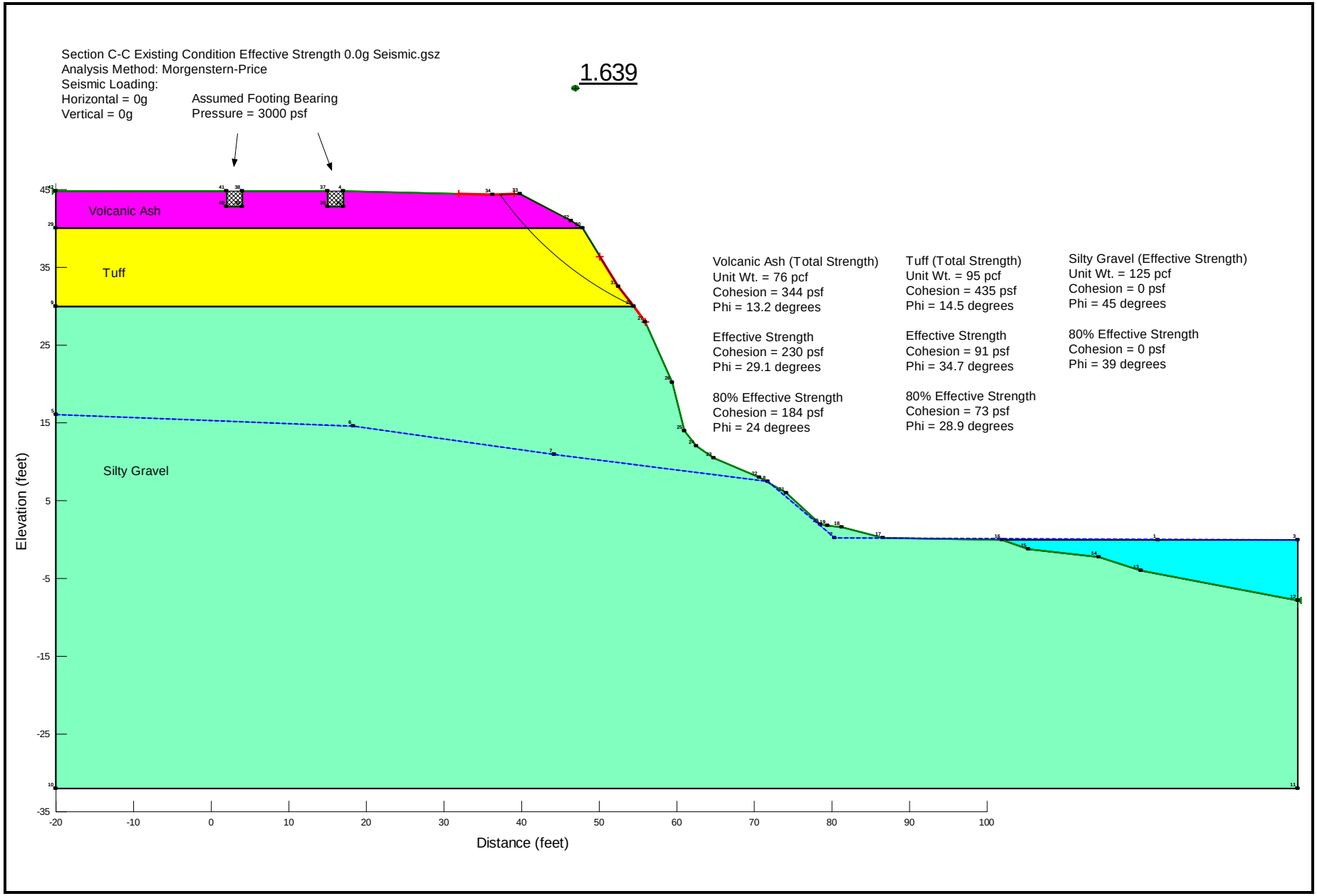
FULLY SATURATED SLOPE CONDITION

Steam Bank Bluff Protection and Stabilization of a Second Erosion Scarp

Second Level of the Riverside Apartments Property at 333 Ohai Street, Hilo, Hawaii (TMK 2-6-003:009) Project No. 12014

Yogi Kwong Engineers, LLC

APPENDIX E-17



SLOPE STABILITY ANALYSIS: SECTION C-C EXISTING CONDITION

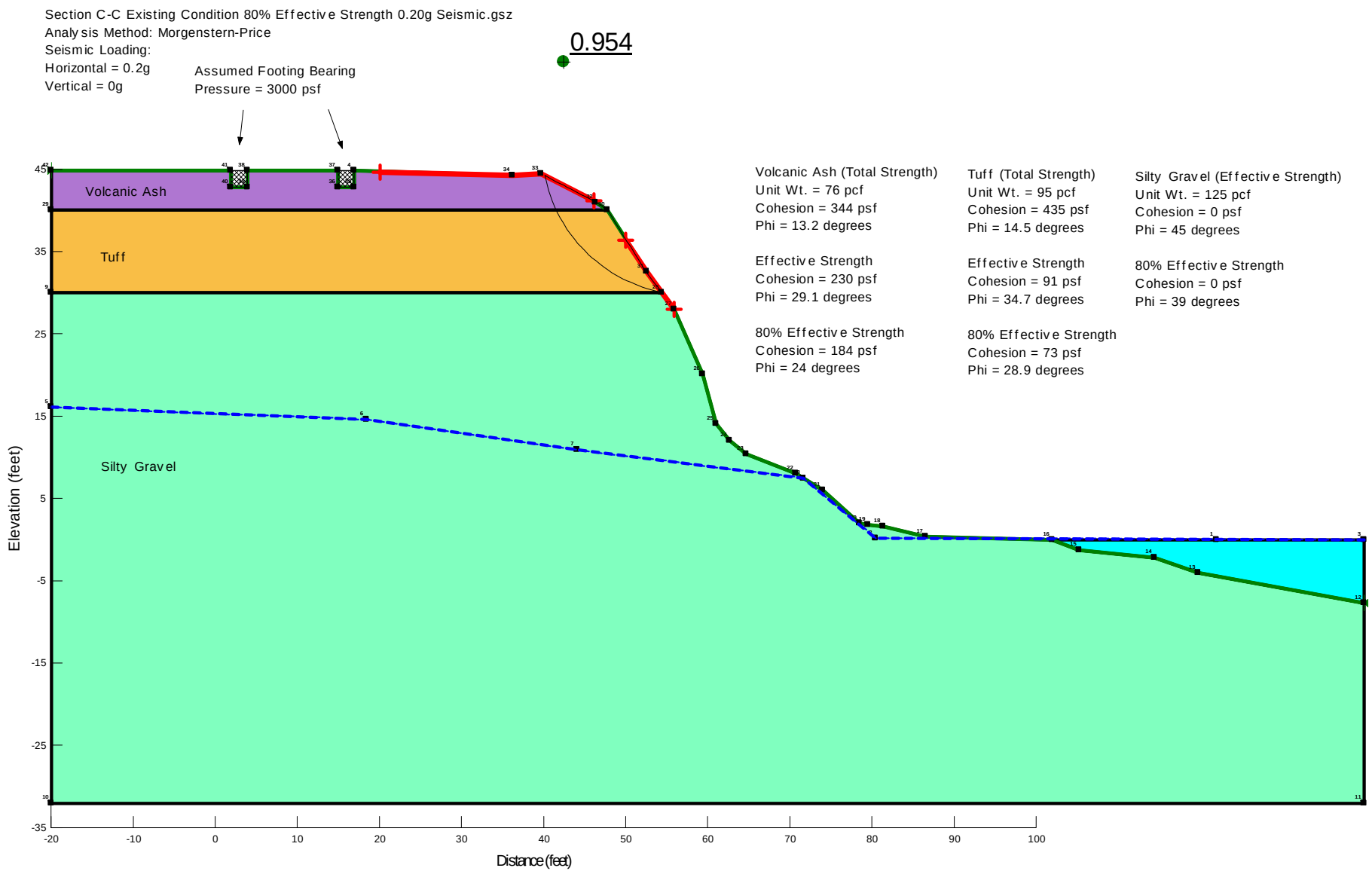
STATIC LOADING

Steam Bank Bluff Protection and Stabilization of a Second Erosion Scarp

Second Level of the Riverside Apartments Property at 333 Ohai Street, Hilo, Hawaii (TMK 2-6-003:009) Project No. 12014

Yogi Kwong Engineers, LLC

APPENDIX E-18



SLOPE STABILITY ANALYSIS: SECTION C-C EXISTING CONDITION

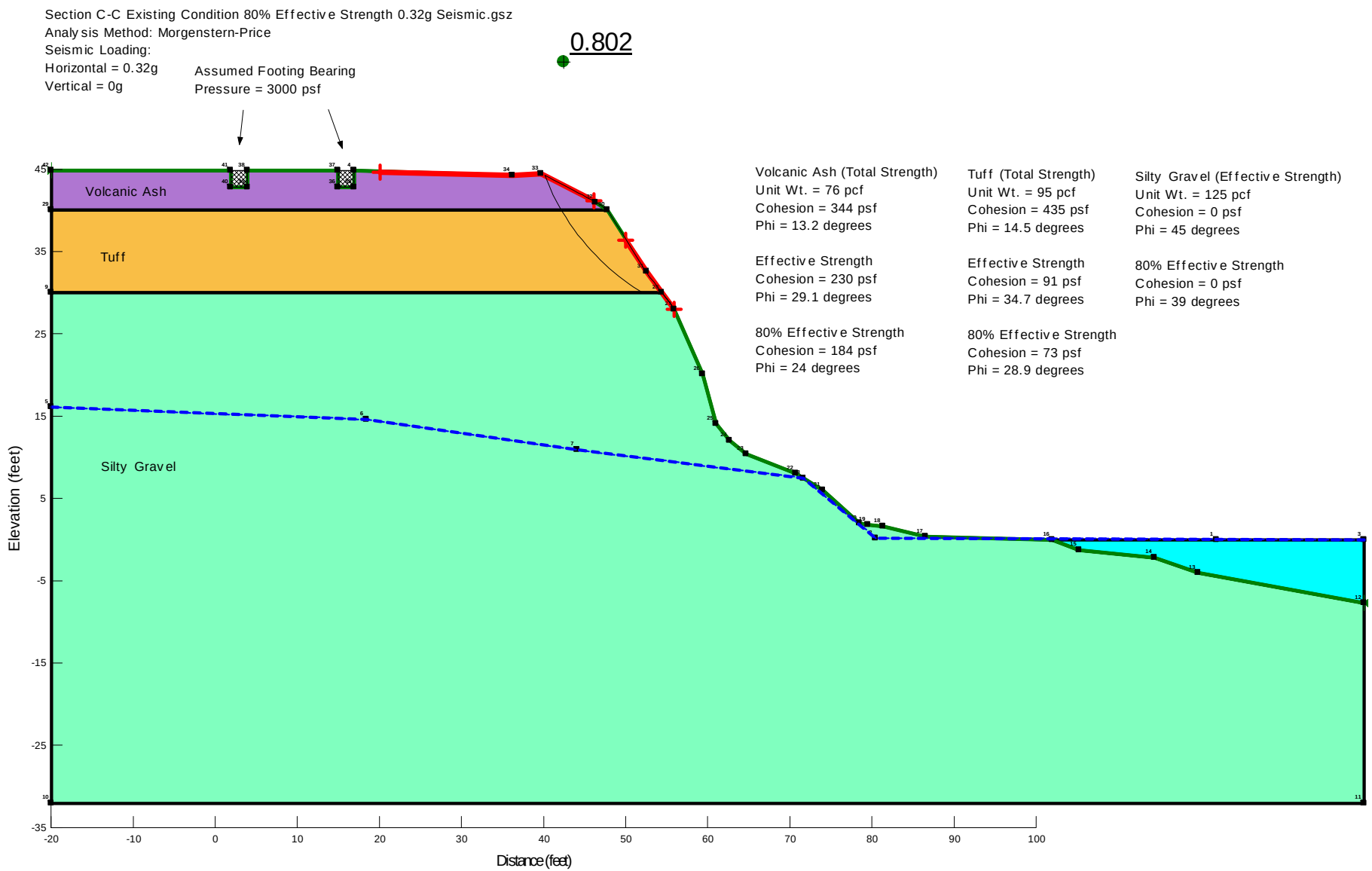
0.2G PSEUDOSTATIC SEISMIC LOADING

Steam Bank Bluff Protection and Stabilization of a Second Erosion Scarp

Second Level of the Riverside Apartments Property at 333 Ohai Street, Hilo, Hawaii (TMK 2-6-003:009) Project No. 12014

Yogi Kwong Engineers, LLC

APPENDIX E-19



SLOPE STABILITY ANALYSIS: SECTION C-C EXISTING CONDITION

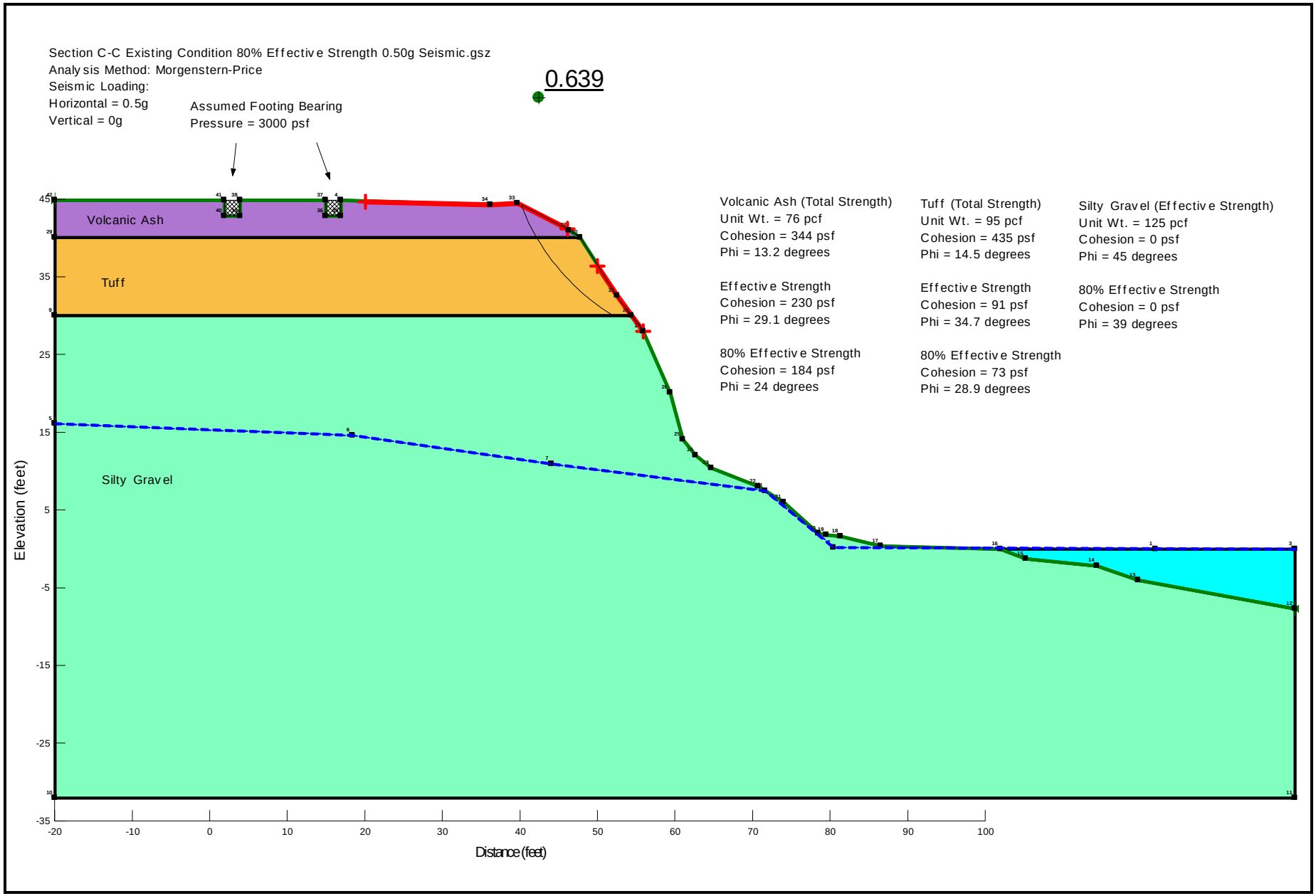
0.32G PSEUDOSTATIC SEISMIC LOADING

Steam Bank Bluff Protection and Stabilization of a Second Erosion Scarp

Second Level of the Riverside Apartments Property at 333 Ohai Street, Hilo, Hawaii (TMK 2-6-003:009) Project No. 12014

Yogi Kwong Engineers, LLC

APPENDIX E-20



SLOPE STABILITY ANALYSIS: SECTION C-C EXISTING CONDITION

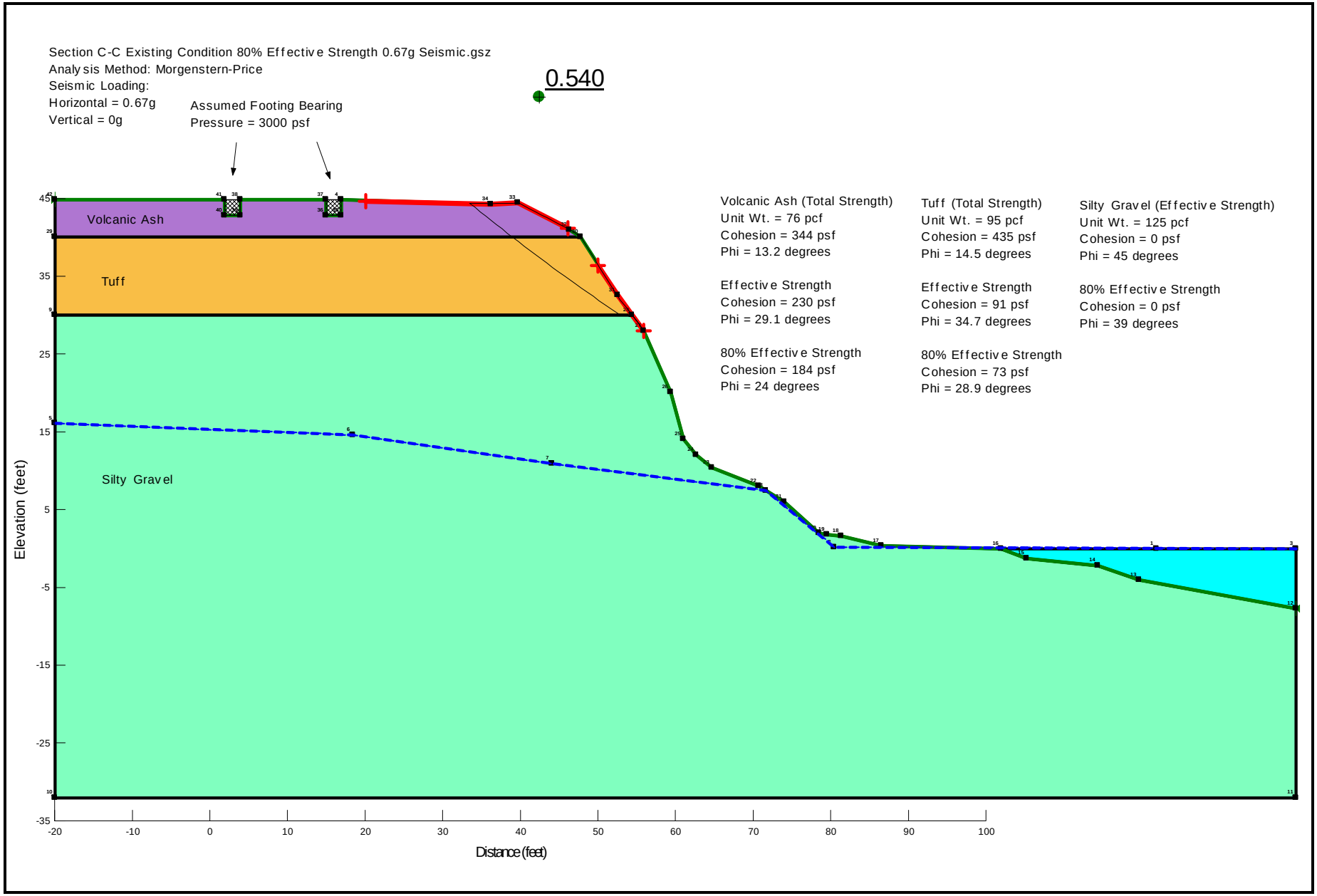
0.50G PSEUDOSTATIC SEISMIC LOADING

Steam Bank Bluff Protection and Stabilization of a Second Erosion Scarp

Second Level of the Riverside Apartments Property at 333 Ohai Street, Hilo, Hawaii (TMK 2-6-003:009) Project No. 12014

Yogi Kwong Engineers, LLC

APPENDIX E-21



SLOPE STABILITY ANALYSIS: SECTION C-C EXISTING CONDITION

0.67G PSEUDOSTATIC SEISMIC LOADING

Steam Bank Bluff Protection and Stabilization of a Second Erosion Scarp

Second Level of the Riverside Apartments Property at 333 Ohai Street, Hilo, Hawaii (TMK 2-6-003:009) Project No. 12014

Yogi Kwong Engineers, LLC

APPENDIX E-22

Section C-C Soil Nail & Micropile Total Strength 0.00g Seismic.gsz
Analysis Method: Morgenstern-Price
Seismic Loading:
Horizontal = 0g
Vertical = 0g

3.766

Assumed Footing Bearing
Pressure = 3000 psf

Volcanic Ash (Total Strength)
Unit Wt. = 76 pcf
Cohesion = 344 psf
Phi = 13.2 degrees

Effective Strength
Cohesion = 230 psf
Phi = 29.1 degrees

80% Effective Strength
Cohesion = 184 psf
Phi = 24 degrees

Tuff (Total Strength)
Unit Wt. = 95 pcf
Cohesion = 435 psf
Phi = 14.5 degrees

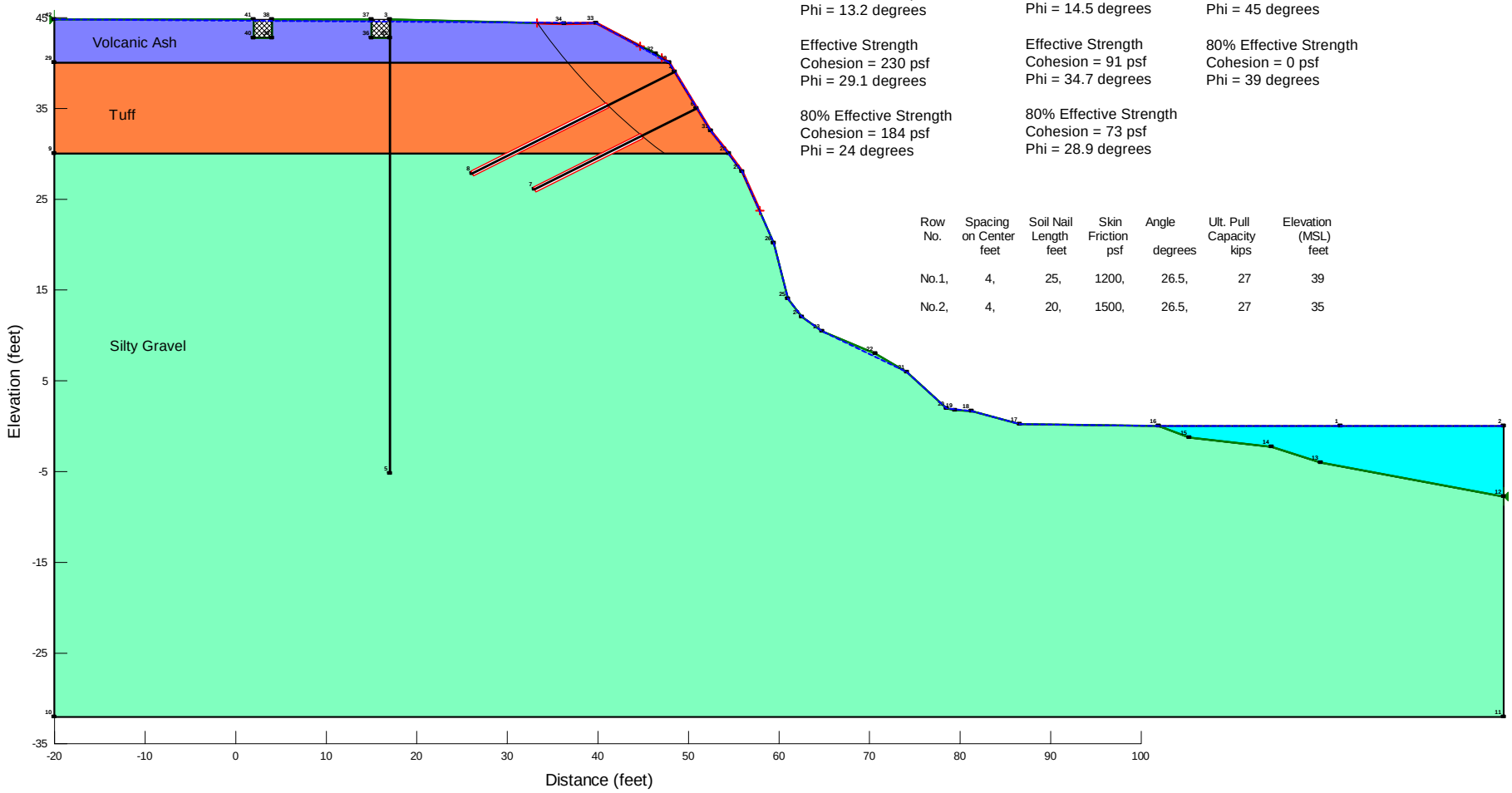
Effective Strength
Cohesion = 91 psf
Phi = 34.7 degrees

80% Effective Strength
Cohesion = 73 psf
Phi = 28.9 degrees

Silty Gravel (Effective Strength)
Unit Wt. = 125 pcf
Cohesion = 0 psf
Phi = 45 degrees

80% Effective Strength
Cohesion = 0 psf
Phi = 39 degrees

Row No.	Spacing on Center feet	Soil Nail Length feet	Skin Friction psf	Angle degrees	Ult. Pull Capacity kips	Elevation (MSL) feet
No.1,	4,	25,	1200,	26.5,	27	39
No.2,	4,	20,	1500,	26.5,	27	35



SLOPE STABILITY ANALYSIS: SECTION C-C SOIL NAILS AND SHOTCRETE

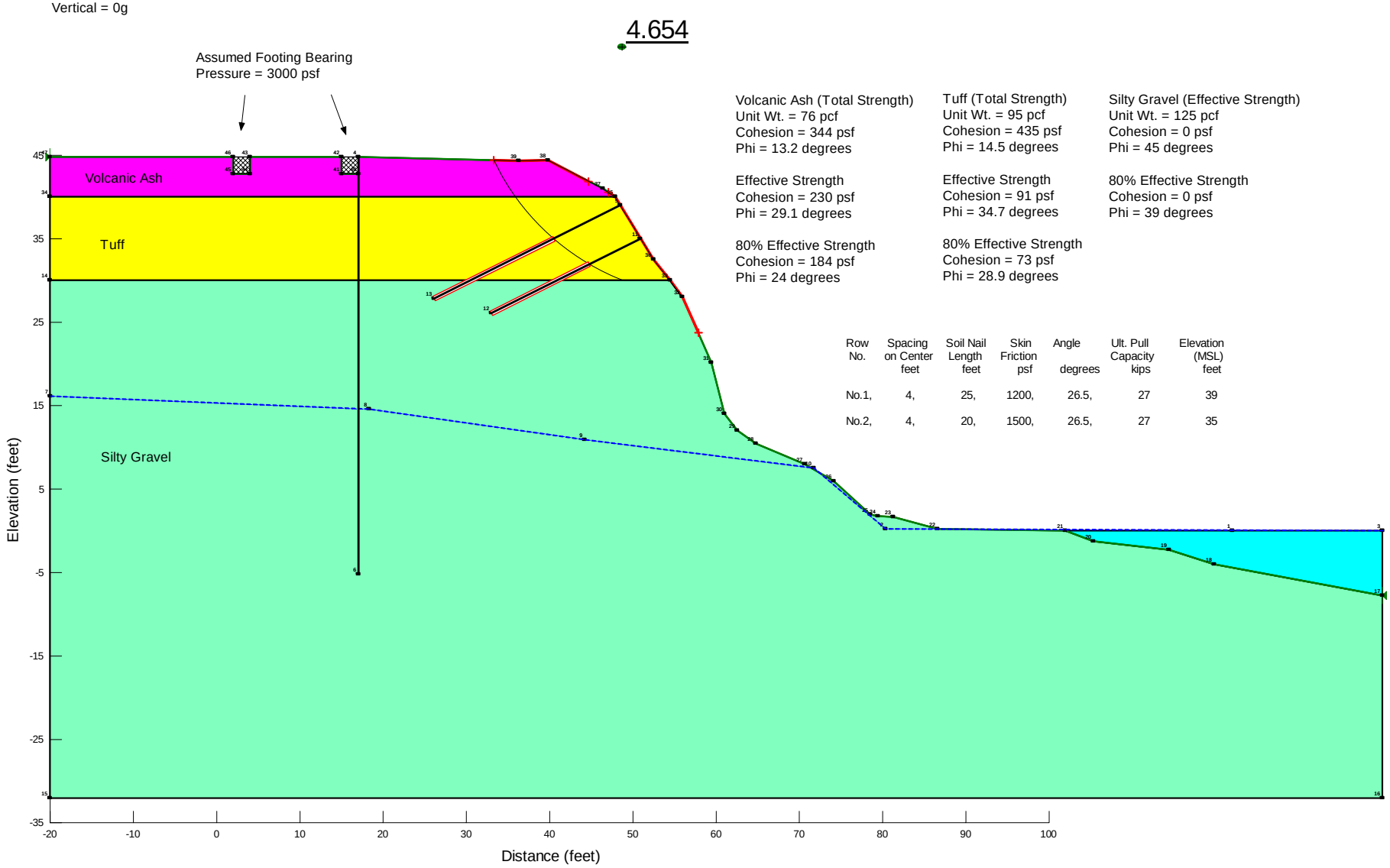
FULLY SATURATED SLOPE CONDITION

Steam Bank Bluff Protection and Stabilization of a Second Erosion Scarp
Second Level of the Riverside Apartments Property at 333 Ohai Street, Hilo, Hawaii (TMK 2-6-003:009) Project No. 12014

Yogi Kwong Engineers, LLC

APPENDIX E-23

Section C-C Soil Nail & Micropile Effective Strength 0.00g Seismic.gsz
Analysis Method: Morgenstern-Price
Seismic Loading:
Horizontal = 0g
Vertical = 0g



Row No.	Spacing on Center feet	Soil Nail Length feet	Skin Friction psf	Angle degrees	Ult. Pull Capacity kips	Elevation (MSL) feet
No.1,	4,	25,	1200,	26.5,	27	39
No.2,	4,	20,	1500,	26.5,	27	35

SLOPE STABILITY ANALYSIS: SECTION C-C SOIL NAILS AND SHOTCRETE

STATIC LOADING

Steam Bank Bluff Protection and Stabilization of a Second Erosion Scarp
Second Level of the Riverside Apartments Property at 333 Ohai Street, Hilo, Hawaii (TMK 2-6-003:009) Project No. 12014

Yogi Kwong Engineers, LLC

APPENDIX E-24

Section C-C Soil Nail & Micropile 80% Effective Strength 0.20g Seismic.gsz
Analysis Method: Morgenstern-Price
Seismic Loading:
Horizontal = 0.2g
Vertical = 0g

2.308

Assumed Footing Bearing
Pressure = 3000 psf

Volcanic Ash (Total Strength)
Unit Wt. = 76 pcf
Cohesion = 344 psf
Phi = 13.2 degrees

Effective Strength
Cohesion = 230 psf
Phi = 29.1 degrees

80% Effective Strength
Cohesion = 184 psf
Phi = 24 degrees

Tuff (Total Strength)
Unit Wt. = 95 pcf
Cohesion = 435 psf
Phi = 14.5 degrees

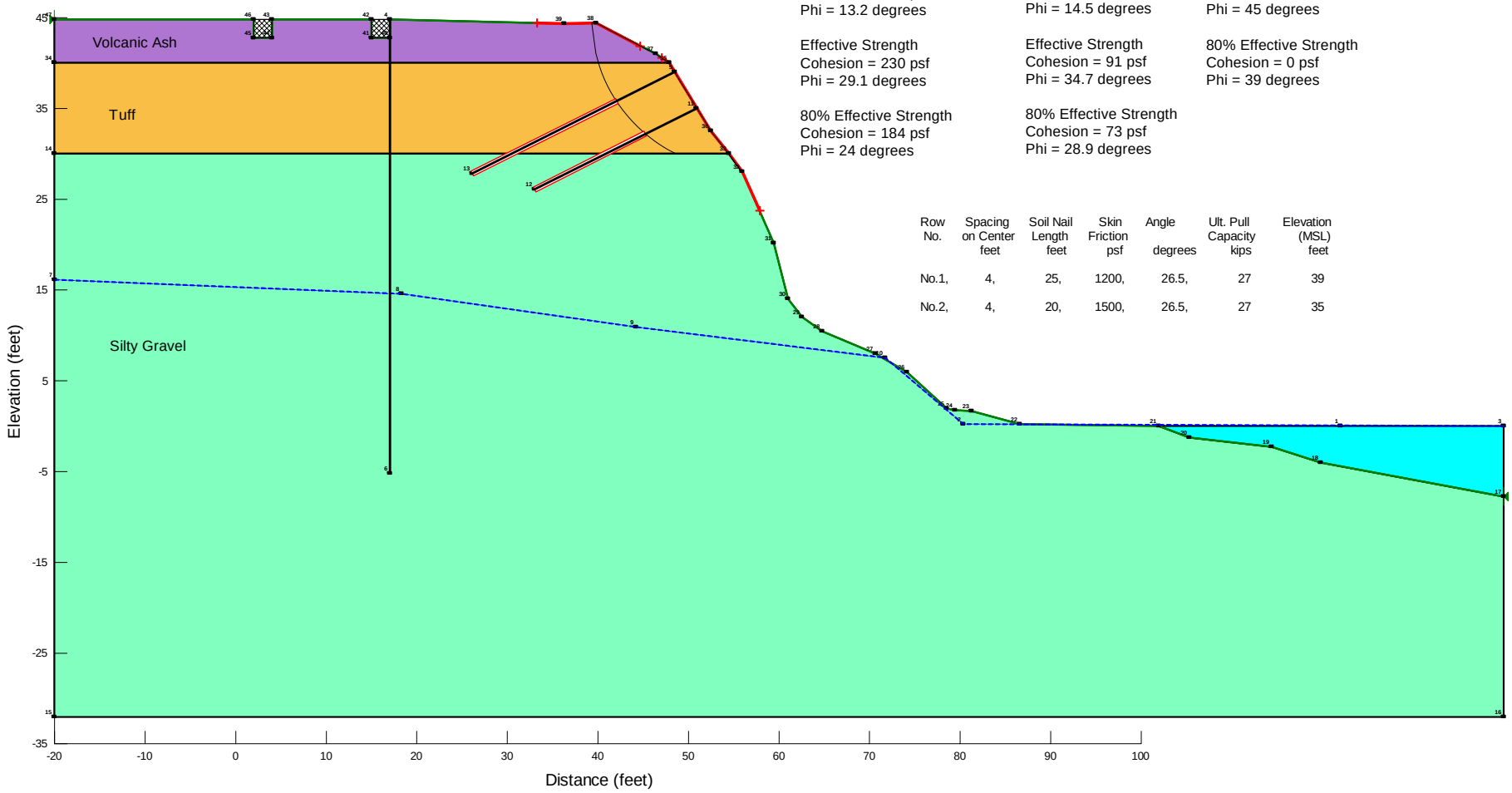
Effective Strength
Cohesion = 91 psf
Phi = 34.7 degrees

80% Effective Strength
Cohesion = 73 psf
Phi = 28.9 degrees

Silty Gravel (Effective Strength)
Unit Wt. = 125 pcf
Cohesion = 0 psf
Phi = 45 degrees

80% Effective Strength
Cohesion = 0 psf
Phi = 39 degrees

Row No.	Spacing on Center feet	Soil Nail Length feet	Skin Friction psf	Angle degrees	Ult. Pull Capacity kips	Elevation (MSL) feet
No.1,	4,	25,	1200,	26.5,	27	39
No.2,	4,	20,	1500,	26.5,	27	35



SLOPE STABILITY ANALYSIS: SECTION C-C SOIL NAILS AND SHOTCRETE

0.2G PSEUDOSTATIC SEISMIC LOADING

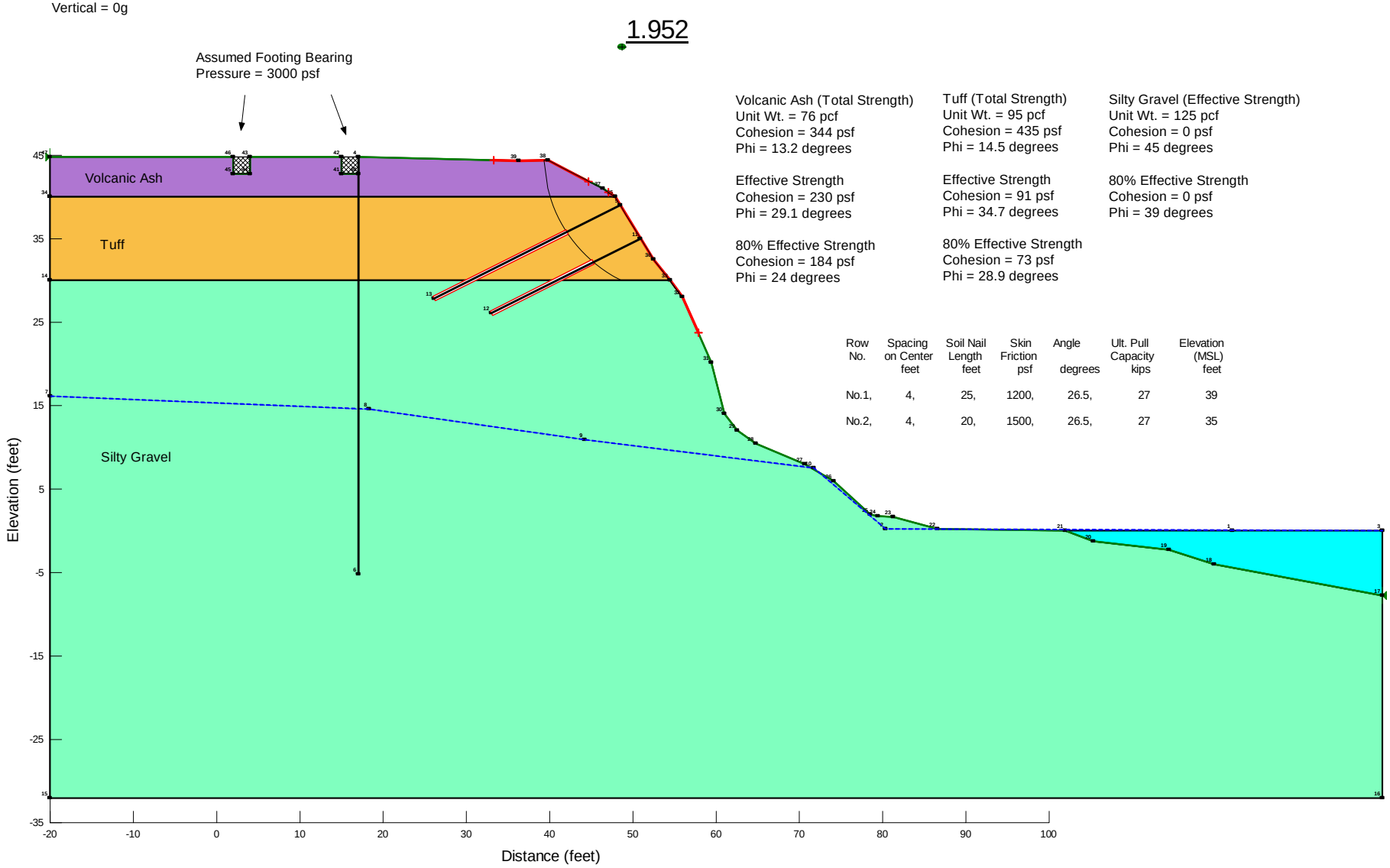
Steam Bank Bluff Protection and Stabilization of a Second Erosion Scarp

Second Level of the Riverside Apartments Property at 333 Ohai Street, Hilo, Hawaii (TMK 2-6-003:009) Project No. 12014

Yogi Kwong Engineers, LLC

APPENDIX E-25

Section C-C Soil Nail & Micropile 80% Effective Strength 0.32g Seismic.gsz
Analysis Method: Morgenstern-Price
Seismic Loading:
Horizontal = 0.32g
Vertical = 0g



Row No.	Spacing on Center feet	Soil Nail Length feet	Skin Friction psf	Angle degrees	Ult. Pull Capacity kips	Elevation (MSL) feet
No.1,	4,	25,	1200,	26.5,	27	39
No.2,	4,	20,	1500,	26.5,	27	35

SLOPE STABILITY ANALYSIS: SECTION C-C SOIL NAILS AND SHOTCRETE

0.32G PSEUDOSTATIC SEISMIC LOADING

Steam Bank Bluff Protection and Stabilization of a Second Erosion Scarp

Second Level of the Riverside Apartments Property at 333 Ohai Street, Hilo, Hawaii (TMK 2-6-003:009) Project No. 12014

Yogi Kwong Engineers, LLC

APPENDIX E-26

Section C-C Soil Nail & Micropile 80% Effective Strength 0.50g Seismic.gsz
Analysis Method: Morgenstern-Price
Seismic Loading:
Horizontal = 0.5g
Vertical = 0g

1.537

Assumed Footing Bearing
Pressure = 3000 psf

Volcanic Ash (Total Strength)
Unit Wt. = 76 pcf
Cohesion = 344 psf
Phi = 13.2 degrees

Effective Strength
Cohesion = 230 psf
Phi = 29.1 degrees

80% Effective Strength
Cohesion = 184 psf
Phi = 24 degrees

Tuff (Total Strength)
Unit Wt. = 95 pcf
Cohesion = 435 psf
Phi = 14.5 degrees

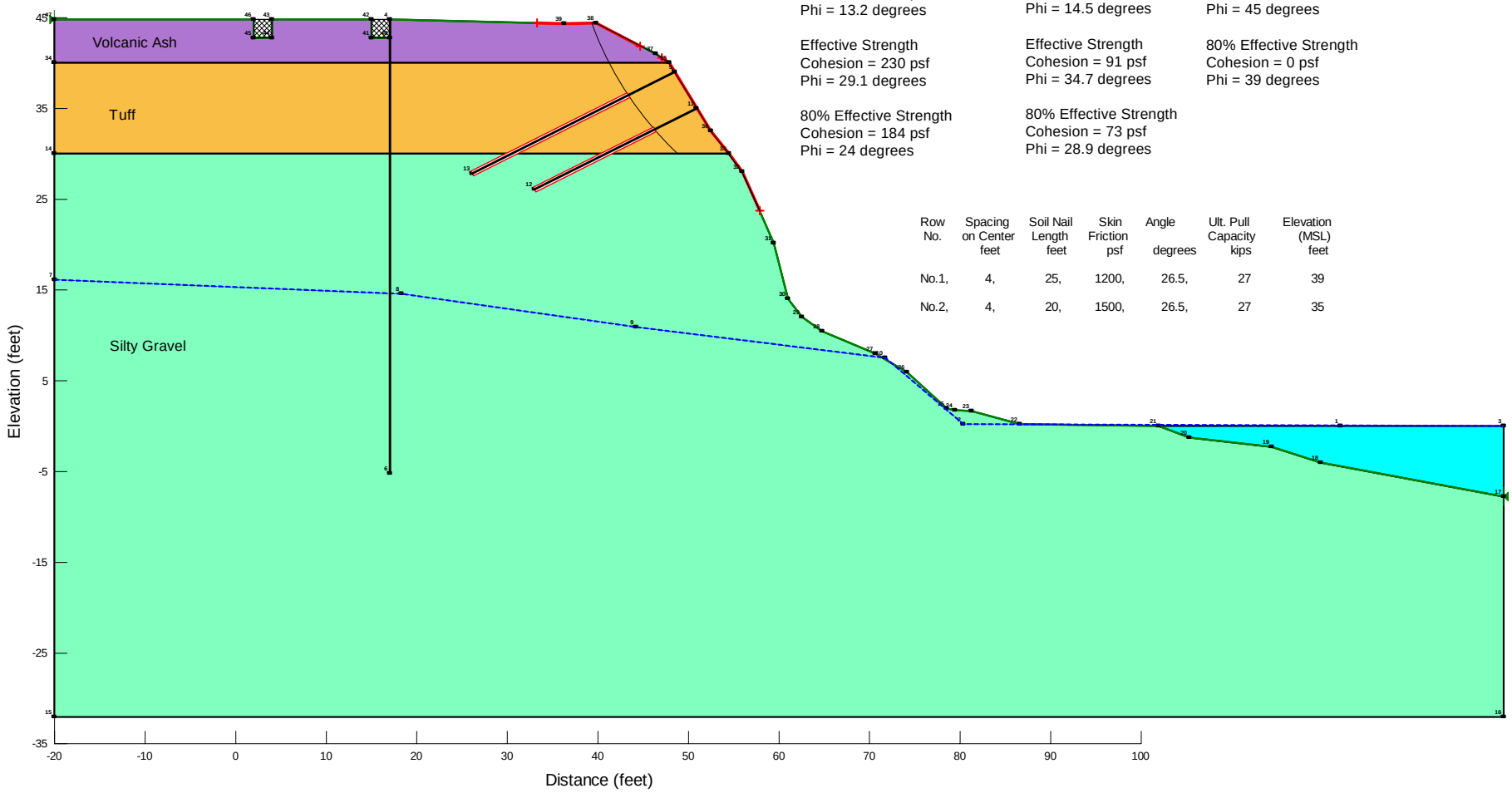
Effective Strength
Cohesion = 91 psf
Phi = 34.7 degrees

80% Effective Strength
Cohesion = 73 psf
Phi = 28.9 degrees

Silty Gravel (Effective Strength)
Unit Wt. = 125 pcf
Cohesion = 0 psf
Phi = 45 degrees

80% Effective Strength
Cohesion = 0 psf
Phi = 39 degrees

Row No.	Spacing on Center feet	Soil Nail Length feet	Skin Friction psf	Angle degrees	Ult. Pull Capacity kips	Elevation (MSL) feet
No.1,	4,	25,	1200,	26.5,	27	39
No.2,	4,	20,	1500,	26.5,	27	35



SLOPE STABILITY ANALYSIS: SECTION C-C SOIL NAILS AND SHOTCRETE

0.5G PSEUDOSTATIC SEISMIC LOADING

Steam Bank Bluff Protection and Stabilization of a Second Erosion Scarp

Second Level of the Riverside Apartments Property at 333 Ohai Street, Hilo, Hawaii (TMK 2-6-003:009) Project No. 12014

Yogi Kwong Engineers, LLC

APPENDIX E-27

Section C-C Soil Nail & Micropile 80% Effective Strength 0.67g Seismic.gsz
Analysis Method: Morgenstern-Price
Seismic Loading:
Horizontal = 0.67g
Vertical = 0g

1.118

Assumed Footing Bearing
Pressure = 3000 psf

Volcanic Ash (Total Strength)
Unit Wt. = 76 pcf
Cohesion = 344 psf
Phi = 13.2 degrees

Effective Strength
Cohesion = 230 psf
Phi = 29.1 degrees

80% Effective Strength
Cohesion = 184 psf
Phi = 24 degrees

Tuff (Total Strength)
Unit Wt. = 95 pcf
Cohesion = 435 psf
Phi = 14.5 degrees

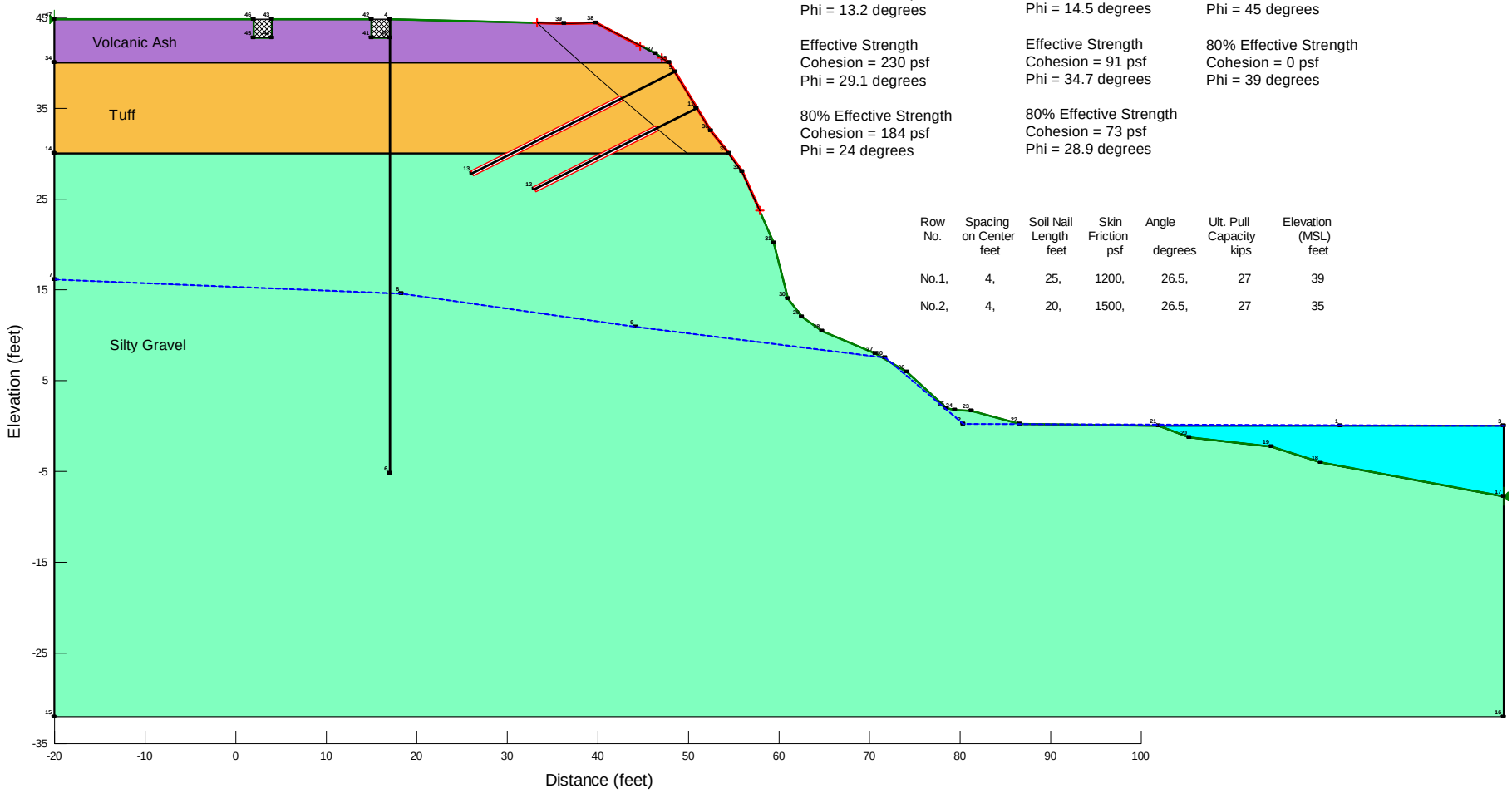
Effective Strength
Cohesion = 91 psf
Phi = 34.7 degrees

80% Effective Strength
Cohesion = 73 psf
Phi = 28.9 degrees

Silty Gravel (Effective Strength)
Unit Wt. = 125 pcf
Cohesion = 0 psf
Phi = 45 degrees

80% Effective Strength
Cohesion = 0 psf
Phi = 39 degrees

Row No.	Spacing on Center feet	Soil Nail Length feet	Skin Friction psf	Angle degrees	Ult. Pull Capacity kips	Elevation (MSL) feet
No.1,	4,	25,	1200,	26.5,	27	39
No.2,	4,	20,	1500,	26.5,	27	35



SLOPE STABILITY ANALYSIS: SECTION C-C SOIL NAILS AND SHOTCRETE

0.67G PSEUDOSTATIC SEISMIC LOADING

Steam Bank Bluff Protection and Stabilization of a Second Erosion Scarp

Second Level of the Riverside Apartments Property at 333 Ohai Street, Hilo, Hawaii (TMK 2-6-003:009) Project No. 12014

Yogi Kwong Engineers, LLC

APPENDIX E-28

PUBLICATION No. FHWA-SA-96-069R

U.S. Department
of Transportation
**Federal Highway
Administration**

MANUAL FOR DESIGN & CONSTRUCTION MONITORING OF SOIL NAIL WALLS

Revised October 1998

Innovation Through Partnerships

3.2 Estimating Nail Pullout Resistance for Design

Verification of the ultimate soil-nail pullout resistance, Q_u, assumed in design is essential to ensure structure safety. It should be considered an extension of design. Further, the actual pullout resistance achieved can be affected by:

- Soil or rock type and shear strength.
- Roughness of drillhole wall (will vary with drilling method used).
- Final drillhole diameter.
- Loose drill cuttings left along the bottom of the drillhole (can occur particularly with auger drilling or when air is used to remove drill cuttings if air compressor capacity is not large enough).
- Contractor drilling and grouting techniques, expertise, and workmanship.
- Amount of time hole left open before grouting.

Nail pullout resistance estimates should be based on experience with open hole methods of construction if soil conditions allow. If inadequate experience exists to provide a conservative design value, then a pre-contract test nail program should be considered to determine the appropriate design values, particularly on large projects.
It is imperative that field pullout testing be done during construction to verify the estimated pullout resistance used in design. Field pullout tests should be conducted as recommended in FHWA-SA-93-068, "Soil Nailing Field Inspectors Manual [26]." In contrast to ground anchorages, it is not normal to test each individual production soil nail.

Guidance for estimation of ground anchor and nail pullout resistance has been previously summarized in FHWA reports titled "Tiebacks," Report No. FHWA/RD-82/047 [27]; "Permanent Ground Anchors," FHWA-DP-68-1 R [13]; and "Soil Nailing for Stabilization of Highway Slopes and Excavations," FHWA-RD-89-198 [25]. Local experience and practice can also be used to estimate nail pullout resistances for use in design. Guideline unit ultimate grout-ground bond stress values, are given below.

A. Cohesionless (Granular) Soils

For tremie or low pressure grouted nails in dry cohesionless soils, data reported in the literature suggest the following ranges of ultimate pullout resistance.

TABLE 3.2
ULTIMATE BOND STRESS - COHESIONLESS SOILS

Construction Method	Soil Type	Unit Ultimate Bond Stress kN/m^2 (psi)
Open Hole	Non-plastic silt	20 -30 (3.0-4.5)
	Medium dense sand and silty sand/sandy silt	50 - 75 (7.0-11.0)
	Dense silty sand and gravel	80 - 100 (11.5-14.5)
	Very dense silty sand and gravel	120 - 240 (17.5-34.5)
	Loess	25 – 75 (3.5 – 11.0)

B. Cohesive Soil

For tremie grouted nails, the ultimate pullout resistance can be estimated as 0.25 to 0.75 times the average undrained shear strength, with the lower factors associated with the stiffer or harder clays. For augered holes, a lower factor may be warranted because it is influenced by the care taken in cleaning the drillhole. For sandy and silty clays, the factor is somewhat higher than the range shown above. Typical values of ultimate pullout resistance for cohesive soils are indicated below.

TABLE 3.3
ULTIMATE BOND STRESS - COHESIVE SOILS

Construction Method	Soil Type	Unit Ultimate Bond Stress kN/m^2 (psi)
Open Hole	Stiff Clay	40 - 60 (6.0-8.5)
	Stiff Clayey Silt	40 - 100 (6.0-14.5)
	Stiff Sandy Clay	100 - 200 (16.5-29.0)

C. Rock

The ultimate pullout resistance for tremie grouted nails in competent massive rock may be taken as 10 percent of the uniaxial compressive strength of the rock up to a maximum value of 4000 kN/m^2. Estimated ultimate pullout resistance for different rock types are given below.

TABLE 3.4
ULTIMATE BOND STRESS -ROCK

Construction Method	Rock Type	Unit Ultimate Bond Stress kN/m^2 (psi)
Rotary Drilled	Marl/Limestone	300 - 400 (43.5-58.0)
	Phillite	100 - 300 (14.5-43.5)
	Chalk	500 - 600 (72.0-86.5)
	Soft Dolomite	400 - 600 (58.0-86.5)
	Fissured Dolomite	600 - 1000 (86.5-144.5)
	Weathered Sandstone	200 - 300 (29.0-43.5)
	Weathered Shale	100 - 150 (14.5-21.5)
	Weathered Schist	100 - 175 (14.5-25.5)
	Basalt	500 - 600 (72.0-86.5)

Additional information on the ultimate pullout resistance of anchors installed in rock is given in "Rock Anchors: State of the Art" [28].

Note: In the design procedure and guide construction specifications set forth in this manual, the nail pullout resistance is expressed in terms of force per unit length of nail, kN/m. The way to compute pullout resistance in terms of force per unit length of nail using the unit bond stresses tabulated above is:

Ultimate Pullout Resistance, Qu (kN/m) = (Unit Ultimate Bond Stress (kN/m^2))(π)(D(m))

Where:

πD = Nail Drillhole Circumference
D = Nail Drillhole Diameter (m)

Example:

Assume nail drillhole dia. = 150 mm = 0.15 m.
Assume soil is dense to very dense silty sand.
From table 3.2 estimate unit Ultimate Bond Stress = 130 kN/m^2.
Ultimate Pullout Resistance, kN/m = 130 kN/m^2 x 3.14 x 0.15 m = 61.2 kN/m.
Use 60 kN/m.

The Clouterre experimental program [7] has summarized the results of nail pullout tests as a function of the material type and installation technique. The unit ultimate bond stress is presented as a function of the limit pressuremeter pressure, for each material type and construction method. The pressuremeter is widely used in France for obtaining an initial estimate of the ultimate ground-nail pullout resistance, but this technique has not found widespread acceptance in U.S. practice to date.

For simple configurations (i.e., uniform soil conditions, no surcharge, etc.) the active earth pressure coefficient K_A can be determined directly from published equations and charts, neglecting the cohesive component of soil strength in accordance with the discussion in sections 2.4.4 and 2.4.5. For more complex configurations that are not tabulated in the published literature (e.g., variable soil layers, complex wall geometries and surcharge load distributions), the nail head service load can be estimated from

$$t_F = 2 F_F P_A S_H S_V / H \qquad (4.7)$$

The active load P_A can typically be determined using a Coulomb-type slip surface (i.e., slope stability) calculation. If the computed allowable nail head load is less than the empirically estimated nail head service load, the trial facing/connector design should be modified and step 2 repeated.

Note: This check is not applied for seismic loading conditions. Since 1)There is no service load data for seismic conditions 2)There is no evidence of poor permanent facing performance under such loading.

Step 4 - Define the Allowable Nail Load Support Diagrams

Define the allowable nail load for each of the nails as a function of location along the nail length. As shown on figure 4.3, the allowable nail load will vary along the length of the nail and will depend on the allowable nail head load, the allowable nail tendon load, and the allowable nail-ground pullout resistance.

The allowable nail head load is determined as discussed in step 2.

The allowable nail tendon load is taken as the nail tendon strength factor times the nail tendon yield strength, as shown in table 4.5, in accordance with the Standard Specifications for Highway Bridges, 15th Edition [30]. It is recommended that the minimum bar size used for soil nails be No. 19 (Soft Metric designation) - corresponding to a No. 6 standard bar size. However, nail sizes smaller than No. 25 (metric) may cause installation problems for moderate to long nail lengths due to their low stiffness. Bar size designations are provided in Table 4.8A and in appendix F.

The allowable nail pullout resistance will determine the rate at which the allowable nail load can change along the length of the nail and is taken as the nail pullout resistance factor (see table 4.5) times the ultimate ground-grout pullout resistance. The ultimate pullout resistance may be determined from local experience, published data or field testing, and is often expressed in terms of a force per unit length of nail. See section 3.2 for guideline published pullout resistance data.

The first column of the nail strength factors of table 4.5 apply to Load Combination Group I (table 4.3). For other Load Combination Groups, these Group I nail strength factors of table 4.5 are **increased** in accordance with the percentage factors of the final column of table 4.3. As noted previously, for soil nail wall applications, Load Combination Groups I, IV and VII

are likely to control the design in most cases. Therefore, the corresponding nail strength factors for Load Combination Groups IV and VII are also shown in table 4.5.

TABLE 4.5
STRENGTH FACTORS AND FACTORS OF SAFETY - SLD

Element	Strength Factor (Group I) α	Strength Factor (Group IV)	Strength Factor (Group VII) (Seismic)
Nail Head Strength	α_F = Table 4.4	see Table 4.4	see Table 4.4
Nail Tendon Tensile Strength	$\alpha_N = 0.55$	1.25(0.55)=0.69	1.33(0.55)= 0.73
Ground-Grout Pullout Resistance	$\alpha_Q = 0.50$	1.25(0.50)=0.63	1.33(0.50)=0.67
Soil	F=1.35 (1.50*)	1.08 (1.20*)	1.01 (1.13*)
Soil-Temporary Construction Condition†	F=1.20 (1.35*)	NA	NA

Notes:
Allowable Nail Head Load (T_F) = α_F (Nominal Nail Head Strength) = $\alpha_F T_{FN}$
Allowable Nail Tendon Load (T_N) = α_N (Tendon Yield Strength) = $\alpha_N T_{NN}$
Allowable Pullout Resistance (Q) = α_Q (Ultimate Pullout Resistance) = $\alpha_Q Q_U$
Minimum Required Global Soil Factor of Safety "F" (Group I) = 1.35 (= 1.50 for critical structures).
Minimum Required Global Soil Factor of Safety "F" (Group IV) = 1.35/1.25 = 1.08 (= 1.20 for critical structures.
Minimum Required Global Soil Factor of Safety "F" (Group VII) = 1.35/1.33 = 1.01 (= 1.13 for critical structures).
Minimum Required Global Soil Factor of Safety "F" - Temporary Construction Condition = 1.20 (= 1.35 for critical structures).
* Soil Factors of Safety for Critical Structures.
† Refers to temporary condition existing following cut excavation but before nail installation. Does not refer to "temporary" versus "permanent" wall.

Step 5 - Select Trial Nail Spacings and Lengths

As discussed in section 4.3.2 and as shown on figure 4.7, satisfaction of the strength limit state requirements will not of itself ensure an appropriate design. Additional constraints are required to provide for an appropriate nail layout. The following empirical constraints on the design analysis nail length pattern are therefore recommended for use when performing the limiting equilibrium design calculations:

(a) Nails with heads located in the upper half of the wall height should be of uniform length.

(b) Nails with heads located in the lower half of the wall height should be considered to have a reduced length in accordance with the recommendations given on figure 4.11.

The Design Test Load (DTL) during verification testing shall be determined by the following equation:

DTL = Design Test Load (kN) = L_{BV} x Q_d
L_{BV} = As-built bonded test length (m)
Q_d = Allowable pullout resistance (kN/m, kilonewtons per lineal meter of grouted nail length, specified herein or on the Plans)
MTL = 2.0 x DTL = Maximum Test Load (kN)

Verification test nails shall be incrementally loaded to a maximum test load of 200 percent of the Design Test Load (DTL) in accordance with the following loading schedule. The soil nail movements shall be recorded at each load increment.

VERIFICATION TEST LOADING SCHEDULE

LOAD	HOLD TIME
AL (.05 DTL max.)	1 minute
0.25 DTL	10 minutes
0.50 DTL	10 minutes
0.75 DTL	10 minutes
1.00 DTL	10 minutes
1.25 DTL	10 minutes
1.50 DTL (Creep Test)	60 minutes
1.75 DTL	10 minutes
2.00 DTL(Max.Test Load)	10 minutes

The alignment load (AL) should be the minimum load required to align the testing apparatus and should not exceed 5 percent of the Design Test Load (DTL). Dial gauges should be set to "zero" after the alignment load has been applied.

Each load increment shall be held for at least 10 minutes. The verification test nail shall be monitored for creep at the 1.50 DTL load increment. Nail movements during the creep portion of the test shall be measured and recorded at 1 minute, 2, 3, 5, 6, 10, 20, 30, 50, and 60 minutes. The load during the creep test shall be maintained within 2 percent of the intended load by use of the load cell.

3.5.4 Proof Testing of Production Nails. Perform proof testing on 5 percent (1 in 20) of the production nails in each nail row or minimum of 1 per row. The locations shall be designated by the Engineer. A verification test nail successfully completed during production work shall be considered equivalent to a proof test nail and shall be accounted for in determining the number of proof tests required in that particular row.

Production proof test nails shall have both bonded and temporary unbonded lengths. Prior to testing only the bonded length of the test nail shall be grouted. The temporary unbonded length of the test nail shall be at least 1 meter. The bonded length of the test nail shall be determined based on the production nail bar grade and size such that the allowable bar structural load is not exceeded during testing, but shall not be less than 3 meters. Production proof test nails shorter than 4 meters in length may be constructed with less than the minimum 3 meter bond length with the unbonded length limited to 1 meter. The allowable bar structural load during testing shall not be greater than 90 percent of the yield strength for Grade 420 and Grade 520 bars, or 80 percent of the ultimate strength for Grade 1035 bars.

The proof test bonded length L_{BP} shall not exceed the test allowable bar load divided by 1.5 times the allowable pullout resistance value, or above minimum lengths, whichever is greater. The following equation shall be used for sizing the proof test nail bonded length to avoid overstressing the production nail bar size:

$L_{BP} = C\, f_Y\, A_S / 1.5\, Q_d$, or above minimum lengths, whichever is greater.

L_{BP} = Maximum Proof Test Nail Bonded Length (m)
C = 0.9 for Grade 420 and 520 bars and 0.8 for Grade 1035 bars
f_Y = Bar Yield or Ultimate Stress (kN/m^2)
(Note: f_Y = 420,000 kN/m^2, 520,000 kN/m^2 and 1,035,000 kN/m^2 respectively for Grade 420, 520 and 1035 bars)
A_S = Bar Steel Area (m^2)
1.5 = Pullout resistance safety factor
Q_d = Allowable pullout resistance (kN/m, kilonewtons per lineal meter of grouted nail length, specified herein or on the Plans)

The Design Test Load (DTL) during proof testing shall be determined by the following equation:

DTL = Design Test Load (kN) = $L_{BP} \times Q_d$
L_{BP} = As-built bonded test length (m)
Q_d = Allowable pullout resistance (kN/m, kilonewtons per lineal meter of grouted nail length, specified herein or on the Plans)
MTL = 1.5 x DTL = Maximum Test Load (kN)

Proof tests shall be performed by incrementally loading the proof test nail to a maximum test load of 150 percent of the Design Test Load (DTL). The nail movement at each load shall be measured and recorded by the Engineer in the same manner as for verification tests. The test load shall be monitored by a jack pressure gauge with a sensitivity and range meeting the requirements of pressure gauges used for verification test nails. At load increments other than maximum test load, the load shall be held long enough to obtain a stable reading. Incremental loading for proof tests shall be in accordance with the following loading schedule. The soil nail movements shall be recorded at each load increment.

PROOF TEST LOADING SCHEDULE

LOAD	HOLD TIME
AL (.05 DTL max.)	Until Stable
0.25 DTL	Until Stable
0.50 DTL	Until Stable
0.75 DTL	Until Stable
1.00 DTL	Until Stable
1.25 DTL	Until Stable
1.50 DTL (Max. Test Load)	See Below

The alignment load (AL) should be the minimum load required to align the testing apparatus and should not exceed 5 percent of the Design Test Load (DTL). Dial gauges should be set to "zero" after the alignment load has been applied.

All load increments shall be maintained within 5 percent of the intended load. Depending on performance, either 10 minute or 60 minute creep tests shall be performed at the maximum test load (1.50 DTL). The creep period shall start as soon as the maximum test load is applied and the nail movement shall be measured and recorded at 1 minutes, 2, 3, 5, 6, and 10 minutes. Where the nail movement between 1 minute and 10 minutes exceeds 1 mm, the maximum test load shall be maintained an additional 50 minutes and movements shall be recorded at 20 minutes, 30, 50, and 60 minutes.
(See Commentary 3.5.4)

3.5.5 Test Nail Acceptance Criteria. A test nail shall be considered acceptable when:

1. For verification tests, a total creep movement of less than 2 mm per log cycle of time between the 6 and 60 minute readings is measured during creep testing and the creep rate is linear or decreasing throughout the creep test load hold period.

2. For proof tests, a total creep movement of less than 1 mm is measured between the 1 and 10 minute readings or a total creep movement of less than 2 mm is measured between the 6 and 60 minute readings and the creep rate is linear or decreasing throughout the creep test load hold period.

3. The total measured movement at the maximum test load exceeds 80 percent of the theoretical elastic elongation of the test nail unbonded length. ***(See Commentary 3.5.5)***

4. A pullout failure does not occur at the maximum test load. Pullout failure is defined as the load at which attempts to further increase the test load simply result in continued pullout movement of the test nail. The pullout failure load shall be recorded as part of the test data.

Successful proof tested nails meeting the above test acceptance criteria may be incorporated as

APPENDIX F

LOGS OF PREVIOUS BORINGS AND RECORDS OF PREVIOUS LABORATORY TESTING

SOIL CLASSIFICATION CHART

	Major Divisions		Symbol	Typical Names	Other Criteria
COARSE GRAINED SOILS More than 50% of material larger than No. 200 sieve size	**Gravels** More than 50% of coarse fraction retained on No. 4 sieve	**Clean Gravel** Little or no fines (<5%)	GW	Well-graded gravels, gravel-sand mixtures, little or no fines	Cu>4 and 1<=Cc=3
			GP	Poorly graded gravels, gravel-sand mixtures, little or no fines	Not meeting Cu and Cc criteria for GW
		Gravels with Fines Appreciable amount of fines (>12%)	GM	Silty gravels, gravel-sand-silt mixtures	Atterberg limit below A-line or PI<4
			GC	Clayey gravels, gravel-sand-silt mixtures	Atterberg limit above A-line with PI>7
	Sands More than 50% of coarse fraction passing No. 4 sieve	**Clean Sands** Little or no fines (<5%)	SW	Well-graded sands, gravelly sands, little or no fines	Cu>6 and 1<=Cc=3
			SP	Poorly graded sands, gravelly sands, little or no fines	Not meeting Cu and Cc criteria for SW
		Sands with Fines Appreciable amount of fines (>12%)	SM	Silty sands, sand-silt mixture	Atterberg limit below A-line or PI<4
			SC	Clayey sands, sand-clay mixture	Atterberg limit above A-line with PI>7
FINE GRAINED SOILS More than 50% of material smaller than No. 200 sieve size	**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	Atterberg limit below A-line
			CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, lean clay	Atterberg limit above A-line
			OL	Organic silts and organic silty clays flow plasticity	Atterberg limit below A-line
	Silts and Clays Liquid limit larger than 50%		MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts	Atterberg limit below A-line
			CH	Inorganic clays of high plasticity, fat clays	Atterberg limit above A-line
			OH	Organic clays of high plasticity, organic silts	Atterberg limit below A-line
HIGHLY ORGANIC SOILS			Pt	Peat and other highly organic soils	

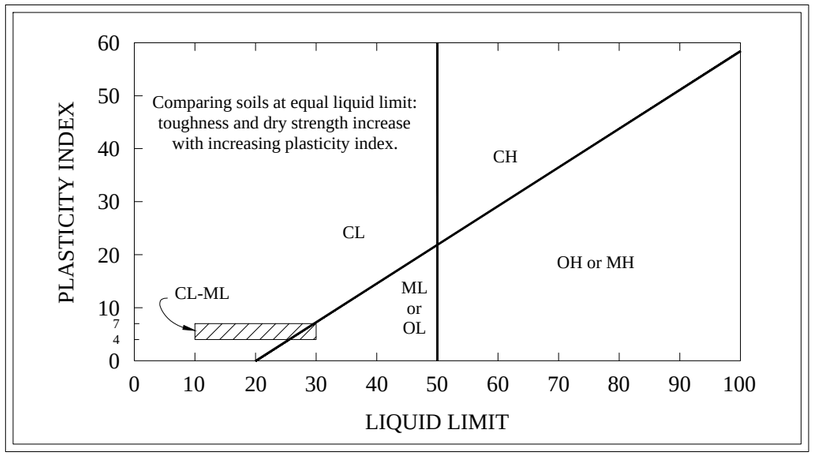
Notes: 1. Cu = D60/D10, Cc = (D30)^2/(D60 x D10) where D60, D30 and D10 are diameters associated with 60%, 30% and 10% smaller in gradation curves.
2. Dual symbols are used to indicate borderline classifications such as GP/SP.

GRADATION CHART

Soil Fraction	Size Range			
	Lower Limit		Upper Limit	
	Millimeters	Sieve	Millimeters	Sieve
Boulders	304.8	12*	914.4	36*
Cobbles	76.2	3*	304.8	12*
Gravel				
Coarse	2	10**	4.76	4**
Medium	0.42	40**	2	10**
Fine	0.074	200**	0.42	40**
Fines			0.074	200**

* U.S. standard sieve opening in inches
** U.S. standard sieve number

PLASTICITY CHART



UNIFIED SOIL CLASSIFICATION

Emergency Stream Bank Bluff Slope Protection and Stabilization Riverside Apartments At 333 Ohai Street, Hilo, Hawaii (TMK 2-6-003:009)

YOGI KWONG ENGINEERS, LLC
PROJECT NO. 08029

FIGURE F-1

DESCRIPTION OF ROCK MATERIALS

A. DEGREE OF WEATHERING

The following terms were used to describe the chemical weathering of rock:

Extremely Weathered: The original minerals of the rock have been almost entirely altered to secondary minerals, even though the original fabric may be intact.

Highly Weathered: The rock is weakened to such an extent that a 2-inch diameter core can be broken readily by hand across the rock fabric.

Moderately Weathered: Rock is discolored and noticeably weakened, but a 2-inch diameter core cannot usually be broken by hand, across the rock fabric.

Slightly Weathered: Rock is slightly discolored, but not noticeably lower in strength than fresh rock.

Unweathered: Rock shows no discoloration, loss of strength, or any other effect of weathering.

B. HARDNESS

The following terms were used to describe the hardness of rock and soil (per ASTM D4879-08 Standard Guide for Geotechnical Mapping of Large Underground Opening in Rock):

Very Soft or Hard, Soil-like Material (Friable): Scratched with fingernail. Slight indention produced by light blow of point of geologic pick. Requires power tools for excavation. Peels with pocket knife.

Soft Rock: Hand-held specimen crumbles under firm blows with point of geologic pick.

Moderately Soft Rock: Shallow indention (1-3mm) produced by light blows with point of geologic pick. Peels with pocket knife with difficulty.

Moderately Hard Rock: Cannot be scraped or peeled with pocket knife. Intact hand held specimen breaks with single blow of geologic hammer. Can be distinctly scratched with 20d common steel nail.

Hard Rock: Intact held specimen requires more than one hammer blow to break it. Can be faintly scratched with 20d common steel nail.

Very Hard Rock: Intact specimen breaks only by repeated, heavy blows with geologic hammer. Cannot be scratched with 20d common steel nail.

C. ROCK FRACTURE CHARACTERISTICS

The general fracture spacing is described in the boring log according to the following criteria:

Crushed: Less than 5 microns (mechanical clay) to 0.1 foot.

Intensely Fractured: 0.05 to 0.1 foot (contain no clay).

Closely Fractured: 0.1 to 0.5 feet.

Moderately Fractured: 1.0 to 3.0 feet.

Very Widely Fractured: Over 3 feet.

EMERGENCY STREAM BANK BLUFF SLOPE PROTECTION AND STABILIZATION

LOG OF BORING KEY

LOCATION: RIVERSIDE APARTMENTS 333 OHAI STREET, HILO, HAWAII
DATE(S) DRILLED:
GROUND SURFACE ELEVATION:
LOGGED BY:
CHECKED BY:
GROUNDWATER LEVEL / DATE:
HAMMER TYPE:
HAMMER WEIGHT/DROP:
CONTRACTOR:
DRILLING METHOD:
DRILL EQUIP:
BOREHOLE BACKFILL:

DEPTH (FT)	SAMPLE TYPE	SAMPLE NO.	SAMPLING RESISTENCE	RECOVERY, %	RQD, %	GRAPHIC LOG	DESCRIPTION	WATER CONTENT, %	DRY UNIT WEIGHT, pcf	UCS, psi	LIQUID LIMIT	PLASTICITY INDEX	OTHER TESTS AND REMARKS
0							STRATA SYMBOLS						
							Asphalt Concrete						
							Elastic silt (MH)						
							Silty Gravel (GM)						
							Basalt Rock						
5							Well-graded gravel (GW)						
							Cobbles						
							SAMPLER SYMBOLS						
							Standard Penetration Test (SPT) sampler						
10							Dames and Moore (D&M) sampler						
			10				Number of blows to advance sampler 12 inches, or distance indicated						
							ABBREVIATIONS FOR TESTS						
							Gravel = % of sampler passing through 76.2 mm sieve and retained on #4 sieve						
15							Sand = % of sample passing through #4 sieve and retained on #200 sieve						
							Fines = % of sample passing through #200 sieve						
							TXCU = Triaxial Shear Consolidated Undrained Test						
							DS = Direct Shear Test						
							pH = pH Test Performed						
20							RESISTIVITY = Resistivity Test Performed						
							SULFATES = Sulfates Content Test Performed						
							CHLORIDE = Chloride Content Test Performed						
							PP = Pocket Penetrometer Test, tsf						
							TV = Torvane Test, tsf						
25													
30													

EMERGENCY STREAM BANK BLUFF SLOPE PROTECTION AND STABILIZATION

LOG OF BORING B-1

LOCATION: RIVERSIDE APARTMENTS 333 OHAI STREET, HILO, HAWAII
DATE(S) DRILLED: 10-1-08
GROUND SURFACE ELEVATION: (+/-) 56 FT MSL
LOGGED BY: K. SANDEFUR
CHECKED BY: J. KWONG
GROUNDWATER LEVEL / DATE: NOT ENCOUNTERED
HAMMER TYPE: SAFETY
HAMMER WEIGHT/DROP: 140 LB / 30 IN
CONTRACTOR: HAWAII TEST BORINGS, INC.
DRILLING METHOD: 4-INCH SOLID STEM AUGER
DRILL EQUIP: SIMCO
BOREHOLE BACKFILL: GRAVEL, CONCRETE

DEPTH (FT)	SAMPLE TYPE	SAMPLE NO.	SAMPLING RESISTENCE	RECOVERY, %	RQD, %	GRAPHIC LOG	DESCRIPTION	WATER CONTENT, %	DRY UNIT WEIGHT, pcf	UCS, psi	LIQUID LIMIT	PLASTICITY INDEX	OTHER TESTS AND REMARKS
0							AMORPHIC VOLCANIC ASH Brown with some orange-brown elastic silt with some roots (MH), soft, wet						
								305	17				TV=0.13 tsf PP=2.1 tsf
		1	4	67				271	16				TV=0.28 tsf
5		2	2.5	67			becomes very soft, with sand	180	29	4	19	77	pH, RESISTIVITY, SULFATES, CHLORIDE TXCU
		3	3	67			becomes very soft to soft						TV=0.27 tsf PP=1.3 tsf TV=0.35 tsf
		4	2.2	78			becomes very soft, with some sand	195 217	23			92	TXCU PP=1.2 tsf TV=0.29 tsf
10													
		5	17	89				224 214 184	22 33			96	DS
		6	33	78			WEATHERED TUFFACEOUS DEPOSIT Mottled light brown, brown, olivene and orange silty gravel with sand (GM), moist, dense	22		42	41	17	
15							with cobbles						Auger grinding and slow penetration from 15 to 16.5 feet
		7	12	42			becomes very stiff becomes medium stiff						
20													
		8	4	78			becomes soft						PP=3.1 tsf TV=0.38 tsf
		9	1-12"	100			becomes very soft						PP=1.6 tsf TV=0.29 tsf
25							becomes stiff						
		10	58	78									
							BASALT LAVA FLOWS						
30													

YOGI KWONG ENGINEERS, LLC

FIGURE F-4

EMERGENCY STREAM BANK BLUFF SLOPE PROTECTION AND STABILIZATION

LOG OF BORING B-1

LOCATION: RIVERSIDE APARTMENTS 333 OHAI STREET, HILO, HAWAII
DATE(S) DRILLED: 10-1-08
GROUND SURFACE ELEVATION: (+/-) 56 FT MSL
LOGGED BY: K. SANDEFUR
CHECKED BY: J. KWONG
GROUNDWATER LEVEL / DATE: NOT ENCOUNTERED
HAMMER TYPE: SAFETY
HAMMER WEIGHT/DROP: 140 LB / 30 IN
CONTRACTOR: HAWAII TEST BORINGS, INC.
DRILLING METHOD: 4-INCH SOLID STEM AUGER
DRILL EQUIP: SIMCO
BOREHOLE BACKFILL: GRAVEL, CONCRETE

DEPTH (FT)	SAMPLE TYPE	SAMPLE NO.	SAMPLING RESISTENCE	RECOVERY, %	RQD, %	GRAPHIC LOG	DESCRIPTION	WATER CONTENT, %	DRY UNIT WEIGHT, pcf	UCS, psi	LIQUID LIMIT	PLASTICITY INDEX	OTHER TESTS AND REMARKS
30							Highly weathered, low to moderately hard vesicular basaltic rock						Auger grinding 29.5 to 31.5 ft, very slow drilling
		11	85-4"	50			becomes slightly to moderately weathered, hard to very hard rock						Auger grinding and slow penetration from 32 to 34 feet
							with probable highly weathered softer zones or clinkers						Less grinding and faster penetration
35													
		12	50-4"	100			becomes hard to very hard						
							Boring completed at 36.8 feet below existing ground surface on 10-1-08						
40													
45													
50													
55													
60													

YKE
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FIGURE F-4

EMERGENCY STREAM BANK BLUFF SLOPE PROTECTION AND STABILIZATION

LOG OF BORING B-2

LOCATION: RIVERSIDE APARTMENTS 333 OHAI STREET, HILO, HAWAII
DATE(S) DRILLED: 10-2-08
GROUND SURFACE ELEVATION: (+/-) 56.9 FT MSL
LOGGED BY: E. LAMPITOC
CHECKED BY: J. KWONG
GROUNDWATER LEVEL / DATE: NOT ENCOUNTERED
HAMMER TYPE: SAFETY
HAMMER WEIGHT/DROP: 140 LB / 30 IN
CONTRACTOR: HAWAII TEST BORINGS, INC.
DRILLING METHOD: 4-INCH SOLID STEM AUGER
DRILL EQUIP: SIMCO
BOREHOLE BACKFILL: GRAVEL, CONCRETE

DEPTH (FT)	SAMPLE TYPE	SAMPLE NO.	SAMPLING RESISTENCE	RECOVERY, %	RQD, %	GRAPHIC LOG	DESCRIPTION	WATER CONTENT, %	DRY UNIT WEIGHT, pcf	UCS, psi	LIQUID LIMIT	PLASTICITY INDEX	OTHER TESTS AND REMARKS
0							ASPHALT (1.5-inches thick)						
							FILL Dark brown well graded gravel (GW)						
		1	6	100			AMORPHIC VOLCANIC ASH						PP=2.5 tsf TV=0.25 tsf
							Orange-brown elastic silt (MH), soft to medium stiff, moist to wet						
5								281	18				PP=2.5 tsf TV=0.25 tsf
		2	4	100			becomes soft	287	18				TV=0.15 tsf
		3	3	100			becomes light brown, very soft to soft, with sand	163 178	30			80	TXCU PP=1.5 tsf TV=0.15 tsf
10		4	2	67			becomes very soft						PP=2.0 tsf TV=0.25 tsf
		5	3	100			becomes very soft to soft	149	34			88	pH, RESISTIVITY, SULFATES, CHLORIDE TXCU PP=1.0 tsf TV=0.15 tsf
							WEATHERED TUFFACEOUS DEPOSIT Greyish brown mottled with orange and yellow spots elastic silt with sand (MH), stiff, moist						
15		6	13	100									PP=3.0 tsf TV=0.25 tsf
		7	11	56				162 212	31 26				PP=3.0 tsf TV=0.30 tsf TXCU PP=1.0 tsf TV=0.15 tsf
20		8	8	100			becomes medium stiff with some roots						PP=4.0 tsf TV=0.35 tsf
25		9	4	100			becomes soft	80 82	54			86	DS PP=3.0 tsf TV=0.20 tsf
							becomes stiff or very stiff						Increased auger motor resistance
30													

YOGI KWONG ENGINEERS, LLC

FIGURE F-5

EMERGENCY STREAM BANK BLUFF SLOPE PROTECTION AND STABILIZATION

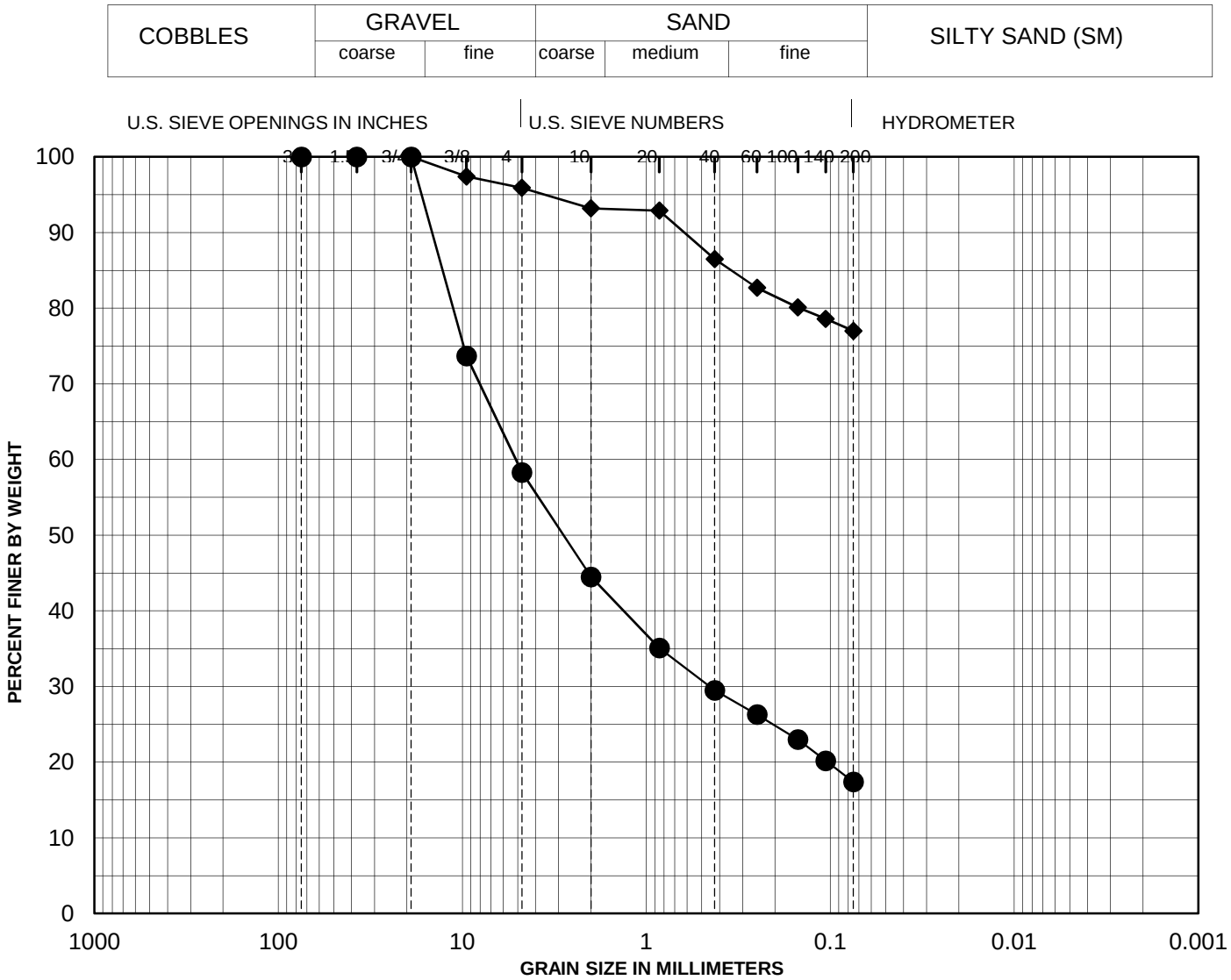
LOG OF BORING B-2

LOCATION: RIVERSIDE APARTMENTS 333 OHAI STREET, HILO, HAWAII
DATE(S) DRILLED: 10-2-08
GROUND SURFACE ELEVATION: (+/-) 56.9 FT MSL
LOGGED BY: E. LAMPITOC
CHECKED BY: J. KWONG
GROUNDWATER LEVEL / DATE: NOT ENCOUNTERED
HAMMER TYPE: SAFETY
HAMMER WEIGHT/DROP: 140 LB / 30 IN
CONTRACTOR: HAWAII TEST BORINGS, INC.
DRILLING METHOD: 4-INCH SOLID STEM AUGER
DRILL EQUIP: SIMCO
BOREHOLE BACKFILL: GRAVEL, CONCRETE

DEPTH (FT)	SAMPLE TYPE	SAMPLE NO.	SAMPLING RESISTENCE	RECOVERY, %	RQD, %	GRAPHIC LOG	DESCRIPTION	WATER CONTENT, %	DRY UNIT WEIGHT, pcf	UCS, psi	LIQUID LIMIT	PLASTICITY INDEX	OTHER TESTS AND REMARKS
30		10	59	100			Greyish brown mottled with orange and yellow spots elastic silt with some roots (MH),very stiff, moist with friable basalt rock						PP=4.5+ tsf
							BASALT LAVA FLOWS Slightly to moderately weathered, hard to very hard, vesicualr basaltic rocks						Auger grinding and very slow penetration
35		11	70-2"	100									
		12	77-1"	0									
							Boring completed at 36.6 feet below existing ground surface on 10-2-08						
40													
45													
50													
55													
60													

YOGI KWONG ENGINEERS, LLC

FIGURE F-5



Boring		Depth (ft)	Description	LL %	PI %	Gravel %	Sand %	Fines %
●	B-1	6.0	AMORPHIC VOLCANIC ASH: Elastic silt with sand (MH)			4	19	77
■	B-1	10.0	AMORPHIC VOLCANIC ASH: Elastic silt (MH)			NA	NA	92
▲	B-1	13.0	AMORPHIC VOLCANIC ASH: Elastic silt (MH)			NA	NA	96
◆	B-1	14.5	WEATHERED TUFFCEOUS DEPOSIT: Silty gravel with sand (GM)			42	41	17
○	B-2	7.5	AMORPHIC VOLCANIC ASH: Elastic silt with sand (MH)			NA	NA	80
□	B-2	12.5	AMORPHIC VOLCANIC ASH: Elastic silt with sand (MH)			NA	NA	88
△	B-2	25.0	WEATHERED TUFFACEOUS DEPOSIT: Elastic silt with sand (MH)			NA	NA	86

Project: Emergency Stream Bank Bluff Slope Protection and Stabilization

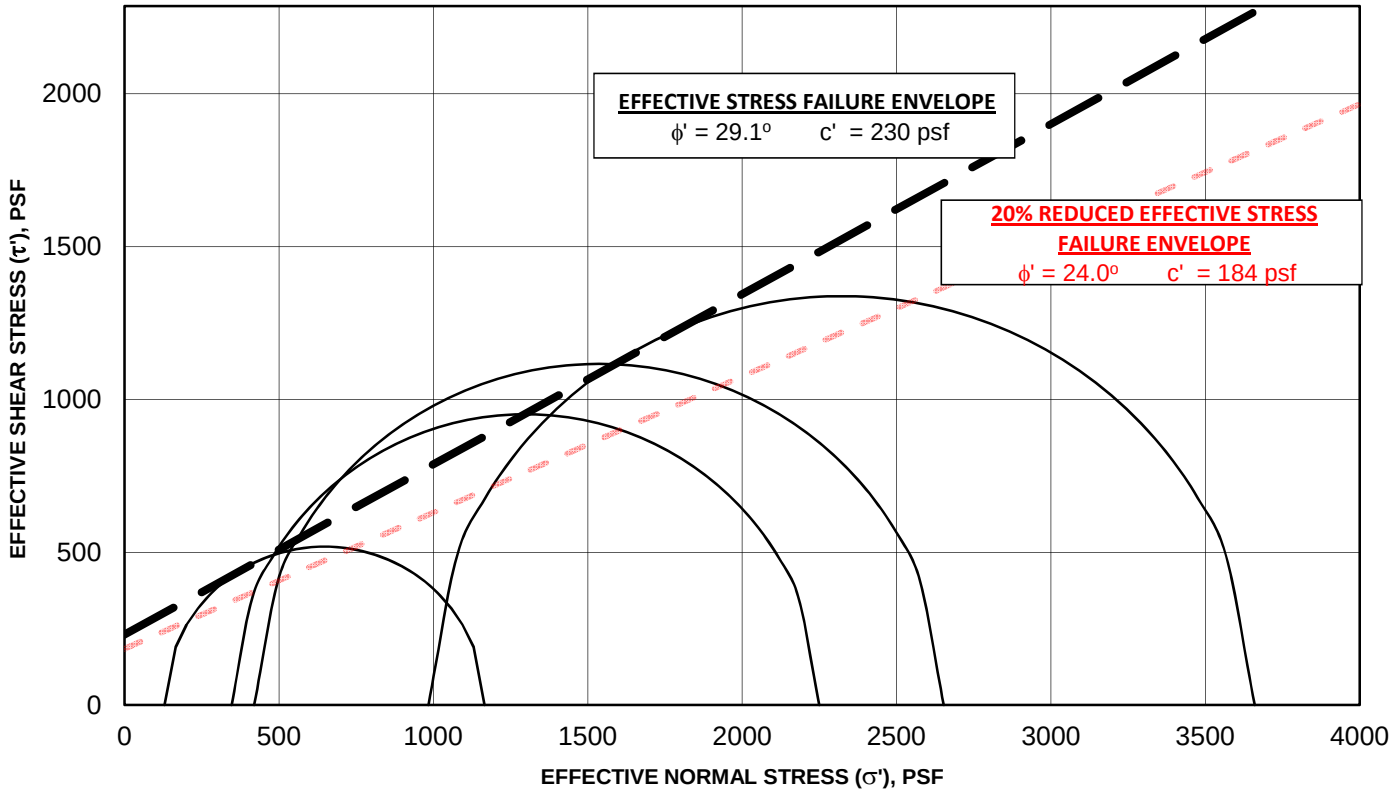
Location: Riverside Apartments 333 Ohai Street, Hilo, HI

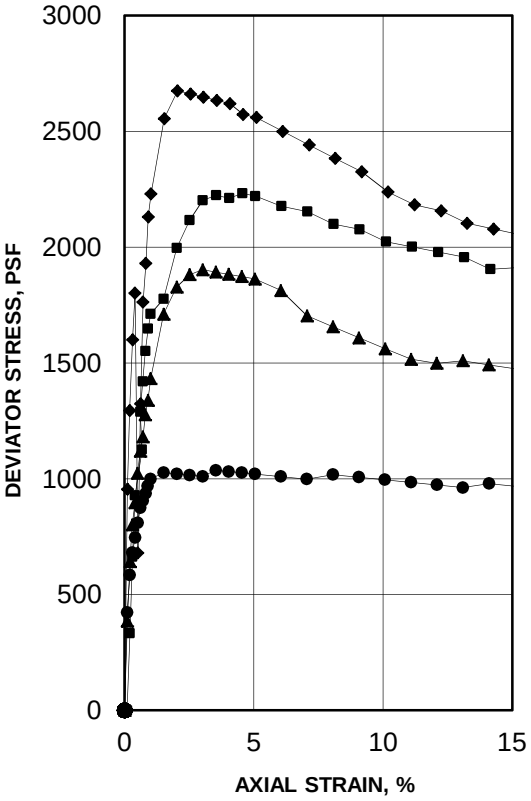
GRAIN SIZE DISTRIBUTION CURVES

Project Number: 08029

Yogi Kwong Engineers,LLC

FIGURE F-6





Boring	B-1	B-1	B-2	B-2		
Depth (ft)	6.0 ●	10.0 ■	7.5 ▲	13 ◆		
γ_d (pcf)	29	25	30	34		
w_o (%)	212%	217%	178%	149%		
σ'_{1f} (psf)	1166	2653	2249	3659		
σ_{3f} (psf)	288	1500	750	3000		
σ_{df} (psf)	1036	2233	1903	2675		
u_f (psf)	158	1080	403	2016		
Gravel (%)	4	NA	NA	NA		
Sand (%)	19	NA	NA	NA		
Fines (%)	77	93	80	88		
NOTES:						

Sample Description:
Weathered Amorphic Ash

Project: Emergency Stream Bank Bluff Slope Protection and Stabilization

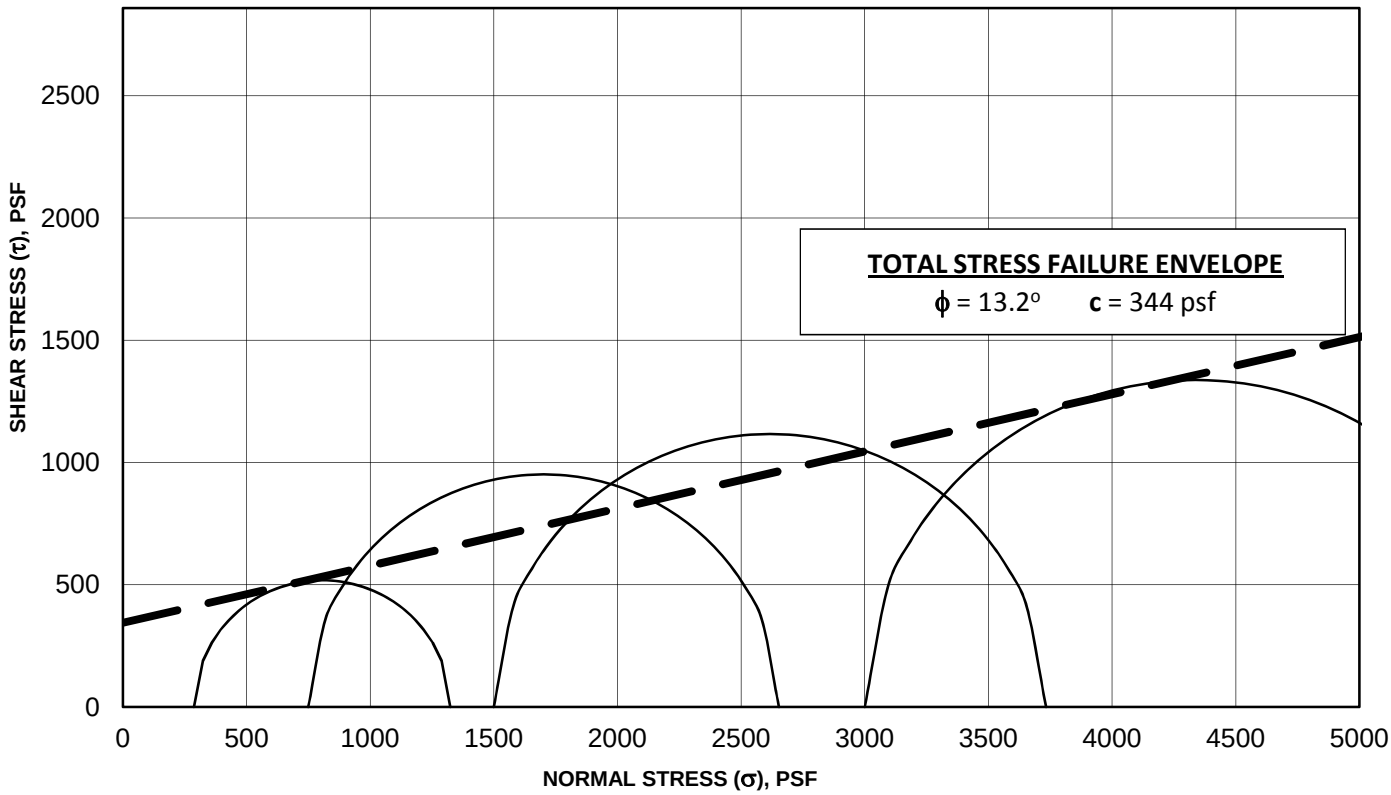
Location: Riverside Apartments 333 Ohai Street, Hilo, HI

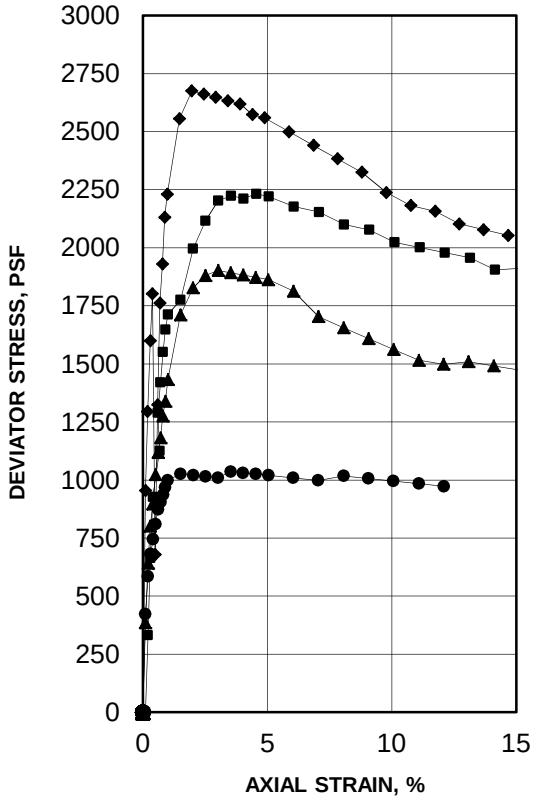
CU TRIAXIAL: EFFECTIVE STRESS ANALYSIS

Project Number: 08029

Yogi Kwong Engineers, LLC

FIGURE F-7





Boring	B-1	B-1	B-2	B-2		
Depth (ft)	6.0 ●	10.0 ■	7.5 ▲	13 ◆	○	△
γ_d (pcf)	29	25	30	34		
w_o (%)	212%	217%	178%	149%		
σ_{1f} (psf)	1195	2681	2249	3659		
σ_{3f} (psf)	288	1500	750	3000		
σ_{df} (psf)	1036	2233	1903	2675		
u_f (psf)	130	1051	403	2016		
Gravel (%)	4	NA	NA	NA		
Sand (%)	19	NA	NA	NA		
Fines (%)	77	93	80	88		
NOTES:						

Sample Description:
Weathered Amorphic Ash

Project: Emergency Stream Bank Bluff Slope Protection and Stabilization

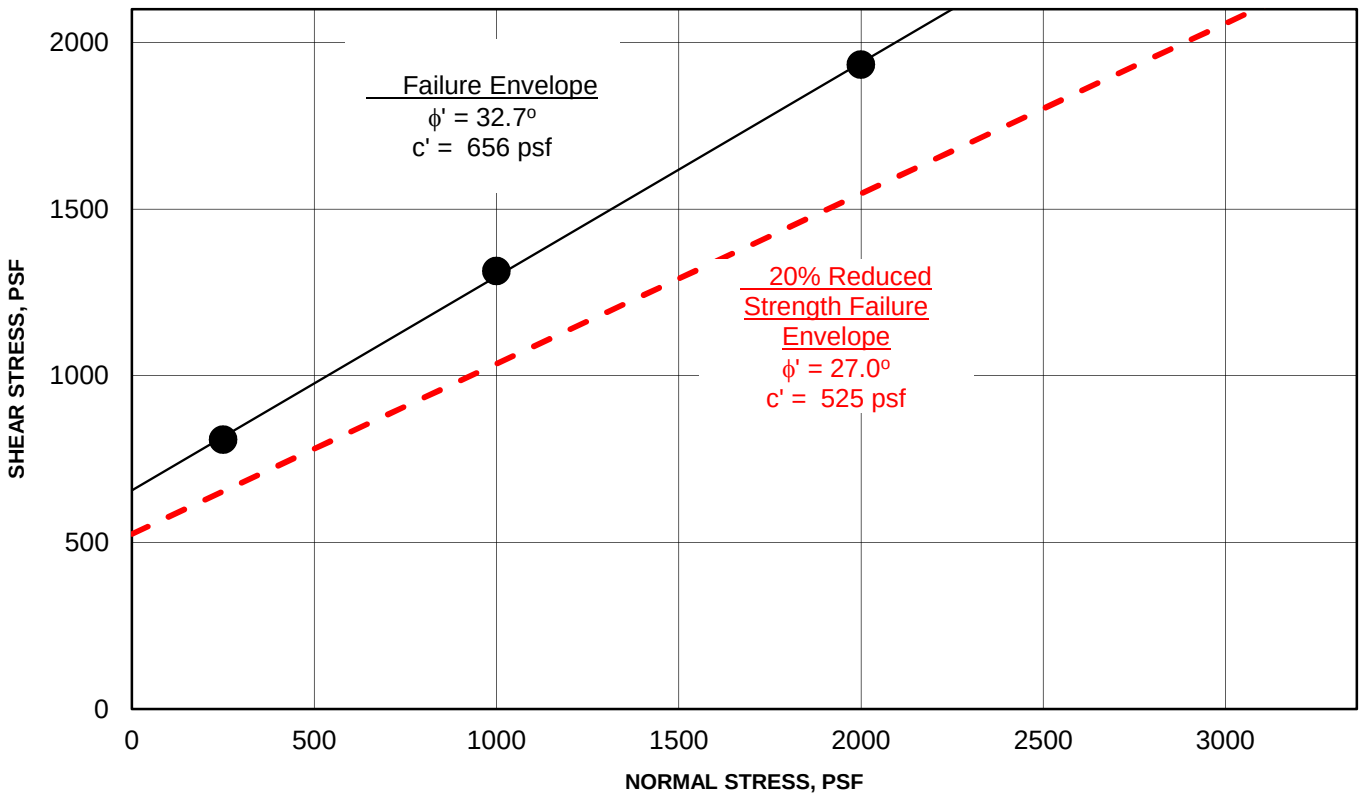
Location: Riverside Apartments 333 Ohai Street, Hilo, HI

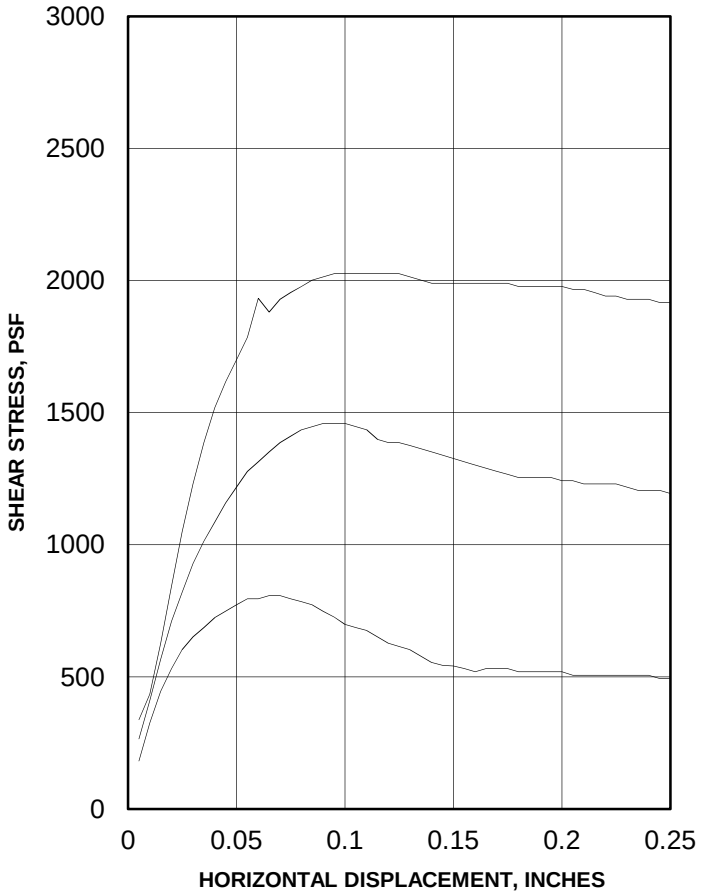
Project Number: 08029

CU TRIAXIAL: TOTAL STRESS ANALYSIS

Yogi Kwong Engineers, LLC

FIGURE F-8





Boring	B-1	**Depth**	13 ft bgs
Description	**WEATHERED AMORPHIC ASH:** Elastic Silt, Medium Stiff Fines = 96% N_u=17		

Sample No.		1	2	3
Initial	Water Content, %	232.2	222.6	186.9
	Dry Density, pcf	20.5	21.0	24.9
	Diameter, inches	2.41	2.41	2.41
	Height, inches	1.0	1.0	1.0
Final	Water Content, %	258.0	221.8	191.3
	Dry Density, pcf	21.0	21.3	25.1
	Diameter, inches	2.4	2.4	2.4
	Height, inches	0.983	0.996	0.998
Strain Rate, in./minute		0.0134	0.0134	0.0134
Normal Stress, psf		**250**	**1000**	**2000**
Peak Stress, psf		**808**	**1314**	**1933**
Displacement, in.		0.065	0.060	0.060
Ultimate Stress, psf		**494**	**1194**	**1917**
Displacement, in.		0.250	0.250	0.250

Project: Emergency Stream Bank Bluff Slope Protection and Stabilization

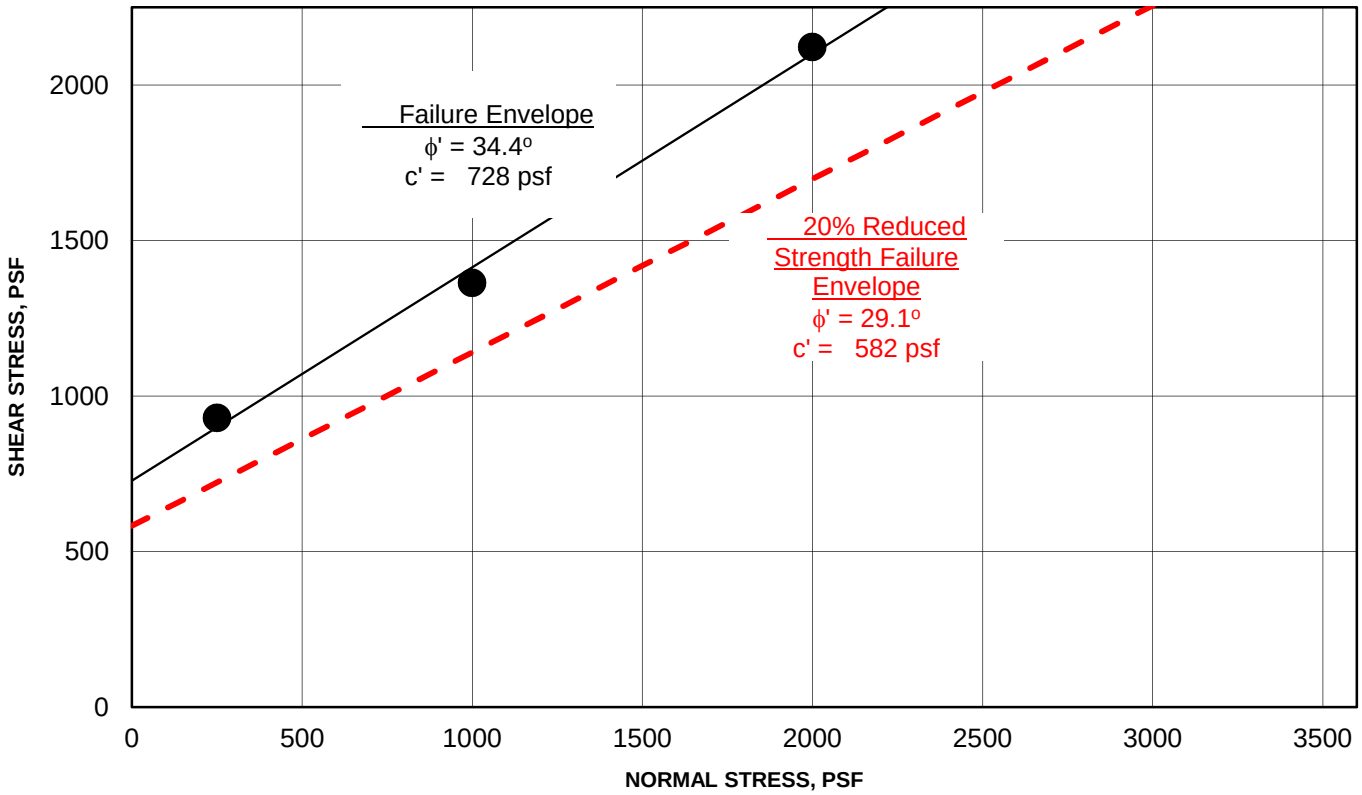
Location: Riverside Apartments 333 Ohai Street, Hilo, HI

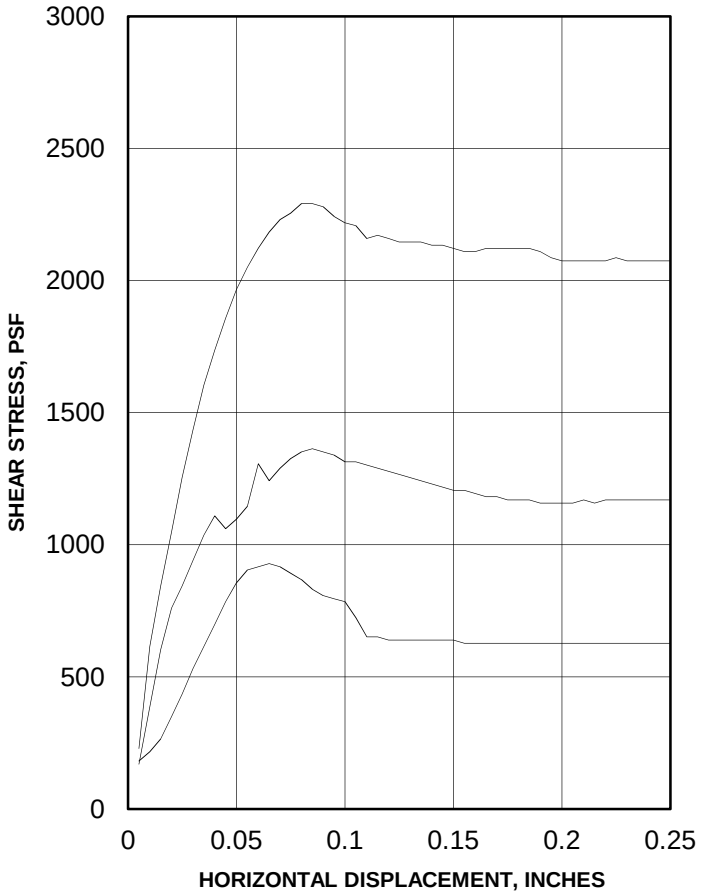
Project Number: 08029

DIRECT SHEAR TEST

FIGURE F-9

Yogi Kwong Engineers, LLC





Boring	B-2	**Depth**	25 ft bgs
Description	**WEATHERED AMORPHIC ASH:** Elastic Silt, Medium Stiff Fines = 96% N_u=17		

Sample No.		1	2	3
Initial	Water Content, %	73.5	83.4	82.6
	Dry Density, pcf	57.6	51.4	52.7
	Diameter, inches	2.41	2.41	2.41
	Height, inches	1.0	1.0	1.0
Final	Water Content, %	77.5	84.9	82.7
	Dry Density, pcf	57.7	52.1	53.7
	Diameter, inches	2.41	2.41	2.41
	Height, inches	0.998	0.985	0.981
Strain Rate, in./minute		0.0134	0.0134	0.0134
Normal Stress, psf		**250**	**1000**	**2000**
Peak Stress, psf		**929**	**1363**	**2122**
Displacement, in.		0.065	0.085	0.060
Ultimate Stress, psf		**627**	**1158**	**2074**
Displacement, in.		0.250	0.215	0.250

Project: Emergency Stream Bank Bluff Slope Protection and Stabilization

Location: Riverside Apartments 333 Ohai Street, Hilo, HI

Project Number: 08029

DIRECT SHEAR TEST

FIGURE F-10

Yogi Kwong Engineers, LLC

Appendix B

Biological Surveys

Rana Biological Consulting and AECOS Consultants
January 2013

Biological Surveys Conducted for the Stream Bank Bluff Protection & Stabilization, Second Slope Scarp at the Riverside Apartments 333 ʻŌhai Street, Hilo, HI 96720 (TMK 2-6-003:009)

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Introduction and Background

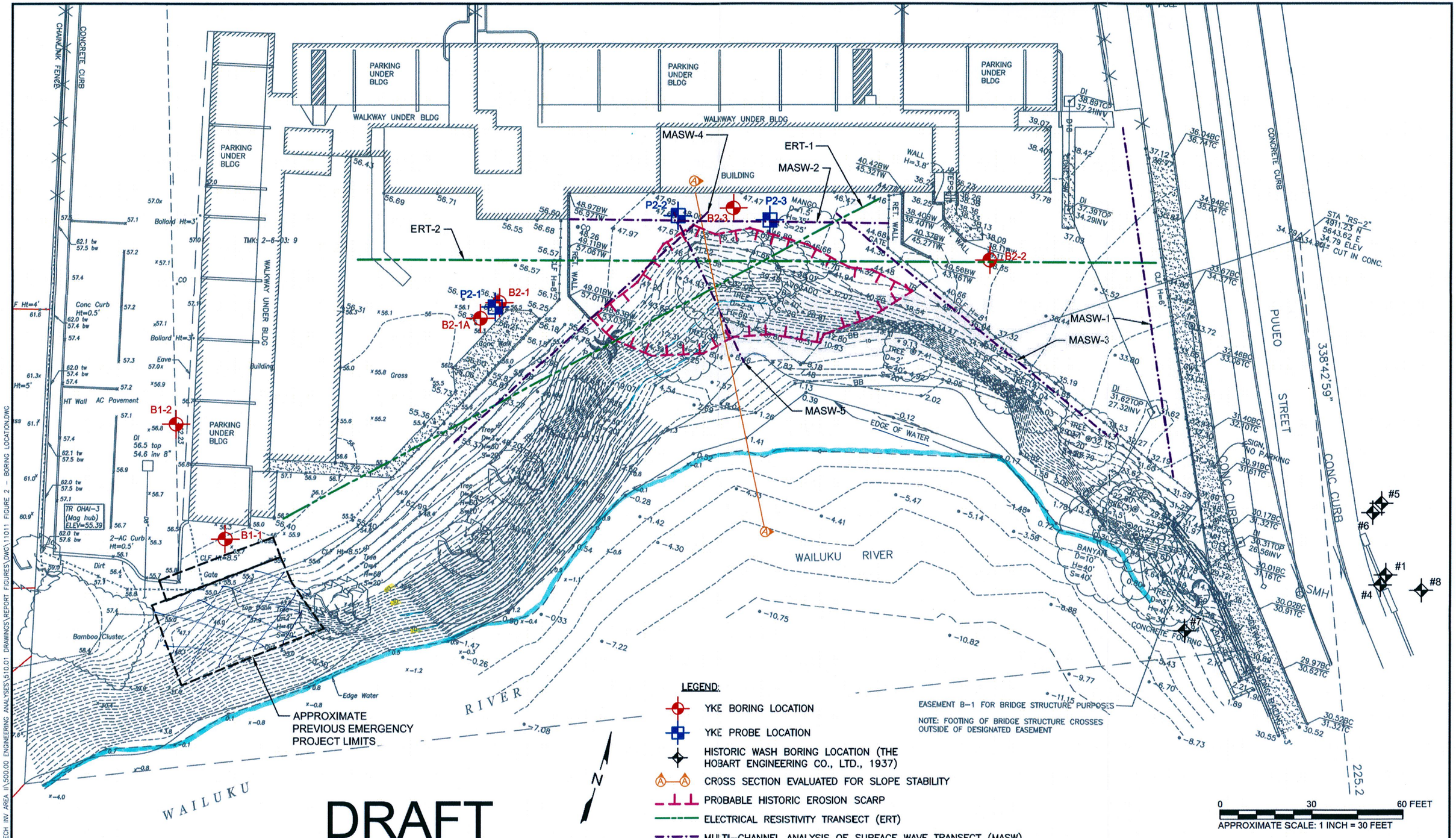
The Big Island Housing Foundation Riverside, a community-based non-profit corporation, is proposing erosion control improvements along a section of Wailuku Stream, on the property occupied by the Riverside Apartment complex, at 333 ʻŌhai Street in Hilo (TMK 2-6-003:009), see Figure 1. The Riverside Apartments are a 4-story residential complex providing subsidized housing to qualified low-income tenants through the support of U.S Department of Housing and Urban Development. The State of Hawai'i Housing Finance and Development Corporation are funding these erosion control improvements.

This report describes the methods used and the results of, botanical, avian and mammalian surveys conducted on the subject property as part of the environmental disclosure process associated with the proposed project. The primary purpose of the surveys was to determine if there are any botanical, avian or mammalian species currently listed, or proposed for listing under either federal or State of Hawaiʻi endangered species statutes within or adjacent to the study area. The federal and State of Hawaiʻi listed species status follows species identified in the following referenced documents, (Department of Land and Natural Resources (DLNR), 1998; U. S. Fish & Wildlife Service (USFWS), 2005a, 2012). Fieldwork was conducted on January 16, 2013.

General Project and Site Descriptions

The Riverside Apartment complex is located on a 1.8 acre parcel on ʻŌhai Street, located on the block between Puʻuʻeo Road and Wainaku Street. The L-shaped building is situated on a three-level terraced stream bank fronting ʻŌhai Street on the north, and bordered by the Wailuku River on the south, along the rear of the apartment complex. The property sites on a bluff above the river, and is terraced in the east to west direction. The lowest of the three terraces, known as the First Level, is on the eastern most side of the parcel. The project area is located on the Second Level, and the Third Level, which is situated at the highest elevation, is located on the western most side of the parcel.

The project will install a series of micropiles to underpin the building footings nearest the stream bank, to provide foundation support during extreme seismic events. Building record drawings show that the building's shallow spread foundations are located as close as 10 to 11 feet from the edge of the stream bank in this Second Level area. The micropiles will consist of a high strength central reinforcing bar encased in cement grout within a galvanized steel casing, with an approximately 6 to 8 inch outer diameter. The micropiles will be placed along the southern building wall, and be structurally connected directly to the existing continuous wall footings. The micropiles will be spaced at approximately 4 feet, and installed to a depth of at least 60 feet in order to develop a minimum of 20 tons of allowable axial load per micropile.



BORING AND GEOPHYSICAL SURVEY LOCATION MAP

Stream Bank Bluff Protection and Stabilization of a Second Erosion Scarp
Second Level of the Riverside Apartments Property
333 Ohai Street, Hilo, Hawaii (TMK 2-6-003:009)

Project No. 11011

REFERENCES:
1. Topographic Survey by R.M. Towill Corporation, Dated August 3, 2011.
2. ALTA/ASCM Land Title Survey by Walter D. Thompson Inc., December 2007.
3. Geophysical Survey by Global Geophysics (December 2011).

YOGI KWONG ENGINEERS, LLC

FIGURE 2

P:\11011 RIVERSIDE GEOTECH INV AREA II\500.00 ENGINEERING ANALYSES\510.01 DRAWINGS\REPORT FIGURES\DWG\11011 FIGURE 2 - BORING LOCATION.DWG

In order to stabilize the stream bank slope, a series of soil rock anchors will be installed into the slope. A total of seven rows of soil rock anchors will be installed horizontally and at various inclinations across the slope with individual rows spaced at a 4-foot elevation intervals going up the slope to provide added stability. Anchors within each row will be spaced approximately three feet apart. In addition to the anchors, an 8 to 10 inch thick layer of reinforced shotcrete (gunite) will be installed up and over the stream bank to protect and stabilize the slope face. The shotcrete will be colored an earth tone to blend into the natural environment, similar to what was done at the Third Level. The toe of the slope, near the Wailuku River, will be protected against future erosion, scour and undermining by such methods as a localized grouted rip rap buttress.

The vegetation on the site is a dense forest of bamboo and various large trees on a very steep bank of Wailuku Stream. Various ornamentals are mixed into this vegetation in the vicinity of the Riverside Apartments.

Figure 2 – Top of bank showing vegetation, looking towards stream

Figure 3 - The dominant vegetation at the project site as seen from across the river is bamboo and bingabing trees.

Methods

Plant names follow *Hawai'i's Ferns and Fern Allies* (Palmer, 2003) for ferns, *Manual of the Flowering Plants of Hawai'i* (Wagner *et al*., 1990, 1999) for native and naturalized flowering plants, and *A Tropical Garden Flora* (Staples & Herbst, 2005) for ornamental species. Updates on name changes are taken from Imada (2012). The avian phylogenetic order and nomenclature used in this report follows the *AOU Check-List of North American Birds* (American Ornithologists' Union, 1998), and the 42nd through the 52nd supplements to the Check-List (American Ornithologists' Union, 2000; Banks et al., 2002, 2003, 2004, 2005, 2006, 2007, 2008; Chesser et al., 2009, 2010, 2011, 2012). Mammal scientific names follow (Tomich, 1986). Place names follow *Place Names of Hawaii* (Pukui et al., 1974).

Botanical Survey Methods

The site is a high, extremely steep bank of loose soil material and only accessible parts of the site could be traversed on foot. Inaccessible parts were viewed from the top of the bank, from within where possible to access, and from the river (looking upstream from the Pu'ueo Street bridge). The survey area included the left bank along the full length of the Riverside Apartments in order to observe all plant species potentially in the specific project site. Because of the deep shade created by the dense tree growth, understory plants were generally sparse and few if any small plants were likely missed in the survey.

Avian Survey Methods

One avian count station was sited within the study site. A single 8-minute avian point count was made at the count station. Field observations were made with the aid of Leica 8 X 42 binoculars and by listening for vocalizations. The count and subsequent search of the site were conducted between 8:00 am and 10:00 am. Time not spent counting the point count station was used to search the remainder of the site for species and habitats not detected during the point count. Weather conditions were ideal, with no rain, unlimited visibility on the site, and winds of between 1 and 4 kilometers an hour.

Mammalian Survey Methods

With the exception of the endangered Hawaiian hoary bat (*Lasiurus cinereus semotus*), or *ʻōpeʻapeʻa* as it is known locally, all terrestrial mammals currently found on the Island of Hawai'i are alien species, and most are ubiquitous. The survey of mammals was limited to visual and auditory detection, coupled with visual observation of scat, tracks, and other animal sign. A running tally was kept of all terrestrial vertebrate mammalian species detected within the study site.

Results

Botanical

The project site is a steep erosion face rising some 50 feet up from the Wailuku River. At the very top, the ground levels off into the Riverside Apartments with a tall chainlink fence separating the apartment grounds from the drop-off. Plants at and near the top of the bank are mostly landscape ornamentals. Down the slope, a forest of large trees and bamboo creates dense shade, somewhat limiting understory growth. However, small ferns, shrubs and vines climbing into the trees contribute to the lush vegetation.

Despite access difficulties, a total of 6 ferns and 47 flowering plants were recorded from the site and immediately adjacent areas along the river (Table 1). Of the 53 spp. recorded, only 2 (3.7%) are plants native to the Hawaiian Islands; however, another 5 (9.4%) are early Polynesian introductions (so-called canoe plants). The two native plants are *neleau* (*Rhus sandwicensis*) and *hau* (*Hibiscus tiliaceus*). Hau may be a Polynesian introduction and the *neleau* was only observed along the bank outside of the project site. Neither are rare in the Hilo area. The early Polynesian introductions—*kukui* (*Aleurites moluccana*), *ʻulu* (*Artocarpus altilis*), *ʻihiʻai* (*Oxalis corniculata*), *ki* (*Cordyline fruticosa*), and *ʻohe* (*Schizostachyum glaucifolium*)—are also common species in Hawaiʻi. A total of 12 species (22.6%) of those recorded are considered ornamentals: plants placed or spreading from landscaping efforts of species not considered naturalized in the Hawaiian Islands.

Table 1. Flora for Riverside Apartments Retaining Wall Site, Hilo, Hawai'I.

Family Species	Common name	Status	Abundance	Notes
	FERNS			
ATHYRIACEAE				
Diplazium esculentum (Retz.) Sw.	*paca*	Nat	U	
NEPHROLEPIDACEAE				
Nephrolepis sp.	inaccessible	ukw	R	<2>
POLYPODIACEAE				
Phlebodium aureum (L.) J. Sm.	rabbit's-foot fern	Nat	U	
Phymatosorus grossus (Langsd. & Fisch.) Brownlie	*lauae, maile*-scented fern	Nat	O	
PTERIDACEAE				
Pityrogramma calomelanos (L.) LInk	silver fern	Nat	U	
Pteris sp.	juv. on bank	ukw	R	<2>
	FLOWERING PLANTS			
	DICOTYLEDONS			
ACANTHACEAE				
Aphelandra squarrosa C. Nees	zebra plant	Orn	R	
ANACARDIACEAE				
Mangifera indica L.	mango	Nat	U	
Rhus sandwicensis A. Gray	*neleau*	**End**	R	<1,2>
APIACEAE				
Centella asiatica (L.) Urb.	Asiatic pennywort	Nat	U	
ARALIACEAE				
Polyscias guilfoylei (W. Bull.) L.H. Bailey	panax	Orn	R	
Schefflera actinophylla (Endl.) Harms	umbrella tree	Nat	U	
ASTERACEAE (COMPOSITAE)				
Ageratum conyzoides L.	*maile hohono*	Nat	U	
Crassocephalum crepidioides (Benth.) S. Moore	---	Nat	R	
Emilia fosbergii Nicolson	Flora's paintbrush	Nat	R	
Youngia japonica (L.) DC	Oriental hawksbeard	Nat	R1	
BIGNONIACEAE				
Spathodea campanulata P. Beauv.	African tulip tree	Nat	U	
EUPHORBIACEAE				
Aleurites moluccana (L.) Willd.	*kukui*	**Pol**	R	
Codiaeum variagatum (L.) Blume	croton	Nat	R	
Macaranga mappa L.	bingabing	Nat	C	
Phyllanthus debilis Klein ex Willd.	niuri	Nat	R	
FABACEAE				
Falcataria moluccana (Miq.) Barneby & J.W. Grimes	albizia	Nat	R	
LAURACEAE				
Persea americana P. Miller	avocado	Nat	R	
MALVACEAE				
Hibiscus tiliaceus L.	*hau*	**Ind**	O	
Malvaviscus penduliflorus A.P. de Candolle	Turk's-cap	Orn	O	

Table 1 – continued…

Family Species	Common name	Status	Abundance	Notes
MELASTOMATACEAE				
Dissotis rotundifolia (Sm.) Triana	---	Nat	O1	
MORACEAE				
Artocarpus altilis (Z) Fosb.	*'ulu*; breadfruit	**Pol**	R	
Ficus microcarpa L. fil.	Chinese banyan	Nat	R	
NYCTAGINACEAE				
Bougainvellea spectabilis Willd.	bougainvillea	Nat	R	
OXALIDACEAE				
Oxalis corniculata L.	yellow wood sorrel, *'ihi'ai*	Pol	U	
PLANTAGINACEAE				
Plantago major L.	brd-lvd. plantain	Nat	R	
RUBIACEAE				
Hedyotis corymbosa (L.) Lam.	---	Nat	R1	
Padaera foetida L.	*maile pilau*	Nat	O	
STERCULIACEAE				
Melochia umbellata (Houtt.) Stapf	---	Nat	O	
ULMACEAE				
Trema orientalis L.	gunpowder tree	Nat	U	
VERBENACEAE				
Duranta erecta L.	golden dewdrop	Orn	R	<1,2>
	MONOCOTYLEDONES			
AGAVACEAE				
Cordyline fruticosa (L.) A. Chev.	*ki*, ti	**Pol**	U	
Dracaensa fragrans (L.) Ker Gawl.	fragrant dracaena; corn plant	Orn	R	
Dracaena marginata Lam.	money tree	Orn	R	
Sansevieria trifasciata Prain	mother-in-law's tongue	Orn	R	
ARACEAE				
Epipremnum pinnatum (L.) Engler	pothos	Nat	C	
Philodendron scandens K. Koch & Sello	heart-leaf philodendron	Orn	O	
ARECACEAE				
Archontophoenix alexandrae (F. v. Muell.) H. A. Wendl. & Drude	king palm	Nat	R	
Livistonia chinensis (Jacq.) R. Br. ex Mart.	Chinese fan palm	Nat	R	
COMMELINACEAE				
Dichorisandra thyrisiflora J.C. Mikan	blue ginger	Orn	R	
HELICONIACEAE				
Heliconia sp.	indet. heliconia	Orn	R	<2>
MARANTACEAE				
Calathea crotalifera S. Watson	rattlesnake plant	Orn	R	
MUSACEAE				
Musa acuminata hybrid	banana	Orn	C	
POACEAE (GRAMINEAE)				
Bambusa vulgaris J.C. Wendl.	golden bamboo	Nat	C	
Eragrostis tenella (L.) P. Beauv. ex Roem. & Schult.	lovegrass	Nat	R	
Paspalum conjugatum Bergius	Hilo grass	Nat	R1	
Schizostachyum glaucifolium (Rupr.) Munro	*'ohe*	**Pol**	O	

Table 1 – continued…

Family Species	Common name	Status	Abundance	Notes
ZINGIBERACEAE				
Hedychium sp.	ginger	Nat	R	<2>

Legend to Table 1:

Status = distributional status

E**nd** = endemic; native to Hawai'i and found naturally nowhere else.

I**nd** = indigenous; native to Hawai'i, but not unique to the Hawaiian Islands;

Ind? = probably indigenous.

Nat = naturalized, exotic, plant introduced to the Hawaiian Islands since the arrival of Cook Expedition in 1778, and well-established outside of cultivation.

Pol = introduced to Hawai'i by Polynesian migrants.

ukw = unknown; genus has both native and naturalized species in Hawai'i.

Abundance = occurrence ratings for plants on property in March 2008

R – Rare - only one or two plants seen.

U - Uncommon - several to 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.

Numbers (as in R3) offset occurrence ratings (1 – several plants; 2 – many plants; 3 – abundant in a limited area) in cases where distribution across the survey area may be limited, but individuals seen are more than indicated by the occurrence rating alone.

Notes: <1> Observed on stream bank, but only outside of project site.

<2> Plant lacking flowers or fruit at time of survey; identification uncertain.

Avian Surveys

A total of 35 individual birds of six species, representing five separate families, were recorded during the station count. All of the avian species recorded during the course of this survey are alien to the Hawaiian Islands (Table 2).

No avian species currently protected or proposed for protection under either the federal or State of Hawai'i endangered species programs were detected during the course of this survey (DLNR, 1998; USFWS, 2005, 2013).

Avian diversity and densities were low, though in keeping with the location and vegetation present on the site. Japanese White-eye (*Zosterops japonicus*), were the most frequently

recorded species, accounting for 31 percent of the total number of birds recorded during the station count.

Table 2 – Avian Species Detected Riverside Apartment Project Site

Common Name	*Scientific Name*	*ST*	#
	COLUMBIFORMES		
	COLUMBIDAE - Pigeons & Doves		
Spotted Dove	*Streptopelia chinensis*	A	5
Zebra Dove	*Geopelia striata*	A	4
	PASSERIFORMES		
	ZOSTEROPIDAE - White-eyes		
Japanese White-eye	*Zosterops japonicus*	A	11
	STURNIDAE - Starlings		
Common Myna	*Acridotheres tristis*	A	7
	CARDINALIDAE - Cardinals Saltators & Allies		
Northern Cardinal	*Cardinalis cardinalis*	A	4
	FRINGILLIDAE - Fringilline and Carduline Finches & Allies		
	Carduelinae - Carduline Finches		
House Finch	*Haemorhous mexicanus*	A	4

Key to table 1

ST Status

A Alien – Introduced to the Hawaiian Islands by humans

Number of individual birds detected

Mammalian Survey

No mammalian species were detected during the course of this survey.

No mammalian species currently protected or proposed for protection under either the federal or State of Hawaiʻi endangered species programs were detected during the course of this survey (DLNR, 1998; USFWS, 2005, 2013).

Discussion

Botanical Resources

This survey of botanical resources found that there are no species within the project site that are considered important from resource or cultural perspectives, or that are currently listed or proposed for listing under either federal or State of Hawaiʻi endangered species statutes (DLNR, 1998; USFWS 2012).

Avian Resources

The findings of the avian survey are consistent with the location of the site. As previously discussed a total of six avian species were detected during the time spent within the study area. All of the species recorded are alien to the Hawaiian Islands.

Although no seabirds were detected during this survey, it is probable that both the endangered Hawaiian Petrel (*Pterodroma sandwichensis*), and the threatened endemic sub-species of the Newell's Shearwater (*Puffinus auricularis newelli*), over-fly the project area in small numbers between April and the middle of December each year. Both species have been recorded flying to and from their nesting colonies over the greater Hilo area (Day et al., 2003; David 2013). Both of these pelagic seabird species nest high in the mountains in burrows excavated under thick vegetation, especially *'uluhe* (*Dicranopteris lineraris*) fern. Although there is a large amount of *'uluhe* on the site, the site is no longer, even if ever was suitable nesting habitat for either of these seabird species.

The primary cause of mortality in the two aforementioned seabird species is thought to be predation by alien mammalian species at the nesting colonies (USFWS 1983; Simons and Hodges 1998; Ainley et al., 2001). Collision with man-made structures is considered to be the second most significant cause of mortality of these seabird species in Hawai'i. Nocturnally flying seabirds, especially fledglings on their way to sea in the summer and fall, can become disoriented by exterior lighting. When disoriented, seabirds often collide with manmade structures, and if they are not killed outright, the dazed or injured birds are easy targets of opportunity for feral mammals (Hadley 1961; Telfer 1979; Sincock 1981; Reed et al., 1985; Telfer et al., 1987; Cooper and Day, 1998; Podolsky et al. 1998; Ainley et al., 2001; Hue et al., 2001; Day et al 2003).

Mammalian Resources

The findings of the mammalian survey are consistent with the location of the site. Although no rodents were detected, is likely that the several of the four established alien *muridae* found on Hawai'i, roof rat (*Rattus r. rattus*), Norway rat (*Rattus norvegicus*), European house mouse (*Mus domesticus*) and possibly Polynesian rats (*Rattus exulans hawaiiensis*) use resources found within the site on a seasonal basis. These human commensal species are all but ubiquitous around human activity. A number of rodent bait stations were observed along the fence around the apartment complex, suggesting that rodent are present in the greater project area.

No Hawaiian hoary bats were detected during the course of this survey. Hawaiian hoary bats are widely distributed within the greater Hilo area and are present in most areas that still have tree and dense shrubs, (USFWS, 1998; Bonaccorso et al., 2005, 2007; 2011; David, 2013).

Potential Impacts to Protected Species

Hawaiian hoary bat

The principal potential impact that the construction of this project poses to bats is during the clearing and grubbing phases of construction as vegetation is removed. The removal of vegetation within the project site may temporarily displace individual bats, which may use the vegetation as a roosting location. As bats use multiple roosts within their home territories, the potential disturbance resulting from the removal of the vegetation is likely to be minimal. During the pupping season, females carrying their pups may be less able to rapidly vacate a roost site as the vegetation is cleared. Additionally, adult female bats sometimes leave their pups in the roost tree while they forage. Very small pups may be unable to flee a tree that is being felled. Potential adverse effects from such disturbance can be avoided or minimized by not clearing woody vegetation taller than 4.6 meters (15-feet), between June 1 and September 15, the period in which bats are potentially at risk from vegetation clearing.

Seabirds

The principal potential impact that the construction of the poses to protected seabirds is the increased threat that birds will be downed after becoming disoriented during the nesting season by lights associated with the project. The main area that outdoor lighting could pose a threat to these nocturnally flying seabirds is if, during construction if it is deemed expedient, or necessary to conduct nighttime construction activities. There are no plans to do any nighttime construction or install any lighting as part of the project, thus it is not expected that the construction of the project will result in impacts to listed seabirds.

Recommendations

1. It is recommended that woody vegetation taller than 4.6 meters (15-feet), not be cleared between June 1 and September 15, the period in which bats are potentially at risk from vegetation clearing.

Critical Habitat

There is no federally delineated Critical Habitat present on or adjacent to the project site. Thus the proposed project will not result in impacts to federally designated Critical Habitat. There is no equivalent statute under State law.

Glossary

Alien – Introduced to Hawaiʻi by humans
Endangered – Listed and protected under the Endangered Species Act of 1973, as amended (ESA) as an endangered species
Muridae – Rodents, including rats, mice and voles, one of the most diverse family of mammals
Nocturnal – Night-time, after dark.
ʻŌpeʻapeʻa – Endemic endangered Hawaiian hoary bat (*Lasiurus cinereus semotus*)
Pelagic – An animal that spends its life at sea – in this case seabirds that only return to land to nest and rear their young

DLNR – State of Hawaiʻi Division of Land and Natural Resources
ESA – Endangered Species Act of 1973, as amended
USFWS – United State Fish & Wildlife Service

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Appendix C

SHPD Ltrs dated February 4, 2012 and March 28, 2013
Concurring that no historic properties affected

Final Archaeological Field Inspection and Literature Review
With Subsurface Testing

Cultural Surveys Hawai‘i
February 2013

NEIL ABERCROMBIE
GOVERNOR OF HAWAII

WILLIAM J. AILA, JR.
CHAIRPERSON
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CONSERVATION AND COASTAL LANDS
CONSERVATION AND RESOURCES ENFORCEMENT
ENGINEERING
FORESTRY AND WILDLIFE
HISTORIC PRESERVATION
KAHOOLAWE ISLAND RESERVE COMMISSION
LAND
STATE PARKS

HISTORIC PRESERVATION DIVISION
DEPARTMENT OF LAND AND NATURAL RESOURCES

601 Kamokila Boulevard, Suite 555
Kapolei, HI 96806

March 28, 2013

Mr. Glenn T. Kimura
Kimura International, Inc.
1600 Kapiolani Blvd. Suite 1610
Honolulu, Hawai`i 96814
Attn. Leslie Kurisaki

LOG NO: 2013.2189
DOC NO: 1303SN15
Archaeology

RECEIVED APR 13 2013

Dear Mr. Kimura:

SUBJECT: **Chapter 6E-42 Historic Preservation Review –**
Draft Environmental Assessment for Riverside Apartments Improvements: Stream Bank Protection and Stabilization, Second Slope Scarp and Interior Renovations
Pu'u'eo Ahupua'a, South Hilo District, Island of Hawai'i
TMK: (3) 2-6-003:009

Thank you for the opportunity to provide comments for the draft environmental assessment. We received your submittal March 7, 2013. The proposed project will stabilize the slope along the stream bank to support building footings nearest the stream bank and include interior renovations of the existing building. Both the building renovations and stream bank stabilization are considered a "single action" of an overall improvement effort subject to Chapter 343 HRS. The Riverside Apartment Complex was built in 1973; the inerior renovations are therefore not subject to historic preservation review at this time. According to your letter, a 3,320 sq. ft. area will be stabilized along the stream bank to support the building footings nearest the stream bank. The project plans to install a series of micopiles and to construct a series of soil anchors in the stream bank slope with a 8-10 inch layer of reinforced shotcrete (gunite) to facilitate the stabilization of the stream bank slope face.

The the lower reaches of the Wailuku Stream is within an area that was an important political center and was densely populated prior to and following western contact. Although the aforementioned project area has been impacted by modern development, previous surface disturbance may not have fully destroyed the subsurface remains of archaeological and natural history deposits or human skeletal remains that could potentially be preserved in subsurface deposits within this project area. Our office reviewed a draft report titled *Draft Archaeological Field Inspection and Literature Review for the Stream Bank Bluff Protection and Stabilization, Second Slope Scarp at the Riverside Apartments, Pu'u'eo Ahupua'a, South Hilo District, Island of Hawai'i TMK: (3) 2-6-003:009* (C. O'Hara, D. Shideler, and H. Hammatt 2012) and requested subsurface testing to address concerns that unidentified subsurface deposits might be present (letter dated December 17, 2012, *Log 2012.3284, Doc. 1212SN07*). Additional fieldwork was conducted within the project area and a revised report was approved by our office in a letter dated February 4, 2013 (*Log 2013.0555, Doc. 1302SN01*). No evidence of subsurface deposits or features was identified.

Based on current information, we believe that **no historic properties will be affected**. However, we would like to be informed in the event that historic resources, including human skeletal remains, structural remains, sand deposits, midden doposis, or lava tubes are identified during construction activities. If any of these are identified, please cease work in the immediate vicinity, protect the find from additional disturbance, and contact the State Historic Preservation Division at (808 933-7651. Please contact Sean Nāleimaile at (808) 933-7651 or Sean.P.Naleimaile@Hawaii.gov if you have any questions or concerns regarding this letter.

Aloha,

Theresa K. Donham
Archaeology Branch Chief

NEIL ABERCROMBIE
GOVERNOR OF HAWAII

WILLIAM J. AILA, JR.
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
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601 Kamokila Boulevard, Suite 555
Kapolei, HI 96806

February 4, 2013

Hallatt H. Hammatt, Ph.D.
Cultural Surveys Hawai'i, Inc..
P.O.Box 1114
Honolulu, Hawai'i 96734
Attn. David Shidler

LOG NO: 2013.0555
DOC NO: 1302SN01

Dear Dr. Hammatt:

SUBJECT: **Chapter 6E-42 Historic Preservation Review –**
Revised Draft Archaeological Field Inspection and Literature Review for Stream Bank Protection and Stabilization at the Riverside Apartments
Pu'u'eo Ahupua'a, South Hilo District, Island of Hawai'i
TMK: (3) 2-6-003:009 (por)

Thank you for submitting the revised report titled *Draft Archaeological Field Inspection and Literature Review for the Stream Bank Bluff Protection and Stabilization, Second Slope Scarp at the Riverside Apartments, Pu'u'eo Ahupua'a, South Hilo District, Island of Hawai'i TMK: (3) 2-6-003:009* (C.. O'Hara, D. Shideler, and H. Hammatt 2012). We received your submittal January 28th, 2013. As submitted in your report, a .65 acre area was surveyed along a steep slope on the south side of the subject 1.808-acre parcel, located along Wailuku Stream. The proposed project will stabilize the slope along the stream bank to support building footings nearest the stream bank. The project plans to install a series of micopiles and to construct a series of soil anchors in the stream bank slope with a 8-10 inch layer of reinforced shotcrete (gunite) to facilitate the stabilization of the stream bank slope face.

We appreciate the effort made to satisfy our concerns relating to the potential for subsurface historic properties within or near the proposed project area, as noted in our letter dated December 17th, 2012 (*Log 2012.3284, Doc. 1212SN07*). Our concern was that although the project area has been impacted by modern use and natural processes associated with the Wailuku River, previous surface disturbance may not have fully destroyed subsurface remains of archaeological and natural history deposits, or human skeletal remains that could potentially be preserved in the project area. As discussed with CSH archaeologist Oliver Bautista, an excavation was conducted to further determine the presence or absence of subsurface resources. Information regarding the location and findings of a 1.0 m by 1.0 m hand excavation unit was added to the report. Two soil layers, both of which were determined to be culturally sterile, were identified in the test unit. Due to safety concerns, the excavation was terminated at 120 cmbs. Based on this information, we concur with your recommendation of no further work for this location; and we believe that there will be no historic properties affected by the project.

We request that information regarding the safety concerns and reason for not extending the excavation beyond 120 cmbs be included in the final report. We also ask that the excavated soil layers be identified as fill, to better define the existing landscape in the project area. With these revisions, the report is accepted as final, pursuant to HAR 13-284-5(b)(2). Please send hard copies of the final report, clearly marked FINAL, to the Hilo and Kapolei offices of SHPD, with an electronic copy on CD to the SHPD library in Kapolei. Please contact Sean Nāleimaile at Sean.P.Naleimaile@Hawaii.gov or (808) 933-7651 if you have any questions or concerns regarding this letter.

Aloha,

Theresa K. Donham
Archaeology Branch Chief

cc: Glen T. Kimura, ATTN: Leslie Kurisaki
1600 Kapiolani Blvd., Suite 1610
Honolulu, Hawaii 96814

FINAL
Archaeological Field Inspection and Literature Review With Subsurface Testing for the Stream Bank Bluff Protection and Stabilization, Second Slope Scarp at the Riverside Apartments, Pu‘u‘eo Ahupua‘a, South Hilo District, Hawai‘i Island TMK (3) 2-6-003:009

Prepared for

Kimura International, Inc.

Prepared by

Constance R. O’Hare, B.A.,

David W. Shideler, M.A.

and

Hallett H. Hammatt, Ph.D.

Cultural Surveys Hawai‘i, Inc.

Kailua, Hawai‘i

(Job Code: PUUEO 1)

February 2013

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Management Summary

Reference	Archaeological Field Inspection and Literature Review with Subsurface Testing for the Stream Bank Stabilization Project Along Wailuku Stream (adjacent to the Riverside Apartments), Pu‘u‘eo Ahupua‘a, South Hilo District, Hawai‘i Island, TMK (3) 2-6-003:009 O’Hare et al. 2012)
Date	February 2013
CSH Job Code	Cultural Surveys Hawai‘i Inc. (CSH) Job Code: PUUEO 1
Investigation Permit Number	The fieldwork component of this study was carried out under archaeological permit numbers 12-04 and 13-06, issued by the Hawai‘i State Historic Preservation Division/Department of Land and Natural Resources (SHPD/DLNR), per Hawai‘i Administrative Rules (HAR) Chapter 13-282.
Project Location	The subject parcel (1.808 acres (ac) or 0.732 hectares [ha]) is located on the block between Pu‘u‘eo Road, Amau‘ulu Road, Wainaku Street, and Wailuku Stream; the Riverside Apartments covers most of this parcel. The area subject to a field inspection is a smaller area (0.065 ac or 0.026 ha) within this subject parcel on the steep slope on the south side of this parcel adjacent to Wailuku Stream
Land Jurisdiction	City and County of Hawai‘i
Project Description	The project proponent intends to install a series of 6.5 inch (in) (16.51 centimeters [cm]) diameter micropiles to underpin the Riversides Apartment building footing nearest the stream bank. They also intend to construct a series of soil anchors in the stream bank scarp slope with an 8-10 in (20.3 – 25.4 cm) thick layer of reinforced shotcrete (gunite) to stabilize and protect the stream bank slope face.
Project Acreage	The subject parcel is 1.808 ac (0.732 ha); the field inspection project area is 0.065 ac (0.026 ha)
Historic Preservation Regulatory Context	This investigation does not fulfill the requirements of an archaeological inventory survey (per Hawai‘i Administrative Rules (HAR) Chapter 13-276). Rather, it serves as a document to facilitate the proposed project’s planning, and it supports historic preservation review compliance by identifying any archaeological concerns within the study area. This document develops data on the likely general nature, density and distribution of archaeological resources as can be gleaned from available sources.

Fieldwork Effort	The initial fieldwork component of the study was accomplished on October 25, 2012 by CSH archaeologists Olivier M. Bautista, B.A., and Johnny Dudoit, B.A., under the general supervision of Hallett H. Hammatt, Ph.D (principal investigator). The fieldwork required approximately one (1) person day to complete and consisted of a complete pedestrian inspection of the project area. In consultation with the SHPD on an earlier (November 2012) draft of this study it was agreed to carry out a test excavation to further inform the project regarding the potential for subsurface resources. The excavation reported here was carried out by Ollie Bautista, B.A. and Johnny Dudoit, B.A. under the overall guidance of Hallett Hammatt Ph.D on January 17 2013. The excavation took an additional two person days to complete.
Results Summary	No historic properties were identified.
Mitigation Recommendation	No further work is recommended. However, if at any time during construction subsurface features (including lava tubes) or deposits are encountered, CSH recommends that construction activities cease and that the SHPD be contacted immediately.

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Section 1 Introduction

1.1 Project Background

At the request of Kimura International, Inc., (1600 Kapi‘olani Bld., Suite 1610, Honolulu, HI 96814), Cultural Surveys Hawai‘i, Inc. (CSH) has completed this archaeological literature review and field inspection (LR&FI) study for the Stream Bank Bluff Protection and Stabilization, Second Slope Scarp at the Riverside Apartments, 333 Ohai Street, Hilo, HI 96720. The project area is located in Pu‘u‘eo Ahupua‘a, South Hilo District, Island of Hawai‘i, TMK 2-6-003:009, as shown on a 1995 U.S. Geological Survey map, a Hawai‘i Tax Map, and an aerial photograph (Figure 1 through Figure 3).

The subject parcel (1.808 acres (ac) or 0.732 hectares [ha]) is located on the block between Pu‘u‘eo Road, Amau‘ulu Road, Wainaku Street, and Wailuku Stream. The area subject to a field inspection is a smaller area (0.065 ac or 0.026 ha) within this subject parcel on the steep slope on the south side of this parcel adjacent to Wailuku Stream, as shown on Figure 4.

Kimura International, Inc. is preparing an Environmental Assessment (EA) on behalf of BIHF Riverside Community Based Non Profit Corporation (BIHF Riverside CBNPC) for a proposed stream bank bluff stabilization project at the Riverside Apartments in accordance with Hawai‘i Revised Statutes (HRS) Chapter 343 environmental guidelines and requirements. Kimura International explains the project thus:

> The Riverside Apartments is a 4-story low-income apartment complex located at 333 Ohai Street in Hilo Hawaii that provides project-based subsidized housing to qualified low-income tenants through the support of U.S Department of Housing and Urban Development (HUD).
>
> The L-shaped building resides along a three level terraced stream bank, which fronts the Wailuku River along the southern boundary of the boundary. From the downstream to the upstream end of the property, the top of three terraced stream bank is located at approximately 33 feet (ft) MSL [meters above sea level] at the 1st level, 47 ft MSL at the 2nd level and 60 ft MSL at the 3rd level.
>
> In 2008, heavy rains contributed to the failure of portion of the uppermost the 3rd level terrace stream bank. An emergency project was completed in July 2011 to protect and stabilize that failed portion of the stream bank. During the process of evaluating and stabilizing the 3rd level slope failure, a second historic slope scarp located adjacent to the building at the 2nd level terrace was documented. BIHF Riverside CBNPC subsequently contracted a geotechnical engineer to investigate the stability of this historic slope scarp. The geotechnical investigation found that the 2nd level stream bank bluff slope could be susceptible to slope failures under evaluated seismic and flood conditions potentially causing distress to the adjacent apartment building.

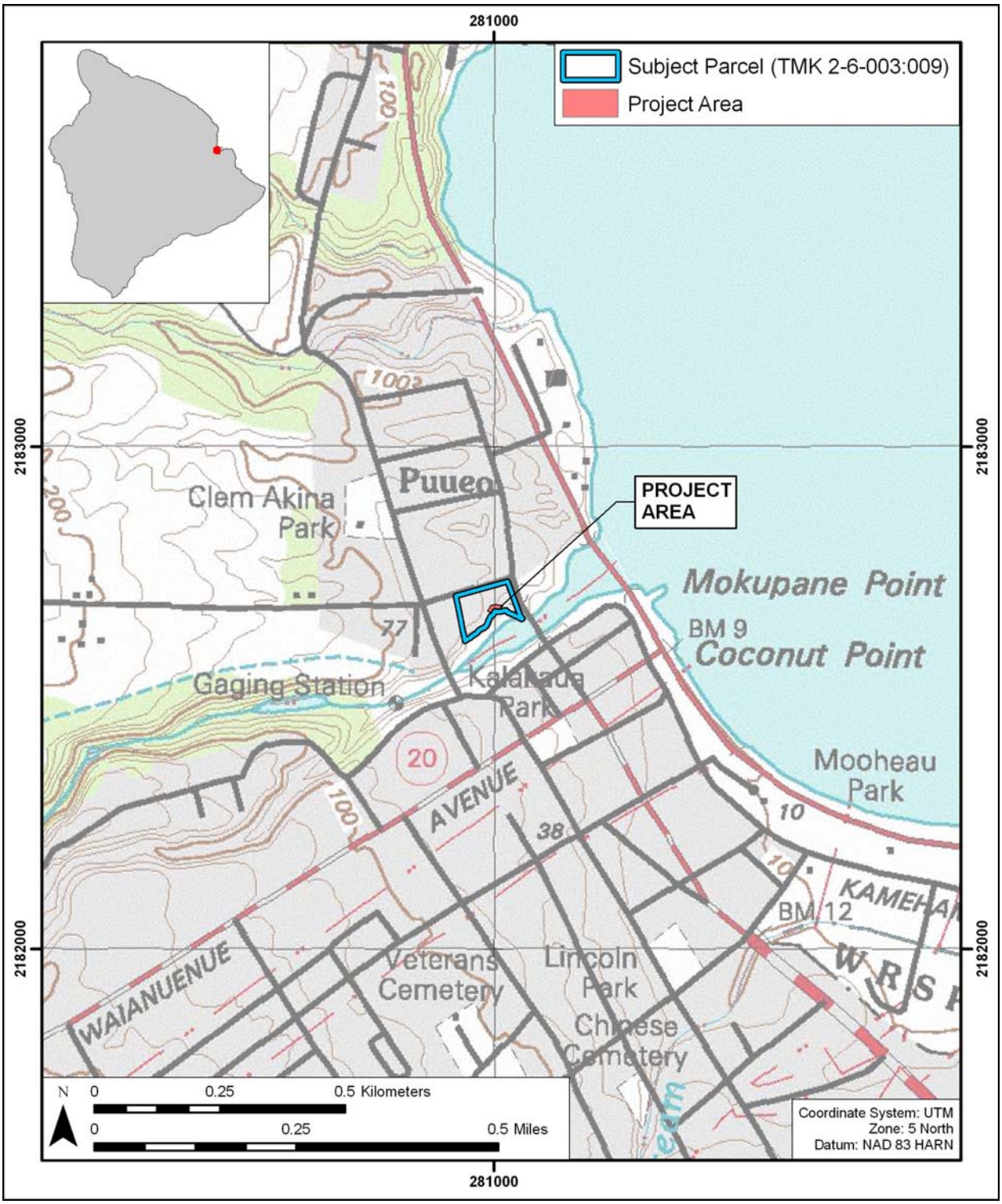

Figure 1. 1995 U.S. Geological Survey 7.5 Minute Topographic Map of Hawai‘i, Hilo Quadrangle, showing the project area location in Pu‘u‘eo Ahupua‘a

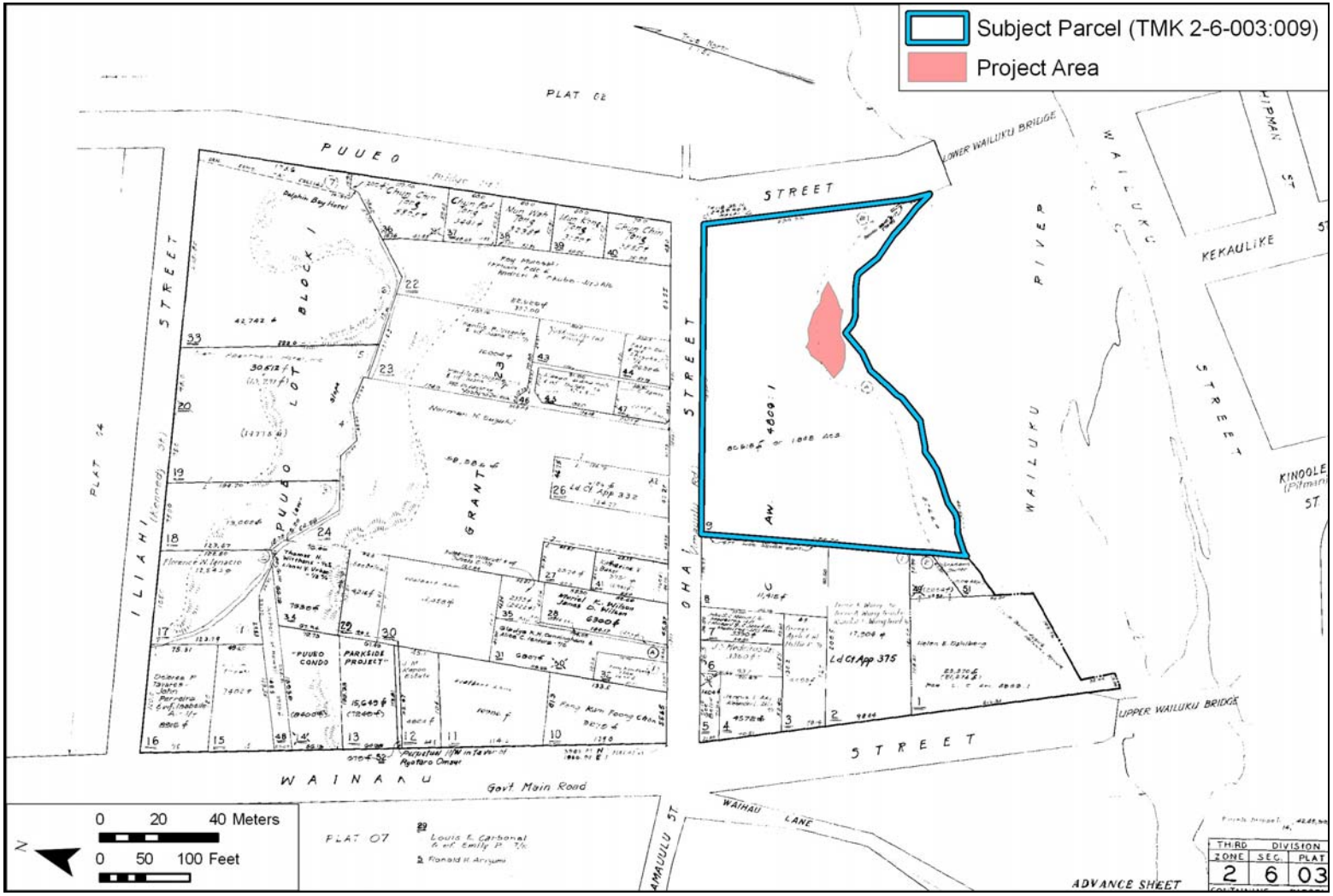

Figure 2. Tax Map Key (TMK) plat [3] 2-6-003, showing the location of the project area on the Wailuku River (Hawai‘i TMK Service 2011)

Figure 3. Aerial photograph, showing location of the project area (Google Earth 2010)

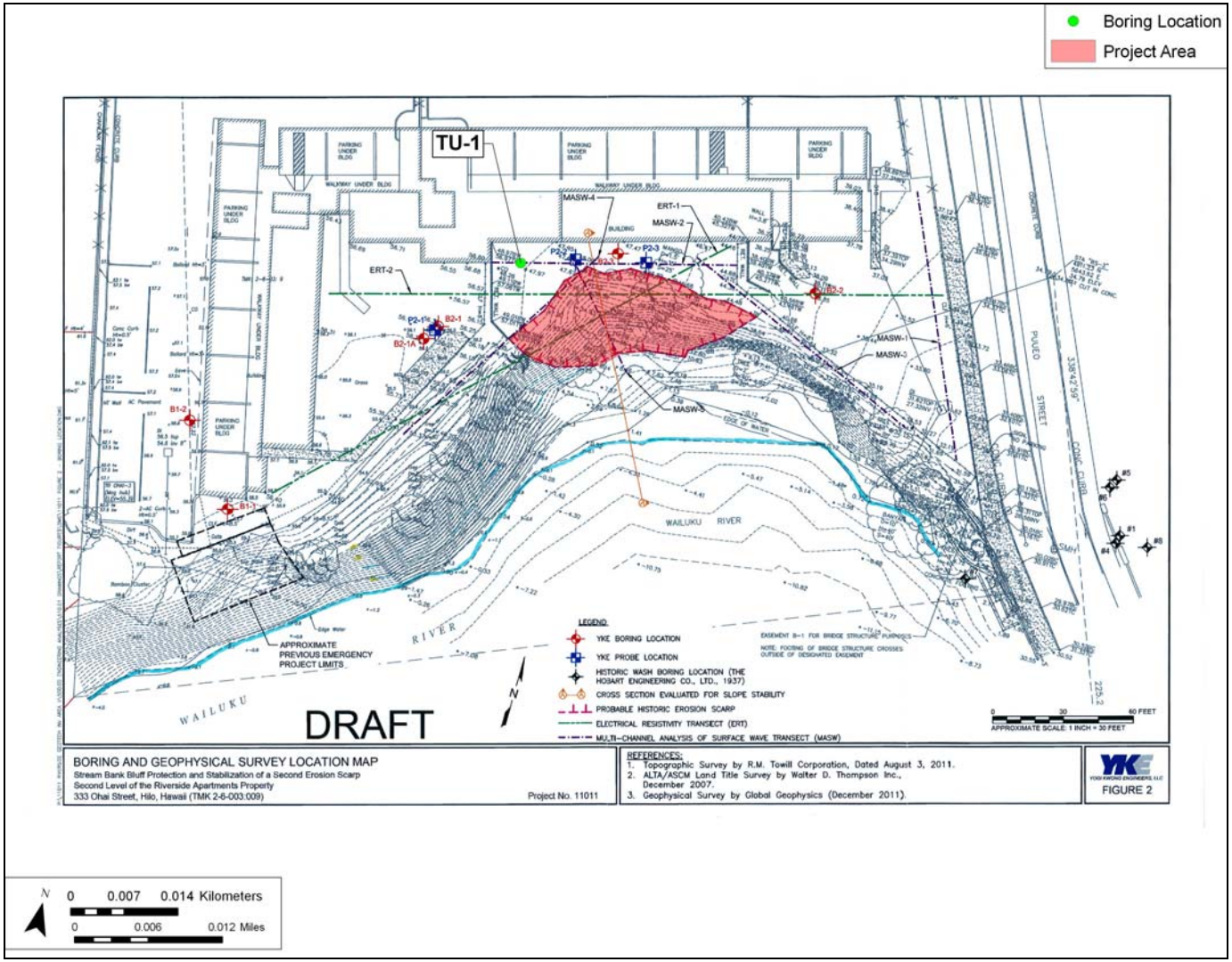

Figure 4. Geophysical Survey Map showing project parcel and field inspection project area (outlined in red) and contour lines of Wailuku River slope (Kimura 2012)

> This current project is intended to address the findings of the geotechnical investigation of the 2nd level terrace slope. This current project area is generally bound by two existing retaining walls with delineate the 2nd level terrace, and approximately 3320 square ft in area. (Kimura International 2012:1)

The project proponent intends to install a series of 6.5 inches (in) (16.51 centimeters [cm]) diameter micropiles to underpin the building footing nearest the stream bank. They also intend to construct a series of soil anchors in the stream bank scarp slope with an 8-10 in (20.3 – 25.4 cm) thick layer of reinforced shotcrete (gunite) to stabilize and protect the stream bank slope face.

This investigation by CSH in the current report does not fulfill the requirements of an archaeological inventory survey (per Hawai‘i Administrative Rules (HAR) Chapter 13-276). Rather, it serves as a document to facilitate the proposed project's planning, and it supports historic preservation review compliance by identifying any archaeological concerns within the study area. This document develops data on the general nature, density and distribution of archaeological resources as can be gleaned from available sources.

1.2 Scope of Work

The scope of work for report includes:

1. Historical research to include a study of archival sources, historic maps, Land Commission Awards (LCA), and previous archaeological reports to construct a history of land use and to determine if archaeological sites have been recorded on or near this property.
2. Limited field inspection of the project area to identify any surface archaeological features and to investigate and assess the potential for impact to such sites. This assessment will identify any sensitive areas that may require further investigation or mitigation before the project proceeds.
3. Preparation of a report to include the results of the historical research and the limited fieldwork with an assessment of archaeological potential based on that research, with recommendations for further archaeological work, if appropriate. It will also provide mitigation recommendations if there are archaeological sensitive areas that need to be taken into consideration.
4. This scope of work includes full coordination with the Hawai‘i State Historic Preservation Division/Department of Land and Natural Resources (SHPD/DLNR) relating to archaeological matters. This coordination takes place after consent of the owner or representatives.

1.3 Environmental Setting

1.3.1 Natural Environment

Pu‘u‘eo Ahupua‘a represents a section of land that is a major part of the Hilo Watershed. Streams, waterfalls, ponds, and other water features are abundant in this area, supporting lush forest and varied ecosystems where development has not occurred. The Hilo Forest Reserve borders Pu‘u‘eo Ahupua‘a to the west, and comprises its *mauka* (inland) reaches.

The topography of the project area is moderately sloped toward Hilo Bay to the east, with elevation ranging from approximately 20 to 45 meters (m), or 65 to 130 ft. According to the National Oceanic Atmospheric Administration (NOAA) website, “Within the city of Hilo, average rainfall varies from about 130 in a year near the shore to as much as 200 in upslope,” (NOAA 2009).

The soil type within the project area is Hilo Silty Clay Loam, with slopes of 0 to 10 percent (HoC) (Figure 5). The Hilo series is characterized by well-drained silty clay loams, which are described as having been “formed in a series of volcanic ash layers that give them a banded appearance. They are gently sloping to steep soils on uplands at an elevation ranging from near sea level to 800 ft,” (Foote et al. 1972). This soil type is categorized as receiving between 120 and 180 in of rainfall a year, with rapid permeability, slow runoff, slight erosion hazard, and good root penetration. Common modern vegetation includes hilo grass (*Paspalum confugatum*), guinea grass (*Urochloa mixima*), California grass (*Urochloa mutica*), and strawberry guava (*Psidum cattleianum*). Historically, this soil type has been used mainly for building site development, orchard crops, agroforestry, and livestock grazing (Foote et al. 1972).

1.3.2 Built Environment

The large L-shaped Riverside Apartments, built between 1957 and 1977 (information from maps and aerial photography) covers most of the project area on the north and west sides of the project area. The Wailuku bank portion, the focus of the field inspection for this project, has a steep gradient from 0-15 m (0-50 ft), making this area unusable for building purposes.

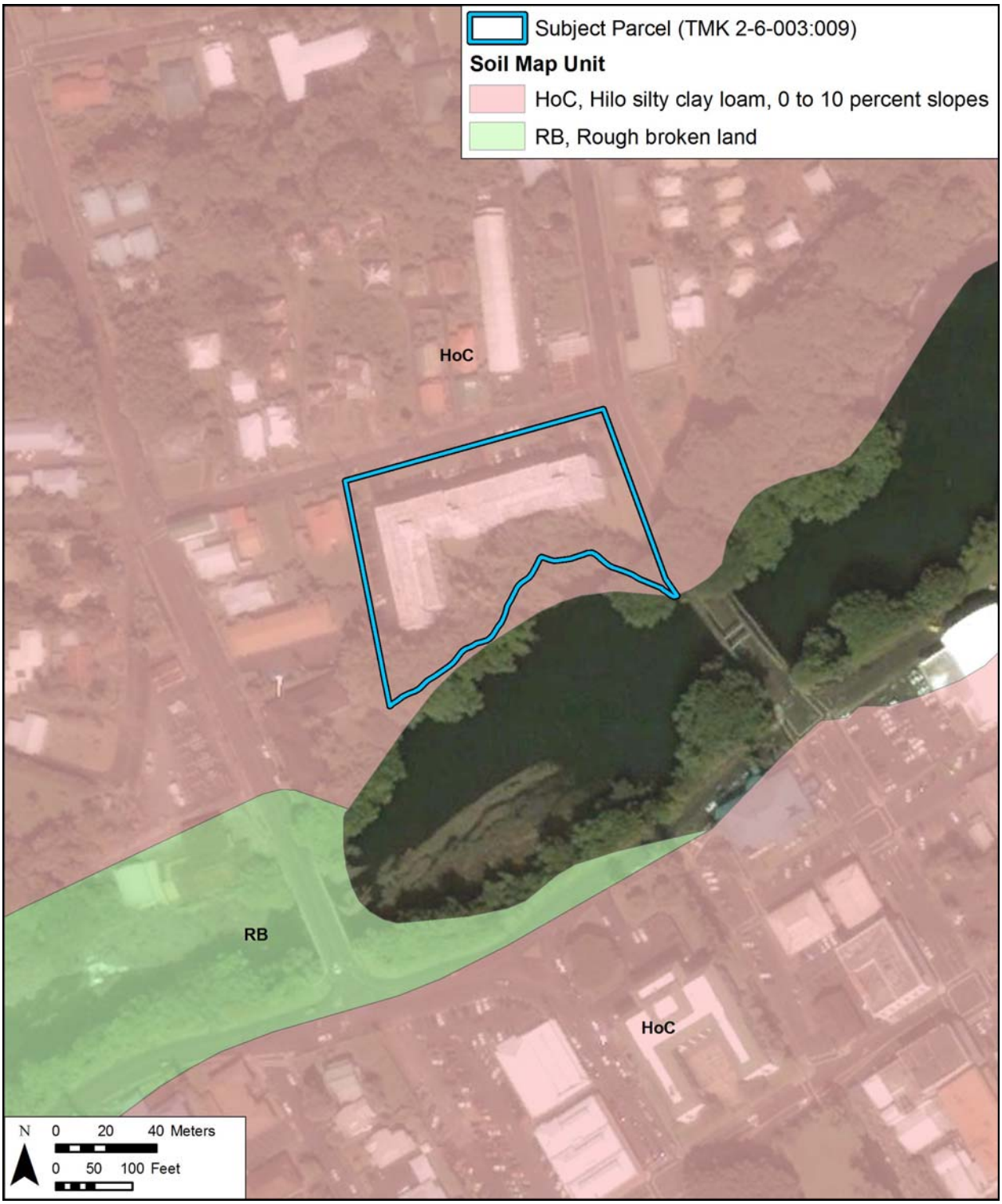

Figure 5. Soil survey overlay (information from Foote et al. 1972) of the project area on a portion of the 1995 U.S. Geological Survey 7.5-Minute Series Topographic Map, Hilo Quadrangle

Section 2 Methods

2.1 Document Review

2.2 Field Methods

The fieldwork component of the FI&LR was carried out under archaeological permit number 12-04, issued by the SHPD/DLNR per HAR Chapter 13-282. The field inspection was conducted on October 25, by Olivier M. Bautista, B.A., and Johnny Dudoit B.A. under the general supervision of principal investigator Hallett H. Hammatt, Ph.D. All accessible portions of the property (outside buildings) were surveyed on foot and photographs were taken.

In general, the purpose of the field inspection was to develop data on the nature, density, and distribution of archaeological sites within the project area, and also to develop information on the degree of difficulty that vegetation and terrain create for future archaeological studies. The field inspection consisted of a walk-through reconnaissance of the project area. The spacing between the archaeologists was generally 5-10 m.

In consultation with the SHPD on an earlier (November 2012) draft of this study it was agreed to carry out a test excavation to further inform the project regarding the potential for subsurface resources. The excavation reported here was carried out by Ollie Bautista, B.A. and Johnny Dudoit, B.A. under the overall guidance of Hallett Hammatt Ph.D on January 17 2013. The excavation took an additional two person days to complete.

2.3 Document Review

Background research for this report includes: a review of previous archaeological studies on file at the SHPD; a review of documents at Hamilton Library of the University of Hawai‘i-Mānoa, the Hawai‘i State Archives, the Hawai‘i Public Library, the Archives of the Bernice Pauahi Bishop Museum (BPBM), Lyman Memorial Museum Archives, and the Hilo High School Library; a study of historic photographs at the Hawai‘i State Archives and the Archives of the BPBM and several online sources. Research included a study of historic maps at the Survey Office of the DLNR. Historic maps and photographs from the CSH library were also consulted. In addition, Māhele records were examined from the Waihona ‘Āina (2012) database. This research provided the environmental, cultural, historic, and archaeological background for the study area to formulate a predictive model regarding the expected types and locations of cultural resources in the project area.

Section 3 Background Research

3.1 Mythological and Legendary Accounts

3.1.1 Place Names in Pu‘u‘eo Ahupua‘a

Place names mentioned in this section are a compilation from several sources. The main source is Lloyd Soehren’s (2012) excellent place name database at the internet site Ulukau.com. Soehren has compiled lists of place names for each *ahupua‘a* in Hawai‘i, based mainly on mid-nineteenth century land documents, such as Māhele LCA testimony and Boundary Commission documents. Soehren includes place name meanings from Pukui et al.’s (1974) *Place Names of Hawai‘i.* When no meaning is given from this definitive place name text, Soehren presents possible meanings from Pukui and Elbert’s (1986) *Hawaiian Dictionary* (source listed as Soehren 2012 in the following Table 1). The information from the Ulukau database is presented in Table 1, along with additional information on place names and their meanings from other texts (Hawaii Boundary Commission 1864-1935; BPBM n.d. Hawaiian Ethnological Notes (HEN); ‘Ī‘ī 1959; Stokes and Dye 1991; Thrum 1907, 1922) and from historic maps (U.S. Geological Survey 1963; Baldwin 1891).

Pu‘u‘eo Ahupua‘a in on the northwest shore of Hilo Bay, bound by the *ahupua‘a* of Pi‘ihonua Ahupua‘a on the south and Kalalau Ahupua‘a on the north. It does not extend into the mountainous area, but is “cut-off” by the *ahupua‘a* of Pi‘ihonua on the south and ‘Alae Ahupua‘a on the north. The relationship of these four *ahupua‘a* is shown on an 1880 map (Figure 6), and several of the place names near the Wailuku River mouth are shown on an 1891 map of Hilo town (Figure 7).

Generally Pu‘u‘eo is separated from Pi‘ihonua Ahupua‘a by the Wailuku Stream or one of its tributaries. From the coastal point, called Makaolanakila, on the ocean, the Wailuku River is the boundary. Heading upstream, one would pass Piliamo‘o Point, Kolopulepule Estuary, Make Falls, Kalepeamoa Point, and the large river island once called Koloiki, or called Reed’s Island in the historic period. Past Reed’s Island are two waterfalls within the Wailuku River, Waiānuenue (Rainbow Falls) and Kaimukanaka Falls. Above the last falls, the boundary changes to a tributary stream, called Waiau at the lower end and ‘Āwehi at the upper end. It passes Kulaniapia and Lelekoa‘e waterfalls, and a place called Papakōlea. The ahupua‘a boundary ends at Waihīloa Falls at an elevation of 2270 ft, where Pi‘ihonua Ahupua‘a “cuts off” the end of Pu‘u‘eo Ahupua‘a. The *mauka* boundary of the *ahupua‘a* is an arbitrary line from Waihīloa Falls north to two points called Namahana and Nāhuina, where the boundary line meets the *mauka* corner of ‘Alae Ahupua‘a. The boundary then follows the Pūkīhae Stream back to the ocean; this stream is the boundary between Pu‘u‘eo and Kalalau Ahupua‘a to the north. Table 1 also lists 12 *‘ili* (small land divisions) mentioned in Māhele testimony, several small streams shown on maps, and some *wahi pana*, or legendary places, discussed in the next section of this report.

Table 1. Pu‘u‘eo Place Names

Place Name	Meaning (Source)	Text/Map Source
Pu‘u‘eo Ahupua‘a	victory hill (Soehren 2012); victor hill (Thrum 1922:669)	Not named in Māhele Book. Sold by Government. (Soehren 2012)
Ha‘alo‘u ‘Ili	to bend over, as a heavy branch; to droop, as in sorrow (Soehren 2012)	LCA testimony
Ho‘oke‘o ‘Ili	to whiten, bleach (Soehren 2012)	LCA testimony
Ka‘io‘io ‘Ili		LCA testimony
Kahalauoulu ‘Ili		LCA testimony
Kaneaa ‘Ili		LCA testimony
Keamoali‘i ‘Ili	the burden [of the] chief (Soehren 2012)	LCA testimony
Kinailoa ‘Ili	very persistent (Soehren 2012)	LCA testimony
Makaolanakila ‘Ili		LCA testimony
Nalomalū ‘Ili	furtive fly (Soehren 2012)	LCA testimony
Poupou ‘Ili	stout (Pukui et al. 1974:190); stubby, short (Thrum 1922:667)	LCA testimony
Waimalino ‘Ili	calm water (Soehren 2012); smooth waters (Thrum 1922:673)	LCA testimony
Waipuka ‘Ili	issuing water (Pukui et al. 1974:228).	LCA testimony
Kānoa Heiau	bowl (as for *kava*) (Pukui et al. 1974:85)	"...land of Pu‘ueo, Hilo. Located at the eastern end of Kanoa Street, near the sea cliff. . . . A heiau for human sacrifices. Entirely destroyed" (Stokes and Dye 1991:154). "Kanowa, or Kanoa, Puueo, site of L. Severance's house; of medium size, about 80 x 60 ft., consecrated by Kalaniopuu to his war god; Luupule its priest. Its walls were thrown down prior to 1853, and entirely destroyed for roads in 1898" (Thrum 1907:40).
Kiniakua Heiau	multitude of gods (Soehren 2012)	"...near Waikapū spring. A small heiau of ho‘oūlu ‘ai (agricultural) class, now entirely destroyed" (Stokes and Dye 1991:156).
Kāluakanaka (*pit*)	the human pit (Pukui et al. 1974:179)	"A stone in the Wailuku River, Hilo, that tipped when stepped upon, dropping the stepper into a pit (Ka-lua-kanaka) where he died unless he found the opening that led underground to Moku-ola (Coconut Island)" (Pukui et al. 1974:78, 179).

Place Name	Meaning (Source)	Text/Map Source
Papakāhulihuli (*pōhaku*)	swaying rock (Pukui et al. 1974:179)	A *pōhaku* (stone) in the Wailuku River; see above entry for Kāluakanaka *pōhaku* (Pukui et al. 1974:78, 179)
Papakōlea (*pōhaku*)	plover flats (Pukui et al. 1974:179)	“A bell rock (eho) in the Wailuku river by the old trail, three or four ft from the Puna bank; part of Papakolea is above water” (BPBM HEN I:817).
Pā‘ula (beach, surf)	red enclosure (Pukui et al. 1974:181)	Beach & surfing area east of Wailuku River mouth; place where Queen Liliu‘okalani planted seaweed (Pukui et al. 1974:181; ‘Ī‘ī 1959:134; Baldwin 1891-map)
Ka‘aua Gulch		A dry gulch that enters the Wailuku River opposite Koloiki (Reed's Island). (Baldwin 1891-map)
Kawala Gulch		The Pi‘ihonua/Pu‘u‘eo [‘Alae] boundary runs up ‘Āwehi Gulch “to the junction of Kawala with the Awehi gulch, thence along that gulch to Namahana” (Boundary Commission [BC] Testimony 2: 22, 24).”
Wailuku River	water [of] destruction (Pukui et al. 1974:225)	Rises at 11,080 ft. Boundary between Pi‘ihonua and Pu‘u‘eo below its junction with Waiau Stream (U.S. Geological Survey 1963-map)
Makaolanakila Point		At the mouth of the Wailuku River (Baldwin 1891-map). “Makaolanakila, is on the Puueo side, close to the edge of the water of Wailuku, by a wharf built by Poonahoahoa (Spencer). There sugar was loaded on boats and taken out to ships. Maka-o-Lanakila is a rocky cliff” (BPBM HEN I:817).
Piliamo‘o Point	PEM: cling, as a lizard (Pukui et al. 1974:184)	A cove or small point on the Wailuku River west of Makaolanakila Point (Baldwin 1891-map)
Kolopulepule Estuary	aimless creeping (Pukui et al. 1974:116)	The upper estuary of the Wailuku River, at the head of tidewater below Make Falls (Baldwin 1891-map)
Make Falls	dead (Soehren 2012)	In the Wailuku River (Baldwin 1891-map)
Kalepeamoa Point	the comb [acquired] by [a] chicken (Pukui et al. 1974:76-77)	At the east end of Reed's Island, at the junction of the Wailuku River and Waikapū Stream (Baldwin 1891-map)
Koloiki (Reed's Island)	little crawling (Pukui et al. 1974:116)	(Baldwin 1891-map)
Kioho‘ole Gulch		Rises at 630 ft., enters the Wailuku River at 160 ft. elev. (U.S. Geological Survey map 1963)
Mokupau Stream		Rises at about 1050 ft., enters the Wailuku River at about 375 ft. elev. (U.S. Geological Survey map 1963); junction of Mokupau and Wailuku Stream on boundary with Pi‘ihonua
Waiānuenue (Rainbow Falls)	rainbow [seen in] water (Pukui et al. 1974:221)	At 380 ft. elev. On Wailuku River. “The cave under the falls was said to be the home of Hina, mother of Māui. The Hawaiian name is Wai-ānuenue” (Pukui et al. 1974:208).

Place Name	Meaning (Source)	Text/Map Source
Kaimukanaka Falls	the earth oven [for a] man (Soehren 2012)	Wailuku Stream, at junction of Wailuku and Waiau Streams; Pu‘u‘eo boundary follows northern Waiau Stream; Elev. About 510 ft. on Waiau Stream (U.S. Geological Survey map 1963)
Waiau Stream	swirling water (Pukui et al. 1974:221)	Marks boundary with Pi‘ihonua; Begins at the junction of ‘Aale and ‘Āwehi Streams, elev. 1290 ft., enters the Wailuku River at about 470 ft. elev. At Waiele. The Pi‘ihonua/Pu‘u‘eo boundary follows Waiau Stream, then the ‘Āwehi Stream to above Waihīloa Falls. (U.S. Geological Survey map1963)
Kulaniapia Falls		Elev. 880 ft. on Waiau Stream and on boundary with Pi‘ihonua (U.S. Geological Survey map 1963)
Lelekoa‘e Falls	flight of tropic birds (Pukui et al. 1974:131)	Elev. About 1120 on Waiau Stream and on boundary with Pi‘ihonua (U.S. Geological Survey map 1963)
‘Āwehi Stream	decoration (Thrum 1922:628)	Boundary of Pi‘ihonua and Pu‘u‘eo extends from junction of ‘Āwehi and ‘Aale Streams (tributaries that merge to form Waiau); Rises at about 8470 ft., joins ‘Aale Stream to form Waiau Stream at 1290 ft. elev. The Pi‘ihonua/Pu‘u‘eo boundary follows this stream to the end of Pu‘u‘eo at Waihīloa Falls, elev. about 2270 ft. (U.S. Geological Survey map 1963)
Papakōlea (boundary point)	plover flats (Pukui et al. 1974:179-180)	The Pi‘ihonua/Pu‘u‘eo boundary runs down the center of the ‘Āwehi gulch “to Papakolea, the Amau[u] Plantation water head” (BC Certificate 53:3:90). Between Lelekoa‘e and Waihīloa falls
Waihīloa Falls	high trickling water (Soehren 2012).	The *mauka* corner of Pu‘u‘eo (BC 49; 3:66; BC Testimony 2:24, 25, 286). Elev. 2270 ft. on ‘Āwehi Stream (U.S. Geological Survey map 1963)
Namahana (boundary point)	pair of things (Thrum 1922:661)	The Pi‘ihonua/Pu‘u‘eo [Alae] boundary runs up the Kawala gulch to Namahana, “thence across land to Nahuina the mauka corner of Alae” (BC Testimony 53:2:24).
Nāhuina (boundary point)	the junction (Soehren 2012).	The Pi‘ihonua/Pu‘u‘eo [Alae] boundary runs from Namahana “across land to Nahuina, the mauka corner of Alae and where the Puueo and Alae roads join close to Honolii gulch” (BC Testimony 2:25,162).
Pūkīhae Stream	inspiration conch (Thrum 1922:668)	Rises at about 2230 ft. elev., flows to sea. Boundary between Pu‘u‘eo and Kalalau “...the water in said gulch belonging to the land of Puueo” (BC Certificate 48). (Baldwin 1891-map; U.S. Geological Survey map 1963)

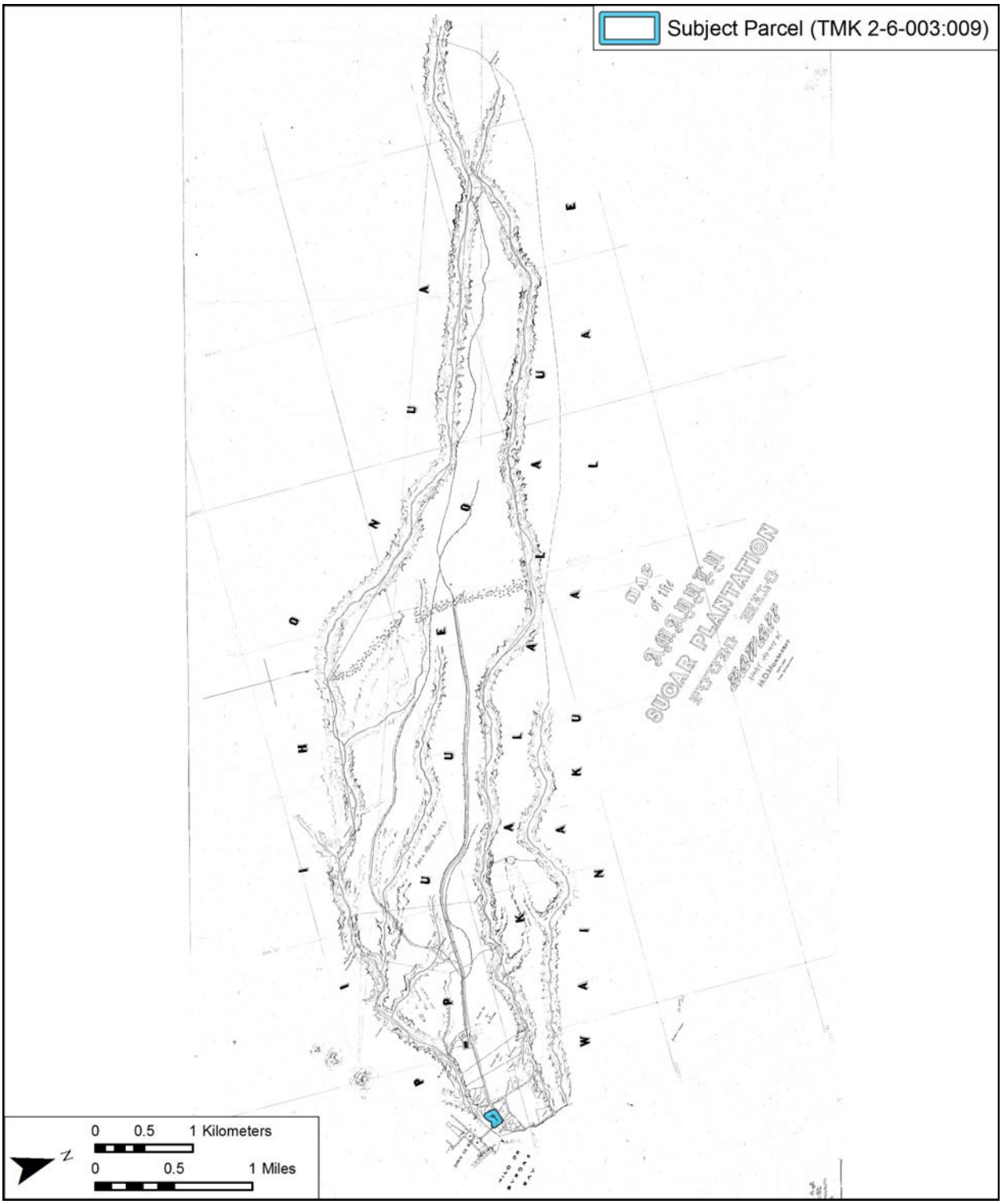

Figure 6. 1880 map of the Amau‘ulu Plantation (Monsarrat 1880), showing boundary of Pu‘u‘eo Ahupua‘a, with Pi‘ihonua to the south, and Kalalalau and ‘Alae to the north (Hawai‘i Land Survey Division, Registered Map No. 812 and 917)

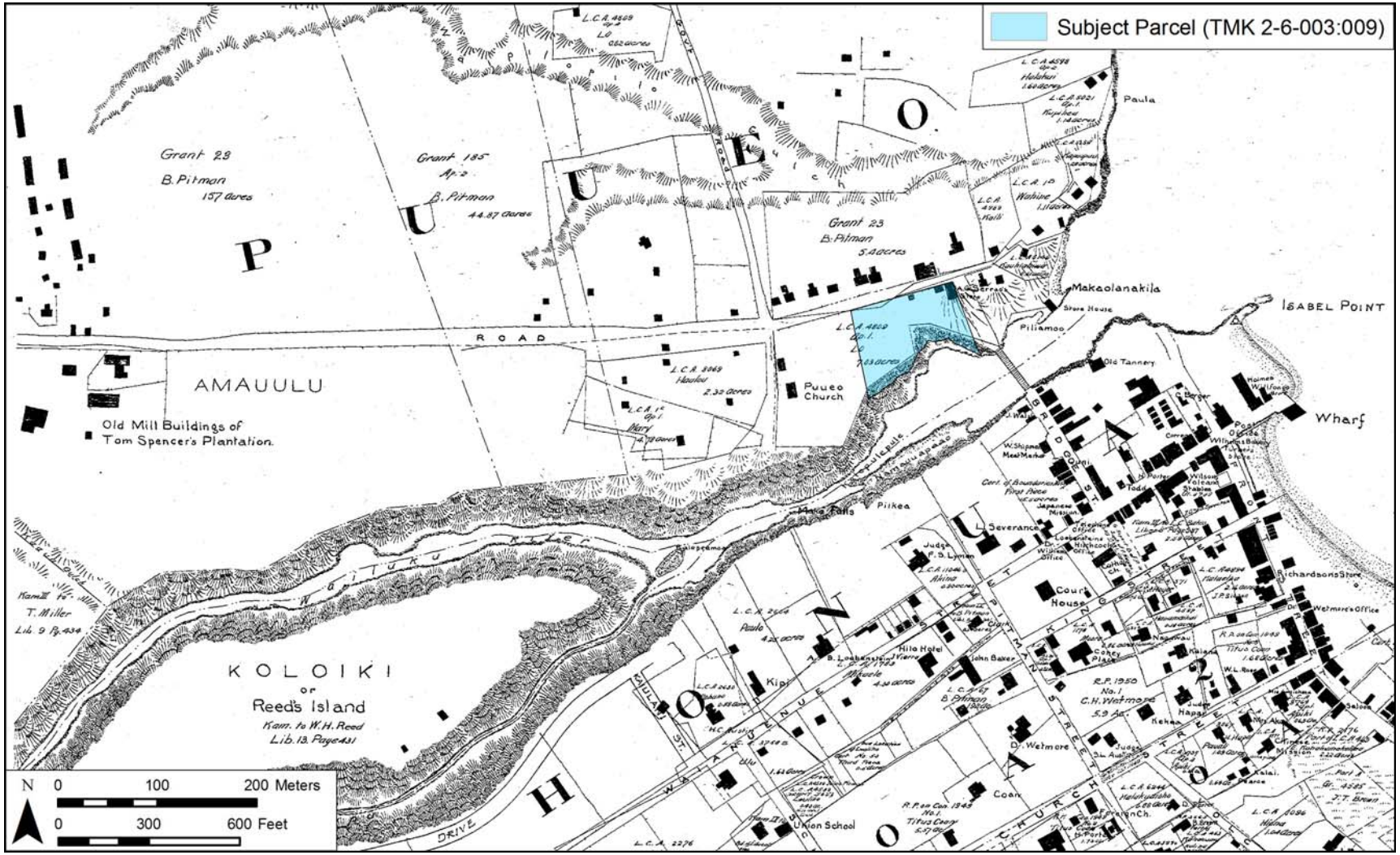

Figure 7. 1891 map of Hilo Town (Baldwin 1891), showing LCA parcels and Land Grants near the project area; note: place names at the Wailuku River mouth near the project area, including Makaolanakila Point, Piliamo‘o Point, Kalopulepule, Kalepeamoa, and Kaloiki (Reed’s Island) (Hawai‘i Land Survey Division, Registered Map 1561)

3.1.2 Waves, Winds and Rains of Pu‘u‘eo

A famous beach and surfing spot, called Pā‘ula was on the east side of the Wailuku River mouth in Pu‘u‘eo. John Papa ‘Ī‘ī (1963:134) briefly mentions it in a list of the surfing spots of Hilo. It is used as a poetic phrase in several writings in early Hawaiian language newspapers, as compiled in John Clark's (2011) book *Hawaiian Surfing*.

> *Ke hoi nei ko Kaipalaoa keiki, ua hai ka nalu o* ***Paula****.*
> (*Ke Au Okoa,* June 12, 1865:4)
> Kaipalaoa‘s son is going home. The waves at **Pā‘ula** have broken.
> (English translation in Clark 2011:110)
>
> *Mai ka nalu nehe i ka iliili o* ***Paula****.*
> (*Ko Hawaii Pae Aina*, Apr. 12, 1879:4)
> From the waves that rustle the pebbles at **Pā‘ula**.
> (English translation in Clark 2011:11)

No Waiakea ke aloha la,	My beloved one is from Waiākea,
I ka ulu au nui makai la.	In the strong Uluau wind near the sea,
I ka nalu hai o ***Paula la****.*	In the breaking waves of **Pā‘ula**.

(*Ka Hoku o ka Pakipika,* Mar. 13, 1862:4, English translation from Clark 2011:110)

The first poem also mentions Kaipalaoa, the coastal point that divides the *ahupua‘a* of Pi‘ihonua on the south with Pu‘u‘eo. The third poem mentions the wind called Uluau, which is associated with Hilopalikū. Pukui et al. (1974:46) note there were three traditional areas of Hilo, Hilo-one (sand Hilo), the coastal area, Hilo-Hanakahi, the inland area, and Hilopalikū (Hilo of the upright cliffs). Soehren (2012) identifies this place name as a possible reference to Pu‘u‘eo and the areas of Hilo north of the Wailuku River.

In the story of the wind gourd of La‘amaomao, Kūapāka‘a, can release any wind from the gourd with its name. To prove he knows the winds, he recites all the wind names of Hawai‘i. From the end of the district of Ka‘ū, through Hilo, and to beginning of the district of Hāmākua, the winds are:

> Uahipele is of Kīlauea, [Kīlauea Crater in Ka‘u District]
> ‘Awa is of Leleiwi, [coastal point in Waiākea Ahupua‘a, Hilo District]
> Pu‘ulena is of Waiakea, [Waiākea Ahupua‘a, Hilo District]
> Uluau is of Hilo-pali-kū, [Hilo District]
> Koholālele is of Hāmākua, [Hāmākua District]
> Nakuina (1992:49)

There are no specific rains associated with Pu‘u‘eo, but a noted mist-like rain of the Hilo District was Kanilehua, the rain that *lehua* flowers drink (Pukui and Elbert 1986:129). This led to several famous *‘ōlelo no‘eau* (poetical) saying related to this rain:

> *Hilo Hanakai, i ka ua Kani-lehua.*
> Hilo [land of] chief Hanakahi and of the rain that gives drink to *lehua* flowers.
> (Pukui and Elbert 1986:129)

Hilo i ka ua Kani-lehua.
Hilo of the Kanilehua rain.
The Kanilehua rain, or the rain that patters in the *lehua* forest, is frequently referred to in the chants and songs of Hilo (Pukui 1983:107).

Ka ua Kanilehua o Hilo
The Kanilihua rain of Hilo.
Hilo. Where the rain moistens the *lehua* blossoms (Pukui 1983:168).

Two other *‘ōlelo no‘eau* refer to Pu‘u‘eo specifically.

Le‘a ka ‘ai ka ‘iole, ua nui ka‘ili.
The rats joyously eat their fill, there are many skins [remaining.]
(Pukui 1983:212)

This phrase is often used to refer to people who are more generous with outsiders than with their own family. It is based on a story of two brothers, a wealthy one who lived in Kukuau Ahupua‘u, and a poor one who lived in Pu‘u‘eo. One day the poor brother went to Kukuau and saw that his brother was hosting a lavish feast for his friends. When the brother bitterly spoke about the feast, he was overheard. The remark was repeated for the host, and the Kukuau brother realized that he had neglected his own family (Pukui 1983:212).

The second *‘ōlelo no‘eau* concerns a place called Ha‘akua, which Pukui identified as a place under the Pu‘u‘eo side of the Wailuku River bridge.

Piha‘ōpala ke one o Ha‘akua.
The sand of Ha‘akua is filled with rubbish.
Said of one who is untidy, or who talks nonsense . . . .
(Pukui 1983:289)

3.1.3 The Wailuku River

The Wailuku River is the most substantial waterway within Pu‘u‘eo Ahupua‘a. This perennial stream is an integral part of the Hilo Watershed system. In times of heavy rain this river becomes a raging, destructive force, hence its name: Wailuku literally means “water of destruction,” (Pukui et al. 1974:225). This river is the basis of the most well-known mythologies associated with Pu‘u‘eo Ahupua‘a.

3.1.3.1 The Battle of the Wailuku River

This legend (Westervelt 1910:99-100, 148-154) recounts the battle between the demi-god Māui and the *mo‘o* (lizard) Kuna. Some of the most widely recognized features along the Wailuku River are said to have been created during this battle.

Hina, the mother of Māui, lived in a cave behind Waiānuenue (Rainbow Falls) on the Wailuku River. Maui and his mother lived on the north side of the river, but a dragon spirit, a *mo‘o,* lived in the pools below the falls. Kuna attacked Hina by throwing rocks and making a dam, so that the water flooded into Hina’s cave. Hina called on her demi-god son for help, and caused a cloud to rise above her home as a signal. Maui leapt into his magic canoe and sailed to

the Wailuku River. A rock formation in the river represents this magic canoe, Ka-Waa- o-Maui, “the canoe of Maui.” Maui swept the dam away with his magic club and created a new channel for the river, so that his mother would not drown. Kuna tried to flee, but Maui chased him down and thrust his magic spear into the waters in a place called Ka-puka-a-Maui, “the door of Maui.” Kuna fled to a series of deep pools, today called the “Boiling Pots”, but Maui flushed him out by pouring a lava flow into the water. Finally Maui killed the *mo‘o* where his body turned into a long black stone in the river called the Mo‘o Kuna.

> As for the deep pool above, though Māui no longer pours in red-hot lava, the waters of the “boiling pots” still bubble and boil as if remembering his mighty battle with Kuna Mo‘o (Pukui and Curtis 1960:40).

3.1.3.2 Hi‘iakaikapoleopele and the Wailuku Bridge

In the legend of Hi‘iakaikapoleopele, favorite sister of the volcano goddess Pele, Hi‘iaka and her companions traveled around Hawai‘i Island, along coastal and inland trails. After saving the chiefess Punahoa at Hilo Bay, Hi‘aka and her companions stopped to ask an old couple if they were on the right trail to Hilo:

> “Yes, follow that trail,” the old people answered. “Soon you will come to the Wailuku River. Two logs make a bridge over the river. But do not cross until you have made offering to the gods who guard the bridge.”
>
> “Gods?” asked Hi‘iaka.
>
> “Yes, two powerful gods live there in a cave. The logs belong to them. When we want to cross we lay food on the logs—vegetable food or fish. If the gods are pleased they hold the logs firm and we cross safely.”
>
> “We have no food,” Hi‘iaka said. “We shall make no offering. What then?”
>
> “Then do not try to cross, for the gods will turn these logs beneath your ft and you will fall into the raging river. You will be dashed to death upon the rocks.”
>
> Hi‘iaka said no more and the three walked on. Soon they came to the river and the bridge of logs.
>
> “Here is Hi‘iaka!” called a voice from a great cave. “She is one of our family—a goddess.”
>
> “She may be one of our family,” said another voice, “but I am hungry. Let her pay to cross. Bring an offering of food, O Hi‘iaka. Make offering to the gods for a safe crossing.”
>
> “Gods!” shouted Hi‘iaka angrily. “You are no gods! We have no food for you!”
>
> By this time people had gathered on each side of the river. “They are indeed gods!” these people cried. “We never try to cross without making an offering.”
>
> “I’ll show you they are no gods!” shouted Hi‘iaka as she whirled her *pā‘ū* [woman’s skirt]. The people saw two frightened figures rushing away to hide in a cave far up the river. Hi‘iaka followed them and the two dashed out to find

> another hiding place. The *pā‘ū* of the goddess flashed and the figures were turned to stone.
>
> Hi‘iaka returned to the people. “The crossing is safe,” she said.
>
> Thankfully people followed the three companions into the village. They set food before them and hung sweet smelling *lei* about their necks. “We have long feared those evil ones,” they said. “Now you have given us safe crossing,” (Pukui and Curtis 1949:42-43).

In another version of this *mo‘olelo*, Hi‘iaka meets several people whose names are the same as the places through which she is travelling. She meets the chiefess Punahoa (Punahoa Ahupua‘a) surfing in Hilo Bay and then two gamblers, named Pi‘ihonua and Pu‘u‘eo (names of the *ahupua‘a* on each side of the Wailuku Stream). Climbing into the Hilo uplands, she looks down Wailuku Stream and sees the *mo‘o*, or guardian spirits, of the stream. These are Kuāua and Piliamo‘o. Piliamoo is the name of a small promontory near the mouth of Wailuku Stream. They demand an offering of food, fish, or *kapa* before Hi‘iaka can cross the footbridge made of a fallen tree that spans the stream. Hi‘aka refuses and Piliamo‘o shoots her tongue up the ravine and knocks down the bridge. Hi‘iaka guides her companions over the log, now in the water, rebuffing every violent effort of the *mo‘o* to dislodge the group. Once they have crossed, Hi‘iaka turns the two *mo‘o* into stones in Wailuku Stream (Ho‘oulumāhiehie 2006:85-89).

In the section of the Wailuku Stream that borders Pu‘u‘eo there are also several named *pōhak*u (rocks). One rock is called a bellstone called Papakōlea (Bishop Museum n.d. HEN :817). The location is not given in the text, but it may be the same as a point called Papakōlea given in the Boundary Commission on the ‘Āwehi Stream, a tributary of the Wailuku River, near the mauka end of Pu‘u‘eo. Another stone in the Wailuku River was called Papakāhulihuli, meaning “swaying rock.” If one stepped on this rock and it tipped, the person would be dropped into a pit called Kaluakanaka, meaning “the human pit,” where he would die unless he found an opening that would leave to Coconut Island in Hilo Bay (Pukui et al. 1974:78, 179).

3.2 Traditional and Historical Accounts

3.2.1 Settlement Patterns for Hilo

The U.S. Army Engineer Division contracted for an archaeological and historical literature search as part of the Lava Flow Control Study for Hilo, Hawai‘i (McEldowney 1979). The search included *ahupua‘a* in the Hilo and Puna districts. Relevant to the present project are the geographic and ecological zone classifications for early historic-period land use, which are presented in the report. These five zone classifications (McEldowney 1979:64) are listed below:

I:	Coastal Settlement	20-50 ft in elevation
II:	Upland Agricultural	50-1,500 ft in elevation
III:	Lower Forest	1,500-2,500 ft in elevation
IV:	Rainforest	2,599-5,500 ft in elevation
V:	Subalpine/ Montane	Over 5,500 ft in elevation

The coastal settlement zone contained both temporary and permanent habitations, with associated garden plots. The gardens were bordered by banana plants, sugarcane and *wauke.* Dry

land taro, sweet potatoes, and other vegetables were grown within the gardens. Groves of breadfruit and coconuts were interspersed between the houses and the gardens. Wetland taro was grown along the streams, along the coastal fishponds, and in the swampy land near the coast. The upland agricultural zone contained scattered agricultural features and some temporary residences. The main cultivated plants were dry land taro and bananas, with groves of *kukui*, *pandanus*, and mountain apples. The current project area is entirely within the coastal settlement zone.

The lower forest was used to gather resources such as wood, bird feathers, fiber, and some food crops. The upland rainforest was used mainly by bird catchers to collect feathers and to gather other resources not available at the lower elevations. In the post-Contact era, the forest areas were also used for the collection of resources that could be sold as trade items to foreigners, such as sandalwood and *pulu. Pulu* is the soft substance at the base of *hāpu‘u* ferns, which was shipped to California to be used for furniture and mattress stuffing (Baxley 1865:596). In the sub-alpine zone, trails from one district to another are the major features.

The settlement pattern of the South Hilo area is best summed by Handy and Handy (1972) in their study on the traditional agricultural patterns of the Hawaiians.

> The population of Hilo was anciently as now concentrated mostly around and out from Hilo Bay, which is still the island’s principal port. . . . In lava-strewn South Hilo there were no streams whose valleys or banks were capable of being developed in terraces, but [taro] cuttings were stuck into the ground on the shores and islets for many miles along the course of the Wailuku River far up into the forest zone. . . . on the lava–strewn plain of Waiakea and the slopes between Waiakea and the Wailuku River, dry taro was formerly planted wherever there was enough soil. (Handy and Handy 1972:538-539)

3.2.2 Pre-Contact and Early Post-Contact History

In the pre-Contact period, the area around Hilo Bay was densely inhabited. Ross Cordy (2000:45) describes the settlement pattern of this area:

> Here [Hilo Bay] houses and heiau were concentrated in clusters near the sandy shore amidst groves of breadfruit, bananas and coconuts, and houses were also scattered inland for 3-6 miles. Dryland fields of kalo [taro] and sweet potatoes were around these houses and extended slightly farther inland. Kipikipi wet kalo fields and fishponds were along the Waimoa and Wailoa streams near the coastal houses.

Handy (1940:125) describes the *kanu kipi, a* Hilo name for mound taro patches (Pukui and Elbert 1986:143) method as planting taro on mounds (*kipi*) built on the bottom of the marshy lands along Hilo Bay. Handy also notes that dry taro was planted along the fern-forest zone in the uplands above the bay.

The districts of Hilo and Hāmākua were once ruled by the descendants of paramount chief ‘Umi, who ruled from about A.D. 1600-1620 (Cordy 2000:464). When he visited the Hilo area he married the daughter of Kulukuʻua, chief of Hilo. When he saw her, she wore a *palaoa* pendant made of *wiliwili*, rather than whale ivory, the preferred material used by the *ali‘i* for

these ornaments. ‘Umi broke the *wiliwili palaoa*, and the Hilo chief demanded that he replace it with his own ivory *palaoa*. Kulukuʻua bound ‘Umi and two of his friends, and allowed one man to return to Waipiʻo Valley to bring back the pendant. The chief swore that if the man did not return with the *palaoa* in one day, the three captives would be sacrificed at the *heiau* of Kānoa in **Puʻuʻeo.** The ivory *palaoa* was brought back and given to the Hilo wife of ‘Umi, but he was sad to have lost the pendant to the Hilo chiefs (Fornander 1917:222).

After being held captive by his father-in-law in Hilo:

> . . . ‘Umi and his companions returned to Hamakua and went down to Waipiʻo. There he conferred with his chiefs and his father’s old war leaders. It was decided to make war on the chiefs of Hilo and to go without delay by way of Mauna Kea. From back of Kaʻumana they were to descend to Hilo. It was shorter to go by way of the mountain to the trail of Poliʻau and Poliʻahu’s spring at the top of Mauna Kea, and then down toward Hilo. It was an ancient trail used by those of Hamakua, Kohala, and Waimea to go to Hilo. They made ready to go with their fighting parties to Mauna Kea, descended back of Hilo, and encamped just above the stream of Waianuenue without the knowledge of Hilo’s people that war was coming from the upland. Hilo’s chiefs were unprepared.
>
> A certain fisherman of **Puʻueo** was at sea, catching nehu fish, and he noticed that the water in the ocean was dirty. He was surprised and guessed that there was war in the mountain, and it was that which caused the water to be so dirty. . . . He did not stop to dry his nets, but cooked taro and some nehu fish, picked up his war spear, draped his cape of ti leaves over his back, and departed for the upland. The name of this man was Nau.
>
> When Nau arrived away up in the upland of Kaʻumana, he remained at a narrow pass, and the other side of it was the camp [of ‘Umi]. He sat on a flat stone beside the stream and after opening his bundle of nehu fish, ate some with the cooked taro (kuala). . . The spot in which he sat was comfortable and was in a depression. When someone on the other side reached out to go through, he was stabbed with a spear and fell over the cliff, dead. (Kamakau 1992:16, 17)

Nau kept the invading force at bay, killing forty men, but at last one of ‘Umi’s warriors jumped over the cliff and killed the fishermen. There was no one to warn the people of Hilo about the invading army, and ‘Umi’s men were able to surround the chief’s house and destroy the chief and his men. Fornander (1917:224) gives a similar account of the invasion, and notes that Nau was using a large net at the *hee-nehu* fishing grounds; *hee-nehu* are a type of small anchovy, *Anchovia purpurea*.

Many notable chiefs lived near Hilo Bay, including the chief Keawe-hano, who lived in Punahoa when Kahekili ruled Maui and Kahahana (1773-1785) ruled Oʻahu (Cordy 2002:19). There was one warrior who was loyal to both chiefs named Kapohu. Kahekili had built a chief’s house on Maui; only chiefs that paid their taxes in feather capes and bird feathers could enter this house. To gain the favor of the Maui king, Kapohu and his friend, Kaʻakakai, traveled to Hawaiʻi to obtain bird feathers. They landed at Kohala, and then split, one traveling around the island by way of Hāmākua and one by way of ‘Ōlaʻa in Puna. Kaʻakakai reached the Hilo area first and

made friends with the Hilo chief Keawehano, living at the beach of Punahoa, opposite the surfing areas of Huia in Pi‘ihonua and Hikanui at Punahoa (Kamakau 1992:130). When Kapohu reached Punahoa, he saw the chief and his friend sitting outside a house, each wearing a feather helmet, necklace, and feather cape. Kapohu chanted to the chief, and the chief asked him to enter, to the dismay of his friend, Ka‘akakai (Kamakau 1992:129-131). While entering, Kapohu chanted:

A Kahuku i Ola‘a	From Kahuku to Ola‘a [I have traveled],
Ka uka i Pana‘ewa,	To the uplands of Pana‘ewa
Ka uka o Haili,	To the uplands of Haili
Kapili manu e,	To catch birds with lime,
Kawili manu e,	To catch birds with snares,
Kololio manu e,	To catch birds with lines,
Wiliwili manu e,	To twist the necks of birds,
O ka hulu o ka manu,	For their feathers,
‘Ahu‘ula mai no,	[Give me] a feather cape,
Mahiloe mai no.	[Give me] a feather helmet,
Hulikua mai no.	[Give me] a feather necklace.

[Original Hawaiian text from *Ka Nupepa Ku‘oko‘a,* Mar. 16, 1867; translation in Kamakau 1992:131)

> To these words Keawe-hano responded, “Here is your feather necklace, here is your feather helmet, but the cape you two shall share!” No sooner had he uttered the word share (*mahele*) than Ka-pohu reached for a corner of the feather cape that Ka-‘akakai was wearing and drew it over his own shoulders, leaving Ka-‘akakai without any. (Kamakau 1992:131)

Early Hawaiian scholars began collecting and writing about Hawai‘i’s history in the mid 1800s. John Papa ‘Ī‘ī describes events that occurred in the Hilo region during the life of Kamehameha I:

> Alapai, ruler of Hawaii [from 1730-1754] and great uncle of Kamehameha, and his wife Keaka took charge of him [Kamehameha]. Some years later, Alapai and his chiefs went to Waiolama in Hilo, where Keoua Kupuapaikalani, the father of Kamehameha, was taken sick and died. Before Keoua died he sent for Kalaniopuu, his older half brother and the chief of Kau, to come and see him. Keoua told Kalaniopuu that he would prosper through Kamehameha’s great strength and asked him to take care of the youth, who would have no father to care for him. Keoua warned Kalaniopuu, saying, “Take heed, for Alapai has no regard for you or me, whom he has reared.” After this conversation, Keoua allowed his brother to go, and Kalaniopuu left that night for Puaaloa [situated in the *ahupua‘a* of Waiākea, in the area called Pana‘ewa].
>
> As Kalaniopuu neared Kalanakamaa [in Waiākea], he heard the death wails for Keoua and hastened on toward Kalepolepo [between Mohouli and Kāwili] where he had left his warriors. There they were attacked by Alapai’s men, who had followed Kalaniopuu from Hilo. First the warriors from the lowland gained, then

> those from the upland . . . Kalaniopuu continued his journey, and at midnight reached Puaaloa, where he arranged for the coming battle. The next day all went as he had planned; his forward armies led the enemy into the forest of Paieie, where there was only a narrow trail, branchy on either side and full of undergrowth. There his men in ambush arose up against the enemy warriors, and his rear armies closed in behind them . . .
>
> When news reached Alapai that his warriors had been destroyed, he sent another company of warriors to meet Kalaniopuu at Mokaulele on the outer road, which was an ancient road, known from the time of remote antiquity. (Ī‘ī 1959:3-4)

According to Kelly et al. (1981:3), the lands fronting Hilo were portioned off into named land sections, consisting of the *ahupua‘a* of Pu‘u‘eo, Pi‘ihonua, Punahoa, Ponahawai, Kūkūau and Waiākea, although it is not known when or by what chief. It is assumed that this had been accomplished by the late sixteenth or early seventeenth century.

Samuel Kamakau recorded the events occurring in Hilo during the life of Kamehameha I, and he identified the location of the death of Keōua, father of Kamehameha:

> . . . Keoua, called Ka-lani-kupu-a-pa-i-ka-lani-nui, fell ill of a lingering sickness at Pi‘opi‘o [the site of the present Kamehameha Statue in Hilo] . . . adjoining Wailoa in Waiakea and died there in 1752. . . . His older brother Ka-lani-opuu was with his kahu [guardian-attendant] Pua, above Kalepolepo at the time. (Kamakau 1992:75)

Following the death of Kalani‘ōpu‘u in 1782, the island of Hawai‘i was to be ruled by Kīwala‘ō, Kalani‘ōpu‘u’s son. The god Kūka‘ilimoku was given to Kamehameha I. Disagreement arose about the division and redistribution of land in the Hilo District. The *ahupua‘a* of Waiākea and Ponahawai were among the contested lands:

> Keoua Kuahu-‘ula heard that the land was being divided. He was a twin son of Ka-lani-‘opu‘u, his twin brother being Keoua Pe‘e-‘ale. The beautiful chiefess Kane-kapo-lei was their mother. Keoua was a handsome man, tall and broad of body, with fine features: a distinguished looking figure with strands of hair so long that they hung down his back. That day about nine o’clock he came to the ruling chief, Kiwala‘o, and said, “Are Ola‘a and Kea‘au ours?” The chief answered, “They have been given away; they are not ours.” “How about Waiakea and Ponahawai?” “They have been given away; they are not ours.” (Kamakau 1992: 119-120)

After the death of Kīwala‘ō, the island of Hawai‘i was controlled by three chiefs: Keawema‘uhili, controlled Hilo and Hāmākua; Kēoua-kū‘ahu‘ula, controlled and resided in Ka‘ū; and Kamehameha controlled Kohala and Kona. Kēoua divided the lands of Hilo District between his chiefs and warriors, and “the fat Mullet of Waiakea and Pi‘opi‘o became theirs” (Kamakau 1992:152).

Keawema‘uhili ruled out of Hilo Bay as chief of the Hilo District, dating back to the reign of his brother Kalani‘ōpu‘u. It is likely that the center of rule was at Waiākea Ahupua‘a in Hilo

Bay. It was probably the same center of court used by previous rulers and by Kamehameha after unification of the island in 1791.

Once Kamehameha had full control of Hawai‘i Island, Kamehameha planned to invade the neighboring islands. Kelly et al. (1981:8) believes that ". . . An important part of his preparation was the building of war canoes, and for this Hilo seems to have become his headquarters for considerable periods of time."

When Captain George Vancouver, in his ships the *Discovery* and the *Chatham*, visited Hawai‘i in 1793, they first met up with Kamehameha at Hilo Bay, as he was at that time residing at Waiākea to preside over the Makahiki festival (Menzies 1920:140-141). In 1795, Kamehameha sailed from Hawai‘i to O‘ahu for further conquests. According to John Papa ‘Ī‘ī (1959:15), Kamehameha had to quickly return to the island of Hawai‘i to quell a rebellion. Namakehā, a Maui Chief living in Ka‘ū, fomented a rebellion amongst the people of Ka‘ū, Puna, and Hilo. In 1796, Kamehameha returned to Hawai‘i and defeated Namakehā in a battle at Kaipalao, (‘Ī‘ī 1959:15-16). Kaipalaoa, which literally means "whale sea" (Pukui et al. 1974:70), was an ancient surfing area in Pi‘ihonua at what is now the base of Waiānuenue Avenue. Namakehā's body was sacrificed by Kamehameha on the *heiau* of Kaipalaoa (Kamakau 1992:174). It has been theorized that the correct name of this *heiau* is "Pinao," (Desha 2000:450). This was the name of the *heiau* where the famous Naha stone was situated. Pinao literally translates as "dragonfly," (Pukui et al. 1974:185).

After Kamehameha's death, the lands of Hilo, which includes Pi‘ihonua, Punahoa, and Waiākea, were given to his son Liholiho (Kamehameha II), heir to the kingdom. When Liholiho was born in 1797, "he was taken to the heiau of Kapailaoa, and the sacred rite of the cutting of his navel cord was performed by the kahuna," (Kamakau 1992:220). The *‘ili kūpono* of Pi‘opi‘o was granted to his most favored wife Ka‘ahumanu. His chief advisors, John Young and Isaac Davis, were given Kūkūau ‘Ekahi and Kūkūau ‘Elua (the *ahupua‘a* adjacent to the southern border of Ponahawai). Another favored wife, Kaheiheimalie, was given the *ahupua‘a* of Pu‘u‘eo. Ponahawai Ahupua‘a, Kamehameha gave to his warrior chief Keawe-a-heulu (Kelly et al. 1981:11).

3.2.3 Missionary Accounts of Hilo

In April 1822, members of the London Missionary Society came to Hawai‘i via Tahiti, among them a Tahitian convert named Auna. He was the first missionary to preach in Hilo (Kelly et al. 1981:26). The delegates from the society were hosted by Queen Ka‘ahumanu and her husband Kaumuali‘i, who were making a tour of the islands. The delegates landed in Hilo Bay on May 28, 1822. Auna recorded in his diary the following observation of Hilo.

> Tues. 28th . . . we went on shore at a place called Nukukamanau [Ka-nuku-o-ka-manu], by the side of a very large and rapid stream of water. The place appeared well covered with trees and there was a great deal of taro under cultivation. The houses were thick, and the people very many. (Auna cited in Kelly et al. 1981:27)

The Reverend Ellis, with three American missionaries, returned to Hilo in July and August of 1823 during a walking/canoe tour of the island. Ellis' party was in Hilo for five days in August, staying in a house at Waiākea provided for them by the *konohiki,* Ma‘alo. They preached at

Waiākea, Ponahawai, and Pu‘u‘eo to more or less responsive audiences (Ellis 1826: 282-313). In Waiākea at the east end of Hilo Bay, Rev. Ellis recorded his impressions of South Hilo:

> The face of the country in the vicinity of Waiakea is the most beautiful we have yet seen . . .
>
> The light and fertile soil is formed by decomposed lava, with a considerable portion of vegetable mould. The whole is covered with luxuriant vegetation, and the greater part of it formed into plantations, where plantains, bananas, sugar-cane, taro, potatoes, and melons, grow to the greatest perfection. . . .
>
> We thought the people generally industrious; for in several of the less fertile parts of the district we saw small pieces of lava thrown up in heaps, and potato vines growing very well in the midst of them, though we could scarcely perceive a particle of soil. (Ellis 1826:310-311)

The pioneer company of missionaries, sponsored by the American Board of Commissioners for Foreign Missions in New England, arrived in Hawai‘i in 1820 aboard the Brig *Thaddeus*. With the consent of Liholiho (Kamehameha II) and his chiefs, a missionary couple from the first company of missionaries, Samuel and Nancy Ruggles, and Joseph and Martha Goodrich, a couple from the second company of missionaries, which arrived in the island in 1823, were allowed to set up a new mission in Hilo on the island of Hawai‘i. Hiram Bingham, pastor of Kawaiaha‘o Church in Honolulu relates the first days of this new mission:

> . . . the mission took a station there [Hilo] in the early part of 1824. To accomplish this at some sacrifice, Mr. and Mrs. Ruggles, freely leaving Kauai, where they had happily labored three years, and Mr. and Mrs. Goodrich, of the reinforcement, were associated and employed to commence the new station at Waiākea, central for the large districts of Hilo and Puna, which extend along the seaboard about eighty miles. They embarked from Honolulu about the middle of January, on board the schooner *Waterwitch*, a vessel of thirty tons, owned by J. Hunnewell, Esq., who kindly volunteered to accompany them, and navigate the vessel for them. They were accompanied by Dr. and Mrs. Blatchley, for a temporary stay, by Messrs. Ellis and Chamberlain, on a missionary excursion, and Mr. and Mrs. Ely, bound to Kona. . . .
>
> They anchored in Hilo bay about sun-set, and landed before dark with a few necessary articles. They at once prepared their lodging in a large thatched building, seventy ft by thirty, designed as a shelter for canoes, timber, and other articles, and, by order of the chiefs at Oahu, appropriated to their use. It was without floor, partitions, or windows; and though the canoes were removed, a large pile of long timber still occupied the central part of the building, near the rude posts that supported the ridge-pole. . . .
>
> The next day, the duties of preaching and public worship engaged their attention. To favor this, Kaahumanu had offered the use of another building of similar structure. It was well filled by the people and missionary company, to whom Mr. Ellis preached. In the midst of the service, a large pet hog, black and fat, asserting equal or superior right to occupancy, marched in, swinging her head armed with

> huge tusks. The native crowd, not daring to resist her, gave way, forcing the preacher and his friends from their position. The murmurs of surprise and apprehension among the natives rose to boisterous shouting, and the congregation, retreating through the great doors at each end, left the hall of audience to the persecuting beast, whose rights were regarded, by high and low, as superior to those of the people, having been tabued, and often fed from the mouth of a native. Her feeder, more bold or skilful than the rest, approached the animal, and by repeated, gentle passes of the fingers on her bristly back, composed her to a sort of mesmeric sleep, more easily than leviathan is tamed. The congregation then resumed their places, and the preacher was allowed to finish his discourse. This hog was a tabu, pet of Queen Kaahumanu, and bore her name. (Bingham 1847:207-208)

The mission did not prosper at first and the natives seemed indifferent to the sermons of Ruggles and Goodrich. This changed in late 1824, when the high chiefess Kapi‘olani came to Hilo to help the missionaries. Mr. Goodrich met her party at the Kīlauea Volcano, where Kapi‘olani descended into the crater, defying the priest of Pele. She returned with Goodrich to Hilo and stayed for ten days. After that, the missionaries had greater success in converting the Hawaiians to Christianity (Kamakau 1992:379-385). In 1825, Ka‘ahumanu visited the mission, and gave the land of Punahoa 2 for the use of the mission (Kelly et al. 1981:36). The ownership of this land was confirmed in 1849 during the Māhele and listed as Land Commission Award 387. The missionaries used this land to raise goats and cultivate vegetables so that they could furnish their own food. Goodrich also experimented with making sugar and molasses from sugar cane at his own small mill (Goodrich 1829 cited in Kelly et al. 1981:36).

Other visitors to the mission included Kamehameha III, who visited several times between 1828 and 1830, and Kuakini, governor of Hawai‘i, in 1829. Kuakini helped the missionaries build a church near the coast and helped plan for a saw mill at the forest edge. This saw mill was erected by a group of foreigners who also sold beef, from the wild cattle in the mountains, to the missionaries (Lyman 1970:59).

The Reverend David Beldon Lyman and his wife Sarah Joiner Lyman were members of the Fifth Company of missionaries. They arrived in Hilo, Hawai‘i in 1832 and were stationed at Hilo until their deaths. They were joined in 1835 by Reverend Titus Coan, who converted hundreds of natives during “The Great Revival.” In the 1830s, the Reverend Lyman founded the Hilo Boarding School for Hawaiian Native Boys, which was built about half the way between the coast and the Hāla‘i Hills. Henry Lyman, the son of Reverend David Lyman, remembered the Hilo Boarding School.

> . . . a large thatched building of native construction was erected for the accommodation of the boarding school. Its pupils numbered thirty-five [in 1836] of the brightest Hawaiian boys, chosen from the different primary schools over the whole island. They lived in the big schoolhouse where they were taught by my parents; but their mornings and evenings were spent in manual labor on a little farm nearby, where they raised the vegetables that formed the greater part of their daily food. (Lyman 1906:21-22)

3.2.4 Early Foreign Visitors to Hilo Bay

In 1824, the English ship H.M.S. *Blonde* traveled to Hawai‘i to return the bodies of Liholiho and Kamāmalu, the king and his wife, who had died on a visit to London. On a tour of the islands, the *Blonde* anchored in Hilo Bay, which was then renamed Byron Bay for the ship's commander, Lord Byron. The ship's company stayed at the village of Waiākea for about three weeks. On their departure, Lord Byron noted:

> Byron Bay will, no doubt, become the site of the capital of Hawaii. The fertility of the district of Hido [*sic*] . . .the excellent water and abundant fish-pools which surround it, the easy access it had to the sandal-wood districts, and also to the sulphur, which will doubtless soon become an object of commerce, and the facilities it affords for refitting vessels, render it a place of great importance. (Byron 1826:192-193)

Captain Charles Wilkes, of the U.S. Exploring Expedition, stopped at the Hawaiian Islands between December 9, 1840 and March 5, 1841. One of the goals of this scientific expedition was to ascend to the top of Mauna Loa to observe the volcano. To carry out this goal, they anchored at Hilo Bay, which Wilkes described:

> The scene which the island presents as viewed from the anchorage in Hilo Bay is both novel and splendid: the shores are studded with extensive groves of cocoa-nut and bread-fruit trees, interspersed with plantations of sugar-cane; through them, numerous streams are seen hurrying to the ocean; to these succeeds a belt some miles in width, free from woods, but clothed in verdure; beyond is a wider belt of forest, whose trees, as they rise higher and higher from the sea, change their character from the vegetation of the tropics to that of polar regions; and above all tower the snow-capped summits of the mountains. (Wilkes 1849:143)

3.2.5 Early Foreign Residents and Merchants, 1790-1880

In the late 1700s and early 1800s, ships involved in the trade between the fur outposts of the Northwest coast and the markets of China and the Far East stopped in the Hawaiian Islands to get food, fresh water, salt, and other supplies needed for the long voyage ahead. This limited exchange began to change when sandalwood was discovered on the forest slopes of the islands, in 1790 or earlier (Kuykendall 1938:85). Soon sandalwood became an important export item for the island, gathered by the people for the great chiefs to pay off their debts to foreign traders. Ellis saw one of these early sandalwood expeditions returning from the mountain above Hilo in 1823 under the *konohiki* (overseer for the chief) Ma‘alo. Presumably the sandalwood would have been transferred to a ship anchored off Hilo Bay at Waiākea.

> During the same journey we overtook Maaro, the chief of Waiakea, and three or four hundred people, returning with sandal wood, which they had been cutting in the mountains. Each man carried two or three pieces, from four to six ft long, and about three inches in diameter. . . .
>
> It is sold by weight, and the merchants, who exchange for it articles of European or Chinese manufacture, take it to the Canton market, where it is bought by the

> Chinese for the purpose of preparing incense to burn in their idol temples. (Ellis 1963:214-215)

Supplying foreign ships with food and water continued when whaling ships began to visit the islands. The earliest foreign born merchants of Hilo town were established to cater to this trade. Sometime after the Wilkes expedition in 1838, Henry Lyman was out walking with his father, the missionary David Lyman, and met some interesting early residents of Hilo:

> Here we were welcomed by a short, stout, gray-headed old gentleman, whose kindly features were handsomely set off by an elegant pair of white mutton-chop whiskers. This was Mr. Benjamin P. [Pitman], formerly a resident of Boston, who, years before, left his home to seek a fortune among the merchants of Canton. For some reason, after a time he ceased writing to his family; and his wife, naturally growing anxious, sent their only son, Benjamin, Jr., to find out what had become of his father. Arriving in the Orient, he learned that his parent had gone to the Sandwich Islands; and accordingly he followed him thither. There he discovered the old gentleman, but was unable to dislodge him from the tropical paradise in which he was established. The young man, being only nineteen or twenty years old, also soon yielded to the charm of the place, forgetting the maternal home, and marrying a handsome young Hawaiian princess, who made for him an excellent wife and mother of his children. The father and son, not long before the visit of Commodore Wilkes, opened a little shop for the sale of general merchandise; and having the haole field to themselves were very successful in trade. (Lyman 1906:68-69)

Samuel Hill traveled to Hawai‘i on the whaler *Josephine* in 1848 (Judd 1929:39), and stopped in Hilo to make an expedition to Kīlauea Volcano. On the way back, he noted the landscape on the lower slopes in back of the town. This would have been within the upland agricultural zone.

> . . . it was not until near sunset that we discovered any signs of our approach to the little port of Hilo, when we came suddenly upon a piece of meadow land, on which were feeding several head of cattle, with letters marked upon their skins, which as plainly revealed the fact of their captivity as it assured us of the near termination of our journey. In another half-hour we opened a view of Byron’s bay [Hilo Bay]; after which, we crossed some further meadow land, which brought us to the village of Hilo, seated upon the bay near the shore. The place appeared to consist merely of a few scattered huts, among which it was easy to distinguish the residence of an European; and we rode immediately up to that of Mr. Pitman, to whom I had brought the letter of introduction, and from whom we now met a hearty reception. (Hill 1856:290)

> It [Hilo] consists, at present, of thirty or forty scattered huts, a Protestant church, a small Romish chapel, the dwellings of the missionaries, a school-house, and several houses belonging to Mr. Pitman, by whom all the proper commerce of the place is carried on. (Hill 1856:292)

Benjamin Pitman, Sr. came to Hawai‘i on trading missions in 1826 and 1828, and his son arrived in 1836. Benjamin Pitman, Jr. married the chiefess Kino‘ole-o-Liliha, whose father was

the high chief Ho‘olulu, an uncle of Kamehameha I. She had extensive lands in ‘Ōla‘a 1 and around Hilo (Pitman 1931). In addition to his wife's lands, Pittman purchased several other large tracts from Kamehameha III in 1846 and became the owner of a large area. Some of this land he rented to several Chinese entrepreneurs, who had come to Hilo to set up sugar cane fields and sugar cane mills. The Pitman lands in Pu‘u‘eo can be seen on an 1879 map of Hilo, with the sugar mill on the road extending *mauka* from the project area (Figure 8). Henry Lyman, walking with his father in the late 1830s also met up with these Chinese on the Pitman lands.

> On another day, walking a little farther, we found the new road extended beyond a dense grove of breadfruit trees to a considerable enclosure where a number of thatched houses had been recently erected. Two or three almond-eyed gentlemen, with long braids of hair coiled about their heads, were persuading a yoke of half-tamed oxen to walk in a circle, dragging after them a beam that rotated three vertical wooden rollers, between which a native boy was insinuating slender stalks of sugar-cane drawn from a pile by his side . . . This was the first sugar-mill established on the island of Hawaii. (Lyman 1906:70-71)

Samuel Hill also met noted these early Chinese entrepreneurs on Pitman's estate.

> Mr. PITMAN introduced us, during our stay at Hilo, to a fine estate he had himself planted in the rear of the bay, . . . We found the estate situated upon elevated ground, between one and two miles from the port, commanding a fine view of the bay and the ocean, and in the midst of a country still rising as it recedes from the shore, and comprehending one of the most fertile districts in the island. It produced chiefly sugar as an article of export, at present; but it was in a fair way of adding the profits of a large coffee plantation. (Hill 1856:303)

> Here our attention was arrested by the presence of two of the Chinese who were superintending the works, which led to Mr. Pitman informing us of the plan he had adopted in the management of his estate, and the especial use he was making of the yellow men. . . . upon finding his estate wonderfully thriving under their [the Chinese] management, he had determined to go farther than this, and to give them a direct interest in its prosperity. . . . he let his estate to the same men he had advanced from labourers to be overseers, at a fixed annual rent, from which arrangement he was reaping great benefit. (Hill 1856:305-306)

Among these early Chinese planters was one Ah Kina, who had a 90-acre sugar plantation in Pu‘u‘eo by 1851 (Char and Char 1983:5). Also in the Pu‘u‘eo area, Doong Kwui established a sugar mill in Amau‘ulu in the 1850s and Tong Ah Ping established a general merchandise business in the 1860s-1870s (Char and Char 1983:47). The early appearance of Hilo at this time was of a small village:

> There were few roads beyond the village. Produce from outlying areas was carried in calabashes hung in koko nets (cling nets braided of coconut sennit) hung from carrying poles, or was transported by canoe along the coast. Contact with people and transportation of produce on the north side of the village was further limited by the Wailuku River, which was wide and often turbulent. Even as late as 1865 the river was spanned only by a chain cable bridge. The district

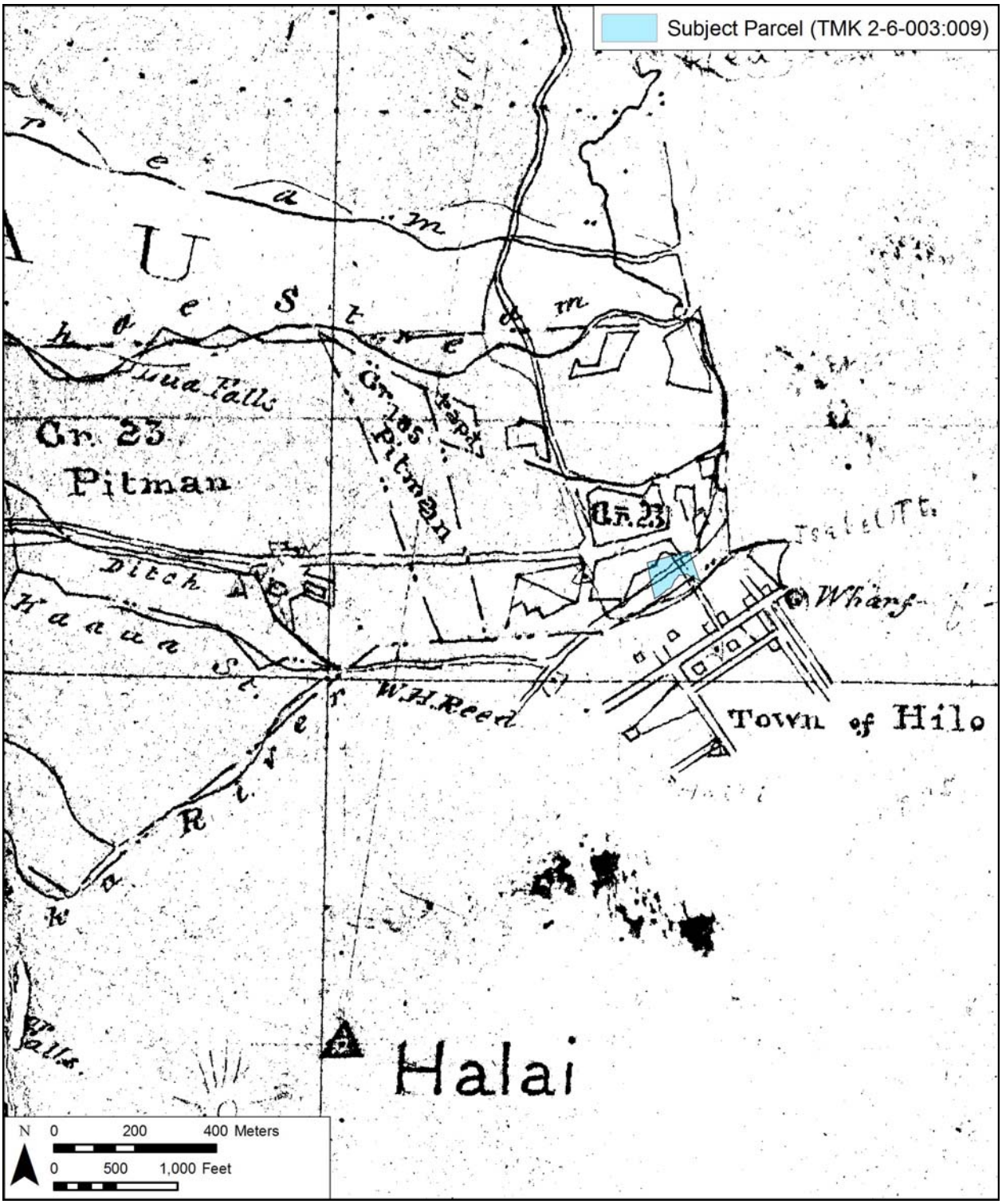

Figure 8. 1879 map of South Hilo (Lyons 1879), showing an early wharf on the south side of the Wailuku River and a bridge crossing the river to Pu‘u‘eo, where Benjamin Pitman owned several large land grants (Hawai‘i Land Survey Division, Registered Map No. 570)

> beyond the river then, as now, offered suitable soil and rainfall for growing sugar cane. (Kai 1974:41)

Early sugar cane mills in the Hilo area were run by several early Chinese “sugar masters” who settled in Hilo and married Hawaiian women. Peggy Kai (1974:45-53) has identified at least seven Chinese men who resided in Hilo before 1852.

Pitman left the islands in 1860 to return to his home in Boston (Merry 2000:156). He sold much of his property, including the Hilo stores and his agricultural land, to a Mr. Thomas Spencer, a former ship’s captain. The Amau‘ulu Plantation (see Figure 6) extended from the coast to Waihīloa Falls, and covered three *ahupua‘a*, Pi‘ihonua, Pu‘u‘eo, Kalalau. The location of the Amau‘ulu Sugar Mill is shown on an 1882 map of Hilo Bay (Figure 9). Thrum (1923a:123-126) reprints material from a pamphlet on this early Hilo resident, which was probably written by Thomas Spencer himself:

> Thomas Spencer. . . Formerly carried on the ship-chandlery business in Honolulu, but is now in Hilo, having lately purchased a large estate at that place of B. Pitman, where he is extensively engaged in the country store line, having three or more stores. Is interested largely in pulu, and according to his own statement is making money fast. Attempted while in Honolulu to make himself popular through being noisy but failed in it and became notorious as a braggart, making a great cry and little wool. (Thrum 1923a:123)

Thrum adds additional information on this Hilo sugar plantation:

> Among the lands Spencer acquired from Pitman was a tract under lease to the Chinese and planted to cane, known as the Amauulu plantation [in Pu‘u‘eo Ahupua‘a]. This eventually came under Spencer’s control and gradually won him away from merchandising. Just when he withdrew from the store is not definite, but probably about 1870. . . .
>
> On devoting himself to the sugar business, the old style system of Chinese mill and boiling-house work was done away with, grinding then being done by an overshot water wheel-and a new and modern plant of Watson's Scotch sugar machinery installed. Very naturally the name changed to Spencer’s Plantation. (Thrum 1923a:123-124)

3.2.6 The Māhele and Traditional Native Hawaiian Settlement in the mid 1800s

The Organic Acts of 1845 and 1846 initiated the process of the Māhele, the division of Hawaiian lands, which introduced private property into Hawaiian society. In 1848, the crown and the *ali‘i* (royalty) received their land titles. The common people (*maka‘āinana*) received their *kuleana* awards (individual land parcels) in 1850. It is through records for LCAs generated during the Māhele that the first specific documentation of life in Hawai‘i, as it had evolved up to the mid-nineteenth century come to light (Chinen 1958:15-16). Although many Hawaiians did not submit or follow through on claims for their lands, the distribution of LCAs can provide insight into patterns of residence and agriculture. Many of these patterns of residence and agriculture probably had existed for centuries past.

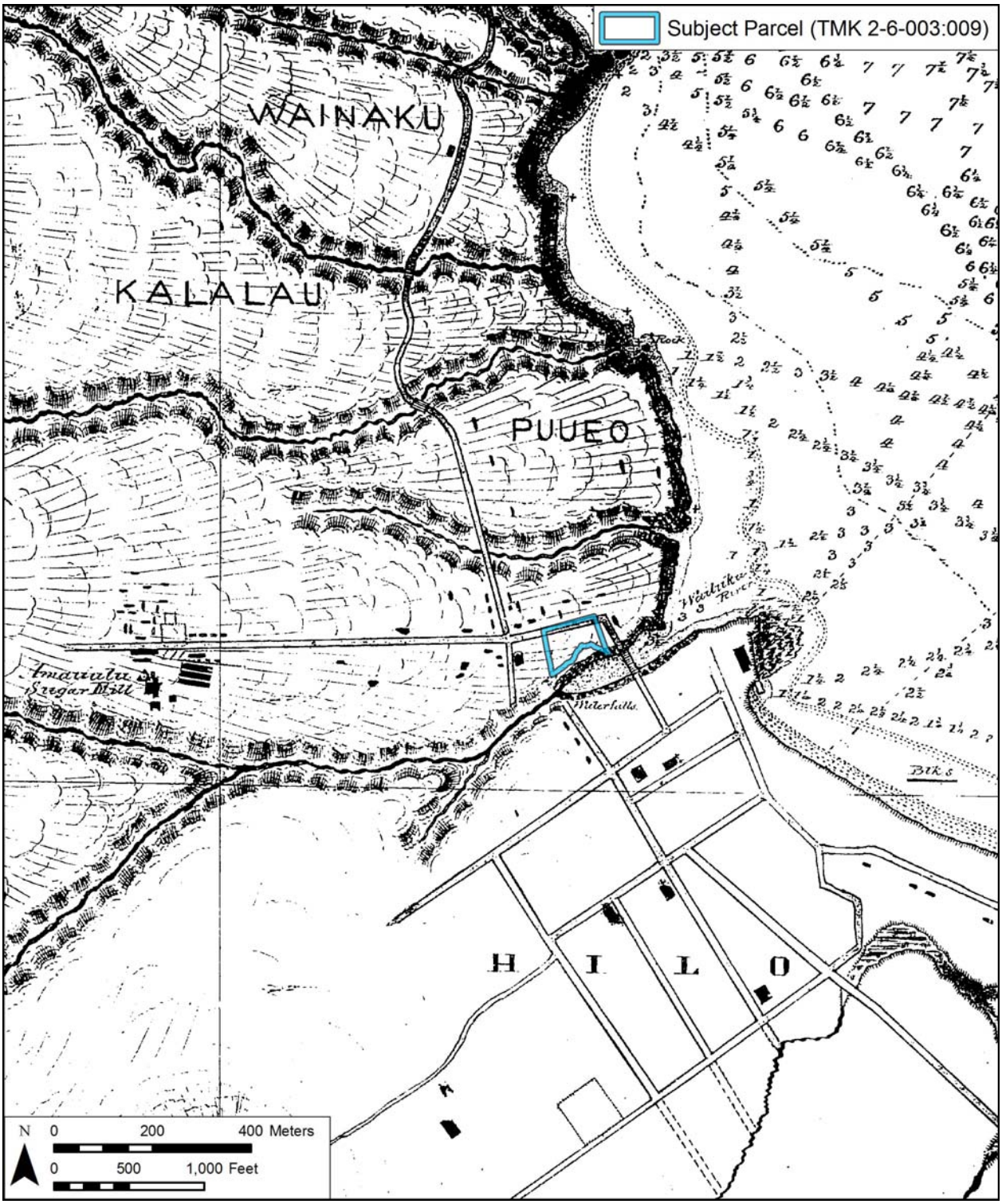

Figure 9. 1882 map of Hilo Bay (Jackson 1882), showing location of Amau‘ula Sugar Mill *mauka* of the project area; also note scarcity of large structures within Hilo town (Hawai‘i Land Survey Division, Registered Map No. 1322)

By examining the patterns of *kuleana* (commoner) LCA parcels in the vicinity of the project area, insight can be gained to the likely intensity and nature of Hawaiian activity in the area.

After his conquest of Hawai‘i Island, Kamehameha I gave away many of his conquered lands to his relatives or friends. He gave many of the Hilo lands, including the *ahupua‘a* of Pu‘u‘eo to Kaheiheimalie, a favored wife, who was also the sister of Ka‘ahumanu and a cousin of the high chief Boki. After Kamehameha’s death, Kaheiheimalie became the wife of the chief Ulumaheihei Haopili. When Kaheiheimalie died in 1845, the land descended to her daughter Kekeuluohi, and then in turn to her grandson Lunalilo, who became the Hawaiian monarch in 1873. The *ahupua‘a* of Pu‘u‘eo is not specifically mentioned in the Māhele Book, but it must have been considered a Crown Land as parcels were being sold by the Commissioners of Crown Lands as Land Grants in the late nineteenth century (Kelly et al. 1981:40).

In Pu‘u‘eo, only 16 *kuleana* Land Commission claims for commoners were made and only 13 LCA parcels were awarded (Waihona ‘Āina database 2012; Soehren 2012). These awards were generally clustered around the coast and along the lower portions of Wailuku and Pūkīhae Streams (see Figure 7). The awards (Table 2) range from small, less than one acre lots, to quite large parcels, as much as 8.8 acres with four separate *‘āpana* (lots). However, as noted, much of the land in Pu‘u‘eo was sold as Land Grants, but the documents for the land grants contain little information on the use of the land.

Table 2. Land Commission Claims and Awards in Pu‘u‘eo

LCA No.		Claimant	‘Ili	‘Āpana (Lots)	Acres
1B		Wahine	Ho‘oke‘o, Kahalauoulu, Nalomalu	2	1.09
1C		Mary	Waimalino, Kaioio	2	5.68
4598		Halaki	Ha‘alo‘u	2	1.81
4659		Papa		3	5.78
4696		Laauohala	Waipilopilo	1	5.88
4786		Nalona, wahine		1	2.86
4809		Lo, Moses		4	8.86
4989B		Kaili	Kaneaa, Kinailoa	1	0.57
5021		Kupihe		2	1.48
5145		Kauhiahiwa	Keamoali‘i, Makaolanakila	2	0.59
5159		Kapuupuu		1	0.8
8069		Haalou		1	2.31
8629 /2228		Kaapa		1	0.57

The largest award, 8.86 acres, LCA 4809 with four separate ‘*āpana* (lots) was awarded to Moses Lo. ‘Āpana 1 overlaps with the current project area. According to the LCA testimony from LCA 4809 (presented in full in Appendix A), ‘Āpana 1 was bound by the main road on the west, by Benjamin Pitman’s land on the north, by the ocean on the east, and by the Wailuku

River to the south. There were seven houses on this large lot, occupied by several families. The lot seems to have been residential; there is no testimony indicating any agricultural use.

3.2.7 Coffee Cultivation in Hilo

The first coffee trees in the islands were planted by Don Paulo Marin on his O‘ahu estate in 1817. An attempt to grow the trees on a plantation was made by Mr. John Wilkinson in 1825 in Mānoa. Other early plantations were at Kona and Hilo on the island of Hawai‘i. Thrum (1875:46-47) comments on the successful growth by, ". . . the Rev. Mr. Goodrich [the missionary] planting the first slips in Hilo, which grew luxuriantly in Hilo. This planting was probably near Goodrich's house near Hilo town. It was soon decided, however, that coffee grew better at higher elevation. Thrum (1875:48) reports that at Hilo in 1847, a "Dr. Maxwell and Mr. Miller, officers of the U.S.S. *Cyane*, leased of the government 100 acres of the best land for fifty years for the purpose of establishing a coffee plantation, and were to commend operations within six months, but of any after result we have no information." Another early coffee grower in Hilo was Mr. Pitman, who wrote a letter to the agricultural society in 1852 about the coffee blight of that year that was destroying the crop.

Samuel Hill, after observing Pitmans' sugar cane lands and mill in his 1848 visit, also toured his coffee plantings:

> From the sugar works we proceeded, still rising, towards the more elevated ground of the coffee plantation. Arrived here, we found ourselves at an elevation which on one side commanded a noble view of the sea beyond the bays with a portion of the coast, and on the other, the mountainous land in the interior of the island. A broad way conducted through an extensive plantation, sown with 22,000 young coffee trees, and producing a considerable number of breadfruit, and tall and fine tamarind, trees. The greater part of the coffee trees were very young, and were rearing beneath the broad leaves of the hardier plantain, which protected them from the too-scorching rays of the sun. (Hill 1856:317)

Homesteaders began to buy government land in the Hilo area in the 1880s, but the coffee growers in this area could not compete with the Kona growers, who had richer soil and less rain. The importance of coffee declined in the Hilo area between 1905 and 1937, and eventually most of the former coffee lands would be acquired by the large sugar plantation companies. These independent homesteaders would soon be swallowed by larger companies (Cordy 1977:4)

3.2.8 Large-Scale Sugar Cultivation

Amau‘ulu Sugar Plantation operated from 1840 to 1867 (Dorrance and Morgan 2000:13). One of four sugar masters brought to Hawaii by the French was Aiko, He worked on several islands and lived in the Hilo area in the 1850s and 1860 until 1869, helping the Chinese run the mill and plantation at Amau‘ula. As previously noted, in 1884, the plantation was taken over by Capt. Thomas Spencer in 1867 from Aiko (Dorrance and Morgan 2000:83).

In 1880, Claus Spreckels, known as the "Sugar King," entered into a partnership with William Irwin to form the Hilo Sugar Company. They bought a number of small parcels near Hilo,

including lands in Punahoa and at the base of Mauna Kea. In 1884, they added the lands of Spencer’s Plantation (Amau‘ulu Plantation) and the Wainaku Plantation to their own. At its greatest extent, the plantation was 4,800 acres in size; some of the land was leased to individual sugar cane growers living in the Hilo area (Dorrance and Morgan 2000:102-103).

Sugar cane plantations belonging to other companies were also present in the Hilo area around the turn of the century. The Waiākea Sugar Company and Hawaii Mill Company are known to have had plantations in upland Hilo. The extensive sugar cane production in the Hilo area meant an influx of workers, and camps sprung up off of plantation roads, as shown on a 1922 map (Figure 10). In 1910, C. Brewer & Co. became the agent for the Hilo Sugar Company. After World War II, the residential areas of Hilo began to further expand, and in 1965, C. Brewer & Company sold the sugar cane fields around Hilo, and merged their remaining agricultural lands with the Onomea Sugar Company to form the Mauna Kea Sugar Company. Production of sugar cane in the Hilo area ended in 1994, when the Hilo Coast Processing Company, a subsequent company of several merged plantations, shut down (Dorrance and Morgan 2000:104-105).

3.2.9 The Development of Hilo

In 1899, Hilo had a population of 5,000 and was second only to Honolulu in size and commercial enterprise (Godfrey 1899:37). By 1910, the population of Hilo had reached 6,745 persons, and the population of the entire South Hilo District was at 18,468 (Kelly et al. 1981:288). The great majority of this increase was the influx of immigrant workers, first the Chinese, then the Japanese, to work in the new sugar plantations that stretched throughout Hilo into the Hāmākua District. The density of residential and commercial structures in the Hilo Bay area is shown on a 1914 U.S. Geological Survey map (Figure 11). There are three large structures in the project area, as shown on this map, all north of the steep slope along the Wailuku River.

By 1940, the population of Hilo was 27,198, and 32,588 for the entire South Hilo District. In the years between the turn of the century and the 1940s, extensive dredging, filling, and construction work had been conducted to make Hilo Harbor a major port. The 1946 tsunami destroyed much of this harbor infrastructure, but rebuilding took place immediately in the following years (Kelly et al. 1981:291). However, by the 1960s, the closure of so many sugar plantations in the east Hilo area decreased Hilo’s importance as a major port. By 1979, there were only five sugar plantations open on the island of Hawai‘i (Kelly et al. 1981:293). A 1977 aerial photograph illustrates the growth of Hilo in the late twentieth century (Figure 12).

3.2.10 Wailuku River Bridges

The western, *makai* boundary of the project area is bound by Pu‘u‘eo Street, but in the late nineteenth and early twentieth century, this road was referred to as “Bridge Street.” Bridge Street was the major thoroughfare though coastal Pu‘u‘eo and the major link between the southern section and northern sections of Hilo town. Until 1909, the “first” bridge (closest to the river mouth) was located over the Wailuku Stream along this road. The following section describes the bridges in the Pu‘u‘eo section of Hilo town.

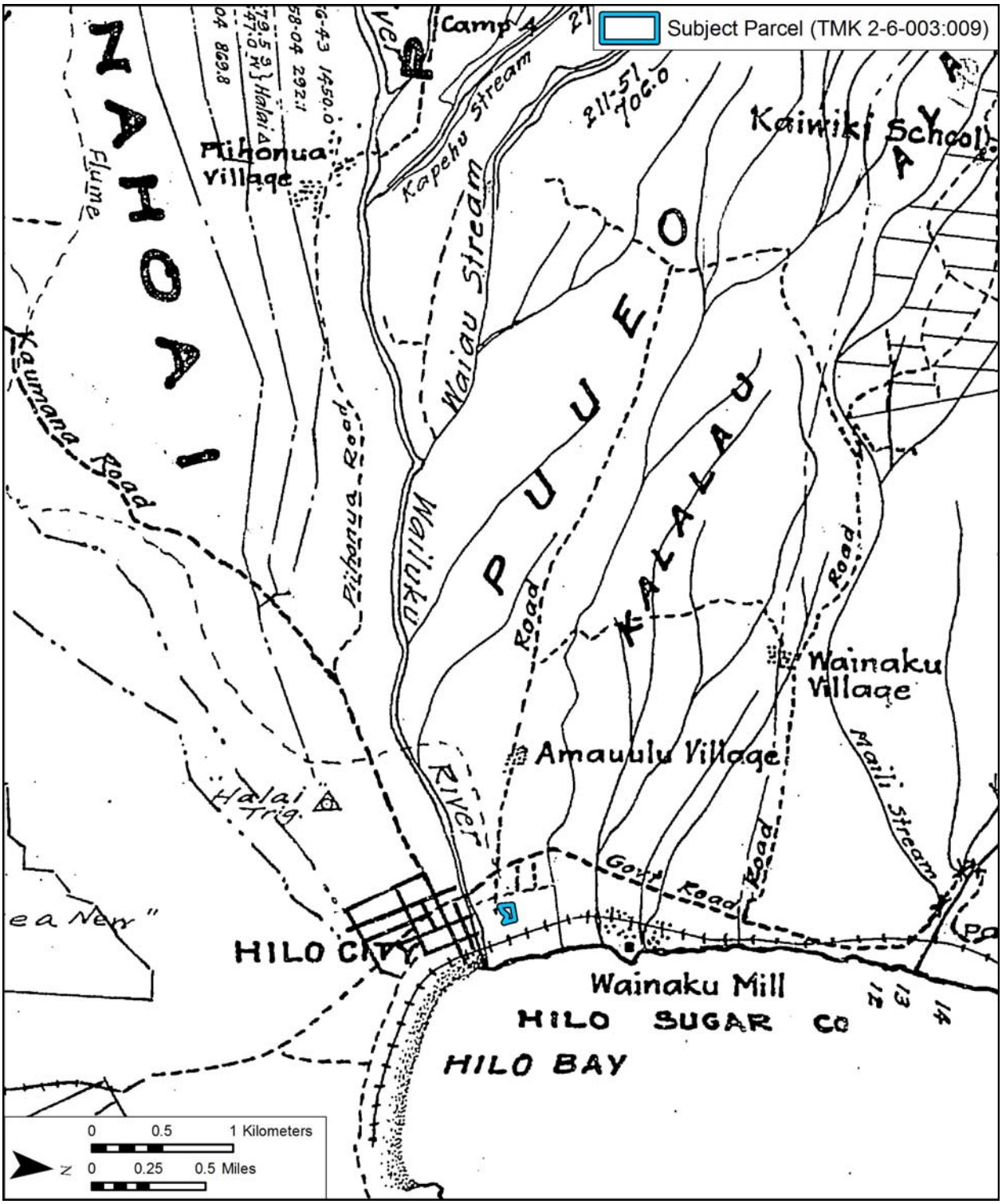

Figure 10. 1922 Map of the Hilo and Mauna Kea Forest Reserves (Wall 1922), showing inland roads to sugar plantation camps for Amau‘ulu and Wainaku (Hawai‘i Land Survey Division, Plat Map No. 799)

Figure 11. 1914 U. S. Geological Survey 7.4 Minute Topographic map of Hawai‘i, Waiakea Quadrangle, showing project area within an increasingly urbanized area of Hilo town

Figure 12. 1977 U.S. Geological Survey Orthophoto, Hilo Quadrangle, showing development of commercial areas, roads, and bridges near the project area

In the pre-Contact period and early historic period, there were no bridges across the “dangerous” waters of Wailuku Stream. The missionary William Ellis noted that although there were no bridges, the natives did cross the stream, passing one large rock where a toll had to be paid.

> Having been informed by our guide that travelling along the coast to the northward would be tedious and difficult,, on account of the numerous deep ravines that intersected the whole extent of Hiro and Hamakua, it seemed desirable to take a can0e as far as Laupahoeho. . .I therefore walked to Pueo [*sic*], on the western shore, where for six dolloard, I hired one. . . .
>
> Returning from Pueo, I visited Wairuku, a beautiful stream of water. . . .Makoa [Ellis’s guide] and the natives pointed out a square rock in the middle of the stream, on which, during the reign of Tamehameha, and former kings, a toll used to be paid by every traveler who passed over the river. Whenever any one approached the stream, he stood on the brink, and called to the collector of the toll, who resided on the opposite side. He came down with a broad piece of board, which he place on the rock above mentioned. Those who wished to cross met him there, and deposited on the board whatever articles had been brought; and if satisfactory, the person was allowed to pass the river. It did not appear that any uniform toll was required, the amount or value, being generally left to the collector. The natives said it was principally regulated by the rank or number of those who passed over. (Ellis 1826:295-296)

Ellis also noted that markets were set up for trading between the people of Hilo and Hāmākua with the inhabitants of Puna and Ka‘ū on the banks and in the middle of the stream.

> The river of Wairuka was also distinguished by the markets or fairs held at stated periods on its banks. At those times the people of Puna, and the desolate shore of Kau, even from the south point of the island, brought mats, and mamake tapa . . .
>
> These, together with vast quantities of dried salt fish, were arranged along on the south side of the ravine. The people of Hiro and Hamakua, as far as the north point, brought hogs, tobacco, tapa of various kinds, large mats made of the pandanus leaves, and bundles of ai pa [hard baked taro], which were collected on the north bank. From bank to bank the traders shouted to each other, and arranged the preliminaries of their bargains. From thence the articles were taken down to the before-mentioned rock in the middle of the stream, which in this place is almost covered by large stones. . . . According to the account of the natives, this institution was in force till the accession of Rihoriha [Liholiho, son of Kamehameha I], since which time it has been abolished. (Ellis 1826:296-297)

This account is also interesting in that it describes a natural “ford” area, where the crossing of the river could be made across several large above-water rocks near the falls, possibly near the area depicted in a ca. 1844-1848 painting of the Wailuku River (Figure 13, below).

The first bridge over the Wailuku River was just a crude footbridge, as noted in 1825 by Charles Stewart, a member of the Byron expedition to Hawai‘i. He rowed across the bay:

> . . . to another stream on the western side of the harbor, called Wairuku – *river of destruction* – where the ships get their water. The entrance of this river is highly romantic and beautiful, the banks being precipitous and rocky, and covered with a variety of vegetation. . . . A rude bridge crosses the stream just above the falls; and it is a favourite [*sic*] amusement of the natives to plunge from it, or from the adjoining rocks, into the rapids, and pass head foremost over both falls, into the lower basin (Stewart 1828:365).

However, this bridge may have been short-lived, as Sereno Bishop, who was born on Hawai‘i Island in 1827, states that: “There were no bridges in these islands until after 1840” (Bishop cited in Schmitt 1986:151). Another early resident noted that from this time until 1868, a crude bridge of wooden planks was used to cross the Wailuku, although horses had to swim across the stream (Hitchcock 1897:215).

In 1859, a bridge over the Wailuku was built. This was an experimental suspension bridge; 196-ft long; however, the experiment failed, and the bridge collapsed seven weeks after completion. It was replaced with double-strength steel, and this bridge lasted for forty years, with one major reconstruction in 1884. In 1903, this bridge was replaced with a steel-through truss bridge. This bridge was replaced with a concrete single-span arch bridge in 1938, which still remains (Spencer Mason Architects 1996:VI-44). All of these bridges are on Pu‘u‘eo Street, the east boundary of the current project study area (Figure 14 to Figure 16). In the late nineteenth-early twentieth century, this was called simply Bridge Street.

There was another bridge in the Pu‘u‘eo area that crossed the Wailuku River. The Waiakea Mill Company was the first company to use a steam locomotive to haul their raw sugar from the mill to the port of Hilo. Walter Dillingham gained an interest in the adjoining Ola‘a Sugar Co. plantation and decided to start his own railway line, the Hilo railroad. The first part of the tract extended from the ‘Ōla‘a sugar mill to the harbor at Waiākea (east of the project area), but the lines were quickly extended to both the north and east, including a branch to Hilo town in 1902.

By 1908, they began to extend the line to the Hāmākua Coast. The company was reorganized as the Hawaii Consolidated Railway in 1916 (Treiber 2004:46-55). When Hawai‘i Consolidated Railroad began to expand its tracks throughout the Hilo and Hāmākua area, they built a number of steel-truss bridges. The one along the Wailuku ran just at the mouth of the stream, *makai* of the current project area (Figure 17 to Figure 20).

> The Wailuku railroad bridge suffered several mishaps. While it was being erected in 1909, a Porter tank engine slipped over its edge into the river. Fifteen years later, “it collapsed in a mysterious manner,” its piers folding like dominoes [Thrum 1923b:94]. The collapse was attributed to the 1923 tidal wave and earthquake, and was precipitated by the passage of a loaded passenger train. In 1924, the Wailuku Bridge was replaced by a metal truss bridge of three spans, mounted on concrete piers. These bridges only lasted in place until the 1946 *tsunami*. . . .
>
> On April 1, 1945, a tsunami hit Hilo at 7:01 AM. . . . the first span of the Wailuku River bridge, a steel truss, was washed hundreds of feet up the river. (Spencer Mason Architects 1996:IV-22) . . .

Figure 13. “Landing in Byron Bay, Hawai‘i Island”, by René Gillotin, ca. 1844-1848 (Honolulu Museum of Art); note natural “ford” area above the falls on Wailuku Stream and high, steep bank on north side

Figure 14. 1859-1903 Bridge on Bridge Street over Wailuku Stream (C. J. Hedemann Collection, reprinted in Lang 2007:60)

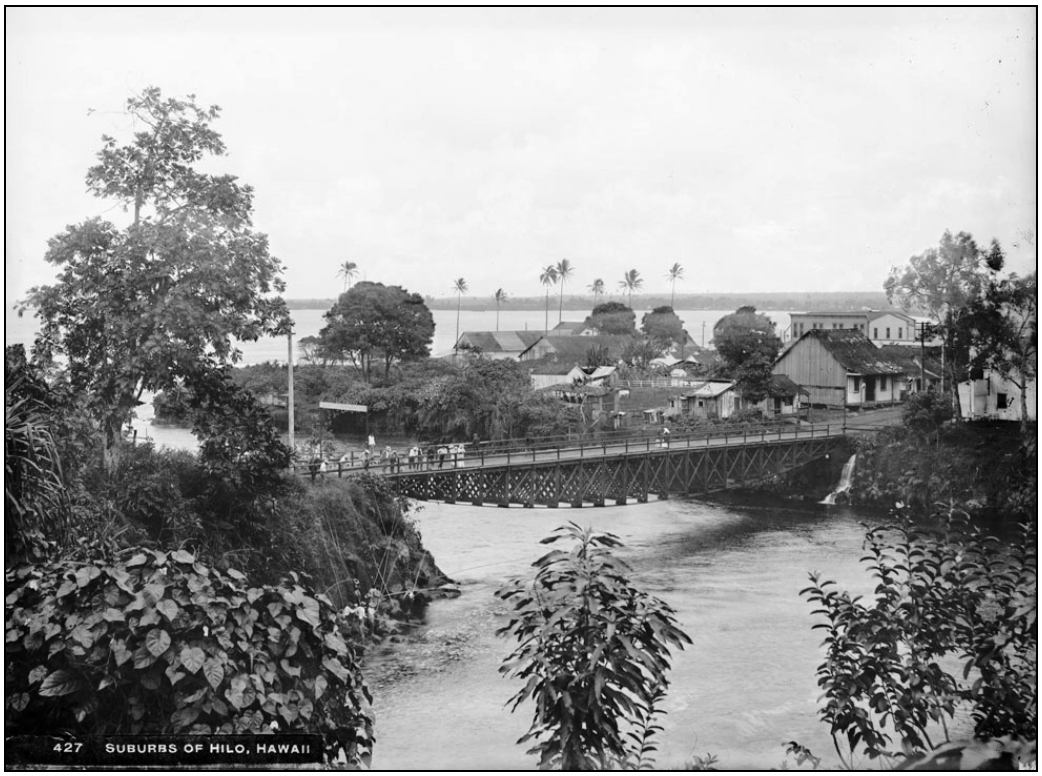

Figure 15. 1903-1938 Steel Truss Bridge on Bridge Street across Wailuku Stream (University of Southern California, C. C. Pierce Collection, photograph dated ca. 1907)

Figure 16. Concrete arch bridge on Bridge-Pu‘u‘eo Street over Wailuku River, built in 1938; photograph taken during the 1946 tsunami; note missing span of railroad bridge in background (Pacific Tsunami Museum, reprinted in Lang 2007:93)

Figure 17. Construction of the Railroad Bridge, *makai* of the project area near the coast, ca. 1909 (Richard Otaki Collection, reprinted in Schwietzer and Hymer 2009:95)

Figure 18. Collapse of Railroad Bridge in 1924, probably due to 1923 tsunami (Laupāhoehoe Train Museum Archives, reprinted in Lang 2007:93)

Figure 19. Hilo Railroad Bridge pre-1941, before World War II (Victor Norton, Jr. Collection, reprinted in Treiber 2004:67)

Figure 20. Destruction of Railroad Bridge by 1946 Tsunami; the southern span was swept upriver (Hawai‘i State Archives)

Due to the destruction of many railway bridges by the 1946 tsunami, the railway gained permission to abandon the line. In 1950, the Territorial Highways Division made plans to use the old railroad trestles into highway bridges. The two remaining truss spans of the Wailuku River Railroad Bridges were used as a foundation for the Kolekole Highway Bridge, although the original concrete piers remain below the existing Wailuku Bridge (Spencer Mason Architects 1996:IV-23).

3.2.11 The Project Area

Around the turn of the century, Pu‘u‘eo portion of Hilo, called “Greater Hilo” was the residential section of the town, with many “elegant residences” (Godfrey 1899:34, 43). In that era, Hilo had a population of 5,000 and was second only to Honolulu in size and commercial enterprise (Godfrey 1899:37). This was still true in 1928, when a tourist noted that:

> The main portion of the little city lies between two rivers. The principal residential quarter, Puueo, lies to the north of the Wailuku River, while south of the Wailoa River is the Waiakea suburb, the headquarters of the fishing industry. (Ladd 1938:38)

The 1891 map of Hilo, and two Sanborn Fire Insurance maps, dated 1914, and 1957 (Figure 21 to Figure 23) provide specific information on the development of the current project area from the late nineteenth into the twentieth century. According to Godfrey’s tour book (Godfrey 1899:37), Pu‘u‘eo was the main residential subdivision of the Hilo area in 1899. The 1891 map shows two small structures and one large structure in the project area, all adjacent to the main inland road. The large structure on the corner is listed as the A. G. Serrao store. There are two men named Serrao listed in the Godfrey’s Hilo directory (1899:77), J. C. Serrao, proprietor of the Union Saloon, with a liquor store on Shipman Street in Hilo and A. G. Serrao, who had a dry goods stone on the corner of Waiānuenue and Front streets. Neither listing mentions a store in Pu‘u‘eo, but the store in the project area was probably an extension of A. G. Serrao’s dry goods business. This corner structure is labeled as a store (“S”) on both the 1914 and 1957 maps, although it may have changed hands during this time.

The 1891 map shows a church, the Pu‘u‘eo Chapel, *mauka* of the project area. In 1883, there were four churches in the Hilo area, three on the south side and one on the north side of Wailuku Stream, as noted by a visitor to the islands, Constance Gordon-Cumming:

> There are three churches in the village, a large Roman Catholic church painted white, with two square towers which form a prominent feature of the settlement as seen from the sea; Father Coan’s large native church for the Hawaiians; and a small church for the foreign residents, in charge of the Rev. A. O. Forbes. The two latter are Congregational, as is also a small church on the other side of the Wailuku river [in Pu‘u‘eo]. (Gordon-Cumming 1883, Vol. I:97)

This 1883 structure must have been preceded by an early chapel, as a church building was taken over by the Hilo Boarding School. The Hilo Boarding School originated as two native huts on the south side of the stream. Larger structures were built on School Street in 1840, but these buildings were destroyed by fire in 1853. In 1853, “the old Puueo meetinghouse was purchased and converted into a dining hall for the Hilo Boarding School as a temporary measure. New buildings were completed in 1856” (Warner 1909:136). It is likely that the Pu‘u‘eo Chapel was

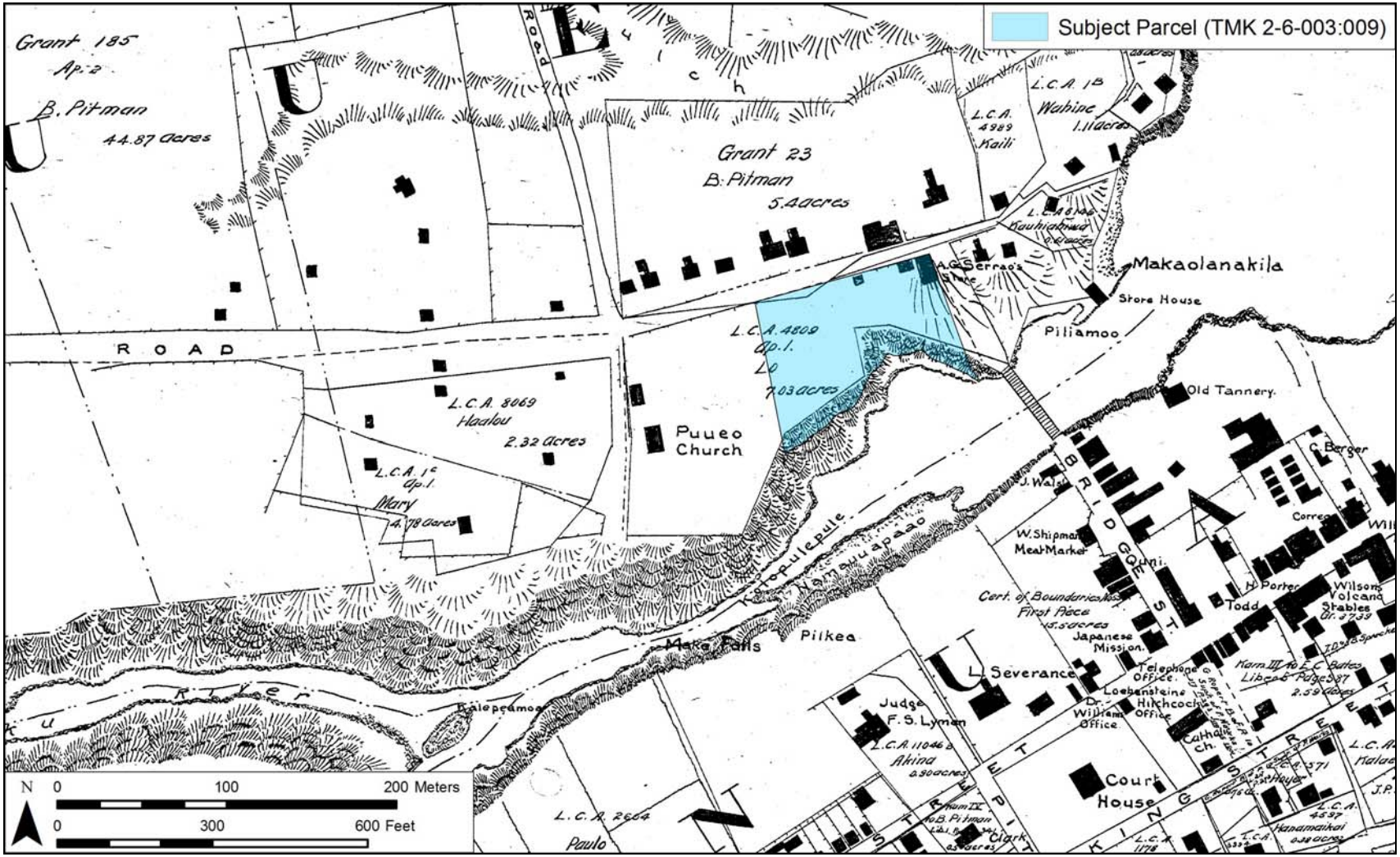

Figure 21. 1891 map of Hilo Town (Baldwin 1891), close-up, showing structures within and surrounding the project area; note the “A. G. Serrao’s Store” in the northeastern corner of the project area, and the “Puueo Church” *mauka* of the project area (Hawai‘i Land Survey Division, Registered Map 1561)

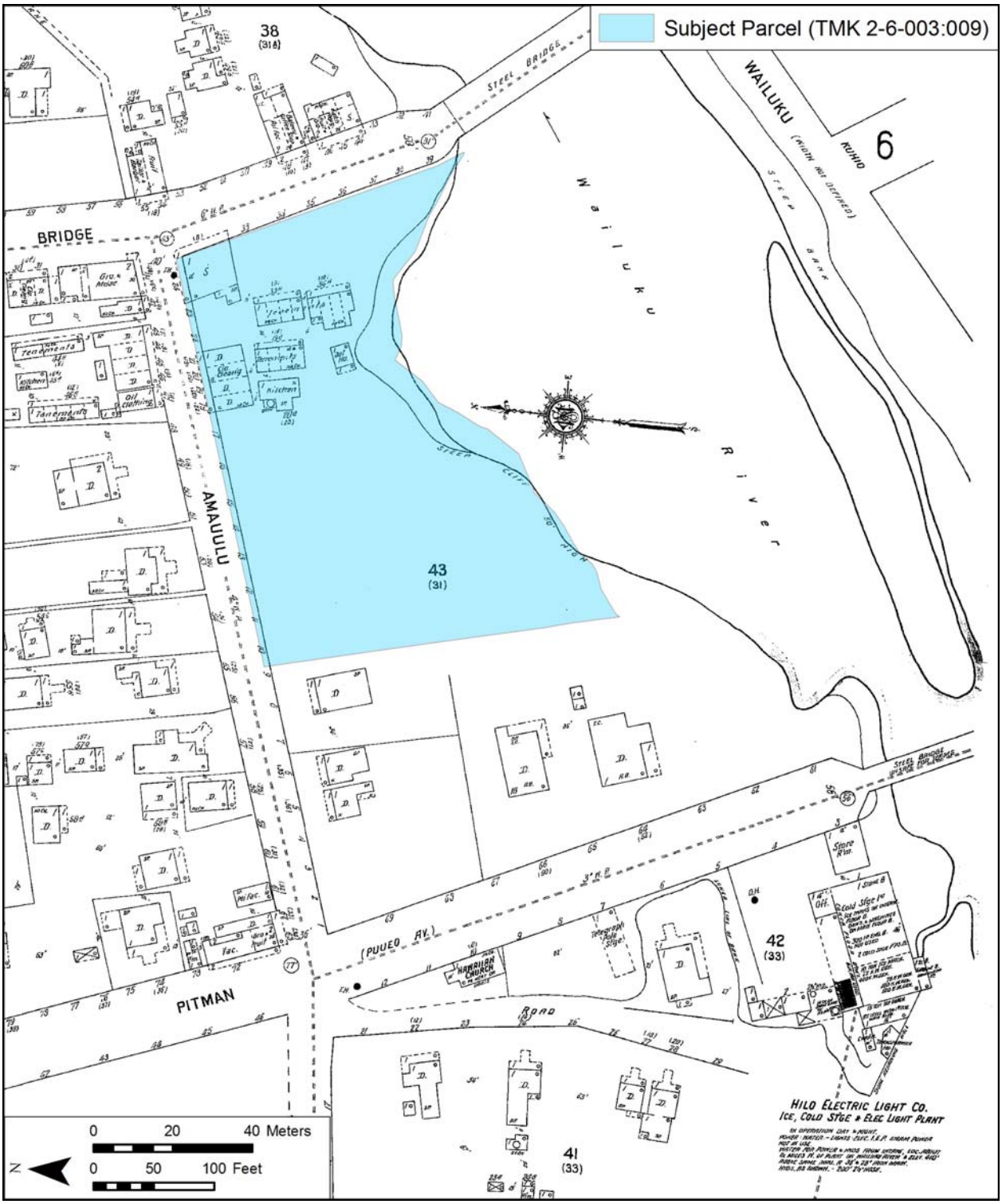

Figure 22. 1914 Sanborn Fire Insurance Map, Sheet 3, showing scattered dwellings and “tenements” within the project area; note the “Store” on the northeast corner of the project area and the “Hawaiian Church” on the west side of Pu‘u‘eo Street, *mauka* of the project area

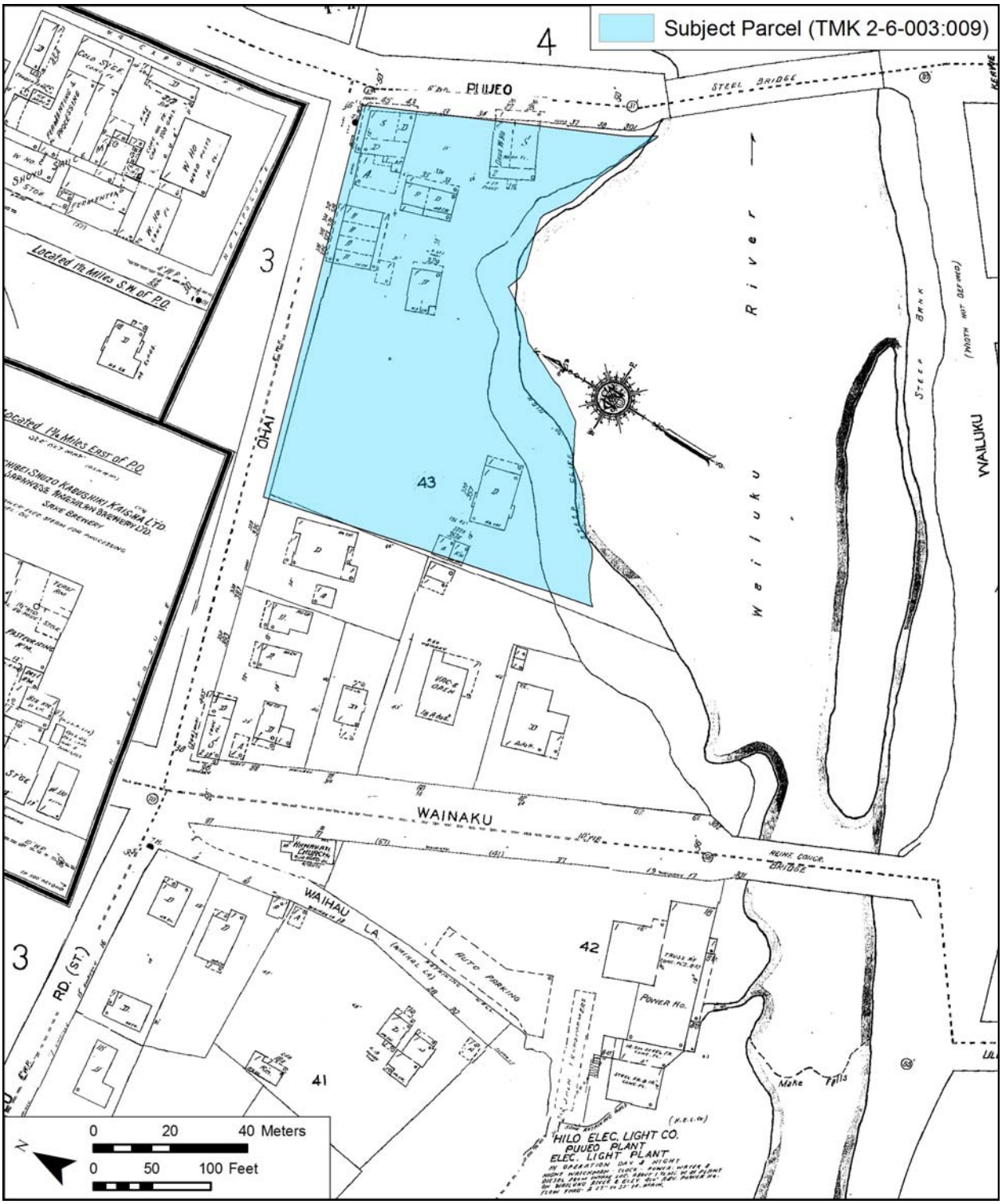

Figure 23. 1957 Sanborn Fire Insurance Map, Sheet 5, showing scattered dwellings, a store, and a drug warehouse in the project; “Hawaiian Church” still present mauka of the project area

for native Hawaiians and was associated with the main Protestant churches in Hilo. By 1908, there was a Sunday School in Pu‘u‘eo run by Protestant missionaries.

> A Sunday School has been organized near Puueo by a member of my family with an average attendance of forty. To this school the Christian people of the neighborhood are willingly lending their aid. (Oleson 1908:34-44)

This may be related to the building labeled “Hawaiian Church” on the west side of Pitman Street, *mauka* of the project area, which is shown on both the 1914 and 1957 fire insurance maps.

The 1914 fire insurance map indicates that only the northeastern corner of the project area was developed in the early twentieth century. In this year, there was a store, two tenements with separate structures for a kitchen and an outhouse, three dwellings, and a clothes cleaning establishment. The Wailuku Stream bank is labeled as “Steep Cliff 50’ High.”

By 1957, the tenements have become small attached dwellings, and there is a drug warehouse on the east side. There is also development on the western side of the project area, with the additional of one large dwelling and associated auto shed.

The L-shaped Riverside Apartments, which is presently within the project area, appears on the 1977 aerial photograph (see Figure 12), so it was built sometime between 1957 and 1977.

Section 4 Previous Archaeological Research

4.1.1 Archaeological Studies in the Vicinity of the Project Area.

Early surveys of Pu‘u‘eo noted only two *heiau* in the *ahupua‘a,* Kānoa and Kiniakua Heiau. Kānoa Heiau, also called Pu‘u‘eo Heiau, were once located near the eastern end of Kānoa Street near the sea cliff. This was a *heiau* for human sacrifices, and it had been “thrown down” (abandoned and desecrated) before 1853, and all the stones had been removed for road work in 1898 (Stokes and Dye 1991:154; Thrum 1907:40). Kiniakua Heiau “was ...near Waikapū spring. A small heiau of ho‘oūlu ‘ai (agricultural) class, now entirely destroyed” (Stokes and Dye 1991:156). Soehren (2012) placed this *heiau* in Pu‘u‘eo Ahupua‘a, although the location of “Waikapu Spring” is unknown.

Archaeological studies in and above Hilo town are widely scattered (Figure 24). The density of finds is quite low, as can be seen in Table 3.

In 1988, Margaret Rosendahl (1988) completed a report on an archaeological survey for five proposed parcels for a Hilo Judiciary Complex. One parcel was 400 m southwest of the current project area, across the Wailuku River in a parcel once occupied by the old Riverside School. A second of the five parcels is over 1 km southeast of the current project area. No sites were found on any of the five parcels.

In 1991 Susan T. Goodfellow conducted an inventory survey for the Noelani Gardens project. The project at the mouth of the Wailuku River is adjacent, east, and *makai* of the current project area. The crew excavated 11 test trenches on the property, most on the banks of the Wailuku River, and four shovel tests along the beach. Charcoal concentrations and fire-cracked rock were noted in five of the trenches on the river bank. Historic structural remains were also noted on the surface and in subsurface deposits. These possible firepits and the structural remains were designated State Inventory of Historic Places (SIHP) # 50-10-35-15415. The boundary of the site is the same as the boundary of the project parcel. Two of the four charcoal radiocarbon samples were dated to A. D. 1400-1670. No further work was recommended for this site (Goodfellow 1991:25). This project area is located in the coastal settlement zone, which extends from 0-50 ft in elevation (McEldowny 1979), which is the same settlement zone as the current project area.

In 1992 Joseph Kennedy conducted an inventory survey of a substantial 482.-acre portion of the inland section of Pu‘u‘eo Ahupua‘a extending from Wainaku Street (80 ft in elevation) to Kaimukanaka Falls (600 ft in elevation), within the Upland Agricultural Zone. The *makai* boundary of the project area at Wainaku Street, is less that 50 m *mauka* of the current project area. Kennedy identified one site, SIHP # 50-10-35-18074. This site was described as being a rock mound measuring 2.7 m long, 1.8 m wide and 50 cm high. According to the report for this project, “The exact function of this structure is undetermined at this time, however we suspect that SIHP # -18074 may be a grave,” (Kennedy 1992:17). It was recommended that more precise determination about function be made prior to any disturbance, though none was planned in that area. The archaeologists concluded that the lack of archaeological features was due to the extensive modifications to the landscape from sugar plantation activities over the last 150 years.

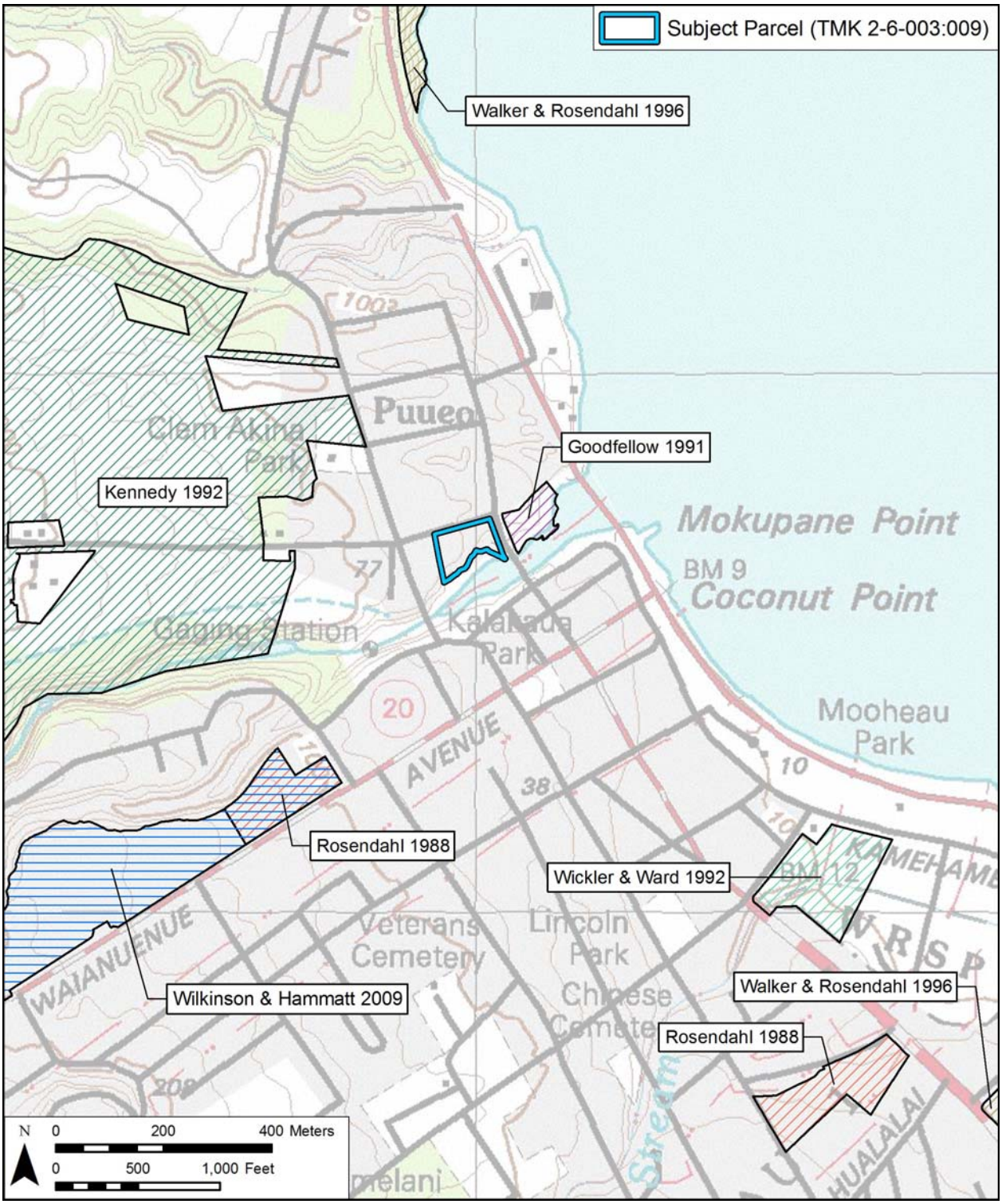

Figure 24. Previous Archaeological Study Areas in Relation to the current project area (base map: 1995 U.S. Geological Survey map of O‘ahu, Hilo Quadrangle)

Table 3. Archaeological Studies near the Current Project Area

Source	Project	Findings (SIHP # 50-10-35-)
Rosendahl 1988	Archaeological Reconnaissance Survey for Environmental Impact Statement (EIS), Hilo Judiciary Sites [TMK:[3]2-2-002:001, 054, 055, 056, 062; 2-2-010:016; 2-2-033:011, 012, 013, 014, 019, 020; 2-3-015:001; 2-3-044:009]	No finds
Goodfellow 1991	Archaeological Inventory Survey of the Noelani Gardens Project, TMK [3] 2-6-002:001, 002	Diffuse prehistoric hearths and historic refuse (SIHP # -15415). This site is located along the coast and Wailuku Stream mouth
Kennedy 1992	Archaeological Inventory Final Report for TMK:2-6-08:26, 27, 28, 29, 31, 32, 33, 34, 35, 36, 37, 38, and 39; and TMK:2-6-29:09, 10, 11, 12, 14, and15; Located at Pu‘u‘eo on the Island of Hawaii	Rock mound (SIHP # -18074) interpreted as a possible burial
Wickler and Ward 1992	Archaeological and Paleo-environmental Investigations for Alenaio Stream Flood Control Project, TMK [3] 2-2-006, 007	No finds
Walker and Rosendahl 1996	Assessment Study of Hilo Judiciary Complex Project, 7 locations TMK: [3] 2-2-015:033; 2-3-032:001; 2-6-015:001, 002; -016:002; 2-4-049:018, 019; 2-4-001:012; 2-3-036:003; 2-4-057:001	C-shape (SIHP # -19431), U-shape (SIHP # -19432), complex (SIHP # -19433), complex (SIHP # -19434), sugar cane mill (SIHP # -21133).
Wilkinson & Hammatt 2009	Hilo High School Gymnasium Project, Pi‘ihonua Ahupua‘a, TMK 2-3-015:001	Only historic buildings of the Hilo High School, constructed from 1921 to 1937 were noted during the field inspection; no SIHP number designated

In 1992, Wickler and Ward (1992) completed a report on archaeological and paleontological investigations of the Alenaoi Stream near the coast. The study consisted of the excavation of 30 backhoe trenches. No cultural deposits or artifacts dating earlier than the late nineteenth century were found. Deep coring indicated that the pre-Contact period this area of Hilo was a marsh.

In 1996 Alan Walker and Paul H. Rosendahl conducted an assessment study at seven parcels around Hilo for the proposed Hilo Judiciary Complex. The report for this study described a total of five sites. These five sites are all historic in nature, including 47+ features relating to sugar cane cultivation and production (SIHP #s 50-10-35-19431 through -19434) and the old Hilo

Sugar Co. Mill (SIHP # 50-10-35-21133) (Walker and Rosendahl 1996:20 and 22).One of the parcels along the coast is approximately 600 m north of the current project area, and consists of the remains of the Hilo Sugar Company’s Wainaku Mill, SIHP -21133. A second parcel is located over 1.4 km south of the current project area. The parcel, at the time of the survey, was a shopping mall, and no archaeological or historic structures were found on the parcel. The other five parcels are more than 1.5 km from the current project area.

In 2009, CSH (Wilkinson and Hammatt 2009) completed a field inspection and literature review for the Hilo High School Gymnasium Project. No archaeological features were noted, but brief notes were made on the status of the historic buildings on the property, all buildings constructed for the Hilo High School between 1921 and 1937.

Many of the features found during South Hilo archaeological surveys are features associated with sugar cane cultivation, ranching or historic habitation (refer to Table 3). Water control features such as ditches or flumes are present throughout the upland zone of South Hilo, utilized for all of the aforementioned activities. Throughout this area pre-Contact and early post-Contact (pre-1850) features were probably largely destroyed by the extensive modification of the land that took place during the sugar cane era, which extended from the early 1800s to the closing of the Hilo Coast Processing Company sugar cane fields in 1994. The subsequent development of homesteads and residential subdivisions has also contributed to modification of the land and probable destruction of early Hawaiian sites.

4.1.2 Background Summary and Predictive Model

Based on historic documents and maps, Holly McEldowney presented a settlement and land use model for the Hilo and Puna Districts. This model uses elevation, distance from the coast, vegetation, and land use to subdivide the land into five zones, a coastal settlement zone, an upland agricultural zone, a lower forest zone, a rainforest zone, and a sub-alpine zone. The project area extends from an elevation of 30-40 ft, placing it within the coastal settlement zone.

In the pre-Contact and early post-Contact period, the coastal settlement zone had habitations clustered along the coast and along streams. Small garden patches were used to grow dryland crops, such as sweet potatoes, and streams were used to irrigate taro patches. In the post-Contact period, many of these scattered habitations and agricultural areas were abandoned, as the number of the native Hawaiians decreased and people moved to population centers, such as Hilo town. The coastal areas became the prime area for residences, churches, and stores.

Chinese sugar masters began to plant and mill sugar cane in the upland Hilo area by the 1830s. There were also experiments with coffee cultivation in the early nineteenth century. Most of these early small plantations were near the coast or near Hāla‘i Hill. However, sugar cane and coffee began to be planted in the upper elevations by the late nineteenth century, some by individual homesteaders scattered in the upland area. These homesteaders also planted vegetables to sell in the Hilo market. With the termination of the large sugar plantations in the Hilo District, these homestead areas gradually became residential subdivisions and communities, such as the Amau‘ulu Camp in Pu‘u‘eo Ahupua‘a.

A review of reports on previous archaeological work in and around Hilo town shows that few pre-Contact features have been found. Most of the extant features are associated with cattle ranching, sugar cane cultivation, and historic habitation. Hilo had a system of ditches, built

throughout the historic period, which served all of these activities. Remnants of some of these ditches still exist. It is not unreasonable to conclude that some of these ditches are still in use today. Older features were probably either destroyed or modified for coffee cultivation, sugar cane cultivation, ranching, truck farming, and more recent homesteading and subdivision residence.

Section 5 Results of Field Work

5.1 Survey Findings

The fieldwork component of the archaeological literature review and field inspection was carried out under archaeological permit number 12-04, issued by the SHPD/DLNR, per HAR Chapter 13-282. CSH archaeologists Olivier (Oli) M. Bautista, B.A., and Johnny Dudoit B.A. carried out the pedestrian survey on October 24, 2012, under the general supervision of principal investigator Hallett H. Hammatt, Ph.D.

The archaeologists completed 100 percent pedestrian coverage of the project area on October 25, 2012. The survey was conducted through dense vegetation from the top of the scarp to the base of the scarp and along the Wailuku River’s edge. The archaeologists used a rope to climb down the steep slope (Figure 28 to Figure 31).

A scattering of modern trash was observed along the edge of the high water mark on the streambed and on the slope. The trash consisted of plastic, wood, metal and ceramic objects, all broken, discarded pieces. They were not buried in the soil, and likely were tossed down the slope as trash. The deposition appeared to be contemporary. The items were not collected. No historic properties were identified during the survey.

Figure 25. Outer Fence of Riverside Apartments, top of the scarp, view to the east (CSH photograph)

Figure 26. Traverse down slope with rope, view to the north (CSH photograph)

Figure 27. Traverse to base of slope with rope, view to the east (CSH photograph)

Figure 28. Vegetation and steep slope; view to the southwest (CSH photograph)

Figure 29. Photo of the Wailuku River’s edge: view to the east.

Figure 30. Photo showing broken ceramic bowl/planter on slope of scarp, near the edge of the Wailuku River; view to the west

Figure 31. Photo showing modern rubbish and plastic at the base of the scarp, near the edge of the Wailuku River; view to the west

5.2 Excavation Results

In consultation with the SHPD on an earlier (November 2012) draft of this study it was agreed to carry out a test excavation to further inform the project regarding the potential for subsurface resources. The excavation reported below was carried out by Ollie Bautista, B.A. and Johnny Dudoit, B.A. under the overall guidance of Hallett Hammatt Ph.D on January 17 2013.The location of the excavation was discussed with the SHPD and is shown on Figure 4.

Test Unit 1

Test Unit 1 (TU-1) was excavated near the edge of the escarpment. A 1.0 m by 1.0 m (1.0 m^2) unit was placed on level ground near a clump of banana trees in an area of maximum soil, accessibility, and safety. Figure 32 shows the unit area marked prior to excavation. The unit was excavated to termination through two stratigraphic levels or components (Figure 33 and Figure 34). The stratigraphy observed at this location consisted of organic silt loam (Stratum I) overlying a layer of fill (Stratum II) which was culturally sterile (**Error! Not a valid bookmark self-reference.**). The excavation was terminated due to safety concerns. Furthermore, continuing the excavation could have had the potential to further destabilize the escarpment.

Table 4.Stratigraphy of Test Unit 1

Stratum	Depth (cmbs*)	Description
I	0–05	0 Horizon; 10 YR 2/2, very dark brown; silt loam; single grain; moderate, fine, platy structure; slightly sticky consistency; non-plastic; weak cementation; terrestrial origin; very abrupt lower boundary; few very fine to coarse roots; no cultural material; organic surface layer
II	05-120	Fill; 7.5 YR 2.5/3, very dark brown; silt loam; single grain; moderate; platy structure; slightly sticky; weak cementation; non-plastic; terrestrial origin; lower boundary not visible; few roots; no cultural materials present; excavation terminated at 120 cmbs; fill material

Figure 32. Photo of TU-1 prior to excavation; view to the north

Figure 33. Photo of base of excavation and profiled eastern wall; view to the east

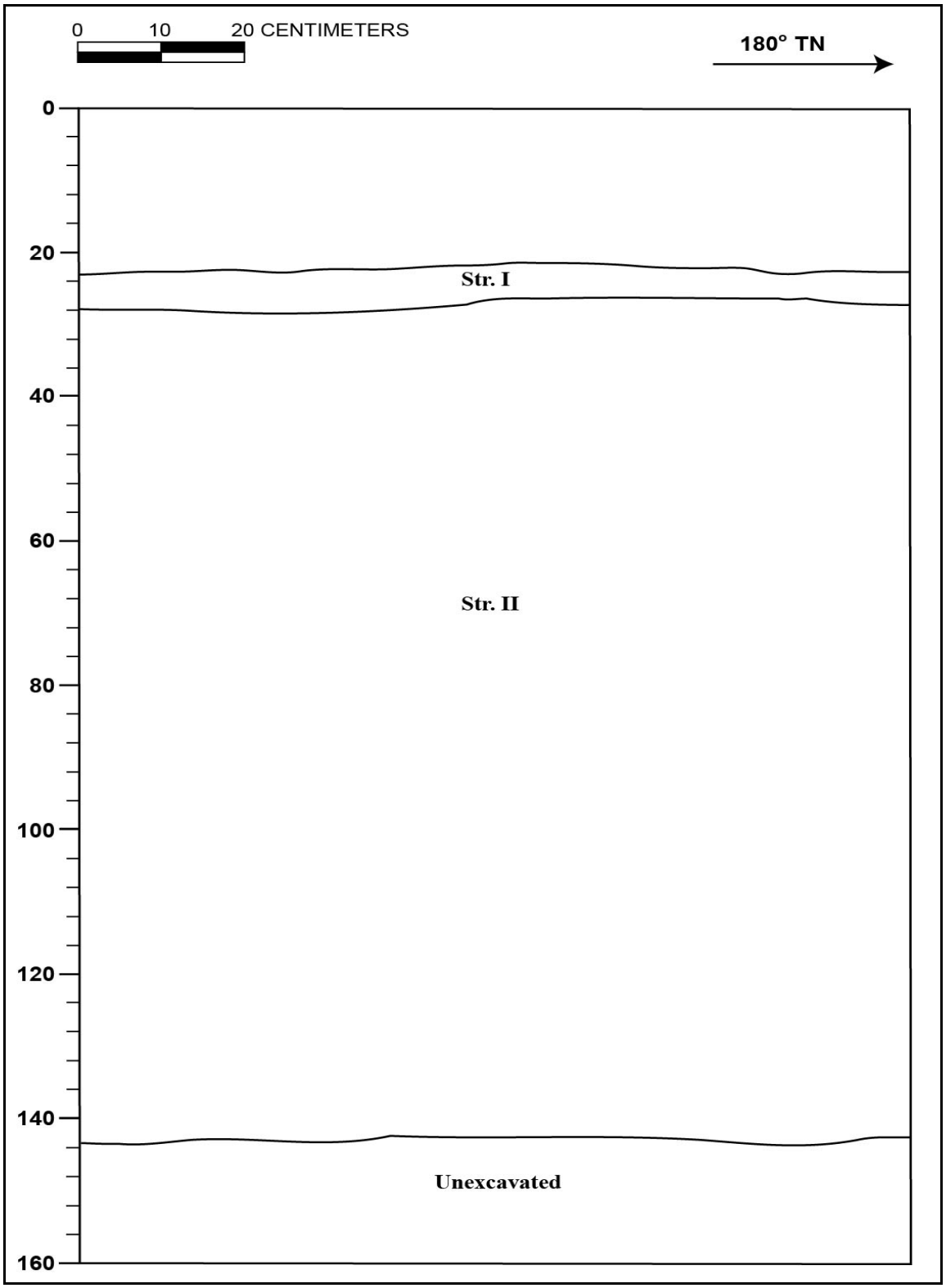

Figure 34. Profile of east wall of Test Unit 1

Section 6 Summary and Recommendations

Early historical and legendary accounts indicate that the immediate area had a long history as a crossing area across the Wailuku River, including as a simple ford in the pre-Contact and early post-Contact period, to the early plank cross-bridges, to later concrete and steel bridges. Mid-nineteenth century land documents indicate that the coastal Pu‘u‘eo area was used for habitation. Although the steep banks of the Wailuku River in this area were probably not used for irrigated taro agriculture, the land at the top of the scarp may have been used for dryland sweet potato crops. In the mid-nineteenth century to the late twentieth century, the focus of agriculture switched to sugar cane cultivation. There were several camps for the new immigrant sugar plantation workers along the coast and in the uplands.

In the late nineteenth century, Pu‘u‘eo became a favored residential section, separated from the commercial section of Hilo by several bridges across the Wailuku River. However, there were a few shops in the Pu‘u‘eo area, including the Serrao store, once on the northeast corner of the subject parcel. In the later twentieth century, the residents, tenements, and stores in the subject parcel were demolished to make way for the new Riverside Apartments.

The background information, therefore, indicates that this area had a rich history of habitation and agricultural use from the pre-Contact period to the present, However, the proposed stream bank stabilization work will affect only the steep scarp on the south side of the Riversides Apartment study area, which is a portion of the north bank of the Wailuku River upstream of the Keawe/Pu‘u‘eo Street Bridge. Early photographs indicate that the project area was always a steep slope. The easiest place to cross, across a natural ford over several large rocks, seems to have been upstream of the present project area near Make Falls (see Figure 7) near present Wainaku Street. The first bridge near the project area, along the Pu‘u‘eo Street/Keawe Street alignment (once known as “Bridge Street”) to the southeast, was built in 1859. It was replaced by three other bridges over the years. A railroad bridge was also built *makai* of the project area, first in 1909. The history of these bridges illustrates one of the reasons the Wailuku River was named for the Hawaiian phrase “dangerous waters.” Several earthquakes, tsunamis, and floods damaged and destroyed several bridges. It is likely that the scarp in the project area has been scoured by the rising waters of the Wailuku River many times including several flood and tsunami events.

It is unlikely that the steep slope was ever used for habitation or agriculture. If there were any evidence of this use, it is likely that it would have been swept downstream during the turbulent history of the Wailuku River in Hilo. CSH recommends that there is no need for any additional background research, any further subsurface testing, or any monitoring during stream bank stabilization.

No further work is recommended. However, if at any time during construction subsurface features (including lava tubes) or deposits are encountered, CSH recommends that construction activities cease and that the SHPD be contacted immediately.

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Appendix A Land Commission Award 4809

No. 4809, Lo, Puueo, Hilo, Hawaii, January 11, 1848

N.R. 692v8

Greetings to the Land Commissioners: I, Lo, of Puueo, Hilo, hereby state my claim for land in Puueo, received from my makuas. The length of my land is 144 fathoms and the width is 83 fathoms, as far as Wailuku. This land is good in a portion and a portion is a pali along the Muliwai of Kolopulepule. There is another parcel of land adjoining this land and in another place, 19 fathoms by 8 fathoms. Another parcel which does not adjoin these parcels is 52 fathoms by 43 fathoms. Another parcel is 45 fathoms by 20 fathoms. Another parcel is 80 fathoms by 17 fathoms. These land claims are known and were received from my father. The old timers in Puueo are my witnesses for my claim.

LO

F.T. 13v5

No. 4809, Lo, Friday, November 10th, 1848 [Moses Lo]

Mahi, sworn deposed, that he know the claim of Lo to be situated on the Ahupuaa Puueo and to consist of 5 lots.

Lot 1 is bounded:

On the west by the main road
On the north by Pitman's ground
On the east by the sea
On the south by the mountain stream Wailuku.

That there are 7 houses on the lot, 2 belong to Lo, 2 Hoaai, 1 Papa, 1 Kanealua, 1 Kaehuaku, but none of them have any right in the soil, but Lo, the whole of these lots were given him by Hoolulu in the year 1829.

Lot 2 contains 1 field bounded:

On the west by Kanakapalupalu
On the north by konohiki
On the east by the ground of Laauohala and
On the south by a water course.
There is no house on this lot.

Lot 3 consists of 1 field bounded:

On the west by konohiki
On the north by water run
On the east by the ground of Kaiohe
On the south by mountain road.

Lot 4 consists of 1 field surrounded by waste land of konohiki, has no house on this lot.

Lot 5 consists of 1 field bounded:

On the west by Kanaiana's ground
On the north by the ground of Kauhiahiwa
On the east by the ground of Halaki and
On the south by water run.

His right has never been disputed.

Wahine, sworn deposed, that the evidence of Mahi was true.

N.T. 418-419v4

No. 4809, Lo

Mahi, sworn, he has seen in Puueo ahupuaa of Hilo, a land section.

Mauka by street
Hamakua by Britinan's lot
Makai by beach
Puna by Wailuku.

2 houses for Lo, 2 for Honai, 1 each for Kapapa, Kaneelaa and Kaehuaku, they have no claim. Land from Hoolulu in 1829.

Mio section:

Mauka by Kamakapalupalu's house.
Hamakua by idle land
Makai by Laanohala's land
Puna by ditch
1 cultivated kihapai.

Section 3 - Makai, Laauohala's land

Mauka by idle land
Hamakua by ditch
Makai by Kaiohe's house
Puna by street.

1 partially cultivated kihapai: Mauka and all around this kihapai is idle land.

New Kihapai:
Mauka by Kaenaena's land
Hamakua by Kauhiahiwa's land
Makai by Haleki's land
Puna by stream.
1 cultivated kihapai

Land from Hoolulu in 1829, no one has objected.

Wahine, sworn, he has seen this land exactly as Mahi has seen it.

[Award 4809; R.P. 4687; Puueo Hilo; 4 ap.; 8.86 Acs; (Moses Lo)]