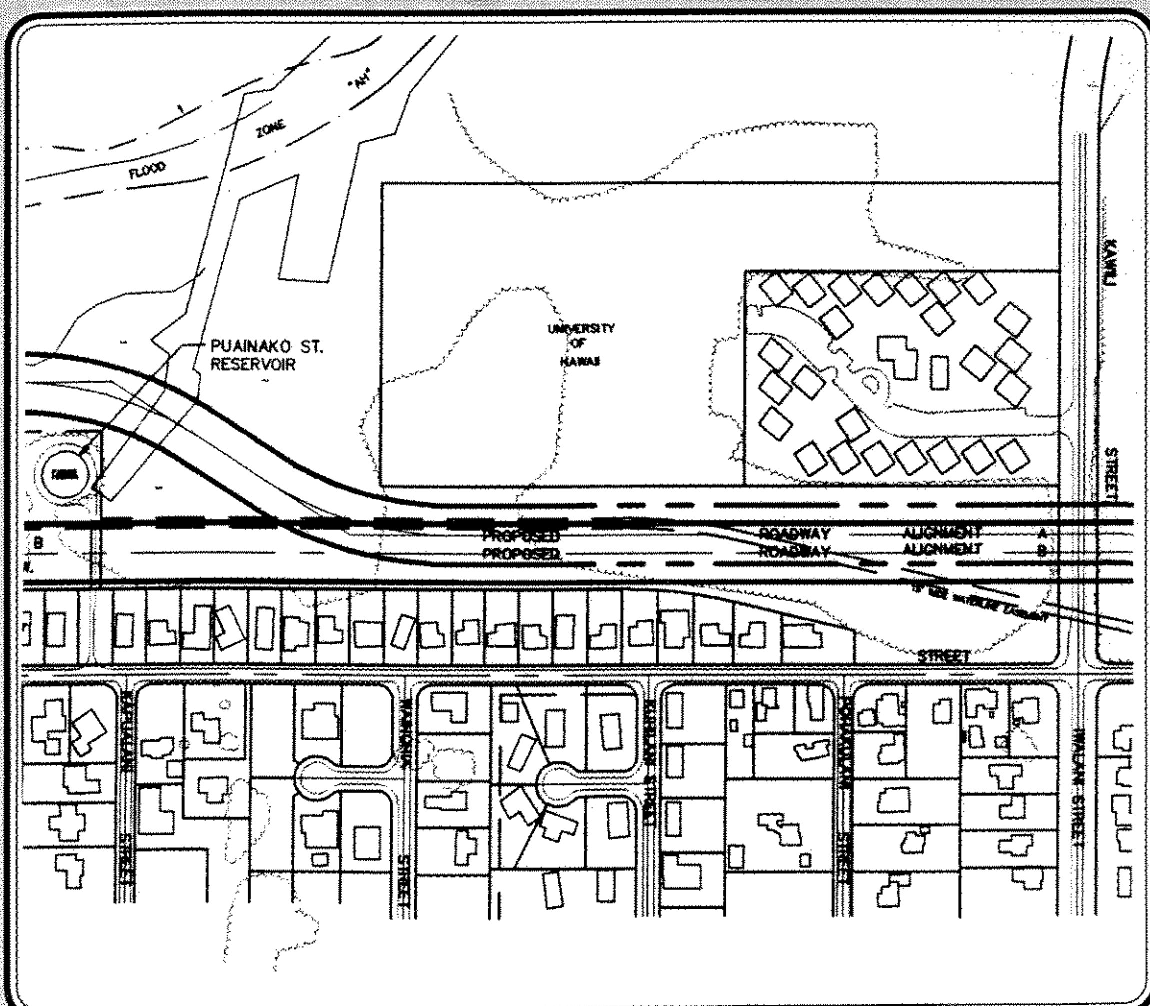
Final

Environmental Impact Statement

Puainako Street Extension and Widening

Island of Hawai`i



August 1993

FILE COPY

JOHN WAIHEE
GOVERNOR

BRIAN J. J. CHOY
Director

STATE OF HAWAII
OFFICE OF ENVIRONMENTAL QUALITY CONTROL
220 SOUTH KING STREET
FOURTH FLOOR
HONOLULU, HAWAII 96813
TELEPHONE (808) 586-4185

November 29, 1993

TO: The Honorable John Waihee
Governor, State of Hawaii

THROUGH: The Honorable John Lewin, M.D.
Director, Department of Health

FROM: Brian J. J. Choy
Director, Office of Environmental Quality Control

SUBJECT: Recommendation for Acceptance - Final Environmental Impact Statement for the Puainako Street Extension and Widening, South Hilo, Hawaii

We have reviewed this Final Environmental Impact Statement and have found it to meet the requirements of Chapter 343, Hawaii Revised Statutes and Chapter 200 of Title 11, Hawaii Administrative Rules, Environmental Impact Statement Rules. We recommend that this statement be accepted by you. An acceptance report is attached for your review. The Final Environmental Impact Statement is also attached for your information and use.

Attachments

JOHN WAIHEE
GOVERNOR

BRIAN J. J. CHOY
Director

STATE OF HAWAII
OFFICE OF ENVIRONMENTAL QUALITY CONTROL

220 SOUTH KING STREET
FOURTH FLOOR
HONOLULU, HAWAII 96813
TELEPHONE (808) 586-4185

November 29, 1993

FINAL ENVIRONMENTAL IMPACT STATEMENT ACCEPTANCE REPORT

Project: Puainako Street Extension and Widening

Location: South Hilo, Hawaii

TMK: 2-2, 2-4, 2-5

Proposing Agency: County of Hawaii, Department of Public Works

A. BACKGROUND

The Puainako Road Extension has been a part of the Hawaii County General Plan since 1967, when "A Plan for Metropolitan Area of Hilo" designated Puainako as a secondary arterial street. The proposed project involves the widening and extension of Puainako Street between Kilauea Avenue and Country Club Road in Kaumana, South Hilo, Big Island of Hawaii. The project is comprised of two major components, a widening and partial realignment of Puainako Street between Kilauea Avenue and Komohana Street, and the creation of a new highway between Komohana Street and Country Club Road. The total length of the roadway improvements is approximately 6.1 miles.

The Puainako Street Extension and Widening Project has long been envisioned as an opportunity to: 1) improve the congested traffic conditions on Puainako Street and Kaumana Drive, 2) improve arterial traffic flow between Highway 11 (Volcano Highway) and the Saddle Road (Highway 20) thereby minimizing travel time and traffic hazards, and 3) provide an alternative evacuation route from Kaumana in the event of volcanic hazard from Mauna Loa.

The project implementation would involve typical construction activities associated with building a roadway system. These would include effects on traffic, noise, air quality, scenic resources, and flora and fauna. There are numerous archaeological features within a portion of the project

area. These features are plantation-era in age and primarily reflect activities associated with sugar cultivation. Proposed mitigation measures include additional data recovery from the features that will be destroyed by construction. The project might also necessitate the relocation of as many as six houses. Thus, short-term construction related impacts on the environment would be generated by the project. Mitigative measures would be implemented to minimize these impacts.

B. PROCEDURE

1. The notice of availability of the Environmental Impact Statement Preparation Notice for this project was published in the June 8, 1992, *OEQC Bulletin*. The 30-day consultation period for this project expired on July 8, 1992. During this period three comment letters were received. The substantive comment letters as well as the responses to them are included in the Draft Environmental Impact Statement.

2. The notice of availability of the Draft Environmental Impact Statement for this project was published in the January 23, 1993, *OEQC Bulletin*. The 45-day review period expired on March 9, 1993. During the Draft Environmental Impact Statement review period a total of 21 comment letters were received. The substantive comment letters as well as the responses to them are included in the Final Environmental Impact Statement.

3. The notice of availability of the Final Environmental Impact Statement for this project was published in the September 23, 1993, *OEQC Bulletin*.

The Office of Environmental Quality Control has determined that this document is in compliance with the filing requirements of Chapter 200 of Title 11, Hawaii Administrative Rules, Environmental Impact Statement Rules and with Chapter 343, Hawaii Revised Statutes.

C. ENVIRONMENTAL IMPACT STATEMENT CONTENT

The Final Environmental Impact Statement for the Puainako Street Extension and Widening contains or incorporates by reference the following:

1. Summary sheet
2. Table of contents
3. Statement of purpose and need for action
4. Project description
5. Discussion of known alternatives to the proposed action
6. Description of the environmental setting

7. A statement of the proposed action's relationship to the land use plans, policies, and controls for the affected area
8. A statement of probable impact on the environment
9. Relationship between local short-term uses and enhancement of long-term productivity
10. Discloses all irreversible and irretrievable commitments of resources
11. Addresses all probable unavoidable adverse environmental effects
12. Description of mitigation measures to minimize impacts
13. A summary of unresolved issues
14. A list of organizations and individuals consulted in the Draft Environmental Impact Statement process
15. Reproductions of all substantive comments and responses made during the Draft Environmental Impact Statement review period

The Office of Environmental Quality Control has determined that the content requirements of the Environmental Impact Statement, as specified in Section 11-200-17 of the Environmental Impact Statement Rules, have been met.

D. RESPONSES TO COMMENTS

The County of Hawaii, Department of Public Works has responded to all substantive comments made during the review period of the Draft Environmental Impact Statement. The substantive comment letters as well as the responses to them are included in the Final Environmental Impact Statement.

The Office of Environmental Quality Control has determined that this Environmental Impact Statement has fulfilled the public review requirement of Chapter 200 of Title 11, Hawaii Administrative Rules, Environmental Impact Statement Rules.

E. UNRESOLVED ISSUES

Review of Archaeological Inventory Survey

This project is a joint state and county undertaking. Therefore, compliance with the State's historic preservation law is required prior to construction. The State Historic Preservation Division is presently reviewing the project's archaeological inventory survey to verify: (1) adequacy of site/feature recordation and coverage, (2) site/feature functional determination, and (3) site significance assessment.

Once the review of the archaeological inventory survey is complete, mitigation measures must be determined and approved by the State Historic Preservation Division, in order to comply with

the State's historic preservation law. These mitigation measures must be finalized before construction begins.

F. SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT

After this Final Environmental Impact Statement for the Puainako Street Extension and Widening is accepted, a supplemental environmental impact statement shall be prepared if there is a major or substantial change to the proposed project, or if different environmental impacts are anticipated.

Any supplemental environmental impact statement shall be reviewed in accordance with Chapter 343, Hawaii Revised Statutes, and Chapter 200, of Title 11, Hawaii Administrative Rules.

G. DETERMINATION

It is important to note that all comments received during the development of the Puainako Street Extension and Widening Environmental Impact Statement should be given consideration equal to the analyses and conclusions presented in the Final Environmental Impact Statement. For this reason, public and agency comments are required to be included as part of the Final Environmental Impact Statement.

The Office of Environmental Quality Control has determined this Final Environmental Impact Statement to be acceptable under the procedures established in Chapter 343, Hawaii Revised Statutes. Therefore, we recommend that this document be accepted.

Sincerely,

Brian J. J. Choy
Director

Ms. Donna Fay K. Kiyosaki
Chief Engineer
County of Hawaii Department of Public Works
25 Aupuni Street, Room 202
Hilo, Hawaii 96720

Dear Ms. Kiyosaki:

Subject: Final Environmental Impact Statement for the Puainako Street Extension and Widening, South Hilo, Hawaii

I am pleased to accept the Final Environmental Impact Statement for the Puainako Street Extension and Widening as satisfactory fulfillment of the requirements of Chapter 343, Hawaii Revised Statutes. This environmental impact statement will be a useful tool in the process of deciding if the action described therein should be allowed to proceed. My acceptance of the statement is an affirmation of the adequacy of that statement under the applicable laws and does not constitute an endorsement of the proposed action.

When the decision is made regarding the proposed action itself, I expect the appropriate legislative bodies and governmental agencies to consider if the societal benefits justify the economic, social and environmental impacts which will likely occur. These impacts are adequately described in the statement, which together with the comments made by reviewers, provide useful analysis of the proposed action.

JOHN WAIHEE

c: Office of Environmental Quality Control

DEPARTMENT OF PUBLIC WORKS
COUNTY OF HAWAII

The Environmental Document is Submitted
Pursuant to Chapter 343, HRS

FINAL ENVIRONMENTAL IMPACT STATEMENT
PUAINAKO STREET EXTENSION AND WIDENING,
ISLAND OF HAWAII

PROPOSING AGENCY:
Department of Public Works
County of Hawaii
25 Aupuni Street
Hilo, Hawaii 96720

ACCEPTING AGENCY:
Governor, State of Hawaii

for Donna Fay K. Kiyosaki
Chief Engineer
County of Hawaii

August 1993

FINAL ENVIRONMENTAL IMPACT STATEMENT

PUAINAKO STREET EXTENSION AND WIDENING

ISLAND OF HAWAII

County of Hawaii
Department of Public Works

August 1993

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

Executive Summary

EXECUTIVE SUMMARY

This Final Environmental Impact Statement (Final EIS) has been prepared to address potential environmental impacts of the proposed Puainako Street Widening and Extension project in Hilo on the Island of Hawaii. This executive summary includes brief descriptions of the proposed project, beneficial and adverse impacts, proposed mitigative measures, alternatives, recommendations, and the project's relationship to existing government policies and plans.

Project Description, Purpose And Need

The Puainako Road Extension has been a part of the Hawaii County General Plan since 1967, when "A Plan for Metropolitan Area of Hilo" designated Puainako as a secondary arterial street. At that time, it was planned that the project would ultimately connect the Saddle Road to the Hilo International Airport. Most of the right-of-way in the Lower Portion (makai of Komohana) has been owned by the State of Hawaii for several decades and is dedicated to eventual use by the highway. Local planning developments have been granted approval with the ultimate development of the highway in mind.

The proposed project involves the widening and extension of Puainako Street between Kilauea Avenue and Country Club Road in Kaumana, South Hilo, Hawaii. The project is comprised of two major components, a widening and partial realignment of Puainako Street between Kilauea Avenue and Komohana Street, and the creation of a new highway between Komohana Street and Country Club Road. The total length of the roadway improvements is approximately 6.1 miles.

As the upland neighborhoods of Hilo have grown in population, Puainako Street has become a principal conduit collecting traffic to and from the neighborhoods of Kaumana and Waiakea Uka. Puainako Street serves drivers destined for a number of locations within Hilo and in surrounding districts. Waiakea High School, Waiakea Intermediate, Waiakea Elementary, Hawaii Community College and the University of Hawaii at Hilo are all located on or near Puainako Street. Commuters using the existing Puainako Street and Kaumana Drive currently experience congested traffic conditions. Traffic engineers have calculated that traffic Level of Service operates at undesirable levels at peak periods. With an increase in traffic of up to 68 percent forecast for the year 2010, it is clear that congestion will worsen to critical levels without some remedial measures.

The proposed project consists of the following elements:

1. Lower Portion

- o Design and construction of a four-lane roadway within the existing and realigned Puainako Street right-of-way between Komohana Street and Kilauea Avenue. Review of alternatives for the roadway design, including limited and full turning options along intersections with Puainako Street, as well as a possible frontage road along the south side of Puainako Street.

- o Realignment of the existing Puainako Street right-of-way between Komohana Street and Kawili Street, parallel to and north of the existing Puainako Street. Acquisition of necessary land to provide a minimum 120-foot right-of-way.

2. Upper Portion

- o Design, acquisition, and construction of a new two-lane road within a 120-foot right-of-way beginning on Kaumana Drive, at a point between Wilder Road and Country Club Drive, to Komohana Street. The design width of the right-of-way may be reduced before construction because of engineering or cost considerations. The actual width of the right-of-way may be somewhat wider than the design width in some locations as roadway structures dictate.

- o Review of a minimum of two alternative alignments to ensure the route selected will be cost-effective, will address the circulation and safety issues, and will not adversely affect any significant environmental resource.

Alternative Alignment Consideration

In order to ensure that the route selected will be cost effective, will address the circulation and safety issues, and will not adversely affect any significant environmental resource, several alternative alignments have been reviewed. For both the Lower and Upper Portions, two alternative alignments are considered (Figures 1-1a and 1-1b). For the Lower Portion, Alignments A and B are identical from the beginning of the Lower Portion, at Kilauea Avenue, to the intersection of Puainako and Kawili/Iwalani Streets. Mauka of this point, Alignment A crosses University of Hawaii land parallel to and approximately 800 feet from Puainako Street. The purpose of this alignment was to lessen impacts to Puainako Street residents.

Alignment B consists of the existing state right-of-way between the Puainako State Housing Project and the University of Hawaii at Hilo. It crosses Komohana Street near the existing bridge across Waiakea Stream.

The Upper Portion begins where Alignments A and B cross Komohana Street. Alignment 1 begins at Komohana Street 2,000 feet mauka of Komohana Street where the Lower Portion Alignments A and B converge. Alignments 1 and 2 share the same path for approximately the first 6,000 feet. Just mauka of the upper end of Sunrise Estates, at elevation 520 feet, Alignments 1 and 2 bifurcate. Alignment 1 crosses Edita Street approximately 1,000 feet from its intersection with Kaumana Drive and continues uphill parallel to Kaumana Drive, staying south of most existing housing developments on Kaumana until it reaches Wilder Road. Alignment 1 then crosses Wilder Road approximately 1,500 feet from the intersection with Kaumana Drive, and then intersects with Kaumana Drive about 1,000 feet mauka of Kaumana Village.

After splitting from Alignment 1 above Sunrise Estates, Alignment 2 traverses towards the south, wide of all existing development, including that on Wilder Road. It would be necessary to construct extensions from one or more streets, including Wilder Road, in order to connect existing homes and streets in Kaumana with Alignment 2. This alignment makes a large radius right-turn turn to the northwest, mauka of Wilder Road, in order to connect with Kaumana Drive, just below Country Club Road.

Alternative Design Option Consideration

Two further issues in the Lower Portion require careful consideration in order to accomplish the goal of efficient traffic flow. One is the treatment of turning options in the section of Puainako Street between Kilauea Avenue and Kawili Street, and the other is how to channel traffic flow from the segment of the existing Puainako Street mauka of Kawili Street. The design engineers arrived at two sets of design options to handle these issues.

On the segment of Puainako Street between Kilauea Avenue and Kawili Street, Design Option I would widen the existing right-of-way to 160 feet and create a frontage road out of the existing street. Design Option II differs from Design Option I in that no frontage road would be built, reducing the total right-of-way to 120 feet. Full left-turn freedom would be accommodated from all intersections and driveways in both options. Design Option III is identical to Design Option II except in its treatment of left turns. Left turn/stacking lanes would be provided at all major intersections, but left turn movements would be prohibited from most of the existing side streets onto the proposed roadway.

Preservation of the present configuration of the existing segment of Puainako Street between Kawili and Komohana Streets conflicts with the recommended spacing of intersections on major arterials. Engineers have proposed two options to increase the efficiency and reduce the traffic hazards in the immediate vicinity of these two intersections. Design Option X would cul-de-sac the makai end of the existing segment of Puainako Street (i.e., just mauka of the Kawili Street intersection). Access from the existing Puainako Street to the proposed roadway would take place through an existing right-of-way near the water tank behind the State Housing Project. Design Option Y would cul-de-sac the mauka end of the existing segment of Puainako

Street (i.e., just makai of the Komohana Street intersection). Access to the proposed roadway would take place as in Design Option X.

Funding

The estimated cost for the planning and construction of the project is $30.23 to $33.26 million in 1992 dollars. The project is a joint project of the State of Hawaii and the County of Hawaii, and the source of this funding is likely to come from the State. However, the exact date of availability of this funding and, therefore, the probable date for the construction of the project, is not clear at this time. Funding for the planning and design has been provided through the state and transferred to the County of Hawaii Department of Public Works. The state has appropriated $6.8 million for the project, including $4.8 million for construction and the balance for planning, design, and land acquisition.

Anticipated Short-term Adverse Impacts and Mitigative Measures

The project implementation would involve typical construction activities associated with building a roadway system. These would include effects on traffic, noise, air quality, scenic resources, and flora and fauna. The project might also necessitate the relocation of as many as six houses. Thus, short-term construction related impacts on the environment would be generated by the project. Mitigative measures would be implemented to minimize these impacts.

1. Traffic Congestion

It is expected that construction would last two to three years. During the construction period, operation of construction equipment, trucks, and worker vehicles would impede traffic along the lower portion of Puainako Street, particularly during school hours. The traffic congestion problem during the construction of the upper portion of Puainako Street is not anticipated to be significant.

Mitigation

Construction will avoid peak traffic hours. Construction of the section in front of the Waiakea schools should be scheduled for the summer vacation to the greatest extent possible.

2. Noise and Air Impacts

Construction activities would create short-term unavoidable impacts on noise and air quality (fugitive dust) within the project area.

Mitigation

These short term adverse effects will be minimized through the use of standard abatement procedures. Special care will be taken to mitigate dust, noise and related construction activities in order to maintain traffic safety during school operating hours.

3. Fauna and Ecosystem Impacts

The construction phase of the project poses a low but not insignificant threat to nests and potential habitat of the 'Io, an endangered native hawk.

Mitigation

Since the mitigation recommendations for short-term adverse effects are included within long-term mitigation plans, they will be discussed in the following section.

4. Relocation Impacts

Implementation of the roadway project may necessitate acquisition of certain houses along both sides of Puainako Street between Kilauea Avenue and Kawili Street, requiring the displacement of current residences.

Mitigation

Right-of-way and relocation activities will be carried out in accordance with applicable state and/or federal guidelines. A relocation plan which includes direct contact and discussion with and assistance to all affected parties shall be coordinated with the State Housing Finance and Development Corporation.

5. Visual Impacts

The visual character of the area would be affected by construction activities and by the presence of construction equipment. No mitigation is planned for these short-term effects.

Anticipated Long-term Adverse and Beneficial Impacts and Mitigative Measures

Once the roadways are in place and operational, some long-term adverse effects would have occurred or would continue to occur. Mitigative measures have also been proposed to minimize the long-term adverse effects of the project. The anticipated long-term adverse impacts and proposed mitigative measures are listed below:

1. Traffic Impacts

It is expected that implementation of this project would improve the overall efficiency and safety of the roadway network between the Waiakea and Kaumana sections of Hilo. However, there would be permanent **increase** in traffic flow as a result of improvements of the roadway system. There would be cumulative effects of the Puainako Street Extension and Saddle Road Improvements.

Mitigation

The Design Options discussed in this document are designed to optimize traffic flow and to create a level of service that exceeds present conditions. Also, the Island of Hawaii Long Range Highway Plan (State of Hawaii 1991) has proposed the extension of Kawailani Street, which would intersect with the Puainako Street Extension and terminate at Kaumana Drive, makai of the Puainako Street junction. This addition to the road network would provide alternate access from upper Waiakea and Kaumana to locations within and outside Hilo, reducing congestion on Puainako.

2. Historic and Archaeological Preservation Impacts

The development of the Puainako Street Extension would destroy some archaeological features associated with sugar cane cultivation. This disturbance of archaeological resources can be minimized by selecting the road alternatives with the fewest and least significant archaeological remains. From a historic preservation standpoint, Alternative Alignment 1 (upper) and Alternative Alignment B (lower) are preferable. This route avoids most of the features identified in the project area.

Mitigation

Mitigation in the alternative route selected for development will include detailed data recovery from the sites that would be lost in development. Data recovery will include complete mapping, photography, and excavations to determine site content and chronology. Preservation of archaeological sites identified in the other routes (not developed) near the project area should be considered. The University of Hawaii at Hilo is currently considering plans for preservation of some of the remnants of cane cultivation activities located near the campus.

Monitoring by an experienced archaeologist during all vegetation clearing and earthwork activities is recommended to identify any additional subsurface archaeological resources that may be discovered.

3. Hazard Exposure Impacts

No feasible alternative for serving Kaumana traffic can avoid the hazard of lava flows, and there are no practical mitigating measures.

However, the new road would offer an alternative escape route from Kaumana in case of natural disasters or auto accidents. The Puainako Extension would be connected to Kaumana Drive along several streets -- at a minimum, Wilder Road, Edita, and at its terminus near Country Club Drive -- and would thus more efficiently conduct traffic away from Kaumana, even if Kaumana Drive were blocked by an auto accident. The wider roadbed and shoulders of the highway would also be less likely to become completely blocked in case of an auto accident. The proposed highway would also offer alternative access to Hilo Hospital for emergency vehicles. The sum of these conditions represents a beneficial impact in terms of hazard exposure for the residents of Kaumana.

4. Air Quality Impacts

Use of the project would entail traffic, which thus would seem to imply greater levels of automobile pollution. Because any increase would be negligible in terms of overall traffic and the dispersive ability of regional winds, no direct mitigation is proposed for this project. However, two possible indirect mitigating factors would be the increased efficiency of automobile engines--because stop-and-go traffic would be reduced--and shorter total commuting distances for residents of Kaumana.

5. Noise Impacts

In the Lower Portion of the project area the proposed alignments and improvements may raise noise levels at the schools as well as through the residential areas because of greater traffic volume and less physical setback from the roadway. It is anticipated that the new roadway may lower highway noise levels for the section of the Lower Portion between Kawili Street and Komohana Street.

Mitigation

The final alignment's location will be carefully considered so as to maximize distance from existing residences and the school complex. Buffer strips will be provided and planted with vegetation in order to diffuse the sound waves before they reach the receivers. In areas where it would not be possible to provide buffer strips or planter strips, structures such as cement/rubble masonry or concrete walls will be constructed. At the Waiakea school complex, another noise reduction strategy would be to close doors and windows during times of high source emissions, to replace existing doors and windows with noise reduction types, and to install sound reducing insulation.

6. Floodplain and Drainage Impacts

Without appropriate mitigation, the project could alter the hydrological characteristics of the area by marginally increasing the proportion of low-permeability surface, by presenting the potential for a speedier delivery of surface floodwater, by crossing existing drainage channels, and possibly by altering the directions and rates of soil water and groundwater passage.

Mitigation

The goal and purpose of drainage impact mitigation measures is to eliminate net impact to the overall flow of the natural drainage system. This objective will be accomplished through a number of measures. In the vicinity of flood zone crossings, the actual limits of the floodplain and the expected flood water elevations will be determined. The project will utilize drywells, percolation ponds, detention ponds and retention ponds to balance the pre-developed are post-developed rate of rainfall runoff. Culverts could be installed to permit the 100-year design storm runoff to pass beneath the roadway. Provisions will be made to minimize the potential for soil erosion during construction grading and earthwork. Details of the techniques to be employed may be found in Section 3.3.5.

7. Flora, Fauna, and Ecosystem Impacts

Construction of this project would unavoidably result in the destruction of some or all of the existing vegetation within the right-of-way. However, the flora and vegetation of the project area were found to have little conservation value. Therefore, it is concluded that the impact on native flora and vegetation is insignificant.

This project poses a low but not insignificant threat to nests and potential nesting habitat of the ‘Io, a listed endangered bird. No nests are known in the project area, but the ‘Io does forage in the area. Most of the nesting habitat that would be destroyed is of only marginal value to the ‘Io; abundant habitat of similar or higher quality remains in the vicinity.

The project poses no significant threat to other native birds since none are likely to utilize this habitat. No rare or endangered birds, except the ‘Io, are known to utilize the project area. Although the Hawaiian Hoary Bat does occur in the project area, the project poses no significant threat to this listed endangered species. The bat is known to adapt to urbanization and is non-specific in its choice of roost sites.

Construction of this project could pose a significant threat to the native invertebrate species and the below-ground ecosystem of Kaumana Cave. If the cave is collapsed or breached, or if native vegetation above the cave is disturbed, there may be loss of cave habitat and the potential of contamination by groundwater runoff that may carry pesticides or other harmful substances.

Mitigation

Measures to restrict the spread of alien plant species into semi-intact native communities shall be taken, including limiting construction activities as far as feasible to the actual right-of-way corridor and landscaping with appropriate native plants.

Efforts will be made to avoid disturbing active nests of 'Io if any are encountered. 'Io aggressively defend their nests by calling and flying at intruders. Any hawk acting in this manner is an indication of a nest nearby. If an aggressive 'Io is encountered, activities in the immediate area will be suspended until contact is made with the Protection Forester, Division of Forestry and Wildlife (DOFAW) in Hilo and the Endangered Species Office of the U.S. Fish and Wildlife Service (FWS) in Honolulu. Construction activity may resume when the nest is located and consultation with DOFAW and FWS is completed.

To avoid damage to the native invertebrates and ecosystem of Kaumana Cave, it is recommended that construction over Kaumana Cave should be avoided and the vegetation intact over the cave. As a part of this project, professional surveyors accurately mapped the cave for the first time. The final alignment will afford sufficient undisturbed buffer between the road and the cave.

8. Wetland Impacts

The biological survey revealed the widespread presence of California grass, honohono grass and other species considered by the U.S. Army Corps of Engineers to signal the potential for a wetland. Two obligate wetland species, the spikerush and Mexican rattlebox, were found on Alignment 2. Therefore, the possibility exists that patches of wetland are present in the area. Prior to any construction activities, an analysis of wetland status will be conducted for the chosen alignment, following the criteria outlined in the U.S. Army Corps of Engineers' 1987 *Wetland Delineation Manual.*

9. Visual Impacts

The mitigation structures described above in the section on Noise Impacts would partially screen residents of the State Housing Project from visual impacts as well. Landscaping including trees and shrubbery could also be planted on the edge of the right-of-way to further screen the residents from views of the highway. The residents would be aware of the construction of the highway and would be able to take measures for themselves to screen out the highway with plantings or structures on their own property if they wish to.

Relationship to Other Policies and Land Use Plans

This Final EIS includes a detailed discussion of the compatibility of the existing State and County plans and policies. Plans and policies considered in this evaluation were:

1. Hawaii State Plan
2. Hawaii State Functional Plans
3. State Land Use Districts
4. Hawaii County General Plan
5. Land Use Pattern Allocation Guide Maps
6. Hawaii County Comprehensive Zoning Ordinance
7. Hilo Community Development Plan
8. Island of Hawaii Long Range Highway Plan

The extensive discussion of the project in relationship to these policies and plans is contained in Chapter 4.

Alternatives To the Proposed Project

1. No Action

This option implies continued dependence on the existing roadway network. Traffic between Kaumana and South Hilo, which is already regularly congested, is forecasted to become worse as existing and future housing developments in Kaumana begin to "fill in." Some of this growth may be avoided as the inconvenience and unsafe conditions discourage full utilization of residential land in this neighborhood. The continuing shortage of convenient housing in other locations, however, will probably mean that Kaumana will maintain its population increase as long as Hilo continues to grow. In the absence of some form of improvement, accidents would rise at an even greater rate than traffic volumes as crowded conditions exacerbate the unsafe roadway conditions on Kaumana Drive.

2. Improved Transportation System Management

There are a number of solutions to commuter congestion on highways. Approaches that merit consideration in this situation include:

a. Minor changes to existing roads

b. Restrictions involving road use, such as work- and school-time staggering, car-pool incentives, or High Occupancy Vehicle Lanes

c. Public transportation system improvement

These options are discussed in detail in the body of the Final EIS.

3. Recommendations

Recommendations are made on three issues: whether the proposed project is the best alternative to satisfy the perceived need for reduced traffic congestion, and, if the proposed project is to be recommended, which combination of alternative alignments and design options would be environmentally most sound.

a. Preferred Alternative Action

It is the recommendation of this document that the preferred alternative is the proposed project. Traffic studies, discussions with public officials, accident statistics, and public opinion surveys emphasize that the traffic congestion problem is quite genuine and growing.

The No Action Alternative would be lead to further traffic congestion in the project area and adjacent roads. Improved transportation management systems hold little promise of a real solution for this specific circulation problem. Detailed discussion of the practicality of such measures is discussed in Section 5.2.

The proposed project appears to be the most effective solution because it involves:

(1) Significant shortening of distance and travel time between Kaumana and frequently used destinations in Hilo.

(2) Widening of lower Puainako Street to four lanes with turning options.

(3) Objectives accomplished with relatively few adverse environmental impacts.

b. Preferred Alignments

It is the recommendation of this document that Alignment B be selected for the Lower Portion and Alignment 1 be selected for the Upper Portion. The rationale behind these choices is stated explicitly in Section 5.3.2.

c. Preferred Design Options

It is the recommendation of this document that Design Option III and Design Option X be selected. The rationale behind these choices is stated explicitly in Section 5.3.2.

Unresolved Issues

There are no unresolved issues remaining.

Chapter 1:
Purpose and Need, and Project Description

CHAPTER 1: PURPOSE AND NEED, AND PROJECT DESCRIPTION

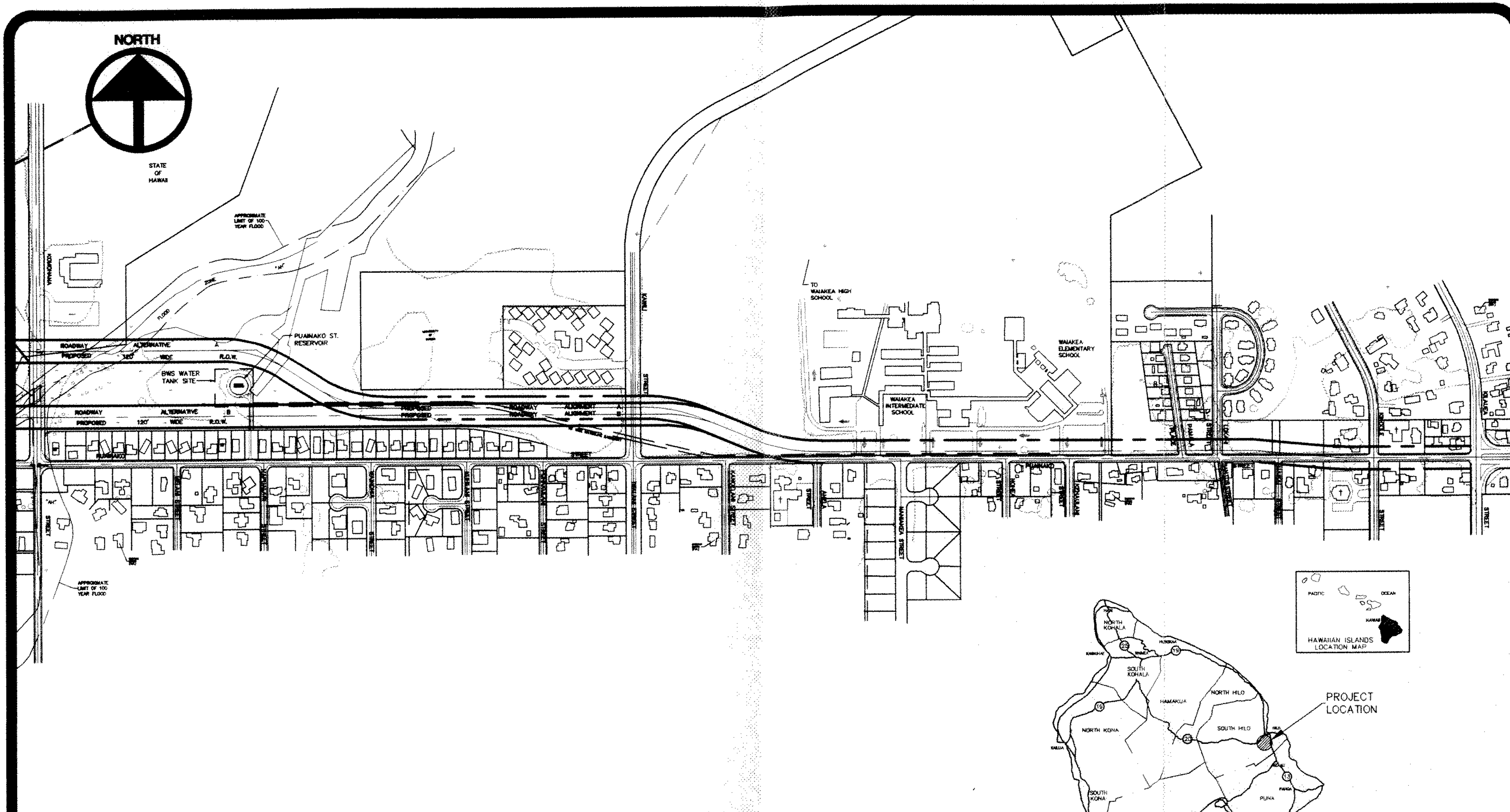
This Final Environmental Impact Statement is divided into six chapters and a set of appendices. Chapter 1 outlines the proposed project, then discusses the purpose and need for the project, and finally describes the specific location and alternative alignments. Chapter 2 consists of a description of the existing social, economic, cultural, and environmental conditions surrounding the proposed project. Chapter 3 discusses the probable impacts of the proposed action and mitigation measures designed to reduce or eliminate adverse environmental impacts. Chapter 4 describes the relationship of the proposed project to other policies and plans at the State and County levels. In Chapter 5, the alternatives to the proposed project are presented, along with an evaluation of the potential of each to address the problem. Chapter 6 lists the consulted parties and also provides a list of the researchers who prepared this Final EIS. Appendix A1 is the transcript of a public meeting on the proposed project held on 20 July 1992, and Appendix A2 presents comments received during the preparation of the Final EIS, as well as the responses to these comments. Appendices B-I are the full research reports on which much of the technical information in the Final EIS chapters is based.

Section 1.1 describes the proposed project, including location, land ownership, and alternative alignments. Section 1.2 discusses the purpose and need for the proposed Puainako Street Widening and Extension project, including the congestion and safety problems of the existing roadway network and the opportunity to alleviate these problems.

1.1 Project Description and Location

The Puainako Road Extension has been a part of the Hawaii County General Plan since 1967 when "A Plan for Metropolitan Area of Hilo" designated Puainako as a secondary arterial street, providing a new corridor between the Waiakea and Kaumana districts and beyond to West Hawaii. At that time, it was planned that the project would ultimately connect the Saddle Road to the Hilo International Airport. Most of the right-of-way in the Lower Portion (makai of Komohana) has been owned by the State of Hawaii for several decades and is dedicated to eventual use by the highway. Local planning developments have been granted approval with the ultimate development of the highway in mind.

The proposed project is comprised of two major components: a widening to four lanes and partial realignment of Puainako Street between Kilauea Avenue and Komohana Street (hereafter referred to as the Lower Portion), and the creation of a new highway between Komohana Street and Kaumana Drive near the Country Club Road Intersection (hereafter referred to as the Upper Portion) (see Figures 1-1a and 1-1b). The total length of the roadway improvements is approximately 6.1 miles.



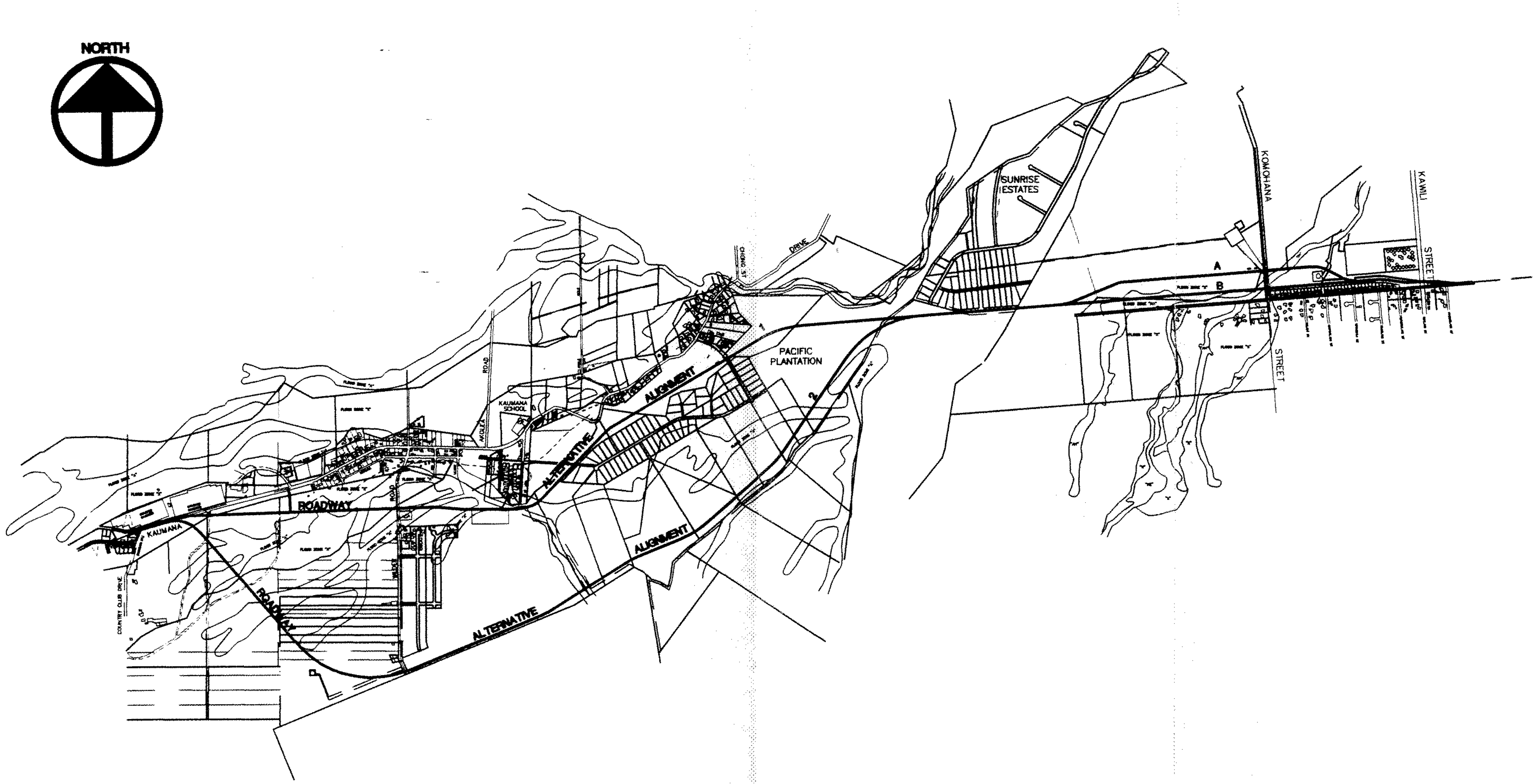
TITLE **ALTERNATIVE ALIGNMENTS: LOWER PORTION**
KOMOHANA STREET TO KILAUEA STREET

FIGURE 1-1a

PROJECT PUAINAKO STREET EXTENSION
HILO, HAWAII

DATE 9/1/92

92014F1



TITLE **ALTERNATIVE ALIGNMENTS: UPPER PORTION**
COUNTRY CLUB DRIVE TO KOMOHANA STREET

FIGURE 1-1b

PROJECT PUAINAKO STREET EXTENSION
HILO, HAWAII

DATE 9/1/92

SCALE: 1"=2000'

91003F3

1.1.1 Project Location

The proposed project is between Kilauea Avenue and Kaumana Drive in the South Hilo District, County of Hawaii. The project ranges in elevation from approximately 325 to 1,475 feet above mean sea level. Table 1-1 lists the Tax Map Key numbers and owners for properties traversed or adjacent to the proposed improvements.

1.1.2 Proposed Action

The proposed action consists of the following elements:

1. Lower Portion:

    a. Review of alternatives for the roadway design, including limited and full turning options along intersections with Puainako Street, as well as a possible frontage road along the south side of Puainako Street.

    b. Realignment of the existing Puainako Street right-of-way between Komohana Street and Kawili Street, parallel and to the north of the existing Puainako Street alignment. Acquisition of necessary land to provide a minimum 120-foot right-of-way.

    c. Design and construction of a four-lane roadway within the existing and realigned Puainako Street right-of-way between Komohana Street and Kilauea Avenue.

2. Upper Portion

    a. Review of a minimum of two alternative alignments to ensure the route selected will be cost-effective, will address the circulation and safety issues, and will not adversely affect any significant environmental resource.

    b. Design, acquisition, and construction of a new two-lane road within a 120-foot right-of-way beginning on Kaumana Drive, at a point between Wilder Road and Country Club Drive, to Komohana Street. The design width of the right-of-way may be reduced before construction because of engineering or cost considerations. The actual width of the right-of-way may be somewhat wider than the design width in some locations as roadway structures dictate.

Construction of the proposed project would necessitate realignment of utilities such as power poles, waterlines, and gas lines. New sewer lines may perhaps be necessary. Construction work would include excavation, embankment, trenching, installation of

TABLE 1.1: **Tax Map Key Identification of Affected Properties**

DATE: 3-10-93
PAGE 1

(LOWER PORTION)		
LOT	2-2-39-31	H. SHIROMA INC.
LOT	2-2-39-57	H. SHIROMA INC.
LOT	2-2-40-12	TAURUKO KAMIYAMA
LOT	2-2-40-26	H.A.K. ASSOCIATES
LOT	2-2-40-25	NOBARU OKUDA
LOT	2-2-40-56	ALLAN K. OKUDA
LOT	2-2-40-42	R.C.J.C.L.D.S. (CHURCH)
LOT	2-4-9-95	WALTER U.C. LOW
LOT	2-4-9-18	JAMES N. NAKAHANA
LOT	2-2-39-58	TSUKASA INOUE
LOT	2-2-39-11	HAWAII BAPTIST CONVENTION
LOT	2-2-39-1	HATADA BAKERY INC.
LOT	2-4-52-21	STATE OF HAWAII
LOT	2-4-52-16	STATE OF HAWAII
LOT	2-4-52-1	STATE OF HAWAII
LOT	2-4-9-17	HILDA M. MANALILI
LOT	2-4-9-16	DOUGLAS W. AGASA
LOT	2-4-9-40	ELLEN S. KUMUJI
LOT	2-4-9-33	STATE OF HAWAII
LOT	2-4-9-41	MASAO M. SUZUKI
LOT	2-4-9-91	TSURUE AKAMINE
LOT	2-4-9-53	HANAKO ARAKAKI
LOT	2-4-9-51	RICHARD H.K. ONISHI
LOT	2-4-9-50	CLINTON C. LEONG, JR.
LOT	2-4-9-83	JOHN C. TAIRA
LOT	2-4-1-5	STATE OF HAWAII
LOT	2-4-1-163	STATE OF HAWAII (UNIVERSITY OF HAWAII)
LOT	2-4-1-162	STATE OF HAWAII (UNIVERSITY OF HAWAII)
LOT	2-4-1-7	STATE OF HAWAII
LOT	2-4-9-113	DOROTHY P. WINGATE
LOT	2-4-9-70	AKIRA FUKUCHI
LOT	2-4-9-69	EUGENE S. OKAMOTO
LOT	2-4-9-68	KIYOSHI YONEMORI
LOT	2-4-9-67	GEORGE T. YAMADA
LOT	2-4-9-79	WENDELL P. GAUCUSANA
LOT	2-4-14-1	ANNIE A. PEDRO
LOT	2-4-14-134	THOMAS T. KURITANI
LOT	2-4-14-61	IGAWA JOINT TRUST
LOT	2-4-14-112	HILO DAIJINGU
LOT	2-4-14-42	DAVID M. BLACKMOR TRUST
LOT	2-4-14-41	FUMIE SAKODA
LOT	2-4-14-86	AGATON B. BARROGA
LOT	2-4-14-87	JACK I. MIYASHIRO TRUST
LOT	2-4-14-88	KAZUYOSHI IDE
LOT	2-4-14-89	SHIZUO KANEKO
LOT	2-4-14-16	ELIZABETH K. MEDERIOS
LOT	2-4-14-15	JAMES F. WELLER ,JR.
LOT	2-4-14-63	HENRY K. APAO
LOT	2-4-14-58	DARRYL H. ARRUDA
LOT	2-4-14-13	CARAMELO DELGADO

Table 1.1: Tax Map Key Identification of Affected Properties (continued)

DATE: 3-10-93
PAGE 2

LOT	2-4-1-10	STATE OF HAWAII
LOT	2-4-22-16	SEIGO NAGAO
LOT	2-4-13-203	HARRY H. NISHIMURA
LOT	2-4-13-204	HARRY H. NISHIMURA
LOT	2-4-1-122 (12)	STATE OF HAWAII
LOT	2-4-13-97	IWAO HASHIMOTO TRUST
LOT	2-4-13-87	PAUL K. FUJIOKA
LOT	2-4-13-29	PAUL K. FUJIOKA
LOT	2-4-13-30	ALAN M. KIMURA
LOT	2-4-1-156	ARNOLD T. KOYA
LOT	2-4-1-43	COUNTY OF HAWAII
LOT	2-4-1-155	JOSE P. PARAS
LOT	2-4-1-154	DEREK S. MORISHITA
LOT	2-4-1-153	REX R. DALERE
LOT	2-4-1-152	STEVEN J. SANTIAGO
LOT	2-4-1-151	CARL P. CONOL
LOT	2-4-1-150	LORETO S. BALANGATAN
LOT	2-4-1-149	WADE I. KITAMURA
LOT	2-4-1-148	MASAMI DAIMARU
LOT	2-4-1-147	QUIRINO ANTONIO, JR.
LOT	2-4-1-146	MICHAEL M.H. TENGAN
LOT	2-4-1-145	JITSUO NISHIDA
LOT	2-4-1-144	ADAM CARVALHO
LOT	2-4-1-143	STATE OF HAWAII (DEPT. WATER SUPPLY)
LOT	2-4-1-157	STATE OF HAWAII (DEPT. WATER SUPPLY)
LOT	2-4-1-142	MARVIN L. ENOS, SR.
LOT	2-4-1-141	MELVIN F. URBANOZO
LOT	2-4-1-140	GARFIELD H. ARAKAKI
LOT	2-4-1-139	BLAYNE S. HANAGAMI
LOT	2-4-1-138	DENNIS I. YOSHIDA
LOT	2-4-1-137	EDWIN S. TAIRA
LOT	2-4-1-136	CLYDE SARAGOSA
LOT	2-4-1-135	WAYNE K. WAGATSUMA
LOT	2-4-1-134	ROBERT J. OSBORN
LOT	2-4-1-133	THELMA S. CLARK
LOT	2-4-1-132	BANJAMIN HIMALAYA
LOT	2-4-1-131	GLEN K. TAKEHARA
LOT	2-4-1-130	WESLEY I. OGATA
LOT	2-4-1-129	NELSON S. FUKUHARA
LOT	2-4-1-128	MILTON K. KALUA
LOT	2-4-1-127	MAXIMO A. CARLOS
LOT	2-4-1-126	WILLIAM R. HALM
LOT	2-4-1-125	SHIGEYOSHI SHINDO
LOT	2-4-1-124	IVAN T. NAKAGAWA
LOT	2-4-1-123	EVELYN Y. TOGASHI
LOT	2-4-1-41	STATE OF HAWAII (UNIVERSITY OF HAWAII)
LOT	2-4-13-31	HAROLD T. HATANAKA
LOT	2-4-13-32	ALICE H. KIM TRUST
LOT	2-4-13-85	HAROLD T. SAITO
LOT	2-4-13-84	ROBERT C. MARTIN
LOT	2-4-13-48	KENICHI YOTSUJI

Table 1.1: Tax Map Key Identification of Affected Properties (continued)

DATE: 3-10-93
PAGE 3

LOT	2-4-13-45	DAN K. MATSUMOTO
LOT	2-4-13-96	ALLEN AHN
LOT	2-4-13-151	YUN HOW C. CHING, et al.
LOT	2-4-13-152	ABRAHAM A. KUBO
LOT	2-4-13-153	ALFREDO ALIPIO
LOT	2-4-13-108	ROY O. SATO
LOT	2-4-13-198	SANDRA DEMATTO
LOT	2-4-13-199	TOMONO FAMILY TRUST
LOT	2-4-13-200	PAUL C. CANTOR
LOT	2-4-13-155	DONNA N. HARA
(UPPER PORTION)		
LOT	2-4-3-29	UNKNOWN
LOT	2-4-1-10	STATE OF HAWAII
LOT	2-4-1-11	STATE OF HAWAII
LOT	2-4-3-28	DONALD S. TONG TRUST
LOT	2-4-1-12	STATE OF HAWAII
LOT	2-4-03-26	STATE OF HAWAII
LOT	2-4-8-26	SUNRISE ESTATES JOINT VENTURE
LOT	2-4-8-14	SUNRISE ESTATES JOINT VENTURE II
LOT	2-5-6-2	BRILHANTE-HAWAII, INC.
LOT	2-5-6-141	STATE OF HAWAII
LOT	2-5-6-2	BRILHANTE-HAWAII, INC.
LOT	2-5-6-3	STATE OF HAWAII
LOT	2-5-61-34	BRILHANTE HAWAII, INC.
LOT	2-5-61-35	BRILHANTE HAWAII, INC.
LOT	2-5-61-36	BRILHANTE HAWAII, INC.
LOT	2-5-61-37	BRILHANTE HAWAII, INC.
LOT	2-5-46-1	TAKAGI BIRU CO., LTD.
LOT	2-5-46-9	DAVID H. MURAKAMI
LOT	2-5-46-7	HAWAIIANA INVESTMENT CO., INC.
LOT	2-5-46-6	MICHAEL O. CUNNINGHAM
LOT	2-5-45-2	M.K. SUGAR CO., LTD.
LOT	2-5-44-1	ORLANDO H. LYMAN TRUST
LOT	2-5-44-15	CLESSON Y. MURASAKI
LOT	2-5-3-20	STATE OF HAWAII
LOT	2-5-55-45	LEITE TRUST
LOT	2-5-55-47	STATE OF HAWAII

utilities, dust and erosion control, installation of traffic signals, reconstruction of driveways, construction of drainage structures including culverts, drywells and retaining walls, landscaping, noise barrier construction, and traffic control.

Construction activities would not be limited to the 120-foot right-of-way due to limited space and the proximity of houses. Sidewalk construction would entail grade changes that would alter driveway profiles, requiring construction to take place within private property to match existing driveway grades. Construction of retaining walls, fences, and drainage infrastructure may also necessitate activity within private property.

1.1.3 Design Criteria and Standards

Preliminary engineering design for the project has been prepared by Okahara and Associates of Hilo, Hawaii. Proposed design criteria and standards for the various aspects of the project are listed in Appendix I. A summary of these criteria is presented here.

For the Lower Portion, the design speed of the roadway is to be 40 MPH, with a planned posted speed of 35 MPH except in the school zone, where the a speed limit of 25 MPH during school hours would be posted using signs and flashing beacons. The vertical alignment of the roadway is to be improved by regrading in sections of poor sight distance to a maximum grade of 8.0%. A stopping sight distance of 325 feet is specified. The right-of-way width is to be 120 feet, with two twelve-foot lanes in both directions and 12-foot left turn lanes. A median with a typical width of 44 feet and a minimum width of 20 feet is also specified. The shoulders shall consist of concrete curbs and 2-foot wide gutters, adjacent to a 7-foot wide sidewalk. Bicycle lanes will be constructed on both sides of the highway. The determination of the precise location and type of traffic signals awaits the selection of Alternate Alignments and Design Options. Any areas disturbed by the construction operations are to be replanted with shrubs, trees, or lawn to restore the aesthetic quality of the existing landscape and to prevent soil erosion.

At or near where the proposed project crosses Komohana Street (depending on the choice of alignment), a bridge structure would be necessary to cross the Waiakea Flood Control Channel. The structure would be designed to accommodate the 100-year flood.

Design criteria for the Upper Portion specify a design speed of 45 MPH and a posted speed of 40 MPH. A maximum grade of 9.0% is planned, with a 400 foot minimum stopping sight distance. The right-of-way width is to be 120 feet, with a 10-foot shoulder of 6-inch aggregate sub-base with a seal coat. All lane widths are to be 12 feet. Signalization details await the selection of the final alignment, but it is anticipated that traffic signals would be required at Komohana Street, Wilder Road, and possibly Kaumana Drive. Landscaping criteria are similar to those for the Lower Portion.

1.1.4 Alternative Alignments

Figures 1-1a and 1-1b illustrate the various alignments analyzed in this EIS. As a point of clarification, the EIS is an information document only. The selection of the final alignment will be made the Hawaii County Department of Public Works and the Hawaii State Department of Transportation.

Existing residential development severely constrains the possible routing of alternative alignments in the Lower Portion. During initial project design, alternative alignments and design options that avoided the necessity of displacing existing houses were considered. A drawback with such options was that they required either narrowing Puainako Street to two lanes or causing its intersection with Kilauea Avenue to be at a sharp angle. All of these options resulted in creating a less safe roadway. Consequently, it was determined that there was no reasonable alternative to the displacement of certain houses along this section of Puainako Street.

During initial project design, many possible alignments for the Upper Portion were developed. However, for reasons of safety, convenience, social consideration, and the cost of land acquisition and intersection construction, most of these alignments were eliminated, leaving two major alignments for detailed analysis.

1.1.4.1 Lower Portion

1. Alignment A

Alignment A and B are identical from the beginning of the Lower Portion, at Kilauea Avenue, to a distance several hundred feet makai of the intersection of Puainako Street with Kawili/Iwalani Street. Mauka of this point, Alignment A turns northward, crosses Kawili Street 287 feet Hamakua side (north) of the intersection with Puainako, then crosses University of Hawaii land, then resumes westward parallel to and approximately 800 feet north of Puainako Street. This alignment would lessen impacts to Puainako Street residents and would simplify bridge construction across Waiakea Stream.

2. Alignment B

After it diverges from Alignment A, Alignment B also traverses northward, crosses Kawili Street 250 feet Hamakua side of the intersection with Puainako, and then proceeds towards Komohana Street within a state-owned parcel between the Puainako State Housing Project and the University of Hawaii at Hilo. This alignment abuts the north side of the house lots of the State Housing Project. Alignment B crosses Komohana Street at the site of the existing bridge across Waiakea Stream.

1.1.4.2 Upper Portion

1. Alignment 1

The Upper Portion begins where Alignments A and B cross Komohana Street. Alignment 1 begins 2,000 feet mauka of Komohana Street, where Alignments A and B converge. Alignment 1 runs west from Komohana Street, passing just south of Sunrise Estates until approaching Kaumana Drive, where it turns south-southwest to cross Edita Street about 1,000 feet from its intersection with Kaumana Drive. From Edita Street, Alignment 1 passes between the housing development bordering the southwest side of Kaumana Drive and the newer Pacific Plantation subdivision. The route roughly parallels Kaumana Drive and continues uphill crossing Wilder Road approximately 1,500 feet from its intersection with Kaumana Drive. Alignment 1 ends at Kaumana Drive, about 1,000 feet mauka of Kaumana Village.

2. Alignment 2

Alignments 1 and 2 share the same path for approximately the first 6,000 feet, from Komohana Street to the upper end of Sunrise Estates, at elevation 520 feet, where the two alignments bifurcate. After the split, Alignment 2 traverses toward the south, wide of all existing development, including that on Wilder Road. This alignment makes a large radius right-turn to the northwest, mauka of Wilder Road, in order to connect with Kaumana Drive just below Country Club Road. Extensions from one or more cross streets, including Wilder Road, would be necessary to connect existing homes and streets in Kaumana with Alignment 2.

1.1.5 Lower Portion Design Options

Regardless of whether Alignment A or B is selected for the Lower Portion, there are two further issues that require careful design in order to accomplish the goal of efficient traffic flow. One is the treatment of turning options in the section of Puainako Street between Kilauea Avenue and Kawili Street, and the other is how to channel traffic flow from the segment of the existing Puainako Street mauka of Kawili Street. The design engineers arrived at several sets of design options to handle these issues. Because each option may have implications in terms of impacts to the social environment, they are discussed and analyzed in the Final EIS.

1.1.5.1 Puainako Between Kilauea and Kawili

1. Design Option I

Design Option I would widen the existing right-of-way to a total width of 160 feet, utilizing the existing roadway pavement and facilities as a frontage road. On the Hamakua (north) side of the existing road, an additional four lanes, each 12 feet wide, would be constructed. There would also be a median of 20-44 feet in width, and a paved, 5-foot bicycle lane adjacent to the outermost travel lane.

The outer lanes would be utilized for right turn movements and the inner lanes as through lanes and passing lanes. Left-turn/ stacking lanes would be provided at all major intersections, and left-turn movements would be allowed out of most of the existing side streets onto the proposed roadway. Breaks or openings in the center median would be required at all of the intersections to allow left-turn movements. Due to the large number of possible turning movements at each of the intersections under this scheme, most of the intersections would require traffic signals. The median would be raised, with a concrete curbing, and a lawn and other plantings. The outer edge of pavement would transition into a concrete curb, gutter and sidewalk.

The existing local collector streets as well as the residential lots on the Puna (south) side of Puainako St. would utilize the frontage road as access to the proposed new roadway at a single intersection. The new roadway would essentially have limited access. The roadways and residential lots on the Hamakua side of Puainako St. would be allowed access, but their points of entry and turning movements would be severely limited so as to expedite the flow of traffic. Special provisions would be made to achieve the necessary traffic flow in and out of the Waiakea school complex while minimizing the disturbance to the flow of through traffic on the roadway.

Design Option I has the advantage of leaving the existing Puainako Street facilities intact, allowing their use by the residents on the Puna side of Puainako Street. This would limit the disturbance to these residents and possibly lower construction costs by reducing the facilities to be removed, relocated or reconstructed. This option would also limit the amount of disruptive accesses and random turning movements onto the proposed roadway, creating a more efficient flow of traffic.

A major disadvantage associated with Design Option I is that it would require more land on the Hamakua side of the existing road, bringing the new highway closer to the school complex. This would increase the disturbance to the school activities, and perhaps raise the risk of traffic-related injury to students and other pedestrians. It is projected that this option would also be more expensive in terms of right-of-way acquisition.

2. Design Option II

Design Option II differs from Design Option I in that no frontage road would be accommodated, reducing the total right-of-way to 120 feet. Other specifications concerning the lane width, turning options, median design, sidewalks and bicycle lanes would be similar to Design Option I.

One advantage of Design Option II is that most driveways and side streets fronting Puainako Street would be allowed the freedom of full turning movements as opposed to limited access (i.e. right-turn in, right-turn out). Also, this option would center the proposed roadway on the existing right-of-way, locating it farther from the Waiakea School complex. This option would require the acquisition of an additional 80 feet to attain a 120-foot right-of-way, reducing land acquisition costs.

A disadvantage of Design Option II is that the large number of accesses with full turning movements would reduce the overall efficiency of the roadway for through traffic due to frequent traffic flow conflicts. Also, most intersections would require traffic signals to allow for the large number of turning movements. This would increase the construction cost of this alternative.

3. Design Option III

Design Option III is similar to Design Option II except in its treatment of left-turns. Left-turn/stacking lanes would be provided at all major intersections, but left-turn movements would be prohibited from most of the existing side streets onto the proposed roadway. Breaks or openings in the center median would not be provided at all of the intersections, limiting the number of left-turn movements. The limiting of left-turn movements is expected to improve traffic flow. Fewer traffic signals would be required in this option.

The advantages of Design Option III relative to Design Option II include an increase in the efficiency of the traffic flow and a reduced construction cost due to a reduction in the number of traffic signals required.

The increase in traffic flow efficiency, however, comes at a cost of reducing the freedom of turning movements from the driveways and side streets that face Puainako Street.

1.1.5.2 Puainako Between Kawili and Komohana

The recommended spacing of intersections on major arterials is no closer than 1,200 feet. However, use of either Alignment A or B would create the potential for intersection conflict in two locations. The distance between the existing Puainako Street-

Komohana Street intersection and the proposed intersection of Komohana and Alignments "A" and "B" would be 600 feet and 250 feet respectively. The distance between the existing Puainako Street-Kawili Street intersection and the proposed intersection of Kawili and Alignments "A" and "B" would be 287 feet and 250 feet respectively. It is apparent that all of the proposed intersections are well below the recommended intersection spacing requirements. The existing intersection of Puainako Street and Kawili Street is signalized, and Kawili Street provides a right-turn lane for a turning movement onto Puainako Street in the direction of Komohana Street. The intersection of Komohana Street and Puainako Street is an unsignalized tee intersection with no specialized provisions for right- or left-turning movements. Engineers have proposed several options to increase the efficiency and reduce the traffic hazards in the immediate vicinity of these two intersections.

1. Design Option X

Design Option X is a proposal to remove the existing intersection of Iwalani Street and Puainako Street by constructing a cul-de-sac at the makai end of this segment (i.e., just mauka of the Kawili Street intersection). Access from the existing Puainako Street to the proposed roadway would take place through an existing right-of-way near the water tank behind the State Housing Project (see Figure 1-1a).

2. Design Option Y

Design Option Y is a proposal to construct a cul-de-sac on Puainako Street at the intersection of Puainako Street and Komohana Street. Access from the existing Puainako Street to the proposed roadway would take place through an existing right-of-way near the water tank behind the State Housing Project (see Figure 1-1a).

1.1.6 Proposed Project Funding, Cost, and Scheduling

The proposed Puainako Street Widening and Extension is a joint project of the State of Hawaii and County of Hawaii and would become part of the state highway system. Funding for the planning and design has been provided through the state and transferred to the County of Hawaii Department of Public Works. The state has appropriated \$6.8 million for the project, including \$4.8 million for construction and the balance for planning, design, and land acquisition. It is estimated that an additional \$23.5 million to \$28.5 million will be required to complete the proposed project. Detailed cost estimates for the project are provided in Appendix I. A summary of the cost estimates is provided below.

The Lower Portion is estimated to cost approximately \$15 million. Major components of the cost include intersection construction (\$3.75 million), bridge

construction ($2.5 million), and excavation/embankment ($1.08 million). At this time, no estimate of the cost differences between the two alignments or the choices in the two sets of design options are available.

A comparison of costs between Alignments 1 and 2 in the Upper Portion is available. The total cost for Alignment 1 is estimated at $15.23 million. For Alignment 2, total cost is estimated at $18.26 million. The reason for the difference is the greater length of Alignment 2, which in turn entails increased costs for land acquisition, clearing, excavating, paving, etc.

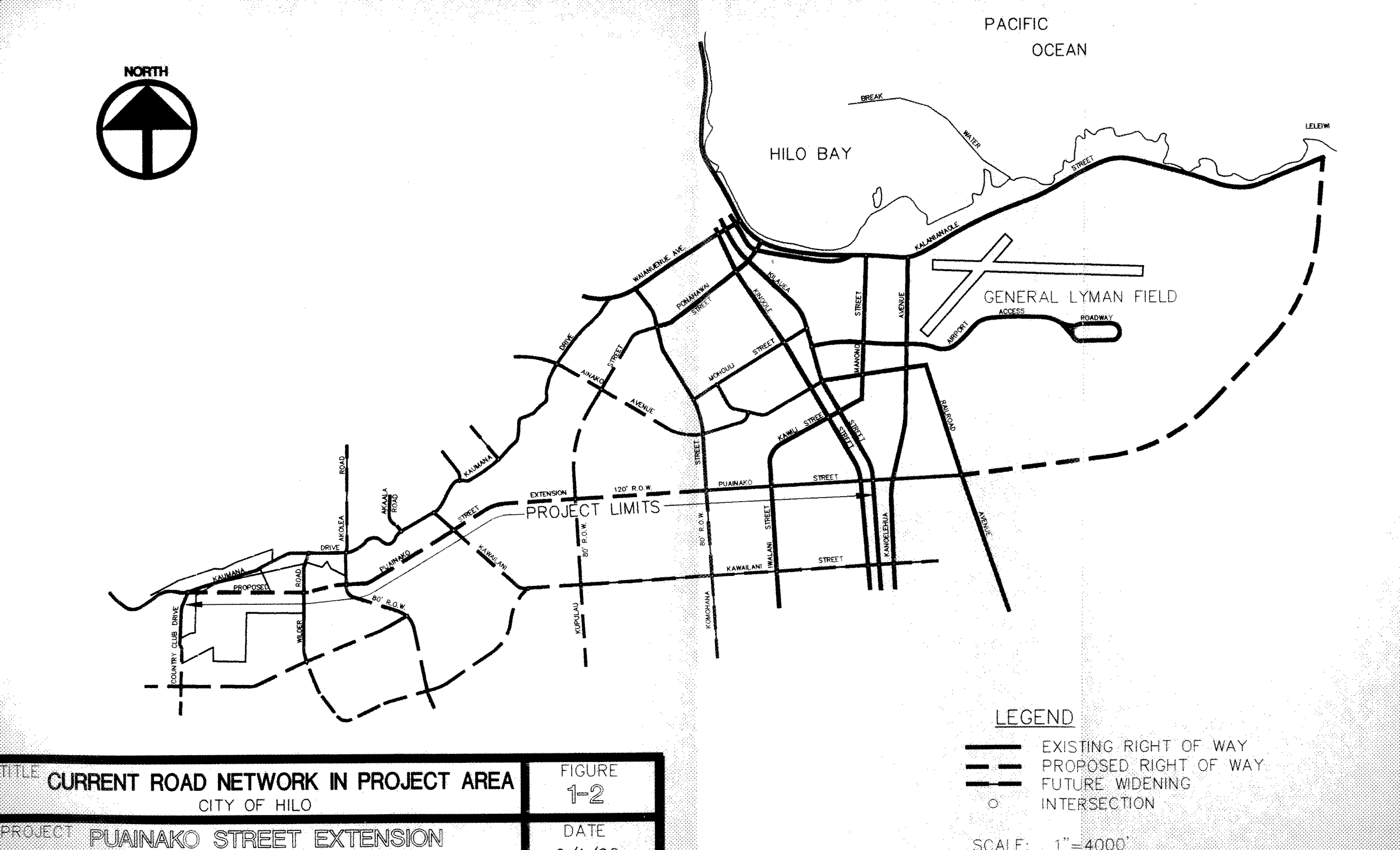
The project is designed to be accomplished in two phases. However, if funding is available, it is recommended that both phases be built concurrently. Should funding limitations require phased construction, it is recommended that the Lower Portion of the project be undertaken first. This would take approximately two years to complete. The existing Puainako Street from Kilauea to Kawili Street could be used as is while improvements for the additional two lanes are being constructed. Construction could be coordinated in such a manner to cause minimal disturbance to traffic flow. The Komohana Street Bridge could be widened during or after this phase. Construction of the approximately 4.6 miles of the Upper Portion would take place during Phase 2. Traffic control would be implemented at Kaumana Drive, Edita and Wilder Streets if necessary, and Komohana Street. No major traffic interruption is anticipated except, at times, at Komohana Street. Phase 2 is expected to require two years to complete, yielding a total construction time of 4 years. If sufficient funding is available, it is possible for both sections of the road to be constructed concurrently.

1.2 Purpose and Need

The Puainako Street Extension and Widening Project has long been envisioned as an opportunity to 1) improve the congested traffic conditions on Puainako Street and Kaumana Drive, 2) improve arterial traffic flow between Highway 11 (Volcano Highway) and the Saddle Road (Highway 20) thereby minimizing travel time and traffic hazards, and 3) provide an alternative evacuation route from Kaumana in the event of volcanic hazard from Mauna Loa (see Figure 1-2).

1.2.1 Existing Roadway

Puainako Street is a two-way collector street running east-west between Highway 11 and Komohana Street. It is owned and maintained by the State of Hawaii. Between Highway 11 and Kilauea Avenue, Puainako is a four-lane roadway; from Kilauea Avenue to Komohana Street, it is a two-lane roadway.



TITLE **CURRENT ROAD NETWORK IN PROJECT AREA**
CITY OF HILO

FIGURE 1-2

PROJECT PUAINAKO STREET EXTENSION
HILO, HAWAII

DATE 9/1/92

91003F2

As the upland neighborhoods of Hilo have grown in population, Puainako Street has become a principle conduit collecting traffic moving to and from the mauka (upland) neighborhoods of Kaumana and Waiakea Uka. Puainako Street serves drivers destined for a number of locations including Waiakea Elementary, Intermediate, and High Schools, Hawaii Community College, the University of Hawaii at Hilo, Prince Kuhio Plaza, Hilo Shopping Center, KTA Supermarket, Puainako Town Center, Hilo International Airport, Keaau and points south via Highway 11.

The Hawaii County General Plan Facilities Map depicts Puainako Street as a link in the arterial flow between East and West Hawaii. Even in its current form it connects Hilo to the Kona and Kohala Districts via the Saddle Road (Highway 20).

Puainako Street is a link in the regional traffic network. Other major roads in the network are listed below:

Komohana Street directly connects the two major mauka (upland) Hilo neighborhoods, Waiakea Uka and Kaumana, and provides the most direct cross-town route for the residents of those two districts. Currently, the western terminus of Puainako Street is at Komohana Street.

Kaumana Drive/Waianuenue Avenue connects downtown Hilo with Kaumana and Saddle Road. Kaumana Drive is a two-lane, two-way roadway with a curvilinear horizontal alignment and rolling vertical alignment. At the makai end, Kaumana Drive connects to Waianuenue Avenue, which passes Hilo High School and terminates at the Hilo Bayfront Highway.

Saddle Road (Highway 20) begins at the mauka end of Kaumana Drive and crosses the island connecting the Kona and Kohala districts with East Hawaii. Improvements of Saddle Road that are underway or planned will increase traffic on the roadways connecting it to arterial roads of Hilo and East Hawaii.

Puainako Street now carries traffic destined for Kaumana Drive/ Waianuenue Avenue and Saddle Road via Komohana Street.

Kilauea Avenue runs along the long axis of the older sections of Hilo, connecting the southern part of the city and the Puna District with downtown. Kilauea Avenue intersects Puainako Street near its eastern terminus at Highway 11.

State Highway 11 (Volcano Highway/Kanoelehua Avenue), a four-lane divided highway, is the primary arterial in the project vicinity and is a segment of the round-the-island "Belt Highway" carrying traffic into Hilo from all parts of the island to the south.

Within Hilo, Highway 11 carries traffic from the port and hotel areas of Hilo and the Hilo Bayfront Highway (State Highway 19) through Hilo's industrial district. Highway 11 provides the only public access to Hilo International Airport. The eastern terminus of Puainako Street is at Railroad Avenue to the east of Highway 11.

1.2.2 Existing Traffic Conditions

Commuters using the existing Puainako Street and Kaumana Drive currently experience congested traffic conditions. Specific roadway conditions that prevent efficient traffic flow from these neighborhoods to other parts of Hilo are detailed below in Section 1.2.3. Congestion and other undesirable features of these two streets lead to safety hazards.

Both Waiakea Elementary and Waiakea Intermediate Schools are located on Puainako Street between Kinoole Street and Kawili Street. Traffic congestion associated with the school start (7:00 to 8:00 a.m.) and close (2:00 to 3:00 p.m.) is a daily occurrence, as vehicles carrying students enter and exit the school complex. Because school start coincides with the morning work commute, particularly bad congestion occurs in the morning. Traffic circulation can also be poor between 4:00 and 6:00 p.m. because of returning commuters. Another source of traffic involves students, faculty, staff and visitors of the University of Hawaii ad Hilo and Hawaii Community College. Traffic going to and from the colleges exhibits moderate peaks in the morning and late afternoon, but also contributes a steady flow throughout the day and into the evening.

Additionally, the existing road network presents an indirect and circuitous route for local or arterial traffic between Highway 11 and areas south of Hilo, and Saddle Road and West Hawaii.

A field traffic study and data analysis was conducted by Randall S. Okaneku, P.E. of The Traffic Management Consultant (Appendix G). The field investigation was conducted in May and June 1992, while school was in session. Manual traffic count surveys were conducted from 6:30 a.m. to 8:30 a.m. and from 4:00 p.m. to 6:00 p.m. at a number of affected intersections. Additional traffic data were obtained from the State DOT.

A highway capacity analysis was performed on the data, based upon procedures presented in the Highway Capacity Manual (Transportation Research Board 1985) and associated software from the Federal Highways Administration. Several descriptors of the traffic demand relative to the road's traffic carrying ability were generated for all intersections.

Many intersections were found to be operating at poor condition according to one or all of the above descriptors. During the a.m. peak hour, between 7:00 and 8:00 a.m., the intersection of Puainako Street and Iwalani/Kawili operates at over-capacity conditions. The mauka-bound approach of Puainako Street at Komohana operates at Level of Service (LOS) "F" ("unacceptable"). The makai-bound approach operates at LOS "D" ("desirable minimum"). Anela Street operates at "D." The left-turn movements from the exit driveways of Waiakea Elementary and Intermediate Schools both operate at LOS "E"("undesirable"). Vehicles on the makai-bound lane of Puainako Street turning left at the school entrances must cross driveways from the through traffic lane. This results in queuing on Puainako Street, and, occasionally, gridlock. Kaumana Drive operates at LOS "D" at a.m. peak. The other intersections in the study area operate satisfactorily.

The p.m. peak hour generally occurs between 4:15 and 5:15 p.m. The intersections of Puainako Street with Kanoelehua Avenue and Kinoole Street operate at near capacity condition. The mauka-bound approach of Puainako Street at Komohana Street operates at LOS "E", while the makai-bound approach operates at LOS "D". Kaumana Drive operates at LOS "D" during this period. Side streets and driveways operate satisfactorily.

Many Hilo trips by Kaumana residents are destined for locations served by Puainako Street. The circuitous route of these trips congests Kaumana Drive, Waianuenue Avenue, Komohana Street, and finally, Puainako Street itself.

For reasons of location, congestion and size, Puainako has been unable to accommodate all the traffic that might be expected to use it. Traffic overflows along a number of streets essentially parallel to Puainako, such as Kawailani, Mohouli, Kukuau, Kawili, and Ponahawai Streets, adding a congesting factor to the normal traffic on these streets.

1.2.3 Accidents and Road Safety

Puainako Street is straight but must nevertheless be considered a hazardous roadway. The existing Puainako Street has several undesirable features, including 1) limited sight distance due to poor vertical alignment, 2) large percentage of no-passing zones based on poor sight distances, 3) 10-foot wide traffic lanes that decrease potential level of service as traffic increases, 4) narrow shoulders, and 5) too many access points from existing driveways and street intersections. According to Hawaii County Police Department records, 313 accidents occurred on Puainako Street in the years 1987-1991.

Kaumana Drive suffers from 1) narrow lanes, 2) steep profiles, and 3) severe curves, which, when combined with the frequent and abundant rainfall, produce hazardous conditions. The Police Department recorded 969 accidents on Kaumana Drive in the years 1987-1991. Many of these resulted from intrinsically hazardous road conditions combined with poor driving, while others resulted from failure to yield, a problem made more common by excessive traffic volume.

As transcripts from the project information meeting held for the public indicate (Appendix A), many residents of Kaumana are concerned about the lack of alternate access roads to their area. Currently, Kaumana residents mauka of Ainako Street must backtrack as much as five miles via Akolea Road and Waianuenue Avenue when Kaumana becomes heavily congested or blocked. This condition is perceived as a potential safety hazard in the event of a rapid evacuation necessitated by volcanic activity on Mauna Loa or a traffic accident blocking Kaumana Drive.

1.2.4 Traffic Projections

The Island of Hawaii Long Range Highway Plan (State of Hawaii 1991) projects that the average daily traffic utilizing Puainako street from Kilauea Street to Komohana Street is expected to rise from 22,000 in 1992 to 37,000 by year 2010 (68 percent increase) without the improvements. With the proposed improvements, however, the traffic volume for this portion of Puainako Street is expected to rise to 44,000 (100 percent increase). From Kanoelehua Avenue to Kilauea, traffic is expected to increase from the current 20,500 trips to 27,300 (33 percent) by the year 2010 without the improvements. With the improvements, the volume would rise to 29,800. The Puainako Street Extension from Komohana Street to Kaumana Drive is expected to register 23,400 trips per year by the year 2010.

1.2.5 Conditions Without Proposed Project

Needless to say, the present level of traffic already creates traffic congestion during school hours and increases commuting travel time significantly. The projected increase of 68 percent in traffic volume will entail much more serious congestion unless some form of traffic system improvements is made.

Chapter 2:
Environmental Setting

CHAPTER 2: ENVIRONMENTAL SETTING

This chapter describes the existing social, economic, cultural, and environmental conditions surrounding the proposed project. Chapter 3 discusses the probable impacts of the proposed action and mitigation measures designed to reduce or eliminate adverse environmental impacts.

2.1 Natural Environment

2.1.1 Geology and Geological Hazards

The project area mainly rests on a'a and pahoehoe lava from Pleistocene and Holocene eruptions of Mauna Loa, and is aligned along the somewhat inactive Northeast Rift Zone of Mauna Loa. The mauka end of the Upper Portion passes over inclusions of Pahala Ash. Numerous small lava tubes and one known large tube (Kaumana Cave) underlie the pahoehoe portions of the surface.

Just as is all development in Hilo, the project would be subject to volcanic hazard, particularly lava inundation. The United States Geological Survey classifies the area as Lava Flow Hazard Zone 3, on a scale of ascending risk 9 to 1. Zone 3 is considered "less hazardous than zone 2 [which is adjacent to and downslope of active risk zones] because of greater distance from recently active vents and/or because the topography makes it less likely that flows will cover these areas" (Heliker 1990:23).

The Northeast Rift Zone of Mauna Loa was active in the last century, sending flows towards Hilo in the years 1880, 1899, 1935, and 1942 (Macdonald et al 1986:64). A 22-day eruption in 1984 again threatened Hilo, approaching within 4 miles of the Kaumana neighborhood before halting. The lava flows of 1881 lava flows penetrated the area now occupied by the City of Hilo. Much of the proposed roadway would lie on the 1881 Mauna Loa flow.

Lava flow hazard is a fact of life for all who reside on the slopes of Kilauea, Mauna Loa, and Hualalai volcanos, including the residents of Kaumana. The only practical escape routes lead downhill, along either Kaumana Drive, or less directly, Akolea Road/Waianuenue Avenue.

In terms of seismic risk, the entire Island of Hawaii has a Zone 3 Seismic Probability Rating (Furumoto et al. 1973:34). Zone 3 areas are at risk from major earthquake damage, especially to structures that are poorly designed or built. Partly owing to the lack of unconsolidated sediments in the local substrate, none of the several earthquakes of Richter magnitude 6.0 or greater that have occurred in the Hilo area since 1950 has caused significant damage to well-engineered roads, bridges or other roadway structures.

Lava tubes occasionally present problems in roadway construction. No major tubes other than Kaumana Cave are known to exist in the area. Kaumana Cave comes within 40 feet of Alignment 1 at its closest point. Because of this close approach, an accurate survey of the cave was conducted as part of the examination of the alternative alignments (Figure 2-1). This mapping will help ensure that the alignment avoids the cave, which is important from an engineering standpoint and to preserve the cave's biological integrity.

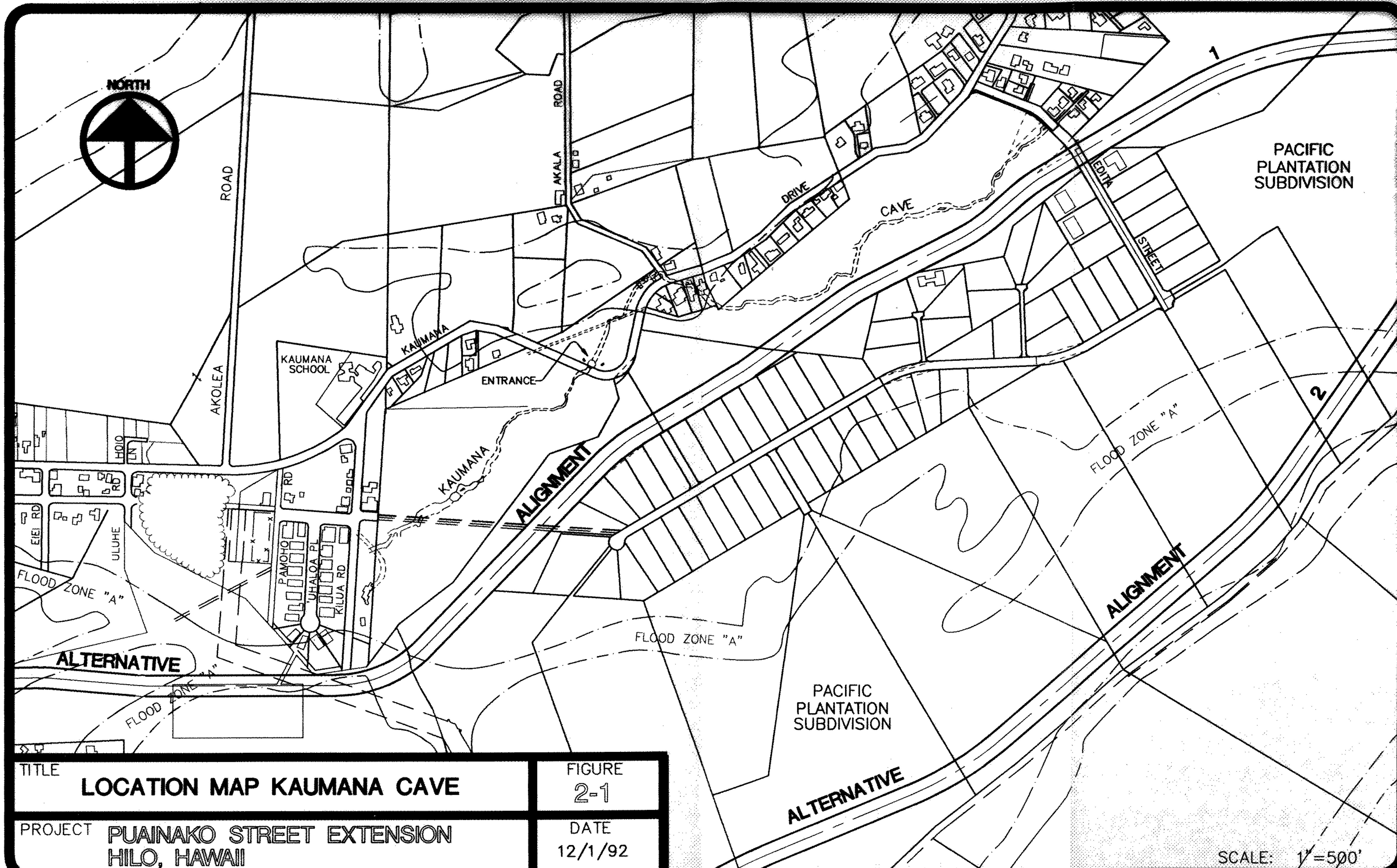
2.1.2. Physiography and Soils

The terrain of the project site is principally composed of the downslope segments of major basalt lava flows from Mauna Loa's northeast rift zone. Slopes range from 1 to 7 degrees and are not anticipated to pose major highway construction problems in themselves. Local relief across this generally uniform slope is minor. A few incipient drainage channels do provide sharp elevational changes of up to 20 feet, and thus would require limited terrain modification, such as grading, filling, and construction of culverts and bridges.

The soils along most of the alternative alignments overly recent lava flows and are thus acidic, poorly developed, shallow, and stony. Permeability and runoff are variable and erodibility minor to moderate. There are several pockets of better developed, agriculturally useful soils along the mauka section of both Alignments 1 and 2. The Pahala Ash-derived soils possess moderate flood and erodibility potential, particularly where slopes are steeper (U.S. Soil Conservation Service 1973).

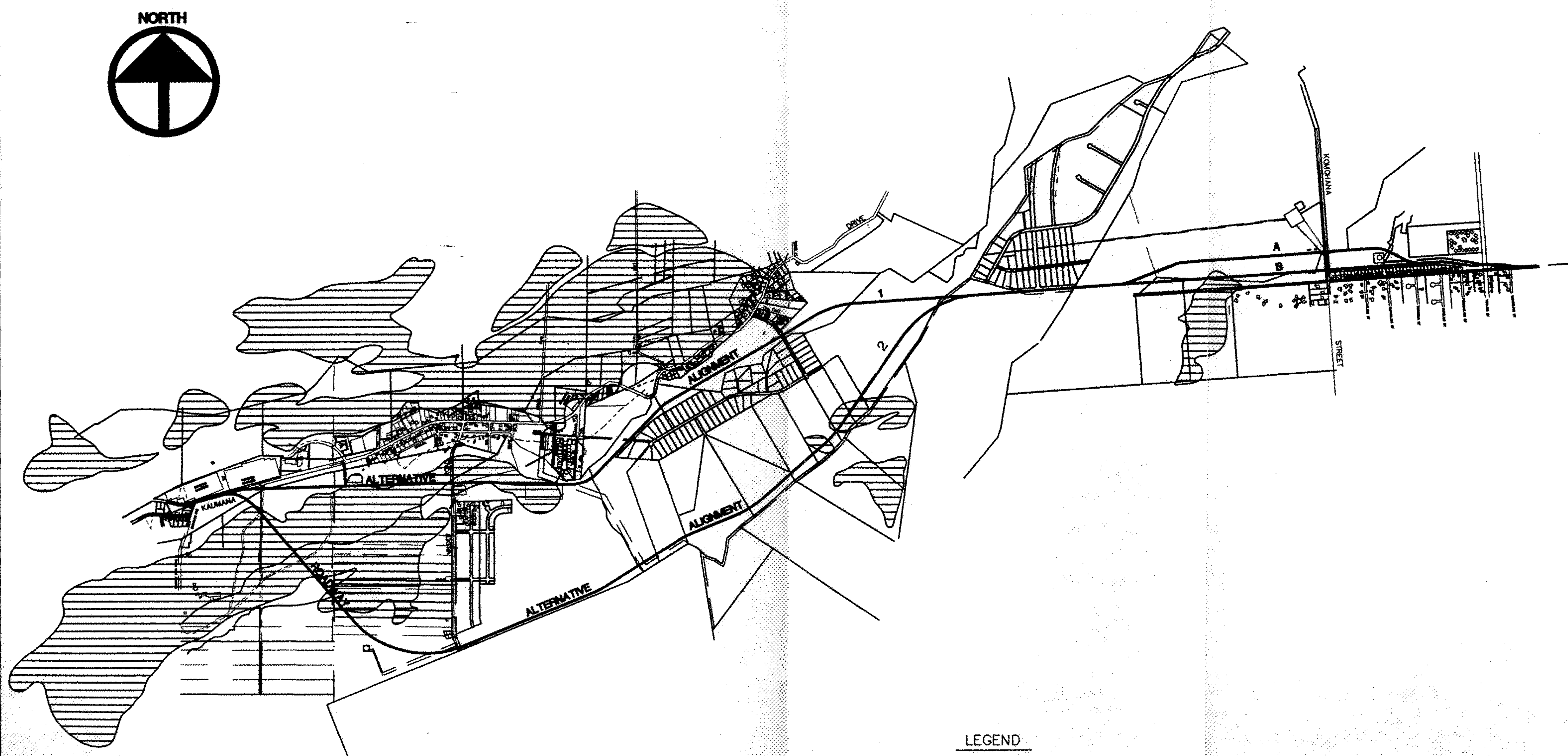
The principal soil properties to be considered in route selection and roadway design are the engineering properties of the soil, soil erosion problems, and the preservation of prime agricultural soil. The engineering properties (e.g., shrink-swell, bearing strength, and thixotropic characteristics) of the soils present are reasonably adaptable to road construction, and specific solutions are most appropriately addressed in road design and engineering work.

The agricultural utility of the soil has been assessed by the U.S. Soil Conservation Service and mapped as part of map series "Agricultural Lands of Importance to the State of Hawaii" (ALISH). Three categories of valuable agricultural land are identified: Prime, Unique, and Other (Baker 1976:4). Prime Land "has the soil quality, growing season, and moisture supply needed to produce sustained high yields of crops economically when treated and managed . . . according to modern farming methods" (Ibid:2). Island-wide, Prime Lands constitute about 4 percent of the surface, Unique Lands less than 1 percent, Other Lands about 18 percent, and Unclassified the remaining 78 percent. (See Figure 2-2)



TITLE	FIGURE
LOCATION MAP KAUMANA CAVE	2-1
PROJECT PUAINAKO STREET EXTENSION HILO, HAWAII	DATE 12/1/92

91003F11



LEGEND

- UNCLASSIFIED
- PRIME AGRICULTURAL LANDS
- UNIQUE AGRICULTURAL LANDS

SCALE: 1"=2000'

TITLE **AGRICULTURAL LANDS OF IMPORTANCE STATE OF HAWAII**	FIGURE 2-2
PROJECT PUAINAKO STREET EXTENSION HILO, HAWAII	DATE 10/7/92

91003F5

Only the mauka section of the Upper Portion in the Project contains agricultural lands identified as Prime. Both Alignment 1 and Alignment 2 cross approximately 3,000 feet of better-developed soil that was once used for sugarcane cultivation but is now fallow. Calculations show that each alignment displaces approximately 8.2 acres of Prime Agricultural Land.

2.1.3 Weather and Climate

Rainfall and fog are the elements of weather and climate most relevant to the design of a safe roadway for the proposed project. Since the project is essentially parallel to the topographic gradient and encompasses 1,390 feet vertical elevation change, considerable climatic variation occurs. Mean annual rainfall near the lower end of the project is estimated at 130 inches, while the mean annual rainfall at the project terminus on Kaumana Drive is close to 200 inches (UH-Manoa Dept. of Geography 1983).

Fog is essentially absent at sea level in Hawaii because of the radiative properties of the ocean and the abundant wind mixing, which combine to prevent surface temperature inversions. (Fog should not be confused with driving rain, which can obscure vision.) The natural cooling that takes place as air is forced to higher elevations does permit fog development, and most locations over 800 feet in Hawaii experience some fog. Driving conditions at high elevations on the Saddle Road are notoriously dangerous due to frequent fog. The Lower Portion of the project is below the minimum elevation for fog. The upper elevations of the Upper Project are subject to occasional fog, but data indicate that foggy conditions are rare even at the highest project elevation and thus merit negligible consideration (personal communication with Prof. James O. Juvik, Sept. 1992).

2.1.4 Hydrology and Drainage

The remarkably high rainfall of the region coupled with variable soil permeability conditions makes drainage a major consideration in the project design.

The United States Geographical Survey (USGS) topographic maps identify several intermittent and perennial streams throughout the project area, the most significant being Alenaio (Waipahoehoe) stream and Waiakea Stream/Flood Channel.

Floodplain status for much of the planning area has been determined by the Federal Emergency Management Agency (FEMA), which has mapped the area as part of the National Flood Insurance Program's Flood Insurance Rate Maps (FIRM) (see Figure 2-3). Applicable Special Flood Hazard Areas (SPFHA) designations are as follows:

1. Zone A. SFHAs subject to inundation by the 100-year flood. Because detailed hydraulic analyses have not been performed, no base flood elevation or depths are shown.

2. Zone AE: SFHAs subject to inundation by the 100-year flood determined in a Flood Insurance Study by detailed methods. Base flood elevations are shown within these zones. In this area, there is a base flood elevation of 312 feet above mean sea level.

3. Zone AH: SFHAs subject to inundation by 100-year shallow flooding (usually areas of ponding where average depths are between one and three feet). Base flood elevations derived from detailed hydraulic analyses are shown in this zone. In this area, there is a base flood elevation of 348-372 feet above mean sea level.

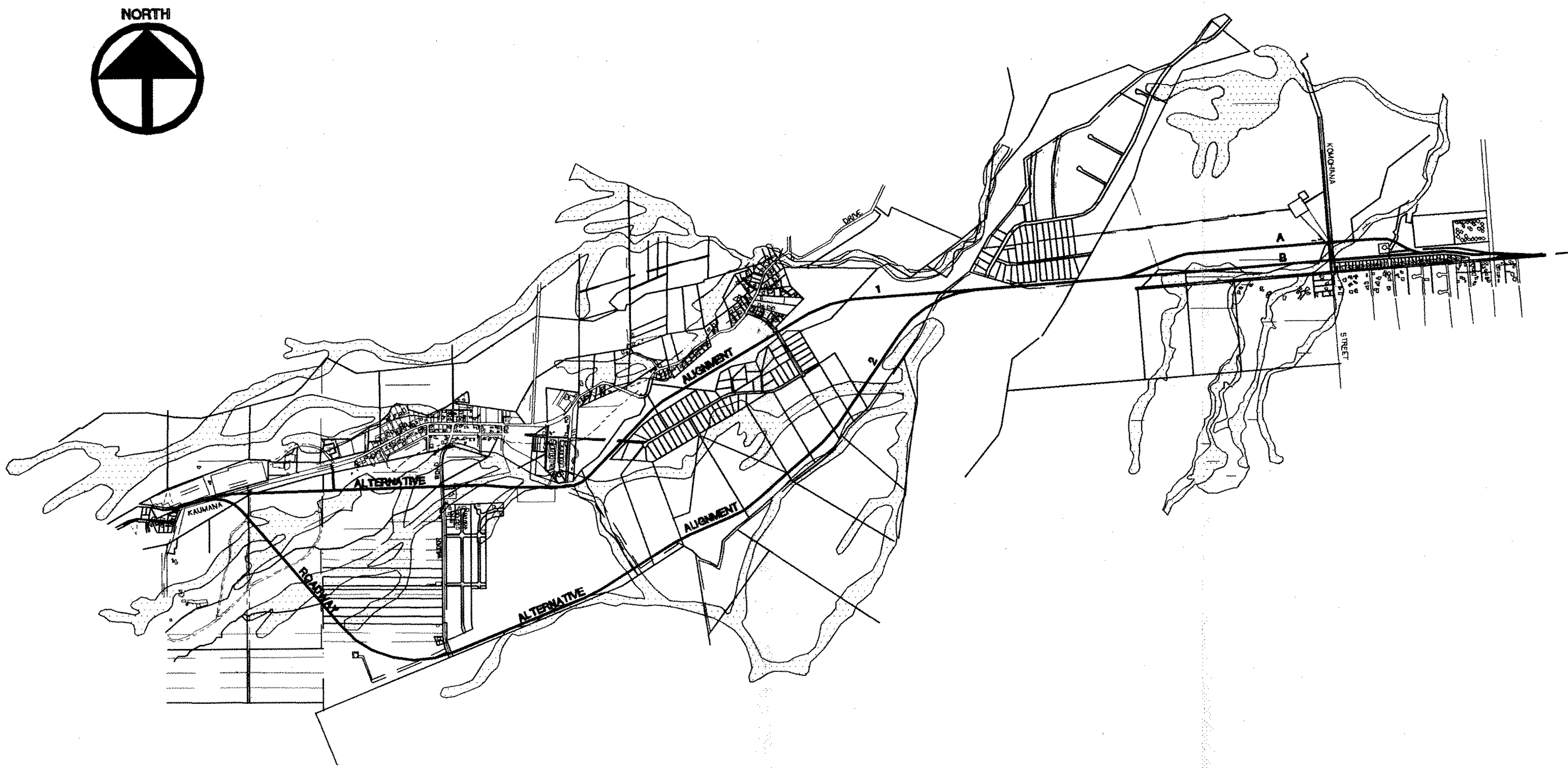
4. Zone X: Areas identified in the community flood insurance study as areas of moderate or minimal hazard from the principal source of flood in the area. However, buildings in these zones could be flooded by severe, concentrated rainfall coupled with inadequate local drainage systems. In this area, such a zone may be inundated by the 500 year flood.

Most of the areas in all projected alignments are classified as Flood Zone type X or Zone A.

A preliminary drainage study was conducted by Okahara and Associates, Inc., in June of 1992. The study is included as Appendix F and is summarized below.

At locations where the proposed roadway crosses a stream or obvious drainage path, culverts would be installed to permit the runoff to pass beneath the roadway. The culverts would be sized to allow the passage of the normal or base flow of the stream along with the runoff associated with the design rain storm.

In the drainage study, the proposed roadway alignments were delineated and the tributary drainage areas to each required drainage structure or culvert were determined, identified (19 total) and labeled "A" through "S". The corresponding quantity of runoff for each of the 19 subareas was calculated using the rational method and the drainage structures sized accordingly. The sub-basins, A through L, drain via gullies into an isolated floodplain located on the tracts of land Kukuau 1 and Kukuau 2. The runoff waters are believed to flow down to the low point within this floodplain, located about 2,500 ft. east/northeast of the existing Edita Street cul-de-sac/intersection. Whether the flow leaves this floodplain through subsurface caverns or spills over and flows down gradient overland has yet to be determined (see Figure 2-3). Sub-basins M and N are believed to drain overland into the Alenaio (Waipahoehoe) stream and eventually into Hilo Bay. Sub-basins O through S are believed to flow overland into the Waiakea Stream Tributary No. 3 and Waiakea Stream, and eventually into Waiakea Pond.



TITLE	FIGURE
APPROXIMATE LIMITS 100 YR. FLOOD ZONE	2-3
PROJECT PUAINAKO STREET EXTENSION HILO, HAWAII	DATE 9/1/92

SCALE: 1"=2000'

91003F4

In addition to the preliminary design of the proposed roadway culverts, the existing 8-foot diameter corrugated metal pipe (C.M.P.) and the 5-foot diameter reinforced concrete pipe (R.C.P.) culverts along Wilder Road were checked for adequate capacity to ensure proper drainage of the proposed roadway.

The sub-basins are depicted in Appendix A of the Drainage Report. The existing general drainage patterns are as follows:

In the area **between Country Club Drive and Wilder Road,** rainfall that falls to the south and southwest of the alignment flows north-northeast overland through primarily old cane fields overgrown with dense grass and brush. This runoff eventually makes its way into one of the two existing streams that converge at Wilder Road and pass beneath Wilder Road through two existing 8-foot diameter C.M.P. culverts. In the area between Wilder Road and Pacific Plantation subdivision, rainfall which falls to the south and southwest of the alignment flows north-northeast overland through residential areas and into undeveloped areas and eventually into the existing stream which flows to the east-southeast. Rainfall falling to the north of the alignment flows overland through some residential areas but passes mainly through undeveloped land and into the stream which flows east-southeast.

In the area **between Kilua Road and Edita Street (Alignment 1 only)**, rainfall that falls to the north and northwest of the alignment flows overland through undeveloped land (mainly scrub and brush) into the Pacific Plantation subdivision.

In the area **between Edita Street and Sunrise Ridge subdivision**, rainfall that falls to the north of the alignment flows eastward overland through scrub and dense woods, to where it eventually enters the Waipahoehoe Stream, which flows to the northeast. Rainfall that falls to the south of the alignment flows northeast-east, overland through dense woods, to where it eventually enters the existing flood control channel at Waiakea Stream, which flows to the northeast and passes beneath the Komohana Street Bridge.

Roadway alternative Alignments 1 and 2 traverse a number of gullies. These gullies are believed to be tributaries to the isolated floodplain located in the tracts of land Kukuau 1 and Kukuau 2. Alignment 1 makes a large flood zone crossing southeast of Kilua Road. This is at a point where a large number of the gullies and isolated flood ways converge. The roadway culvert at this point would need to be designed to pass the combined flows of each of the flood ways which converge at this point. For a crossing at this point, it is expected that a very large culvert or even a bridge structure would be required to pass the design year flow. Alignment 1 also crosses four more independent flood ways in the vicinity of Wilder Road. These crossings are the tributary gullies and flood ways to the previously mentioned crossing. Since these crossings are up gradient and the crossings would be made independently, the flows for which the culverts would need to be designed are expected to be much smaller. Alternative roadway Alignment 2 crosses a flood hazard zone to the southeast of Pacific Plantation subdivision. Of all the alternative roadway alignments studied, this crossing was located at the lowest elevation within the isolated floodplain of Kukuau. This point is the furthest down gradient of any crossing and is expected to have the largest storm runoff flow rate. For a crossing at this point, it is expected that a very large culvert or even a bridge structure would be required to pass the design year storm flow. Alignment 2 makes four additional flood zone crossings: one to the east of Wilder Road and three to the southeast of Country Club Drive. The crossing to the east of Wilder Road is expected to be similar in magnitude to any one of the Alignment 1 crossings to the west of Wilder Road. The three crossings to the southeast of Country Club Drive are located at the highest elevations of any proposed crossings. Since these points are the furthest up-gradient, these crossings are expected to have the smallest flows of any proposed crossings. The culverts required to pass the flows at these crossings would be expected to be the smallest and, in turn, the least expensive.

2.1.5 Flora and Plant Communities

A botanical survey of all alternative road segments was conducted by botanist Grant Gerrish, Ph.D. (Appendix B.) The purpose of this study was to describe and evaluate the vegetation of the alternative alignments and to identify ecologically sensitive communities or valuable plants within the right-of-ways. Special attention was given to the search for rare or endangered species and for ecosystems that might be unique to the project area. If found, resources such as these might require mitigative planning.

The study began with a literature search to determine which, if any, plant species listed or proposed for listing as endangered or threatened by the U. S. Fish and Wildlife Service might occur within the region of the Puainako Street extension. Such listed plants are legally protected by Federal and State law. The lists of threatened and endangered plants were reviewed (Federal Register 1990a, 1990b; and updated lists provided by U.S. Fish and Wildlife Service, Pacific Islands Office, Honolulu). The ranges of these listed and proposed plants were determined from the Manual of Flowering Plants of Hawaii (Wagner et al. 1990).

Initial reconnaissance showed that the natural vegetation of the Lower Portion had been completely replaced by human activity and contained no valuable native plants or plant communities. The botanical survey of the alignments within the Lower Portion was thus limited to reconnaissance-level survey. Within the Upper Portion, the botanist walked the entire length of all alignments, following the staked center-line, with excursions to either side to identify plants or vegetation within the proposed 120-foot right-of-ways.

Vegetation descriptions were recorded in all plant communities encountered along the alignments, and all plant species found were recorded. A list of plant species was prepared (Appendix B: Tables 1-4).

2.1.5.1 Original Vegetation

Originally, the natural vegetation of most of the project area was 'Ohi'a/Uluhe (Metrosideros/Dicranopteris) Fern Forest, which is a subtype of the Lowland Wet Forest (Gagne and U.C. Cuddihy 1990). This 'Ohi'a/Uluhe Fern Forest community is associated with young lava flows and shallow soils on the lower windward slope of Mauna Loa. This community is dominated by a deep mat of uluhe, more or less scattered 'ohi'a trees, and relatively few other plant species. At a few sites within the project area with deeper soil, the vegetation has further developed into the 'Ohi'a (Metrosideros) Lowland Wet Forest or the Koa/'Ohi'a (Acacia/Metrosideros) Lowland Forest communities (Gagne and Cuddihy 1990). These communities have a closed tree canopy, less uluhe ground cover, and a somewhat richer assortment of associated species.

2.1.5.2 Present Vegetation of Lower Portion

The original vegetation of all the Lower Portion has been destroyed by intense human activity. Most of this area appears to have once been cultivated sugar cane fields. The present vegetation is a secondary forest dominated by gunpowder trees (Trema orientalis) up to 60 feet tall. Other common trees, all alien, are octopus tree (Schefflera actinophylla), melochia (Melochia umbellata), chinese banyan (Ficus microcarpa), and bingabing (Macaranaga mappa). The ground cover is also made up of alien plants, including oak fern (Cyclosorus dentatus), palm grass (Setaria palmifolia), thimble-berry (Rubus rosifolius), and sensitive plant (Mimosa pudica). In openings, the vegetation is chiefly sugarcane (Saccharum officarum), California grass (Brachiaria mutica), and wedelia (Wedelia trilobata).

2.1.5.3 Present Vegetation of Upper Portion

The vegetation over much of the Upper Portion still strongly reflects the original vegetation. However, human activity, especially agriculture, has significantly modified the vegetation in many areas. The botanical survey identified two communities that are dominated by native plants, one community that is predominantly alien, and one that is a variable mix of native and alien plants.

1. <u>'Ohi'a/Uluhe Fern Forest</u>

The most extensive native community in the project area is an open 'ohi'a forest with the ground completely covered by a dense mat of uluhe. The 'ohi'a trees have narrow, columnar crowns up to 40 feet high.

Three variants of this type were identified. Where the 'Ohi'a/Uluhe Fern Forest occurs on the 1881 lava flow, the community is very simple with few species. The substrate is a very thin layer of organic matter over pahoehoe lava.

'Ohi'a/Uluhe Fern Forest also occurs on older lava flows where the soil is a shallow organic layer classified as Keei or Keaukaha "extremely rocky muck." On this slightly more developed soil, the open forest contains a few more species of native trees and ferns, widely scattered within the uluhe mat.

The least common variant has scattered mature koa (<u>Acacia koa</u>) trees mixed with the 'ohi'a. Otherwise, the community is very simple and similar to the 'Ohi'a/Uluhe Fern Forest on older lava flows as described above.

'Ohi'a/Uluhe Fern Forest covers 53 percent (8,500 linear feet) of Alignment 1 between Kaumana Drive and Sunrise Estates, and 39 percent (7,300 linear feet) of Alignment 2 between these same two points. This community does not occur along the alignment from Sunrise Estates to Komohana Street. The koa variant covers 4 percent of Alignment 2 but was not found along Alignment 1 (Appendix B, Table 1).

2. <u>Closed Canopy 'Ohi'a Forest</u>

The canopy here is about 50 feet high. This community has several more native species than the fern forest community described above. The most abundant of these additional trees is kopiko (<u>Psychotria hawaiiense</u>), with occasional pilo (<u>Coprosma</u> sp.) Hapu'u are fairly common. Some uluhe does grow in sunnier spots, but the ground-cover is generally dominated by the alien swordferns. The epiphytic flora is well-developed, including 'ie'ie (<u>Freycinetia arborea</u>) and 'ekaha (<u>Elaphoglossum</u> spp.). Alien trees are also common in this community, such as strawberry guava or wai'awi (<u>Psidium cattleianum</u>), which forms dense understory thickets in many places, common guava (<u>Psidium guajava</u>), African tulip tree (<u>Spathodea campanulata</u>), and Alexander palm (<u>Archontophoenix alexandrae</u>).

Closed Canopy 'Ohi'a Forest was found only near Kaumana Drive, covering 11 percent (1,800 linear feet) of Alignment 1 and 4 percent (800 linear feet) of Alignment 2 between Kaumana Drive and Sunrise Estates (Appendix B, Table 1).

3. Savanna dominated by alien plants

This community now occurs on sites with deeper soil where the original vegetation has been removed for sugar cane cultivation or other purposes in the recent past. Presumably, the vegetation of the savanna would develop into a secondary forest given time. The savanna vegetation is highly variable and includes many species of alien plants and a smaller number of native plants as well. Generally, the ground-cover is tall, dense grass with widely scattered trees of many species. The most common grass is California grass (Brachiaria mutica) which forms extensive, impenetrable mats. In other areas the dominant grasses are broomsedge (Andropogon virginicus) and little bluestem (Schizachyrium condensatum). Trees occur singly or in groves or thickets, including albizia (Albizia falcataria), common guava, wai'awi, melochia (Melochia umbellata), gunpowder tree (Trema orientalis), and the native koa.

In many areas, the native 'Ohi'a/Uluhe community still persists or is reinvading. 'Ohi'a, hapu'u and uluhe are commonly seen in gullies where they may have survived land clearing. In other places, it is clear that 'ohi'a saplings are becoming reestablished and uluhe mats are spreading into the grasslands of the savanna.

The Savanna community covers 10 percent (1,600 linear feet) of Alignment 1 and 11 percent (2,000 linear feet) of Alignment 2 between Kaumana Drive and Sunrise Estates.

4. Mixed 'Ohi'a/Wai'awi

Many areas are a mix of dense wai'awi thickets intermingled with 'ohi'a and uluhe. The presence of other native and alien plants is also variable. Some of these areas appear to be native vegetation that was not completely cleared but has been degraded and invaded by wai'awi and other alien species. Other areas appear to have been cleared but then partially reinvaded by 'ohi'a and uluhe. In either case, these communities may contain any of the species of the savanna and of the 'ohi'a/uluhe communities described above.

The Mixed 'Ohi'a/Wai'awi community covers 16 percent (2,600 linear feet) of Alignment 1 and 46 percent (8,700 linear feet) of Alignment 2. The vegetation of the entire alignment (5,100 linear feet) between Sunrise Estates and Komohana Street is Mixed 'Ohi'a/Wai'awi.

A more detailed discussion of vegetation along the alignments can be found in Appendix B.

2.1.5.4 Biological Resource Values of the Vegetation

For the purposes of this assessment, alien plants and communities dominated by alien plants are considered to have no biological resource value. Vegetation attributes that are valued are 1) rare or endangered native plants and 2) plant communities dominated by native plants, especially if the community is a combination of plant species found only in that area.

No legally protected threatened or endangered plant species were found, nor is it considered likely that any such plants occur in or near either of the alignments. One herbaceous plant species, Scleria testacea, which is probably unique to the Hilo area in Hawaii, was found infrequently within Alignment 1. This species has never been included on lists of plants proposed or considered for threatened or endangered status. Scleria, while not common, is widespread within its range around Hilo and in the past was reported to grow on West Maui as well.

The natural vegetation of the entire Lower Portion has been replaced with alien secondary forest. This vegetation has no biological resource value. Much of the natural vegetation within the Upper Portion has been heavily disturbed by land-clearing and is dominated by communities of alien plants. In some other areas, alien plants, especially wai'awi and melastoma, have heavily invaded the natural vegetation and compromised its native character. There are, however, stretches on each alignment where the vegetation is near its natural state, but no area is outstanding in terms of the diversity of plant species nor particularly unique to the project area. Similar communities occur elsewhere in North Hilo, South Hilo, and Puna districts on relatively young lava flows.

2.1.6 Wetlands Status

In order to satisfy federal guidelines for wetland identification and protection, the determination of wetland status must follow the criteria outlined in the U.S. Army Corps of Engineers' 1987 *Wetland Delineation Manual*. The criteria are highly technical, but basically consist of determination of three conditions: hydrology, soil type, and vegetation.

The initial biological survey identified plant communities and species, and did not perform a full wetland analysis. Two obligate wetland species, Eleocharis obtusa (spikerush, an indigenous sedge) and Ludwigia octovalvis (Mexican seedbox, possibly indigenous), were present in a gully on Alignment 2. Several other species present on the alignments, including Commelina diffusa (honohono, an alien herb) and Brachiara mutica (California grass, an alien grass), are classified as "Facultative" or "Facultative Wetland" by the *Wetland Delineation Manual*. These designations refer to species that are sometimes found in wetland areas, sometimes outside of a wetland. It was reported in the Draft EIS that because no continuous areas of boggy soil or vegetation were discovered during the intensive reconnaissance of all alignments, it could be assumed that no wetlands were present, despite the existence of Obligate, Facultative, and Facultative Wetlands species.

Subsequent communications with the U.S. Army Corps of Engineers have identified the need to perform an analysis in precise conformance with the *Wetlands Delineation Manual* for the alignments that are chosen by the Hawaii County Public Works Department as the preferred route. Prior to commencement of construction, a complete wetland analysis will be conducted on the chosen alignment. If wetlands are discovered in the alignment, appropriate mitigation measures will be developed and acted upon in coordination and compliance with the U.S. Army Corps of Engineers prior to construction.

2.1.7 Fauna

2.1.7.1 Birds

The value of the native animal habitat along the alignments was assessed by Maile Kjargaard, M.S., using information from published records, unpublished reports and discussions with the biologist who conducted the flora study (Appendix C). The study principally concerns the avian (bird) fauna.

Because of the low elevation of the study site, the bird communities are dominated by common alien species. Native forest bird species are unlikely to occur in the area since they are generally found only above 1,600 feet (500 m) elevation. None were seen by Dr. Gerrish during the flora survey. Endangered night-flying seabirds such as the A'o or Newell's Shearwater (Puffinus auricularis) have been detected flying through the area in the past, but since this species requires steep, densely vegetated slopes for nesting burrows, it almost certainly does not breed in the area.

Conversely, the native hawk (Buteo solitarius) and owl (Asio flammeus sandwichensis) regularly occur at low elevations and are likely to utilize the area. The 'Io or Hawaiian Hawk is widely distributed on the Island of Hawaii and is regularly seen foraging in the Hilo area. There is no available information indicating that 'Io breed and nest in the project area. The 'Io is listed as an endangered species by both the State of Hawaii and the U.S. Department of the Interior. It is the only endangered bird likely to utilize the project area.

The plant communities along the alignments were grouped into three habitat types that have different potential for supporting avian communities: 1) savanna on sites of former sugar cane cultivation, 2) 'ohi'a/uluhe scrub on young lava flows with short trees, and 3) 'ohi'a-dominated vegetation on older substrates with taller trees. The third type includes all vegetation with trees large enough to be used as nest sites by the endangered 'Io. This third type is found at the upper end of both Alignments 1 and 2 near Country

Club Road in the form of Closed ‘Ohi‘a Forest. It also includes the sections of ‘Ohi‘a/Uluhe Fern Forest with taller trees characteristic of Alignment 2; however, this vegetation is not high quality nesting habitat. The trees in the ‘Ohi‘a/Uluhe Fern Forest on the 1881 lava flow, which is characteristic of Alignment 1, are generally too small and short to provide nest sites for ‘Io.

2.1.7.2 Mammals

The Hawaiian Hoary Bat (Lasiurus cinereus semotus), a listed endangered species, is the only terrestrial mammal native to Hawaii. This mammal species is widespread in the lowland forests of Hawaii and has been sighted in the project area. These bats are non-selective in the choice of roost site, utilizing native and alien vegetation as well as man-made structures.

2.1.7.3 Invertebrates

The invertebrate fauna of the project area has never been completely described or scientifically studied. In general, native invertebrate species are associated with native vegetation. Areas dominated by native plant cover, such as the 1881 lava flow, may provide corridors connecting pockets of lowland vegetation with larger areas of native vegetation upslope. These corridors may have major survival value for some species. No invertebrate species listed as endangered by the U.S. Department of the Interior is likely to occur in the project area.

The endemic invertebrate fauna of Kaumana Cave has been studied and partially described. Native species of crustaceans, spiders, and insects have been found. This ecosystem is important for evolutionary studies because related surface-dwelling species still live in the native forest above the cave. The native vegetation above the cave is also essential for the well-being of the cave species since roots of ‘ohi‘a trees are the food source for herbivorous species. (See Appendix D: Kaumana Cave Report)

2.1.8 Air Quality

The Hilo region normally has very low levels of pollutants and dust because of dispersive effects of tradewinds. Occasional deterioration in Hilo's air quality due to volcanic emissions ("vog") occurs in the project area. The Lower Portion of the project area is a busy throughway for much of Hilo's traffic and thus periodically suffers from poor air quality due to automobile emissions. These are especially bad during times of congested traffic when automobiles are running at poor fuel efficiency.

2.1.9 Ambient Noise Levels

A noise level study was conducted to determine ambient noise levels on Puainako Street. Instrument measure of the human reaction to sound is problematic. Factors such as pitch, intermittency and more subjective considerations such as the context of the noise and the visibility of the source will influence the "annoyance" generated by noise. A quantitative approximation of noise levels can be obtained using the A-scale on a standard decibel meter (dBA or effective decibels) (AASHTO 1990).

Sound Source

Technicians monitored noise at several locations on Puainako Street in order to determine the average dBA at the edge of houses with a typical setback of approximately 25 feet from the edge of the roadway. Table 2.1 shows the results of the study:

Table 2.1 Existing Noise Levels on Lower Puainako

	dBA Reading*
No Traffic	56.2
Near-Lane Automobile	70.8
Near-Lane Light Truck	73.9
Far-Lane Automobile	66.0
Far-Lane Light Truck	68.3
Traffic Present in Both Lanes	71.6
Loud Trucks or Buses	>90.0

*Value is mean of sample except for last row.

Noise levels are diminished by increasing distance between source and receiver. A doubling of distance from a noise source reduces the decibel level by approximately 3.0 to 4.5 dBA, and a decrease of 10 dBA will appear to an observer to be a halving of the noise. In other words, noise diminishes rather slowly with increasing distance. Barriers such as vegetation and walls also reduce noise, while certain arrangements of reflective surfaces can augment noise. Therefore, the actual noise level experienced by people within and surrounding the homes and other structures on Puainako Street varies widely.

Maximum recommended noise levels for various categories of land use are listed in Table 2.2 below.

Table 2.2 Noise Level/Land Use Relationships

Land Use Category	Design Noise Level (L_{10})	Description of Land Use Category
A	60dBA (Exterior)	Tracts of land in which serenity and quiet are of extraordinary significance and serve an important need, and where the preservation of those qualities is essential if the area is to continue to serve its intended purpose. May include all or portions of certain parks, or open spaces which are dedicated or recognized by appropriate local officials for activities requiring special qualities of serenity and quiet.
B	70dBA (Exterior)	Residences, motels, hotels, public meeting rooms, schools, churches, libraries, hospitals, picnic areas, recreation areas, playgrounds, active sports areas, and parks.
C	75dBA	Developed lands, properties or activites not included in categories A and B.
D	55dBA (Interior)	Residences, motels, hotels, public meeting rooms, schools, churches, libraries, hospitals and auditoriums.

Source: U.S. Department of Transportation Policy and Procedure Memorandum 90-2

Noise levels on Puainako Street during rush hours are often near the maximum recommended level, particularly on the steep uphill grade between Kawili/Iwalani Street and Komohana Street. The public has expressed the belief in correspondence and public meetings that current noise levels are already excessive.

2.2 Archaeological/Historical Environment

An archaeological investigation of the project area was conducted by Terry L. Hunt, Ph.D., and a field crew. This study included a review of previous archaeological work, a historical literature and documents search, and an inventory-level field survey of all proposed right-of-way alignments. The results of these studies are summarized below. A final report is included as Appendix E.

2.2.1 Regional Land Use Patterns

Prehistoric and post-contact land uses of the project area are classified as "upland agricultural" and "lower forest." The upland agricultural zone extended mauka to the lower edge of the forest and was characterized by scattered habitations and garden plots. Archaeological resources may be present in this zone. The lower forest zone probably lacked permanent habitation, but was used for cultivation and gathering forest products. Temporary huts and small religious shrines may have been utilized by family units. By the late 1800's, large tracts of land in the Hilo area (including some of the Project Area) were converted to sugar cane cultivation, followed by settlement and urbanization.

2.2.2 Methodology

An archaeological inventory survey and historical background study were conducted by Terry L. Hunt, Ph.D., and an experienced field crew. This study included a review of previous archaeological work in the region, an historical literature and documents search, a Land Commission (Great Mahele) Award search, analysis of historic maps, in-depth interviews with knowledgeable local informants, intensive field recording of all archaeological sites/features, and test excavations of representative features in the project area. This work was conducted in consultation with Dr. Ross Cordy and Kanalei Shun of the State Historic Preservation Division of the Department of Land and Natural Resources (SHPD). The objective of this work was to provide a complete inventory of the archaeological resources in the project area, make functional and significance designations, and recommendations to mitigating the impact of construction on historic resources. These objectives were set to satisfy all historic preservation regulatory review requirements of SHPD.

In the initial reconnaissance survey of July and August, 1992, the archaeologists identified project areas with relatively high concentrations of archaeological features, and those with none. A second phase of more intensive inventory-level archaeological field recording and test excavations, historical research, and interviews were completed from May-July, 1993. This continued work focused on areas where archaeological features had been identified during the reconnaissance phase.

2.2.3 Existing Conditions

Eleven archaeological sites comprised of 88 individual structural features were identified in the field survey of the project area (see Appendix E, and figures therein). These archaeological remains are plantation-era in age (ranging from ca. 1880 to 1950), and primarily reflect activities associated with the commercial cultivation of sugarcane from the late nineteenth and early twentieth century by the Waiakea Mill Company. These include faced stone mounds from field clearing, railroad bed remnants, platforms, and other stone structures that served planting, loading, and hauling of harvested cane. The sites and their features are listed in Table 2.3 with their function and significance designations.

The archaeological sites are significant in terms of their potential to yield information on recent plantation history in Hilo (Criterion D, *Code of Federal Regulations*, 36 CFR Part 60; and used by Hawai'i SHPD-DLNR), and possibly significant in their interpretive value (Criterion C).

Table 2.3 Archaeological Site Summary

Site#	Feat. #	Structural class	Formal class	Max. areal dim.(sq.m)	Fac-ing?	Function	Prob. age	Signif-icance	Recom-mendation
18911		Complex				Agriculture	H	D	DR
	A	Terrace	Curv-linear	276	Y	Retainwall	H		
	B	Mound	Linear	43	N	Clearing	H		
	C	Mod.outcrp	Linear	20.5	Y	Clearing	H		
	D	Mound	Rect.	84	N	Clearing	H		
	E	Mound	Irregular	56	Y	Clearing	H		
	F	Terrace	Linear	132	Y	Retainwall	H		
	G	Mound	Rect.	96	N	Clearing	H		
	H	Terrace	Linear	64	Y	Retainwall	H		
	I	Terrace	Curv-linear	99	Y	Retainwall	H		
	J	Mound	Irregular	22.5	Y	Clearing	H		
	K	Mound	Irregular	96.5	N	Clearing	H		
18912		Mound	Irregular	54	Y	Agriculture	H	D	DR
18913		Mound	Rect.	29	Y	Agriculture	H	NLS	NFW
18914		Complex				Agriculture	H	D	DR
	A	Platform	Rect.	34	Y	Clear/Found.	H		
	B	Platform	Rect.	60	Y	Clear/Found.	H		
	C	Mound	Irregular	25	N	Clearing	H		
	D	Mound	Irregular	34.5	Y	Clearing	H		
	E	Terrace	Linear	55	Y	Retwall/Found.	H		
	F	Platform	Rect.	66	Y	Clear/Found.	H		
	G	Mod.outcrp	Irregular	1092	Y	Clearing	H		
	H	Mod.outcrp	Curv-linear	62.5	Y	Clearing	H		
18915		Complex				Agriculture	H	D	DR
	A	Enclosure	Oval	112.5	Y	Clear/Found.	H		
	B	Terr/mound	Linear	20	Y	RR bed	H		
	C	Platform	Rect.	42	Y	Clear/Found.	H		
	D	Mound	Rect.	3.5	N	Clearing	H		
	E	Platform	Rect.	42	Y	Clear/Found.	H		
	F	Platform	Rect.	46	Y	Clear/Found.	H		
	G	Mound	Rect.	13	N	Clearing	H		
	H	Platform	Oval	45	Y	Clear/Found.	H		
	I	Mound	Irregular	29.5	Y	Clearing	H		
18916		Complex				Agriculture	H	D	DR
	A	Platform	Rect.	45	Y	Clear/Found.	H		
	B	Terr/wall	Curv-linear	217.5	Y	Retainwall	H		
18917		Complex				Agriculture	H	D	DR
	A	Wall seg.	Linear	13	N	Clearing	H		
	B	Mound	Rect.	9	Y	Clearing	H		
	C	Mound	Rect.	20.5	Y	Clearing	H		
18918		Complex				Pasture	H	D	DR
	A	Mod.outcrp	Irregular	3.5	Y	Clearing	H		
	B	Mod.outcrp	Rect.	1.5	Y	Clearing	H		
	C	Mound	Oval	8.5	Y	Clearing	H		
	D	Mod.outcrp	Irregular	15.5	Y	Enclosure	H		

Table 2.3, continued

Site#	Feat #	Structural class	Formal class	Max. areal dim.(sq.m)	Fac-ing?	Function	Prob age	Signif-icance	Recom-mendation
18919		Complex				Agriculture	H	D	DR
	A	Mod.outcrp	Irregular	490	Y	Clear/Found.	H		
	B	Mod.outcrp	Rect.	15	Y	Clear/Found.	H		
	C	Mod.outcrp	Curv-linear	15.5	Y	Clearing	H		
	D	Mound	Rect.	2	Y	Clearing	H		
	E	Wall	Linear	81.5	Y	Boundary	H		
	F	Mod.outcrp	Curv-linear	10	Y	Clearing	H		
	G	Mod.outcrp	Rect.	7	Y	Clearing	H		
	H	Mod.outcrp	Irregular	3	Y	Clearing	H		
	I	Mod.outcrp	Curv-linear	12	Y	Clearing	H		
	J	Mod.outcrp	Irregular	18	Y	Clearing	H		
	K	Mound	Rect.	2	N	Clearing	H		
	L	Mod.outcrp	Rect.	30	Y	Clearing	H		
	M	Mod.outcrp	Circular	23	Y	Clearing	H		
	N	Mod.outcrp	Oval	14	N	Clearing	H		
	O	Mound	Irregular	4	Y	Clearing	H		
	P	Mod.outcrp	Rect.	5	Y	Clearing	H		
	Q	Platform	Rect.	11	Y	Clear/Found.	H		
	R	Mound	Circular	4	Y	Clearing	H		
	S	Mod.outcrp	Rect.	3	Y	Clearing	H		
	T	Mod.outcrp	Irregular	72	Y	Clearing	H		
	U	Platform	Rect.	21	Y	Clear/Found.	H		
	V	Mound	Circular	2.5	Y	Clearing	H		
	W	Mound	Rect.	2.5	Y	Clearing	H		
	X	Mound	Rect.	2	Y	Clearing	H		
	Y	Mound	Oval	2	Y	Clearing	H		
	Z	Mound	Rect.	2	Y	Clearing	H		
	AA	Mod.outcrp	Rect.	7.5	Y	Clear/Found.	H		
	BB	Mod.outcrp	Irregular	2	Y	Clearing	H		
	CC	Mod.outcrp	Linear	1.5	Y	Clearing	H		
	DD	Mod.outcrp	Irregular	2	Y	Clearing	H		
	EE	Mod.outcrp	Irregular	3	Y	Clearing	H		
	FF	Mod.outcrp	Rect.	3.5	N	Clearing	H		
	GG	Mod.outcrp	Linear	8	Y	Clearing	H		
	HH	Mod.outcrp	Linear	3.5	Y	Clearing	H		
	II	Mod.outcrp	Linear	1.5	Y	Clearing	H		
	JJ	Mod.outcrp	Linear	2	Y	Clearing	H		
18920		Complex				Agriculture	H	NLS	NFW
	A	Mound	Rect.	20	N	Clearing	H		
	B	Mound	Circular	8.5	N	Clearing	H		
	C	Mound	Circular	7.5	N	Clearing	H		
	D	Mound	Circular	8.5	N	Clearing	H		
	E	Mound	Circular	9	N	Clearing	H		
	F	Mound	Circular	6.5	N	Clearing	H		
	G	Mound	Circular	8.5	N	Clearing	H		

Table 2.3, continued

Site#	Feat.#	Structural class	Formal class	Max. areal dim.(sq.m)	Fac-ing?	Function	Prob. age	Signif-icance	Recom-mendation
	H	Mound	Circular	7.5	N	Clearing	H		
18921		Complex				Agriculture	H	D	DR
	A	Mound	Irregular	48	N	Clearing	N		
	B	Terrace	Linear	50	N	Clearing	N		
	C	Mound	Linear	35	N	Clearing	N		
	D	Wall seg.	Curv-linear	24	N	Clear/Found.	N		
	E	Terrace	Linear	32	N	Clearing	N		

Significance criteria codes (from Code of Federal Regulations, 36 CFR Part 60; these criteria are used by Hawaii DLNR-SHPO):

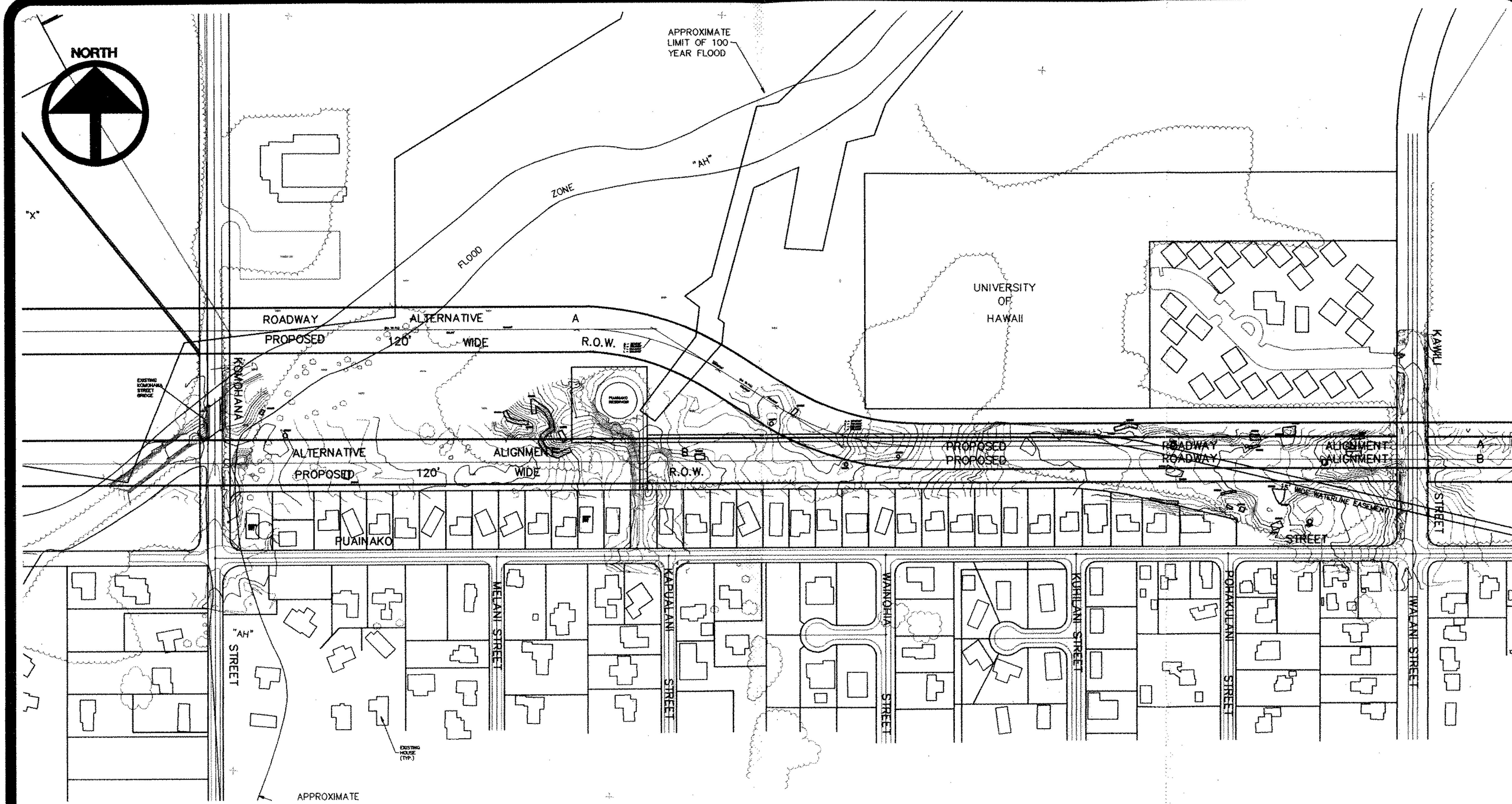
C Site is an excellent example of a site type
D Site may be likely to yield information important in history or prehistory
E Site has cultural significance (Native Hawaiian or other ethnic group)

Recommendation codes:

DR Data recovery (mapping, excavation, etc.) as a mitigation
NFW No further work

Possible Age

HIST Historic
PRE Prehistoric



TITLE **Archaeological Site Map: Lower Portion**

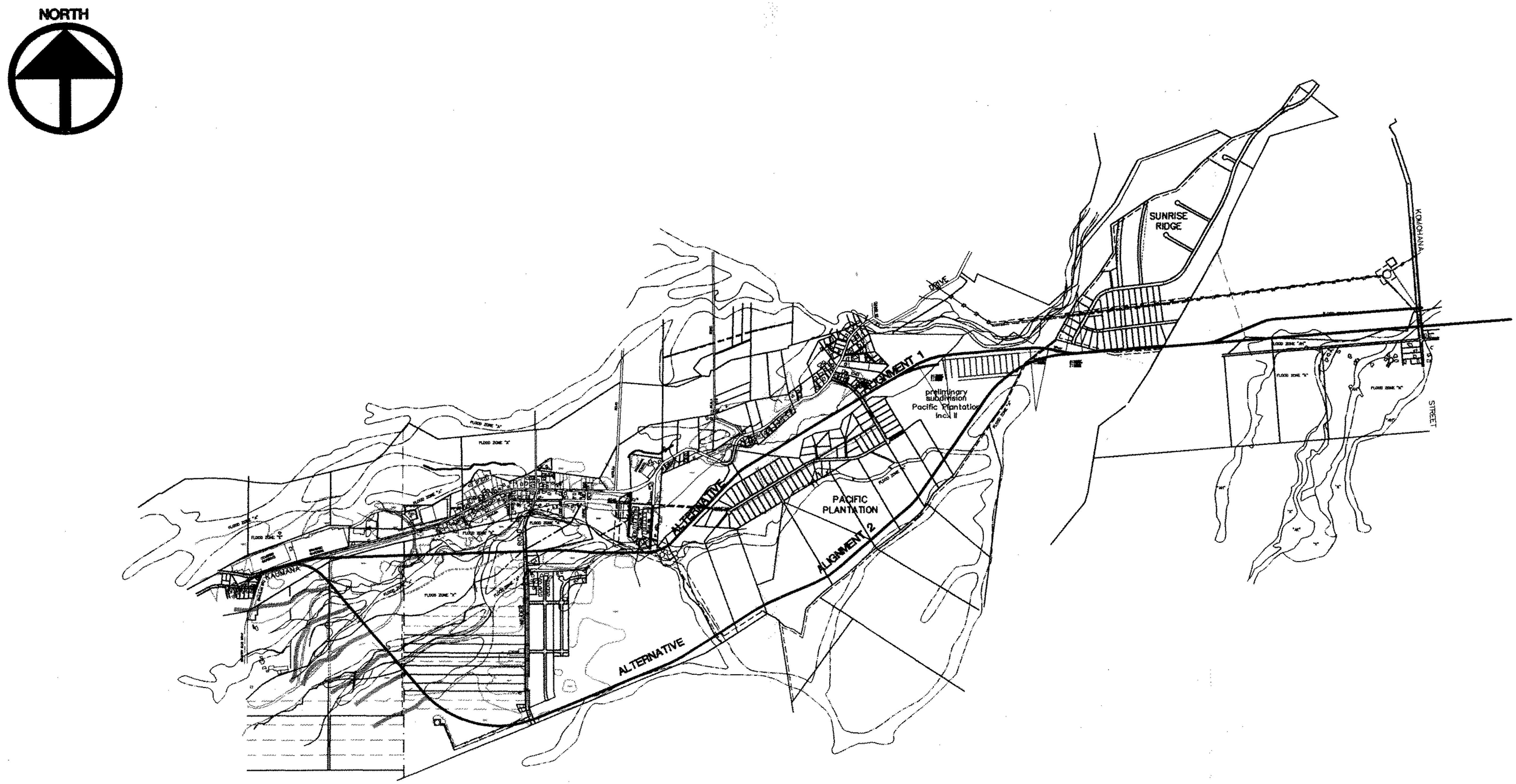
FIGURE 2-4

PROJECT PUAINAKO STREET EXTENSION
HILO, HAWAII

DATE 7/30/93

SCALE: 1"=250'

93042F6



TITLE **Archaeological Site Map: Upper Portion**

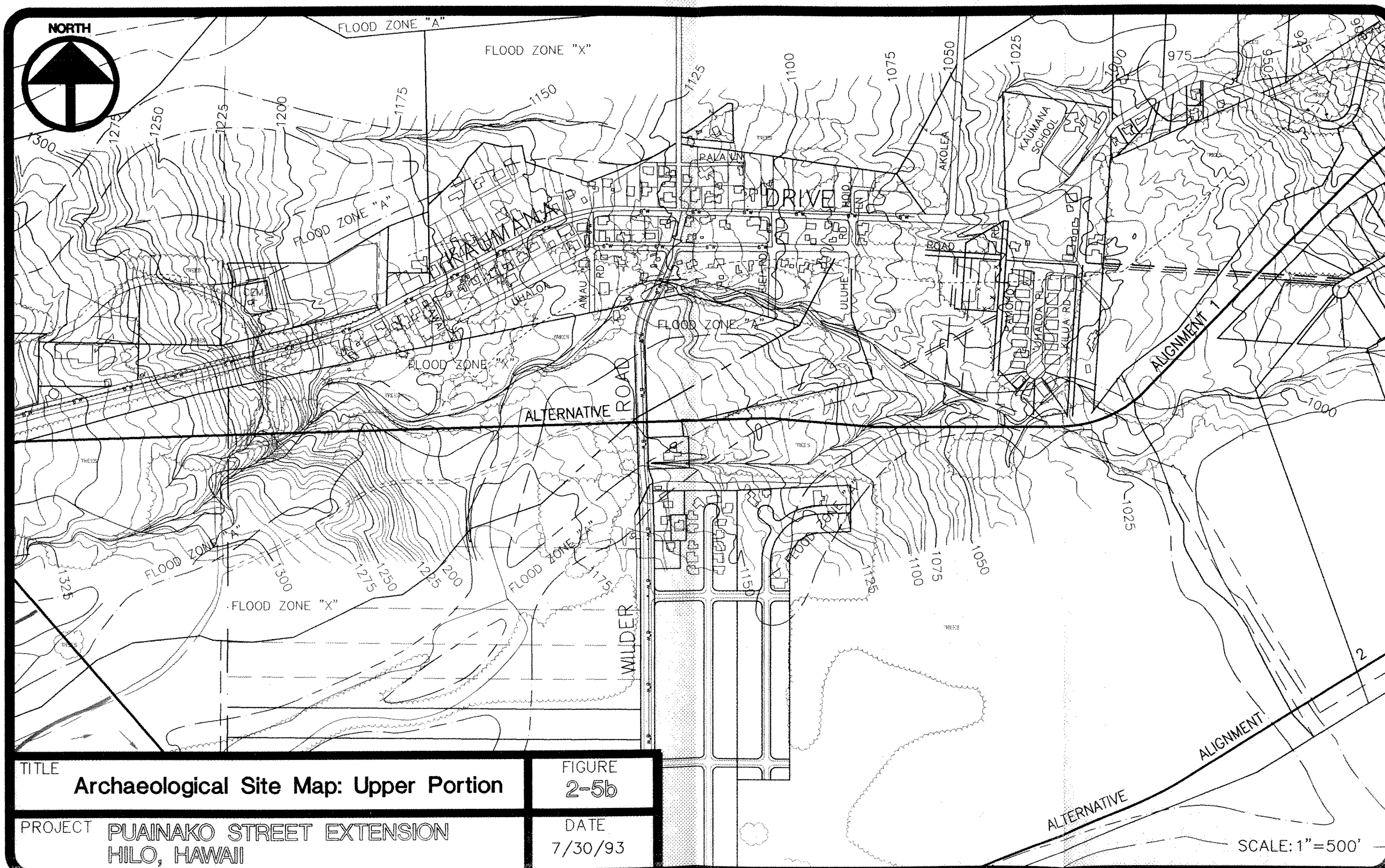
FIGURE 2-5a

PROJECT PUAINAKO STREET EXTENSION
HILO, HAWAII

DATE 7/30/93

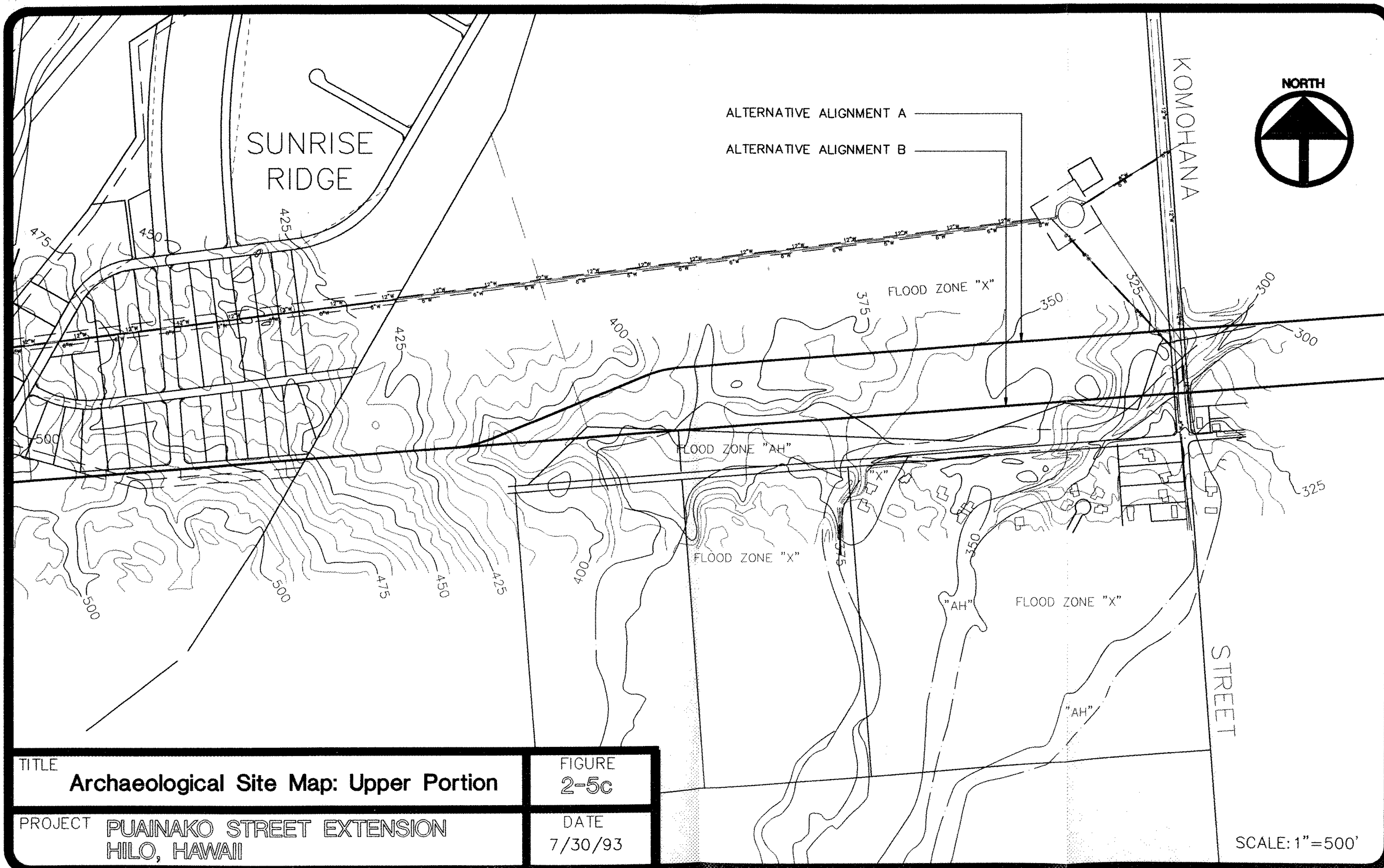
SCALE: 1"=2000'

93042F2



TITLE Archaeological Site Map: Upper Portion	FIGURE 2-5b
PROJECT PUAINAKO STREET EXTENSION HILO, HAWAII	DATE 7/30/93

93042F3



TITLE **Archaeological Site Map: Upper Portion**

FIGURE 2-5c

PROJECT PUAINAKO STREET EXTENSION
HILO, HAWAII

DATE 7/30/93

93042F4

2.3 Social and Economic Environment

2.3.1 Demography and Infrastructure

The population of the island has grown in tandem with visitor industry growth, increasing by 45.0 percent from 63,468 in 1970 to 92,053 in 1980, and by 30.7 percent to 120,137 between 1980 and 1990. These growth rates exceed the state-wide growth rate of 14.9 percent in the 1980s. According to a State population projection, Hawaii County will grow at an annual average of 3.56 percent into year 2010, reaching 206,000 by 2010 (DBED, M-K Population projection series, State of Hawaii). The population of East Hawaii alone is estimated to grow at an annual rate of 2.24 percent, reaching 95,385 by year 2010.

Although the Big Island has the lowest population density of any county in the state, its rapid population growth increasingly strains existing road networks and other public services such as schools, hospital, police and fire. Many Hilo streets are often congested due to an antiquated roadway system that is unable to handle the burgeoning population. There are a number of traffic bottlenecks that develop during rush hours within Hilo.

2.3.2 Neighborhood Characteristics

The potential impact zone of the proposed action includes the three residential neighborhoods of Upper Kaumana, Waiakea Homestead and Waiakea Uka. A study of the social environment and impacts on these neighborhoods was conducted by Alton Okinaka, Ph.D., using census data and direct surveys of the residents. The report is included in this Final EIS as Appendix H. Research from this study showed that some small-scale agricultural lots are included in the Waiakea Uka and Upper Kaumana areas. Most respondents to the survey occupied their own single-family structures on relatively large lots (86 percent for Kaumana, 93 percent for Waiakea). Respondents to the survey reported an average of 2.00 drivers per household in Kaumana and 2.36 in Waiakea. These figures indicate small households such as typify suburban neighborhoods.

The high rate of owner-occupied households reported in the survey indicates a stable population. The low rate of renting indicates an absence of a significant transient population. The recent expansion of housing construction in these areas suggests a mixture of older, established families and younger, starting families. Recent and proposed developments for the area are in character with current housing as single-family homes on moderate-sized lots. Expansion will likely continue at a moderate pace with additional owner/builders and small-scale residential developments.

While Waiakea Homestead in particular has a reputation for being heavily populated by ethnic Japanese, there are no areas homogeneous in racial/ethnic terms. People of all the major ethnic groups live in each neighborhood.

2.3.3 Land Use

The Lower Portion of the proposed project passes through Waiakea, a primarily residential neighborhood that contains several schools, churches, and one small store. The segment between Kilauea Avenue and Kawili Street passes through a heterogeneous mixture of homes from various dates. The segment between Kawili Street and Komohana Street would pass between a State Housing Project built in the 1970s and the University of Hawaii at Hilo Associated Student Housing (ASH) apartment complex.

The Upper Portion passes primarily through undeveloped forest land or unutilized agricultural land. Depending on the alignment chosen, a varying number of residents of Kaumana Drive and side-streets that branch off towards the southeast would be within 300 feet of the proposed roadway.

2.3.4 Economic Conditions

With all the environmental diversity the Island of Hawaii offers, the economy of East Hawaii for the past century has been based largely on agricultural activities, primarily sugar production. However, the sugar industry in Hawaii has been declining steadily over the past twenty years, largely due to foreign competition.

Offsetting the declining sugar industry has been the rapidly increasing diversified agriculture sector, including activities such as ranching, floriculture, macadamia nut, coffee, and varieties of truck farming. In addition, the cloudless and pollution-free atmospheric conditions at high altitude on Mauna Kea have fostered the growth of the world's leading astronomical research facilities. It is estimated that by the year 2000, the total capital invested in 13 telescopes on Mauna Kea will near $1 billion, with total annual operating expenses over $50 million. In preparation for the anticipated expansion of this science/technology industry, the University Research Park had its groundbreaking in 1992 at the campus site of the University of Hawaii at Hilo.

Hawaii's ideal climate and landscape are natural attractions for tourists. The visitor industry of Hawaii County has grown rapidly over the past two decades, with the number of annual visitor arrivals reaching one million in 1991. This rapid development has been concentrated on the drier west side of the island, and as a consequence, the districts of North Kona and South Kohala boast world-class destination-resort communities. As with the rest of the state, Hawaii Island's economy is becoming increasingly dependent on the visitor industry sector. A recent issue of First Hawaiian Bank's Economic Indicator notes that "steady visitor traffic, rapid resort development, robust construction activity and a booming population have provided the County with the fastest growing economy in the state." (Economic Indicator First Hawaiian Bank, March-April, 1992.)

The economy of East Hawaii has evolved from a reliance on agriculture to a more diversified economy. Two of the top three employers on the island, jointly accounting for over 15 percent of all jobs, are the State of Hawaii and the County of Hawaii. Most of these jobs are located near Hilo. Several large wholesalers, distributors and grocery and building material chains also provide thousands of jobs for East Hawaii.

Unfortunately, East Hawaii's infrastructure, particularly the roadway system, has not kept pace with the expansion in population and commercial activities. Many major streets are unable to accommodate the volume of traffic. The proposed Puainako Street Widening and Extension would provide much-needed relief from traffic congestion. It would also expected to contribute significantly to the efficiency of the roadways that connect East Hawaii to West Hawaii via the Saddle Road, encouraging more economic connections between the districts.

Chapter 3:

Environmental Impacts of the Proposed Action and Proposed Mitigation

CHAPTER 3: ENVIRONMENTAL IMPACTS OF THE PROPOSED ACTION AND PROPOSED MITIGATION

This chapter discusses the potential beneficial and adverse impacts of the proposed action, the mitigation measures proposed to reduce adverse impacts, and then compares the relative impact of the alternative alignments and design options.

The specific scope of this EIS is to evaluate the environmental impacts directly associated with site-specific roadway construction and improvement activities. A second category of impacts to be evaluated, those with regional implications, would have an effect on the surrounding region regardless of which specific site is selected for the project and would include, for example, economic impacts associated with the construction of the project.

In this chapter, the environmental impacts of the proposed action on specific resources are organized as Traffic Impacts, Physical Impacts, and Social and Economic Impacts. Proposed mitigation measures and comparison of the relative impact of the alternative alignments follow the discussion of the potential impact on individual resource categories. The chapter concludes with a summary of 1) Impacts that Cannot Be Avoided, 2) Irreversible Impacts, and 3) Irretrievable Commitment of Resources.

3.1 Overview of Potential Impacts

Potential adverse and beneficial impacts of the proposed action are summarized in Table 3-1. The potential impacts on each resource category are more thoroughly analyzed in the following sections.

The symbols in Table 3-1 do not indicate the absolute magnitude of impacts but only the direction, i.e. beneficial ("+") or adverse ("-"), and the magnitude relative to the No Action Alternative and to the one other alternative alignment for each portion of the proposed roadway. Impacts judged to be non-existent or negligible are indicated by "0"; all impacts marked with any other symbol are estimated to be greater than negligible. Consult the appropriate subsections below for analysis of significance of the impact. Because the alternative design options produce impacts in relatively few categories, they have not been included in the table.

The double symbols (i.e., "--" or "++") in some cells of the table are meant to compare the relative strength of the impact, either positive or negative, in each of the alternative alignments.

Table 3.1 Overview of Potential Impacts of Alternative Alignments
See individual text resource subsections for complete analysis. Table does not list resource categories in which all potential impacts estimated to be negligible. Symbols do not indicate significance or magnitude of impacts. "0" impact negligible relative to NO ACTION (N/A); "-" adverse impact relative to N/A; "--" adverse impact relative to alternative alignment; "+" beneficial impact relative to N/A; "+-" both beneficial and adverse impacts requiring separate analyses.

RESOURCE IMPACTED	LOWER PORTION		UPPER PORTION	
	Align A	Align B	Align 1	Align 2
TRAFFIC IMPACTS				
Construction-Related	-	-	0	0
Local Flow	+-	+-	+-	+-
Regional Flow	+	+	+	+
SOCIAL/ECONOMIC				
Community Cohesion	+	+	-	+
Pedestrian Safety	0	-	0	0
Relocation	-	-	0	0
Visual/Aesthetic	-	--	+-	+-
Archaeological Sites	-/0	-/0	0	0
Economic	+	+	+	+
Land Use	-	0	0	0
PHYSICAL IMPACTS				
Kaumana Escape Route	+	+	+	+
Air - Short Term	-	-	0	0
Air - Long Term	0	0	0	0
Noise - Short Term	-	--	0	0
Noise - Long Term	+	-	0	0
Fauna ('Io)	0	0	0	-
Kaumana Cave/	0	0	-	0

3.2 Traffic Impacts

It is expected that implementation of this project would improve the overall efficiency and safety of the roadway network between the Waiakea and Kaumana sections of Hilo. However, there would be short-term congestion during the construction period. In addition, there would be permanent impact on traffic flow on Puainako Street. Inter-regional traffic is also expected to increase as a response to the proposed improvements and other projects in planning or construction. These impacts are considered separately below.

3.2.1 Short-Term Impacts of Construction

3.2.1.1 Probable Impact

It is expected that construction would last three to four years depending on the availability of construction funding. During the construction period, operation of construction equipment, trucks, and worker vehicles would impede traffic along the makai end of Puainako Street between Kilauea Avenue and Kawili Street, particularly during school hours. The public has expressed concern that the project be scheduled to minimize construction interference with school traffic.

No significant traffic congestion problem is anticipated during the construction of the upper portion of Puainako Street.

3.2.1.2 Proposed Mitigation

Construction should be scheduled to avoid peak traffic hours. Construction of the section in front of Waiakea Elementary and Waiakea Intermediate schools should be scheduled for the summer school vacation as much as possible to minimize increasing congestion.

3.2.1.3 Comparison Between Alternatives

The construction-related impact on traffic congestion would be equal for both Alignments A and B.

Negligible construction-related traffic congestion is anticipated for either Alignment 1 or 2, except at the Komohana Street intersection, where impacts would probably be equal.

Design Option I would leave the existing Puainako Street largely intact during and after construction, and thus poses fewer short-term traffic impacts to Puainako Street through-traffic than options II or III. However, that portion of the Puainako Street traffic going to or from the Waiakea school complex may suffer more impacts under Design Option I than with options II or III.

The construction-related impact on traffic congestion would be equal for both Design Options X and Y.

3.2.2 Long-Term Impact on Puainako Street Traffic Movements

3.2.2.1 Probable Impact

In general, traffic congestion on lower Puainako Street would be greatly relieved by the widening, which would provide through lanes and proper turning lanes into the Waiakea schools. The use of the Upper Portion of the project, however, would add traffic to the Lower Portion. It is anticipated that the improvements of the Lower Portion would be able to absorb the added traffic, and the net result should be a much smoother traffic flows.

Concerns raised during the traffic study (Appendix G) and the Social Impact Research (Appendix H) center around the issues of turning movements and accessibility. Residents of Puainako Street wish to retain their current ease of access to the roadway; parents of schoolchildren and teachers emphasize the need for a safe and convenient access to the Waiakea school complex; and commuters require a level of service on the roadway that allows reasonably rapid, safe, and smooth traffic flow on the way to workplaces, shopping centers, and the colleges. Section 1.1.5 (Design Options) discusses the engineering aspects of balancing full-turning options at every intersection with efficient flow of traffic. It is clear that all Design Options involve trade-offs of these aspects.

3.2.2.2 Proposed Mitigation

The principal rationale behind the selection of the ultimate alignments and design options will be optimization of traffic flow. Although every concern at every intersection cannot be satisfied, the overall pattern should be one of less congestion, and traffic congestion should be mitigated to below the pre-project level.

3.2.2.3 Comparison Between Alternatives

The beneficial and adverse impacts of the proposed action on traffic movement along the realigned Lower Portion (existing) of Puainako Street are essentially identical for either Alignment A or B and for either Alignment 1 or 2. Choice of alignment would not significantly alter the impact.

Each design option, however, has consequences in terms of traffic flow efficiency and ease of access.

For the Kilauea-to-Kawili segment of Puainako Street, Design Option I (frontage road) would limit the number of disruptive accesses and turning movements onto the main portion of the road, creating a more efficient flow of traffic. Design Option II (unlimited left-turn movement) would permit full access to all driveways and streets but would reduce traffic flow efficiency. Design Option III (limited left-turn movements) would reduce access to driveways and streets but would enhance traffic flow efficiency.

For the Kawili-to-Komohana segment of Puainako Street, Design Option X, which would create a barrier and cul-de-sac at the makai end of the segment (i.e., just above Kawili Street), would eliminate what could be a confusing and problematic set of intersections on Kawili Street. At the same time, access to lower Puainako Street would become marginally more difficult for residents on this segment, who would need to use the proposed Water Tank right-of-way (see Figure 1-1). Design Option Y, which would cul-de-sac the mauka end of this segment (i.e., just before the current intersection with Komohana Street), would pose an opposite problem: access to upper Puainako Street would become marginally more difficult for segment residents.

3.2.3 Long-Range Travel Forecast and Cumulative Impact

3.2.3.1 Probable Impact

There would be cumulative effects of the Puainako Street Extension and Saddle Road Improvements. The State DOT travel forecast, presented in IHLRHP [Island of Hawaii Long Range Highway Plan], which is based upon the existing road network and proposed improvements to Saddle Road as well as Puainako Extension, is shown in Table 3-2 below:

Table 3.2 State DOT Traffic Projection

Puainako Street Section	1992 ADT	2010 ADT Without Improvements	2010 ADT With Improvements
From Kanoelehua Avenue To Kilauea Avenue	20,456	27,300	29,800
From Kilauea Avenue To Kinoole Street	14,266	15,400	23,500
From Kinoole Street To Komohana Street	6,489-8,812	11,100	19,500
From Komohana Street To Kawailani Street Extension	------	------	23,400
From Kawailani Street Extension To Saddle Road (Kaumana Drive)	------	------	8,600

The IHLRHP estimates an increase of as many as 8,000 trips per day on the improved Saddle Road. Puainako Street, if extended, would be expected to accommodate a share of this traffic. The proposed Puainako Street Extension is expected to accommodate the increase in traffic to the Year 2010.

3.2.3.2 Proposed Mitigation

As a mitigating measure, the IHLRHP also proposes the extension of Kawailani Street, which would intersect with the Puainako Street Extension and terminate at Kaumana Drive, makai of the Puainako Street junction. This additional network would increase access by reducing travel distances and travel times, which would result in inducing travel between East and West Hawaii. The proposed improvements to Puainako Street are expected to decrease, or at any rate to modify the increase of, inter-regional traffic along Kaumana Drive.

3.2.3.3 Comparison Between Alternatives

Choice of alignment would not significantly alter long-term or cumulative traffic impacts.

3.2.4 Considerations Relating to Pedestrians and Bicycles

In the Lower Portion at present, the principal pedestrian traffic consists of school children who live in the vicinity of the Waiakea school complex. The existing Puainako Street has dual asphalt sidewalk/bikeways separated from the roadway by intermittent raised asphalt curbing. Most of the local cross-streets have pedestrian crosswalks. Design plans for the new section would include similar facilities for all modified segments and the new segment between Kawili Street and Komohana Street. It is recommended that, in coordination with the State Department of Education, new facilities be incorporated in the roadway design to increase pedestrian access and safety. Options would include pedestrian overpasses or underpasses, sidewalks, and crosswalks.

Bicycle lanes will be constructed on both sides of the highway in the Lower Portion. In the Upper Portion (mauka of Komohana Street), a wide shoulder would be provided for a bicycle lane. Little pedestrian use of the Upper Portion is expected at this time since the roadway would connect mostly residential neighborhoods separated by miles of open space. Pedestrians could also use the shoulder. The size of the right-of-way allows for future improvements in sidewalks and bicycle paths as needed.

3.3 Physical Impacts

3.3.1 Hazard Exposure Impacts

No feasible alternative for serving Kaumana traffic can avoid the hazard to the roadway of lava flows. There are no practical measures to mitigate this threat to the roadway.

The new road would beneficially reduce the hazard exposure for the residents of Kaumana by providing an alternate escape route in the event of natural disasters or accidents. Unlike the Akolea-Waianuenue alternate escape route, the Puainako Extension would be connected to Kaumana Drive along several streets. At a minimum, these would include Wilder Road, Edita Street, and at its terminus near Country Club Drive. This street network would more efficiently conduct traffic away from Kaumana. The wider roadbed and shoulders of the proposed highway would also be less likely to become completely blocked in case of an accident.

3.3.2 Air Quality Impacts

3.3.2.1 Probable Impact

It is anticipated that construction activities would significantly raise levels of dust and engine pollution for short periods of time over limited areas. This pollution would be particularly noticeable in the Lower Portion, where residences and traffic are already present. Impact from construction on the Upper Portion would be largely or almost completely isolated from residences and roads.

Federal and State Air Quality Standards limit carbon monoxide, the principal health concern and key automobile exhaust pollution indicator, to the values below:

Sampling Period	Federal Standards Primary	Federal Standards Secondary	State Standards
Maximum Average in any 8 Hours	10	10	5
Maximum Average in any Hour	40	40	10

Recently, the Federal Environmental Protection Agencies "HIWAY" model for computing levels of carbon monoxide has been applied to proposed highway projects similar to the Puainako Roadway Extension. These calculations have yielded values far below such maximum standards (Belt, Collins and Associates 1984). Given the findings of these studies, conducted in areas less favorable in terms of traffic volume and wind dispersal than the project area, there is no need to conduct a projected air quality analysis for the Puainako project.

Two features of the proposed project may actually decrease air pollution from automobiles: the increased efficiency of automobile engines because of reduced stop-and-go traffic conditions, and shorter total commuting distances for residents of Kaumana. This beneficial impact, however, might be offset partially or fully by the increase in total traffic that is projected for the roadway system. Depending on the alignments chosen for the Upper and Lower Portions, not only might the total quantity of air pollutants released potentially diminish, but also the pollution might be transferred from residential streets to areas with wide, open spaces for free dispersal of pollutants to harmless levels. It is concluded that the net long-term impact of automobile emissions related to the proposed project on air quality would be neutral.

3.3.2.2 Mitigation of Air Quality Impacts

It is recommended that during construction, water be periodically sprayed on the road surface to reduce dust pollution. It is also recommended that heavy equipment movement in and out of the construction zone be timed to avoid peak traffic hours in order to mitigate peak auto and truck exhaust emissions. All requirements of the State Department of Health relating to dust control will be complied with.

3.3.2.3 Comparison Between Alternatives

As far as air quality deterioration for residents of the mauka portion of the existing Puainako Street, Alternative A is preferable to B, since it is farther from the homes. However, because of the mitigating measures proposed for noise control, long-term impacts associated with the project might actually be less severe than current conditions, regardless of the alignment chosen.

Construction-related and long term increases (if any) in air pollution along the Upper Portion may be slightly more intrusive in developed areas on the southeast side of Kaumana Drive with the selection of Alignment 1. No quantitative projections are available, but it is estimated that the difference in air quality impact between alignments would probably be undetectable.

3.3.3 Water Quality Impacts

Sediment increases often accompany highway construction. In order to ensure that extra sediment input caused by the proposed project is reduced to negligible levels, best management practices regarding sediment control will be adhered to. All requirements of the State Department of Health relating to water quality control will be complied with.

Water and sediment may also contain small amounts of heavy metals, hydrocarbons, and other by-products of automobiles. However, all run-off would either percolate into the porous lava rock or be channeled into existing drainage systems, which already route far greater quantities of run-off from other developed areas. The ultimate destination for both run-off and groundwater is Hilo Bay, which receives effluent from several boat and ship harbors, storm run-off from most of Hilo, and partially filtered sewage from Hilo's many cesspools. The filtration effect of the long passage to the ocean of project sediments and pollutants would reduce any adverse impact on water quality effects to negligible levels.

3.3.4 Noise Impacts

3.3.4.1 Probable Impacts

As with air pollution, noise would rise temporarily during construction, sometimes to levels exceeding the acceptable range. Construction noise in the Upper Portion would be far less problematic because there are few houses near the proposed alignments.

In the Lower Portion of the project area, the proposed alignments and improvements are located close to many existing residences and the Waiakea school complex. The widening of the section between Kilauea and Iwalani Streets may raise noise levels at the schools because of greater traffic volume and less physical setback from the roadway.

It is clear that any increase in noise may reduce the quality of life in the project area. Therefore, noise mitigation should be employed as part of the project.

3.3.4.2 Mitigation

Traffic-generated noise is a combination of sounds from several sources: vehicle engines, tire-to-pavement interaction, vehicle-to-air interaction, and various minor sources such as horns, radios, brakes, and exhaust systems. The intensity of sound at the receiver is a function of several factors, the most influential being the distance between the receiver and the source. The sound intensity diminishes the further it travels from the source. If the sound waves encounter solid objects, they tend to be reflected. Trees, shrubs and other vegetation, because of their shape and composition, tend to diffuse the sound waves.

With these concerns in mind, the following noise mitigation strategies should be incorporated into the final design wherever feasible:

1. The final alignment's location should be carefully considered so as to maximize distance from existing residences and the school complex, utilizing distance from the source to the receiver to diminish the intensity of the generated sound at the receiving point.

2. Buffer strips should be provided and planted with vegetation, i.e., trees, shrubs, etc. This would diffuse the sound waves before they reach the receivers.

3. In high noise intensity areas, where the source is very close to the receivers and cannot be moved away or shielded with a planted buffer strip, structures such as cement/rubble masonry or concrete walls shall be constructed to reflect the sound waves away from the receivers.

4. Along with source control, optional control of the sound intensity can be implemented at the receiver locations. Receivers may close doors and windows during times of high source emissions. Receiver control could also include replacing existing doors and windows with noise reduction types and installing sound reducing insulation.

3.3.4.3 Comparison Between Alternatives

Use of Alignment A between Iwalani and Komohana Streets would probably result in a net decrease in noise for the residents on Puainako Street because Alignment A would be farther from the homes than the existing Puainako Street, which would be converted to a quiet, dead-end street. Alignment B abuts the existing houses and, with no mitigation, would probably lead to a marginal increase in noise levels as noise in the front yards would be reduced but noise in the back yards increased. Depending on the way each household has structured the use of its lot space, the new noise source may be more or less disruptive than at present.

Noise impacts for would be equal for Design Options II and III. Design option I would impose more noise impacts on the Waiakea school complex. Noise impacts would also be equal in magnitude for Design Options X and Y. Choice of Design Option X (a cul-de-sac on Puainako Street just mauka of the current intersection with Kawili Street) would lessen noise impacts on the makai section of the Komohana-to-Kawili segment of Puainako Street, whereas Design Option Y would lessen noise impacts at the mauka end of this segment.

Along the Upper Portion, Alignment 1 would more likely be audible to the residents of the developments along the southeast side of Kaumana Drive. Alignment 2 would be less audible in these developments because of the greater distance to the roadway. Choice of alignment would not alter the impact for future residents of Sunrise Estates since both alternatives share the same alignment in this area.

3.3.5 Floodplain and Drainage Impacts

Construction activities for the extension of the roadway would include tree removal, clearing and grubbing, excavation, embankment construction, paving of the roadway and shoulders, lawn/vegetation replication and the construction of drainage facilities.

The proposed roadway typical section would be crowned to shed water and prevent standing water on the roadway. This runoff would be collected in roadside ditches and drainage structures (i.e. drywells, retention ponds and/or detention ponds) and disposed of by both infiltrating it into the ground and discharging it into the natural drainage paths.

3.3.5.1 Probable Impacts

The paving of the roadway would increase the amount of impervious surface area within the project limits. This increased impervious area has the potential of increasing the amount of rainfall runoff within the project limits. It is proposed to dispose of any increase in runoff through the use of drywells and percolation ponds.

In areas where the proposed roadway traverses existing streams, natural drainage courses or flood ways, drainage culverts would be required to pass the runoff beneath the roadway. The location, alignment and hydraulic design of these structures would require special attention to prevent alterations to the general drainage and flood patterns within the project limits. Flood pattern characteristics of major concern would be the base flood elevation and limits of inundation.

During the construction earthwork operations, the removal of vegetation and ground cover may leave soils susceptible to erosion due to rainfall runoff. In turn, soil sediment entering drainage structures and drainage paths would be a concern.

3.3.5.2 Mitigation of Floodplain and Drainage Impacts

The goal and purpose of drainage impact mitigation measures is to eliminate net impact to the overall flow of the natural drainage system. A number of techniques can help accomplish this objective.

Any increase in runoff associated with the increase in impervious area will be dealt with through the utilization of drywells, percolation ponds, detention ponds and retention ponds.

At locations where the proposed roadway crosses a stream or obvious drainage path, culverts will be installed to permit the runoff to pass beneath the roadway. The culverts will be sized to allow the passage of the normal or base flow of the stream along with the runoff associated with the design rain storm. The design storm will have a frequency of return of 50 years or less. In the final design stage, the proposed culverts will be checked against a design storm having a frequency of return of 100 years and recommendations made based upon their performance.

In locations where the proposed roadway crosses flood hazard zones, measures will be taken to prevent changes in the flood water patterns. A flood zone determination and study is necessary to locate the actual limits of the floodplain and determine the expected flood water elevations. This information is required to insure sound floodplain management and construction practices within the flood hazard areas. Flood water elevation and flow characteristics would be integrated into the design of flood zone crossings to determine the best design, and at the same time, evaluate upstream areas for potential flood damages. Floodplain management strategies would include sizing culverts at the floodplain crossings to allow the passage of 100-year frequency of return flood waters and to prevent any increase in the flood water elevations or limits of inundation. This could also include replicating flood storage volumes in areas where it is necessary to fill floodways to construct the roadway embankment. Replicating flood storage volume would ensure the existing volume of flood storage would be maintained.

During the construction grading and earthwork, provisions will be made to minimize the potential for soil erosion and measures will be taken to minimize the amount of sediment that leaves the construction limits. Soil erosion and sediment control standard management practices, as described in the "Erosion and Sediment Control Guide for Hawaii", (U.S. Soil Conservation Service 1981) shall be implemented. These management measures could include:

1. Timing construction activities, such as grading or the installation of culverts, during periods of minimum rainfall.

2. Limit the amount of surface areas graded at any given time to 15 acres or less to reduce the area subject to potential erosion. Graded areas should be protected with geotextile material or mulched and seeded to permanent cover before additional acreage is graded.

3. Constructing temporary drainage ditches to divert runoff away from areas susceptible to soil erosion.

4. Utilizing soil erosion protective materials such as mulch or geotextiles on areas where soils have a high potential for erosion until permanent provisions such as lawns and grasses can be developed. Planting grass as soon as grading operations permit to minimize the amount of time soils are exposed to possible erosion.

5. Building sedimentation basins to collect sediment from runoff waters before discharge into receiving waters. Utilizing geotextiles such as siltation fencing will minimize the amount of sediment which could leave the site to collect in drainage structures and streams.

6. Wherever possible, base flow should be diverted to stable flow areas while construction work is being conducted in the stream channel.

All State and County requirements regarding drainage improvements will be complied with.

3.3.5.3 Comparison Between Alternatives

Restating a principle from the previous section, the goal of drainage mitigation measures is to ensure that there is no net impact to the overall flow of the natural drainage system. Therefore, the issue in comparing one of alternatives is not to assess the magnitude of impact, which is assumed to be mitigated to negligible levels, but to assess relative cost of the mitigation efforts. Precise costs await more advanced design work and therefore the recommendation of the preferred alignment from the standpoint of drainage impact mitigation costs is tentative. Alignment 1 has been initially determined to preferable in the Upper Portion; in the Lower Portion, mitigation on Alignments A and B are projected to cost roughly the same.

3.3.6 Wetland Impacts

Possible impacts to wetlands and mitigation measures are discussed in Section 2.1.6. If wetlands are discovered in the selected alignment, appropriate mitigation measures will be developed and implemented in coordination and compliance with the U.S. Army Corps of Engineers wetland regulations.

3.3.7 Flora, Fauna, and Ecosystem Impacts

3.3.7.1 Probable Impacts

Construction of this project would result in the unavoidable destruction of some or all the existing vegetation within the right-of-way. However, the flora and vegetation of the project area were found to have little conservation value for the following reasons: 1) no plant species listed as threatened or endangered, or proposed for listing, by the U.S. Department of the Interior or the State of Hawaii, are known to occur in the project area; 2) no unique or high-diversity native plant communities occur in the project area; and 3) construction of this project would not eliminate any plant community type from the region. Therefore, it is concluded that the impact on native species and vegetation is insignificant.

Construction and operation of this project may lead to the spread of alien plant species along the right-of-way. Some of these species may invade and degrade native plant communities along the right-of-way. This impact is considered to be insignificant because most of the native vegetation has already been degraded by alien plant invasion and because the vegetation has little conservation value for the reasons listed in the above paragraph.

This project poses a low but not insignificant threat to nests and potential nesting habitat of the ‘Io, a listed endangered bird. No nests are known in the project area, but the ‘Io does forage in the area. Most of the nesting habitat that would be destroyed is of only marginal value to the ‘Io; abundant habitat of similar or higher quality remains in the vicinity.

The project poses no significant threat to other native birds since none are likely to utilize this habitat. No rare or endangered birds, except the ʻIo, are known to utilize the project area. Although the Hawaiian Hoary Bat does occur in the project area, the project poses no significant threat to this listed endangered species. The bat is known to adapt to urbanization and is non-specific in its choice of roost sites.

The impact of this project on native invertebrate species is not known since populations of above-ground invertebrate species are poorly known to science. It is assumed that there would be some loss of invertebrate individuals and habitat since the project would result in the destruction of some native plants and native vegetation. It is considered highly unlikely that this project would seriously threaten the existence of a species or entire population since this action, by itself, would not eliminate any native plant community type in its entirety. No listed endangered invertebrate species are known from the project area.

Construction of this project could pose a significant threat to the native invertebrate species and the below-ground ecosystem of Kaumana Cave. If the cave is collapsed or breached, there may be loss of cave habitat and the potential of contamination by groundwater runoff that may carry pesticides or other harmful substances.

Construction of this project could pose a significant threat to the species and ecosystem of Kaumana Cave if the native vegetation above the cave is disturbed. Roots of native plants, especially ʻohiʻa trees, are the major food source for the herbivorous species in the cave community.

3.3.7.2 Mitigation

To avoid damage to the native invertebrates and ecosystem of Kaumana Cave, it is recommended that construction over Kaumana Cave should be avoided and the vegetation be left intact over the cave. As a part of this project, professional surveyors accurately mapped the cave for the first time. The final alignment will afford sufficient undisturbed buffer between the road and the cave.

Despite the limited native species conservation value of most of the Project Area, it would still be advisable to take measures to restrict the spread of alien plant species into semi-intact native communities. As far as is feasible, construction activities should be limited to the actual right-of-way corridor to restrict the footprint of disturbance. Landscaping with native plants appropriate to the lowland rain forest shall be explored.

Efforts should be made to avoid disturbing active nests of ʻIo if any are encountered. ʻIo aggressively defend their nests by calling and flying at intruders. Any hawk acting in this manner is an indication of a nest nearby. If an aggressive ʻIo is encountered, all activities should be suspended in the immediate area until contact is made with the Protection Forester, Division of Forestry and Wildlife (DOFAW) in Hilo and the Endangered Species Office of the U.S. Fish and Wildlife Service (FWS) in Honolulu. Construction activity may resume when the nest is located and consultation with DOFAW and FWS is completed.

3.3.7.3 Comparison Between Alternatives

No valuable biological resources have been identified along the Lower Portion. No consideration of biological resources need be taken in choosing between Alignments A and B.

The single most unique and valuable ecosystem identified along the Upper Portion is Kaumana Cave. The edge of Alignment 1 is situated as close as 50 feet from the edge of Kaumana Cave in places (see Figure 2-1). If Alignment 1 is chosen, a buffer of width sufficient to avoid structural problems and ecological impacts must be established between the cave and the roadway. Alignment 2 completely avoids the vicinity of Kaumana Cave.

The endangered Hawaiian Hawk or ʻIo may nest within the project area. Alignment 2 has more area with trees tall enough to be used for nests by ʻIo than Alignment 1. On this basis, Alignment 2 may be more valuable for protecting the ʻIo. However, none of the project area is high quality nesting habitat for ʻIo, and any impact on the species by selection of either alignment is estimated to be negligible.

Native vegetation of varying quality covers part of both proposed alignments in the Upper Portion. Because of low species diversity, no rare plants or unique character, these plant communities are judged to have no special conservation value. Alignment 1 supports slightly more early succession ʻOhiʻa/Uluhe Fern Forest that is nearly free of alien species than Alignment 2. However, Alignment 2 has somewhat higher diversity of vegetation types and slightly higher species diversity. Given that the value of this vegetation is judged insignificant on a regional scale, no recommendation of alignments based on vegetation character is justified.

3.4 Historic and Archaeological Preservation Impacts

3.4.1 Probable Impacts and Mitigation Measures

The development of the Puainako Street Extension, along one of the proposed alternative sets, will destroy archaeological features associated with sugar cane cultivation. Other considerations being equal, this impact to archaeological resources can be minimized by selecting the road alternatives with the fewest archaeological remains.

Mitigation in the alternative route selected for development should include additional data recovery from a representative sample of features in the sites that will be lost in development. A data recovery plan to further sample representative sites/features may include additional excavation. Continued oral history interviews may prove useful in learning more of feature construction and their role in sugarcane field activities. The data recovery plan will be devised in consultation with archaeologists of the State Historic Preservation Division. Archaeological resources outside the area of road development should be considered for preservation where possible. Finally, monitoring by an experienced archaeologist during vegetation clearing and earthwork activities in areas where archaeological resources exist is recommended.

3.5 Social and Economic Impacts

3.5.1 Introduction

A majority of residents attending the public meeting from all three neighborhoods (Kaumana, Waiakea Homestead and Waiakea Uka) recognized that the widening and extension of Puainako Street is needed. Concerns about adverse impacts generally fell into three categories: 1) the impact on current residents of Puainako Street, especially those on the north side of the street between Kawili Street and Komohana Street (discussed in this and following sections), 2) the impact of the completed project on traffic into and out of Waiakea Elementary and Waiakea Intermediate schools (discussed in section 3.2.2), and 3) the timing of the project (discussed in section 3.2.1 and the following paragraph).

The public expressed opposing views regarding which part of the project to complete first. Kaumana residents felt that the need for a second access route should give the Upper Portion priority. Waiakea residents felt that the traffic congestion on the current road gave the Lower Portion priority. Given that the extension would likely increase traffic load on the current section of Puainako Street in an area with an already serious congestion problem at peak hours, it is recommended that the widening of the Lower Portion be given first priority. Ideally, both sections would be completed concurrently.

The Puainako Road Extension has been a part of the Hawaii County General Plan since 1967 when "A Plan for Metropolitan Area of Hilo" designated Puainako as a secondary arterial street. At that time, it was planned that the project would ultimately connect the Saddle Road to the Hilo International Airport. Most of the right-of-way in the Lower Portion (makai of Komohana) has been owned by the State of Hawaii for several decades and is dedicated to eventual use by the highway. Local planning developments have been granted approval with the ultimate development of the highway in mind. Affected property owners have built knowing that eventually a highway would be built nearby. Thus, while some negative impacts to landowners immediately adjacent to the right-of-way are unavoidable, they have been anticipated for several decades.

The project is consistent with the County General Plan and Hilo Zone Map and all other State and County Plans (see Chapter 4). Consequently, the project would not result in any unanticipated development within the Hilo area. However, the highway would probably accelerate the pace of development in Kaumana by providing access for future housing subdivisions.

3.5.2 Neighborhood and Community Impacts

3.5.2.1 Probable Impacts

The widening and extension of Puainako Street is unlikely to have major impacts on neighborhood or community cohesion. Puainako Street serves as a boundary to the Waiakea Homestead neighborhood and as an artery for access to and from Waiakea Uka. The extension would allow Puainako Street to serve the same role for the Kaumana community. Given that the road would facilitate access to and from the neighborhoods but not through any of the neighborhoods, it would not create any additional divisions within the neighborhoods. While a major traffic artery can often serve to make travel to other areas easier and faster, it often serves as a psychological boundary for the neighborhood and may increase cohesion in the Waiakea Homestead neighborhood.

Increased traffic along the Lower Portion of Puainako Street may increase the danger of automobile-pedestrian accidents, especially near the Waiakea school complex.

3.5.2.2 Mitigation

Appropriate crossing points, signalized intersections, and the construction of a wall/hedge as a physical barrier between the roadway and adjacent houses can help reduce danger to children and other pedestrians. The addition of sidewalks and bicycle lanes called for in the design criteria should increase the current level of safety on the road.

3.5.2.3 Comparison Between Alternatives

Selection of Alignment A or B would have essentially the same insignificant impact on the community cohesion and related issues for Waiakea.

The impacts on community cohesion in Kaumana would probably be insignificant, but would vary in terms of separating certain housing developments south of Kaumana Drive from the rest of Upper Kaumana. Alignment 1 would separate Pacific Plantation subdivision and the Wilder Road subdivisions from the rest of the Upper Kaumana neighborhood. Alignment 2 passes south of all the housing developments in Kaumana, thus encircling rather than separating the housing south of Kaumana Drive.

3.5.3 Relocation Impacts

3.5.3.1 Probable Impacts

Widening the existing Puainako Street between Kilauea and Kawili Street may necessitate acquisition of as many as six houses along both sides of Puainako Street, requiring the displacement of current residences. This displacement is necessary in order to provide a safe roadway design.

The State Housing Finance and Development Corporation has oversight responsibility for ensuring that proper relocation assistance is provided to displaced persons, businesses and non-profits. A relocation plan which includes direct contact and discussion with and assistance to all affected parties must be coordinated with HFDC in accordance with Chapter 111, HRS and Hawaii Administrative Rules, Title 6, Chapter 391.

3.5.3.2 Mitigation

Right-of-way and relocation activities will be carried out in accordance with applicable state and/or federal guidelines. The state and county will work with each owner/occupant to ensure that the relocation is done in a fair and equitable manner.

3.5.3.3 Comparison Between Alternatives

The proposed alignment for the widened Puainako Street between Kilauea Avenue and Kawili Street is the same for both Alignments A and B. Choice of alignments would not affect relocation impacts.

3.5.4 Land Use Impacts

3.5.4.1 Probable Impacts

The Lower Portion of Puainako Street is fully developed except for the state-owned land along the north side of the road. Some of this land has been designated for expansion of the University of Hawaii at Hilo. The Upper Portion extends through lands that are in the State Land Use Agricultural District and are zoned for agricultural use by the county (see Figure 4-1). As stated in section 3.5.1, and expanded upon in section 3.5.8, the proposed highway would probably accelerate development that has already been anticipated for this area by the state and county.

3.5.4.2 Comparison Between Alternatives

Alignment A crosses State lands designated for university expansion. In addition to the approximately five acres consumed by the actual right-of-way of Alignment A, approximately six acres of State lands would be isolated from the campus by the new Puainako Street. Alignment B is situated on State lands that have for decades been identified as the future right-of-way of Puainako Street.

3.5.5 Visual Impacts

3.5.5.1 Probable Impacts

Visual impacts on the Lower Portion, where an existing road would be widened and realigned, would differ from those on the Upper Portion, where a new road would be created.

Along the Lower Portion, expanding the right-of-way, creating turning lanes and signals, and re-grading the road would cause noticeable differences in the appearance of the roadway. This portion of Puainako Street would take on a more urban character in contrast to its current suburban (although often congested) appearance. The road currently offers little of scenic interest for a driver whose attention, for reasons of safety, must be clearly focused on the roadway.

Adverse visual impacts would be borne by residents of the State Housing Project on the north side of Puainako Street who would have roadways on either side of their houses.

The topography in the Upper Portion of the project area lacks significant promontories or depressions and is for the most part heavily covered with scrub or forest. These conditions would tend to obscure the road from the view of most nearby streets and the houses that front them. Exceptions would be a few houses with second stories facing the roadway, a few houses very close to the new road, and several houses on small hills nuar the road. Initially, the roadway would have little other development associated with it, and the road would thus pose little problem for residents of houses that can view it. Later, as housing is built along the road, views could become more urban than pastoral.

The surrounding terrain, from the perspective of a driver on the new road, would initially consist of pleasant vistas of low forest with many native trees in places. Little in the way of landscaping would thus be required until new housing developments emerge.

3.5.5.2 Mitigation

The mitigation structures described in the Section 3.3.4, Noise Impacts, would partially screen residents of the State Housing Project from visual impacts as well. It is recommended that trees and shrubbery also be planted in a manner consistent with public safety on the edge of the right-of-way to further screen the residents from views of the highway. The residents would be aware of the construction of the highway and will be able to take measures for themselves to screen out the highway with plantings or structures on their own property if they wish to.

3.5.5.3 Comparison Between Alternatives

Within the Lower Portion, Alignment B passes very near the houses along the north side of the existing Puainako Street. Alignment A is farther north from Puainako Street, crossing open land. Selection of Alignment A would reduce the visual impact of the roadway on residents on the north side of Puainako, and the greater distance from the houses may provide motorists a less congested landscape.

Along the Upper Portion, Alignments 1 and 2 offer somewhat differing visual characteristics. Much of Alignment 1 parallels Kaumana Drive and passes near some developed areas, notably at Edita and Pamoho Streets and Wilder Road. Alignment 2 avoids these and adjoining developments by taking a more southeasterly route. The levels of impact of these two alignments on several aspects of the visual environment would be different. Selection of Alignment 2 would have less adverse visual impact for residents of existing developments and may provide a more pleasant open landscape for motorists. However, from a regional perspective, selection of Alignment 2 would extend the boundary of urbanization further into open agricultural lands of southwest Hilo. Selection of Alignment 1 would have less adverse aesthetic impact on the rural surroundings.

Choice of alignment would not alter the visual impacts for future residents of Sunrise Estates since both alternatives share the same alignment along the southern side of this subdivision.

3.5.6 Income, Employment and Public Revenue

The proposed project is expected to generate one-time income and employment from construction activities. Of the projected total construction cost of $30 million, approximately $14.1 million would be spent on local construction and related expenditures over 12 to 18 months. In addition, $4.5 million would be spent on planning and engineering design work before construction. A direct income of $8.7 million is expected to be generated during this period. Considering indirect and induced impacts, the newly generated income can reach $15.1 million over the same period.

The construction project is also expected to generate as many as 176 labor-years of direct construction and related jobs each year during this period. Additionally, 90 labor-years of professional jobs are expected to be generated from the project. The construction activity is expected to increase employment in that sector by 7.8 percent during project construction. In addition, approximately 465 labor-year equivalent indirect jobs would be created over the same period of time.

The project would also have a positive impact on both State and County resources. Additional revenues to the government would be generated in the form of sales and income taxes, and by permits and other fees. The projected State revenue from general excise taxes is $1.164 to $2.030 million, based on a 4.16 percent general excise tax rate. The revenue from income taxes is estimated to be $0.875 million from direct and indirect income from the project, based on the average of a 5.8 percent state income tax rate.

3.5.7 Other Economic Impacts

It is anticipated that the new improved roadway system would draw larger shopping crowds, particularly from upper Kaumana communities into the Prince Kuhio Mall. The existing Kai store may have an increase in business due to the improved roadway.

3.5.8 Secondary Population and Growth Impacts

The construction of the proposed project may generate secondary population and growth impacts as a result of increased ease of access to upper Kaumana and possibly development adjacent to the roadway corridor.

The Hawaii County General Plan (County of Hawaii 1989) designates the area for a mixture of uses including Urban Expansion, Open Area and Orchards in the Land Use Pattern Allocation Guide Maps. Current county zoning for the area, however, is primarily agriculture (See Section 4.6 and Figure 4.1). Any future urbanization would require many levels of review, often including State Land Use District Boundary Amendments, County General Plan Amendments, County Change of Zone and Subdivision permits. As such, the State and County will essentially control the location, nature and rate of urban change in the Project Area.

It is likely that the proposed project may support infilling of existing subdivisions containing undeveloped lots in the Kaumana area. The project may also encourage developers to propose further residential subdivisions in land made more accessible by the project. However, because growth in the Project Area will be largely at the discretion of the State and County governments, estimates of the magnitude of population increase and secondary growth impacts are not possible. Government leaders will need to balance concerns over excessive urban development (which several respondents to the social survey expressed) with demand for a larger and more affordable housing stock.

3.6 Adverse Environmental Effects Which Cannot Be Avoided

The roadway construction project would create limited adverse environmental impacts which cannot be fully mitigated by the measures planned to be implemented at the site. The following two lists include those short-term and long-term impacts that are expected to be unavoidable.

3.6.1 Unavoidable Adverse Short-term Impacts

1. Negligible temporary increases in soil erosion would result from construction operations, and a negligible amount of soil would be carried off-site in surface runoff water.

2. Operation of construction equipment, trucks, and worker vehicles may temporarily impede traffic in the area during the construction period.

3. Negligible release of air contaminants would occur from construction equipment. Small amounts of dust may be generated during dry periods as a result of construction operation.

4. The visual character of the area would be affected by construction activities and by the presence of construction equipment.

5. Minor increase in noise levels may result from construction activities.

3.6.2 Unavoidable Adverse Long-Term Impacts

1. Soils would be disturbed by grading, excavation, and mounding activities at the site during construction. Since soil cover on the site is very sparse, soil would be imported to cover cleared and graded land for planting landscaping materials, except for areas left in natural vegetation.

2. Modifications to the current topography would be made at the site to accommodate project development.

3. Approximately 10-15 acres of early successional native scrub forest along the proposed roadway from Komohana Street to Country Club road.

4. Air quality at area roadways would receive a minor addition of traffic-related emissions.

5. Noise levels will increase in the Upper Portion and in the Lower Portion between Kawili Street and Kilauea Avenue. Depending on the success of mitigation efforts and the exact route of the final alignment, noise levels might actually decrease along Puainako Street between Kawili and Komohana Streets.

6. Some loss of archaeological features related to sugar cane cultivation will be necessary.

3.7 Irreversible and Irretrievable Impacts

The construction and operation of the proposed roadway system would involve the irretrievable commitment of certain natural and fiscal resources. Major resource commitments include land, money, construction materials, manpower and energy. The impact of using these resources should, however, be weighted against the economic benefits to the residents of the County and State and the consequences resulting from taking no action (see Chapter 5.0, Alternatives to the Proposed Action).

The commitment of resources required to accomplish the project includes labor and materials which are primarily nonrenewable and irretrievable. The operation of the project would also include the consumption of petroleum-derived fuels, which also represents an irretrievable commitment of resources.

3.8 Relationship Between Local Short-Term Productivity and Maintenance and Enhancement of Long-Term Productivity

No short-term exploitation of resources that will have negative long-term consequences has been identified. All negative impacts resulting from the project are capable of mitigation using reasonable measures. The principal long-term benefit is the decreased traffic congestion and more efficient travel that would be made possible by the proposed project.

Chapter 4:
Relationship to Other Policies and Land Use Plans

CHAPTER 4: RELATIONSHIP TO OTHER POLICIES AND LAND USE PLANS

4.1 Hawaii State Plan

The Hawaii State Plan was adopted in 1978 and was revised in 1986 and again in 1991 (Hawaii Revised Statutes, Chapter 226, as amended). The Plan establishes a set of goals, objectives and policies that are meant to guide the State's long-run growth and development activities. The proposed project is consistent with State goals and objectives that call for increases in employment, income and job choices, and a growing, diversified economic base extending to the neighbor islands.

The sections of the Hawaii State Plan most relevant to the proposed project are centered on the theme of facility systems. The following objectives and policies are taken from the section dealing with transportation (Section 226-17 as amended, HRS).

1. Objective a1: An integrated multi-modal transportation system that services statewide needs and promotes the efficient, economical, safe, and convenient movement of people and goods.

2. Objective a2: A statewide transportation system consistent with planned growth objectives throughout the State.

3. Policy b1: Design, program, and develop a multi-modal system in conformance with desired growth and physical development as stated in this chapter.

4. Policy b6: Encourage transportation systems that serve to accommodate present and future development needs of communities.

5. Policy b9: Encourage the development of transportation systems and programs which would assist statewide economic growth and diversification.

6. Policy b10: Encourage the design and development of transportation systems sensitive to the needs of affected communities and the quality of Hawaii's natural environment.

Discussion:

The proposed project closely matches the specific intent of these policies. The highway is meant to accommodate present needs while anticipating future needs, and it would help in the ultimate connection of East and West Hawaii. The balance between such goals and environmental and community costs is considered in the Environmental Impact Statement.

4.2 Hawaii State Functional Plans

The Hawaii State Plan contains 12 separate Functional Plans which deal with specific areas of concern. The 1991 revision of the Functional Plan for Transportation has several objectives, policies, and implementing actions which are relevant to the project.

1. Objective 1.A: Expansion of Transportation System

2. Implementing Action I.A.1.aaa: Improve regional mobility in areas of the state experiencing rapid urban growth and road congestion.

3. Objective 1.C: Management of existing transportation systems through a program of transportation system management.

4. Policy 1.G.2: Conduct maintenance work to minimize disruption to the general public.

Discussion:

The proposed project clearly fulfills the goal of increasing mobility in areas experiencing growth and congestion. The Puainako Road Widening and Extension has been identified in many county and state planning documents as a vital link. The proposed project does not fulfill Objective 1.C, although it does not preclude other actions that might fulfill the objective. It is recommended that construction on the project be scheduled so as to minimize disruption to the public, per Policy 1.G.2.

4.3 State Land Use Districts

All land in the State of Hawaii is classified into one of four land use categories -- Urban, Rural, Agricultural, or Conservation -- by the State Land Use Commission as shown in Figure 4-1-a. The Lower Portion of the project is entirely Urban. Mauka of Komohana Street, the designation is Agriculture. No Petition to Amend State Land Use District Boundaries is anticipated or necessary for the project.

4.4 Hawaii County General Plan

The General Plan for the County of Hawaii is a policy document expressing the broad goals and policies for the long-range development of the Island of Hawaii. The plan was adopted by ordinance in 1989. The General Plan is organized into thirteen elements, with policies, objectives, standards, and principles for each. There are also discussions of the specific applicability of each element to the nine judicial districts comprising the County of Hawaii. The section most relevant to the proposed project deals with transportation.

Transportation Goals:

1. Provide a transportation system whereby people and goods can move efficiently, safely, comfortably and economically.

2. Make available a variety of modes of transportation which best meets the needs of the County.

3. Provide a system of thoroughfares and streets for the safe, efficient and comfortable movement of people and goods between and within the various sections of the County.

4. Provide an integrated State and County system so that new major routes would complement and encourage proposed land uses.

Transportation Policies:

1. A framework of transportation facilities which will promote and influence desired land use shall be established by concerned agencies.

2. The agencies concerned with transportation systems should provide for present traffic and future demands, including mass transit programs for high growth areas.

3. The improvement of transportation service shall be encouraged.

Specific Courses of Action

1. A realignment of the Saddle Road from the Forest Reserve boundary on the south side of Kaumana Drive and along the north side of Puainako Street, intersecting the present Puainako alignment at Kinoole Street and continuing to the intersection of Kanoelehua Avenue should be constructed. Limited access control is recommended with intersections at the major cross arterials serving the various areas of the city.

Discussion:

The proposed project is consistent with the County's General Plan and Zoning Map. Consequently, the roadway would not prematurely encourage development of areas not presently anticipated for development. However, the project would support the ongoing development activities both in the Waiakea and Kaumana areas as circulation patterns improve.

4.5 Land Use Pattern Allocation Guide Maps and Facilities Map

The Land Use Pattern Allocation Guide (LUPAG) map component of the General Plan is a graphic representation of the Plan's goals and policies. The Facilities Map of the General Plan identifies present and standards, as well as of the physical relationship between land uses. It also establishes the basic urban and non-urban form for areas within theplanned public and cultural facilities, public utilities and safety features, and transportation corridors.

The Puainako Road Extension links areas identified as High- and Medium-Density Urban in the makai portion to areas identified as Medium- and Low-Density Urban, as well as land slated for Urban Expansion. The proposed project is thus an appropriate corridor for traffic between areas designated as urban. The Facilities Map (effective date 14 November 1989) explicitly identifies the Lower Portion of Puainako Street as a primary arterial to be improved. The Upper Portion of the proposed project is designated as a planned primary arterial.

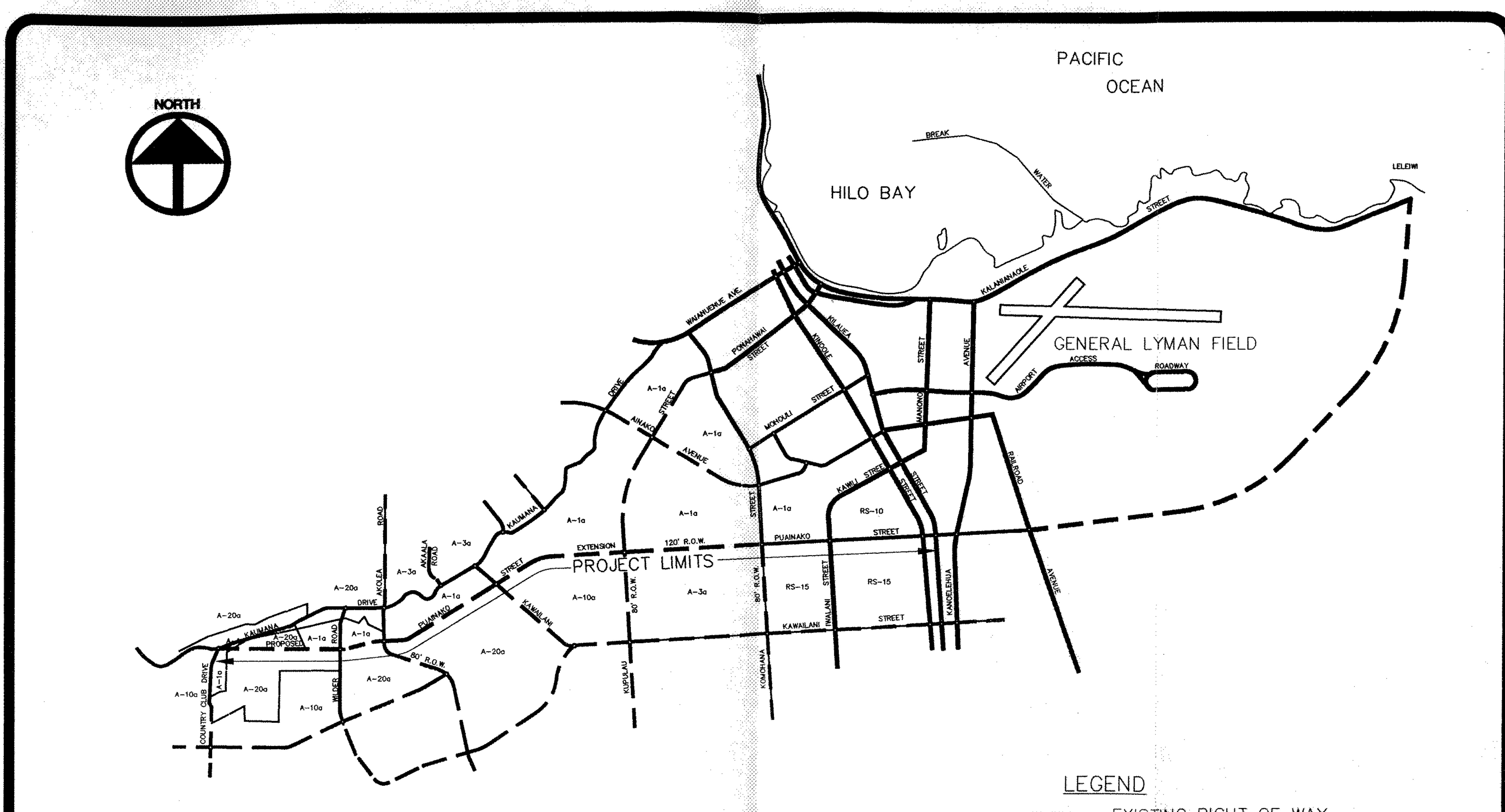
4.6 Hawaii County Comprehensive Zoning Ordinance

The Hawaii General Plan is the basis for Ordinance No. 63, the County Comprehensive Zoning Ordinance, which was adopted in 1967. Zoning maps (portion duplicated in Figure 4-1) show the project as a secondary arterial street of a 120-foot wide right-of-way. Note that the roadway indicated on the map is only an approximation of the path of the Puainako Extension, the ultimate alignment of which can only be determined through considerations of design, environmental impact, and land ownership.

The zoning of areas crossed by the proposed project are either Residential (RS-15) or Agricultural (A-1a, A-3a, A-10a, and A-20a). Nearly all of this land will ultimately be developed as either urban or agricultural/residential lots, for which the proposed project would be both appropriate and convenient.

4.7 Hilo Community Development Plan

The Hilo Community Development Plan, developed by the County Planning Department in 1975 and still in effect, identifies planning priorities for the Hilo area (Belt, Collins and Assoc. 1975). The Puainako Road Extension is explicitly identified as an integral part of the Transportation Plan of Hilo (Ibid:90).



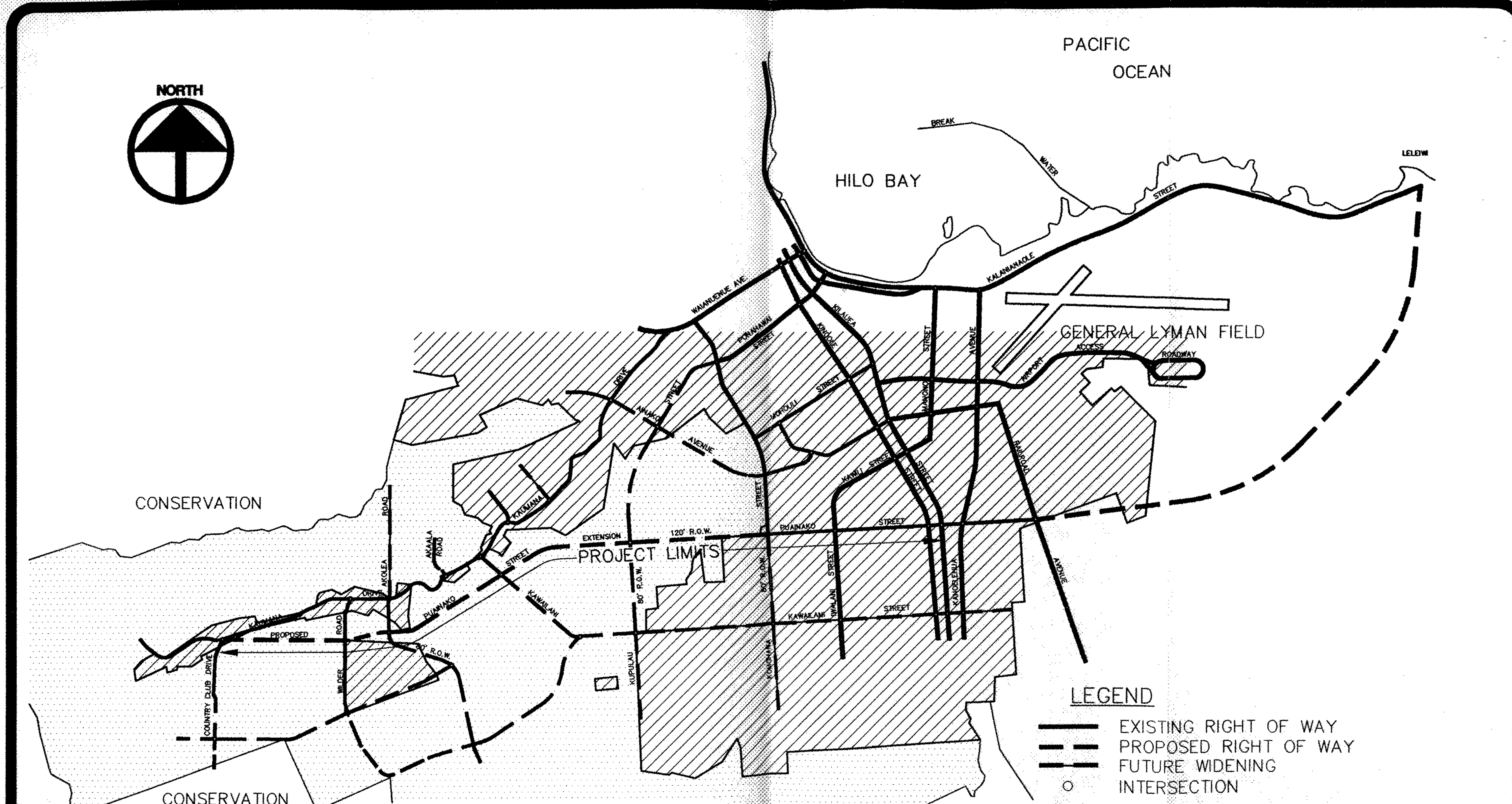
TITLE **RIGHT OF WAYS AND ZONING MAP**
CITY OF HILO

FIGURE 4-1

PROJECT PUAINAKO STREET EXTENSION
HILO, HAWAII

DATE 9/1/92

91003F2



TITLE **STATE LAND USE DISTRICT MAP** CITY OF HILO	FIGURE 4-1a
PROJECT PUAINAKO STREET EXTENSION HILO, HAWAII	DATE 9/15/93

91003F1a

4.8 Island of Hawaii Long-Range Highway Plan

The Island of Hawaii Long Range Highway Plan (IHLRHP) was prepared in 1991 for the State Department of Transportation and the County of Hawaii Departments of Public Works and Planning, in cooperation with the U.S. Department of Transportation, Federal Highways Administration. The purpose of the study was to identify major highway corridors that would require roadway improvements to accommodate traffic demands projected for the Year 2010. The widening of Puainako Street, between Kilauea Avenue and Komohana Street, and the extension of Puainako Street, from Komohana Street to Kaumana Drive, are ranked Nos. 17 and 19 on Tier 1 of the priority listing.

4.9 Required Permits and Approvals

Several permits and approvals would be required to implement this project. They are listed here under their granting agencies:

1. State Department of Transportation:
    a. Permit to Perform Work on State Highway
2. State Department of Health:
    a. National Pollutant Discharge Elimination System Permit
3. County Department of Public Works:
    a. Permits for Excavation of Public Highway, Grading, Grubbing, and Stockpiling
    b. Permits for Outdoor Lighting
    c. Permits for Electrical Work
4. County Planning Department
    a. Permit for Subdivision

Chapter 5:
Alternative to the Proposed Project

CHAPTER 5: ALTERNATIVES TO THE PROPOSED PROJECT

5.1 Introduction

There are several possible responses to the growing traffic problem centered on Puainako Street. First, the problem can be ignored and the costs in terms of safety, time, and convenience be absorbed. Second, the traffic may be "managed" better, by implementing slight changes to existing roads and restrictions involving their use, such as work- and school-time staggering, car-pool incentives, or public transportation system improvement or implementation. This section outlines these alternatives and the pros and cons of each.

5.2 Alternatives

5.2.1 No Action

Chapter 343 HRS mandates that every Environmental Impact Statement should consider a "no-action" scenario; i.e., evaluate the consequences of failing to pursue any solution to a perceived need for action.

This option implies continued dependence on the existing roadway network. Traffic between Kaumana and South Hilo, which is already regularly congested, is forecasted to become worse as existing and future housing developments in Kaumana begin to "fill in." Some population growth might conceivably be avoided as inconvenience and unsafe conditions discourage full utilization of residential land in this neighborhood. The continuing shortage of convenient housing in other locations, however, will probably mean that Kaumana will maintain its population increase as long as Hilo continues to grow. Without some form of improvement in the traffic congestion problem, accidents would rise at an even greater rate than traffic volumes, as crowded conditions exacerbate the unsafe roadway conditions on Kaumana Drive.

Traffic along the existing Puainako Street would reach congested conditions during a greater number of mornings and evenings. Commuters who are bound for destinations other than the two schools on Puainako Street would be even more likely to choose an alternate route, adding to traffic on Kawailani, Mohouli, Kukuau, and Ponahawai Streets. Such pressure may require short-term fixes, such as more signals or one-way patterns on these streets.

The usefulness of the Saddle Road as a connector between East and West Hawaii would diminish, as traffic would more frequently become bottlenecked in the six miles closest to Hilo. Some drivers might be diverted through Hamakua, and others would simply endure longer waits. Emergency vehicles and residents with emergencies would find that it would often take more time to exit through the Kaumana area and Puainako Street.

5.2.2 Improved Transportation Management System

There are a number of solutions to commuter congestion on highways. Approaches that merit consideration in this situation include:

1. Minor changes to existing roads

2. Restrictions involving road use, such as work- and school-time staggering, car-pool incentives, or High Occupancy Vehicle Lanes

3. Public Transportation System improvement

These techniques often have great merit in relieving road congestion and in improving the general urban environment in certain situations. The Hawaii State Functional Plan for Transportation calls for increased use of such measures wherever possible. Nevertheless, for the particular case under consideration, each of these techniques also entails significant problems. A discussion of the merits and shortcomings of these alternative solutions follows.

5.2.2.1 Minor Changes to Existing Roads

Road modifications under this heading include use of existing shoulders for through or travel lanes and better signalization to optimize queuing.

The traffic congestion problem is most intense during rush hours along Puainako Street and Kaumana Drive. Neither of these roadways has sufficient unused right-of-way space to support an additional lane. Komohana Street, by contrast, is designated as a future four-lane road and could be expanded in parts to relieve congestion. However, Komohana already has left turn lanes where they are most necessary. Furthermore, Komohana is the least congested portion of the route from Kaumana to Kanoelehua Avenue. Therefore, the only road that could actually support expanded lanes would probably not benefit from them.

At present, there are demand-type traffic signals at the following intersections: Waianuenue and Komohana, Kawili/Iwalani and Puainako, Kinoole and Puainako, and Kilauea and Puainako. Additional signals at Ainako Street and Kaumana would ease the long queue that can develop on Ainako, but would probably increase congestion on Kaumana Drive. Many drivers bound from Kaumana to the Puainako area commonly try to proceed directly and avoid the stop light at Waianuenue Avenue and Komohana Street by turning right off Kaumana at Punahele Street. During morning rush hour this intersection is part of a police-controlled one-way pattern to accommodate school traffic. A traffic signal might alleviate congestion problems, although this idea would require further study. Signalization is also possible at the Waiakea school complex, but with the current lack of space for turning lanes, a situation not much better than the present congestion might develop. In summary, although added signals might alleviate congestion on feeder roads leading into the main route under discussion, overall traffic flow would probably not proceed any more smoothly without considerable widening.

5.2.2.2 Restrictions Involving Road Use

The morning one-way traffic pattern involving Waianuenue Avenue and adjacent streets has for may years been the solution for handling the joint influx of students and commuters from Kaumana. Despite the elaborate and labor-intensive transformation of the traffic patterns on weekday mornings, considerable congestion remains.

At present there is no coordinated policy of work- or school-time staggering for traffic congestion alleviation. Classes at all schools begin at approximately 8:00 a.m. Most state and county workers report to their jobs between 7:30 and 8:00 a.m. A County of Hawaii policy effective October 10, 1991 set guidelines for "flex-time" and "staggered-time" work scheduling for county employees. The policy was instituted by the mayor to respond to both traffic problems and the need for county workers to fulfill family responsibilities. A "core time" of 9:00 a.m. to 3:15 p.m. is required of all employees other than those assigned to special shifts. Employees have the option to distribute the remaining 2 1/2 hours before and/or after the core time. Each county department was encouraged to adapt the policy to their situation and to institute it as soon as possible. Many departments have yet to do so, and even of those that have offered flex-time, probably less than 20 percent of employees take advantage of it.

Workdays at private businesses begin at a variety of times, with as early as 6:00 a.m. to as late as 9:00 a.m. being common, depending on the type of business. Most, however, begin the workday between 7:30 and 8:30 a.m., and thus concentrate congestion at just the time school traffic is still in place.

There is thus a very real potential to alleviate congestion by staggering work times across a four-hour period. The problems inherent in such a policy, however, are wide-ranging. Locally, it appears that most existing car-pooling consists of shared rides between couples and their children on their way to school and work. Staggering work and school times might actually prevent family members from sharing rides, forcing multiple, separate trips. Any staggering policy would have to be sensitive to such situations and, from the standpoint of employees and students, would need to be implemented on a voluntary basis to promote common sense solutions designed by individual families. The problem with such individualistic applications is that schools and businesses may not function well without organization-coordinated start-times. It is probably the case that only when a well-developed mass transit system is in place will work- and school-time staggering be practical.

Car-pooling has never, for a variety of reasons, been popular in the United States. Some Puna residents do car-pool, and workers at the Kohala Coast hotels living in Hilo regularly car-pool (on special buses, for the most part). However, the short commuting distance from Kaumana to Hilo makes car-pooling more trouble than it is worth for most commuters. It is doubtful that any measures short of mandatory car-pooling or incentives such as High Occupancy Vehicle Lanes would be successful in inducing this behavior in commuters.

High Occupancy Vehicle Lanes (HOVL), on which travel is permitted only by vehicles carrying over a specified number of occupants (typically 2 or 3), are often successful in encouraging car-pooling in large cities. Unfortunately, the roadways under consideration for this project are two-lane and cannot accommodate extra lanes.

In summary, restrictions involving road use are not practical for dealing with the congestion problem found in the project area.

5.2.2.3 Public Transportation System Improvement

At present, the public transportation system in Hilo consists solely of a county bus system. There are currently three buses in the Hilo area offering seven total hours of service. Two buses link the Kaumana area with downtown and the shopping centers on Kanoelehua Avenue. The first bus departs Kaumana at 7:30 a.m. and the second at 2:30 p.m. A major planned capital expenditure is earmarked to replace the entire fleet of county buses, each of which has over a million miles of service. There are no plans in the immediate future for service expansion, which would probably require funding from the county budget and increased rider fees.

The history of public transportation in Hilo is one of low ridership, with very few working commuters. This is often explained as a function of the city's small population, which prevents the frequent scheduling needed to satisfy the complex demands of commuters. The small scale of Hilo also offers very short automobile commutes in terms of mileage and minutes. When commuters balance the cost and effort of driving versus the convenience and mobility a car affords, they nearly always opt to drive. This would probably be true even if a better bus schedule were available. For many reasons, a gradual improvement in the public transportation system is warranted, but such a scheme offers little in the way of solutions for the congestion seen in the project area.

5.3 Recommendations

The scope of the recommendations presented here is to offer rational choices, based on the best information possible, regarding two issues. The first is whether the proposed project is the best alternative to satisfy the perceived need for reduced traffic congestion. The second issue, only relevant if the proposed project is to be recommended, is to decide which combination of alternative alignments and design options is environmentally most sound.

5.3.1 Preferred Alternative Action

It is the recommendation of this document that the preferred alternative is the widening and extension of Puainako Street. Traffic studies, discussions with public officials, accident statistics, and public opinion surveys emphasize that the traffic congestion problem is quite genuine and growing.

The problem is unlikely to disappear on its own. The "No Action" Alternative would be lead to further traffic congestion in the project area and adjacent roads. This would ultimately be far more costly in terms of lost work-time, inconvenience, and accident-related property damage, injury, and deaths than the cost of the proposed project.

Improved transportation management systems are often preferable to expensive highway projects, but none of the options listed above is likely to solve the congestion problems on Puainako Street and Kaumana Drive. Those roadways with the worst congestion cannot support turn lanes or widening in their present configuration. Even if a right-of-way on Kaumana Drive sufficient to support such lanes could be obtained, that road would still present a very circuitous route for accessing the Puainako area from middle and upper Kaumana. Road-use restrictions currently in effect are extremely disruptive to traffic and are employed only because the traffic stream from Kaumana is so heavy at morning rush-hour. Further restrictions could conceivably be imposed on the Puainako-Kawailani circulation, but it is extremely doubtful whether there is a combination of temporary one-way patterns that could satisfy the complex needs of commuters and students in the "crossroads" area of Hilo. As for public transportation systems, given the relatively short distances involved and the evident reluctance of commuters to employ public transportation, it is unlikely that most residents would readily switch to riding buses. And work- and school-time staggering, in the absence of effective public transportation, would probably have only a negligible effect on congestion.

The proposed project appears to be the most effective solution for the congestion problem. Among the key factors in its favor is the significant shortening of distance and travel time between Kaumana and such important destinations as the Prince Kuhio Shopping Plaza, Puainako Town Center/KTA, the University of Hawaii at Hilo and Hawaii Community College. Another important element is the widening of lower Puainako Street to four lanes with turning options. Only a major restructuring of the route, such as the proposed project, offers realistic hopes of traffic congestion reduction.

Another advantage of the proposed project is that it entails relatively few adverse environmental impacts, especially considering the significant benefits of the project. Very little area with habitat value to endangered, threatened or rare native species will be lost as a result of the project. Drainage impacts could be mitigated to zero, scenic resources would not be lost, and the project might well result in a net decrease in noise for many residents of Puainako Street between Iwalani and Komohana Streets. Some archaeological features discovered during the course of fieldwork for this project would be casualties of the project; however, the information recovered as part of the mitigation work would contribute to the archaeological record of East Hawaii, which is not well known.

5.3.2 Preferred Alignments

The reader is again referred to Table 3-1, which compares the alternative alignments in terms of environmental impacts. The Lower Portion (Alignments A and B) and the Upper Portion (Alignments 1 and 2) are considered separately.

In the Lower Portion, Alignment A has negative impacts in less categories than Alignment B, including pedestrian safety, visual/aesthetic characteristics, short- and long-term air quality impacts, and short- and long-term noise impacts. However, use of Alignment A may restrict the choices for expansion of the University of Hawaii at Hilo. It is clear that some sacrifice is necessary no matter which alignment is chosen. It is the recommendation of this document that Alignment B be selected.

In the Upper Portion, Alignment 1 has advantages in terms of preserving habitat that is marginal, but perhaps useful, to the 'Io, the endangered Hawaiian hawk. Alignment 2 would avoid impacts to Kaumana Cave, and also would not cross any existing streets in Kaumana and thus pose a potential barrier to community interaction and cohesion. Alignment 1, however, would be more convenient, integrated and useful to residents of Kaumana. From an engineering/cost standpoint, the greater length of Alignment 2 implies greater cost. Considering all these factors, it is the recommendation of this document that Alignment 1 be chosen for the Puainako Extension.

5.3.3 Preferred Design Options

In contrast to the selection of appropriate alignments, there are relatively few environmental issues and impacts associated with the various alternatives in the two sets of Design Options. On the basis of environmental considerations alone, disregarding construction costs, Design Option III and Design Option X are slightly preferable to the other options.

Design Option III would reduce noise impacts to the Waiakea school complex as compared to Design Option I, and would appear to offer the best solution to efficient traffic flow, although this benefit comes as a trade-off for the more convenient access of unlimited left-turns offered by Design Option II.

Design Option X would provide the safest and most efficient solution to handling the local traffic generated by the segment of Puainako between Kawili and Komohana Streets.

5.4 Unresolved Issues

No unresolved issues remain.

Chapter 6:
Consulted Parties, List of Preparers

CHAPTER 6: CONSULTED PARTIES AND LIST OF PREPARERS

This section includes lists of the various agencies, individuals, and organizations who have been consulted for the preparation of this Final EIS and the names of preparers and technical consultants who have contributed to producing this document.

6.1 List of Agencies and Individuals Contacted in Preparation of Final Environmental Impact Statement

The following list includes governmental agencies, individuals, and organizations who have been contacted as part of the planning process and analysis process for the preparation of this Final Environmental Impact Statement.

County of Hawaii

o Planning Department
o Department of Water Supply
o Fire Department
o Police Department
o Department of Parks and Recreation
o County Council

State of Hawaii

o Department of Land and Natural Resources
  Division of Water and Land Development
o Department of Health
o Department of Transportation
o Department of Human Services
o Department of Education
o Department of Agriculture

Federal Agencies

o Department of the Army
o Pohakuloa Training Area Headquarters
o U.S. Department of Interior
o U.S. Geological Survey
o U.S. Army Corps of Engineers
o Department of Agriculture, Soil Conservation

Other Organizations

- o University of Hawaii at Hilo
- o Hawaii Electric Light Company
- o Kinoole Baptist Church
- o Kai Store
- o Chambers of Commerce
- o Affected Property Owners and Residents
- o Community Associations
- o Traffic Safety Council
- o American Lung Association
- o Sierra Club
- o Audubon Society
- o Hawaii Island Environmental Council
- o Ho'oikaika

6.2 List of Individuals Who Prepared the Final Environmental Impact Statement

This Environmental Impact Statement was prepared for the County of Hawaii by Okahara and Associates jointly with Y. K. Hahn and Associates. The following individuals were involved:

Co-Consultant

Okahara and Associates
200 Kohola Street
Hilo, Hawaii 96720

Masa Nishida,
Civil Engineer
Co-Project Manager

Tim Nicholson
Civil Engineer
Project Engineer

Co-Consultant

Y.K. Hahn and Associates
1180 Kumuwaina Place
Hilo, Hawaii 96720

Youngki Hahn
PhD. Economics, Planner
Co-Project Manager

Sub-Consultants

Ron Terry
PhD. Geography, Environmental Consultant
Principal Investigator

Grant Gerrish
PhD. Botany
Botanical and Ecological Consultant

William L. Moore
Land Use Planning
Land Planning Consultant

Terry L. Hunt
PhD. Anthropology
Archaeological Consultant

Fred Stone
PhD. Geography, M.A. Biology
Zoological Consultant

REFERENCES

AASHTO American Association of State Highway and Transportation Officials. 1990. A Policy on Geometric Design of Highways and Streets Washington, D.C.: Authors.

Baker, H.L. 1976. "Agricultural Lands of Importance to the State of Hawaii." University of Hawaii at Manoa College of Tropical Agriculture Cooperative Extensions Service Circular 496. Honolulu.

Belt, Collins and Associates. 1975. Hilo Community Development Plan. Hilo: Hawaii County Planning Dept.

Belt, Collins and Associates. 1984. Alii Highway Project, Kailua-Keauhou, Final Environmental Impact Statement. Prep. for Hawaii County Public Works Dept. Honolulu: State Dept. of Transportation.

Federal Register. 1990a. "Endangered & threatened wildlife and plants." 50 CFR 17.11 & 17.12. April 15, 1990.

Federal Register. 1990b. "Endangered and threatened wildlife and plants; review of plant taxa proposed for listing as endangered or threatened species; notice of review." 50 CFR Part 17. Feb. 21, 1990.

Gagne, W. and L. Cuddihy. 1990. "Vegetation," pp. 45-114 in Wagner, W.L. et al., eds., Manual of the Flowering Plants of Hawaii. 2 vols. Honolulu: University of Hawaii Press.

Hawaii, State of. 1991. Hawaii State Plan. Prep. by Office of State Planning. Honolulu.

Hawaii, State of. 1991. Hawaii State Plan, State Functional Plan: Transportation. Rept. prep. in coop. with State Dept. of Transportation. Honolulu.

Hawaii, State of. 1991. Island of Hawaii Long Range Highway Plan. Rept. prep. in coop. with Hawaii County Depts. of Public Works and Planning and U.S. Dept. of Transportation.

Heliker, C. 1990. Volcanic and Seismic Hazards on the Island of Hawaii. Washington: U.S. GPO.

Macdonald, G.A., A.T. Abbott, and F.L. Peterson. 1986. Volcanoes in the Sea: The Geology of Hawaii. 2nd ed. Honolulu: University of Hawaii Press.

McEldowney, H. 1979. Archeological and Historical Literature Search and Research Design, Lava Flow Control Study, Hilo, Hawaii. Prep. for U.S. Army Corps Engineer Div., Pacific Ocean. Honolulu: Anthropology Dept., B.P. Bishop Museum.

Neal M.C. 1965. In Gardens of Hawaii. B.P. Bishop Museum Special Publication 50. Honolulu: Bishop Museum Press.

St. John, H. 1973. "List and Summary of the Flowering Plants in the Hawaiian Islands." Pacific Tropical Botanical Garden Memoir 1:1-519. Lawai, Hawaii.

Transportation Research Board. 1985. Highway Capacity Manual. Special Report 209. Washington: U.S. GPO.

U.S. Soil Conservation Service. 1973. Soil Survey of Island of Hawaii, State of Hawaii. Washington: U.S. GPO.

U.S. Soil Conservation Service. 1981. Erosion and Sediment Control Guide for Hawaii. Honolulu: USSCS.

University of Hawaii at Manoa, Dept. of Geography. 1983. Atlas of Hawaii. 2nd ed. Honolulu: University of Hawaii Press.

Wagner, W.L., D.R. Herbst, and S.H. Sohmer. 1990. Manual of the Flowering Plants of Hawaii, 2 vols. B.P. Bishop Museum Spec. Pub. 83. Honolulu: University of Hawaii Press.

Appendix A1:	Transcript of Public Meeting, 20 July 1992
Appendix A2:	Comments and Responses
Appendix B:	Flora and Ecosystems Report
Appendix C:	Vertebrate Fauna Report
Appendix D:	Invertebrate Fauna Report
Appendix E:	Archaeological Report
Appendix F:	Drainage Report
Appendix G:	Traffic Report
Appendix H:	Social Impact Assessment Report
Appendix I:	Preliminary Engineering Design Tabular Summary

Appendix A1

BRUCE McCLURE: Thank you very much for coming out. I'm Bruce McClure. I'm your chief engineer, Department of Public Works.

We will be passing around a sign-up sheet. It's voluntary, but we would like your name, phone number and address in case we want to get in touch with you later. With us tonight is the Mayor whom I'll introduce in just a minute, our consultant, and they will explain the purpose of this meeting. And we have some very distinguished guests in the audience which I'll let our Mayor introduce to you. So, at this time, I'd like to introduce our Mayor, Mayor Inouye.

[applause]

MAYOR INOUYE: Thank you, Bruce. Good evening. It's so nice to see all of you here, and that's just to let us know that you are interested in what happens in your district and your community. What we'll be doing tonight is giving you an overview of this project, then discuss the potential benefits and the impacts of the road realignment. We view that the Puainako Road Extension as a critical element in ensuring that Hilo's road system can not only support, but also sustain it's continued growth. This project also serves as the foundation for the continued improvement of the Saddle Road, the Mauna Kea Observatories, linking Hilo, Pohakuloa and, of course, West Hawaii. Although this Extension is part of the State's Highway System, last year the County has taken a more active role to ensure that this project can be developed in a timely manner which effectively meets the needs of the residents of both Hilo and the County as a whole. In fact, this development, if some of you remember--I remember--was first discussed over twenty-five years ago. And this was supposed to be the major link between Hilo Airport, Waiakea, Waiakea Uka, the suburbs, and on to the Saddle Road junction.

The reason for this meeting is to solicit your input and concerns about this roadway. I want to emphasize, though, that no decisions has [sic] been made as yet. This project must meet all of your needs and will need the benefit of your input that we can--to determine how to achieve that objective.

I'd like to introduce several officials here who has [sic] been instrumental in helping us proceed with this project and with the help of our Senator Matsuura who took the time out tonight--Senator Matsuura, thank you for coming. Of course our Representative Harvey Tajiri also played a key role. With us as well we have our council members--we have Brian DeLima here and we have our new council member, Eddie Alonzo. Eddie, why don't you stand since, um, you've just taken office--and Brian, thanks for coming.

At this time I'm going to turn the, things over to Billy Moore, and he is representing Okahara & Associates that the County has hired as the primary consultant on this project.

Thank you, again, for coming.

BILLY MOORE: Thank you, Mayor. At the start, I just uh, a couple of things. The bathrooms, the men's bathroom, the boys' bathroom since we're in elementary school is to the back on the left, the girls' is, it does say that, the girls' is back on the right. The drinking fountains are back out this way--okay. I also would like to apologize. We had hoped to have this a little less formal than we need to have it tonight, but we're going to be taping the proceedings and coming up with a transcript. So we're going to ask that when we get to the public input side of it, and that is the main purpose that we're here, although we'll give you a foundation and try to provide you with some basic information, so we're not scrambling for that information. But we're going to ask that you come up and speak into the mike. When you speak if you can please give us your name, and if you represent anybody, that. We also have Joy--can you wave your hand. Joy will also be asking for confirmation just so we can make sure we get it for the record, just so you know who she is.

With that, I would like to just start by getting into some background and where we are with this project. The Puainako Extension, as indicated in the Mayor's comments, is part of the State Highway System. It is a State road. The County, there were some State appropriations for this funds, and given the State priorities, where things are, it just wasn't a real high priority or as high a priority as I think some people in the County felt it should be. The County, through the Department of Public Works, requested that the funds be turned over to the County to manage at least the design and engineering portion of the projects. What we are doing, Okahara & Associates is doing the planning and preliminary design work which basically involves trying to identify the appropriate alignments for this section of the road. The project area starts from Kilauea Street. And just to orient yourself, Hilo Bay is here, the airport, this is Kanoelehua, Kilauea, Kinoole, Komohana Street. The black line here is Kaumana Drive or the existing Saddle Road. Just so you have some orientation. The project itself starts at Kilauea, and it really is in two phases or two sections. And if you look at our information it's identified that way. What we call the lower section is from Kilauea Street to Komohana Street. This is going to involve basically widening Puainako from a two-lane to a four-lane, and then realigning the portion above Kawili Street behind the existing housing along Puainako. So the new alignment would be behind that. The upper section would basically be a new roadway from Komohana Street, tying back in to near Country Club Road up in Kaumana. We are looking at two alignments at this point. We started with many more, but as we started looking at some of the engineering and some of the issues, those dropped out. We are now looking at two basic alignments on how to--where this roadway should be in the upper section. The concept up here is that it will be a two-lane roadway within a hundred and twenty foot right-of-way, so it could eventually be widened to a four-lane.

What we're looking tonight at is really to explain to you a little bit as to how we got where we are in terms of looking at these alignments. For your information, this roadway and the basic alignment of the concept is part of the County's planning documents. This roadway, it's width and general alignment has been adopted by the County as part of it's planning or this General Plan which was originally adopted in 1967. Prior to that it was part of it's older zoning maps which were adopted in the '60's. So this road has been on the books since the mid-'60's and been an active project or been looked at for about twenty-five years now. We are finally at a stage where there has actually been some money appropriated and we're starting to come down to brass tacks of actually siting the project.

Within the upper section, basically again we're looking at these two different alignments. One alignment parallels Kaumana Drive fairly closely. There is some additional development along Edita Street. As part of that development a right-of-way was reserved, so it doesn't impact any existing houses, although there's some lots and developments that it comes pretty close to. We just looked at another alignment, swinging it out to avoid the development plans just to make sure that if worse comes to worse we could at least have a right-of-way that doesn't impact on the existing development plans. But we're looking at these two alignments. What we're asking, we're going to ask you to do is comment and see how you feel about them. If you want us to look at something else, that's fine. You're not limited to just commenting on these alignments right now.

With respect to the lower section, what we have, and it's really hard to explain or to see. We have some different concepts on how we handle traffic really from Kawili to Kilauea Street. And what we have there are three basic concepts. And you don't need to look at those plans per se, but just understand as generally we talk about them. One would be to basically create the existing Puainako as a frontage road and all of the new alignment, one hundred twenty feet, would be on the other side into the school. It does some things for the residences 'cuz it doesn't impact any of the residences but it creates some severe hardship on the schools in terms of its traffic circulation. We just need to balance some of these issues.

Another concept that we have, we have a number of intersections coming down. Another concept is to allow each of these intersections full movement--so you'd make a left turn, a right turn, left turn in at each major intersection. And this involves, basically it'd probably involve a signal at each intersection and what that would do to the traffic flow. A third concept just to think about is having some of these roads with limited movements. It might be every-other-one, it might be every-third-one. So for some of these roads you can only make a right turn. So, let's just for say example, you're at this new subdivision, Naniakea, the improvements are going in, you might be able, if you wanted to go mauka you might have to make a right turn and to make a U-turn at some point. But it would then mean that there would be less signal lights along this road and freer flow of traffic. So those are the basic concepts that we are putting out there. The details we need to work out later. But just wanted you to think about that, give us your thoughts on how they lay out.

As we look, as the consultants look at these alignments, some of the things that we're really trying to take into consideration, as we try to come up with the final recommendation to Public Works that we will then be part of the Environmental Impact Statement and--is looking at the cost considerations. Again, money in these times is a real major concern. So we're trying to come up with something that makes sense financially. We need to do something that makes sense environmentally. One of the things that we found as we did our analysis is that there are some potential archaeological sites in the area along Puainako. So we're in the midst of continuing our archaeological reconnaissance with continuous mapping. We need to finalize the analysis and really determine finally what those sites are, come up with the mitigation plan with the State. So there's still some uncertainty as to where and how the roadway would work right in this area. There's a water tank--some of you are familiar with along upper section--right around that water tank there are some sites that are potentially prehistoric. Some of them has been identified as post-contact archaeological sites. There's some other features that we're--we just need to assess and continue working out exactly what they are. The other things that we're looking at coming out of some of the concerns are the noise impacts--that was raised in some community meetings and through some survey. The traffic and how we handle the schools. And that is something I just want to indicate. While there are some concepts there, we do need--and I'm glad to see Herbert here--we do need to sit down and will be sitting down with the DOE to work out how best to handle the traffic flow within the schools and how best to handle their traffic concerns and not impact, not severely impact the parking and everything else here.

Basically, before we get into the public comments, and I would be--I'm not sure--we can answer questions or you can make your statements, but while we're in this planning stage, and again I want to emphasize that we're in a stage taking your input on this concept. We've done a lot of work, but we're still open, nothing has been set yet. We're still looking at the environmental and design. We have a traffic engineer out looking at some traffic concerns. And that needs to all be completed. So we don't have a lot of answers. People ask, how we're going to handle this. A lot of these things we don't know yet. Where's the final alignment going to be--we have no idea until we finish our archaeology. We may not be able to do it here--as a worse case--we just have to find something else. So those are the types of things that we're still in the preliminary stage and really are soliciting your input. You know, as we look at things, if there are other concerns, we just need to hear them and really seeking it out.

In terms of where we go from here, once we complete this meeting and take your input, there's a series of things that we need to do yet. One is we need to complete our archaeology. Basically we have completed most of our environmental review, we're in the midst of a community involvement program--I think there's been a series of six meetings for the residents along Puainako, there's been a mail-out survey, trying to keep people informed and understand what the concerns are. We've done some preliminary engineering to understand what the costs are and I'll run some of those through you as we, lined up my section. But we still need to complete our archaeological mapping and survey work. We need to run that through and whatever we come up with we need to work through with the Department of Land and Natural Resources to have them confirm and make sure that what we're doing meets with their standards. Once we do that, we need to come and actually select the final alignments on how we're going to handle traffic in this area, which alignment we're going to actually start designing on. At that point we can complete the Environmental Impact Statement which, again, provides additional public review as part of that process--is with the draft EIS. Once the draft EIS is completed, the Environmental Impact Statement is completed, the project would move into the actual construction design. Once that's completed, we still need to secure the funding for this road. There is some funding for construction, but not much, and I'll get into some of the numbers just so you understand. This may or may not happen right away. There is funding for the planning and design work. There is not total funding for construction. Once the funding is secured then construction can start. In terms of scheduling, the EIS, Environmental Impact Statement is tentatively scheduled to be completed by the end of this year, early next year, so let's say January '93. Once that's completed the actual construction design of the road, doing a topo, topographic survey--there's a number of bridges or drainage crossings that have to be designed, we have to look at how we design each specific intersection, what kind of traffic signals are going to be, making sure that every driveway along Puainako can actually access it. So it's a lot of detail work. We have to identify where all the water lines are. So it's not just drawing two lines on the road and saying that's it. So that process takes approximately a year to complete a construction design--which takes us, excuse me, to some time in January, early January. Assuming that construction funds are available, the project can actually be built in about eighteen to twenty-four months, which, again, in the best of circumstances would be approximately 1996, end of 1996. Now that assumes that funding is available. Part of our scope is not to secure that funding, as much as we'd love to.

So far, what we've identified is a really preliminary cost estimate. Alignment number one, from Country Club road to Komohana is approximately fourteen million dollars. Again, this is very rough figures, we're still in a very preliminary stage, but that's about the scale of funding or cost that we're anticipating for alignment one. Alignment two, we're anticipating to be about fifteen million dollars. The basic difference--it's about a half-mile, three-quarters of a mile longer, and it's just a function of distance. There is nothing really different in terms of drainage crossings. It's just how far the crossing is. The lower section from Kinoole to Komohana, we're anticipating a cost of about fourteen-and-a-half million dollars. That includes some monies, although we haven't finalized it--there's some monies in there for land acquisition and, again, just, this is a four-lane section, this is a two-lane, so there's some cost differences, but just the number of intersections and the number of signal lights that we're anticipating just brings the cost up. So we're looking at approximately a twenty-eight-and-a-half million dollar project here to do the entire thing.

Thanks to our legislators, and I really do want to recognize them for that, approximately six point eight million dollars has been appropriated, both for design and some monies for construction. So basically before this road can be completed, another twenty-two million dollars approximately needs to be secured. That's something that I think we all need to be aware of since a lot of that comes from the community in terms of setting priorities. I know the County is looking at securing funds, we need to work with the State, and I know both the State and the County are looking at trying to get some Federal funds for this project.

At this stage, unless there's any definitional questions, what I'd like to do, and again, unfortunately we're going to ask people to come up and speak into the mike, to either ask questions or make statements--and again, we're seeking both, either way, you know, it's wide open in that regard.

But before we get into that, I'd like to recognize our Planning Director, Norman Hayashi, way in the back. Larry Capellas, our chief engineer--or deputy chief engineer.

On that note, again, the purpose of this meeting, I've gone on a little longer than I wanted to, but it's to take your input. So, I really encourage if there's anything--a lot of people were coming in and talking to me and other people prior, I encourage you to just come up and get some of this on the record. Talking to us is, you know, it makes a difference too--we'll keep notes--please.

HERBERT WATANABE: My name is Herb Watanabe. I represent the Department of Education--about time. I've been in my job for twenty-eight years and the first day I go on board with Ralph Kiyosaki, District Superintendent, the instruction I got was, stay away from the front. And I couldn't see the loss of a hundred and twenty-five feet. Then he say, that's our boundary line. There's a lone telephone pole in front of Waiakea Intermediate School. I heard then, back in 1964, that this was to be a four-lane highway. I'm just wondering what's going to happen to Tsukasa [laughter], 'cuz he was a long-time member of the contract association, worked with us in construction of the schools. My concern is, looking at the three alternatives, is that please don't use number two. And the reason is this. What you're doing there is using the present Puainako Street as a kind of a secondary road and you're building four more new lane [sic] all towards the school because it's State property. Harvey, listen now. So please, stay away from us. The reasons are we tried our best to build our school facilities away from this right-of-way. As you know, all of the facilities are now back here because we knew about this right-of-way. But what you're doing is you're coming closer and closer. And I know it's State land, and State land, deeper pocket, easy to grab hold. But, if you can, please consider one and three. I know that other people on the other side have your concerns because your private property's involved. But perhaps you could narrow down the center portion, you know that island-- But what you see there is a roadway that just, not too far from the front of this building. Now our plan is to complete this structure, to build a whole new cafeteria. This is just the dining room section and if Dick can get us the additional five million dollars, Dick--we'll build a cafeteria, dining, uh, kitchen over there and that's the plan right now and a playground over here. And this school is going to be somewhere around twelve, fourteen hundred kids. Another twelve hundred mauka. And right now Waiakea High School will have two thousand two hundred September of this year. So you can see the student impact. I suggest also that you look closely at how the buses come in. Now we have buses that are carrying ninety-nine kids and coming down Puainako from Komohana, Kawailani, Kilauea, all coming up and they bring the kids all the way down from Kanoelehua, from the Panaewa Forest. We'll be still carrying these kids until, I don't know when but--we have on plan right now, Senator Matsuura and Harvey--to build a new high school in Keaau. We have to. And that's on our agenda between now and the year 2000 because by year 2010 there's no way that we can handle three thousand kids at Waiakea High School. As I indicated to Dr. Garson, the enrollment at Waiakea is such that we can justify a high school at Keaau more than we can justify in North Kona High, by enrollment, I mean--not by politics. Okay, so the numbers are there. That's what our concern is. So we indicate to you Bill and your colleagues that--one is, try to stay as far away from the building if you can. So, if you have anything to say, recommend, don't consider two because that brings your road very close to us. And today, you know, noise is not--can be considered a pollution, noise pollution--and we don't want noise pollution for the kids in the morn--in the daytime. And I know that if you are a parent and you bring your kids to school each morning, you know what the congestion is, and it could become worse. I know that, we do thank Lo-- Li-- the people on your staff Lorraine that uh, and Norman working with us and telling us how you're designing this. We appreciate being involved, at least contacting us. But for the kids, please, stay away from number two. Thank you.

BILLY MOORE: Thank you, Herb. I'd also like to recognize Representative Jerry Chang, in the back.

THOMAS SHIROMA: My name is Tom Shiroma and if the route goes on beyond the Komohana Bridge, we have myself and Mr. Donald Tong, I don't know whether Mr. Donald Tong is over here--we abut the--parallel to the highway. Are we going to be granted an access to that highway? That's my question. I'm lot 520.

BILLY MOORE: Just um, for your information, at this time there are no plans. This is proposed to be a limited access highway. It's something that we can take a look at, though, as part of our planning for that.

THOMAS SHIROMA: About eight years ago when Mr. Hiroshi Kasamoto made the original, first plan for the Komohana Extension, we had a meeting right over here and we had two meeting [sic] over here and two meeting [sic] at Kaumana. At that time, questioning Mr. Kasamoto, he said yes, we would be granting access to the property owners along the, Puainako Street.

BILLY MOORE: Again, that's something we're going to have to take a look at. And not to get into difficulty, but the Waiakea drainage way comes down right through there, which require bridging that, an additional place, but we'll be happy to take a look at that and see if that is feasible or not.

THOMAS SHIROMA: Thank you.

MARK TOBIN: My name is Mark Tobin and I'm the president of the Hilo Country Club Estates and Park Hokulani Estates Neighborhood Association--we're up there off of Wilder, the five-mile marker. Can everybody-- Is that better? I'd like to make a statement and then ask a question.

First I'd like to second what Mr. Watanabe said--it's about time. We've been waiting a long time for this and upper Kaumana, we're, I think, one of the fastest growing parts of Hilo and the present Kaumana Drive is totally inadequate. In fact, we have some concerns. For instance, if Mauna Loa went again, you know, there's only one way to get off of the mountain. And reading the Honolulu Advertiser today, they described the plan is to build the lower section first and sometimes, who knows, to build the upper section. I'd like to ask, is that true and how did--if so, how did the priorities get established to start the bottom first?

BILLY MOORE: That's um, some of the different concepts that--again, in answer to that question, been looking at in terms of mitigation impact. One of the worst areas-- And again, part of this is we're going to have a traffic consultant that is doing some work now, some background work, that will be coming in and doing a technical assessment of the intersections and then seeing which one is worse, and there's design standards that will actually drive this in a lot of ways. But what we're looking at, one of the real concerns of the lower area, is the congestion along Waiakea Elementary & Intermediate. One of the issues that came up in our community discussions is that if we build the upper section first, it will bring all of that traffic down to Komohana, most of it will probably come down Puainako on the existing Puainako and what is a nightmare now will be even worse. So, it's not set in concrete, it's just something that we have tossed out there as some of the types of things that we're looking at to help mitigate some of these impacts. If there is a concern, and hearing you, you want that upper section first, to address some of that upper section, or the hazardous of conditions--that's going to be part of the balancing act that we all need to go through as a community. So, you know, I appreciate that and it is quite well taken.

MARK TOBIN: Thank you.

BEVERLY PAPALIMU: I'm Beverly Papalimu and I've lived in Kaumana for thirty years and tried to get this road done for twenty-five, so I'm with you, Herb. I think that Mark is absolutely right. The health and welfare of our citizens should be one of the most important things that we should be concerned with and Kaumana Drive has become a disaster. We have so much traffic on that coming down and right now it's all going down to Komohana--it's the same traffic. Just because we put Puainako there, it's still going to be the same traffic that is travelling these streets. So I would certainly say that we should have the upper portion done first.

Now, number two, have you contacted, or worked with, or asked the military, the Federal government to subsidize on this? Because military does use the road a tremendous amount and I think if we, you know, work things the right way we might be able to get some big bucks from there.

BILLY MOORE: Thank you. Just let me assure you I think both the State and the County have been exploring, I know the State and the County have been exploring the possibility of Federal funding to supplement this.

AMY SHIROMA: I'm Amy Shiroma. My husband spoke a few minutes ago. We did get our place way back in 1948 and at that time it was land-locked, it's still land-locked. That is why we are requesting if you will give us a right-of, right-of-way. And then as far as the drainage canal, it cuts off at the bottom of our land--excuse me, I have a cold--bottom of our lot, so it will not be a problem as far as giving us an access.

BILLY MOORE: Can you make sure, uh, Tim, can you raise your hand. Tim is one of the staff engineers. Can you give him your name and we'll sit down with you and meet with you on this.

AMY SHIROMA: Okay. I--

BILLY MOORE: This really gets to be your lot, so we'll be happy to meet with you and just explore this with you.

AMY SHIROMA: Okay. Thank you.

BILLY MOORE: Thank you very much.

Uh, again, we're-- Yes, please.

DEBORAH WARD: My name is Deborah Ward. You talked about the archaeological resources and I wanted to bring up just one other resource and that would be the biological resources. I use the Kaumana Cave as an educational and recreational resource. I feel that it's a very special natural area, reknown world-wide because of it biological value. Several television programs, such as Life on Earth and Nova have featured Kaumana Cave in recent years and just a couple of months ago there was another Nova program on the small-eyed, big-eyed, no-eyed hunting spider and the cave is deserving of a lot of care. I'd like to give you a few examples of its importance to the people of Hilo. The cave is used by a lot of residents and visitors as an educational, or as a recreational resource and they enjoy the County park at the entrance up on Kaumana road. It's also used by teachers as an educational resource, by 4-H clubs, such as mine, by south, uh, by scout troops and by about three hundred science students from the University of Hawaii, the HCC and the high schools. It's important biologically because most of the native Hawaiian cave species can be found in this particular area, and so much research is conducted in Kaumana Cave due to its accessibility and its proximity to the Hilo area. And this research actually brings in money to the Hilo economy and diversified the economic base. So, how would the road extension affect the cave. The value of the cave for biological research lies in the health of the ohia roots that grow down into the cave and extend into the cave passages. If the roots and trees above the, adjacent to the cave are disturbed, then the cave inhabitants are also disturbed. Also, the spraying of poisons along the roadside, the bulldozing and the filling could affect the cave as well. Unfortunately, this is what happened a few years ago when Edita Road was built and bulldozers clearing the area broke into the cave celing and crushed the geologic feature of the cave and filled a portion of the cave so that the passage is no longer accessible. Ideally a buffer of about fifty feet and optimally five hundred feet between the road and the mapped cave passage could protect both the geologic structure and the ohia trees that are vital to the health of the cave. The entire area, primarily State land, could be protected by conservation zoning.

Therefore, I urge the planners to choose the route most likely to avoid proximity to the natural resource so close to the heart of Hilo and protect it in perpetuity for future generations.

BILLY MOORE: Thank you very much. Just for your information, the consultant assisting us is Fred Stone, Dr. Fred Stone, who is one of the foremost experts in cave biota, so he has been in there and is participating as one of the experts on the project team.

For the community's information, excuse me just a sec-- The alignment number one through Edita up through Kiloa Street really pretty closely parallels the Kaumana Caves. So it is something that we are aware of and very, I think share the concerns--this is something, um, point, really appreciate the concern.

JOE PAPALIMU: My name is Joe Papalimu. I'm the husband of Beverly Papalimu. I would like to ask you to go, to proceed as soon as you can with the upper section of the new road to be built. I think worrying about Waiakea at this time is not all that necessary because you can--at the intersection of Komohana can be a no-through street through Kupulau, I mean, through what's it, Kawailani--Kupulau? Well, it's not necessary for us to come through here. Most of the traffic that I travel on, coming through, in fact it's so light going that way that most of the people who are wanting to go that way would automatically go. Trying to come down here is foolish for a guy who drives every morning to hit the school traffic. So, you know, there's no reason for you not to start that upper section. And we need--we need it now, we needed it yesterday, and please work on it as soon as you can. Thank you.

Uh, wait, one more thing. Has the Corps of Engineers done a flood control study in between Komohana and that section right below that intersection where the new road goes through?

BILLY MOORE: There are flood maps which are produced by the Army Corps of Engineers which guides basically where the floodways are and those floodways have been mapped and have been one of the major considerations in siting this roadway and trying to--what you don't want to do is run right up the middle of a flood, where, you want to try cross them in a parallel point to minimize your bridge structure. So, again, a lot of engineering has been done in a preliminary conceptual way to try and address some of these concerns. So, yes, it has been looked at.

JOE PAPALIMU: The reason I say that, for those who are not familiar with that area, there is, during our rainy season there's a fifty-acre lake that builds up in that area. I don't know, I don't understand--

BILLY MOORE: Can you, um, afterwards, can you point it out-- These types of things are of interests, so after the meeting--

JOE PAPALIMU: Sure.

BILLY MOORE: --identify it specifically. Thank you very much.

GEORGE STONE: My name is George Stone, I live right across the street. I think we're, you're tied in to a twenty-five-year-old program here. When you could--if you look at Lanaikaula, or Lanikaula Street rather than Puainako. It's where it makes the bend, you could go straight up and leave this part of Puainako alone. We got enough problems now with school traffic. Puainako needs to be up-graded, but no more traffic dumped on it.

BILLY MOORE: Excuse me. Just to clarify. Are you looking at trying to keep, or keeping the makai section and having the upper section come in in this direction is what you're, as a concept? Okay. Thank you.

TSUKASA INOUE: My name is Tsukasa Inoue. No relation to Lorraine. She always gotta stand back of me because she has a "Y". I don't have a "Y." I-N-O-U-E. I'm still ahead of her. [laughter] But I've heard this story for many, many years. And I am the one that gonna stop the project because I'm at, right at Kilauea and Puainako, but I will not do that. This is a Puainako Extension, it's not a Kaumana Extension. Puainako, lower Puainako must be fixed first. I live in the street, I cannot go out in the morning, I cannot make a left turn, it's only a right turn. But some good people stop the traffic and let me get out, and thank you for I don't know who the people are, but I'm grateful for that. And I think the lower Puainako is the road that is to be fixed. And that's where we're going to get at the Federal money and the State money because we are preparing to go up to Saddle Road. To go to Kaumana area, that has nothing to do with the Saddle Road. Puainako, lower Puainako supposed to be fixed first. Thank you very much.

BILLY MOORE: Thank you. That's part of the balancing act that we all have to deal with.

DAVID BLACKMER: Hi, Billy. David Blackmer on Puainako Street. And one thing I'd like to remark to the County people, PU doesn't mean a damn thing, PUU does. And when I bought my house in 1956 it was Puuainako. Hilo fertility, because there were so damn many kids. But I was asked--I would like to find out how many people come from Kaumana down Puainako Street, whereas if they could go over to Komohana, uh, from, not, if, just don't even get to Komohana, go down Mohouli, how many people come down that way and then have to go back to town again. Now think about that also. So, that eliminates a lot of the traffic. The intersection at Komohana, the way you have it planned now could be a congestion area. Those poeple don't have to come down that way, let 'em go someplace else. Don't use our road. We like it the way it is. Rename it.

BILLY MOORE: Thank you, Dave.

JOHN TAN: My name is John Tan. I live up Kawailani Street. The Komohana Road was long time, was called for and it was escape road. So why don't we do the one on Kaumana just like an escape road for the volcano that coming down from Mauna Loa. Get the money from the Federal Government, open up the easement so that in the future you can have a wide road like Komohana. Build a base, solid, a sub-base. Put the thick, two-inch asphalt macadam on top of that, be serving the purpose for an escape road. Right now if you're gonna go the other way around it gonna cost lots of money. I would suggest make Mohouli, too. Go right up and let us in --same thing, with the same good solid base and a two-inch asphalt concrete. That will last long like the olden days the County was building roads all around the area. It's not costly, it's [sic] be cheaper, but serve the purpose. This town here, all the people up Kaumana, we have a big, new city up there. If there's a fast lava flow, what gonna happen. We gonna destroy people. That's the thing I'm worried about. Not down below. Down below we have enough already. But we need the road up there to escape. That's the thing. And the Federal Government--you can get the money from the Federal Government by paying low interest loan and we can do that. Not by going around selling, buying bonds and go sell what, bonds and all that so that we can get and, we'd be more in the hole. But the Federal Government is lending money outside to anybody else, why don't we go ahead and take it. That's the way. That's all I have to say. Thank you.

BILLY MOORE: Thank you.

TEDDY GUMBS: Hi, my name is Teddy Gumbs. We're talking about working on widening Puainako and all that, but we're talking about four years from now maybe? Longer? I've been suggesting to the school for a long time that they look into making a one-way traffic pattern every morning like what they do on Waianuenue Avenue and that will alleviate the situation at least until when the road can be built. Because it's getting in gridlock every morning down here and it's not going to get any better. In four years it'll be ten times worse than it is today. That's all.

BILLY MOORE: Appreciate the comments.

Anybody else, really, um, again, good idea, bad idea, concerns.

Can you hold up, we have some [inaudible]

JOE VALENTE: Aloha, my name is Joe Valente and I'm a recent graduate of UHH. I spent a lot of time studying the archaeological sites on campus and my concern is that one of the proposed routes is going to go through a lot of sites and I feel that that would be a mistake because having this archaeological site provides a great opportunity for education as well as other opportunities that we could use in the community. We don't have too many sites left in this area and the site is definitely prehistoric as well as historic. So my concern is that the arachaeological site be left intact in its entirety.

BILLY MOORE: Thank you for-- Again, I assure you that the archaeology is a concern and we will be taking a real hard look at that.

JEAN NOBRIGA: Hi, I'm Jean Nobriga and I represent Komohana Gardens. I don't know if your survey is aware of the traffic on Komohana Garden coming from the Puna direction. We have a hundred and thirty-six lots in our subdivision. If you're not at that corner by 7:00, no later than 7:15, you won't get out of the subdivision. We have literally seen the traffic from the school all the way up Puainako and stopped on Komohana. I sympathize with upper Kaumana because they have a problem, but I don't think you realize how much is coming in from the Puna direction. Komohana is a real thoroughfare in the morning. We've had two children hurt seriously out here. I think we need to stay away from the school or do something to alleviate the traffic.

BILLY MOORE: Thank you. Is there anybody else--

CHARMAINE NAPOLEON: Hi, my name is Charmaine Napoleon and I'm representing the University of Hawaii's Student Association, in other words, the Student Government. Currently I'm the Treasurer of the new Student Senate and the new Student Senate would like to state that we're in opposition to the proposed road that would run straight through the archaeological sites, like Joe said, and we feel that the site should be preserved because of it's significant cultural, archaeological and historic structures.

Last semester the Student Senate of 1991-'92 also passed a resolution in support of preserving the site and I will hand that in for you guys' consideration. Thank you.

BILLY MOORE: Thank you very much.

MARK TOBIN: Yeah, I just have one additional comment, question, what have you, and that concerns lower Puainako. And I know this is just below Kilauea

Street. And I know not only in the morning but in the evenings or lot of times whenever the traffic heavy, you know, I've been driving down there and it gets real congested and I'm not an engineer, but it seems to me, at least on Kinoole Street, that lot of that could be relieved, 'cuz the traffic gets backed up anytime somebody's gonna make a left turn. And there's a big island there that's at least two lanes and I don't know who built it, but why didn't they think of putting in a left-turn lane, so the cars that're gonna make the left turn can pull over and people can go around. And you wait there the whole light, and then it turns yellow, and as soon as it turns red he turns left and then everybody else is still stuck there. But that seems to be something relatively cheap and could go a long way towards at least in that one section of Puainako, relieving some pressure. Yeah, my name is Mark Tobin, again. I'm from the upper Kaumana area.

BILLY MOORE: Okay. We'll be-- We'll take a look at that as part of our assessment.

[Question from audience--inaudible]

Yes. This alignment--alignment number two, you're asking? Basically what this alignment does is that there is a proposed development, actually an existing development here, the Sunrise Estates Subdivision, and that is, or just has been approved to be expanded up in this area. There is also a proposed development into here--this, Pacific Plantation, I believe, that is an expansion. What this alignment does is basically try to follow the boundary of those property lines to avoid impacting those two developments. So it goes around these developments, around the Gentry, the Park Hokulani Project, and then comes back in. So, basically, is looking at an alternate that will try to minimize impact on the existing developments. We wanted to make sure we had that in case we ran into some problems here. Again, as we noted, this alignment does run fairly close to the Kaumana Caves and it does run fairly close to some existing residences, so the potential or impact is a lot higher. This area is basically vacant. I think, you know, some of the concerns can be addressed. As we indicated, there's a higher cost to this--it's about a million dollars more. So whether it's cost-effective or not--some of the things that we just need to look at.

Excuse me, we are taping these proceedings. Please, no, no, don't limit that. Please come up and--

If there is, again-- I know you guys all wanna speak. If there is no more formal testimony, what we'd be happy to do is, there's some of the staff from Okahara, some of our consultants here, they'd be happy to identify themselves, that can help answer some of the questions. You know, again, we want to get this formally, but your verbal comments, your subsequent written comments will be just as effective. So, I don't want to do anything that will cut us off in terms of providing us with more input.

Yes, Mrs. Papalimu.

The question from Mrs. Papalimu was, where the archaeological sites are?

They are in the vicinity of the water tank, right along in this area. Actually, you can come up and identify what-- Again, what I wanna really indicate is that our archaelogist, we have an archaeologist as part of our team, he has been out there mapping. The reason that there was some staking was to exactly locate these sites so we can map them and then do our assessment [inaudible].

JOE VALENTE: Okay, the site is a very large site. It extends above the water tank in this area right here. It goes down off through here. There're sites all in this area here and a lot of it is in this shot. This is the Waiakea Stream right here. So there's sites all along the stream, on both sides of the stream. It goes all the way down through campus. And why I think it is important is because it's one of the only left sites in Hilo.

BILLY MOORE: Thank you. Again, it's something that our assessment or analysis is not complete and it will be and again, what we will do or be happy to do is get our archaeologist out here to meet with the interested parties, so we really can get your input and involve you guys in our assessments. So that's something we'd be willing to do.

DAVID PAUL: My name is David Paul. I'm the campus naturalist over at UH-Hilo and, um, like to oppose again the road that's going through the archaeological site or even that part, and for one reason, why does this have to be on Puainako. If you go down Puainako on any school morning, you basically can't go anywhere, you're stuck. And bringing the cars down from Kaumana right in the Puainako again, where're they gonna go? Aside from there, we have alternative routes--we're already pounding a roadway through campus for the technology part--that might be an alternative route--go right through there, too. It's already a major highway coming through campus. And, aside from that, how come there has not been any talk about public transportation to alleviate traffic?

BILLY MOORE: Thank you for your comments. Again, if there is nobody else, what we're gonna do is close the formal part of the hearing--hearing, excuse me--the meeting, informational meeting, and just be here to answer your questions; again, just make sure that you're satisfied with what we're doing, provide additional input.

I really would like to thank the people who have been here, the Mayor, Senator Matsuura, Harvey, Brian, Jerry, who have stayed here and listened to your concerns throughout, too, so it's not just talking to us, the consultants, the County is here, our chief engineer, so they're hearing you as well.

So, with that, I'd like to thank you very much again for coming out on this miserable night to hear what I think is a really exciting and important project. I'm really pleased with the turnout--with you guys who are here. Thank you very much.

[Question from audience--inaudible]

The question was, will there be a future meeting? I think with this level of interest, we probably will have one when we come up with our alignment. I think that's something we need to define, but most likely.

University of Hawaii at Hilo
STUDENT ASSOCIATION

1992 UHHSA RESOLUTION

Preservation of the Hawaiian Site Located on the University of Hawaii at Hilo Grounds that contains significant cultural, historical and archaeological structures.

BE IT ENACTED BY THE STUDENT SENATE:

WHEREAS, UHH has significant physical and cultural resources in its undeveloped regions; and

WHEREAS, These resources contribute great educational, cultural, and aesthetic value to the UHH campus; and

WHEREAS, Students, faculty and community can directly benefit from the use and preservation of these resources; and

WHEREAS, Part of those resources are stone structures of apparent archaeological and cultural significance, as well as indigenous low land forest; and

WHEREAS, There is a need to officially determine the exact nature and location of these stone structures.

WHEREAS, Historical sites must be preserved under State law and further bulldozing can destroy hidden attributes; and

WHEREAS, UHH needs to be a leader in the community by demonstrating innovative planning and development; therefore,

BE IT RESOLVED, AND ACKNOWLEDGED BY THE SENATE OF THE UNIVERSITY OF HAWAII AT HILO STUDENT ASSOCIATION THAT A MORATORIUM BE IMPOSED ON FURTHER BULLDOZING OF THE UNDEVELOPED PORTIONS OF THE UHH CAMPUS UNTIL A SUFFICIENT ARCHAEOLOGICAL AND BIOLOGICAL SURVEY IS COMPLETE.

BE IT ALSO RESOLVED THAT THE STATE OF HAWAI'I FINANCIALLY ASSIST IN ACQUIRING THE ARCHAEOLOGICAL AND BIOLOGICAL SURVEYS.

BE IT FURTHER RESOLVED THAT UHHSA REQUIRES ALL SIGNIFICANT INDIGENOUS LOWLAND FOREST ARCHAEOLOGICAL REMAINS BE LEFT INTACT WITH A SIGNIFICANT BUFFER SURROUNDING THE AREAS SO AS TO PRESERVE THE INTEGRITY OF THE SITE AND THE FOREST.

BE IT FURTHER RESOLVED THAT UHHSA SUPPORTS THE STUDENTS AND COMMUNITY IN ITS EFFORTS TO REPLACE THE EXISTING EXOTIC VEGETATION IN THIS AREA WITH AN INDIGENOUS HAWAIIAN THEME GARDEN.

BE IT FINALLY RESOLVED THAT A COPY OF THIS RESOLUTION BE SENT TO THE UNIVERSITY OF HAWAII PRESIDENT ALBERT SIMONE; BOARD OF REGENTS; THE UNIVERSITY OF HAWAII AT HILO CHANCELLOR EDWARD J. KORMONDY; STATE SENATOR MIKE MCCARTNEY; STATE REPRESENTATIVE DAVID IGE; STATE REPRESENTATIVE HARVEY TAJIRI; UNIVERSITY OF HAWAII AT HILO FACULTY SENATE; VULCAN NEWS; AND THE DEPARTMENT OF HAWAIIAN STUDIES AT UHH AND UHM; THE HO'OIKAIKA CLUB.

RECEIVED
JUL 21 1992
OKAHARA & ASSOC., INC.
HILO OFFICE

My name is Deborah Ward, and I reside at P.O.Box 918 Kurtistown, HI 96760 in Puna District. I have a vital concern about the proposed route of the Puainako Extension route because I use Kaumana Cave as an educational and recreational resource.

Kaumana Cave is a very special natural area reknown worldwide for its biologically unique creatures, found only in Hawaii and nowhere else on earth. Several television programs such as Life on Earth and NOVA have featured the cave numerous times over the years, and just three months ago a NOVA team interviewed local scientists about the strange evolution of cave adapted insects such as the cave cricket and the small-eyed big-eyed hunting spider. The cave is deserving of the upmost care.

I would like to give you a few examples of its importance to the people of Hilo. The cave is a recreational resource; many residents and visitors explore the cave daily, and enjoy the County park at its entrance.

The cave is used by teachers as an educational resource, as well as by 4-H clubs, scout troups, and over 300 science students from the University of Hawaii, HCC and high schools.

The cave is very important biologically; most of the native Hawaiian cave species can be found in this area, and so much research is conducted in Kaumana cave due to its accessibility and proximity to the Hilo area. The research conducted brings in money to the Hilo economy and diversifies the economic base.

How could the road extension affect the cave? The value of the cave for biological research lies in the health of the ohia roots that extend into the cave passages. If the roots and trees above and adjacent to the cave are undisturbed, the cave inhabitants can thrive. If the trees are disturbed by clearing, spraying of poisons, bulldozing or filling, the value of the cave for recreation, education and research are seriously diminished.

Unfortunately, this is exactly what happened a few years ago when Edita Road was built. Bulldozers clearing the area broke into the cave ceiling, crushing and filling a portion of the cave so that the continuing passage is no longer accessible.

Ideally a buffer of at least 50 feet and optimally 500 feet between the road and the mapped cave passage could protect both the geologic structure and the ohia trees so vital to the health and value of the cave. The entire area, primarily state land, over and surrounding the cave passage should be protected by conservation zoning.

Therefore, I urge our planners to choose the route most likely to avoid proximity to this natural resource so close to the heart of Hilo, and protect it in perpetuity for future generations.

RECEIVED
JUL [illegible] 1992
OKAHARA & ASSOC., INC.
HILO OFFICE

SIGN IN SHEET

NAME	ADDRESS	PHONE
MASAHIRO Nishida	43 KILUO Rd	961 4461
MARGARET P. BLACKMER	239 PUAINAKO St	959.7228
Herbert Watanabe	93 Kapualani St Hilo	959-8427
[illegible] Inoue	1994 Kilauea AVE	959-6427
Grant Gerrish	Box 282 Laupahoehoe	962-6957
Deborah Ward	P.O. Box 918 Kurtistown	966-7361
Amy Shiroma	992A Puainako	959-8366
Lillian K. Pedro	187 Hoku St.	935-5355
Ron Terry	HCR 9575 Keaau	982-5831
GORDON NOBRIGA	1039 LAULIMA WAY	959-8244
HAROLD P. LUSCOMB	892 Komomala Dr	959-5181
Signe Luscomb	" " "	959-5181
Jan Nobriga	1039 Laulima Way	959-8244
LOWELL KIM	P.O. BOX 5897 Hilo Hi	961-6355
Mr. & Mrs. Darrell Auston	PO Box 1624 Keaau, Hi	968-6376
Mr. & Mrs. Robert Osborn	342 Puainako St	9597353
Jerry Chang	245 D Keeaumoku ST.	934-9042
TEDDY GUMBS	585 Kupulau Rd.	959-9852

RICHARD NISHIMOTO	932 PUKU ST.	959-0500
Virgil L. Kennedy	165 Lukea St.	961-5979
Dorothy M. Swan	165 Lukea St	961-5979
JOHN P. CALLEN	440A KAUMANA DR	934-7080
Charmaine Napoleon	430 W. Kawili St # 25B	959-9148
Colin Yong	1387 Kinoole Street	935-7517
ALICE KIM	377 Puanela	959-3448
Dr & Mrs. Allan Takase	287 Kanoelani	959-7579
Tai Sun Chung	655 Mililani	9356238
Sop HAHN	1180 N. KUMUWAINA PL.	959-6123
[illegible]	385 Pobkiko St.	959-6728
EDDIE ALONZO	PO BOX 791 KEAAU, HI 96749	925-0379 PAGER
ERNEST Carvalho	96 Lucan Way Hilo Hi.	935-7094
John Tom	821-W KAUKAILANI ST.	959-7593
Wayne Suzuki	1989 Kilauea	959-8494
Jean Netorba	196 Iwalani St	9598024
Lo-Li Chih	P.O.Box 1605 Keaau	966-7038
TOM SHIROMA	992 A Puueneho St	9598366
Joe Pupeakin	1253 Kaumana Dr. Hilo	
HARRY SUZUKI	39 HOOMALU ST.	959-8487
YIKMAN Lee	1211 KUMUKOA	935-8739
George Kodani	P.O. Box 4277 Hilo HI.	933-4604
DICK MATSUURA	131 Halai St. Hilo, Hi	9358933
SHUN HATADA	55 Kukuau St Hilo Hi	935-6868
Donald Okahara	1199 Kumukoa St	9352574
HARVEY TAJIRI	310 KIPA ST.	959-7707
Juliane Mansur	400 Hualani 20D	935-4893
Marcia Sakai	101 Iwipolena Rd	961 6157
DAVID SAKAI	101 IWIPOLENA RD.	961-6157

Chris Sadayasu	RR#1 Box 196 Papaikou	964-1803
James Y. Sadayasu	280 Ponahawai St Hilo	935-5268
Herbert Yoshizumi	324 Mohouli St. Hilo (350 Wainohea Pl.)	935-8064
Terrance Nago	1504 Pukana Pl.	961-5527
Chris Brilhante	1342 Kilauea Ave.	935-3908
Jason Inaba	273 Waianuenue Ave	961-3727
Steven Santiago	404 Puainako St	959-3096
Wayne Nakamura	29 Kanoelani St.	959-5527
Richard Wolfe	259 Edita St.	
Melissa Kirkendall	P.O. Box 428 Pahoa	934-7358
Dante K. Carpenter	303 Kuikahi St.	961-5902

Appendix A2:
Comments and Responses to Draft Environmental Impact Statement

U.S. ARMY ENGINEER DISTRICT, HONOLULU
BUILDING 230
FT. SHAFTER, HAWAII 96858-5440

REPLY TO
ATTENTION OF:

January 25, 1993

Planning Division

RECEIVED
JAN 28 1993
OKAHARA & ASSOC., INC.
HILO OFFICE

Office of Environmental Quality Control
State of Hawaii
220 South King Street, Fourth Floor
Honolulu, Hawaii 96813

Dear Sir/Madam:

Thank you for the opportunity to review and comment on the Draft Environmental Impact Statement for the Puainako Street Extension and Widening, Island of Hawaii. The following comments are provided pursuant to Corps of Engineers authorities to disseminate flood hazard information under the Flood Control Act of 1960 and to issue Department of the Army (DA) permits under the Clean Water Act; the Rivers and Harbors Act of 1899; and the Marine Protection, Research and Sanctuaries Act.

a. We disagree with the statements made on page 9 (paragraph 8) and page 69 (paragraph 69) which conclude that wetlands are not present in the project area based on the botanical survey. The botanical survey indicates the presence of facultative and obligate wetland species. Additionally, page 39 indicates that the proposed extension will cross intermittent streams. As stated in our previous letter of July 1, 1992, a DA permit would be required for the placement of fill material in any waters of the U.S., which includes wetlands and streams. For further information on permit requirements, please contact the Operations Division at 438-9258 and refer to file number PO92-150.

b. The revised flood hazard information provided on page 38 is now correct.

Sincerely,

Kisuk Cheung, P.E.
Director of Engineering

Stephen K. Yamashiro
Mayor

Donna Fay K. Kiyosaki
Chief Engineer

Riley W. Smith
Deputy Chief Engineer

County of Hawaii
DEPARTMENT OF PUBLIC WORKS
25 Aupuni Street, Room 202 · Hilo, Hawaii 96720-4252
(808) 961-8321 · Fax (808) 969-7138

April 6, 1993

Mr. Kisuk Cheung, P.E.
Director of Engineering
Department of the Army
U.S. Army Engineer District, Honolulu
Building 230
Ft. Shafter, HI 96858-5440

Dear Mr. Cheung:

SUBJECT: Puainako Street Extension and Widening EIS

Thank you for reviewing the Draft Environmental Impact Statement (DEIS) for the Puainako Street Extension and Widening project on the Island of Hawaii. Each reviewers's comments have been carefully examined and appropriate additions and modifications are being incorporated in the Final EIS.

The specific comments you submitted are responded to below:

Comment: We disagree with the statements...which conclude that wetlands are not present in the project area based on the botanical survey. The botanical survey indicates the presence of facultative and obligate wetland species.

Response: Biologist Grant Gerrish, Ph.D., has conducted a review and comparison of the flora, vegetation and habitats of the Project Area with the U.S. Fish and Wildlife Service's "National List of Plant Species That Occur in Wetlands: Hawaii (Region H)," (1988).

The two obligate wetland species referred to are *Eleocharis obtusa* (spikerush) and *Ludwigia octovalis* (Mexican seedbox). *Eleocharis* was found in an intermittent stream (or, more properly, gully) which at the time of the survey was partially submerged. The Project Area contains many linear sections of gullies

RECEIVED
[illegible] 1993
OKAHARA & ASSOC., INC.
HILO OFFICE

where soil moisture remains high enough for aquatic plants to survive, and yet these small patches should not properly be considered wetlands. _Ludwigia_ was found mixed in the vegetation type referred to in the text as _Psidium cattleianum_ thicket, along with _Trema orientalis_, _Melochia umbellata_ and a host of other non-obligate wetlands species. Also present was _Brachiaria mutica_ (California grass), a "Facultative Wetland" plant. Some of the accompanying species are in the separate "Facultative" category, which means that they may be found in wetlands in 34-66% of their occurrences. The site where _Ludwigia_ was found lacks other wetland indicators, i.e., other obligate wetland plants and a poorly drained soil.

A large number of species found along the proposed Puainako Extension alignments is listed as "Facultative" and a few as "Facultative Wetland" plants. The most abundant of the latter are _Brachiaria_ and _Commelina diffusa_ (honohono grass). While we concur that these two species are facultative wetland plants, they are also found very frequently on well-drained soils in high rainfall areas that have no other wetland characteristics. We believe that their presence on sites in the Hilo area cannot be taken alone to be a reasonable indication of a wetland.

Comment: Page 39 indicates that the proposed extension will cross intermittent streams. As stated in our previous letter of July 1, 1992, a DA permit would be required for the placement of fill material in any waters of the U.S., which includes wetlands and streams.

Response: In discussions between the Hawaii County Department of Public Works and the U.S. Army Engineer District it was determined that the "intermittent streams" referred to in the Draft EIS are not actually streams but occasional drainage channels more properly referred to by drainage geomorphologists as gullies. These features are not depicted or named on U.S.G.S. topographical 1:24,000 scale maps of the area, and do not meet the definition of an intermittent stream as understood by the U.S. Army Engineers. As such, no DA permit should be required for fill work near these features. References to these features will be modified in the Final EIS to more accurately reflect their nature.

One genuine intermittent stream intersected by the project is Waiakea Stream, which is channelized in places. Project design calls for a bridge to be constructed over this stream channel, and no fill will be placed in the channel.

Again, thank you for your careful consideration of the document.

Sincerely,

Donna Fay K. Kiyosaki
Chief Engineer

JOHN WAIHEE
GOVERNOR

STATE OF HAWAII
OFFICE OF ENVIRONMENTAL QUALITY CONTROL
220 SOUTH KING STREET
FOURTH FLOOR
HONOLULU, HAWAII 96813
TELEPHONE (808) 586-4185

BRIAN J. J. CHOY
Director

March 3, 1993

Mr. Bruce McClure, Acting Chief Engineer
County of Hawaii, Department of Public Works
25 Aupuni Street, Room 202
Hilo, Hawaii 96720

RECEIVED
MAR 05 1993
OKAHARA & ASSOC., INC.
HILO OFFICE

Attention: Ms. Donna Kiyosaki

Dear Mr. McClure:

SUBJECT: DRAFT EIS FOR THE PUAINAKO STREET EXTENSION AND WIDENING, SOUTH HILO, HAWAII

We have completed our review of the subject document and have several comments. Please include the following information when submitting the Final EIS for this project, as required by §11-200-17 and 18 Hawaii Administrative Rules:

- Determination of secondary population and growth impacts resulting from the proposed action and its alternatives [11-200-17(g)];
- Relationship between local short term uses of humanity's environment and the maintenance and enhancement of long term productivity [§11-200-17(j)];
- A discussion of how any unresolved issues will be resolved prior to commencement of the action, or what overriding reasons there are for proceeding without resolving the problems; [§11-200-17(n)]; and
- A list of all persons, organizations, and public agencies who have commented on the Draft EIS (including "no comment" letters) in the Final EIS [§11-200-18].

Please print the Final EIS on both sides of the paper to cut down on paper and postage costs. If you have any questions, please call Margaret Wilson at 586-4185. Thank you.

Sincerely,

Brian J.J. Choy

Brian J.J. Choy
Director

c: Masahiro Nishida, Okahara & Associates, Inc.

Stephen K. Yamashiro
Mayor

County of Hawaii
DEPARTMENT OF PUBLIC WORKS
25 Aupuni Street, Room 202 · Hilo, Hawaii 96720-4252
(808) 961-8321 · Fax (808) 969-7138

Donna Fay K. Kiyosaki
Chief Engineer

Riley W. Smith
Deputy Chief Engineer

April 6, 1993

Mr. Brian J. J. Choy, Director
State of Hawaii
Office of Environmental Quality Control
220 South King Street, Fourth Floor
Honolulu, HI 96813

Dear Mr. Choy:

SUBJECT: Puainako Street Extension and Widening EIS

Thank you for reviewing the Draft Environmental Impact Statement (DEIS) for the Puainako Street Extension and Widening project on the Island of Hawaii. Each reviewers's comments have been carefully examined and appropriate additions and modifications are being incorporated in the Final EIS.

The specific comments you submitted are responded to below:

<u>Comment:</u> Information on determination of secondary population and growth impacts resulting from the proposed action and its alternatives should be included.

<u>Response:</u> Section 3.5.8, "Secondary Population and Growth Impacts," is included in the Final EIS to explicitly identify and discuss this issue.

<u>Comment:</u> Information on the relationship between local short term uses of humanity's environment and the maintenance and enhancement of long term productivity should be included.

<u>Response:</u> A discussion of the relationship between local short-term uses and maintenance of long-term productivity has been added to the Final EIS as Section 3.8.

RECEIVED
APR 14 1993
OKAHARA & ASSOC., INC.
HILO OFFICE

Comment: A discussion of how any unresolved issues will be resolved prior to commencement of the action, or what overriding reasons there are for proceeding without resolving the problems should be included.

Response: Chapter 6, "Unresolved Issues, has been developed for the Final EIS to address explicitly which unresolved issues reamin and how they will be resolved, or what overriding reasons there are for proceeding without resolving the problems.

Comment: A list of all persons, organizations, and public agencies who have commented on the Draft EIS (including "no comment" letters should be included in the Final EIS.

Response: Appendix A will include the above.

Comment: Please print the Final EIS on both sides of the paper to cut down on paper and postage costs.

Response: This request will be gladly complied with.

Again, thank you for your careful consideration of the document.

Sincerely,

Donna Fay K. Kiyosaki
Chief Engineer

JOHN WAIHEE
GOVERNOR

STATE OF HAWAII
DEPARTMENT OF BUDGET AND FINANCE
HOUSING FINANCE AND DEVELOPMENT CORPORATION
677 QUEEN STREET, SUITE 300
HONOLULU, HAWAII 96813
FAX (808) 567-0600

JOSEPH K. CONANT
EXECUTIVE DIRECTOR

IN REPLY REFER TO:
93:PPE/1235

March 15, 1993

RECEIVED
MAR 18 1993
OKAHARA & ASSOC., INC.
HILO OFFICE

TO: The Honorable John Waihee, Governor
State of Hawaii
c/o Office of Environmental Quality Control

FROM: Joseph K. Conant
Executive Director

SUBJECT: Draft Environmental Impact Statement for the Proposed Puainako Street Extension and Widening, Island of Hawaii

We have reviewed the subject report and offer the following comments.

We note that implementation of the roadway project may necessitate acquisition of certain houses along both sides of Puainako Street between Kilauea Avenue and Kawili Street, requiring the displacement of current residences. Pursuant to Chapter 111, HRS, the HFDC has oversight responsibility for ensuring that proper relocation assistance is provided to displaced persons and businesses. As such, please forward a copy of the draft relocation assistance plan to HFDC for review.

Thank you for the opportunity to comment.

c: County of Hawaii, Dept. of Public Works
Okahara & Associates, Inc.

Stephen K. Yamashiro
Mayor

County of Hawaii
DEPARTMENT OF PUBLIC WORKS
25 Aupuni Street, Room 202 · Hilo, Hawaii 96720-4252
(808) 961-8321 · Fax (808) 969-7138

Donna Fay K. Kiyosaki
Chief Engineer

Riley W. Smith
Deputy Chief Engineer

April 6, 1993

Mr. Joseph K. Conant
Executive Director
State of Hawaii
Department of Budget and Finance
Housing Finance and Development Corporation
677 Queen Street, Suite 300
Honolulu, HI 96813

Dear Mr. Conant:

SUBJECT: Puainako Street Extension and Widening EIS

Thank you for reviewing the Draft Environmental Impact Statement (DEIS) for the Puainako Street Extension and Widening project on the Island of Hawaii. Each reviewers's comments have been carefully examined and appropriate additions and modifications are being incorporated in the Final EIS.

The specific comments you submitted are responded to below:

Comment: Please forward a copy of the draft relocation assistance plan to HFDC for review.

Response: The County of Hawaii will prepare a draft relocation assistance plan and forward it to HFDC.

Again, thank you for your careful consideration of the document.

Sincerely,

Donna Fay K. Kiyosaki
Chief Engineer

RECEIVED
APR 14 1993
OKAHARA & ASSOC., INC.
HILO OFFICE

RECEIVED
MAR 1 0 1993

OKAHARA & ASSOC., INC.
HILO OFFICE

MARCH 8, 1993

Dr. Young Ki Hahn
Okahara and Associates, Inc.
200 Koholā Street
Hilo, Hawai'i 96720

Dear Sir:

I am writing to comment on the Draft Environmental Impact Statement, Puainakō Street Extension and Widening, Island of Hawai'i.

Having visited the site with my students, and having read the report prepared by Dr. Young Ki Hahn and Donald Okahara and their associates, I would like to concur with their recommendations that extensive archaeological work be completed in both alternatives A and B in the lower portion of the Puainakō Street extension, and that if the corridor must be located in one of these alternatives, Corridor B be used, and Corridor A be left intact and cleared.

In the event that further excavation and research provide information to show significant historic and prehistoric sites in corridor B, then those too should be preserved.

As is stated on pp. 10 and 11 of the Archaeology report by Terry Hunt in the document:

"...there exist numerous well preserved archaeological resources...

"These remains gain significance from the fact that so little archaeology has been previously documented in Hilo. Thus, criterion C (excellent examples of site types) applies, as these are some of the only examaples known for the Hilo area.

"The sites identified are also clearly significant for their information content. Again, because so little is known for Hilo, intensive mapping and test excavations would provide a unique contribution to Hawaiian archaeology and our understanding of prehistory and history."

The key item here is the fact that these sites are possibly the only major sites for the Hilo area found in the time since Archaeology has been available to secure their preservation. All other known sites have been destroyed in the past for building, etc. at times when such sites were not considered to be of great importance.

Until the UH students brought this report to our attention last week, virtually no one in Hilo was aware of this site. It is very significant for those of us in education, especially in Hawaiian Studies, Environmental Studies, Anthropology and Archaeology that these sites right in our midst be available to our students for further study, appreciation and use.

In the future, we can possibly have the University Archaeology students clear and work the sites, their Agriculture and Anthropoloy departments can revitalize and interpret the sites, and best of all, the elementary, intermediate and high school students can have access to an agricultural complex as a living resource, similar to Lapakahi State Park in Mahukona, on the Kohala coast.

Let us work together in this unique opportunity to preserve a resource that was previously unknown to us. In this time of increased awareness of the significance of the native heritage of these islands, let us not repeat the debacle of Hālawa Valley on O'ahu. Let us not be forced to hug trees to save a resource that is of major significance to the pride and self-esteem of the generations that will follow us.

I wish to be kept informed of the progress of this undertaking. I want to be able, in the future, to take my students to these cleared sites and have an interpreter explain to us the industry and ingenuity of their ancestors in their use of the land.

Mahalo for considering my comments. I hope your agency will take all such comments very seriously and follow the recommendations of those who have prepared this report and those who will be affected by it.

Me ka ha'aha'a,

Paula De Morales

Paula De Morales
Hawaiian Language
Waiākea High School

cc.Governor
County of Hawai'i

Stephen K. Yamashiro
Mayor

Donna Fay K. Kiyosaki
Chief Engineer

Riley W. Smith
Deputy Chief Engineer

County of Hawaii
DEPARTMENT OF PUBLIC WORKS
25 Aupuni Street, Room 202 · Hilo, Hawaii 96720-4252
(808) 961-8321 · Fax (808) 969-7138

April 6, 1993

Ms. Paula De Morales
Hawaiian Language
Waiakea High School
Hilo, HI 96720

Dear Ms. De Morales:

Thank you for your letter supporting preservation of archaeological sites in the alternative routes for the Pu'ainako Road Extension Project. Our studies have only begun, and we are working toward the best solution for historic preservation. We understand and appreciate your concerns.

Please be aware that this interim report (of the draft EIS) is <u>not</u> the final word. This reconnaissance level survey has only served to alert everyone of the significant sites present. There will be further evaluation of the sites using State Historic Preservation Office (SHPO) guidelines before any final decisions are made about the alignments chosen, appropriate mitigation, or preservation.

Again, thank you for your concerns regarding the preservation of archaelogical sites.

Sincerely,

Donna Fay K. Kiyosaki
Chief Engineer

1993

Stephen K. Yamashiro
Mayor

Virginia Goldstein
Director

Norman F. Olesen
Deputy Director

Planning Department
County of Hawaii • 25 Aupuni Street, Room 109 • Hilo, Hawaii 96720 • (808) 961-8288

March 9, 1993

RECEIVED
MAR 1 1 1993
OKAHARA & ASSOC., INC.
HILO OFFICE

Honorable John Waihee
Governor
State of Hawaii
c/o Office of Environmental Quality Control
220 South King Street, Fourth Floor
Honolulu, HI 96813

Honorable Governor Waihee:

DEIS - PUAINAKO STREET EXTENSION AND WIDENING
SOUTH HILO, HAWAII

We have reviewed the DEIS for the proposed Puainako Street extension and widening and have no comments to offer. Thank you for the opportunity to review the subject document.

Sincerely,

Virginia Goldstein

VIRGINIA GOLDSTEIN
Planning Director

AK:pak
8315D

cc: Ms. Donna Kiyosaki, Chief Engineer
Department of Public Works
Mr. Donald K. Okahara, Okahara & Associates, Inc.

Stephen K. Yamashiro
Mayor

County of Hawaii
DEPARTMENT OF PUBLIC WORKS
25 Aupuni Street, Room 202 • Hilo, Hawaii 96720-4252
(808) 961-8321 • Fax (808) 969-7138

Donna Fay K. Kiyosaki
Chief Engineer

Riley W. Smith
Deputy Chief Engineer

April 6, 1993

Ms. Virginia Goldstein
Planning Director
Planning Department
County of Hawaii
25 Aupuni Street, Room 109
Hilo, HI 96720

Dear Ms. Goldstein:

SUBJECT: Puainako Street Extension and Widening EIS

Thank you for reviewing the Draft Environmental Impact Statement (DEIS) for the Puainako Street Extension and Widening project on the Island of Hawaii. Each reviewers's comments have been carefully examined and appropriate additions and modifications are being incorporated in the Final EIS.

Sincerely,

Donna Fay K. Kiyosaki
Chief Engineer

RECEIVED
1993
OKAHARA & ASSOC., INC.
HILO OFFICE

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

DEPUTY DIRECTORS
JOYCE T. OMINE
AL PANG
JEANNE K. SCHULTZ
CALVIN M. TSUDA

IN REPLY REFER TO:
HWY-PS
2.5765

March 4, 1993

RECEIVED
MAR 05 1993
OKAHARA & ASSOC., INC.
HILO OFFICE

TO: The Honorable John Waihee
Governor, State of Hawaii
c/o Office of Environmental Quality Control

FROM: Rex D. Johnson, Director
Department of Transportation

SUBJECT: DRAFT ENVIRONMENTAL IMPACT STATEMENT, PUAINAKO STREET EXTENSION AND WIDENING, HILO, HAWAII

Thank you for your transmittal requesting our review of the subject project.

We have the following comments:

1. A bike lane should be considered for both sides of the street from Kilauea Avenue to Komohana Street. In the upper portion of the street extension, the shoulders would serve as a bike route. The design of the bike lane/bike route should conform to the State's Master Plan for bikeways.

2. If either the State or the County decides to use federal funds for its portion of this project, the EIS <u>must</u> meet federal requirements. Therefore, it would be prudent to revise this EIS to meet NEPA (National Environmental Protection Act) requirements.

3. Construction plans for work within the State's right-of-way must be submitted for our review and approval.

c: County of Hawaii
Department of Public Works
25 Aupuni Street
Hilo, Hawaii 96720

✓ Okahara & Associates, Inc.
200 Kohola Street
Hilo, Hawaii 96720

Stephen K. Yamashiro
Mayor

Donna Fay K. Kiyosaki
Chief Engineer

Riley W. Smith
Deputy Chief Engineer

County of Hawaii
DEPARTMENT OF PUBLIC WORKS
25 Aupuni Street, Room 202 · Hilo, Hawaii 96720-4252
(808) 961-8321 · Fax (808) 969-7138

April 6, 1993

Mr. Rex D. Johnson, Director
State of Hawaii
Department of Transportation
869 Punchbowl Street
Honolulu, HI 96813-5097

Dear Mr. Johnson:

SUBJECT: Puainako Street Extension and Widening EIS

Thank you for reviewing the Draft Environmental Impact Statement (DEIS) for the Puainako Street Extension and Widening project on the Island of Hawaii. Each reviewers's comments have been carefully examined and appropriate additions and modifications are being incorporated in the Final EIS.

The specific comments you submitted are responded to below:

<u>Comment:</u> A bike lane should be considered for both sides of the street from Kilauea Avenue to Komohana Street. In the upper portion of the street extension, the shoulders would serve as a bike route. The design of the bike lane/bike route should conform to the State's Master Plan for bikeways.

<u>Response:</u> The design specifications for the highway will be revised to include a bike lane on both sides of Puainako Street between Kilauea Avenue and Komohana Street. The design for the Upper Portion currently calls for the use of the shoulders for bike lanes.

<u>Comment:</u> If either the State or the County decides to use federal funds for its portion of this project, the EIS must meet federal requirements. Therefore, it would be prudent to revise this EIS to meet NEPA (National Environmental Protection Act) requirements.

RECEIVED
1993
OKAHARA & ASSOC., INC.
HILO OFFICE

Response: It is recognized that an EIS meeting federal guidelines may be necessary if the project uses federal funds. The County of Hawaii intends to meet all requirements imposed by the NEPA Act as necessary as project development continues.

Comment: Construction plans for work within the State's right-of-way must be submitted for our review and approval.

Response: All construction plans will be submitted to State DOT for review and approval.

Again, thank you for your careful consideration of the document.

Sincerely,

Donna Fay K. Kiyosaki
Chief Engineer

DEPARTMENT OF BUSINESS, ECONOMIC DEVELOPMENT & TOURISM
ENERGY DIVISION, 335 MERCHANT ST., RM. 110, HONOLULU, HAWAII 96813 PHONE: (808) 587-3800 FAX: (808) 587-3820

Director
BARBARA KIM STANTON
Deputy Director
RICK EGGED
Deputy Director
TAKESHI YOSHIHARA
Deputy Director

March 5, 1993

RECEIVED
MAR 11 1993
OKAHARA & ASSOC., INC.
HILO OFFICE

The Honorable John Waihee
Governor, State of Hawaii
c/o Office of Environmental Quality Control
220 South King Street
Fourth Floor
Honolulu, Hawaii 96813

Dear Governor Waihee:

SUBJECT: Puainako Street Extension and Widening
Island of Hawaii

We wish to inform you that we have no comments to offer on the Draft Environmental Impact Statement (DEIS).

Thank you for the opportunity to review the document.

Sincerely,

Maurice H. Kaya
Energy Program Administrator

MHK:yleis61

cc: County of Hawaii, Dept. of Public Works
✓Okahara & Associates

Stephen K. Yamashiro
Mayor

County of Hawaii
DEPARTMENT OF PUBLIC WORKS
25 Aupuni Street, Room 202 • Hilo, Hawaii 96720-4252
(808) 961-8321 • Fax (808) 969-7138

Donna Fay K. Kiyosaki
Chief Engineer

Riley W. Smith
Deputy Chief Engineer

April 6, 1993

Mr. Maurice H. Kaya
Energy Program Administrator
Department of Business, Economic
Development & Tourism
Energy Division
335 Merchant Street, Rm. 110
Honolulu, HI 96813

Dear Mr. Kaya:

SUBJECT: Puainako Street Extension and Widening EIS

Thank you for reviewing the Draft Environmental Impact Statement (DEIS) for the Puainako Street Extension and Widening project on the Island of Hawaii. Each reviewers's comments have been carefully examined and appropriate additions and modifications are being incorporated in the Final EIS.

Sincerely,

Donna Fay K. Kiyosaki
Chief Engineer

RECEIVED
APR 14 1993
OKAHARA & ASSOC., INC.
HILO OFFICE

JOHN WAIHEE
GOVERNOR OF HAWAII

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

JOHN C. LEWIN, M.D.
DIRECTOR OF HEALTH

91000

March 11, 1993

In reply, please refer to: 93-016/epo

RECEIVED
MAR 16 1993
OKAHARA & ASSOC., INC.
HILO OFFICE

To: The Honorable John Waihee
Governor, State of Hawaii

From: John C. Lewin, M.D. for
Director of Health

Subject: Draft Environmental Impact Statement (DEIS)
Puainako Street Extension and Widening
Island of Hawaii

Thank you for allowing us to review and comment on the subject document. We have the following comments to offer:

Nonpoint Source

On page 68, the last line in the last paragraph should read as following:

The management measures will include:

1. Ok as is.
2. Limit the amount of surface area graded at any given time to 15 acres or less to reduce the area subject to potential erosion. Graded areas should be protected with geotextile material or mulched and seeded to permanent cover before additional acreage is graded.
3. Ok as is.
4. Ok as is.
5. Building sedimentation basins to collect sediment from runoff waters before discharge into receiving waters. Utilizing geotextiles such as siltation fencing will minimize the amount of sediments which could leave the site to collect in drainage structures and streams.
6. Where ever possible, base flow should be diverted to stable flow areas while construction work is being conducted in the stream channel.

If you have any questions on this matter, please contact Mr. Jerry Thompson, Environmental Planning Office at 586-4337.

c: Environmental Planning Office
County of Hawaii, Department of Public Works
Okahara & Associates, Inc.

Stephen K. Yamashiro
Mayor

County of Hawaii
DEPARTMENT OF PUBLIC WORKS
25 Aupuni Street, Room 202 • Hilo, Hawaii 96720-4252
(808) 961-8321 • Fax (808) 969-7138

Donna Fay K. Kiyosaki
Chief Engineer
Riley W. Smith
Deputy Chief Engineer

April 6, 1993

John C. Lewin, M.D.
Director of Health
State of Hawaii
Department of Health
P. O. Box 3378
Honolulu, HI 96801

Dear Dr. Lewin:

SUBJECT: Puainako Street Extension and Widening EIS

Thank you for reviewing the Draft Environmental Impact Statement (DEIS) for the Puainako Street Extension and Widening project on the Island of Hawaii. Each reviewers's comments have been carefully examined and appropriate additions and modifications are being incorporated in the Final EIS.

The specific suggestions you offered concerning mitigation measures for non-point source pollution impacts have been incorporated into the Final EIS. Again, thank you very much for your thoughtful review of the document.

Sincerely,

Donna Fay K. Kiyosaki
Chief Engineer

RECEIVED
APR 14 1993
OKAHARA & ASSOC., INC.
HILO OFFICE

NAVAL BASE PEARL HARBOR
BOX 110
PEARL HARBOR, HAWAII 96860-5020

IN REPLY REFER TO
11011
Ser N42/0318
1 FEB 1993

The Honorable John Wahiee
Governor
State of Hawaii
c/o Office of Environmental Quality Control
220 South King St., Fourth Floor
Honolulu, HI 96813

Dear Governor Waihee:

PUAINAKO STREET EXTENSION AND WIDENING

We have reviewed the subject Draft Environmental Impact Statement (DEIS) and have no comments to offer. Since we have no further use for the DEIS, it being returned to your office.

Thank you for the opportunity to review the draft.

Sincerely,

W. K. Liu

W. K. LIU
Facilities Engineer
By direction of
the Commander

Encl:
(1) Draft Environemntal Impact Statement

Copy to: (w/o encl)
County of Hawaii
Department of Public Works
25 Aupuni St.
Hilo, HI 96720

Okahara & Associates, Inc.
200 Kohola St.
Hilo, HI 96820

COPY
ORIGINAL FILED
IN 91003
x C:Y H

Stephen K. Yamashiro
Mayor

Donna Fay K. Kiyosaki
Chief Engineer

Riley W. Smith
Deputy Chief Engineer

County of Hawaii
DEPARTMENT OF PUBLIC WORKS
25 Aupuni Street, Room 202 · Hilo, Hawaii 96720-4252
(808) 961-8321 · Fax (808) 969-7138

April 6, 1993

W. K. Liu
Facilities Engineer
Department of the Navy
Naval Base Pearl Harbor
Box 110
Pearl Harbor, HI 96860-5020

Dear W. K. Liu:

SUBJECT: Puainako Street Extension and Widening EIS

Thank you for reviewing the Draft Environmental Impact Statement (DEIS) for the Puainako Street Extension and Widening project on the Island of Hawaii. Each reviewers's comments have been carefully examined and appropriate additions and modifications are being incorporated in the Final EIS.

Sincerely,

Donna Fay K. Kiyosaki
Chief Engineer

RECEIVED
APR 1 1993
OKAHARA & ASSOC., INC.
HILO OFFICE

United States Department of the Interior

GEOLOGICAL SURVEY
WATER RESOURCES DIVISION
677 Ala Moana Blvd., Suite 415
Honolulu, Hawaii 96813

TAKE PRIDE IN AMERICA

February 19, 1993

RECEIVED
FEB 25 1993
OKAHARA & ASSOC., INC.
HILO OFFICE

Mr. Donald K. Okahara, P.E.
President
Okahara & Associates, Inc.
Engineering Consultants
200 Kohola St.
Hilo, HI 96720

Dear Mr. Okahara:

Subject: Draft Environmental Impact Statement (DEIS), Puainako Street Extension and Widening, Island of Hawaii

The staff of the U.S. Geological Survey, Water Resources Division, Honolulu District, has reviewed the subject DEIS and we have no comments to offer at this time.

Thank you for allowing us to review this DEIS.

We are returning the DEIS to your office for your future use. #37 returned mey

Sincerely,

William Meyer
District Chief

Enclosure

Stephen K. Yamashiro
Mayor

Donna Fay K. Kiyosaki
Chief Engineer

Riley W. Smith
Deputy Chief Engineer

County of Hawaii
DEPARTMENT OF PUBLIC WORKS
25 Aupuni Street, Room 202 · Hilo, Hawaii 96720-4252
(808) 961-8321 · Fax (808) 969-7138

April 6, 1993

Mr. William Meyer
District Chief
United States Department of the Interior
Geological Survey
Water Resources Division
677 Ala Moana Bldg., Suite 415
Honolulu, HI 96813

Dear Mr. Meyer:

SUBJECT: Puainako Street Extension and Widening EIS

Thank you for reviewing the Draft Environmental Impact Statement (DEIS) for the Puainako Street Extension and Widening project on the Island of Hawaii. Each reviewers's comments have been carefully examined and appropriate additions and modifications are being incorporated in the Final EIS.

Sincerely,

Donna Fay K. Kiyosaki
Chief Engineer

RECEIVED
APR 14 1993
OKAHARA & ASSOC., INC.
HILO OFFICE

University of Hawaii at Manoa

Environmental Center
A Unit of Water Resources Research Center
Crawford 317 • 2550 Campus Road • Honolulu, Hawaii 96822
Telephone: (808) 956-7361

RECEIVED
MAR 1 0 1993
OKAHARA & ASSOC., INC.
HILO OFFICE

March 9, 1993
RE:0621

Governor John Waihee
State of Hawaii
c/o Office of Environmental Quality Control
220 South King Street, Suite 400
Honolulu, Hawaii 96813

Dear Governor Waihee:

Draft Environmental Impact Statement
Puainako Street Extension and Widening
Hilo, Hawaii

The proposed project involves the widening and extension of Puainako Street between Kilauea Avenue and Country Club Road in Kaumana, South Hilo, Hawaii. The project is comprised of two major components: 1) a widening and partial realignment to Puainako Street between Kilauea Avenue and Komohana Street, and 2) the creation of a new highway between Komohana Street and Country Club Road. The total length of the roadway improvements is approximately 6.1 miles. Several alternative alignments are reviewed for both the Lower (Alignments A and B) and Upper Portions (Alignments 1 and 2) of the project, as well as alternative design options (Design Option I, II, III, and X). The document recommends that Alignment B be selected for the Lower Portion, Alignment 1 for the Upper Portion, and Design Options III and X, based on consideration of the environmental impacts.

Our review of the Draft Environmental Impact Statement (EIS) was prepared with the assistance of Leonard Freed, Zoology; Charles Lamoureux, Botany/Lyon Arboretum; Jon Matsuoka, School of Social Work; George Taoka, Civil Engineering; and Elizabeth Gordon, Environmental Center.

General Comments

Generally our reviewers have found that the environmental impacts and mitigative measures as outlined by the document are adequately covered for decision making to take place. We have a few comments regarding:

Design Criteria and Standards (Section 1.1.3)

For the Lower Portion of the road, the stopping sight distance should be 325 feet instead of 275 feet (p. 20). Since the Lower Portion of the road

falls within a school zone, the higher value in accordance with highway standards is the safer approach.

Demography and Infrastructure (Section 2.3.1)

The rationale that has been given for the project (i.e., to improve congested traffic conditions, arterial traffic flow, and provide an alternative evacuation route) is created by forecasted population increases (p. 50). What was the formulae used to arrive at the projected population growth rates?

Flora, Fauna, and Ecosystem Impacts (Section 3.3.7)

Paragraph 1 seems to understate the importance of disturbing any reasonably intact cover, whether it be native or alien dominated (p. 70). To say that the flora and vegetation of the area have "little conservation value" places a very narrow definition on conservation, and ignores such things as watershed values and soil conservation properties. Most of the area in question has little remaining native vegetation, however, it would still seem appropriate to take mitigative measures to control alien plant invasion of the construction site, at least to prevent the invasion of alien species not yet present there. Furthermore, given the high rainfall in this area it is prudent to maintain conservative land clearing practices to avoid erosion. This is sound practice, no matter how degraded an area has become in the past.

Social and Economic Impacts (Section 3.5)

In the survey by A.M. Okinada (Appendix H: "Puainako Street Extension Social Impact Assessment") people voiced concerns for safety and further development. More information on the potential ramifications of these issues should be explored in the main body of the document.

Relocation Impacts (Section 3.5.3)

What specifically are the state and/or federal guidelines for right-of-way and relocation activities? (p. 75) How do the prospective displaced residents feel about this?

Appendix H

A copy of the questionnaire distributed to residents, as well as response rates to the questionnaire, should be included in the report so the reader has an idea how the data was interpreted.

Thank you for the opportunity to review the Draft EIS. We hope that our comments will be helpful in the preparation of the final document.

Sincerely,

Jacquelin N. Miller

Jacquelin N. Miller
Associate Environmental Coordinator

cc: Public Works, Hawaii County
Okahara & Associates,
Roger Fujioka
Leonard Freed
Charles Lamoureux
Jon Matsuoka
George Taoka
Elizabeth Gordon

Stephen K. Yamashiro
Mayor

Donna Fay K. Kiyosaki
Chief Engineer

Riley W. Smith
Deputy Chief Engineer

County of Hawaii
DEPARTMENT OF PUBLIC WORKS
25 Aupuni Street, Room 202 • Hilo, Hawaii 96720-4252
(808) 961-8321 • Fax (808) 969-7138

April 6, 1993

Ms. Jacquelin N. Miller
Associate Environmental Coordinator
Environmental Center
A Unit of Water Resources Research Center
University of Hawaii at Manoa
Crawford 317, 2550 Campus Road
Honolulu, HI 96822

Dear Ms. Miller:

SUBJECT: Puainako Street Extension and Widening EIS

Thank you for reviewing the Draft Environmental Impact Statement (DEIS) for the Puainako Street Extension and Widening project on the Island of Hawaii. Each reviewers's comments have been carefully examined and appropriate additions and modifications are being incorporated in the Final EIS.

The specific comments you submitted are responded to below:

Comment: For the Lower Portion of the road, the stopping sight distance should be 325 feet instead of 275 feet (p. 20). Since the Lower Portion of the road falls within a school zone, the higher value in accordance with highway safety is the safer approach.

Response: The design stopping distance in the Lower Portion shall be 325 feet.

Comment: What was the formulae used to arrive at the projected population growth rates?

Response: The population projections cited are from the Hawaii State Department of Business and Economic Development's Revised Long-Range Economic and Population Projections for the State of Hawaii to 2010: M-K Series, Preliminary Report (1988). The methodology utilizes a combination of economic and demographic models (for more information see

RECEIVED
R 14 1993
OKAHARA & ASSOC., INC.
HILO OFFICE

original document). The figures in the forecast are substantially similar to other estimates made by the U.S. Census Bureau, the County of Hawaii and several private entities.

Comment: Paragraph 1 [of Section 3.3.7] seems to understate the importance of disturbing any reasonably intact cover, whether it be native or alien dominated. To say that the flora and vegetation of the area have "little conservation value" places a very narrow definition on conservation, and ignores such things as watershed values and soil conservation properties. Most of the area in question has little remaining native vegetation, however, it would still seem appropriate to take mitigative measures to control alien plant invasion of the construction site, at least to prevent the invasion of alien species not yet present there. Furthermore, given the high rainfall in this area it is prudent to maintain conservative land clearing practices to avoid erosion. This is sound practice, no matter how degraded an area has become in the past.

Response: "Conservation value" as used in Section 3.3.7, "Flora, Fauna and Ecosystem Impacts" is strictly limited to conservation of native Hawaiian ecosystems and species. Impacts and mitigation concerning soil, drainage and water quality are discussed separately in Sections 3.3.3 and 3.3.5.

It is indeed desirable to prevent the spread of alien plant species into semi-intact native communities. As far as is feasible, construction activities will be limited to the actual right-of-way corridor to restrict the footprint of disturbance. Landscaping with native plants appropriate to the lowland rain forest will be explored. The EIS has been revised to include these suggestions.

Comment: In the survey by [A.M. Okinaka] (Appendix H: "Puainako Street Extension Social Impact Assessment") people voiced concerns for safety and further development. More information on the potential ramifications of these issues should be explored in the main body of the document.

Response: Section 3.5.8, "Secondary Population and Growth Impacts," is included in the Final EIS to explicitly identify and discuss this issue.

Comment: What specifically are the state and/or federal guidelines for right-of-way and relocation activities? How do prospective displaced residents feel about this?

Response: The County of Hawaii will follow all applicable state guidelines concerning relocation. The State Housing Finance and Development Corporation has oversight responsibility for ensuring that proper relocation assistance is provided to displaced persons, businesses and non-profits. A relocation plan which includes direct contact and discussion with and assistance to all affected parties will be coordinated with HFDC in accordance with Chapter 111, HRS and Hawaii Administrative Rules, Title 6, Chapter 391.

Comment: A copy of the questionnaire distributed to residents, as well as response rates to the questionnaire, should be included in the report so the reader has an idea how the data was [sic] interpreted.

Response: A copy of the questionnaire and the response rate will be included in the Final EIS.

Again, thank you for your careful consideration of the document.

Sincerely,

Donna Fay K. Kiyosaki
Chief Engineer

APPROI :E PARTIES

8/Mar/1993

POSTED 3/9/93

RECEIVED
MAR 11 1993
OKAHARA & ASSOC., INC.
HILO OFFICE

To: Governor, State of Hawaii
Office of Environmental Quality Control

From: David Paul, Student Naturalist
University of Hawaii at Hilo

This letter is written out of concern for the future of one of U.H. Hilos' valuble cultural and educational resources, namely the archaeological site found on our upper campus which is being threatened by the "Puainako Street Extension and Widening Project". A decision to destroy any of the archaeological structures found in the area would be poor responsibility with historical/prehistorical links to the past. Mitigation to destroy a few and preserve the many also fails to maintain interest in the culture which originally settled the area.

The main reason for not keeping the original alignment of Puainako in building the new road is because of money; it would cost a great deal more to keep the original alignment because of having to buy out the 15 house lots on the State housing project there. The result is that a Hawaiian historical site would be lost because it isn't worth enough money to the State of Hawaii to save it, and the residents in the housing project will have to live with the grief caused by having buzy roadways on two sides of their homes.

The area of the site itself is enough to raise anyones' interest. There are numerous rock platforms, terraces, and walls. The soil there is very rich and fertile, showing that the area had a potential for high productivity under the agricultural uses of the site in prehistoric times. The vegetation of the area is impacted by alien species, but a number of native plants are still vigorous there; such as, neneleau (Rhus sandwicensis), ohia (Metrosideros polymorpha), uluhe (Dicranopteris linearis), ala-ala-wai-nui (Peperomia sp.), and kokio (Hibiscus furcellatus). There are also a number of plants there which were introduced by Polynesians (Hawaiians), such as, awapuhi (Zingiber zerumbet), ti (Cordyline fruticosa), kukui (Aleurites moluccana), and ulu (Artocarpus altilis). These plants are indicators of previous habitation there and should be included in determining the significance of the site.

This site has the potential of becoming a cultural and educational park for the University of Hawaii. Departments such as, Anthropology, Geography, Hawaiian Studies, and others may find the area to be of great resource.

Most prehistoric archaeology has already been destroyed in Hawaii. Please don't let this little glimpse into the past become just another obstruction to the wants of our present macroculture.

Sincerely,

David Paul
David Paul

c: Donna Kiyosaki, County of Hawaii
Department of Public Works
Masahiro Nishida, Okahara and Associates

Stephen K. Yamashiro
Mayor

Donna Fay K. Kiyosaki
Chief Engineer

Riley W. Smith
Deputy Chief Engineer

County of Hawaii
DEPARTMENT OF PUBLIC WORKS
25 Aupuni Street, Room 202 • Hilo, Hawaii 96720-4252
(808) 961-8321 • Fax (808) 969-7138

April 6, 1993

Mr. David Paul
Student
c/o College of Agriculture
University of Hawai'i-Hilo
Hilo, HI 96720

Dear Mr. Paul:

Thank you for your letter to the Governor supporting preservation of archaeological sites in the alternative routes for the Pu'ainako Road Extension Project. Our studies have only begun, and we are working toward the best solution for historic preservation. We understand and appreciate your concerns.

Please be aware that this interim report (of the draft EIS) is <u>not</u> the final word. This reconnaissance level survey has only served to alert everyone of the significant sites present. There will be further evaluation of the sites using State Historic Preservation Office (SHPO) guidelines before any final decisions are made about the alignments chosen, appropriate mitigation, or preservation.

Again, thank you for your concerns regarding the preservation of archaelogical sites.

Sincerely,

Donna Fay K. Kiyosaki
Chief Engineer

MAJOR GENERAL EDWARD V. RICHARDSON
DIRECTOR OF CIVIL DEFENSE

ROY C. PRICE, SR.
VICE DIRECTOR OF CIVIL DEFENSE

STATE OF HAWAII
DEPARTMENT OF DEFENSE
OFFICE OF THE DIRECTOR OF CIVIL DEFENSE
3949 DIAMOND HEAD ROAD
HONOLULU, HAWAII 96816-4495

PHONE (808) 734-2161

XCU
m
Y

'93 MAR -9 P1:55
QUALITY

March 5, 1993

RECEIVED
MAR 11 1993
OKAHARA & ASSOC., INC.
HILO OFFICE

TO: The Honorable John Waihee
Governor of Hawaii
State of Hawaii
c/o Office of Environmental Quality Control
220 South King Street, Fourth Floor
Honolulu, Hawaii 96813

FROM: Roy C. Price, Sr.
Vice Director of Civil Defense

SUBJECT: DRAFT ENVIRONMENTAL IMPACT STATEMENT; PUAINAKO STREET EXTENSION AND WIDENING

We appreciate this opportunity to comment on the County of Hawaii, Department of Public Works, Puainako Street Extension and Widening Project, Hilo, Hawaii, Hawaii.

While we do not have negative comments specifically directed at this draft environmental impact statement, we do wish to offer a proposal that the State and County should consider in this application. This proposal entails that the transportation engineers design and construct this roadway for use as a possible emergency evacuation route. Just as parks, schools, fire hydrants, underground/overhead utilities and sidewalks are planned as integral parts of subdivisions and industrial areas, so must mitigation measures, early warning and emergency warning systems and evacuation routes be planned for the safety of communities.

Our State Civil Defense planners and technicians are available to discuss this further if there is a requirement. Please have your staff call Mr. Mel Nishihara of my staff at 734-2161.

c: Donna Kiyosaki, County of Hawaii Dept. of Public Works
Masahiro Nishida, Okahara and Associates, Inc.

Stephen K. Yamashiro
Mayor

Donna Fay K. Kiyosaki
Chief Engineer

Riley W. Smith
Deputy Chief Engineer

County of Hawaii
DEPARTMENT OF PUBLIC WORKS
25 Aupuni Street, Room 202 · Hilo, Hawaii 96720-4252
(808) 961-8321 · Fax (808) 969-7138

April 6, 1993

Mr. Roy C. Price, Sr.
Vice Director of Civil Defense
State of Hawaii
Department of Defense
Office of the Director of Civil Defense
3949 Diamond Head Road
Honolulu, HI 96816-4495

Dear Mr. Price:

SUBJECT: Puainako Street Extension and Widening EIS

Thank you for reviewing the Draft Environmental Impact Statement (DEIS) for the Puainako Street Extension and Widening project on the Island of Hawaii. Each reviewers's comments have been carefully examined and appropriate additions and modifications are being incorporated in the Final EIS.

Your comments on evacuation route planning are well-taken, and they have been forwarded to state and county agencies for their information and consideration. Again, thank you for your careful consideration of the document.

Sincerely,

Donna Fay K. Kiyosaki
Chief Engineer

RECEIVED
APR 1 1993
OKAHARA & ASSOC., INC.
HILO OFFICE

JOHN WAIHEE
GOVERNOR

STATE OF HAWAII
DEPARTMENT OF ACCOUNTING AND GENERAL SERVICES
P. O. BOX 119, HONOLULU, HAWAII 96810

ROBERT P. TAKUSHI
COMPTROLLER

LLOYD T. UNEBASAMI
DEPUTY COMPTROLLER

LETTER NO. (P)1108.3

'93 MAR -2

FEB 26 1993

RECEIVED
MAR 04 1993
OKAHARA & ASSOC., INC.
HILO OFFICE

The Honorable John Waihee
Governor, State of Hawaii
c/o Office of Environmental
Quality Control
220 South King Street, 4th Floor
Honolulu, Hawaii

Dear Governor Waihee:

Subject: Puainako Street Extension and Widening
Island of Hawaii
Draft EIS

Thank you for the opportunity to review the subject document. We have no comments to offer.

If there are any questions, please have your staff contact Mr. Ralph Yukumoto of the Public Works Division at 586-0488.

Respectfully,

ROBERT P. TAKUSHI
State Comptroller

c: Donna Kiyosaki, County of Hawaii Dept. of Public Works
Masahiro Nishida, Okahara and Associates, Inc.

Stephen K. Yamashiro
Mayor

Donna Fay K. Kiyosaki
Chief Engineer

Riley W. Smith
Deputy Chief Engineer

County of Hawaii
DEPARTMENT OF PUBLIC WORKS
25 Aupuni Street, Room 202 · Hilo, Hawaii 96720-4252
(808) 961-8321 · Fax (808) 969-7138

April 6, 1993

Mr. Robert P. Takushi
State Comptroller
Department of Accounting and General Services
State of Hawaii
P. O. Box 119
Honolulu, HI 96810

Dear Mr. Takushi:

SUBJECT: Puainako Street Extension and Widening EIS

Thank you for reviewing the Draft Environmental Impact Statement (DEIS) for the Puainako Street Extension and Widening project on the Island of Hawaii. Each reviewers's comments have been carefully examined and appropriate additions and modifications are being incorporated in the Final EIS.

Sincerely,

Donna Fay K. Kiyosaki
Chief Engineer

RECEIVED
1993
OKAHARA & ASSOC., INC.
HILO OFFICE

Dear Concerned Parties,

At the University of Hawai'i at Hilo, hidden within a jungle of exotic and native species, a large archaeological site was rediscovered in the Spring of 1990. These remains are from both the prehistoric and historic periods, and are considered significant because so little archaeology exists or has been documented in Hilo. This site is connected to the Waiakea stream. In old Hawai'i the Waiakea ahupua'a, known for its fresh water, was the most densely populated in the Hilo-Puna area and was used for cultivation and homesteading by the Hawaiians. Later the site was influenced by the plantation days and ranching.

The discovery of a large Hawaiian cultural and historical site on the U.H.H. campus presents a tremendous opportunity for the University, and the site certainly should become part of its Long Range Development Plan because it is the mission of U.H.H. *"to demonstrate a special concern for and understanding of the people and cultures of the Pacific"* (1991-1992 U.H.H. General Catalog, p.23). What a better place to start than in our own backyard.

This historical site offers many values that include:
<u>Aesthetic value</u>: The preservation of tangible remains of the past contributes to the character and individuality of Hawai'i and U.H.H. by forming visually interesting and diverse environments.
<u>Community value</u>: The community will be enriched by having this unique learning center in its midst that will draw people together enhancing the exchange between people of Hawai'i and the University.
<u>Economic value</u>: This site will attract visitors and students and could lead to increased enrollment. Also, by using the existing environment, construction costs in this area will be kept to a minimum. Finally, the site can generate funds in the form of grants for research and other projects. As an example of this, Alu Like funded over $18,000 to employ 12 Hawaiian youths who during the summer of 1992 opened up a safe trail for viewing some the sites, as well as carefully uncovering many archaeological structures.
<u>Educational value</u>: This site provides an excellent location for instruction, learning, and counselling for all ages. It can be utilized for agriculture, anthropology, biology, geography, geology, Hawaiian studies and language, as well as music, arts, crafts, and religion.
<u>Research value</u>: Hawai'i's tropical island geography, its polynesian heritage, and the merging of Eastern and Western cultures make Hawai'i unique among the fifty states; therefore, this site forms a significant database for future research.
<u>Spiritual value</u>: Many people who have been to this site realize that it is a place of power that moves one's spirit closer to the earth.

Currently, parts of this site are under threat of development by the proposed Puainako Street Extension and Widening. Both Alignments A and B in the lower portion of the proposed road go through the U.H.H. archaeological site. In the archaeological survey conducted for the Draft EIS for this project, 48 individual archaeological sites were located in the path of these alignments; further study is required to determine the function and age of these structures (Appendix E, p.9). While some information is given about each site, it tends to be vague, and at best is an educated guess. The report then goes on to suggest Alignment B because it goes through a fewer number of sites, and in Alignment A a number of these sites are considered important enough to preserve. While I agree with the latter portion of this recommendation, I question this selection of Alignment B because not enough information is known about each individual site, including religious significance and potential burials (p.11), and there remains no clear understanding of the meaning of the site in its entirety. As a specific example, site number 45, found in Alignment B and described as "walls," appears to me to be a semi-circle or ampitheatre on a hill with a platform at its base; there also is a very old breadfruit tree growing out of the rocks there. If we do not know what this is, how can we give the okay to bulldoze it? It is a wiser planning choice to uncover and understand the archaeology before any decision is reached on its fate, than it is to do this as a mitigation and then allow bulldozing as it is suggested in the Draft EIS (p.12). For these reasons, I feel the archaeological survey for this Draft EIS is inadequate and further study needs to be done before a proper decision can be made. I am also concerned because this report, which is only a preliminary study, is written like it could be used in a Final EIS; whereas, not enough study really has been done even for a Draft EIS.

U.H.H. has an important obligation to the preservation of this site which it needs to be reminded of due to its apathy in this matter. As part of its mission, *"The U.H.H. will serve as an important knowledge and skills resource center for the state of Hawai'i and the Pacific region. It is understood here that the University has an obligation to assume a leadership role in matters where it possesses expertise and resources necessary to assume such a role"* (1992-1993 U.H.H. General Catalog, p.16).

Finally, as D.L.N.R. so eloquently stated in its <u>State Historic Preservation Plan and Technical Document</u>, *"Frequently, but erroneously labeled anti-development and obstructionist, historic preservation merely questions whether the destruction of significant remnants of Hawai'i's heritage must accompany the islands movement into the future, and attempts to devise ways in which remains of the past might be integrated into living fabric of Hawai'i's culture."*

So let's work together to preserve the archaeological site at U.H.H. now, so that future generations will have the opportunity to explore the mysteries of the past that currently sit quietly within a jungle.

Sincerely,

Joseph Valente

Joseph Valente
U.H.H. Graduate
P.O. Box 1944
Hilo, HI 96721

Stephen K. Yamashiro
Mayor

Donna Fay K. Kiyosaki
Chief Engineer

Riley W. Smith
Deputy Chief Engineer

County of Hawaii
DEPARTMENT OF PUBLIC WORKS
25 Aupuni Street, Room 202 · Hilo, Hawaii 96720-4252
(808) 961-8321 · Fax (808) 969-7138

April 6, 1993

Mr. Joseph Valente
P. O. Box 1944
Hilo, HI 96721

Dear Mr. Valente:

Thank you for your letter supporting preservation of archaeological sites in the alternative routes for the Pu'ainako Road Extension Project. Our studies have only begun, and we are working toward the best solution for historic preservation. We understand and appreciate your concerns.

Please be aware that this interim report (of the draft EIS) is <u>not</u> the final word. This reconnaissance level survey has only served to alert everyone of the significant sites present. There will be further evaluation of the sites using State Historic Preservation Office (SHPO) guidelines before any final decisions are made about the alignments chosen, appropriate mitigation, or preservation.

Again, thank you for your concerns regarding the preservation of archaelogical sites.

Sincerely,

Donna Fay K. Kiyosaki
Chief Engineer

1993

University of Hawaii at Hilo
COLLEGE OF ARTS AND SCIENCES
HUMANITIES DIVISION

March 9, 1992

Governor John Waihee
State of Hawai'i
c/o Office of Environmental Quality Control
220 South King Street
Fourth Floor
Honolulu, Hawai'i 96813

Dear Governor Waihee:

Plans are presently being made to extend and widen Pū'ainakō Street here in Hilo. Among the areas that are being considered for this activity is University of Hawai'i at Hilo property containing Hawaiian archaeological sites.

The archaeological sites that lie in the path of this work have educational value to our Hawaiian Studies Program, to the University of Hawai'i at Hilo as a whole and to the community of Hilo. It is important that every effort be made to study these sites to determine their value before any decisions are made regarding the path of the planned work.

I urge you to do everything possible to assure that these sites will remain available for the benefit of our program and community.

Me ka mahalo,

Dr. William H. Wilson
Chair
Hawaiian Studies Department

cc: Department of Public Works of the County of Hawai'i, Okahara & Associates, Inc., Chancellor Kormondy

523 W. LANIKAULA STREET HILO, HAWAII 96720-4091
TEL: (808) 933-3479 ● FAX: (808) 933-3736
An Equal Opportunity/Affirmative Action Institution

Stephen K. Yamashiro
Mayor

Donna Fay K. Kiyosaki
Chief Engineer

Riley W. Smith
Deputy Chief Engineer

County of Hawaii
DEPARTMENT OF PUBLIC WORKS
25 Aupuni Street, Room 202 • Hilo, Hawaii 96720-4252
(808) 961-8321 • Fax (808) 969-7138

April 6, 1993

Dr. William H. Wilson, Chair
Hawaiian Studies Department
University of Hawai'i at Hilo
Hilo, HI 96720

Dear Dr. Wilson:

Thank you for your letter to the Governor supporting preservation of archaeological sites in the alternative routes for the Pu'ainako Road Extension Project. Our studies have only begun, and we are working toward the best solution for historic preservation. We understand and appreciate your concerns.

Please be aware that this interim report (of the draft EIS) is not the final word. This reconnaissance level survey has only served to alert everyone of the significant sites present. There will be further evaluation of the sites using State Historic Preservation Office (SHPO) guidelines before any final decisions are made about the alignments chosen, appropriate mitigation, or preservation.

Again, thank you for your concerns regarding the preservation of archaeological sites.

Sincerely,

Donna Fay K. Kiyosaki
Chief Engineer

JOHN WAIHEE
GOVERNOR OF HAWAII

RECEIVED
MAR 1 8 1993
OKAHARA & ASSOC., INC.
HILO OFFICE

STATE OF HAWAII

DEPARTMENT OF LAND AND NATURAL RESOURCES

STATE HISTORIC PRESERVATION DIVISION
33 SOUTH KING STREET, 6TH FLOOR
HONOLULU, HAWAII 96813

BOARD OF LAND AND NATURAL RESOURCES

DEPUTIES
JOHN P. KEPPELER, II
DONA L. HANAIKE

AQUACULTURE DEVELOPMENT PROGRAM
AQUATIC RESOURCES
CONSERVATION AND ENVIRONMENTAL AFFAIRS
CONSERVATION AND RESOURCES ENFORCEMENT
CONVEYANCES
FORESTRY AND WILDLIFE
HISTORIC PRESERVATION DIVISION
LAND MANAGEMENT
STATE PARKS
WATER AND LAND DEVELOPMENT

COPY

March 11, 1993

LOG NO: 7715
DOC NO: 9303ks02

MEMORANDUM

TO: Brian Choy, Director
Office of Environmental Quality Control

FROM: Don Hibbard, Administrator
State Historic Preservation Division

SUBJECT: **Chapter 6E (HRS) Compliance--Draft Environmental Impact Statement (EIS), Puainako Street Extension and Widening, Island of Hawaii Waiakea, Kukuau 1 & 2, and Ponohawai, South Hilo**

HISTORIC PRESERVATION PROGRAM CONCERNS:

Because this is a direct state/county undertaking, compliance with the State's historic preservation law (Chapter 6E, H.R.S.) is required prior to construction. The subject Draft EIS was submitted to our office (received March 5, 1993) by the engineering consulting firm of Okahara & Associates for review for Chapter 6E compliance.

The document in the Draft EIS detailing the results of the archaeological inventory survey of the road corridor is labelled an interim report (Appendix E: "Interim Report: Archaeological Inventory Survey, Puainaka Street Extension Project" by Terry L. Hunt). It does not provide adequate data for our office to determine if the survey was sufficient to locate all the historic sites in the project area. It seems that there are areas with dense vegetation that may still contain historic sites. Furthermore, the document lacks sufficient detail in site descriptions (such as basic dimensions, construction style, etc.) and site function to be acceptable as an inventory. Until these points are resolved, we are not yet able to evaluate the proposed significance evaluations of the historic sites identified in the project area. The first step in Chapter 6E compliance is to determine if significant historic sites are present, then mitigation measures are considered. The first step has yet to be finalized.

Our office has received within the last two weeks at least five telephone calls from concerned citizens in Hilo attesting to the presence of heiau (religious structures) and burial sites within the

road corridor. The report is too brief to determine if these concerns have been met.

Thus, a final archaeological inventory survey report, and not an interim report, must be submitted to our office for review. Usually, this is what your agency also requires. Once the inventory survey reports is acceptable and the number of significant historic sites that are present can be determined, then mitigation measures must be worked out with the approval of our division as part of compliance with Chapter 6E. Mitigation measures must be finalized before construction begins.

If you should have any further questions, please contact Kanalei Shun at 587-0007.

c: Department of Public Works, County of Hawaii
Donald K. Okahara, Okahara & Associates, Inc.

Stephen K. Yamashiro
Mayor

Chief Engineer

Riley W. Smith
Deputy Chief Engineer

County of Hawaii
DEPARTMENT OF PUBLIC WORKS
25 Aupuni Street, Room 202 · Hilo, Hawaii 96720-4252
(808) 961-8321 · Fax (808) 969-7138

August 10, 1993

Mr. Don Hibbard, Administrator
State Historic Preservation Division
Department of Land & Natural Resources
33 South King Street, 6th Floor
Honolulu, HI 96813

Dear Mr. Hibbard:

In compliance with your recommendation to conduct a more in-depth archaeological survey on the proposed Puainako Street Extension and Widening project in Hilo, Island of Hawaii, an archaeological consultant team has conducted the second phase of more intensive inventory-level archaeological field recording, test excavations, historical research, and interviews during May-July, 1993.

It is my understanding that the work has been completed and a report of the findings and recommendations has been transmitted to your office under separate cover.

Sincerely,

Donna Fay K. Kiyosaki, P.E.
Chief Engineer

YH:BLM:mq

cc: Brian Choy, Office of Environmental Quality Control

bcc: R. Yanabu
Wm. Moore

Michael D. Larish
Chair, Ho'oikaika Research Committee
34 Mala'ai Road
Hilo, HI. 96720
Telephone: 959-9789

July 23, 1993

Mr. Jeyan Thirugnanam
Office of Environmental Quality Control (OEQC)
220 South King Street, 4th Floor
Honolulu, Hi. 96813

I am writing this letter in reference to our two telephone conversations on July 21, 1993. In our first conversation you requested that I draft a letter outlining Ho'oikaika's concerns regarding the draft Environmental Impact Statement (henceforth draft EIS) for the Pu'ainako Realignment, Extension, and Widening Project. After consulting with several archaeologists and reading parts of the OEQC "Guidebook for the Hawaii State Environmental Review Process," I drafted the following comments, some of which I read to you over the telephone:

> The draft EIS for the Pu'ainako Realignment, Extension, Widening Project contained an incomplete "interim" report that did not adequately identify the archaeological resources that will be destroyed by this roadway. For example, no drawings of the numerous stone-stacked structures were included. The report contained only three references. How can any government agency, the public, the university, or anyone comment on such an inadequate report? Ho'oikaika and the other concerned citizens of Hawai'i need to develop an informed opinion on this matter. We question whether this draft EIS conforms to the laws: Don't the environmental council regulations state that the draft EIS should contain a complete archaeological report, which identify the archaeological resources? Can't this report be challenged in court? Shouldn't the next EIS be labelled a draft report instead of a final one?

To support these questions, I cite the EIS Rules in Title 11, Chapter 200 contained in Appendix C of the above mentioned OEQC "Guidebook for the Hawaii State Environmental Review Process" (dated Aug. 1992):

> 11-200-17 (e) The draft EIS shall contain...the following information.... (6) Summary technical data; diagrams; and other information necessary to permit an evaluation of potential environmental impact by commenting agencies and the public;

In addition, Ross Cordy of the State Historic Preservation Office said that his office "rejected" Dr. Terry Hunt's Interim Archaeological Report (personal communication, July 20).

In our second telephone conversation on July 21, 1993, you said that you would draft a letter to the County of Hawai'i, Department of Public Works recommending that their next EIS draft be submitted as an addendum to the draft EIS, which will give the public an additional 45-day review period. As a concerned citizen of the State of Hawai'i, I appreciate your efforts to provide this additional time for review of this project.

We, of Ho'oikaika, would like to address some of our concerns. In a letter that was widely distributed by our Hawaiian-awareness club entitled "Prehistoric Agricultural Village Threatened by Road" on May 5, 1993), we presented arguments for historic preservation of the archaeological complex at UH-Hilo and the establishment of an outdoor "hands-on" educational resource on this site. A copy of this letter was given to Professor Y. K. Hahn, the EIS Coordinator at that time, and another copy is included in the packet of materials enclosed with this letter. This letter is quoted extensively below:

> A significant Hawaiian archaeological site is being threatened by the Pu'ainako Street Extension-and-Widening Project. This prehistoric agricultural village is located in an extensive area mauka (west) of the U. H. Hilo sports facilities and student housing on Kawili Street; the village extends both mauka (west) and makai (east) of Komohana Street. A preliminary reconnaisance-level survey has inventoried 48 prehistoric and historic archaeological sites on this land, although the survey covered only two 40-60 meter slices of the area. The principal archaeologist for this survey, Dr. Terry L. Hunt, states that these remains "gain significance from the fact that so little archaeology has been previously documented in Hilo" (Draft Environmental Impact Statement, E10). Dr. Hunt's interim report provides the initial data to support Ho'oikaika's interpretation that this area contains the remains of a Hawaiian prehistoric agricultural village. Three possible religious sites, 15 habitation sites, 24 agricultural sites, and five sites marked for both habitation and agriculture are listed in Table Two of the draft E. I. S. -- "some of the only examples known for the Hilo area (E10)." But, ONLY SEVEN of these sites HAVE BEEN DESIGNATED FOR PRESERVATION. In fact, six additional <u>prehistoric</u> sites (E16), particularly stacked-stone platforms, were marked for possible cultural significance, AND were designated as excellent examples of site types, BUT were NOT MARKED FOR PRESERVATION.

Ho'oikaika contends that the issues raised in this letter are relevant today. Ho'oikaika is concerned with Dr. Hunt's reinterpretation of his preliminary report (refer to the front-page article by Jason Armstrong in the West-Hawaii Today (A1) entitled "Opinions Differ on Ancient Site" and another front-page article by Radley Kanda in the Hawaii Tribune-Herald entitled "Sites Not Ancient, Study Says: UHH Group Wants Sites in Road's Way Preserved for Future dated July 12, 1993). We hold to our position that some of the structures in the archaeological complex at UH-Hilo may be pre-plantation (prehistoric?) Hawaiian structures; we want to make it clear that we are not criticizing Terry Hunt personally, but are attacking the environmental review process; we are attempting to set precedence for changing the historic preservation laws (Chapter 6E, HRS) and the EIS laws (Chapters 341, 343, and 344, HRS; Act 241, SLH; Title 11, Chapter 200;). We are lobbying to make these laws less favorable to "rapid" and "urgent" development; we strongly feel that a provision for independent assessment prior to an EIS being challenged in court is needed. Independent assessment is an established practice in the medical profession today. We are seeking the Office of Environmental Quality Control's permission to allow excavation by a qualified independent archaeologist. Further, we firmly believe that the practice of engineering firms directly hiring archaeological consultants to conduct EIS studies is not in the best interests of historic preservation. This practice is too pro-development.

While plantations have only been in existence about 100 years, the Hawaiian islands have probably been inhabited for 2,000 years (Protecting Our Past: The Historic Preservation Development Review Process pamphlet published by the State Historic Preservation Division). Consequently, there is a twenty-to-one chance that the archaeological complex will yield significant information about pre-plantation Hawaiian life. Further, we disagree with the assumption that a cane field is valueless to archaeology. There was a maximum depth that a plow could turn the soil--probably twelve inches in the early plantation days (Professor William Bonk, personal communication); therefore, there may be significant Hawaiian remains where the soil is deeper than twelve inches. Even if the complex is definitively determined to be exclusively from the plantation days, it would still be very worthy of historic preservation as-is because there are excellent examples of site types, and these sites will have cultural significance to the ethnic groups that built them (i.e., the railroad). In a sense, both Ho'oikaika's interpretation and Terry Hunt's recent reinterpretation may be correct. There is probably a mixture of prehistoric and historic structures. It is much easier, however, to establish plantation use through archival work than to establish precontact habitation/use, which by definition had no written records. The only way to establish precontact habitation/use is through extensive excavation of sub-surface features prior to data recovery mitigation. Thus, we stress the need for further archaeological investigation, especially excavation of the habitation sites listed in Table 2 of Dr. Hunt's Interim Report contained in the draft EIS (see sites 3, 5, 6, 7, 8, 9, 17, 20, 21, 22, 23, 24, 25, 26, 27, 28, 30, 32, 35, 37, 38, 39, and 45). Dr. Hunt's study area is designated F.12.4 on the Waiakea Mill map (1922/1933/1943). This map gives no indication of plantation habitation in this area (or adjacent areas), so these sites are likely to be very early plantation sites (prior to 1922) or pre-plantation Hawaiian ones. This apparent discrepancy needs to be investigated in detail, preferably by an independent archaeologist.

We estimate that there are at least 150 stone-stacked structures on the UH-Hilo campus and on state lands adjacent to the university. Unless further excavation has been done, Dr. Hunt has partially excavated only five structures within a very limited area of the proposed Pu'ainako roadway. More sampling is needed due to the large number and varied types of sites. No sampling has been done in the upper Kaumana area (sites 1, 2, 46, 47), and no survey work was done in the area makai of Kawili Street.

The Ho'oikaika Research Committee is preparing the following documents, which will be sent to your office upon their completion.

1) AN ANNOTATED RECENT HISTORY OF THE ARCHAEOLOGICAL COMPLEX AT THE UNIVERSITY OF HAWAI'I AT HILO: A BLUEPRINT FOR PRESERVATION *IN SITU* AND THE ESTABLISHMENT OF THE NEED FOR AN OUTDOOR "HANDS-ON" EDUCATIONAL RESOURCE;

2) A FULL LIST OF REASONS FOR FURTHER ECOLOGICAL AND ARCHAEOLOGICAL STUDY;

3) A FULL LIST OF REASONS WHY FURTHER ALTERNATIVES TO THE PU'AINAKO EXTENSION (ALSO KNOW AS SADDLE ROAD EXTENSION) SHOULD BE CONSIDERED.

Thank you very much for your concern in these matters.

Sincerely,

Michael D. Larish

Michael D. Larish
Chair, Ho'oikaika Research Committee

Stephen K. Yamashiro
Mayor

Donna Fay K. Kiyosaki
Chief Engineer

Riley W. Smith
Deputy Chief Engineer

County of Hawaii
DEPARTMENT OF PUBLIC WORKS
25 Aupuni Street, Room 202 · Hilo, Hawaii 96720-4252
(808) 961-8321 · Fax (808) 969-7138

August 10, 1993

Mr. Michael D. Larish, Chair
Ho'oikaika Research Committee
34 Mala'ai Road
Hilo, Hawaii 96720

Dear Mr. Larish:

SUBJECT: Puainako Street Extension and Widening EIS

We have recently received a copy of your letter of July 23, 1993 addressed to Mr. Jeyan Thirugnanam of the Office of Environmental Quality Control. The following is our response to the concerns and issues raised in this letter.

In your letter, you comment that the initial archaeological assessment did not adequately identify the archaeological resources that will be affected by this roadway.

The initial survey conducted by Dr. Terry Hunt was only a reconnaissance-level survey to ascertain the absence or presence of archaeological resources within the project area. This level of survey does not normally include detailed mapping of features nor any excavation and only provides an overview literature search of previous archaeological findings in the area.

After the initial reconnaissance-level survey, Dr. Hunt preliminarily concluded that some of the features might be worthy of preservation. However, he also concluded that mitigation measures were available with respect to archaeology, allowing this project to proceed provided the alternative alignment with the fewest and least significant archaeological remains was selected. More specifically, it was his preliminary conclusion that if Alignment B were selected and proper mitigation measures employed, the roadway could be constructed with no significant loss of archeological resources.

Based on the preliminary findings of the reconnaissance phase of the archaeology, a second phase of more intensive inventory-level archaeological field recording and test excavations, historical research and interviews were conducted from May to July of 1993.

The inventory-level survey was focused on the areas where archaeological features had been identified during the initial survey phase. Ho'oikaika was kept aware of the field survey and mapping activities and members of your group were invited to accompany Dr. Hunt in his investigations.

The Inventory-Level Survey Report was recently completed and submitted to the State Historic Preservation Division (SHPD) of the Department of Land and Natural Resources for their review and approval. A copy of this report is attached for your information.

Based on the varied and more intensive research of the inventory-level work, Dr. Hunt reports that a total of eleven archaeological sites comprised of 88 individual structural features, were identified in the field survey of the project area. These archeological remains are plantation era in age (ranging from ca. 1880 to 1950) and primarily reflect activities associated with the commercial cultivation of sugarcane from the late nineteenth and early twentieth century by the Waiakea Mill Company. These include field clearing mounds, railroad bed remnants, platforms, and other stone structures that served planting, loading and hauling harvested cane.

Dr. Hunt concluded that the archaeological sites are significant in terms of their potential to yield information on the late historic period in Hilo and possibly for their interpretive value.

While the potential exists to find evidence of prehistoric use of the area, it would be independent of the stone surface features. Dr. Hunt explains that such subtle evidence would be sparsely distributed and difficult to detect. The significance of such evidence, should it exist, would be restricted to its potential information content and other historic preservation criteria would not apply. Data recovery is an appropriate mitigation step for archaeological resources that come under this criterion.

In terms of potential impacts and mitigation measures, Dr. Hunt concluded that the development of the Pu'ainako Street extension within the area between Kawili Street and Komohana Street will destroy historic archaeologic sites related to cane planting and harvesting activities. The impact on these resources can be minimized by selecting the road alternative with the fewest archaeological remains.

Mitigation measures for the route selected for development should include additional data recovery from a representative sample of features in the sites that will be affected by the road construction. Data recovery should include additional excavation and continued oral history interviews to learn more details of site construction, content and function. Monitoring by an experienced archaeologist during all vegetation clearing and earthwork activities is also recommended.

The final determination with respect to the acceptability of the archaeological survey report, it's findings, significance designations and proposed mitigation measures lies with the SHPD. The professional archaeologists of the SHPD provide an independent evaluation of the archaeological work done in Hawaii.

We appreciate your concerns and attention to this matter. Please feel free to call my Deputy, Riley Smith if you have any questions on this matter.

Sincerely,

Donna Fay K. Kiyosaki
Chief Engineer

GOVERNOR

ESTHER UEDA
EXECUTIVE OFFICER

STATE OF HAWAII
DEPARTMENT OF BUSINESS, ECONOMIC DEVELOPMENT & TOURISM
LAND USE COMMISSION
Room 104, Old Federal Building
335 Merchant Street
Honolulu, Hawaii 96813
Telephone: 587-3822

February 2, 1993

SUBJECT: Draft Environmental Impact Statement (DEIS) for the Puainako Street Extension and Widening, Island of Hawaii

We have reviewed the subject DEIS and offer the following comments:

1) Based on the maps provided, it appears that Alignments A and B for the lower portion and alignments 1 and 2 for the upper portion of the proposed Puainako Street extension and widening are located within the State Land Use Urban and Agricultural Districts.

2) We suggest that the Final EIS include a map showing all four alignments in relation to the State Land Use Districts.

RECEIVED FROM 8085862452 9. 8.1993 8:28 P. 4

Stephen K. Yamashiro
Mayor

Donna Fay K. Kiyosaki
Chief Engineer

Riley W. Smith
Deputy Chief Engineer

County of Hawaii
DEPARTMENT OF PUBLIC WORKS
25 Aupuni Street, Room 202 · Hilo, Hawaii 96720-4252
(808) 961-8321 · Fax (808) 969-7138

September 15, 1993

State of Hawaii
Department of Business, Economic Development & Tourism
Land Use Commission
Room 104, Old Federal Building
335 Merchant Street
Honolulu, Hawaii 96813

Subject: Puainako Street Extension and Widening EIS

Gentlemen:

Thank you for reviewing the Draft Environmental Impact Statement (DEIS) for the Puainako Street Extension and Widening project on the Island of Hawaii. Each reviewer's comments have been carefully examined and appropriate additions and modifications are being incorporated in the Final EIS.

The specific comments you submitted are responded to below:

Comment: We suggest that the Final EIS include a map showing all four alignments in relation to the State Land Use Districts.

Response: The final EIS has been amended to include this map.

Again, thank you for your careful consideration of the document.

Sincerely,

for Donna Fay K. Kiyosaki
Chief Engineer

DEPARTMENT OF BUSINESS,
ECONOMIC DEVELOPMENT & TOURISM

BARBARA KIM STAN, Deputy Dir.
RICK EG, Deputy Dir.
TAKESHI YOSHIH, Deputy Dir.

Central Pacific Plaza, 220 South King Street, 11th Floor, Honolulu, Hawaii
Mailing Address: P.O. Box 2359, Honolulu, Hawaii 96804 Telephone: (808) 586-2406 Fax: (808) 586-2377

'93 FEB 17 A7:26
OFC. OF E... QUALITY ...

February 12, 1993

Mr. Brian J. J. Choy
Director
Office of Environmental Quality Control
220 South King Street, 4th Floor
Honolulu, Hawaii 96813

Dear Mr. Choy:

The Department of Business, Economic Development & Tourism is pleased to submit the enclosed comments on the Draft Environmental Impact Statement (DEIS) for the Puainako Street Extension and Widening.

The comments were provided by the Land Use Commission. Questions regarding these comments may be directed to Esther Ueda, LUC Executive Officer, at 587-3826.

Thank you for the opportunity to comment.

Sincerely,

Mufi Hannemann

Enclosure

RECEIVED FROM 8085862452 9. 8.1993 8:27 P. 3

Stephen K. Yamashiro
Mayor

Chief Engineer
Riley W. Smith
Deputy Chief Engineer

County of Hawaii
DEPARTMENT OF PUBLIC WORKS
25 Aupuni Street, Room 202 • Hilo, Hawaii 96720-4252
(808) 961-8321 • Fax (808) 969-7138

September 15, 1993

Mr. Mufi Hanneman
Department of Business, Economic Development & Tourism
PO Box 2359
Honolulu, Hawaii 96804

Subject: Puainako Street Extension and Widening EIS

Dear Mr. Hanneman:

Thank you for reviewing the Draft Environmental Impact Statement (DEIS) for the Puainako Street Extension and Widening project on the Island of Hawaii. Each reviewer's comments have been carefully examined and appropriate additions and modifications are being incorporated in the Final EIS.

Thank you for passing on the comments of the Land Use Commission regarding our recent Draft EIS for the Puainako Street Extension and Widening project.

We are providing you with a copy of our response to their comments.

Sincerely,

fw Donna Fay K. Kiyosaki
Chief Engineer

Enclosure

OFFICE OF STATE PLANNING

Office of the Governor
MAILING ADDRESS: P.O. BOX 3540, HONOLULU, HAWAII 96811-3540
STREET ADDRESS: 250 SOUTH HOTEL STREET, 4TH FLOOR
TELEPHONE: (808)587-2846, 587-2800
FAX: Director's Office 587-2848
Planning Division 587-2824

POSTED

'93 MAR -5 A8:57

Ref. No. P-4098

OFC. OF EQ. QUALITY

March 3, 1993

MEMORANDUM

TO: Mr. Brian Choy, Director
Office of Environmental Quality Control
Department of Health

SUBJECT: Draft Environmental Impact Statement, Puainako Street Extension and Widening, Island of Hawaii

We have reviewed the referenced document and have the following comments.

Water quality is a concern that is expressed in Coastal Zone Management by Chapter 205A, Hawaii Revised Statutes. Chapter 205A states, "promote water quantity and quality planning and management practices which reflect the tolerance of freshwater and marine ecosystems and prohibit land and water uses which violate State water quality standards."

With an increase in impermeable surface area as a result of roadway extension and widening, the possibility exists for increased levels of potentially contaminated runoff. Petroleum products such as motor vehicle oil and gasoline may be transported with this water runoff. Measures should be considered to minimize the potential for water contamination as a result of polluted runoff.

A relevant CZM objective is to "protect valuable coastal ecosystems from disruption and minimize adverse impacts on all coastal ecosystems." The proposed Alternative Alignment 1, if selected may have an impact on Kaumana Cave due to the proximity of the proposed roadway. Measures should be implemented to mitigate any potential disruption to the inherent cave features and ecosystems, as they are considered to be a valuable natural resource.

Thank you for the opportunity to comment on the draft environmental impact statement. If you have any questions, please contact Harold Lao at 587-2883.

Harold S. Masumoto
Director

cc: Hawaii County Department of Public Works
Okahara & Associates, Inc.

Stephen K. Yamashiro
Mayor

Donna Fay K. Kiyosaki
Chief Engineer

Riley W. Smith
Deputy Chief Engineer

County of Hawaii

DEPARTMENT OF PUBLIC WORKS

25 Aupuni Street, Room 202 • Hilo, Hawaii 96720-4252
(808) 961-8321 • Fax (808) 969-7138

September 15, 1993

Mr. Harold Masumoto, Director
Office of State Planning
Office of the Governor
PO Box 3540
Honolulu, HI. 96811-3540

Subject: Puainako Street Extension and Widening EIS

Dear Mr. Masumoto:

Thank you for reviewing the Draft Environmental Impact Statement (DEIS) for the Puainako Street Extension and Widening project on the Island of Hawaii. Each reviewer's comments have been carefully examined and appropriate additions and modifications are being incorporated in the Final EIS.

The specific comments you submitted are responded to below.

Comment: Measures should be considered to minimize the potential for water contamination as a result of polluted runoff.

Response: We share your concern about degradation of water quality. We also recognize that any addition of impermeable surface area upon which motor vehicles rest or ride involves at least some increase in petroleum product-contaminated runoff. Unfortunately, no practicable technology exists to collect road runoff and separate contaminants. However, the actual increase in both impermeable surface and traffic levels is projected to be small, and the problem may be considered negligible.

Comment: The proposed Alternative Alignment 1, if selected, may have an impact on Kaumana Cave due to the proximity of the proposed roadway. Measures should be implemented to mitigate any potential disruption to the inherent cave features and ecosystems, as they are considered a valuable natural resource.

Response Alternative alignment 1 was located at the maximum distance from any portion of Kaumana Cave that was feasible given the constraints of remaining within State-owned lands and maintaining safe and proper design standards such as curve radii and sight distance. Alignment 1 is generally further than 100 feet from the cave except for two bends in the cave, where the road approaches to within 40 feet (see figure 2-1, and discussion p. 33 and p. 70). No construction, including grading, drainage structures or landscaping, will be so close as to interfere with the structural integrity or ecological community above the cave. To further ensure the integrity of the cave and associated ecosystems, the State of Hawaii may choose to dedicate the remnants of parcels adjacent to the cave to conservation use.

Again, thank you for your careful consideration of the document.

Sincerely,

for Donna Fay K. Kiyosaki
Chief Engineer

Appendix B

FLORA REPORT

For

PUAINAKO STREET EXTENSION
COUNTRY CLUB DRIVE TO KOMOHANA STREET

Hilo, Hawaii

Prepared for:

Department of Public Works
County of Hawaii

Prepared by:

Grant Gerrish, Ph.D.

Y. K. Hahn and Associates
1180 N. Kumuwaina
Hilo, Hawaii 96720

June 15, 1992

CONTENTS

ABSTRACT

A botanical survey of the proposed and the alternative right-of-ways for the Puainako Street extension was conducted in May, 1992. The objectives were to describe the vegetation and to evaluate its biological value. Special attention was given to the search for rare or endangered plants and for plant communities that might be unique to the project area.

The original vegetation of most of the project area was an ohia/uluhe (Metrosideros/Dicranopteris) fern forest community. This simple community, associated with the young lava flows and shallow soils (Gagne and Cuddihy 1990), is made up of a low number of native plant species. A few small areas with deeper, better developed soils were originally vegetated with ohia lowland wet forest or koa (Acacia koa)/ohia lowland wet forest.

This survey found that much of the original vegetation has been removed for agricultural purposes or has been altered by alien plants. In other areas, the original native vegetation is intact. The deep-soil sites that had supported closed ohia or koa/ohia forests, being well-suited to agriculture, have been nearly completely cleared of the native forest. Most of these cleared fields are now abandoned and support savanna vegetation dominated by alien plants. Much of the shallow soil habitat, including the 1881 lava flow, still supports ohia/uluhe fern forest vegetation. In many areas, the native vegetation is severely degraded by the invasion of alien plants, especially waiawi (Psidium cattleianum) and melastoma (Melastoma candidum). Both alignments do cross sections of the ohia/uluhe fern forest

where this native vegetation is intact and few alien plants are found.

No rare or endangered plants were found within or near the two right-of-ways. A review of the known ranges of all plants listed as endangered by U.S. Fish and Wildlife Service or proposed for listing, revealed that it is unlikely that any occur within this region around Hilo.

The native plant communities within the project area are similar to other communities on young lava flows in the Puna and Hilo districts. The diversity of plants within these communities is low, consisting of native plants common and widespread within the Hawaiian Islands. (With one exception noted in Results section.) It was therefore concluded that the plants and vegetation within the project area do not require protection or mitigative action.

INTRODUCTION

A botanical survey was conducted of the proposed right-of-way alignment (Alignment 1) and the proposed alternative right-of-way alignment (Alignment 2) for the extension of Puainako Street from Country Club Drive to Komohana Street; and from Komohana Street to Kawili Street. The purpose of this study is to describe and evaluate the vegetation of these two alignments and to identify ecologically sensitive or valuable plants and communities within the right-of-ways. Special attention was given to the search for rare or legally protected, endangered species and for ecosystems that might be unique to the project area. These are the resources, if present, that might require mitigative action.

METHODS

The study began with a literature search to determine which, if any, plant species listed or proposed for listing as endangered or threatened by the U. S. Fish and Wildlife Service might occur within the region of the Puainako Street extension. Such listed plants are legally protected by federal and State law. Lists of threatened and endangered plants were reviewed (Federal Register 1990a, 1990b; and updated lists provided by USFWS, Pacific Islands Office, Honolulu) and their ranges were determined from the Manual of Flowering Plants of Hawaii (Wagner et al. 1990).

The botanical field survey was carried-out after the center-line of the two alternative alignments had been surveyed and staked. The surveyors had placed stakes at one-hundred foot intervals. The botanical survey required three days in May, 1992. The botanist walked the entire length of both alignments following the staked center-line. Excursions to the side were made as needed to identify plants or vegetation within the proposed 120 ft. right-of-ways.

Vegetation descriptions were recorded for all plant communities encountered along the alignments and all plant species found were recorded. A list of plant species was prepared (Tables 3-6). Nomenclature used for flowering plants generally follows Wagner et al. (1990); plants not listed in that source are named according to St. John (1973). Fern nomenclature follows Neal (1965), for the most part, or secondarily, Mueller-Dombois et al. (1977).

Factors controlling the vegetation pattern were analyzed. The Soil Survey (Sato et al. 1973) and the U.S. Geological Survey topographic maps (Piihonua and Hilo quadrangles) were consulted for information relating to substrate age and type and to land-use history.

RESULTS

VEGETATION TYPES

ORIGINAL VEGETATION Originally, the natural vegetation of most of the project area was ohia/uluhe (*Metrosideros*/*Dicranopteris*) fern forest, which is a subtype of the lowland wet forest (Gagne and Cuddihy 1990). This ohia/uluhe fern forest community is associated with young lava flows and shallow soils on the lower, windward slope of Mauna Loa. Within the project area, this community is dominated by a deep mat of uluhe, more or less scattered ohia trees, and relatively few other plant species. At a few sites within the project area with deeper soil, the vegetation has further developed into the Ohia (*Metrosideros*) lowland wet forest or the koa/ohia (*Acacia*/*Metrosideros*) lowland forest communities (Gagne and Cuddihy 1990). These communities have a closed tree canopy, less uluhe ground cover, and a somewhat richer assortment of associated species.

The vegetation of the project area was found to still strongly reflect this original vegetation. However, past human land-use has significantly modified the vegetation in many areas. Field observations have identified two predominantly native communities, one predominantly alien, and one variably mixed community. These four communities are described below.

OHIA/ULUHE FERN FOREST The more extensive of the two native communities is an ohia/uluhe fern forest generally as described above. This is an open forest with columnar-shaped ohia (Metrosideros polymorpha) trees up to 40 ft. tall. The ground is completely covered by mats of uluhe (Dicranopteris linearis).

Within the project area, the ohia/uluhe fern forest occurs on two different substrates, according to the soil survey (Sato et al. 1973). The 1881 lava flow is mapped as "pahoehoe lava" and has a very thin, discontinuous layer of accumulated organic matter. The other substrate type supporting this community is slightly older pahoehoe lava with a shallow organic soil classified as Keei or Keaukaha series "extremely rocky muck."

Where the ohia/uluhe fern forest occurs on the 1881 lava flow, few other species of plants may be found. Native plants that do occur infrequently are ahaniu (Machaerina mariscoides), pukiawe (Styphelia tameiameiae), neneleau (Rhus sandwicensis), and wawai-iole (Lycopodium cernuum). On the older lava flows with muck soils, tree ferns (Cibotium spp.), papala-kepau (Pisonia umbellifera), and kawau (Ilex anomala) were infrequently found within the ohia/uluhe fern forest community. The most common alien plants invading this community are bamboo orchid (Arundinia bambusifolia), melastoma (Melastoma candidum), strawberry guava or waiawi (Psidium cattleianum), broomsedge (Andropogon virginicus), and swordfern (Nephrolepis hirsutula).

CLOSED OHIA FOREST The other predominantly native community found in the project area is a closed ohia forest. The canopy is about 50 ft. high and made up of three varieties of Metrosideros polymorpha (ohia): varieties incana, glaberrima and macrophylla. The largest trees are of variety macrophylla. This community has several more native species than the fern forest community described above. The most abundant of these additional tree species is kopiko (Psychotria hawaiiense), with occasional pilo (Coprosma sp.) Tree ferns are fairly common. Some uluhe does grow in sunnier spots, but the ground-cover is generally dominated by the alien swordferns (Nephrolepis hirsutula and N. cordifolia), and kahili ginger (Hedychium gardnerianum). The epiphytic flora is well-developed, including ie'ie (Freycinetia arborea), ekaha (Elaphoglossum spp.), wawae-iole (Lycopodium phyllanthum), palai-lau-li'i (Sphaerocionium lanceolatum), Adenophorus sp., and mosses and liverworts. Alien trees are also common in this community. Waiawi (Psidium cattleianum) forms dense understory thickets in many places. Common guava (Psidium guajava), African tulip tree (Spathodea campanulata), and Alexander palm (Archontophoenix alexandrae) occasionally occur.

SAVANNA A savanna dominated by alien plants now occurs where the original vegetation has been removed for agricultural or other purposes. This community is found on sites with deeper soils that were farmed in the recent past (this century). These areas include abandoned sugar cane fields and pastures. Presumably, the vegetation of the savanna would develop into a secondary forest given time.

The savanna vegetation is highly variable and includes many species of alien plants and a smaller number of native plants as well. Generally, the ground-cover is tall, dense grass with widely scattered trees of many species. Thickets occur in some places. The most common grass is California grass (Brachiaria mutica) which forms extensive, impenetrable mats. Broomsedge (Andropogon virginicus) and little bluestem (Schizachyrium condensatum) dominate in less favorable sites. Volunteer sugar cane (Saccharum officinarum) is often much in evidence. Trees occur singly or in groves or thickets, including albizia (Albizia falcataria), common guava, waiawi, melochia (Melochia umbellata), gunpowder tree (Trema orientalis), and the native koa (Acacia koa).

In many areas, the native ohia/uluhe community still persists or is reinvading. Ohia, tree ferns and uluhe are commonly seen in gullies where they may have survived landclearing. In other places, it is clear that ohia saplings are becoming reestablished and uluhe mats are spreading into the grasslands of the savanna.

MIXED OHIA AND WAIAWI Many areas are a mix of dense waiawi thickets intermingled with ohia and uluhe. Presence of other native and alien plants is also variable. Some of these areas appear to be native vegetation that was not completely cleared but have been degraded and invaded by waiawi and other alien species. Other areas appear to have been cleared but partially reinvaded by ohia and uluhe. In either case, these communities may contain all the species of the savanna and of the ohia/uluhe communities described above.

DETAILED VEGETATION DESCRIPTION ALONG ALIGNMENTS

The vegetation of the two alignments is described from west to east, that is from Country Club Drive to Komohana Street. Locations are referenced to the survey stakes and other landmarks.

ALIGNMENT 1 The segments of alignment 1 within each of the four communities described above are summarized in Tables 1 and 2.

Alignment 1 diverges from Kaumana Drive a short distance east of Country Club Drive at survey mark 1100 ft. From this point to marker 2900 ft., the vegetation is closed ohia forest with trees up to 50 ft. tall. The understory is variably dominated by uluhe, tree ferns and kopiko saplings with alien swordferns, or waiawi thickets. Kahili ginger and melastoma are other common alien plants.

Near marker 2900 ft. the alignment runs near the interface of the forest and savanna vegetation growing in abandoned sugar cane fields. This savanna is an area of deeper soil of the Kaiwiki silty clay loam series (Sato et al. 1973). Closed forest is on the north side of the easement, the center-line and south side are in the savanna. The savanna is a patchwork of areas dominated by either California grass, broomsedge and little bluestem, or uluhe and ohia. The ohia and uluhe patches are especially prominent near the edge of the forest. Many species of alien trees are scattered individually or in groves and thickets across the savanna. The more common trees are albizia, guava, waiawi, avocado (*Persea americana*), rose apple (*Syzigium jambos*), and Alexander palm. There is a small grove of koa trees up to 50 ft. tall at the 4400 ft. marker, near Wilder St. Several steep gullies with streams occur in this section. The streamside vegetation generally resembles the surrounding community.

On the east side of Wilder St., the alignment enters what appears to be a long-abandoned field. Waiawi clumps are mixed with ohia/uluhe patches within a matrix of California grass. The alignment crosses a large stream channel near marker 6600 ft. The stream is lined with mature rose apple trees and dense thickets of waiawi. Some tall ohia trees and tree ferns grow in the stream channel.

From marker 7100 ft. to about 8500 ft, the alignment skirts the residential and farming area on Pamoho St. The vegetation, where not cultivated, is a secondary forest of the alien trees that are found in the savanna. Large gunpowder trees, melochia, guava and waiawi predominate. Extensive areas of California grass occur near the 138 kv electrical power transmission line at marker 7800 ft.

Near the 8500 ft. marker, alignment 1 crosses onto the 1881 lava flow. The vegetation from here to about the 17000 ft. marker is the best example of an undisturbed ohia/uluhe tree fern forest encountered. Pole-sized ohia trees form an open canopy in a sea of uluhe. There is some natural variation in the vegetation. In a few places the native sedge, ahaniu, forms up to 20% of the groundcover and wawae-iole (Lycopodium cernuum) may makeup 1%; in most places, however, the cover of uluhe is near 100%. The height of the ohia canopy varies according to soil conditions from about 25 to 40 ft., with a mean of about 30 ft. In the taller stands, the canopy is more nearly closed and the ground is more moist and shady.

Some alien plants are found within this community, but always as a minor component. The unobtrusive bamboo orchid is the most widely distributed alien plant in this vegetation type. Among the larger, more disruptive aliens, melastoma is the most common. Even melastoma, however, is widely scattered and never dominates, even locally. Waiawi is even less common, but does become somewhat more abundant in the taller, more closed ohia stands. The moist, shady conditions may favor this species.

As alignment 1 nears the Sunrise Estates subdivision, it leaves the 1881 lava flow and enters an ohia/uluhe community where the ohia trees are larger and the vegetation is more heavily degraded by alien plants. Waiawi and melastoma thickets reappear and swordfern often replaces uluhe as the groundcover. The somewhat rare native sedge, Scleria testacea, occurs here sparingly. From marker 17100 ft. to 19300 ft. the alignment skirts the Sunrise Estates subdivision. The north side of the right-of-way impinges on the recently bulldozed areas of the subdivision while the south side is within a disturbed ohia/uluhe community as just described.

East of Sunrise Estates to Komohana St., the alignment passes through a mixed ohia and waiawi vegetation which has a matrix of ohia/uluhe fern forest but also many areas dominated by waiawi and other aliens. The ohia are commonly up to 40 ft. tall, but widely scattered. Presence of a few hala trees (Pandanus tectorius) indicate that this is a later successional stage of the lowland forest. Thickets of large, mature waiawi and melastoma show that this land has long been disturbed, perhaps by cattle grazing. A large number of other alien tree species emerge above the open ohia canopy, these include Alexander palm, African tulip tree, and gunpowder tree.

The vegetation of the remaining section of alignment 1, along Puainako Street from Komohana Street to Kawili Street, is secondary forest. Most of this area appears to have been abandoned sugar cane fields. Large gunpowder trees up to 60 ft. tall dominate. Other trees, all alien, include melochia, octopus tree (Shefflera actinophylla), Chinese banyan (Ficus microcarpa), and bingabing (Macaranga mappa). The groundcover is made up of alien plants including oak fern (Cyclosorus dentatus), palm grass (Setaria palmifolia), thimbleberry (Rubus rosifolius), sensitive plant (Mimosa pudica), and wedelia (Wedelia trilobata). The vegetation in openings is chiefly sugar cane, California grass, and wedelia.

ALIGNMENT 2 The segments of alignment 2 within each of the four communities are summarized in Tables 1 and 2.

Alignment 2 begins at Kaumana Drive between Country Club Drive and the beginning of alignment 1. The vegetation is a closed ohia forest with trees up to 55 ft. tall and some tree ferns. Much of the understory is dominated by waiawi, but kopiko saplings and other native shrubs and fern are common in some spots. The more open areas usually have a groundcover of uluhe; the alien swordferns predominate under the closed canopy. A number of epiphytic species are present, including ie'ie and ekaha. The soil is a very shallow layer of litter and humus over pahoehoe lava.

At marker 1500 ft., the alignment enters long-abandoned sugar cane fields on Kaiwiki silty clay loam soil. Volunteer sugar cane is common in this savanna vegetation. Three subtypes can be recognized based on the dominant groundcover. The most extensive is the California grass subtype, associated with bamboo orchid, sensitive plant, swordfern, umbrella sedge (<u>Cyperus halpan</u>), and many more alien herbs and shrubs. The second subtype is dominated by broomsedge with little bluestem. Ohia seedlings are commonly found here, especially when within a few hundred feet of the forest edge. The third subtype is dominated by uluhe, either as a reinvading species or as a survivor in gullies and rough terrain. In the latter case, ohia trees up to 30 ft. tall are common and tree ferns are found occasionally.

A large number of trees are scattered through the savanna. Perhaps the most conspicuous are young koa up to 25 ft. tall; the only other native trees of the savanna are ohia and neneleau. Alien trees include avocado, eucalyptus (<u>Eucalyptus robusta</u>) rose apple, waiawi, and African tulip tree. Many other alien shrubs and herbs are found in the savanna community. A number of small streams in deep gullies cross this area. Wainaku grass (<u>Panicum repens</u>) is common on the banks.

A remnant of ohia/koa forest persists between markers 3000 ft. and 3700 ft. A deep stream channel is found within this area, too. The open canopy is made up of ohia and a few large koa trees. The uluhe and uluhe-nui (<u>Hicriopteris pinnata</u>) form a deep mat, but there are also many thickets of waiawi and melastoma.

From the 3700 ft. marker to the 4200 ft. marker, the alignment crosses another abandoned field with savanna-type groundcover but no trees. From the 4200 ft. marker to about the 5300 ft. marker the vegetation is mixed ohia and waiawi thickets with many other alien plants, including maile pilau (Paederia scandens), thimbleberry, and swordfern.

From the 5300 ft. marker to the 6200 ft. marker near Wilder Street the vegetation is a relatively undisturbed ohia/uluhe fern forest with only occasional waiawi or melastoma. The vegetation near Wilder Street is disturbed and open with California grass, melastoma, waiawi, as well as some ohia and uluhe. From Wilder Street to the 138 kv electrical power transmission line at marker 10900 ft. the vegetation is mixed ohia and waiawi. Much of this area appears to have been cleared in the past. The vegetation on the south edge of the right-of-way is a low stature, open ohia/ulhe forest. The north side is more open with California grass and broomsedge dominated savanna vegetation. In many parts of the right-of-way itself, the uluhe and ohia appear to be reestablished, but many other areas have dense waiawi thickets.

From the 10900 ft. marker to the bulldozed road at 13100 ft. marker the vegetation is strongly native in character. The uluhe mat is dense with scattered ohia up to 25 ft. tall and frequent tree ferns. Melastoma and waiawi do occasionaly occur.

For most of the stretch southeast of Pacific Plantation subdivision, from 13100 ft. to about the 16000 ft. marker, the vegetation is mixed ohia and waiawi thickets with many other alien trees, including gunpowder tree, melochia, and common guava. Ginger and California grass are common groundcover, as is uluhe. From the 16000 ft. marker to the junction with alignment 1 near Sunrise Estates, the vegetation is more nearly ohia/uluhe fern forest, but still with many of the same alien species.

RARE OR ENDANGERED PLANTS

No plants listed as threatened or endangered by the U.S. Fish and Wildlife Service were found within or near the two surveyed alignments. A review of the list of endangered or threatened plant species revealed that none have ever been previously found within the project area. Based on the field survey and this review, it is concluded that it is very improbable that any plant now listed or proposed for listing as endangered or threatened occurs within the project area.

One species of plant that is somewhat rare in Hawaii and known only from the lowlands around Hilo was found. The indigenous sedge, _Scleria testacea_, was found sparingly along parts of alignment 1 (see the description of alignment 1 above). This species has been considered to be endemic to Hawaii, but the most recent flora (Wagner et al. 1990) considers the Hawaii population to be of the same species as populations found in the Americas that have also been referred to _S. testacea_.

DISCUSSION AND RECOMMENDATION

Biological Resource Values of the Vegetation

For the purposes of this assessment, alien plants and communities dominated by alien plants are considered to have no biological resource value. Vegetation attributes that are valued are 1) rare or endangered native plants; and 2) plant communities dominated by native plants, especially if the community is a combination of plant species found nowhere else.

No legally protected, threatened or endangered plant species were found nor is it considered likely that any such plants occur in or near either of the two alignments. One plant species, *Scleria testacea*, which is probably unique to the Hilo area in Hawaii, was found infrequently within alignment 1. This species has never been included on lists of plants proposed or considered for threatened or endangered status. *Scleria*, while not common, is widespread within its range around Hilo and in the past was reported to grow on West Maui, as well.

Much of the natural vegetation along the two alignments has been heavily disturbed by land-clearing and is dominated by communities of alien plants (Tables 1 and 2). In some other areas, alien plants, especially waiawi and melastoma, have heavily invaded the natural vegetation and compromised its native character. There are, however, stretches on each alignment where the vegetation is near its natural state.

The western ends of both alignments, near Kaumana Drive, begin in closed ohia forest. Although waiawi, swordfern, and other alien species are present, this community appears to be a functioning, mid-succession ohia forest where a few other native tree species are becoming established. The community is floristically simple with no more than a dozen vascular species, including ferns and vascular epiphytes.

Between the 8500 ft. marker and the 17000 ft. marker, where alignment 1 passes between Kaumana Drive and the Pacific Plantation subdivision, the vegetation of the 1881 is an intact representative community of the ohia/uluhe fern forest. Very few alien plants are present. This is a very simple community with perhaps five other native species very sparsely distributed among the ohia and uluhe.

Two stretches of alignment 2 pass through communities that are nearly free of alien plants: from the 5300 ft. marker to about the 6200 ft. marker near Wilder Street, and from the 10900 ft. marker south-southeast of Pamoho Street to the 13100 ft. marker south of Pacific Plantation subdivision. These two sites have ohia/uluhe fern forest slightly more developed than the community just described on the 1881 lava flow. These communities have a very deep mat of uluhe, ohia up to about 25 feet tall, and occasional tree ferns.

None of these native communities described above are outstanding in terms of their diversity of plant species nor are they particularly unique to the project area. Similar communities occur elsewhere in the vicinity of Hilo, South Hilo District, and Puna District on relatively young lava flows.

Recommendation

No biological resources have been identified by this botanical study that deserve priority for protection or conservation.

The presence of *Scleria testacea* does not legally require protection nor is this project likely to threaten its continued survival in the region since it occurs elsewhere off the project site. Furthermore, *Scleria* was observed growing in disturbed parts of the project site as well as undisturbed communities.

The native ohia/uluhe fern forest community and the closed ohia forest are not species rich, nor are they unique to the project area.

No choice between the two proposed alternative alignments is warranted on the basis of plants or plant communities.

REFERENCES

Gagne WC, Cuddihy LW. 1990. Vegetation. in Wagner WL, Herbst DR, Sohmer SH. Eds. Manual of the Flowering Plants of Hawaii. University of Hawaii Press/Bishop Museum Press. Honolulu.

Federal Register. 1990a. Endangered & Threatened Wildlife and Plants. 50 CFR 17.11 & 17.12. April 15, 1990.

Federal Register. 1990b. Endangered and Threatened Wildlife and Plants; Review of Plant Taxa Proposed for Listing as Endangered or Threatened Species; Notice of Review. 50 CFR Part 17. Feb. 21, 1990.

Mueller-Dombois, D, Jacobi JD, Cooray RG, Balakrishnan B. 1977. Ohia Rain Forest Study: Ecological Investigations of the Ohia Dieback Problem in Hawaii. College of Tropical Agriculture and Human Resources, Hawaii Agricultural Experiment Station. Miscellaneous Publication 183.

Neal MC. 1965. In Gardens of Hawaii. Bernice P. Bishop Museum Special Publication 50. Bishop Museum Press, Honolulu.

St. John H. 1973. List and Summary of the Flowering Plants in the Hawaiian Islands. Paacific Tropical Botanical Garden Memoir 1:1-519.

Sato HH, Ikeda W, Paeth R, Smythe R, Takeshiro Jr. M. 1973. Soil Survey of the Island of Hawaii. USDA Soil Conservation Service, Washington, D.C.

Wagner WL, Herbst DR, Sohmer SH. 1990. Manual of the Flowering Plants of Hawaii. University of Hawaii Press/Bishop Museum Press. Honolulu.

Table 1. Listing of alignment segments by community type. Segments designated by survey markers (ft.).

SEGMENT BEGIN	END	COMMUNITY	EXTENT (ft.)
Alignment 1			
1100	2900	Closed Ohia Forest	1800
2900	4500	Savanna	1600
4500	7100	Mixed Ohia/Waiawi	2600
7100	8500	Farm/Residential	1400
8500	17000	Ohia/Uluhe Fern Forest	8500
17000	19300	Sunrise Estates	2300
19300	24400	Mixed Ohia/Waiawi	5100
Alignment 2			
700	1500	Closed Ohia Forest	800
1500	3000	Savanna	1500
3000	3700	Ohia/Uluhe Fern Forest	700
3700	4200	Savanna	500
4200	5300	Mixed Ohia/Waiawi	1100
5300	6200	Ohia/Uluhe Fern Forest	900
6200	10900	Mixed Ohia/Waiawi	4700
10900	13100	Ohia/Uluhe Fern Forest	2200
13100	16000	Mixed Ohia/Waiawi	2900
16000	19500	Ohia/Uluhe Fern Forest	3500

Table 2. Summary of extent of alignment within each community type. Alignment 2 considered to end at junction with alignment 1 west of Sunrise Estates.

	EXTENT WITHIN COMMUNITY (ft.)	
COMMUNITY	ALIGNMENT 1	ALIGNMENT 2
Closed Ohia Forest	1800	800
Ohia/Uluhe Fern Forest	8500	4000
Mixed Ohia/Waiawi	7700	8700
Savanna	1600	2000
Other	3700	0

Table 3. Native trees, tree ferns and shrubs found within alternatives 1 and 2 of the proposed Puainako Street extension right-of-way. Includes both indigenous and endemic plants.

BOTANICAL NAME	COMMON NAME
Acacia koa Gray	koa
Cibotium chamissoi Kaulf.	hapu'u-'i'i
Cibotium glaucum (Sm.) H. & A.	hapu'u
Coprosma rhynchocarpa Gray	pilo
Freycinetia arborea Gaud.	ie'ie
Ilex anomala H.& A.	kawa'u
Metrosideros polymorpha Gaud. var. *glaberrima*	'ohi'a-lehua
Metrosideros polymorpha Gaud. var. *incana*	'ohi'a-lehua
Metrosideros polymorpha Gaud. var. *macrophylla*	'ohi'a-lehua
Pandanus tectorius S. Parkinson ex Z	hala
Pisonia umbellifera (J. R. & G. Forst.) Seem	papala-kepau
Psychotria hawaiiense (Gray) Fosb.	kopiko
Rhus sandwicensis Gray	neneleau
Styphelia tameiameiae (Cham.) F. Muell.	pukiawe

Table 4. Native herbs, grasses and ferns found within alternatives 1 and 2 of the proposed Puainako St. extension. Includes indigenous and endemic plants.

BOTANICAL NAME	COMMON NAME
Dicranopteris linearis (Burm.) Underw.	uluhe, false staghorn
Elaphoglossum alatum Gaud.	'ekaha
Elaphoglossum reticulatum (Kaulf.) Gaud.	'ekaha
Hicriopteris pinnata (G. Kunze) Ching	uluhe-nui
Lycopodium cernuum L.	wawae-'iole
Lycopodium phyllanthum H. & A.	wawae-'iole
Machaerina mariscoides (Gaud.) J. Kern	'ahaniu
Microsorium scolopendria (Burm.) Copel.	laua'e
Ophioglossum pendulum L.	adder's tongue
Pleopeltis thunbergiana Kaulf.	pakahakaha
Psilotum nudum (L.) Griseb.	moa
Sadleria cyatheoides Kaulf.	'ama'u
Scleria testacea Nees	nutgrass
Sphaerocionium lanceolatum (H. & A.) Kopel.	Palai-lau-li'i

Table 5. Alien trees and shrubs found within alternatives 1 and 2 of the proposed Puainako St. extension right-of-way. Includes plants of Polynesian introduction.

BOTANICAL NAME	COMMON NAME
Albizia falcataria L.	albizia
Aleurites moluccana (L.) Wild.	kukui
Archontophoenix alexandrae (F. v. Muell.) H. A. Wendl. & Drude	Alexander palm
Ardisia crenata Sims	Hilo holly
Bambusa sp.	bamboo
Clusia rosea Jacq.	autograph tree
Coffea arabica L.	Arabian coffee
Cordyline fruticosa (L.) A. Chev.	ti, ki
Eucalyptus robusta Sm.	swamp mahogany
Eucalyptus saligna Sm.	Sydney blue gum
Ficus microcarpa L. fil.	Chinese banyan
Lantana camara L.	lantana
Macaranga mappa (L.) Mull. Arg.	Bingabing
Melastoma candidum D. Don	melastoma
Melochia umbellata (Houtt.) Staph.	melochia
Persea americana Mill.	avocado
Pluchea odorata (L.) Cass.	sourbush
Psidium cattleianum Sabine	waiawi, strawberry guava
Psidium guajava L.	common guava
Shefflera actinophylla (Endl.) Harms	octopus tree

Table 5. Alien trees and shrubs. (Continued)

BOTANICAL NAME	COMMON NAME
Spathodea campanulata Beauv.	African tulip tree
Syzigium jambos (L.) Alston	rose apple
Tibouchina herbacea (DC) Cogn.	glorybush
Trema orientalis (L.) Bl.	gunpowder tree

Table 6. Alien herbs, grasses and ferns found within alternatives 1 and 2 of the proposed Puainako St. extension. Includes plants of Polynesian introduction.

BOTANICAL NAME	COMMON NAME
Adenophorus tamariscinus (Kaulf.) Hook. & Grev.	wahine-noho-mauna
Ageratum conyzoides L.	maile-honohono
Andropogon virginicus L.	broomsedge
Arundinia bambusifolia (Roxb.) Lindl.	bamboo orchid
Athyrium esculentum (Retz.) Copel.	Paco
Blechnum occidentale L.	blechnum
Brachiaria mutica (Forsk.) Stapf	California grass
Castilleja arvensis Schlecht. & Cham.	paintbrush
Centella asiatica (L.) Urb.	Asiatic pennywort
Coix lachryma-jobi L.	Job's tears
Commelina diffusa N. L. Burm.	honohono
Conyza bonariensis (L.) Cronq.	hairy horseweed
Crotolaria juncea L.	Sunn hemp
Cuphea carthagenensis (Jacq.) Macbride	tarweed
Cyclosorus dentatus (Forsk.) Ching	oak fern
Cyperus halpan L.	umbrella sedge
Desmodium sandwicense E. Mey.	Spanish clover
Digitaria pentzii Stent.	Pangola grass
Eleocharis obtusa (Willd.) Schult.	spikerush
Hedychium gardnerianum Roscoe	kahili ginger

Table 6. Alien herbs, grasses and ferns. (Continued)

BOTANICAL NAME	COMMON NAME
Justica betonica L.	white shrimp plant
Ludwigia octovalvis (Jacq.) Raven	primrose willow
Melinis minutiflora Beauv.	molassesgrass
Mimosa pudica L.	sensitive plant
Musa x *paradisiaca* L.	banana
Nephrolepis cordifolia (L.) Presl	ncn (fern)
Nephrolepis hirsutula (Forst.) Presl	swordfern
Oplismenus hirtellus (L.) Beauv.	basketgrass
Paederia scandens (Lour.) Merr.	maile pilau
Panicum repens L.	wainaku grass
Paspalum conjugatum Berg.	Hilo grass
Paspalum urvillei Steud.	vaseygrass
Passiflora edulis Sims	liliko'i
Pennisetum purpureum Schumach.	elephant grass
Phaius tankarvilleae (Banks ex L'Her.) Blume	Chinese ground orchid
Phlebodium aureum (L.) J. Sm.	laua'e-haole
Pityrogramma chrysophylla	gold fern
Rubus rosifolius Sm.	thimbleberry
Saccharum officinarum L.	sugar cane
Saciolepis indica (L.) Chase	Glenwoodgrass

Table 6. Alien herbs, grasses and ferns. (Continued)

BOTANICAL NAME	COMMON NAME
Schizachyrium condensatum (Kunth) Nees	little bluestem
Setaria gracilis (Poir.) Beauv.	perennial foxtail
Setaria palmifolia (Koen.) Stapf	palmgrass
Spathoglottis plicata Blume	Philippine ground orchid
Stachytarpheta urticifolia (Salisb.) Sims	ncn
Themeda villosa (Poir.) A. Camus	Lyon's grass
Torenia asiatica L.	Ola'a beauty
Tritonia crocosmiflora Nichols.	montbretia
Wedelia trilobata (L.) Hitchc.	wedelia

Appendix C

An Assessment of the Fauna of the Proposed Puainako Street Extension District of South Hilo, Hawaii

Prepared by
Maile A. Kjargaard, M.S.
P.O. Box 476
Volcano, Hawaii

10 June, 1992

Introduction

The following report is an assessment of the fauna in the area proposed for the site of the Puainako St. extension between Komohana St. and Kaumana Dr. The area affected by the project is between 275 and 1100 feet in elevation, and receives approximately 230 inches of rain per year (State of Hawaii 1970).

Methods

Information used in compiling this report was derived from published records (e.g., Scott et al. 1986), unpublished reports (e.g., Kjargaard 1991, 1992, Kepler 1986), and discussions with the biologist who performed the botanical survey of the site (Gerrish, Pers. comm.). While both the published records and unpublished reports do not specifically pertain to the study area, they contain information about the nature of the avian community in nearby locations that have the same general elevation and climatic characteristics.

Avian Habitats

Three avian habitats are present in the study area. I have delineated these habitat types based not only on vegetation parameters but also on the suitability of the community as nesting habitat for the 'Io (*Buteo solitarius*), which is the predominant native bird species in the area. Because of this, the avian habitat types that I have designated are not strictly comparable to the vegetation communities described in the botanical survey of the site.

The first avian habitat type occurs in areas once used for sugar cane cultivation. Vegetation in these localities consists of a savanna of mixed alien and native trees with an understory of uluhe and alien grasses. This habitat is found between Komohana and Kawili Sts., and along portions of both Alignments 1 and 2.

Young scrub forests consisting of 'ohi'a, uluhe, and assorted alien species (e.g., waiawi guava, Melastoma) occur on portions of alignment 1 that lie on the 1881 lava flow, in the vicinity of the Pacific Plantation subdivision. This scrub is dominated by 'ohi'a and uluhe is relatively undisturbed to moderately disturbed, but is characterized throughout its range by the small stature of its trees and low plant species diversity.

The last avian habitat type is fairly diverse and encompasses several distinct plant communities. It is characterized by the presence of trees large enough to be used for nest sites by 'Io. Included in this habitat type are scrub habitats that are more developed than those on the 1881 flow, and more mature 'ohi'a-dominated communities that occur along the routes of both of the proposed alignment alternatives. At the Country Club Rd. ends of both alignments 1 and 2, closed 'ohi'a forests are found on substrates that are older than the 1881 lava flow. These forests have and a more diverse understory than found in the 'ohi'a scrub communities and include treeferns and kopiko. Also included in this avian habitat type is a 'ohi'a scrub community which occurs along both alignments, but is more common on alignment 2. This community consists of open canopy 'ohi'a forest which is similar, but more developed, than the young scrub which occurs on the 1881 flow, with trees of up to 1 foot dbh (diameter of the trunk at breast height). Although the trees are mature, they are only of moderate height since soil is scarce in these areas. There is little floristic diversity, and variable degrees of degradation are present (some areas appear quite undisturbed while others are heavily invaded by alien plant species). The portion of the study area between Komohana St. and the Sunrise Estates development is vegetated by a moderately to heavily disturbed scrub that is dominated by uluhe, 'ohi'a, Melastoma, and waiawi guava. Large mature 'ohi'a up to 36 feet tall are present throughout this area, but they are scattered and interspersed with the lower stature scrub.

Faunal Communities

Because of the study site's low elevation and the disturbed nature of its vegetation, its bird communities are dominated by non-native species. This assemblage of species is typical of disturbed wet lowland habitats on the island of Hawai'i.

Table 1 lists the bird species that may occur in the area affected by the construction of the extension. Significant populations of the four native passerine (perching bird) species are unlikely to occur in the area as they are generally found only above 1500 ft in elevation. I have included them in the table since their ranges in the Hamakua or Puna areas are known to extend as low as 900 ft. (Scott et al. 1986). Gerrish encountered none of these species during his botanical survey.

Unlike the passerines, the two native raptors regularly occur at lower elevations. The 'Io (Buteo solitarius) in particular is often seen in the Hilo area, and is the only native bird species likely to be affected by the project.

'Io are found only on the island of Hawai'i, where they are widely distributed in forested and agricultural areas. The total population estimate for this species ranges from 1400 to 2500 individuals (Griffin 1984); it is listed as endangered both by the U.S. Department of the Interior (1984a), and the State of Hawaii (Burr and Morin 1984). No 'Io were observed by Gerrish during the course of the botanical survey, nor are they regularly observed by residents of the nearby Pacific Plantations subdivision (B. Brilhante, Pers. Comm.). I have seen 'Io from Kaumana Dr. between Hilo and Kaumana, so they probably occur with some regularity in the study area. Of greatest concern is whether breeding activity occurs along the corridor proposed for roadway construction. The lack of hawk observations suggests that 'Io are not currently breeding in the area. 'Io are generally quite obvious (and sometimes aggressively defensive) in the vicinity of their nests; it is unlikely that a nesting 'Io could have been overlooked by Gerrish, who is very familiar with these birds. In addition, although the third avian habitat type includes areas potentially used by nesting 'Io, there is relatively little high quality nesting habitat for this species along either of the two proposed alignments. Only the mature ohia forest found at the top of the site has large numbers of the sizeable trees favored by these birds for nesting sites (Griffin 1984).

Although A'o (Puffinus auricularis newellii) have been detected in the upland portion of Hilo in the last 20 years (Conant

1980, U.S.A. Corps of Engineers 1980), none of the necessary nesting habitat is present in the study site: this species requires steep, heavily vegetated terrain for its burrows, and is particularly sensitive to predation by feral predators (especially cats and dogs). It is almost certainly absent from this area. Occasional sightings of the endangered (U.S. Department of the Interior 1970, 1984b) Hawaiian Hoary Bat (*Lasiurus cinereus semotus*) have been made at the Pacific Plantations subdivision (Brilhante, Pers. comm.). This species is a regular resident of lowland forests on the Island of Hawai'i (Tomich 1986, and Pers. Obs.). It is never found in very high numbers, but may be locally common in locations such as South Kona (Fujioka and Gon 1983). This species inhabits solitary roosts during the daylight hours, and is frequently seen feeding over wetlands and nearshore waters just after dusk. The Wailuku River mouth is one location where bats are easily seen. Bats are non-selective in the choice of roost site, and have been seen roosting in native and alien vegetation, as well as in man-made structures.

Project Impacts and Mitigation

This project poses no significant threat to populations of native passerine birds. It is also unlikely that the project will affect foraging 'Io in the area. However, nesting individuals are at some risk from construction activities. Harassment of nesting birds has been identified as one of the most significant factors now affecting 'Io populations (Griffin 1984). During the breeding season, these birds are particularly vulnerable: human disturbance of 'Io prior to egg laying and even during incubation can cause nest site abandonment. Disturbance of nests later in the breeding cycle (i.e., after hatching, which peaks in mid June) can cause young birds to leave the nest before the time of normal fledgling, resulting in abandonment by the parents and/or predation of the young birds. Since no nests were seen on either of the alignments, these concerns are not as pressing as they could potentially be. However, since the best potential hawk nesting areas are along alternative alignment 2, I would recommend avoiding construction in this potion of the site and deciding in favor of alternative 1 which has more scrubby habitat and is closer to already built-up areas.

The Hawaiian Hoary Bat is quite adaptable (Tomich 1981) and is much less vulnerable to human disturbance then the native bird species. Construction will probably not affect populations of bats in the area.

Literature Cited

Burr, T. and M. Morin. 1984. Endangered and Threatened Animals and Plants of Hawaii. State of Hawaii Department of Land and Natural Resources.

Conant, S. 1980. Recent records of the 'Ua'u (Dark-rumped Petrel) and the 'A'o (Newel's Shearwater) in Hawaii. 'Elepaio 41(2): 11-13.

Fujioka, K.K., and S. Gon. 1983. An unusual concentration of the Hawaiian Hoary Bat in the South Kona District, Island of Hawaii. J. of Mammology.

Griffin, C. 1984. Hawaiian Hawk Recovery Plan. U. S. Fish and Wildlife Service, Portland, Oregon.

Kepler, C.B., J. Jeffrey, and J.M. Scott. 1979. Possible breeding colonies of Manx Shearwater on the island of Hawaii. 'Elepaio 39:115-116.

Kepler, A.K. 1986. Avifauna., _In_ Associated Engineering Consultants, Wailuku Hydropower Site E.I.S.

Kjargaard, M. 1991. Avifaunal Survey of the Proposed Hilo to Waimea Water Development and Transmission Corridor. Y.K. Hahn.

Kjargaard, M. 1992. Faunal Survey of the Proposed Wailuku River Hydroelectric Project Site. Wailuku River Hydroelectric Co.

Pratt, H.D., P.L. Brunner, and D. G. Berrett. 1987. _The Birds of Hawaii and the Tropical Pacific_. Princeton University Press, Princeton, N.J.

Scott, J. M., S. Mountainspring, F. L. Ramsey, and C. Kepler. 1986 Forest Bird Communities of the Hawaiian Islands: Their Dynamics, Ecology, and Conservation. Studies in Avian Biology 9., Cooper Ornithological Society.

Sincock, J. L., and G.E. Swedberg. 1969. The rediscovery of the nesting grounds of Newell's Manx Shearwater (_Puffinus puffinus newelli_, with initial observations. Condor 71:69-71.

State of Hawaii, DLNR, Division of Water and Land Development. 1970. Basic Water Resources Data: Island of Hawaii. Report R34.

Tomich, P.Q. 1980. _Mammals in Hawaii_. Bishop Museum Press, Honolulu.

United States Army Corps of Engineers. 1980. Lava Flow Control, Island of Hawaii. Review Report and E.I.S.

United States Department of the Interior. 1970. U.S. List of Endangered Fish and Wildlife. Federal Register 35, No. 199.

United States Department of the Interior. 1984. Endangered and Threatened Wildlife and Plants. USFWS 50 CFR 17.11 and 17.12.

United States Fish and Wildlife Service. 1983. Hawaiian Dark-rumped Petrel and Newell's Manx Shearwater Recovery Plan. Portland, Oregon.

United States Fish and Wildlife Service. 1984a. Hawaiian Hawk Recovery Plan. Portland Oregon.

Table 1. Bird species list for the proposed Puainako St. extension corrodor. Relative abundance data are provided for species detected during surveys of an area approximately 1km south of the project site (Kjargaard, 1991). Native species are indicated by bold type.

SPECIES	Relative Abundance*
Buteo solitarius ('Io, Hawaiian Hawk)	.51
Streptopelia chinensis (Spotted Dove)	.45
Geopelia striata (Zebra Dove)	.45
Tyto alba (Barn Owl)**	
Asio flammeus sandwichensis (Pueo, Hawaiian Short-eared Owl)	
Chasiempis s. sandwichensis ('Elepaio)	
Garrulax canorus (Melodious Laughing-thrush)	4.54
Leiothrix lutea (Red-billed Leiothrix)	
Acridotheres tristis (Common Myna)	1.36
Zosterops japonicus (Japanese White-eye)	10.00
Cardinalis cardinalis (Northern Cardinal)	1.81
Carpodacus mexicanus (House Finch)	1.81
Hemignathus v. virens (Hawai'i 'Amakihi)	
Vestiaria coccinea ('I'iwi)	
Himatione s. sanguinea ('Apapane)	
Lonchura punctulata (Nutmeg Mannikin)	.78
Passer domesticus (House Sparrow)	

*Figures given are relative to the most abundant species in the area, in this case, the Japanese White-eye. For example, there were .51 'Io detected during the 1991 survey for each 10 Japanese White-eye.

**Barn Owl seen by resident of Pacific Plantations subdivision (Brilhante, Pers. comm.)

Appendix D

PUAINAKO ROAD EXTENSION

ENVIRONMENTAL IMPACT STUDY:

KAUMANA CAVE

Fred D. Stone, Ph.D.

University of Hawaii at Hilo

Hilo, Hawaii

November, 1992

EXECUTIVE SUMMARY:

Kaumana Cave is the main feeder lava tube of the 1881 pahoehoe lava flow from Mauna Loa. The location of the main Kaumana Cave entrance in a park near Kaumana Drive makes it one of the most visited and studied lava tubes in Hawaii. It is an important natural resource for tourism, recreation, education, and research on lava tube biology and geology. Based on these values, Kaumana Cave should be considered as a natural resource worthy of protection and conservation. The land overlying much of the readily accessible part of the lava tube, between Edita Street at 760 feet elevation and Kilua Street at 1020 feet, is the property of the State of Hawaii. This land is currently undeveloped and could be easily protected from future impacts.

Our preliminary Brunton compass/tape survey of Kaumana Cave determined that part of Puainako Alignment #1 was directly adjacent to and partially overlying the lava tube in two places. An engineering survey was then conducted by Okahara & Associates to determine the exact location of the lava tube, and to find out whether it was necessary to shift the road corridor.

The section of Kaumana Cave below Edita Street, which was mapped in the 1950's, was sealed by construction of Edita Street. During field reconnaissance I was unable to find further entrances to this closed lower section of the lava tube. Since the proposed Alignment #1 crosses the 1881 flow below Edita

Street, road construction might break open a new entrance. If this occurs, an accurate survey of the lava tube should be done. One important reason for knowing the location of the lava tube is that it is a conduit for flood water during heavy rains, and this could impact the road. Other older pahoehoe flows are crossed by the proposed Puainako Alignments between Komohana Street and Edita Street. No entrances were discovered, but clearing and bulldozing for the road might reveal cave entrances.

RECOMMENDED MITIGATION MEASURES:

1. Relocation of the road corridor away from Kaumana Cave to minimize damage to the cave and to the native ecosystems overlying it, and to reduce danger of road flooding from the lava tube conduit. If an adequate buffer zone (50 to 100 feet wide) cannot be provided adjacent to the lava tube along alignment #1, then the alternative alignment #3 would be preferable. The buffer zone should be wide enough to allow a strip of native vegetation between the road and the cave, and to prevent pollutants from the road and its margins, such as herbicides and petroleum spills, from leaching into the lava tube with surface water.

2. Investigation of additional lava tubes intersected during construction should be carried out to determine whether cultural, archaeological or biological resources are present.

DESCRIPTION OF KAUMANA CAVE:

Location, surface vegetation and drainage:

The area proposed for the Puainako Road extension is traversed by a series of pahoehoe lava flows, the most recent being the lava flow of 1881 containing Kaumana Cave. The commonly known portion of this lava tube lies between Edita Street at 760 feet elevation and Kilua Street at 1020 feet. Most of this distance, including over 1 mile of cave, is State of Hawaii land with an early successional community of mainly native plant species dominated by *Metrosideros* ('ohi'a) and *Dicranopteris* (uluhe fern).

Below Edita Street, Kaumana Cave was mapped for about one half mile in 1954 by Caceres, Moore and Carroll. The cave was not explored to its end at that time, and this section of the cave was sealed by construction of Edita Street. The survey used a compass, which led to a large, cumulative error in the location of the lower end of the cave. This area is also covered by *Metrosideros* and dense thickets of *Dicranopteris*. The road corridor traverses the 1881 flow here, and could possible intersect the cave.

Above Kilua Street upper Kaumana Cave continues as a series of 2 or 3 parallel passages to Uhaloa Street at 1070 ft. elevation in Kaumana Village. Upslope of Uhaloa Street it crosses under Wilder Road, and underlies the forested area south of Kaumana Drive as a maze of passages. The cave appears to be sealed by Saddle Road fill at about 1180 ft. Above this elevation, Saddle Road continues on the 1881 lava flow, but no further cave entrances were discovered. Above Kaumana Village the Puainako Alignments are on older lava flows adjacent to the 1881 flow.

Road drainage from Saddle Road is diverted into Kaumana Cave through a roadside entrance at about 1100 feet elevation in Kaumana Village, causing sudden flooding of the cave. Just past the end of Kilua Street, at 1020 feet elevation, a surface stream disappears under the Kaumana lava flow. Below here, the lava apparently flowed down a stream channel, and this resulted in a perched water table underneath the cave. Some cess pools in Kaumana Village drain directly into Kaumana Cave, and others overflow into the cave during heavy rains. Additional road and cess pool drainage enters the lava tube both above and below the main Kaumana Cave (Park) entrance. Lower parts of the lava tube flood during heavy rains, and occasionally flow over Edita Street (according to a local resident, this happened during the extremely heavy rains of the 1970's). A drainage channel has been constructed above Edita Street to carry the flow below the road. This drainage channel is at right angles to the lava tube, and carries the water past the proposed Puainako Alignment #1 to a culvert under Edita Street. Presumably, the water finds its way back into the lower portion of Kaumana Cave below Edita Street. The presence of the lava tube as a drainage conduit beneath parts of the road alignment should be addressed in the engineering plan for Puainako Extension.

Cave description:

The Edita Street entrance to Kaumana Cave is located between 217 and 253 feet along Edita Street northwest of the Puainako Alignment #1, from the metal peg on the southwest margin of the drainage ditch above Edita Street. The entrance, which was opened during construction of Edita Street, is about 35 feet wide and from 1 to 5.5 feet high. Metal bars have been set in this entrance but one of the bars has been cut allowing access to the cave. According to residents across the road from this entrance, during heavy rains in the mid-1970's, Kaumana Cave flooded and water gushed from the cave and covered Edita Street.

Distances are through the cave upslope from the Edita Street entrance

0-40 ft.	Directly inside the entrance, the cave is 35-40 ft. wide and 2.5-5 feet high. This low passage has several large lava boulders wedged between the floor and ceiling, carried down the cave by flood water.
40-450 ft.	About 40 feet inside, a passage 10-28 feet wide and 4-8 feet high continues upslope to about 400 feet from the Edita entrance. Here, the passage splits into two adjacent passages for 50 feet. From the Edita entrance to this point, the cave trends roughly southwest (facing upslope), and gradually approaches the Puainako Alignment #1,

from 200+ feet northwest to 50 feet northwest. This section of cave has abundant <u>Metrosideros</u> roots, and is rich in cave life.

450-800 ft. After rejoining, the passage bends to the south for 60 ft., and falls directly beneath Puainako Alignment #1. Then, from about 500 to 800 feet, the passage bends toward the west, remaining under the alignment for about 250 feet, until just past a second short double passage, and then trending gradually northwest of the alignment. This section of passage is 10 to 20 feet wide and 5 to 8 feet high. The passage continues to have many <u>Metrosideros</u> roots and the associated cave species.

800-925 ft. The passage splits again at about 800 feet, with a broad, low passage to the north and a narrower passage to the south. Maximum width is 45 feet, height is about 6 feet. Breakdown blocks from ceiling stoping occur at the intersections where the passage splits and rejoins.

925-1300 ft. The cave continues to trend west for about 375 feet, 10 to 20 feet wide and 4.5 to 8 feet high. At about 1300 feet from Edita Street, the cave is again about 200 feet northwest of the Alignment. It continues to have abundant <u>Metrosideros</u> roots and cave life.

1300-1700 ft. The tube bends back toward the south for about 250 feet, and again falls under the northwest side of the Alignment. At 1300 feet, the passage splits into two major segments, which rejoin 400 feet later. At 1500 feet, the passage splits again on the north side and south sides, making 4 parallel passages over 100 feet in total width. The passage to the south is a low crawl rich in roots and invertebrate species. It lies directly under proposed Alignment #1. The remaining 3 passages from 1500 to 1700 feet contain massive ceiling collapses. The cave here is 20 to 60 feet wide and 4 to 8 feet high. This section is adjacent to the Alignment, making it extremely susceptible to further collapse from road work.

1700-1850 ft. For the next 150 feet, the cave bends back southwest, remaining directly adjacent to the Alignment. It is large here, 10 to 18 feet wide and 7 to 12 feet high. Roots and cave species continue to occur here.

1850-2350 ft. The cave trends to the west away from the road Alignment for the next 500 feet. The width varies from 10 to 25 feet and the height from 5.5 to 15 feet. This section of the lava tube has Metrosideros roots and is rich in endemic cave species.

2350-2760 ft. The passage trends northwest throught this section. From 2580 to 2640 feet the cave splits into two low passages. The width varies from 10 to 35 feet and the height is 2.5 to 15 feet. A small adit branches off of the north passage, with many names chipped into the wall lining. The cave passes under Kaumana Drive at about this point. Probably because it goes beneath an area with the road and houses, there are no 'ohi'a roots and very few cave invertebrates. There is often a strong odor of sewage at about 2760 feet, where the tube passes under houses.

2760-3020 ft. The lava tube turns southwest again at 2760 feet, and the cave quickly becomes a 2-level passage. The upper level is passable. It has a red surface color, indicating that a sky-light was open here while the lava was flowing, causing it to form an oxidized crust. There are few Metrosideros roots in this section due to the surface construction. At about 2900 feet, just before a depression in the floor of the upper level, a line of calcite is deposited on the floor, probably due to a concrete driveway or culvert overhead.

3020-3490 ft. The passage trends south by southwest to the main Kaumana Cave entrance at 3490 feet from the Edita Street entrance. This passage is generally large, 10 to 20 feet wide by 2 to 15 feet high. A constriction occurs at 3200 feet. After this narrow spot, the entrance is visible and the cave becomes large again. Metrosideros roots again become numerous, and the inner part of this section has a few cave planthoppers and crickets, though it is too close to the entrance to have a diverse cave fauna. A large ceiling and wall collapse has occurred at 3250 feet. At the lower end of the main entrance, Kaumana cave is about 30 feet wide and 12 feet high. A lower level passage passes directly beneath the entrance pit, emerging inside the up-slope end of the lava tube.

Distance upslope from the main Kaumana Cave entrance:

0-750 ft. Just above the Kaumana entrance, the cave passes beneath Kaumana Drive. This section is a large chamber in which a lava lake had frozen over and then drained, causing the oxidized surface to collapse. In the back of this room, a duck-under leads into a large passage 10 to 30 feet wide and 15 to 30 feet high, with one low spot about 5 feet high. This section underlies a native 'ohi'a forest, so it has abundant Metrosideros roots and a rich cave fauna. This large passage is regularly used for class field trips and for research on the ecology and evolution of the cave species.

750-1000' At about 750 feet, the passage becomes wider and filled with ceiling breakdown. Two upper level side passages branch off here. The one on the left (southeast) soon rejoins the main passage. The right passage is low and leads into dead-end chambers rich in cave life. Beyond these side passages, the cave is 15 to 25 feet wide and 10 to 25 feet high, with breakdown from ceiling collapse.

1000 ft to Kilua Street: This section of Kaumana Cave, est. 750 feet long, has not yet been surveyed. A small skylight entrance here is followed after about 50 feet by a second small entrance which opens into native _Metrosideros-Dicranopteris_ forest. After this point, the lava tube is transected by a series of 4 more large entrance pits, alternating with double passages from here to the Kilua Street entrance. The passages are large and breakdown filled, with some nice lava formations. This section of cave is near the proposed Puainako Alignment #1, but the exact location will not be known until the engineering survey is completed. The Kilua Street entrance is located on the makai side of the road, about 300 feet past the Kilua-Pomona Street intersection. The pit (which probably gave its name to Kilua Street) was used as a garbage dump for a long period. Many of the cans and bottles found through lower Kaumana Cave wash down from here during floods.

Kilua Street to Kaumana Village: This section, about 1500 feet long, has not yet been surveyed. About 50 feet beyond the entrance garbage pile, a duckunder leads to an intersection room with 3 passages. The north passage appears to end in lava covered breakdown, but a belly crawl passes over this barrier and leads into the continuation of the lava tube. A series of low double and triple passages continues and becomes larger for about 1500 feet to Kaumana Village, where an entrance occurs next to the first cross street. Few people have entered this part of the cave, and there are numerous delicate lava stalactites and stalagmites. Parts of the tube have thick Metrosideros roots, and the associated cave species. Flooding and sewage contamination regularly occur in this section of the cave.

Under Kaumana Village to the upper entrances:

Just past the first Kaumana Village entrance, a small opening exists on the road margin. The drainage ditch from Kaumana Road channels runoff water into the cave through this roadside entrance. Beyond here, the cave is extremely low and muddy. Double and triple passages are 30 to 40 feet wide and 1 to 5 feet high. This part of the cave is extremely hazardous due to the danger of flash floods. It is also contaminated by cess pool drainage. Above Wilder Road, the lava tube passes under a section of Metrosideros-Dicranopteris forest. There are abundant roots and a rich cave biology. Three small entrances open into the dense vegetation. Beyond the third entrance is a low, complex maze section. Most extensions become too low to allow passage. A large meander occurs here, with a large flood passage going east from the maze section. A passage 5 to 8 feet high passes toward Saddle Road, with an upper level former entrance sealed by road fill. The lower passage passes under Saddle Road to a tight 'a'a choke with good air flow. Near the former entrance, names are chipped into the wall lining: H.P. & C.L., 12/31 91, OAKLAND, CAL. These people must have entered the cave in 1891, when the lava flow was only 10 years old, and still largely unvegetated.

RESOURCE VALUES OF KAUMANA CAVE:

Tourism and recreation:

Nearly any day of the week, a tourists and curious local residents stop at the Kaumana Cave parking area and go into the large lower entrance to look at lava tube and take pictures. The more adventuresome, who remembered to bring lights, venture deeper into the passageways. On weekends, groups are usually picnicking in the pavillion near the entrance pit, before or after exploring the cave. Names pecked into the wall lining of the lower cave passage give a historical record of visits going back to the 1910's. More recently, visitors have sprayed their names with paint.

Part of the attraction of Hilo's "wild" cave is the successional 'ohi'a forest that remains over the cave, sending roots deep into the cracks of lava.

Over the past 8 years, I have had a project with various youth groups (4-H, Hawaiian summer program at UH, visiting high school students from other islands, University of Hawaii at Hilo and Hawaii Community College students) to clean up Kaumana Cave. We have removed much of the garbage, and scrubbed the graffiti from the upper passage and from a large section of the lower cave. Since this project, visitors seem to leave the cave in much better shape than before. Recently, there has been little new trash and graffiti compared to previously.

This lava tube should be recognized by the State of Hawaii as an important addition to the local visitor attractions.

Educational:

Kaumana Cave is near enough to H.C.C. and U.H.Hilo to make it a valuable "field laboratory" to teach classes in volcanism, ecology and evolution of Hawaii's endemic species and psychology of perception. Over the past year, I have taken over 10 classes totaling about 150 students into the cave. The cave is particularly suited for class trips due to its location in Hilo, its proximity to Kaumana Drive, and the large passages with abundant features. I have also taken several groups of science teachers from the entire state into the cave over the past eight years. Many of these teachers have returned with student groups, so the overall impact of the cave is enormous.

Biological resources:

Kaumana Cave has been colonized by at least 15 species of endemic cave invertebrates over its 110 year history (Table 1). This list does not include species found in upper elevation portions of the lava tube, but only those in the section impacted by the planned road extension. Survival of these species is dependent on the native 'ohi'a/uluhe successional forest overlying it. Sections of the cave which do not have Metrosideros roots, due to surface clearing, are virtually devoid of cave species.

Although none of the Kaumana species is unique to the cave, or is on an endangered species list, it offers an almost unparalleled opportunity to study ecological interactions and evolutionary adaptations by the cave invertebrates. Colonization of the lava tube from the surrounding substrate is in itself an interesting research topic. I am currently studying the evolutionary relationships among the 3 species of cave cricket in Kaumana, with joint researchers from Bishop Museum and the University of Connecticut (C. Simon, F. Howarth and F. Stone). A scientist from Japan is studying circadian rhythms in relation to loss of sight in the crickets (I. Nakatani, F. Howarth and F. Stone). German researchers studying the evolution of calling signals by the cave planthoppers of Kaumana Cave have found that populations from different caves have unique calls (Hannalore Hoch, Mannfried Asche and Frank Howarth).

A large National Science Foundation research project is comparing native forest growth in a patch of forest over Kaumana Cave with forests on the same and different lava flows at various elevations (Peter Mueller-Dombois and Peter Vitousek). Their study plot is directly adjacent to the geological bench mark across the road and slightly mauka of Kaumana Cave main entrance.

Table 1

Native Invertebrates Occurring in Kaumana Cave:

Arthropoda

Crustacea:	Papuaphiloscia laevis (introd. ?)	(Isopoda)
Chilopoda:	Lithobius sp.	(Lithobiid)
Diplopoda:	Nannolene sp.	(Cambalid)
Araneida:	Erigone stygius	(Linyphiid)
	Oonops sp. ?	(Oonopid)
Insecta:	Sinella yosiia	(Collembola)
	Caconemobius varius	(Gryllid)
	C. sp. A	(Gryllid)
	C. sp. B	(Gryllid)
	Oliarus polyphemus	(Cixiid)
	Schrankia 2 + sp.	(Noctuid)
	Moth (unknown genus)	
	Forcipomyia pholetor	(Ceratopogonid)
	Limonia cf. jacobus	(Tipulid)
	Phytosciara volcanata	(Sciarid)
	Mycetophilidae ?	(Mycetophilid)

Geology and Hydrology:

The 1881 lava flow is an excellent model for studying the formation of lava tubes. More importantly, it should be used by planners to show how a tube-fed pahoehoe lava flow can cover long distances and reach the lower slopes of Mauna Loa Volcano. From an area above Puu Ulaula, at about 10,000 feet elevation, the 1881 lava flow proceeded through lava tubes for over 25 miles, reaching the 150 foot elevation below Kumukoa Street before the eruption ceased. This flow followed a sequence of earlier pahoehoe lava flows that reached (and formed) the peninsula below Hilo. More recent lava flows, such as those of 1942 and 1984, have followed the same general path, but have stopped before reaching Hilo. However, any hazard assessment should take into account the possibility of future Mauna Loa lava flows following the past of these historic flows toward and into Hilo.

Flood hazards of the 1881 lava flow is mentioned above under the lava tube description. This tube, and other undiscovered lava tubes in older lava flows, serve as conduits that focus and channel flood water toward the upper to the lower segments of the project area. Since the proposed Puainako Extension traverses several of these pahoehoe flows, the potential of flooding is high and should be considered in the road design.

REFERENCES:

Caceres, S., Moore, E.C. & Carroll, J.L. 1954. Map of Kaumana Cave. Hilo Tribune-Herald, 21.Mar.1954, p. 8.

Howarth, F.G. and Stone, F.D. 1982. The Conservation of Hawaii's Cave Resources. in C.W. Smith, ed. Proceedings of the Fourth Conference in Natural Sciences, Hawaii Volcanoes National Park. Dept. of Botany, Univ. of Hawaii, Honolulu, Hawaii.

Simon, C., Howarth, F.G. and Stone, F.D. 1990. Ecology and Evolution of Hawaiian Cave Crickets and Cave Planthoppers. Grant from State of Hawaii, Hawaii-Bishop Research Institute.

Stone, Charles P. and Stone, D.B. 1989. Conservation Biology in Hawaii. Univ. of Hawaii National Park Resources Studies Unit. Honolulu, Hawaii.

Stone, Fred D. 1991. Hilo to Waimea Pipeline Environmental Impact Study: Lava tubes, Invertebrates. Young Ki Hahn and Associates, Hilo, Hawaii

Stone, Fred D. 1986. Native fauna along the Saddle Road right-of-way. Saddle Road improvements Environmental Impact Study. County of Hawaii. Hilo, Hawaii

Stone, Fred D. 1986. Lava tube survey along the Saddle Road right-of-way. Saddle Road improvements Environmental Impact Study. County of Hawaii. Hilo, Hawaii

Wagner, W.L. et al. 1983. Biological reconnaissance and environmental impact assessment of HECO/HELCO proposed cross-Hawaii Island 138 kv transmission line: botanical, entomological and malacological report. Prepared for EDAW, Inc. by B.P. Bishop Museum. Addendum to Environmental Impact Statement, Kaumana to Keamuku 138 kv transmission line. EDAW, Inc., August, 1983.

Appendix E

Archaeological Inventory Survey

Pu'ainako Street Extension Project

Lands of Waiakea, Kukuau 1 and 2, and Ponahawai,

South Hilo District, Island of Hawai'i

By Terry L. Hunt, Ph.D.

and

Matthew J. McDermott, B.A.

Prepared for Okahara & Associates, Engineering Consultants

200 Kohola Street, Hilo, Hawai'i 96720

July 1993

Table of Contents

List of Figures

List of Tables

Acknowledgements

Several people contributed significantly to this project. In particular, We would like to thank Paula DeMorales, Melissa Kirkendall, Eric Komori, Jonas Madeus, Jadelyn Moniz, Ted Novack, Michael Pfeffer, and Alexei Vranich. Special thanks go to Timothy Nicholson, and others at Okahara and Associates, Tim and his assistants provided project maps after many hours with the computer. My colleagues on the EIS team, Youngki Hahn, William Moore, and Ron Terry helped with the project in many ways.

Introduction

Background

At the request of Okahara and Associates, Inc., Hilo, an archaeological inventory survey and historical background study were undertaken on the Pu'ainako Street Extension alternative alignments in Hilo (Figures 1 and 2). This study includes a review of previous archaeological work in the region, an historical literature and documents search, a Land Commission Award search, analysis of historic maps, in-depth interviews with knowledgeable local informants, intensive field recording of all sites/features, and excavation of five representative features in the project area. The objective of our work is to provide an inventory of the archaeological resources in the project area, make functional and significance designations, and recommendations for mitigating the impact of construction to historic resources. These objectives were set to satisfy all historic preservation regulatory review requirements of the State Historic Preservation Division, Department of Land and Natural Resources (SHPD-DLNR).

A reconnaissance survey took place in July and August, 1992. This reconnaissance survey was undertaken under the supervision of Field Archaeologist Melissa Kirkendall, M.A. With the initial field work we identified areas with no archaeological resources, as well as those with comparatively high densities of features. More intensive inventory-level archaeological field recording and test excavations, historical research, and interviews, were completed from May-July, 1993. This continued work focused on areas where archaeological features had been identified during reconnaissance. The 1993 field work was supervised by Field Archaeologist Matthew McDermott, B.A. Overall project direction and research were the responsibility of the author. Preliminary findings from field and historical research were reported in meetings with Okahara and Associates, Dr. Ross Cordy and Kanalei Shun of the State Historic Preservation Division, and with community members and University of Hawai'i-Hilo students.

Scope of Work

This report provides results of an inventory-level archaeological survey and the appropriate background research. The scope of work, established in consultation Ross Cordy and Kanalei Shun,

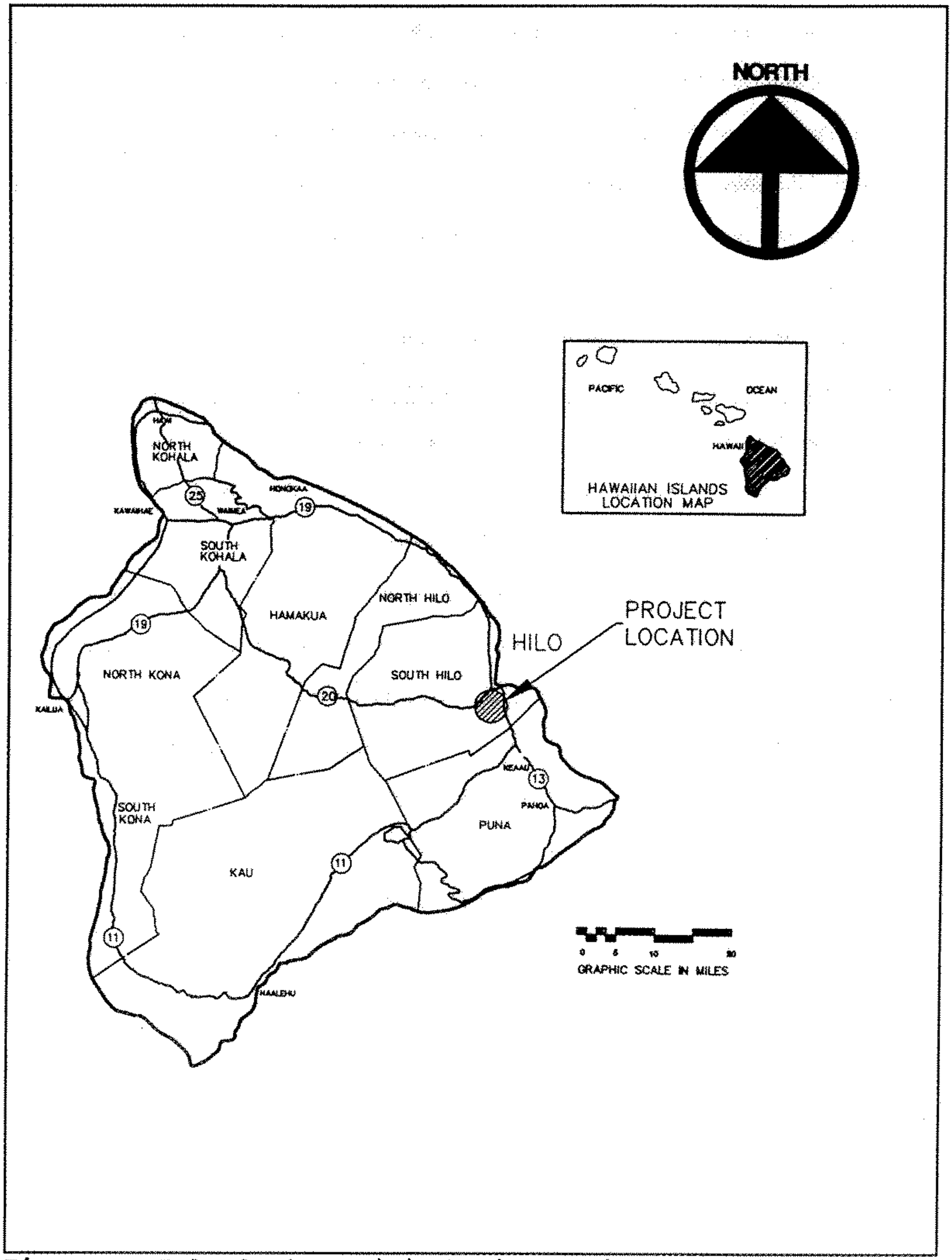


Figure 1 Island of Hawai'i showing project area in Hilo.

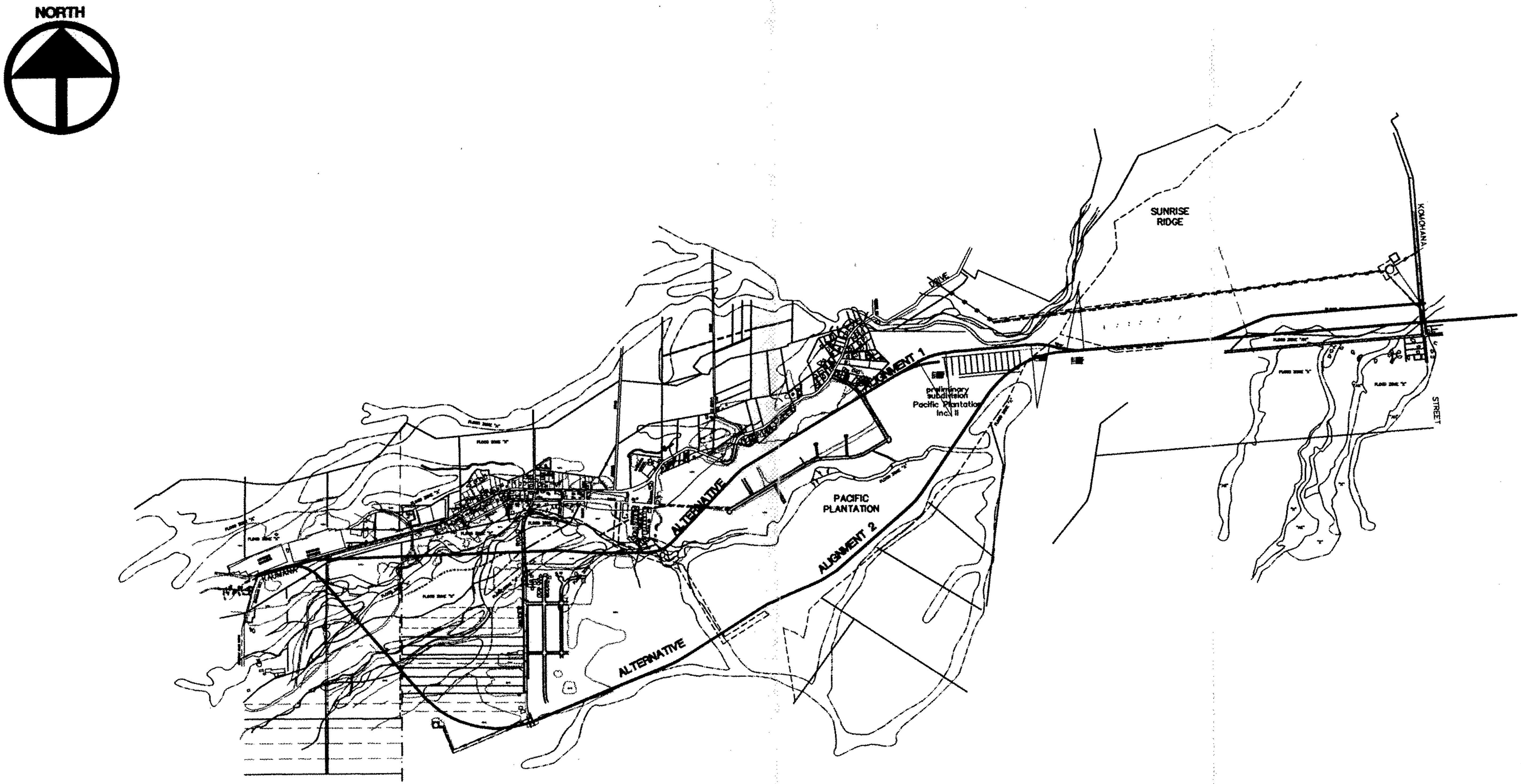


Figure 2 Pu'ainako Road Extension upper project areas (above Komohana Street).

SCALE: 1"=2000'

93042F2

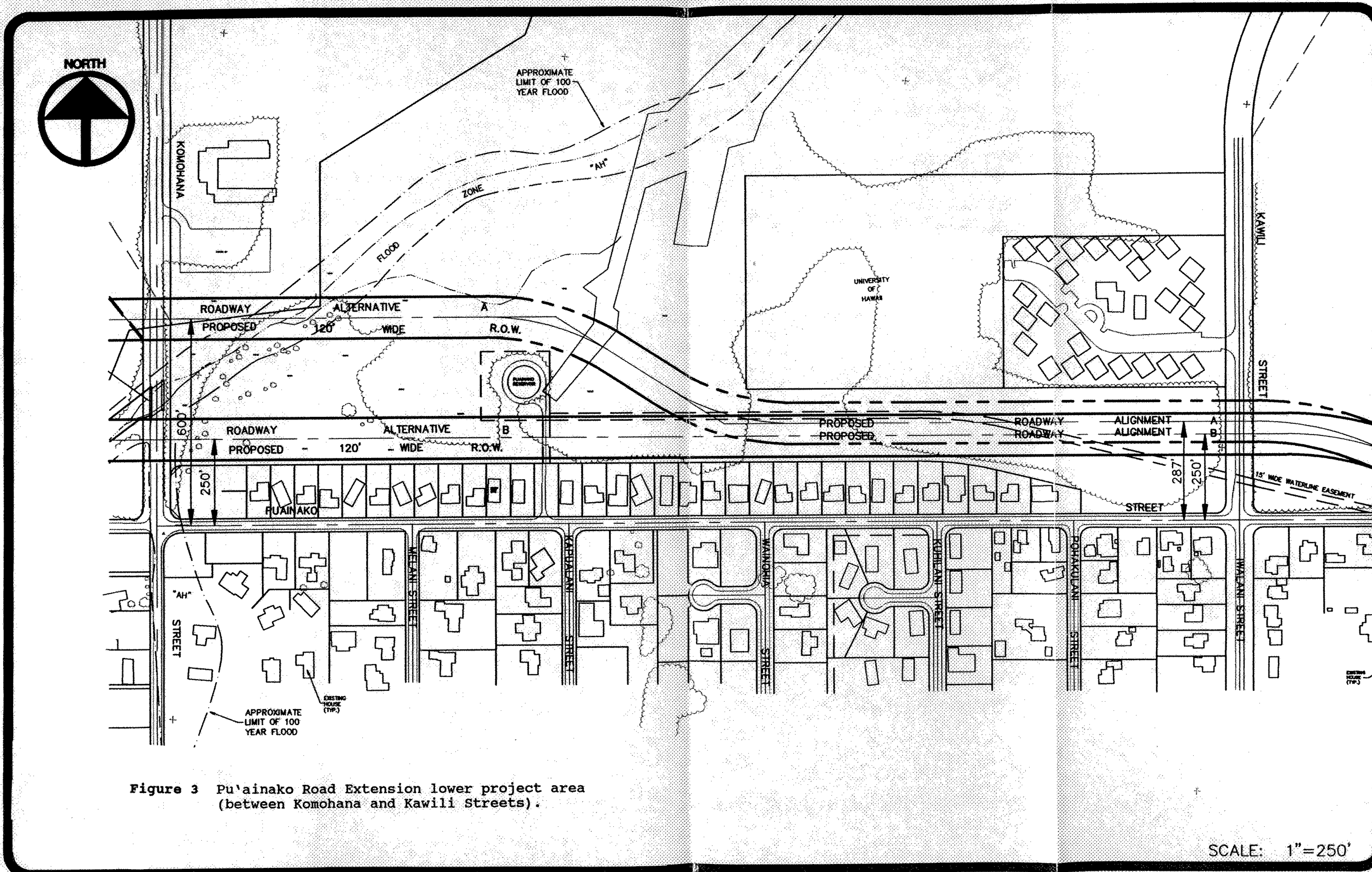


Figure 3 Pu'ainako Road Extension lower project area (between Komohana and Kawili Streets).

93042F5

SHPD, includes three general objectives: 1) to identify all archaeological resources potentially affected (or destroyed) by the proposed project; 2) to ascertain the age, function, and significance of the identified resources in the project area; and 3) to determine what steps to take to minimize impact to the archaeological resources, including preservation, data recovery, or other mitigative work necessary.

These objectives were met by 1) historical (archival) research of lands in and around the project area; 2) interviews with local informants knowledgeable of the area and its history of occupation and land use; 3) a complete, intensive pedestrian survey of the project area (including detailed mapping, description, and photography of the archaeological remains) ; 4) limited subsurface testing of sites/features by hand excavation; 5) analysis of field, interview, and historical evidence; and 6) report preparation, with recommendations for impact mitigation and preservation.

Significance of the archaeological remains identified in this project was assessed according to the criteria delineated in the National Register Criteria, Code of Federal Regulations (36 CFR Part 60), and by the National Advisory Council on Historic Preservation. The site significance criteria include those that 1) reflect major trends in the history of the state or nation (Criterion A, Event); 2) are associated with the lives of persons significant in our past (Criterion B, Person); 3) are excellent examples of site types (Criterion C, Design/Construction, e.g., interpretive value); 4) are likely to yield information important in history or prehistory (Criterion D, Information Potential); and/or 5) have cultural significance (Native Hawaiian, or other ethnic group). Applying these criteria to archaeological remains in Hawai'i most often suggests preservation, or as a form of mitigation, data recovery, where sites yield information important to history or prehistory (D), have notable interpretive potential (C), and reflect, perhaps uniquely, the broad patterns of prehistory or history (B). In the case of Criterion D (information potential), following adequate data recovery, sites are no longer considered significant.

Project Setting

The proposed Pu'ainako Road Extension forms transects that cross lands from Kaumana (Saddle Road) down to lower elevations (Kawili Street, see Figure 2) on the largely undissected uplands of Mauna Loa. Elevations of the project area extend from 1500' to 200' (ca. 460 - 60 m), traversing rain forest, the recent (1881 A.D.) Mauna Loa lava flow, land previously in planted in commercial sugarcane, intermittent streams and flood zones, and residential neighborhoods.

The project area crosses Mauna Loa lava flows that vary in radiocarbon age from the Punahoa (3,000-4,000 BP) in the lower areas (between Komohana and Kawili Streets), to the Kulaloa flow (1,100-1,400 BP, above Komohana), to the well-known 1881 flow (see Lockwood and Buchanan-Banks 1981, 1982). As a consequence of these various ages, flow substrates form a mosaic of differential soil development, vegetation, and agricultural/land use potential. Soils form in limited deposits of volcanic ash and in lava from organic matter and small amounts of sediment, creating limited areas of continuous soil. In the younger substrates soil is found only in pockets.

The predominant soils in the project area, especially where archaeological sites are found (see below), include the Series of Pana'ewa very rocky silty clay loam and Keaukaha extremely rocky muck. In the early *Soil Survey of the Territory of Hawaii* (1955) the Pana'ewa and Keaukaha Series soils came under "soils poorly suited or unsuited to mechanized agriculture" (USDA 1955:396):

> The soils are generally marginal, or in some places submarginal, for sugarcane. The shallow stony soils of this group were used for cane at the time of survey.... The introduction of mechanical harvesting, well underway by 1948, made the shallowness and stoniness of these soils an important handicap. Loose rock collected by the harvesting machines is carried to the mill, where it causes considerable damage. Removal of much of the surface rock was underway in 1948.

Soils of greater agricultural potential (Kaiwiki silty clay loam) formed in volcanic ash deposited several thousand years ago. These soils found in the upper project area were recently under mechanized sugarcane cultivation.

Rainfall over the project area is high (ca. 130-200 inches annually), increases with elevation, and occurs with little seasonal variation. Intermittent and perennial streams cross the project area, notably the Alenaio (Waipahoehoe) and Waiakea streams. However, sections of the Waiakea drainage have been artificially cut after ca. 1940 for purposes of flood control. Earlier maps show a poorly developed channel, that in some sections flooded over wide areas during periods of high rainfall.

Historic and recent land use in the project areas has included woodland/rainforest, pasture, and commercial sugarcane. These uses correspond to the restrictions imposed by geologic substrate and soil development. Vegetation patterns--ranging from *'ohi'a* forest to guava thicket to grassland--reflect these features as well. Secondary growth of non-native flora dominates those zones previously under commercial sugarcane cultivation or used as for pasture.

Historic Background

Prehistory and Early Hawaiian History

The project area crosses the *ahupua'a* of Waiakea, Ponahawai, and Kukuau 1 and 2 in the South Hilo District. According to *Place Names of Hawaii* (Puku'i et al. 1974), Kukuau is the name for a species of graspid crab, Ponahawai means, "water circle," and Waiakea is named after a legendary man who lived in the Hilo area.

The significance of Hilo in ancient times is suggested by Kamakau (1981:15-17) in his account of 'Umi-a-Liloa, a paramount chief who is reported to have ruled Hawai'i Island in the 16th century. The account mentions Umi taking Waiakea, the residence of Kulukulu, a Hilo chief. This reference suggests a prominent place for Hilo in the social and political prehistory of Hawai'i Island, probably owing in part to the dense resources provided by fishponds and irrigated taro. Umi's securing of Kulukulu's chiefdom also implies a relatively dense population in the Hilo area in ancient times. It appears the *ahupua'a* divisions of the Hilo area were created in the late 16th or early 17th century, and include Pu'u'eo, Pi'ihonua, Punahoa, Ponahawai, Kukuau, and Waiakea (Kelly et al. 1981:3).

Several historic sources point to the varied and abundant resources of the Hilo area (e.g., McEldowney 1979; Kelly et al. 1981). Waiakea Ahupua'a runs from the ocean to the from the shoreline to about 3,800 ft in elevation, and Ponahawai extends to 2,700 feet before bordering the *ahupua'a* of

Pi'ihonua. Annual rainfall in this area is between 130 and 200 inches and can be divided into five land use zones: Coastal Settlement, Upland Agricultural, Lower Forest, Rainforest, and Sub-Alpine or Montane (after McEldowney 1979).

<u>Prehistoric Land Use Zones</u>

An archaeological and historical overview of the Hilo region by McEldowney (1979) documents the presence, or previous existence of several significant resources of historic and prehistoric age in the Hilo region. These include *heiau*, legendary places, burial caves, lava tubes with evidence of extensive Hawaiian use, stone constructions (e.g., platforms, terraces, and enclosures), and historic structures. McEldowney's (1979) review also provides a basis for anticipating the distribution and kind of archaeological resources in the project area. In terms of expectations for archaeological resources, McEldowney (1979) used historic sources to outline ancient and post-contact land-use by zones. These include the sub-alpine or montane zone, rainforest, lower forest, upland agricultural, and coastal settlement zone.

Sub-Alpine or Montane Zone

Only Waiakea Ahupua'a contains a representation of all five land-use zones, as the sub-alpine zone extends from the 5,500 foot level upward. Waiakea ends at the 6,000 foot level where it meets the *ahupua'a* of Humu'ula. Humu'ula included the high quality basalt adze quarry near the summit of Mauna Kea (Kelly et al. 1981:5-6).

Rainforest Zone

The rainforest zone extends from 2,500 to 5,500 feet in elevation and, in the Hilo area, was extensively exploited by hunters and bird catchers. Both the *mamo* and *o'o,* two extinct Honeycreepers, were found in great numbers in the Hilo rainforests. These birds were prized for their brightly colored yellow and red feathers (used to make feather helmets, leis, and capes for the chiefs). The presence of these valuable bird species greatly increased the value of the rainforest region of these ahupua'a and were jealously guarded (Kelly et al. 1981: 6-7). Waiakea, Kukuau, and Ponahawai extended into the rainforest zone and were likely exploited in prehistoric times for the birds with their prized feathers.

Lower Forest Zone

The lower forest zone, extending from 1,500 to 2,500 feet in elevation, was utilized, according to McEldowney (1979), for some cultivation and gathering of forest products. Many of the woods used for canoe building, household needs, and religious idol making came from this zone. The large *koa* trees used for canoe building were found in this zone along with many species of plants such as *olona*, *ie'ie* (for fiber), and *mamaki* (for bark cloth). Food plants such as banana, taro, sweet potato, yam, and other crops were grown in small forest clearings (McEldowney 1979:25-28). One example of the use of this zone is Kamehameha's cutting of large *koa* trees by as he prepared his great fleet of war canoes during his conquest of the islands in the 1790s (Kelly et al. 1981:7).

Concerning archaeological potential, McEldowney (1979:25) writes:

> Historic accounts suggest that a cluster of small huts, small religious shrines, and numerous paths were frequented by a family unit or group of workers for these purposes. The probability of finding structural or artifactual evidence of these activities appears low due to the temporary nature of the huts and the dense character of the ground cover, which would close unused paths and cleared areas.

Upland Agricultural Zone

The upland agricultural zone, extending in a belt from variable distances inland to the lower forest zone (1,500 feet), was planted in dryland taro, bananas, breadfruit, *kukui* (candle-nut) and various other plants. According to McEldowney (1979), this zone was probably transformed by extensive swidden, or slash-and-burn agriculture. Historic sources show that the upland agricultural zone had scattered huts, adjacent garden plots, and small groves of economically important trees up to the edge of the forest (McEldowney 1979:18). This zone of cultivation and with limited occupation corresponds to ash-derived soils in the region, but may have extended beyond to the use of younger, more poorly developed soils (e.g., the Keaukaha and Pana'ewa Series). Consequently, prehistoric archaeological resources could occur in this zone, but preservation is unlikely given later land use.

Coastal Settlement Zone

The coastal settlement zone, extending from the shoreline to the upland agricultural zone (varying elevation) was the most intensively utilized land in ancient times. It was also the most densely inhabited. Irrigated and dry taro, bananas, breadfruit, *kukui* nut, pandanus, *ti*, and other plants were intensively cultivated in this zone. In addition, large fishponds and pig enclosures were constructed in this zone. The fishponds in Waiakea, long known as the Royal Ponds, were an important resource that became the exclusive reserve of Kamehameha I. These ponds, along with a number of smaller ponds utilized by the rest of the population supported large populations of mullet, *'awa*, *ahole*, and *'o'opu,* as well as other fish, and provided habitat for large numbers of water fowl. Fishing and shellfish and seaweed (*limu*) gathering were also important coastal resources exploited in this zone (Kelly et al. 1981:7, 11-19).

The wealth of resources and population in Hilo are reflected in the chiefly controls held over the District, especially the *ahupua'a* of Waiakea. Kamehameha I lived for a time in the Hilo area and built many of his large war canoes at Hilo. The availability of large koa trees in the forests of the Hilo area made it an ideal place to carve war canoes. When Vancouver visited Hilo in 1794, he found Kamehameha I stocking food and making war canoes for his conquest of the Hawaiian Islands. Kamehameha I had substantial land holdings in the Hilo area. At his death Kamehameha I gave his land holdings in the Hilo area to his son, and to various of his trusted chiefs. Waiakea, along with several other *ahupua'a*, were given to his son Liholiho. Kukuau 1 and 2 were given to his trusted *haole* advisor chiefs John Young and Isaac Davis. Ponahawai was given to Keawe-a-Heulu, one of Kamehameha's chiefs who died during an epidemic on O'ahu (Kelly et al. 1981:11).

The *ahupua'a* of Waiakea, given to Liholiho at Kamehameha I's death in 1819, was given up in the Great Mahele in 1848 and became a Crown Land. However, the *'ili kupono* of Pi'opi'o, a part of

Waiakea Ahupua'a, was held by Ka'ahumanu and descended to Kina'u and Victoria Kamamalu and became a part of Bishop Estate (Kelly et al. 1981:40).

Kukuau Ahupua'a 1 and 2, given to Isaac Davis and John Young went to their descendants. In the Great Mahele one of Davis' sons received a large portion of Kukuau 2 (3,450 acres, LCA 8521-B) and Young's son received 9,360 acres of Kukuau 1 (LCA 8515, see discussion below). Ponahawai Ahupua'a was given up in the Great Mahele by Kinimaka, the nephew of Keawe-a-Heulu, and became Crown land (Kelly et al. 1981: 40).

Heiau

Drawing on Native Hawaiian informants from around the turn of the century and extensive field survey, Thrum (1907a, 1907b) and Stokes (1991) documented *heiau* sites for the Island of Hawai'i. For Hilo Thrum (1907b:55) wrote:

> Of the heiaus of the district of Hilo little evidence of their existence now remains, so complete has been their destruction, but though their stones are scattered, much of their history is yet preserved.

Thrum (1907a:40-41) lists 16 *heiau* for Hilo District. Of these, three were located near the coastline in the *ahupua'a* of Waiakea. *Heiau* sites are not known for Kukuau or Ponahawai *ahupua'a*. The Waiakea *heiau* included Kapaieie (unknown class, Site 18883) near Honokawailani; Makaoku (*luakini* class, Site 188843) on the shore opposite Coconut Island connected with the Mokuola (Coconut Island) place of refuge (*pu'uhonua*); and Ohele (*luakini* class, Site 18884) reported to have been near the old Pitman store. These *heiau* were entirely destroyed in the nineteenth century (see Thrum 1907a, 1907b; Stokes 1991:154-155).

Prehistoric Settlement Pattern

A careful examination of archaeological evidence, combined with early historic accounts, maps, Land Commission Award information, and oral traditions can be used to reconstruct a picture of the settlement pattern of particular areas in ancient Hawai'i. In the Hilo area prehistoric settlement was centered around the coast (coastal settlement zone), around Hilo Bay, and extended into the upland agricultural zone. The vast majority of the habitation, religious, utilitarian, and other structures would have been located near the coast (McEldowney 1979:15). Early descriptions of Hilo, by Vancouver (in 1794) and others, indicate that the coastal region was inhabited and under anthropogenic vegetation:

> Round the bottom of this bay was a track (sic.) of low land that extended a considerable distance to the eastward and adorned with beautiful groves of cocoa nut palms and bread fruit trees, amongst which were scattered the habitation of the natives. The whole was fertilized by two considerable streams of fresh water that emptied into the bottom of the bay (from Moniz 1992:7).

William Ellis (1963) toured the island in the 1823 and described the Waiakea area of Hilo as:

> *Hiro* [Hilo], which we had now left, though not so extensive and populous as Kona, is the most fertile and interesting division on the island. The coast from Waiakea to this place is bold and steep, and intersected by numerous valleys or ravines... This part of the island, from the district of Waiakea to the northern point, appears to have remained many years undisturbed by volcanic eruptions. The habitations of the natives generally appear in clusters at the opening of the valleys, or scattered over the face of the high land... (Ellis 1969:353).

In a letter From Goodrich (a missionary) to a Professor Silliman for the Philosophical Magazine published in September 1826, Goodrich describes the region from Waiakea to the summit of Mauna Kea as follows:

> There appear to be three or four different regions, in passing from the sea-shore to the summit. The first occupies five or six miles, where cultivation is carried on in a degree, and might be to almost any extent; but as yet, not one twentieth part is cultivated. The next is a sandy region, that is impassible, except in a few foot-paths. Bracken, a species of tall fern, here grow to the size of trees; the bodies of some of them are eighteen inches in diameter. The woody region extends between ten and twenty miles in width. The region higher up produces grass, principally

> of the bent kind. Strawberries, raspberries, and whortle-berries flourish in this region, and herds of wild cattle are seen grazing. It is entirely broken up by hills and valleys, composed of lava, with a very shallow soil. The upper region is composed of lava in almost every form, from huge rocks to volcanic sand of the coarser kind.... (Ellis 1969:403).

The population of Waiakea was, according to Ellis' best estimation in 1825, approximately 2,000 persons living in 400 houses (Ellis 1917:253). This population may correspond to the precontact numbers, although introduced diseases may have already had a devastating affect on the Hilo population (Stannard 1989; Bushnell 1993).

The settlement of Waiakea was concentrated largely near the coast. It was in this zone that the majority of the habitation sites, irrigated pondfields and some dry-land agricultural plots (e.g., including aboriculture), religious structures, fishponds, and animal pens were located. Further upslope, much of the activity consisted of hunting birds, collecting food and other useful wild plants, and felling large trees (mostly *koa* and *'ohi'a*) for canoe building, house construction, and other wood carving.

Land Commission Awards in the Project Area

The Great Mahele of 1848 brought the privatization of land tenure to Hawai'i. Land was divided among the king, chiefs, and the government. Commoners (*maka'ainana*) could petition the court for land they already occupied and worked. Testimonies given in support of these commoner claims provide a rich history of land tenure, including details of residence patterns, cultivation (e.g., *kula* and *lo'i*), and other economic or subsistence pursuits (e.g., fishponds, plant resources, pigs). When these sources are taken together they document patterns of Hawaiian settlement and land use for the early to mid-nineteenth century, and assuming a strong degree of continuity, for late pre-contact times as well.

In order to establish local early historic (as recorded around 1848), and by extrapolation prehistoric land use patterns in the project area, the Land Commission Award (LCA) records were reviewed. These records include the *Indices of Awards*, the Native and Foreign Registers, the Native and Foreign Testimonies, and Registered Map 1561. The search determined that none of the smaller LCAs lie within the project area. Nonetheless, the records reveal land use patterns in the area at large during the early to mid-nineteenth century.

The project area crosses the *ahupua'a* of Waiakea, Kukuau 1 and 2, and a small portion of Ponahawai. A total of 61 Land Commission awards were made to individuals within these native land units: 25 in Waiakea, 14 in Kukuau, and 22 in Ponahawai (Table 1). Additionally, large portions of Ponahawai and Waiakea *ahupua'a* were designated Crown lands. Although not listed in the *Indices of Awards*, several more recent maps show a major land unit named Kaumana in the more northern portion of the project area. LCAs of Kaumana, were there any made, are assumed to have been part of Ponahawai based on earlier maps.

The LCAs were generally small, with most between one-half to four acres (Table 1). Large awards were limited to chiefs. Most of Kukuau 1 Ahupua'a (LCA 8515) was awarded to Keoni Ana (son of John Young and Kaoanaeha, the daughter of Keli'imaika'i). LCA 8521-B included most of Kukuau 2 Ahupua'a and went to G. D. Hueu, son of Isaac Davis (companion of Kamehameha I). Victoria Kamamalu was given LCA 7713, a beachfront *'ili 'aina* in Waiakea Ahupua'a that paralleled the coast. B. Pitman was awarded a 354.2 acre portion of Ponahawai Ahupua'a.

Most of the small LCAs were made to native Hawaiians (Table 1). One Chinese individual, Y. Aiko, received a 1.01 acre parcel in Kukuau (LCA 3205). Two other claims were made by westerners. John G. Perkins (LCA 242) claimed a one-half parcel in Ponahawai Ahupua'a and John Anderson claimed a 0.66 acre parcel in the same land unit. According to the foreign testimonies, both of these lots were converted to the *konohiki* (the head man of an *ahupua'a* or a person who had charge of a land with others under him) as the claimants left Hawai'i for California prior to appearing before the Land Commission Board. Both LCAs, however, appear on Registered Map 1561 suggesting that they may have ultimately been awarded.

Table 1. Land Commission Awards.

Grantee	LCA	Acreage
Waiakea Ahupua'a:		
Barenaba	2327	12.25
Halai, L.K.	1279	0.60
Hale	4004	4.25
Kahue	2663	3.75
Kaiana, J.B.	2281	10.25
Kaihenui	11050-B	5.19
Kalolo	1333	2.25
Kalua	8854	3.40
Kaluhikaua	1738	2.98
Kamamalu, V.	7713	*'Ili 'aina*
Kamanuhaka	8803	1.02
Kapu	1-F	1.60
Kealiko	11174	1.00
Keaniho	2402	5.00
Keawe	5018	0.24
	10505	
Kuaio	4344	1.22
Leoi	9982	0.80
Lolo	4738-B	1.27
Mahoe	1-E	4.46
Moealoha	4737	1.03
Nakai	4785	1.05
Napeahi	2603	1.30
Wahine	4737-B	1.01
Wahinealua	11173	2.50
Wahinenohoihilo	10004	1.69
Kukuau Ahupua'a:		
Aiko, Y	3205	1.01
Haai	1106	4.66
Haoleopunui	3206	2.47
Hio	1091	3.19
Hoomoo	3993	2.05
Kahue	2664	0.33
Kaiwi	1104	4.33
Kanaina	4239-B	2.90
Kanakaole	11045-B	1.52
Kauanui	234-B	0.55
Keoni Ana	8515	4840
	8515	4520
Hueu, G.D.	8521-B	3540
Ouluihi	11144	1.15
Puniono	2606	0.98

Table 1. Land Commission Awards (continued)

Grantee	**LCA**	**Acreage**
Ponahawai Ahupua'a:		
Anderson, J.	2257	0.66
Hewahewa	2578	1.82
Hiona	1096	1.02
Kaapa	2228	3.69
Kahalehau	11048	1.56
Kaiaua	2281	2.87
Kaiu	5701	1.41
Kanoa	2406	0.28
Kapuaa	4994	5.80
Kaulua	1098	0.77
Keaniho	2404	1.94
Keawehano	1334	2.16
Keawekukane	5122	1.29
Kukeleau	4983	12.8
Lahaina	1107	1.53
Lumaina	1108	2.76
Nahalelepo	3996	0.63
Paakaua	1097	0.47
Peleula	1095	1.04
Perkins, J.G.	242	0.49
Puaa	1100	0.97
Puniana	1099	0.82

With few exceptions, the awards were located near to the coast and within the area of Hilo town proper (see Registered Map 1561 of 1891). Grants 2663 and 2402 were situated more inland at approximately 2 kilometers from the coast and straddled the boundary of Kukuau 2 and Waiakea Ahupua'a. Additionally LCAs 2406, 4994, and 4983 of Ponahawai could not be located on Registered Map 1561, indicating that they were located inland of Halai Hill. In the Native Register, the claimant described LCA 4994 as being close to the forest and formerly uncultivated.

The Native and Foreign Registers and Testimonies identify many of the small coastal claims as houselots. Parcels were frequently enclosed and included from one to five houses. Usually the claimant occupied a house on the parcel, but occasionally persons with no claim to the land were also resident. In a few cases, the records indicate a traditional Hawaiian residential pattern was in place, with household units composed of separate dwelling and cook houses.

Many of the claims with houselots also included small *kihapai* or garden plots. Non-residential farm lands were also claimed. Taro (*Colocasia esculenta*) and bamboo are the only crops specifically mentioned. LCA 4293-B, which was located on the coast near to Waiolama Stream and Iaina fishpond, included several *lo'i*. Some parcels were enclosed by *ti* (*Cordyline terminalis*) "fences." In several cases, the adjacent land was referred to as "idle" and belonging to the *konohiki*. The testimonies also mention near-coastal "fishponds" that belonged to the *konohiki*.

Several of the awardees claimed their lands from their parents or grandparents. In other cases, specific persons, possibly lesser chiefs, were named as land grantors. LCA 5701, for example, was given to the claimant's parents by Ali'i Piopio. Frequently the claimant indicated the year that he had received his land from this specific person, with dates ranging from 1832 to 1848.

Land Commission Award Summary

In sum, the LCA evidence shows that claims were heavily concentrated on the coast, reflecting the continuation of the Hawaiian settlement pattern documented by early foreign visitors to Hilo (see McEldowney 1979; Kelly et al. 1981; Moniz 1992 for reviews). Of the *ahupua'a* under study, both

Kukuau 1 and 2, and Ponahawai were given in entirety to Kamehameha I's trusted advisors, but Waiakea was divided up into both large tracts or land given to royalty, and into small LCAs awarded to people living on coastal lands. No LCAs were either claimed, or awarded to individuals for lands located in the upland region near or within the Pu'ainako Road Extension project area. A search of Land Commission Awards given in Waiakea Ahupua'a indicates that lands in the project area were not under use by Hawaiians in the early to mid-nineteenth century. The land in the project area could have been used in earlier times, but, the absence of claims documents the lack of significance to Hawaiians for these areas at the time of the Mahele. The exception being the recognition by Hawaiian chiefs that large tracts of land had increasing commercial value.

Foreign Influence and Change

Sandalwood Trade

One of the first major changes to take place in the Hilo area with the arrival of foreigners in Hawai'i was the sandalwood trade in the 1790s. The sandalwood trade was controlled by Kamehameha I until his death and continued by his son Liholiho and other favored chiefs until about 1830 when the trade collapsed. The over exploitation of the sandalwood endangered the species, and had an impact on the forest ecosystem. The trade also drove the chiefs into debt and forced thousands of commoners to lose their livelihood as they diverted their activities to gather sandalwood. The trade appears to have affected native life in Hilo (Kelly et al. 1981:25-26) as elsewhere in the islands, but little specific evidence is available.

Missionary Influence

The arrival of missionaries from the London Missionary Society and the American Protestant missionaries in 1822 had far reaching influences over Hawaiian populations. In Hilo, missionaries first arrived in 1822 and set up a permanent mission in 1824 under the guidance of two families, the Goodrichs and Ruggles. By 1825 a school had been set up and attendance at both the school and church increased steadily (Kelly et al. 1981:28-29).

Other Historic Influences in Hilo

Hilo, with its natural harbor became, by the mid-nineteenth century a popular stopover. The Wilkes expedition visited Hilo in 1840, representing increased American influence in the area. The arrival of tourists and other adventurers in Hilo had begun as early as 1842, and many stayed and took up residence in Hilo. The increase in foreigners also brought about an increase in the number of small businesses catering to foreign needs. Whaling, an important part of the economy in Honolulu and Lahaina, was present in Hilo in the mid-1800s. But Hilo was not as popular a port Lahaina or Honolulu, it ranked third. According to the sailors, it lacked liquor or women because of the strong missionary influence (Kelly et al. 1981:75).

Agricultural Changes in the Hilo Area

Several plants were cultivated or collected for export in the Hilo area in the early historic period. Among important plants were *pia* (arrowroot, *Tacca leontopetaloides),* taro *(Colocasia esculenta),* and *pulu (Cibotium splendens)*. Arrowroot was refined and exported as a flour substitute, *pulu* was used for mattress and pillow stuffing, and taro was made into dried *poi* and sold as a dried food item (Kelly et al. 1981:80-81).

Sugarcane

Sugarcane was introduced to Hawai'i and cultivated by ancient Hawaiians. Cultivated in small garden plots, the cane was eaten by simply chewing on the stalk. With the arrival of the missionaries in 1822, the cane began to be processed for sugar. Wailuku Mill was the first in Hilo. It was established by the missionaries to supply themselves with sugar. By the 1840s several commercial mills were in operation, including a mill owned by Governor Kuakini Adams. At about the same time, at least one Chinese entrepreneur had a small mill operating in the Hilo area. As early as 1839 Governor Kuakini Adams had a sugar mill and plantation on Ponahawai. However, much of Ponahawai Ahupua'a was covered by the 1880-1881 lava flow (Rosendahl, *et al.*, 1992: Appendix A 21).

By the 1860s sugarcane had become the dominant crop in the Hilo area, and large tracts of land came under commercial cultivation. Foreign interests quickly moved in and acquired large parcels of land in the Hilo area for sugarcane cultivation. One of the earliest foreigners in the Hilo area to acquire large tracts of land was Benjamin Pitman. Beginning in the 1830s he amassed large tracts of land which he then leased out to sugarcane growers, a coffee plantation, and a number of buildings and businesses in the Hilo area (Kelly et al. 1981:84-85). In 1861 Pitman sold most of his interests in the Hilo area to Thomas Spencer. Spencer increased his holdings in sugarcane and bought up the old Chinese sugar mill and plantation.

In 1876 the Reciprocity Treaty with the United States Government assured entry of Hawaiian sugar into the U.S. with no duty, making it a secure and profitable market. This marked the turning point for the sugar industry in the Hawaiian Islands, and by the 1880s there were a large number of sugar plantations in both the Hilo area and throughout the Hawaiian Islands (Kelly et al. 1981:88-89). As a consequence, large tracts of land in Hilo were planted in cane. Indeed, nearly all of the lower slopes of the *ahupua'a* of Waiakea, was planted in cane by 1881.

Despite profits, the industry had its difficulties, and by 1885, two large companies had bought out or taken over the smaller sugar growers. The Hilo Sugar Company (at Wainaku), formed in 1884, and the Waiakea Mill Company, formed in 1879. These two companies became the dominant sugar companies in the immediate Hilo Bay area. These companies developed the narrow gauge railroad lines that led from the sugarcane fields to the mills (Conde and Best 1973). By the late 1890s sugar was the established crop in the Hilo area, although coffee was also a successful commercial crop (Kelly et al. 1981:91-93).

As the sugar industry grew larger tracts of land were cleared for planting in cane. This necessitated the construction of a large scale transportation infrastructure to carry the cane to the mills for processing. From the late 1870s through the first twenty years of the twentieth century a large number of railroad tracks were constructed in the Hilo area to move cane to the mills. Both permanent and temporary track were used for access to harvest areas (see Conde and Best 1973:117-126, for discussion of Waiakea Mill Company). Flumes were also used to transport harvested cane to areas where it could be loaded on rail cars (at "flume-to-car loading stations"). The flumes were primarily in higher elevations beyond the extent of railroad lines (Conde and Best 1973:119).

The mill for Waiakea Company was located just *mauka* of the Waiakea fishponds and its lands extended up the mountains to at least 1,100 feet elevation. After 1918, when the Waiakea lease ended, the land was divided up into parcels that were then homesteaded by individuals who sold their cane to the company. A total of 700 acres was divided up in this manner into many lots of varying sizes (10-73 acres each) and house lots (1-3 acres each) set aside in a township along the Volcano Road (Kelly et al. 1981:121).

The smallest of the large mills in the Hilo area was the Hawaii Mill Company. This mill was located in Ponahawai Ahupua'a in Hilo town and owned or leased 1,780 acres of land. This mill only lasted for a short time and was bought out by the Hilo Sugar Company in 1920 (Kelly et al. 1981:122-127).

The Hilo Sugar Company began operations in 1884 and steadily increased its size by taking over the smaller mills and plantations in the vicinity. By 1936 the area of land under cultivation exceeded 7,770 acres. However, the sugar company reported that it lacked railway facilities for its fields and relied instead on an extensive network of roads to harvest the cane (Kelly et al. 1981:127). The Hilo Sugar Company remained in operation until 1976.

There were several other cane companies in the Hilo area along with several coffee ventures and other crop companies. In addition, a number of railroad companies developed in and around the Hilo area starting about the turn of the century. The Hilo Railroad operated from 1899 to 1946 and was involved primarily in hauling sugar cane to the mills for refining. However, it also transported passengers around the island (Kelly et al. 1981:142).

Previous Archaeological Research

Archaeological field research in the Hilo area has been comparatively rare. However, several field projects have been undertaken in recent years (Note: sources covering significant archaeological research in the Hilo Bay area is provided in the bibliography). The problem for archaeology has been the profound historic transformations of the landscape, with early urbanization and especially commercial sugarcane cultivation, that destroyed much of the prehistoric archaeological record. Extensive synthetic works by McEldowney (1979), Kelly et al. (1981), and Moniz (1992) discuss the archaeological research accomplished, the kinds of sites (historic and prehistoric), and their distribution for the Hilo Bay area. McEldowney's (1979) review suggests that most sites of prehistoric age were located near the coast, and have been altered (e.g., fishpond sites) or completely destroyed (e.g., *heiau* sites). The distribution of historic era sites reflects early urbanization and plantation activities in the Hilo Bay area.

Even in some of the earliest archaeological survey work, Hudson (1932) suggested that little, if any, archaeology will be found in the City of Hilo. Several field studies tend to support Hudson's argument, with only historic remains discovered (e.g., Kelly and Athens 1982; Jensen 1991; Goodfellow and Fager 1992; Borthwick et al. 1993). As Kalima (in Goodfellow and Fager 1992:22) recently concluded concerning archaeological survey in Ponahawai, Hilo:

> ...the extensive clearing needed in order cultivate sugarcane, in addition to the recent guava cultivation, it is highly unlikely that the land retains any prehistoric archaeological sites. Any sites found will probably be associated with sugarcane cultivation.

Thus, as many archaeologists have surmised, the traditional and early historic details of Hilo will not often be supported by field evidence in archaeology of the area. Much of the land has been transformed, with both urbanization and large-scale commercial sugarcane cultivation.

A review of reports and site records at the State Historic Preservation Division revealed that no archaeological sites had been previously recorded in the project area. In a closely adjacent area (TMK 2-4-01:40 &157, proposed Research and Technology Lots, University of Hawai'i-Hilo), Borthwick and others (1993, Draft) provide results from historical background research and archaeological survey with subsurface testing. They recorded (mapped, described, etc.) four sites (with multiple features) determined to be from historic and recent agricultural land use (i.e., stone mounds from field clearing). They note plow furrows from sugarcane cultivation still visible in areas with adequate soil. Their test excavations yielded no cultural materials, and only artifacts of recent origin were observed on the surface in their project area. Borthwick et al. (1993, Draft) point to significance in terms of information content alone (Criterion D). They recommend no additional work, as adequate data have already been collected with mapping and testing of these sites.

Prehistoric and Historic Background of Project Area Lands

Prehistoric Period

The project area encompasses parts of three *ahupua'a* Ponahawai, Kukuau 1, and Waiakea. The area where most archaeological sites exists is in the lower project area (from just above Komohana Street to Kawili Street) in the *ahupua'a* of Waiakea (see below). This portion of the project area is approximately 200-300 feet elevation. This area falls within McEldowney's Zone II (upland agricultural) where early historic sources show that scattered huts, adjacent garden plots, and small groves of economically important trees were once found up to the edge of the forest (McEldowney 1979:18). McEldowney (1979:18) links this zone to *ash-derived soils* in the region, rather than to lava flows and areas with poorly developed shallow and rocky soils. These younger, more poorly developed soils (e.g., the Keaukaha and Pana'ewa Series) of the project area are less likely to have seen prehistoric occupation or use, based on the observations of early visitors to the region (see McEldowney 1979). Consequently, some prehistoric use may have occurred in the project area, but preservation or other remaining archaeological integrity are very unlikely given the later documented land use of intensive sugarcane cultivation.

Historic Period

In historic times the project area has been used primarily to grow sugarcane, before it was converted to pasture and unused land. As documented in a series of historic maps and informant interviews, the project area, and vast tracts of surrounding land were planted in sugarcane. As mentioned above, sugar became the most important crop in Hilo by the end of the nineteenth century. Thus, vast tracts of sugarcane was already under cultivation in Hilo. Sugarcane cultivation was remarkably labor-intensive, and took advantage of an immigrant labor force. Prior to 1930 breaking of ground to plant sugarcane was done by mules. By 1935 most areas (where possible) was plowed by tractors to a depth of six inches. The fields were not irrigated, but relied on Hilo's high rainfall. Cane yields varied with rainfall. The fertility was good, but many fields were rocky (Kelly et al. 1981:121).

Several sugar companies operated in the Hilo area, but only Waiakea Mill Company grew cane in the project area. The Waiakea Mill Company operated from 1897 through 1946 and was one of the largest sugar companies to operate in Hilo. When the company's 30 year lease of Waiakea lands expired in 1918, the government under homestead laws, subdivided a large tract of land into hundreds of lots granted to homesteaders in 1919 (Kelly et al. 1981:121; Figure 4).

Analysis of Maps

Analysis of historic maps provides the clearest evidence of land use for the lower project areas. A map produced in 1922 by Williams (Figure 4 from Kelly et al. 1981; also Figure 5 showing modern street locations) shows land under cultivation by the Waiakea Mill Company. This map shows residential camps, roads (including dirt cane roads, such as what would become Pu'ainako and Komohana Streets), flumes, railroad lines, lease and homestead boundaries, the edge of cane cultivation, and drainages (e.g., the upper Waiakea drainage). The map places homestead lots near the northern (lower right in map) boundary that encompass the project area. In this area is the edge of sugarcane cultivation. The lots have soils of the Pana'ewa and Keaukaha Series, both of marginal value for sugarcane cultivation given

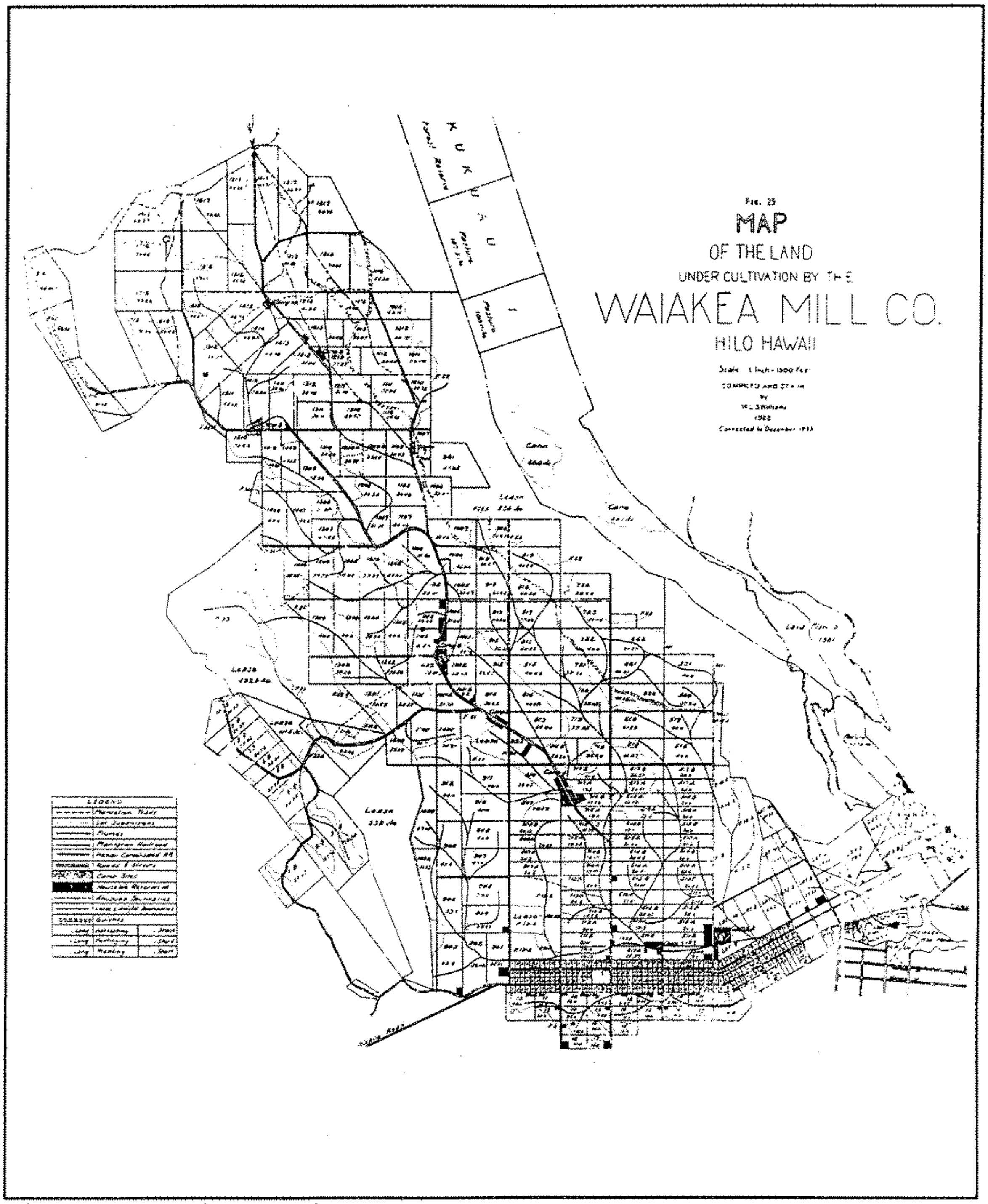


Figure 4 Waiakea Mill Company map, 1922 of homestead lots and leased fields under sugarcane cultivation. Also shown are plantation residential camps (numbered), permanent railroad lines (from Kelly et al. 1981).

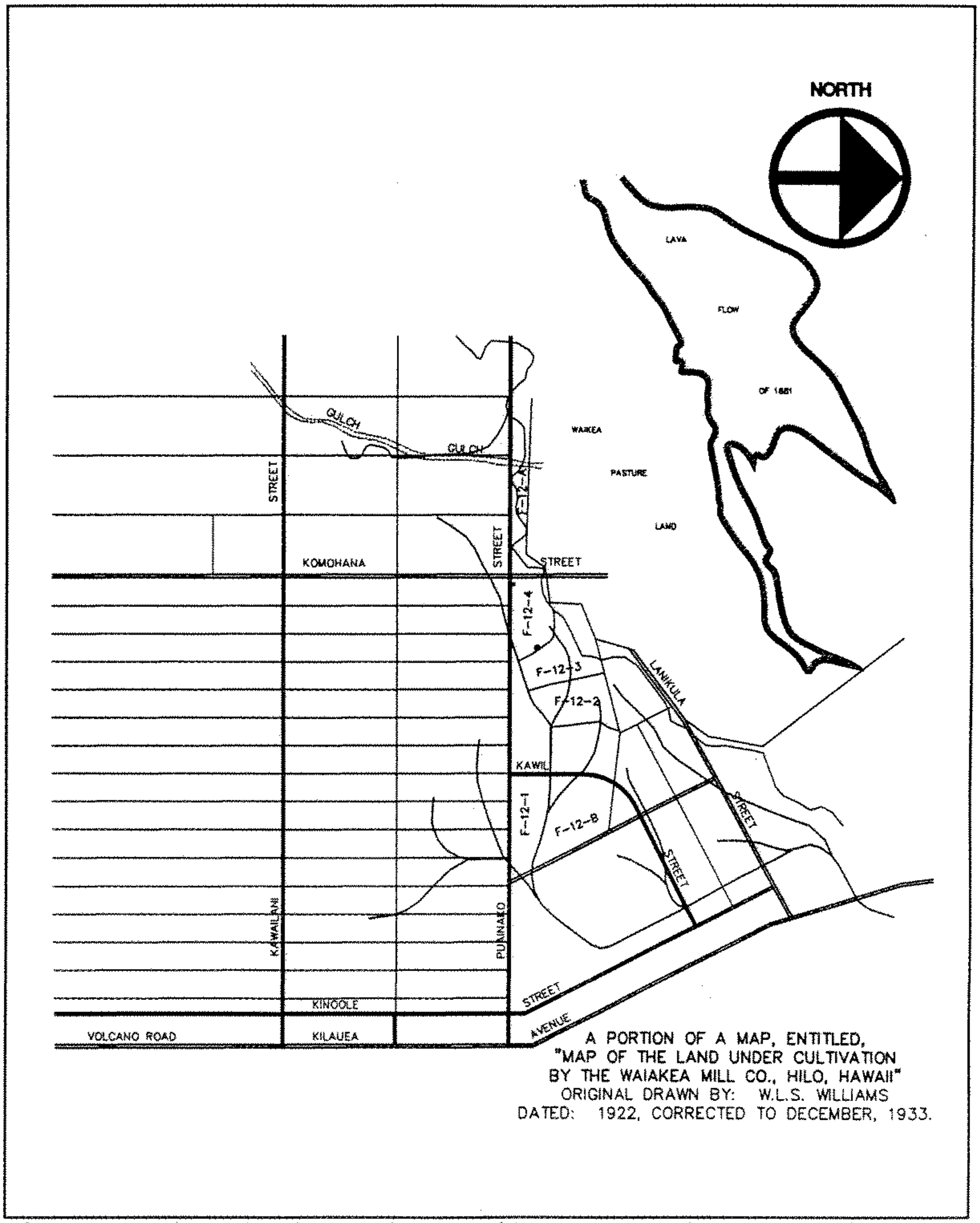


Figure 5 Map showing Waiakea Mill Company in the project area with modern streets for reference, permanent railroad lines, and the boundary of sugarcane and pasture land in 1922 (revised 1933).

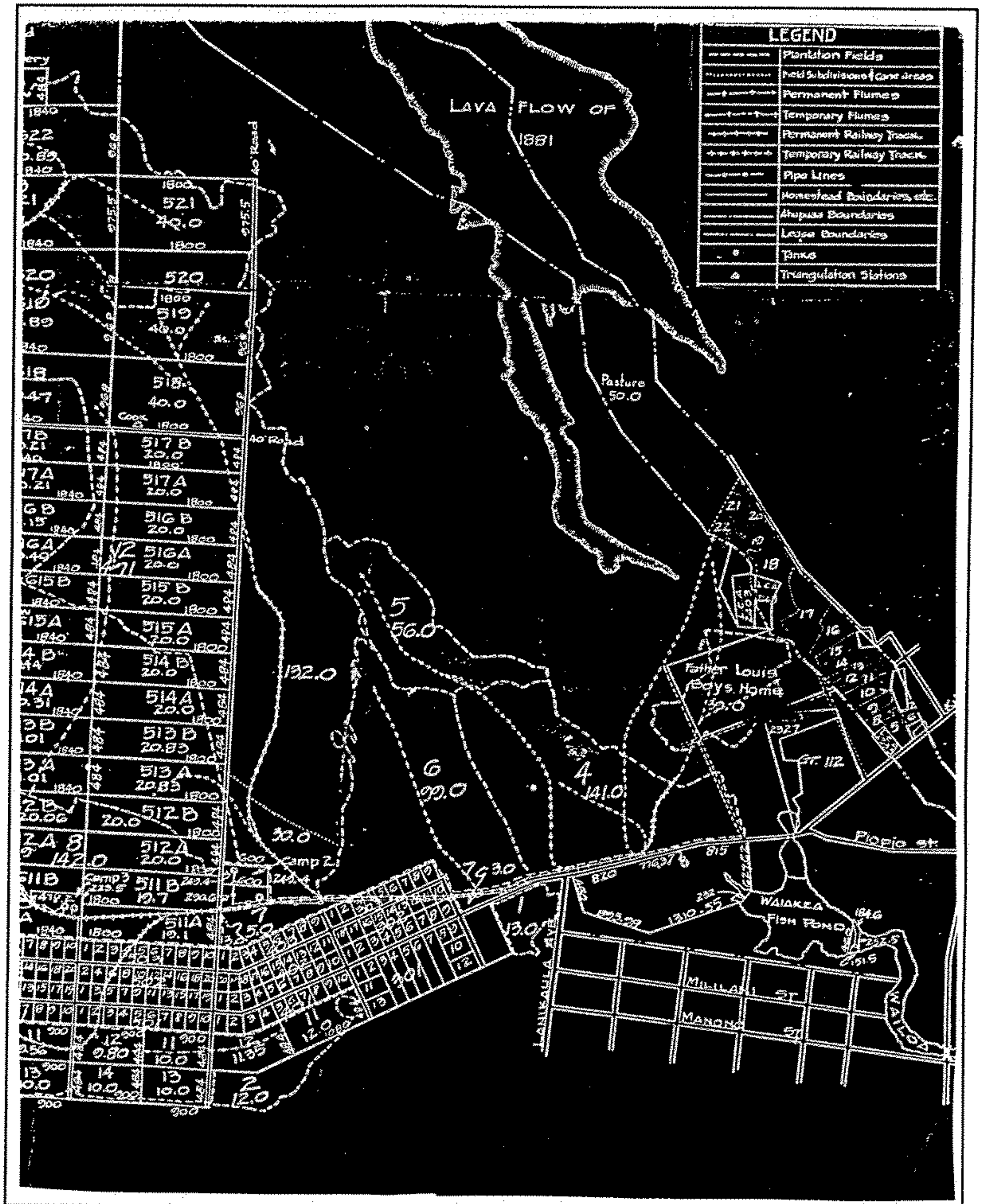


Figure 6 1918 Waiakea Mill survey of homestead lots and railroad lines (temporary and permanent) in the vicinity of the project area (see Figure 5 for street reference).

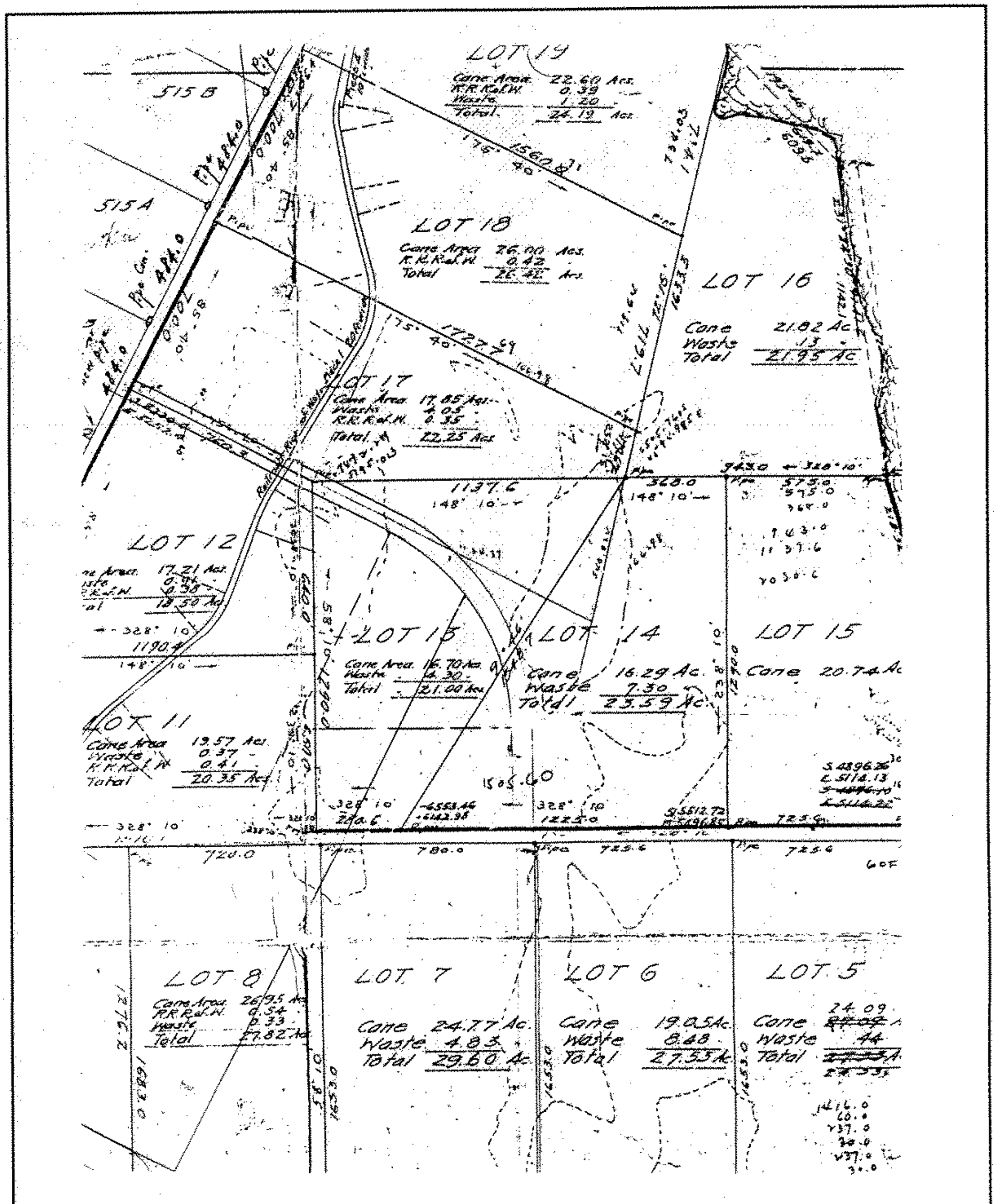


Figure 7 Section of a map entitled "Waiakea Cane Lots" surveyed by A.S. Chaney in 1925. This map shows the railroad line, areas of "waste" and cane for lots 17, 18, and 19, where the lower project area road alignments are located.

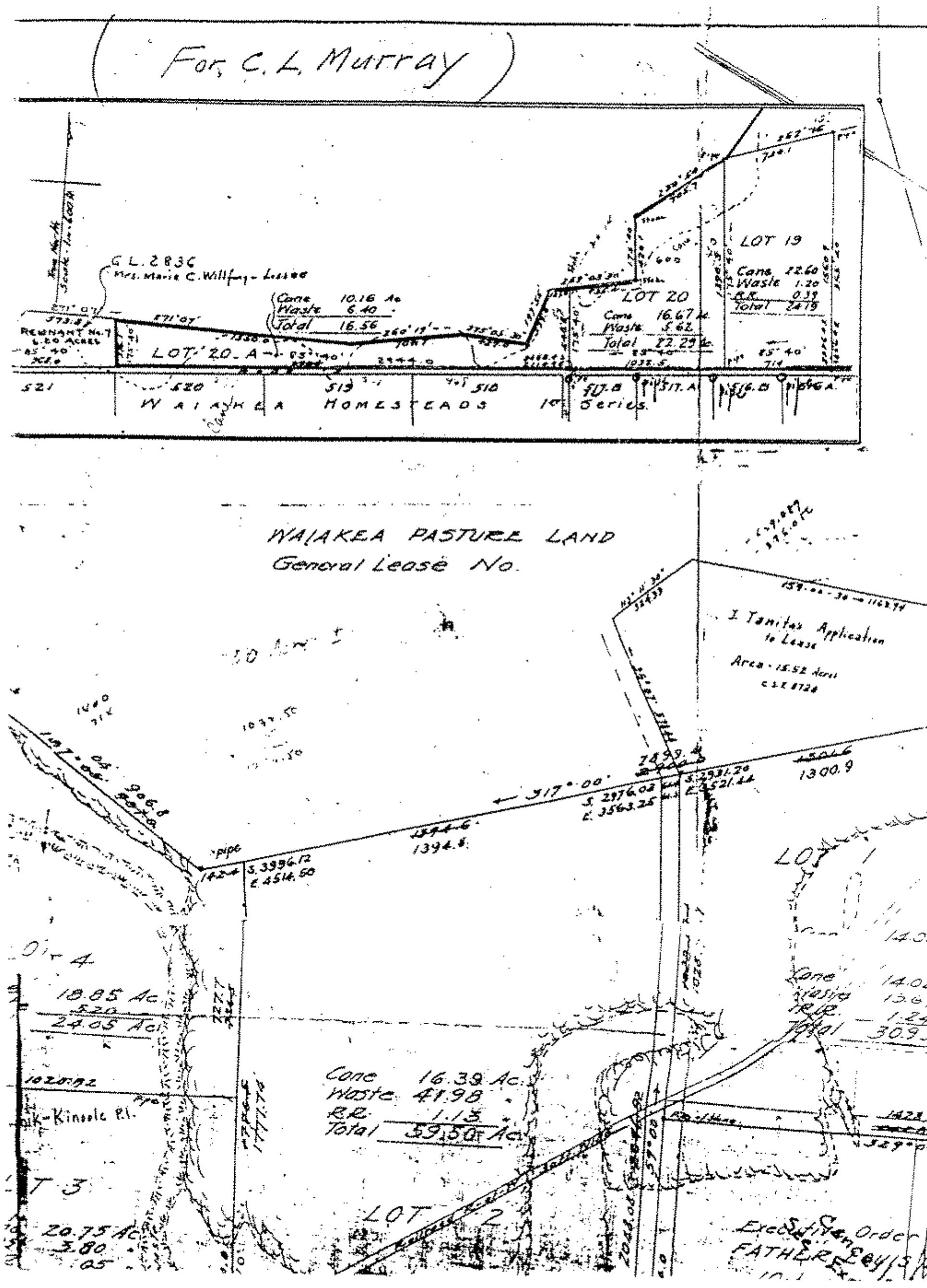


Figure 8 Section (insert) of a map entitled "Waiakea Cane Lots" surveyed by A.S. Chaney in 1925. This portion of the map shows areas of "waste" and cane for lots 19, 20, and 20A, above Komohana Street.

problems of rockiness. The 1922 map also shows permanent narrow-gauge railroad lines passing through the project area.

The original survey, from 1918, is represented in another map (Figure 6). This map shows comparable sugarcane cultivation boundaries and the railroad in the project area in 1918, but the railroad line may have been in this location as early as ca. 1880 (Conde and Best 1973:117-126). It appears that the area north of what would become Pu'ainako Street (the northern or right side boundary) was under sugarcane cultivation, but not yet subdivided for individual leaseholds. By 1925 this area had been subdivided, and added brought into a lease, according to the map information.

A more detailed map survey by Chaney in 1925 (Figures 7 and 8) shows the project area crossing homestead lots 17, 18, 19, and above Komohana Street, lots 20 and 20A. Shown on this map is the railroad right of way (this is the same line shown in the 1922 map, Figures 4 and 5), precise acreage planted in sugarcane, and a quantity of land designated "waste" for some parcels. All of these lots are shown under complete, or nearly complete cultivation of sugarcane. As one would expect, the boundary of cane cultivation and Waiakea pasture land corresponds closely to the geological boundary of the older Punahoa (3,000-4,000 BP) and the younger Kulaloa (1,100-1,400 BP) flows--with the significantly rockier Kulaloa flow substrate used for pasture. Also, the archaeological sites/features (described for the project area below) are found almost entirely within the boundaries of areas with greater soil development and thus previously under commercial cultivation of sugarcane. This marked correspondence suggests the historic age and sugarcane-related function of the sites/features in, and near the project area.

Other Documentary Sources

A variety of sources provides a picture of plantation life and work on the land in the project area. Documentary sources also inform on the age and function of the archaeological features discovered in sugarcane lands. For example, in a *Honolulu Advertiser* article of 10 April, 1932, Jared

Smith describes how Waiakea Mill grinds the homesteaders' cane as well their own. Referring to the Waiakea leased lands and homesteaders' cultivation, Smith writes:

> Other items of interest are that the cultivation contract men tear down and rebuild every stone heap before starting a new crop. These field piles of loose rock are the centers from which weeds and pests spread through the cane. Hence the workers "laundry" them. They also glean the rubbish as well as the loose stone.

Smith also mentions the unusual prevalence of tanks used in the Waiakea fields for water storage. These tanks served in mixing herbicides:

> A feature not seen on any other plantation is the shed roofs stuck around all over the place to fill tanks so that water for mixing the arsenical weed killer will be available in every field.

Evidence similar to that observed by Smith is found in a photograph of Waiakea Mill fields under harvest about 1890 (see Conde 1975:122; Figure 9). This very early photograph shows hand harvesting and numerous stone clearing mounds in the field. While the precise location of the field shown in this photograph is unknown (i.e., it certainly does not appear to be the project area), it illustrates the practice Smith described (above) for areas in the Waiakea homestead lots. In sections with rocky soils stone clearing mounds would necessarily be larger and more densely spread over the field. These clearing mounds took several forms, and were often made with faced sides to increase the efficiency and holding capabilities of the piles, thereby clearing more soil for sugarcane. Similar sugarcane clearing mounds have been documented archaeologically, and confirmed by informant interviews (see concluding section below).

Solving problems of loading harvested cane onto small sleds, carts, or rail cars may also have utilized stone constructed features. Such features would allow workers loading harvested cane by hand (especially in the earliest days) to get the heavy bundles up into the loads headed to the mill.

Figure 9 Photograph of Waiakea cane harvesting about 1890. Note the multiple stone mounds in the harvested fields (from Conde 1975:122).

Finally, in *Story of Sugar in Hawaii* (Hawaiian Sugar Planters' Association, 1926:69), the following information is given on other activities in tenant cane lots:

> The visitor to the fields will often notice vegetables planted along the outside rows next to the sugar cane, and further in the cane fields along the ditches and furrows vegetable gardens are often quite extensively planted in spaces between the cane growth. This is done by the workmen for their own use and saves them a considerable amount on the family food bill.

Hilo Interviews

Paula DeMorales (Hawaiian Language Instructor, Waiakea High School) and I conducted seven interviews in Hilo. In a community notice in the *Hawaii Tribune Herald* we asked old-time residents near the project area (especially around the lower area where we knew sites existed) to talk with us about the history of the area as well as the age and function of the archaeological sites. Each of the informants who shared stories with us had been associated in various ways with the Waiakea Mill Company, or knew details of its operations. Each informant was also old enough to have clear memories dating to between the 1920s to 1940s. The interviews engendered detailed recollections of life in the Plantation Camps. We heard descriptions of plantation field work such as the use of sleds, mules, and the arduous labor of harvesting cane. Informants also recalled the permanent and temporary railroads, patterns of land use, and distinctive features of the local landscape and vegetation.

Concerning the project area (i.e., near Pu'ainako-University of Hawai'i and Komohana Street), every informant confidently stated that all the land in question was in sugarcane. For example, Mr. Joseph Kahe'e described sugarcane under cultivation in the present areas of Pu'ainako and Komohana, by the water tank (off Pu'ainako, adjacent to project areas), and that cane was planted wherever soil could be found. He also mentioned that the location of the present Waiakea flood control channel was previously only a little gully (corroborating changes documented in the analysis of maps). Mr. Isamu Kaneshiro mentioned the whole area being planted in cane. He went on to explain that as children three large mango trees alongside the cane fields served as landmarks for their adventures in the cane fields.

Mr. Masato Hirata, Mrs. Lenora Ka'aukai, Mr. Kahe'e, and Mr. Kaneshiro spoke in detail of the railroads that were used to haul cane to Waiakea Mill. They also mentioned the sleds used to transport cane by the field laborers to carts or rail cars. Harvesting was by hand (using a cane knife) and done by adult men and women. Mr. Hirata mentioned permanent water flumes used to transport cane in *mauka* areas (above Camp Seven) beyond the plantation rail system. In some areas, including the lower fields, temporary flumes were assembled, disassembled, and moved as needed. Mr. Murashige recalled temporary flumes in or near the project area in about 1943.

Concerning stone mounds, our interviews confirmed the need to clear stones from areas under sugarcane cultivation. Mr. Hirata referred to stone piles and "long fences" (stone alignments in the cane fields). He described cucumber commonly planted on the stone mounds in the cane fields. The cucumbers were usually prolific, and they were given to friends or visitors. Mr. Hirata also mentioned that while stones were added to the piles, many were already present in the fields in 1931. Mr. Isamu Kaneshiro, and later Mr. Kenji Kanekuni, described the stone mounds in the cane fields as "*marush*" (derived from Japanese *maru* for round and *ishi* for stone). Mr. Kanekuni mentioned that the fields had a lot of rock and they had to be cleared to cultivate the cane. Kanekuni went on to say that sometimes when a field had plenty of rocks that the foreman would tell the workers to put them on the piles. Mr. Kaneshiro suggested that early Chinese labor had first stacked rocks from the fields when they cleared the land for cane cultivation. Indeed, he mentioned that the fields of Waiakea Mill were known for their rock piles. Finally, Mr. Hirata, who had operated heavy equipment (a "furrow-man") in the cane fields mentioned bulldozing stone mounds to discover that they were often placed directly above bedrock, or very shallow soil. Once they discovered bedrock, they did not bother bulldozing more of the mounds, as it would not yield any more soil area for sugarcane planting.

Results of Field Survey and Testing

Field Methods

Field work was conducted in three phases: 1) an initial reconnaissance survey; 2) intensive survey and historical research/documentation; and 3) subsurface testing. The results of this work are presented below.

The objective of the pedestrian survey was to locate and describe all archaeological features in the Pu'ainako Street Extension project. Pedestrian inspection of each alternative alignment was conducted on several different days between May and August, 1992. The centerline for each alignment had been cleared by a field crew hired by Okahara and Associates, and flagged at 10' intervals. These cleared, flagged centerlines made convenient transects for pedestrian archaeological survey in the project areas. A team of three to five archaeologists covered 40-60 meters in width from the centerline. Vegetation was cleared by hand as necessary to search for archaeological remains. This coverage was greater than the 120' (ca. 38 m) right of way planned for the Pu'ainako Street extension and satisfies met the requirements for a 100-percent coverage of the Project Area.

All features identified were located on project maps, flagged, described, photographed, and in then in the second phase, mapped in detail. Excavation was conducted on features representing formal variability of the features in the project area. Recording included the presence or absence of historic or prehistoric artifacts, and notes on the possible function of each site. In the lower project area *makai* of Komohana Street, where site density is greater, features were sketched to scale on the overall Project Area map (scale 1" = 40'). This preliminary information was compiled in a project interim report.

The documentation and mapping phase of the survey was conducted in May and June, 1993. All features were described and mapped as individual units. Detailed information regarding surrounding topography, vegetation, feature location, feature construction, feature form, feature condition, feature excavation potential, and the presence or absence of any artifacts or midden were recorded on standardized forms. A tape and compass map was made for each feature, showing vertical facing, collapse, and vertical heights of the feature. These maps also show any internal features, such as depressions or post holes, observed on the feature. Notes regarding probable age, function, and relationships to other features were recorded.

Excavation was conducted in June, 1993. The five features sampled by excavation were selected to represent formal variability recognized for features in the project area (see below).

Terminology and Designations

Features were described by structural form. These descriptions were could be further distinguished into categories of structural class and formal class.

Structural class refers to the feature's relationship to the surrounding terrain, or it structural form. These consist of terraces, mounds, modified outcrops, platforms, enclosures, and wall segments. Terraces are defined as artificial accumulations of soil or stone, constructed on slopes, which modify the slope by creating an artificial level area upslope of the feature. Mounds are defined as free standing artificially constructed accumulations of soil or stone which lack the more square-shaped in cross-section construction considered "platforms." Modified outcrops are defined as accumulations of soil or stone added to, but not completely incorporating, the natural contour of the outcrop. Modified outcrops can consist other structural forms, but include use of the natural bedrock outcrop. Platforms are defined as free standing accumulations of soil or stone constructed with vertical faces and level surfaces. These are more squared in cross-section. The designation of platform does not, in itself, imply function. Enclosures are defined as curvilinear wall segments that delineate an interior area. Wall segments are constructed, free standing, linear or curvilinear accumulations of soil or stone which are longer than their average wide by a ratio of greater than five to one.

Formal class refers to the feature's form, as in shape in plan-view. Formal classes include shape designations such as rectangular, circular, irregular, or linear. Function designations were made at a general level to avoid over-interpretation of the field evidence. Features were grouped into sites on the basis of proximity (i.e., clusters of features), and thus by inference, functional and temporal interrelatedness.

Site Descriptions

All sites located in the Pu'ainako project areas are shown in Figures 10-13. Figure 10 shows the upper project area (above Komohana Street). Figures 11 and 12 show detailed sections of the upper project areas, where sites are located. Figure 13 illustrates the lower project area (between Komohana and Kawili Streets) with site/feature locations. Copies of field maps of individual features and profiles of excavation cross-sections will be deposited with the State Historic Preservation Division in Honolulu.

State Site #: 50-10-35-18911

Survey Site #: 1

Number of Features: 11

Areal Extent: 180 m east-west by 25 m north-south

Probable Age: Historic

Probable Function: Land Clearance

Site 50-10-35-18911 is located in the easternmost portion of the project area where the proposed road alignments merge (AB) and run just south of Adult Student Housing. The features are scattered over the width of the road corridor for 180 m beginning just west of where the road corridor crosses Kawili Street. Site 50-10-35-18911 is located within an intermittent drainage which has banks of varying height. In portions they consist of high (4-6 m), vertical, exposures of bedrock. Other portions are lower (2-3 m), more gently sloping banks with soil development. Vegetation is dense and consists of low ferns, stands of California grass, rubber plants, ginger, *ti*, strawberry guava, and larger trees which provide a low canopy.

All of the features of site 50-10-35-18911 appear represent the remains of historic agriculture land clearance and associated activities. The 11 features of the site consist of alignments, terraces, and

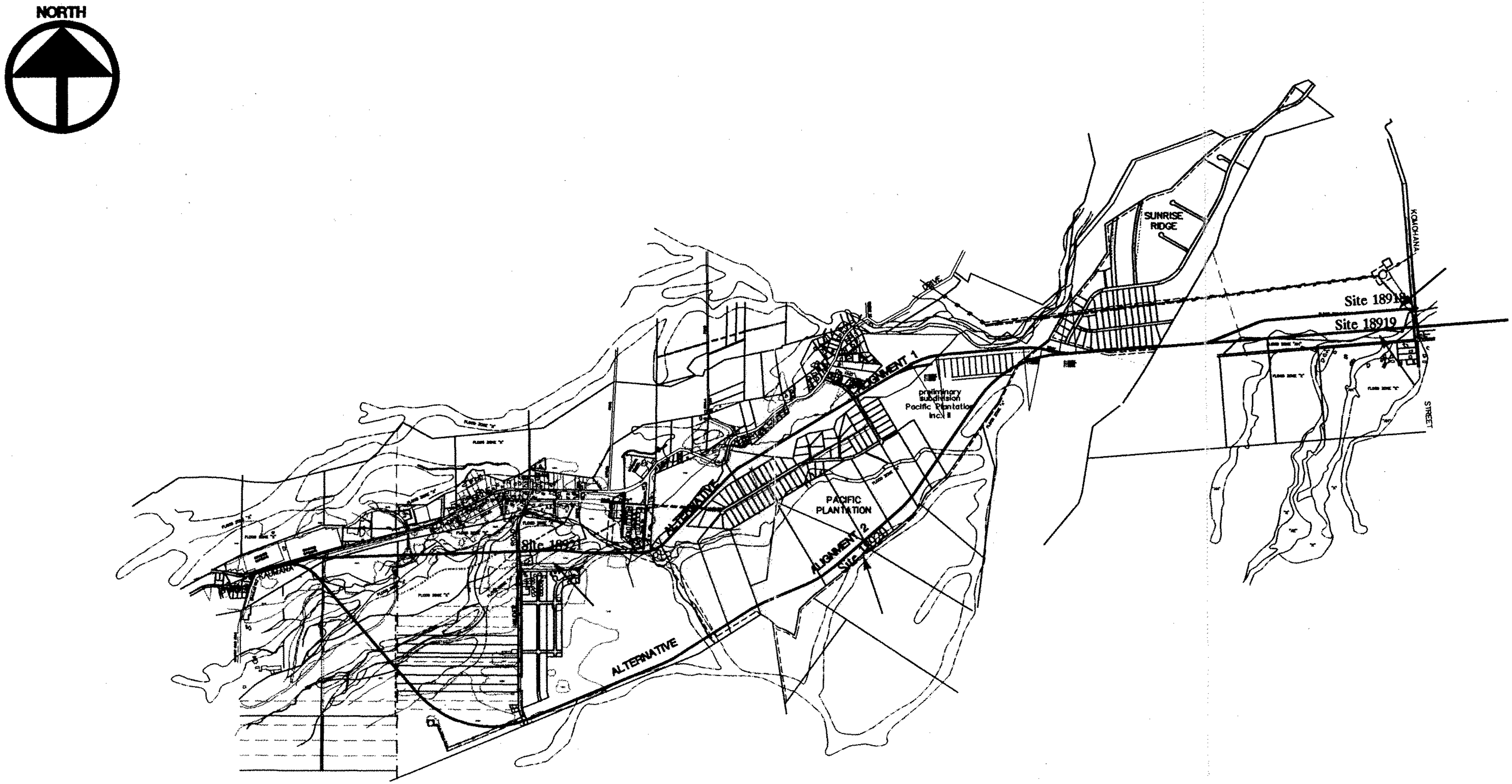


Figure 10 Upper project area showing location of sites.

SCALE: 1"=2000'

93042F2

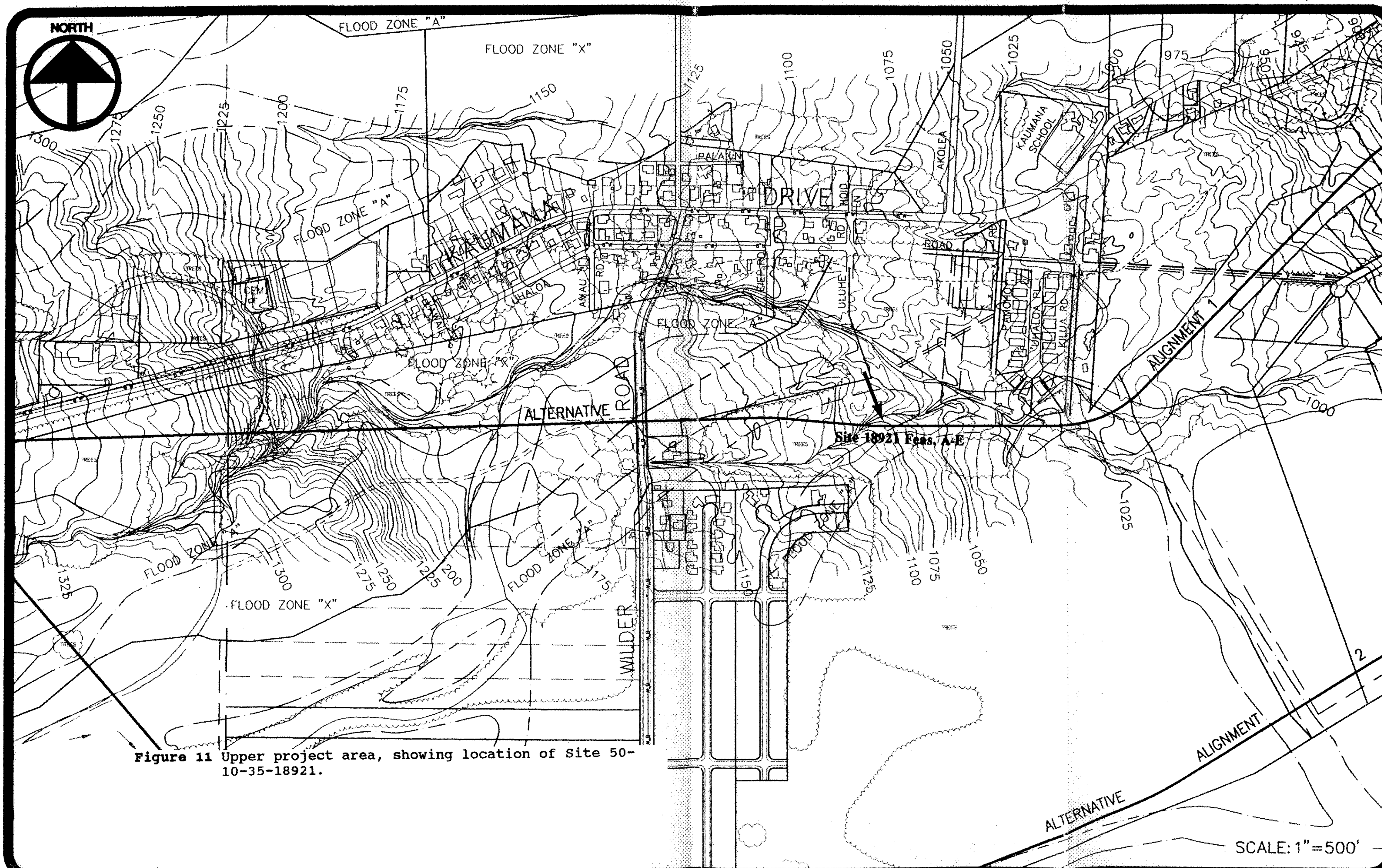


Figure 11 Upper project area, showing location of Site 50-10-35-18921.

93042F3

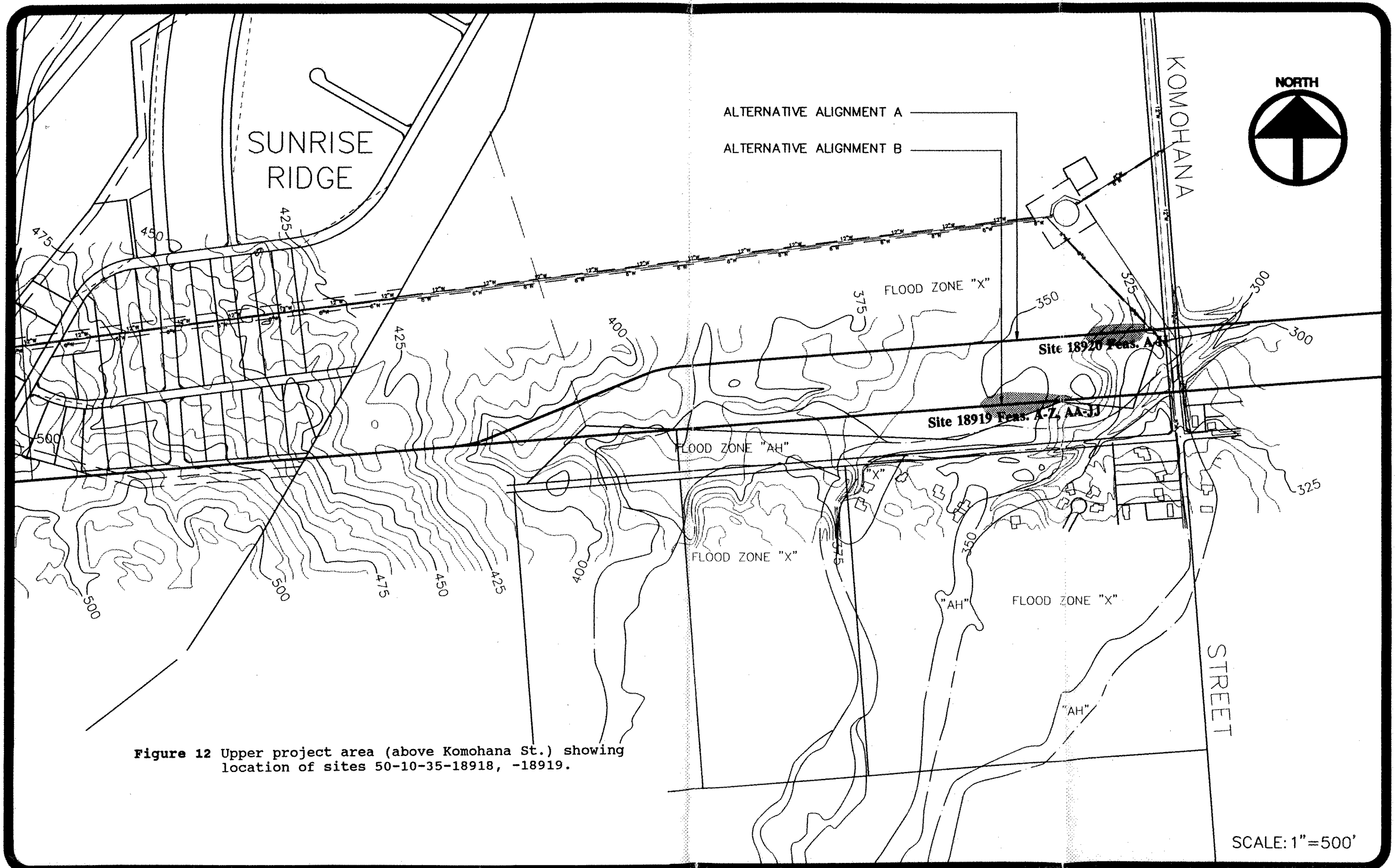


Figure 12 Upper project area (above Komohana St.) showing location of sites 50-10-35-18918, -18919.

93042F4

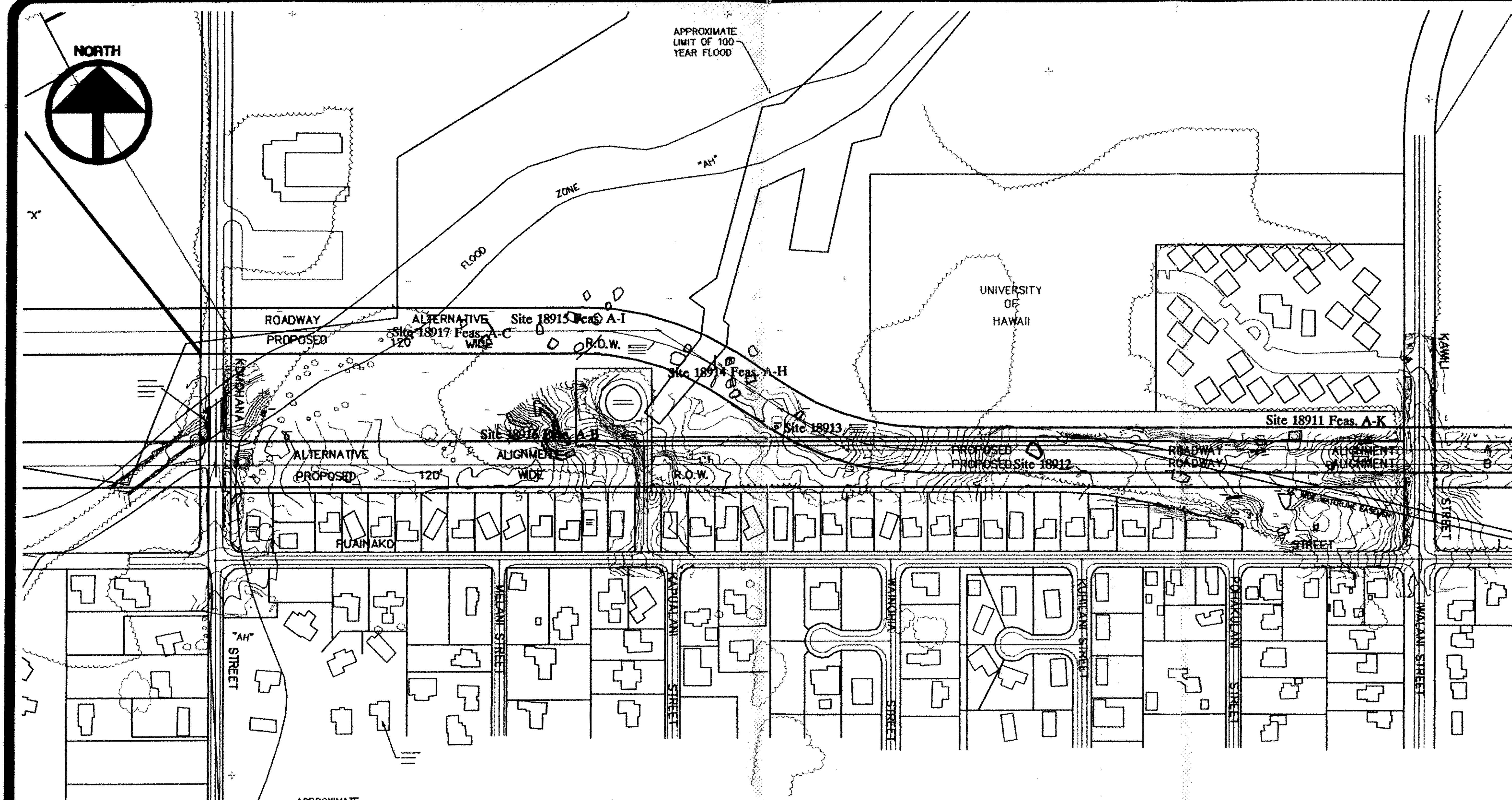


Figure 13 Lower project area showing location of sites 50-10-35-18911 to -18917.

93042F6

mounds constructed of stacked and piled boulders and cobbles. The site is located in Lot 17 of the Waiakea Mill Company land maps, within an area designated as under cane cultivation in 1925 (see Figure 7). The features are constructed on the margins of the drainage, and/or on areas of exposed bedrock (i.e., most often where little or no soil exists). Several features are terrace alignments which are constructed along the edge of the drainage.

The only artifacts observed in association with these features are wooden rail-road cross-ties (sometimes complete with spikes) that were noted on, or close to, several of the features. These ties were re-used as fence posts when the rail lines were abandoned (the ties have lengths of rusted barbed wire attached to them--as well as the original spikes in some cases). This evidence seems to mark the use of the area for pasture following the abandonment of sugarcane in the late 1940s. The stone constructed features appear to be associated with earlier railroad activities. There are accounts of using temporary track during the harvest of cane, and these features may have served as the foundations for loading docks or as railway beds. The use of temporary track is proposed because historic maps do not record a section of rail in this area.

The features are poorly preserved due to periodic flooding of the drainage, the damage caused by the thriving vegetation, and the bulldozer activity of the housing construction of the past 20-30 years. Although some of the features exhibit well constructed vertical facing, generally the features appear mounded and somewhat collapsed. The features are littered with modern rubbish and miscellaneous refuse from small scale marijuana cultivation.

Site 50-10-35-18911 is significant for its information content and is recommended for further data recovery. Continued research, including excavation of the features, and informant interviews from knowledgeable local residents, might prove useful in further interpretation.

Site 50-10-35-18911, Feature A

Feature A comprises two contiguous terraces located on the south side of the drainage approximately seven meters from the edge of Kawili Street. The terraces are constructed on the steep

drainage slope, one above the other. The upper terrace runs along the upper edge of the drainage and was constructed to incorporate the natural bedrock outcrop along that edge. The lower terrace extends down slope from the upper terrace and encloses a steep, soil covered portion of the drainage bank. The feature measures 23.0 m northeast-southwest by 11.5 m northwest-southeast.

Construction consists of piled boulders and cobbles. There is some remnant facing on the northwest side of the lower terrace, but overall the terraces have a mounded and tumbled appearance. The terrace walls vary from 1.5 to 3.5 m thick. The upper terrace has a maximum height of 1.7 m, while the lower terrace has a maximum height of 1.1 m. The feature is in fair to poor condition.

No artifacts or midden were observed. Excavation potential is poor.

Site 50-10-35-18911, Feature B

Feature B is a linear mound located 18.0 m north-northwest from feature A, on the opposite side of the drainage. The mound measures 13.4 m east-west by 3.4 m north-south and is constructed of piled boulders and cobbles. It shows no vertical facing. This linear mound is constructed at the base of the north slope of the drainage below a bedrock outcrop. Feature B has a maximum vertical height of 1.4 m. It is in poor condition. No artifacts or midden were observed and excavation potential is poor.

Site 50-10-35-18911, Feature C

Located 12.0 m west of feature B along the upper edge of the drainage, feature C consists of an area of exposed bedrock that has been modified by stacked boulders and cobbles. The feature measures 14.4 m northeast-southwest by a maximum 2.9 m northwest-southeast. The built-up areas of the outcrop form a well constructed vertical face that forms a shallow terrace level with upper edge of the drainage. The vertical face is 1.1 m high and is most evident on the west end of the feature. The feature is in fair to poor condition. No artifacts or midden were observed and excavation potential is poor.

Site 50-10-35-18911, Feature D

Feature D is a roughly rectangular mound constructed of stacked and piled boulders and cobbles. It is located 9.0 m south of feature B, on the relatively level drainage bottom. Feature D measures 14.0 m northeast-southwest by 5.0 m northwest-southeast and has a maximum vertical height of 1.6 m. The feature is mounded in appearance and lacks vertical facing. No midden or artifacts were observed in association with the feature. The overall condition of the feature is poor, as is the excavation potential.

Site 50-10-35-18911, Feature E

Feature E is an irregular shaped mound located 30.0 m west of feature A on the relatively flat bottom of the drainage. The feature measures 9.5 m north-south by 8.0 m east-west and is constructed of stacked and piled boulders and cobbles. Vertical facing is evident on the east and west sides of the mound. This vertical facing ranges from 1.2 to 0.95 m high. Tree growth has collapsed portions of the feature giving it a tumbled appearance. No artifacts or midden were observed and the feature's excavation potential is poor.

Site 50-10-35-18911, Feature F

Located 15.0 m northwest of feature E, feature F consists of a linear terrace constructed of stacked and piled boulders and cobbles. Because of its position at the base of the drainage's north slope, the terrace functions as a retaining wall which maintains a small level area up-slope. The terrace measures 22.0 m east-west by a maximum 4.5 m north-south, however, the average width of the terrace is 2.0 m. The southern (downslope) edge of the terrace is partially tumbled, but vertical facing is still evident. This facing measures 1.2 m high.

A badly decomposed railroad cross-tie was observed just east of the terrace. Like many of the other cross-ties observed in the this part of the project area, this cross-tie was probably brought to the locality when it was re-used as a fence post. A crude depression was observed in the eastern end of the terrace. This depression in the boulder and cobble construction measured 0.3 m in diameter and 0.2 m deep. It is unclear whether this depression represents a intentionally constructed feature, such as a post hole, or whether it is a natural tree mold.

No other artifacts and no midden were observed in association with the feature. The overall condition of the feature is fair to poor. Excavation potential is poor.

Site 50-10-35-18911, Feature G

Feature G is located directly north (9.0 m upslope) of feature F at the top of the drainage slope. This roughly rectangular mound measures 10.4 m northeast-southwest by 7.4 m northwest-southeast and has a maximum vertical height of 1.2 m. The feature is constructed of piled boulders and cobbles and has no vertical faces. The feature is in fair to poor condition. No artifacts or midden were observed. The excavation potential is low.

Site 50-10-35-18911, Feature H

Located 25.0 m west of feature F, feature H is a terrace similar to feature F. It is constructed of stacked and piled boulders and cobbles and its position at the base of the drainage slope creates a small level area up-slope of the feature. The feature measures 14.0 m east-west by a maximum of 3.7 m north-south. Vertical facing was observed on both the north (upslope) and south (downslope) edges of the terrace. This facing measured 0.3 m on the upslope edge and 0.60 m on the downslope edge. The overall maximum vertical height of the feature is 1.4 m. The downslope portion of the feature is partially collapsed.

Two railroad cross-ties were observed just south of the feature. Approximately 5.0 m north (upslope) of the feature is a large area of bulldozer push--most likely from the construction of the Adult Student Housing complex. This push extends along the top of the drainage's north slope for approximately 8.0 m.

The overall condition of the feature is fair to poor and excavation potential is poor.

Site 50-10-35-18911, Feature I

Feature I is a roughly L-shaped terrace constructed of stacked and piled boulders and cobbles. Feature I is located at the base of the drainage's north slope, 25.0 m west of feature H. The L-shape is open to the north (upslope) and retains a level area of the drainage slope. The terrace measures 18.0 m in length and averages 2.0 m in width. The terrace, measured from the southern (downslope) side, has a maximum vertical height of 1.5 m. Vertical facing was observed on the southwestern edge of the feature.

Four railroad cross-ties were observed just to the south of the feature. These ties still have spikes in them, but also have rusted fragments of barbed wire--suggesting their secondary use as fence posts. The feature is, in part, collapsed and is in fair to poor condition. Excavation potential is poor.

Site 50-10-35-18911, Feature J

Located 27.0 m west of Feature I along the base of the north slope of the drainage, Feature J consist of an irregular shaped mound. It is constructed of piled boulders and cobbles and is very tumbled in appearance due to the destructive forces of tree growth. The mound measures 4.6 m east-west by 4.3 m north-south and has a maximum vertical height of 1.4 m. A small portion of vertical facing was observed on the west side of the mound, measuring 1.1 m high. No artifacts or midden were observed in association with feature J. Feature condition and excavation potential are poor.

Site 50-10-35-18911, Feature K

Feature K consists of an irregular shaped mound located 12.0 m south of Feature J in the relatively level area of the drainage bottom. The feature is constructed of piled boulders and cobbles. No vertical facing was observed, rather the feature has a mounded appearance. Feature K measures 13.7 m east-west by 7.2 m north-south and has a maximum vertical height of 1.05 m. Except for modern garbage, no artifacts or midden were observed. The condition and excavation potential of Feature K is poor.

State Site #:	50-10-35-18912
Survey Site #:	2
# of Features:	1
Areal Extent:	20 m north-south by 20 m east-west
Probable Age:	Historic
Probable Function:	Land clearance/Foundation

The single feature of site 50-10-35-18911 consists of an irregular shaped mound constructed of stacked and piled boulders and cobbles. Like site 50-10-35-18911, site 50-10-35-18912 represents historic agricultural field clearing. The site is located approximately 110.0 m west of site 50-10-35-18911 in the same drainage feature. In the locality of site 50-10-35-18912 the drainage has become wider and less pronounced, with poorly defined banks. Site 50-10-35-18912 is located in the relatively flat bottom of the drainage. The surrounding vegetation is dense, consisting of California grass, low ferns, strawberry guava, and medium sized trees, which form a low canopy.

The mound is roughly triangular in shape and extends southwest off a low bedrock outcrop that has been modified by bulldozer activity. Site 50-10-35-18912 measures 16.0 m northeast-southwest by 14.0 northwest-southeast and has a maximum vertical height of 1.5 m. The dense vegetation and numerous trees growing on the mound have contributed to the mound's tumbled condition. Remnant vertical facing was observed on the west and north sides of the mound.

A channel-like feature is constructed across the surface of site 50-10-35-18912. The channel curves from the west side of the feature to the north side, where the feature abuts the bedrock outcrop. The channel averages a depth of 0.4 to 0.5 m (below the mound surface) and a width of 1.5 m. The northwest side of the channel is well faced with stacked boulders and cobbles, however, as with much of the site, the vegetation growth has greatly disturbed the rest of this channel feature. No artifacts or midden were observed. The overall condition and the excavation potential for site 50-10-35-18912 are poor.

Site 50-10-35-18912 is significant for its information content on plantation agriculture in the region and is recommended for further data recovery (test excavation).

State Site #: 50-10-35-18913

Survey Site #: 3

# of Features: 1

Areal Extent: 11.5 m northeast-southwest by 4.0 m northwest-southeast

Probable Age: Historic

Probable Function: Land clearance

Site 50-10-35-18913 is another single feature site consisting of a linear mound constructed of stacked and piled boulders and cobbles. The site is located approximately 200.0 m northwest of site 50-10-35-18912, or, about 50.0 m southeast of site 50-10-35-18914. The centerline of Road Alignment A runs through site 50-10-35-18913. Site 50-10-35-18913 represents a clearing mound from historic agricultural activities.

The mound is constructed on the edge of a shallow incline which slopes down to the east below the feature. The surrounding topography is undulating, sloping gradually to the east. The surrounding vegetation consists of strawberry guava, low grasses and ferns, *ti*, and various taller trees that from a medium canopy. The vegetation makes the area around the site fairly open. A modern foot path runs past the southwest end of the site.

Site 50-10-35-18913 measures 11.5 m northeast-southwest by 4.0 m northwest-southeast and has a maximum vertical height of 1.6 m. The mound is in poor condition and has been partially collapsed by the roots of a large tree which grows out of the mound's northeast end. Although tumbled in appearance, vertical facing was observed on the southeast side of the mound.

No artifacts or midden were observed. The excavation potential is poor.

Site 50-10-35-18913 is significant for its information content on historic agriculture in the region. Adequate data have been collected on this site, and no further work is recommended.

State Site #: 50-10-35-19814

Survey Site #: 4

# of Features: 8

Areal Extent: 91.0 m northwest-southeast by 41.0 m northeast-southwest

Probable Age: Historic

Probable Function: Land clearance/Foundation

The features of Site 50-10-35-19814 are scattered over the width of Road Alignment A, approximately 50.0 m northwest of site 50-10-35-19813. Feature G of site 50-10-35-19814, the westernmost of the features, is located 20.0 m northeast of the northeast corner of the Pu'ainako Reservoir property. The eight features of the site consist of terraces, mounds, platforms, and modified outcrops. All features are constructed of stacked and piled boulders and cobbles.

The surrounding topography is slightly undulating, sloping gently to the east. Although not located within an obvious drainage like sites 50-10-35-18911 and 50-10-35-18912, during heavy rain water collects and probably flows through site 50-10-35-18914. A small pool of standing water was noted during the survey southwest of feature A. Vegetation consists of low ferns, thimble berry, strawberry guava, weeds, and taller trees that form a medium canopy. The southeastern portion of the site is predominantly tall california grass. Many of the features have *ti* plants growing on or near them.

Site 50-10-35-18914 is located in Lot 18 of the Waiakea Mill land maps, in an area that was under sugarcane cultivation in 1925 (see Figure 7). Historical research indicates that this activity would include clearing mounds, foundations for water tanks and loading platforms, and features associated with the railroad lines. All of the features of site 50-10-35-18914 reflect this historic agricultural activity. The site is significant for its information content and is recommended for some further data recovery.

Site 50-10-35-18914, Feature A

Feature A is located approximately 50.0 northwest of site 50-10-35-18913. This feature is a rectangular mound measuring 7.2 m northwest-southeast by 4.5 m northeast-southwest with a maximum vertical height of 1.2 m. The feature is constructed with near right angle corners and vertical faces on all sides--except for the southwest corner, which is partially collapsed. The top surface of the platform is even and fairly level--sloping slightly to the northwest. The surrounding vegetation is mostly tall grass and strawberry guava. A pool of standing water was observed just southwest of the feature.

Five depressions were observed on the top surface of the platform. These depressions averaged 0.2 m in diameter and appeared to have part of the original surface of the platform. These depressions may represent post holes, perhaps once supporting a water tank. No artifacts or midden were observed in association with Feature A. The feature is in good condition and excavation potential is fair.

Site 50-10-35-18914, Feature B

Located 8.0 m northwest of Feature A, Feature B consists of a roughly rectangular platform with a well-constructed earthen ramp-like feature that bisects the platform. The feature is constructed of stacked and piled boulders and cobbles. The sides of the platform are vertical faces except in the northwest corner and along the northeast side, where the feature is somewhat collapsed. The feature measures 7.5 m northwest-southeast by 8.0 m northeast-southwest and has a maximum vertical height of 2.1 m. The feature is constructed on a natural bedrock outcrop. This bedrock is exposed and forms a rise in the platform surface on the northeast half of the platform.

The ramp-like feature is a consistent 1.5-1.7 m wide and has a soil floor that forms a uniform slope down from the center of the platform in either direction. The sides of the ramp are well faced, like a curbing. Interestingly, Feature F (located 19.0 m to the northwest) is very similar with a corresponding ramp-like feature. Both platforms are constructed on bedrock outcrops that are slightly elevated from the surrounding land surface. The two ramp-like features align perfectly, facing each across an area of lower ground. It is postulated these features were some kind of loading ramps.

No artifacts or midden were observed in association with Feature B. The feature is in good condition and excavation potential is fair.

Site 50-10-35-18914, Feature C

Feature C is located 10.0 m southwest of Feature A and consists of an irregular shaped mound. Feature C measures 4.3 m north-south by 5.5 m east-west and has a maximum vertical height of 1.5 m. The feature adjoins an area of exposed bedrock to the south. The interior of the mound forms a rough depression. Feature C has no vertical facing. No artifacts or midden were observed. The feature is in poor condition and the excavation potential is poor.

Site 50-10-35-18914, Feature D

Feature D is an irregular shaped mound located 12.0 m northwest of feature C at the upper edge of a short slope. The feature measures 6.5 m north-south by 3.8 m east-west with a maximum vertical height of 1.0 m on the west (upslope) side and 2.4 m on the east (downslope) side. Feature D is constructed of stacked and piled boulders and cobbles (Figures 14-15). Vertical facing exists on the feature's east and west sides. The surface of the feature is fairly even and level. Tree growth and erosion along the adjacent slope have collapsed portions of the feature. No artifacts or midden were observed. The overall condition of the feature is fair. Excavation potential is poor.

Site 50-10-35-18914, Feature E

Feature E is located 18.0 m north of feature D and consists of a linear terrace constructed of stacked and piled boulders and cobbles. The feature is constructed along the edge of a shallow incline which slopes to the southeast. The terrace forms a roughly level area. The boulder and cobble surface of the terrace is roughly even with the level of the ground surface at the top of the slope. The feature measures 10.5 m northeast-southwest by 4.5 m northwest-southeast and has a maximum vertical height of 1.05 m. The terrace is well faced on the northeast and southeast sides. The southern portion of the terrace has tumbled. No artifacts or midden were observed. The overall condition and excavation potential of the feature are poor.

Figure 14 Site 50-10-35-18914 Feature D, view to north.

Figure 15 Site 50-10-35-18914 Feature D, view to southwest.

Site 50-10-35-18914, Feature F

Already mentioned in the feature description of Feature B, Feature F consists of a roughly rectangular platform with a ramp-like feature which bisects the platform. Feature F is located 19.0 m northwest of feature B across a shallow depression. The feature measures 9.4 m northwest-southeast by 7.0 m northeast-southwest with a maximum vertical height of 1.15 m. Like Feature B, Feature F is constructed on a bedrock outcrop which is slightly elevated from the surrounding land surface. Also like Feature B, Feature F is well constructed with vertical faces on all sides. The central portion of the platform surface is soil and exposed bedrock. The platform surface is built up to the level of this soil and bedrock core--forming a level surface.

The ramp-like feature is a consistent 1.3-1.5 m wide and the sides of the ramp are well faced. The ramp slopes downward evenly in either direction from the elevated surface at the center of the platform. The ramp-like features of features B and F align with each other. These features may have served as loading platforms.

No artifacts or midden were observed. Feature F is in fair condition and excavation potential is fair.

Site 50-10-35-19814, Feature G

Feature G is located 15.0 m west-northwest of Feature D and consists of an irregularly shaped modified outcrop. The outcrop is a large area of slightly upraised bedrock which has been modified by the stacking and piling of boulders and cobbles around its perimeter. The outcrop measures 24.6 m north-south by 28.8 m east-west with a smaller constructed section that comes off the southwest portion of the outcrop. This smaller, southwest portion measures 10.2 m northeast-southwest by 9.3 m northwest-southeast. Most of the modification consists of the haphazard piling and heaping of boulders and cobbles, however, some portions of the south and southeast perimeter are roughly faced with stacked boulders. The surface of the outcrop consists of soil areas among undulating bedrock. The surface has been modified with three rough linear alignments and a low mound of piled boulders and cobbles.

The smaller, southwest portion of the outcrop shows evidence of bulldozer activity. The bulldozing likely occurred in conjunction with the construction of the adjacent Pu'ainako Reservoir (18.0 m to the southwest).

No artifacts or midden were observed. This feature is in poor condition. Excavation potential is poor.

Site 50-10-35-18914, Feature H

Feature H is exposed bedrock that has been modified by the construction of a curvilinear alignment of stacked and piled boulders and cobbles. The alignment forms a rough C-shape, open to the southwest. Feature H is located 3.0 m north of feature G. Like Feature G, there appears to have been bulldozer activity around Feature H. Feature H measures 10.3 m northwest-southeast by 6.0 m northeast-southwest. The linear alignment has an average width of 2.1 m and has a maximum vertical height of 1.15 m. A small portion of the north side of the feature has vertical facing. No artifacts or midden were observed. This feature is in poor condition. Excavation potential is poor.

State Site #:	50-10-35-18915
Survey Site #:	5
# of Features:	9
Areal Extent:	70.0 m east-west by 50 m north-south
Probable Age:	Historic
Probable Function:	Land clearance/Foundations

The nine features of site 50-10-35-18915 are located directly north and northwest of the Pu'ainako Reservoir in Road Alignment A. Feature A is located 30.0 m northwest of the northeastern corner of the reservoir property. The features of site 50-10-35-19815 consist of an enclosure, a railroad bed, mounds, and platforms.

The topography is fairly level, sloping slightly to the east. This area of the project area appears to be a flood plain for the drainage that runs parallel to and just north of Road Alignment A in this area. The surface in this area shows clear signs of regular flooding, indicating that this drainage overflows its banks on a regular basis. The water has scoured away the shallow soil in numerous places, exposing the underlying pahoehoe bedrock.

The vegetation consists predominantly of low ferns and strawberry guava. There is also *ti*, ginger, banyan, rubber and ʻohiʻa trees. The vegetation, especially the strawberry guava, could be very dense, however, it has been kept in check by use of the hiking trail and visitors that clear vegetation. Site 50-10-35-18915 is located in Lot 18 of the Waiakea Mill cultivation map, in an area designated as being under sugarcane cultivation in 1925. Plotted on these maps are the permanent railroad lines, one of which runs through the area of Site 50-10-35-18915 (rail bed with a cross-tie *in situ*). This site consists of features that are remnants of both the historical agricultural activity as well as the related railroad operation. These features include land clearance mounds, foundations for loading structures and possibly water tanks, and the railroad bed. Site 50-10-35-18915 is significant for its information content regarding this historical agricultural activity and is recommended for further data recovery.

A 1.5 meter square test unit was excavated in feature H. The results of this excavation are discussed in the feature H description (below).

Site 50-10-35-18915, Feature A

Feature A is located 30.0 m northwest of the northeastern corner of the Reservoir property. This feature consists of a crude mound-like enclosure which is roughly oval in shape and opens to the west. The enclosure opening is 1.5 m wide. The enclosure is constructed of stacked and piled boulders and cobbles and measures 12.4 m northeast-southwest by 9.2 m northwest-southeast. The enclosure wall varies in thickness from 1.1 to 3.1 m. The wall ranges between 0.8 and 1.2 m in height. The interior of the enclosure measures 7.5 m northeast-southwest by 4.0 m northwest-southwest and is a jumble of loose boulders and cobbles. The northeast portion of the enclosure has vertical facing. The feature appears to be partially collapsed and in poor condition. However, the original construction was not well made.

No artifacts or midden were observed. Excavation potential is fair.

This feature directly abuts the permanent railroad bed (Feature B). Given this feature's proximity to the railroad bed, it is likely that feature A was associated with railroad use. Possibly it served as the foundation for a wooden structure loading platform or a water tank.

Site 50-10-35-18915, Feature B

Feature B is located directly south-southeast of Feature A and consists of a remnant of the railroad bed which passed through this part of the project area. The bed consists of a terrace-like linear mound, constructed of stacked and piled boulders and cobbles, built along the edge of a shallow erosional depression. The bed is 4.0 m wide. The intact section of the bed is 8.0 m (northeast-southwest) long. At either end the bed appears to have been washed out by intermittent stream flow caused by the periodic flooding of the area. Two cross-ties were found on the bed surface (one *in situ*) with spikes still in place. The distance between the spikes is three feet, indicating the rail was three-foot (narrow) gauge. A large, formed, piece of concrete, measuring 0.5 m by 0.3 m by 0.2 m, was observed on the bed surface. This piece of concrete looked like some sort of piling.

No other artifacts or midden were observed. The feature is in fair condition and excavation potential is fair.

Very similar remnant sections of the same railroad-bed (according to historic maps) were observed just north of the project area and west of the Adult Student Housing complex. The form was the same, consisting of a terrace-like mound along the edge of a depression. These sections outside the project area also had *in situ* cross-ties with spikes still in place. One section also had a length of *in situ* rusted railroad track. It is clear that the information from the historic maps can be correlated with the physical remains still extent on the landscape. In this case we have the remains of the cane railroad that traversed Lots 17 and 18 (see Figures 4-7).

Site 50-10-35-18915, Feature C

Feature C is located 15.5 m north of feature A and consists of a roughly rectangular platform constructed of stacked and piled boulders and cobbles. Like features B and F of site 50-10-35-18914, the Feature C platform is built around an area of natural outcrop and has a ramp-like feature bisecting it. The feature measures 5.7 m northeast-southwest by 7.3 m northwest-southeast and has a maximum vertical height of 1.8 m. The northwest and southeast sides of the platform have vertical facing measuring 0.6 m high. The surface of the platform is rough and not level.

Like the rest of the platform, the ramp-like portion is in a poor state of preservation. It averages 1.2 m wide, but its sides appear collapsed. The surface of the ramp is soil and it slopes down from the level of the platform surface. Like features B and F of site 50-10-35-18914, the ramp-like feature of platform C could have facilitated loading from the surface of the platform.

Feature C is located on the edge of the intermittent drainage which periodically floods this part of the project area. The poor condition of feature C is likely a function of its location adjacent to this drainage which frequently floods.

No artifacts or midden were observed. The excavation potential for the feature is poor.

Site 50-10-35-18915, Feature D

Feature D consists of a low, roughly rectangular mound of stacked boulders and cobbles. It is located 7.0 m northeast of feature C, approximately 2.0 m east of the drainage edge. The feature measures 2.2 m northeast-southwest by 1.5 m northwest-southeast and has a maximum vertical height of 0.9 m. The mound is well constructed with remnant vertical facing. A length of fencing wire was found running completely under this feature. No other artifacts or midden were observed. The feature is in fair condition. Excavation potential is poor.

Site 50-10-35-18915, Feature E

Feature E is located 4.5 m northeast of Feature D and 4.5 m east of the drainage edge. Feature E consists of a rectangular platform constructed of stacked and piled boulders and cobbles. It measures 5.5 m northwest-southeast by 7.5 m northeast-southwest and has a maximum vertical height of 1.1 m. The sides of the mound are well faced on the northwest and southwest sides, averaging 1.0 m high. The other sides have partially collapsed. The surface of the platform slopes to the southeast and forms a shallow depression located in the platform's center. Three smaller depressions averaging 0.20 m in diameter were observed on the surface of the platform. These depressions are possible post holes, although they could be the result of tree growth.

A single artifact was observed in association with feature E. A piece of strapping iron measuring 30 cm long by 3.5 cm wide was found protruding from under a rock (i.e., embedded) on the southwest side of the platform. The piece of iron had an iron bolt passing through one end. The artifact was not collected.

The condition of this feature is fair. Excavation potential is fair (i.e., other metal artifacts may be recovered with disassembling of the mound).

Site 50-10-35-18915, Feature F

Feature F is located 13.0 m northwest of feature A and consists of a rectangular platform that has been badly disturbed on its northwest side by flood water and a large tree-fall. The feature measures 6.2 m northwest-southeast by 7.0 m northeast-southwest and has a maximum vertical height of 1.4 m. Although the feature is highly disturbed, there are still remnants of vertical facing on the southwest and southeast sides of the platform. The surface of the platform consists of jumbled boulders and cobbles. No artifacts or midden were observed in association with the feature. The overall condition and excavation potential of the feature are poor.

Site 50-10-35-18915, Feature G

Located 15.0 m north-northwest of Feature F, Feature G consists of a roughly rectangular mound constructed of piled boulders and cobbles. The feature is located directly southwest of the relatively recently formed drainage (associated with constructed flood control channels upslope). Across the drainage, outside the project area, is a similar mound that has been marked "Cultural Surveys Hawaii #2 'B'--12/15/92". Feature G measures 4.2 m northwest-southeast by 3.1 m northeast-southwest and has a maximum vertical height of 1.75 m. No vertical facing is evident. No artifacts or midden were observed. The feature is in poor condition. The excavation potential is also poor.

Site 50-10-35-18915, Feature H

Feature H is a roughly oval-shaped platform constructed of stacked and piled boulders and cobbles. It is located 25.0 m west of feature F. It measures 7.5 m north-south by 6.1 m east-west and has a maximum vertical height of 1.3 m. Nearly the entire perimeter of the feature has vertical facing measuring between 1.1 and 1.3 m high. The platform surface is rough and uneven and forms a roughly circular depression measuring 2.8 m in diameter. This depression has a maximum depth of 0.35 m below the surrounding platform surface. No artifacts or midden were observed prior to the excavation of the feature. The feature is in fair condition and the excavation potential poor.

Testing Results of Feature H

Excavation in Feature H was undertaken to test for the presence of cultural materials (content) that would inform on its age, form of construction, and function. Feature H was selected for excavation because its size, method of construction, and state of preservation are similar to many of the platforms recorded in the project area. Thus providing, by inference at this stage, an understanding of other (non-excavated) features of comparable form.

A 1.5 meter-square unit was excavated in the center of Feature H, encompassing approximately two-thirds of the depressed area. The excavation reached a maximum depth of 1.50 m below the platform surface, terminating in a stratum of weathered (basal) bedrock. Four distinct strata were encountered in the excavation.

Stratum I is made up of the boulders and cobbles of the platform construction fill. This stratum is 1.0 m thick. No internal structure was observed in the platform fill. Indeed, the stones were jumbled together in an unstable manner. Only in profile did a slight size-sorting of the fill material become apparent. The lower 65 cm of the stratum consisted of slightly smaller boulders and cobbles than the upper 35 cm. The distinction is faint and may not have been intentional in the mounds construction, which perhaps occurred only by accretion. Stratum I contained large quantities of fresh organic material, including leaves, roots, and twigs. No artifacts or midden were observed in this layer. Because of the unstable nature of the platform fill, the trench walls had to be slightly sloping for stability. Consequently, the dimensions of the unit were reduced from 1.5 to 1.0 meter square during the excavation of this first stratum.

Stratum IIa consists of a silty clay loam (Munsell 10YR 2/2, very dark brown), organically enriched, friable, and containing numerous small boulder and cobble inclusions. This sediment largely comprised of the material that has filtered down through the platform since its construction. It has incorporated the lowest levels of the platform fill as it accumulated over time. Stratum IIa begins at approximately 100 cm below the platform surface and is 12 cm thick. No midden or artifacts were observed in this layer.

Stratum IIb is similar to IIa, consisting of a slightly lighter, more compact, very cobbly silty clay loam (Munsell 10YR 3/3, dark brown). This layer contained a much smaller amount of organic material, consisting primarily of small rootlets. The cobble inclusions in this layer were smaller and less numerous than in Stratum IIa above. Stratum IIb begins at approximately 112 cm below platform surface and is 18 cm thick. This layer represents the pre-platform A-B soil horizons. At 120-125 cm below platform surface, three pieces of non-diagnostic debitage of volcanic glass were recovered. Based on stratigraphy, the volcanic glass fragments were deposited before the construction of the platform.

Stratum III was encountered at approximately 130 cm below platform surface. Stratum III consists of a cobbly silty clay loam (Munsell 10YR 4/3, brown). This sediment is the C soil horizon. No organic material, artifacts, or midden were observed in this stratum. Excavation continued to a depth of 150 cm below the platform surface where we reached culturally sterile (and undisturbed) decomposing bedrock.

The three volcanic glass pieces (non-diagnostic debitage) found in stratum IIb may provide evidence for pre-contact, Hawaiian activity in the area. However, with such a small sample of artifacts it is difficult to draw any definitive conclusions. The three flakes are the only prehistoric artifacts that were found in the project area.

Site 50-10-35-19815, Feature I

Feature I consists of an irregular shaped mound that is located 10.0 m northwest of Feature H. The mound measures 7.0 m northeast-southwest by 3.8 m northwest-southeast and has a maximum vertical height of 1.6 m. The mound is constructed of stacked and piled boulders and cobbles. The west side of the feature has remnant vertical facing, although this side of the feature also appears to have been disturbed--many of the stones have tumbled and sections of facing have collapsed. The feature is in fair to poor condition and no artifacts or midden were observed. Excavation potential is poor.

State Site #:	50-10-35-18916
Survey Site #:	6
# of Features:	2
Areal Extent:	55.0 m northwest-southeast by 22.0 m northeast-southwest
Probable Age:	Historic
Probable Function:	Land clearance/Foundation

Site 50-10-35-18916 is located on Road Alignment B, 12.0 m west of the southwest corner of the Pu'ainako Reservoir property. Feature A is a rectangular platform (Figures 16-17). Feature B is a substantial terrace-like wall segment that partially encloses feature A and extends to the northwest.

Site 50-10-35-18916 is built along an incline which slopes to the northwest, north, and northeast forming a natural half-bowl. Feature A is built at the base of this slope, within the half-bowl, and feature B snakes along the incline's top edge.

The vegetation consists almost exclusively of strawberry guava, which forms a low canopy. There is little undergrowth, only a few low bushes, ferns, and ti plants. One breadfruit tree was observed.

Site 50-10-35-18916 is located in Lot 18 of the Waiakea Mill cultivation map in an area designated as completely in sugarcane cultivation in 1925. Like the other stone constructions in the project area, this site reflects the historic agricultural activities. This site is significant for its information content and is recommended for additional data recovery.

A 1.0 by 1.5 m test unit was excavated in Feature A. The results of the excavation are reported following the feature description.

Site 50-10-35-18916, Feature A

Feature A is located 12.0 m west of the Southwest corner of the Pu'ainako Reservoir Property. The feature consists of a rectangular platform constructed of stacked and piled boulders and cobbles. It measures 8.8 m northwest-southeast by 5.0 m northeast-southwest and has a maximum vertical height of 1.4 m. The north corner of the feature is collapsed. The other sides of the feature have well constructed vertical faces. The platform surface is rough, but relatively level. No artifacts or midden were observed in association with the platform. The platform is well constructed with near right-angle corners and well made vertical faces--it is in good condition. Excavation potential is fair to poor.

Figure 16 Site 50-10-35-18916 Feature A, view to west.

Figure 17 Site 50-10-35-18916 Feature A, view to north.

Testing Results of Feature A

Excavation in Feature A was undertaken to test for the presence (and kind) of cultural material, to assess the feature's age, form of construction, and function. Feature A was selected for excavation because its size, method of construction, and state of preservation are similar to many of the platforms recorded in the project area--thus representing a preliminary sample of one formal class of features. Feature A is particularly comparable to feature A of site 50-10-35-18914. Where feature H of site 50-10-35-18915 was selected for excavation to represent the square to oval-shaped platforms, feature A was selected to represent the elongate, rectangular forms.

A 1.0 by 1.5 m test trench was excavated in the southeastern corner of the platform. The excavation reached a maximum depth of 1.05 m below the platform surface, terminating in a stratum of undisturbed weathered bedrock. Three distinct strata were encountered in the excavation.

Stratum I is made up of the boulders and cobbles of the platform construction fill. This stratum is 75 cm thick. No internal structure was observed in the platform fill. Indeed the boulders formed a jumble that held together only in an unstable fashion. Stratum I contained large quantities of organic material, including fresh leaves, roots, and twigs. No artifacts or midden were observed in this layer.

Stratum II consists of an organically rich, very cobbly silty clay loam (Munsell 10YR 3/3, dark brown). This sediment has filtered down through the platform since its construction. It has surrounded the lowest levels of the platform fill as it accumulated over time. Stratum II begins at approximately 75 cm below the platform surface and is 8 cm thick. No midden or artifacts were observed in this layer.

Stratum III was encountered at approximately 82 cm below platform surface. Stratum III consists of a cobbly silty clay loam (Munsell 10YR 4/3, brown). This sediment is the natural C horizon. No organic material, artifacts, or midden were observed in this stratum. Excavation continued to a depth of 105 cm below the platform surface to ensure the excavation had reached culturally sterile (and undisturbed), decomposing bedrock. In sum, no artifacts or midden were observed in association with the platform.

Site 50-10-35-18916, Feature B

Feature B partially encloses Feature A. Feature B is a retaining wall segment that is constructed of stacked and piled boulders and cobbles. The overall plan-view resembles a question mark. It is built along the top edge of an incline and measures 42.0 m long. The wall width ranges from 4.4 m to 1.4 m and averages 2.4 m. The wall is faced in few places, but crudely piled in most sections. The overall construction is of loosely piled boulders.

The northwest portion of the wall segment hooks back on itself, forming a three-sided enclosure that opens to the southeast. The interior of this enclosure measures 3.0 m north-south by 5.0 m east-west. At the northwestern tip of the wall segment there is a shallow depression measuring 2.0 m in diameter.

No artifacts or midden were observed in association with the feature. The feature is in fair to poor condition and the excavation potential is poor.

State Site #:	50-10-35-18917
Survey Site #:	7
# of Features:	3
Areal Extent:	27.0 m north-south by 15.0 m east-west
Probable Age:	Historic
Probable Function:	Land clearance

Site 50-10-35-18917 is located in Road Alignment A approximately 45.0 m west of Feature I of site 50-10-35-18915. The three features of the site are two mounds and a linear alignment, all constructed of stacked and piled boulders and cobbles.

The surrounding landscape is relatively flat. The site is located in what is likely the floodplain of the drainage which runs to the north of the site. The surrounding soil appears to have been eroded by periodic flooding, and there are patches of freshly exposed bedrock. The vegetation consists of abundant strawberry guava, some grasses and ferns, and a few ti plants.

Site 50-10-35-18917 is located in Lot 18 of the Waiakea Mill cultivation map in an area marked as completely under sugarcane cultivation in 1925. The features of Site 50-10-35-18917 reflect historic agricultural activity. Although modest in size and in poor condition these features are significant for their information content. The features of site 50-10-35-18917 are recommended for additional data recovery.

Site 50-10-35-18917, Feature A

Feature A consists of a roughly constructed linear alignment of stacked and piled boulders and cobbles. The feature measures 6.6 m north-south by 1.9 m east-west and has a maximum vertical height of 0.7 m. No vertical facing was observed. The feature is in poor condition. No midden or artifacts were observed. Excavation potential is poor.

Site 50-10-35-18917, Feature B

Feature B is located 9.0 m west of Feature A and consists of a small, roughly rectangular, mound of stacked and piled boulders and cobbles. The mound measures 3.0 m northeast-southwest by 3.2 m northwest-southeast and has a maximum vertical height of 0.85 m. The feature has remnant facing on the northeast and southeast corners. No artifacts or midden were observed. Excavation potential is poor.

Site 50-10-35-18917, Feature C

Feature C consists of a roughly rectangular mound constructed of stacked and piled boulders and cobbles. It is located 15.0 m south-southeast of Feature B. The mound measures 5.5 m northwest-southeast by 3.9 m northeast-southwest and has a maximum vertical height of 1.25 m. Feature C is crudely constructed, only the south side of the mound has vertical facing. The mound surface slopes to the north. No midden or artifacts were observed. The excavation potential is poor.

State Site #:	50-10-35-18918
Survey Site #:	8
# of Features:	4
Areal Extent:	30.0 m northeast-southwest by 20.0 m northwest-southeast
Probable Age:	Historic
Probable Function:	Land Clearance

Site 50-10-35-18918 is located on Road Alignment A mauka of Komohana street between datum stakes 240 + 00 and 238 + 00. The four modest features of the site consist of three modified outcrops and an oval-shaped stone mound.

The surrounding topography is undulating with many shallow depressions and low rises. This rough topography is the Kulaloa pahoehoe flow (1,100-1,400 BP), a significantly rockier substrate previously used for pasture. There are many areas of exposed bedrock amid what appears to be very shallow deposits of soil. The land surface slopes gently to the east.

Vegetation at site 50-10-35-18918 consists predominantly of strawberry guava and low fern. A few ti plants were observed.

Unlike the previous sites in the project area, site 50-10-35-18918 is *not* located in an area designated under cane cultivation on the Waiakea Mill cultivation map of 1925. On this map site 50-10-35-18918 is located in the area designated 'pasture land' north of Lots 20 and 21. Not surprisingly, the boundary of sugarcane cultivation and pasture land follows the geological boundary of the older Punahoa (3,000-4,000 BP) and the younger Kulaloa (1,100-1,400 BP) flow. The poor soil development and undulating surface of the younger of the two flows makes it inadequate for sugarcane cultivation. The few, simple features of site 50-10-35-18918 reflect limited activities carried out in pasture land, probably in this century alone. In this area, to the south of Road Alignment B (and north of Alignment A) are numerous features that include cattle walls with fence wire (sometimes found on old railroad ties), enclosures, stone mounds, and foundations and earthen excavations for livestock water and feed troughs.

These features are not in either alignment of the project area, and were not surveyed, only briefly examined.

Site 50-10-35-18918 is significant for its information content. Data have been acquired in the form of maps, photographs, and descriptions. Limited additional data might be recovered with further work.

Site 50-10-35-18918, Feature A

Feature A is the easternmost feature of the site and consists of a portion of a pahoehoe outcrop that has been modified by the stacking of boulders and cobbles along its west edge. The feature measures 3.2 m north-south by 1.0 m east-west. The feature has a vertical face ranging from 0.6 to 1.0 m high. No artifacts or midden were observed. The feature is in fair to poor condition and the excavation potential is poor.

Site 50-10-35-18918, Feature B

Located 16.0 m west-southwest of feature A, Feature B also consists of a portion of a pahoehoe outcrop that has been modified by the stacking of boulders and cobbles along its west edge. The feature measures 1.5 m north-south by 1.2 m east-west. The feature forms a roughly rectangular constructed area which is vertically faced on two sides. This facing ranges from 0.6 to 0.85 m high. No artifacts or midden were observed. The feature is in fair to poor condition. The excavation potential is poor.

Site 50-10-35-18918, Feature C

Feature C consists of a roughly oval-shaped mound located 8.0 m southwest of Feature B. The mound is constructed of stacked boulders and cobbles, measures 3.7 m north-south by 2.1 m east-west, and has a maximum vertical height of 1.4 m. The entire perimeter of the feature has vertical facing, ranging from 1.1 to 1.4 m high. The only artifact observed was a modern brown beer bottle. The feature is in fair condition. Excavation potential is poor.

Site 50-10-35-18918, Feature D

Feature D is a modified outcrop. It consists of an L-shape of stacked and piled boulders constructed to utilize a portion of natural outcrop to form, overall, a U-shaped enclosure. The feature is located 7.0 m west of Feature B. The enclosure opens to the southeast. The interior area of the enclosure measures 1.5 east-west by 2.0 m north-south. The walls of the enclosure average 0.8 m thick and have a maximum vertical height of 1.1 m. The interior portion of the feature is well faced. Several modern beer bottles were observed within the feature. No other midden or artifacts were observed. Feature D is in fair condition. Excavation potential is poor.

State Site #:	50-10-35-18919
Survey Site #:	9
# of Features:	36
Areal Extent:	200.0 m northeast-southwest by 50.0 m northwest-southeast
Probable Age:	Historic
Probable Function:	Land clearance/Foundations

Site 50-10-35-18919 is located in an area surrounding survey stakes 232 + 00, 233 + 00, 234 + 00, and 235 + 00 of Road Alignment B. The 36 features of the site occupy the width of Road Alignment B (and continue beyond, truncated by the drainage channel to the south). The site consists of mounds, wall segments, platforms, and most commonly, modified outcrops (Figures 18-21).

The surrounding topography is undulating, a landscape made up of low rises and shallow depressions. The raised areas are exposed pahoehoe bedrock and the low areas are usually accumulations of soil. Directly to the south of the site, outside the road alignment, there is a deep, artificially cut concrete-lined drainage which was constructed in modern times for flood control.

The vegetation at the site includes kukui nut trees, ti, ginger, ferns, and ʻohiʻa trees. The most predominant plant is strawberry guava which forms a low canopy. The vegetation cover is mixed, very dense in places and fairly open in others.

The majority of this site's features adjoin the natural land forms or modify them in some way. The most common form is the modified outcrop that consists of a linear or rectangular section of stacked and piled stones. These formations are built against the side of an outcrop, forming an artificial surface that is level with the surface of the outcrop. The sides of these features that do not abut the outcrop are usually vertical faces. In some instances it appeared as though these features were blocking openings that might extend into the outcrop. However, when a number of stones were carefully removed from several of these features, it was clear that only rock outcrop, and not deeper openings, were covered over.

Site 50-10-35-18919, according to historic maps, is located along the boundary that divided the sugarcane land from pasture land. Variation in vegetation reflects this boundary to some degree. The features of site 50-10-35-18919 represent historic agricultural activity, and the division between cane and pasture land. These features are the primarily clearing mounds, field boundaries, and possibly foundations for cane loading platforms and water tanks that were part of field activities. This site is significant for its information content regarding this historic period and it is recommended for additional data recovery where excavation is possible.

Test excavations were undertaken in features Q, R, and AA. The results of these excavations are described following the description of each feature.

Site 50-10-35-18919, Feature A

Feature A is located in the center of the site 50-10-35-18919, approximately 4.5 m west of survey stake 234 + 00 of Road Alignment B. The feature is a linear-shaped area of raised pahoehoe that has been modified by the stacking of boulders and cobbles at different locations around its perimeter. The feature measures 34.0 m north-south by 14.0 m east-west. Around the perimeter of the outcrop there are four separate areas of modification. Starting at the north of the outcrop and continuing counter clockwise, the areas of modification have the following dimensions: The first area measures 2.2 m northwest-southeast by 1.0 m northeast-southwest and has a maximum vertical height of 0.8 m. The second area measures 8.0 m northwest-southeast by 2.0 m northeast-southwest and has a maximum vertical height of 0.4 m. The third area measures 6.0 m northwest-southeast by a maximum 2.0 m northeast-southwest and has a maximum vertical height of 1.0 m. The final area measures 18.0 m north-south by a maximum of 1.5 m east-west. The vertical heights of the facing range from 1.1 to 1.2 m high. In each of these areas the modification conforms to the natural outline of the outcrop.

No artifacts or midden were observed associated with Feature A. The feature is in fair condition--the constructed areas are well faced and fairly well preserved. Excavation potential is poor.

Site 50-10-35-18919, Feature B

Feature B is located 2.5 m north of stake 234 + 00 of Road Alignment B, 4.0 m east of Feature A. The feature is a roughly rectangular modified outcrop constructed of stacked and piled boulders and cobbles. It measures 5.0 m northeast-southwest by 2.8 m northwest-southeast and has a maximum vertical height of 1.1 m. The southeast side of the constructed area abuts the outcrop. The three sides not abutting the outcrop are well faced ranging in height from 0.5 to 1.1 m. The surface of the modified area is uneven but level. No artifacts or midden were observed. The feature is in fair condition. The excavation potential is poor.

Site 50-10-35-18919, Feature C

Feature C is located 6.0 m southeast of Feature B and consists of a section of outcrop that has been modified by the stacking and piling of boulders and cobbles. The modification measures 8.0 m by 1.75 m and follows the perimeter of the outcrop. The constructed area abuts the outcrop to the north. Portions of the feature's south side are well faced with a maximum vertical height of 1.2 m--other portions are tumbled. No artifacts or midden were observed. The feature is in fair to poor condition and the excavation potential is poor.

Site 50-10-35-18919, Feature D

Feature D is located 4.4 m southeast of Feature C and consists of a small rectangular mound constructed of stacked boulders and cobbles. The feature measures 1.5 meters square and has a maximum vertical height of 0.6 m. The feature is faced on all sides and is in fair condition. No artifacts or midden were observed. The excavation potential is poor.

Site 50-10-35-18919, Feature E

Feature E is a wall segment constructed of stacked and piled boulders and cobbles. The wall is located 6.0 m southeast of Feature D. The wall segment runs 23.0 m northeast-southwest, is an average 2.0 m wide, and an average 0.75 m high (Figure 18). The wall segment is faced in sections, and partially collapsed in others. Several postholes were observed on the top surface of the wall--some of which still contained the rotted remains of the posts (Figure 19). Lengths of fencing wire and rotted posts were observed on or adjacent to the wall as well. The posts were made from railroad cross-ties. The wall was undoubtedly topped by a wooden post and wire fence. The feature is in fair condition. Excavation potential is poor. The wall segment is in the right location and has the proper orientation to have been part of the long boundary fence which historic maps show divided the sugarcane fields and pasture lands in this region.

Site 50-10-35-18919, Feature F

Feature F is located 7.0 m north of Feature B and consists of a natural bowl-shaped indentation in a pahoehoe outcrop. This bowl-shaped indentation has been modified by the stacking of boulders and cobbles around it's interior. The feature measures 6.0 m northeast-southwest by 4.3 m northwest-southeast. The interior area measures 3.6 m northeast-southwest by 3.0 m northwest-southeast. The interior of the feature has well constructed vertical faces measuring between 1.2 and 1.4 m high.

Also part of Feature F is a rectangular mound located 5.0 m north of the bowl-shaped indentation. The mound is well constructed of stacked and piled boulders and cobbles and measures 2.4 m north-south by 2.1 m east-west. Its well constructed vertical faces have a maximum vertical height of

Figure 18 Site 50-10-35-18919 Feature E, view to East.

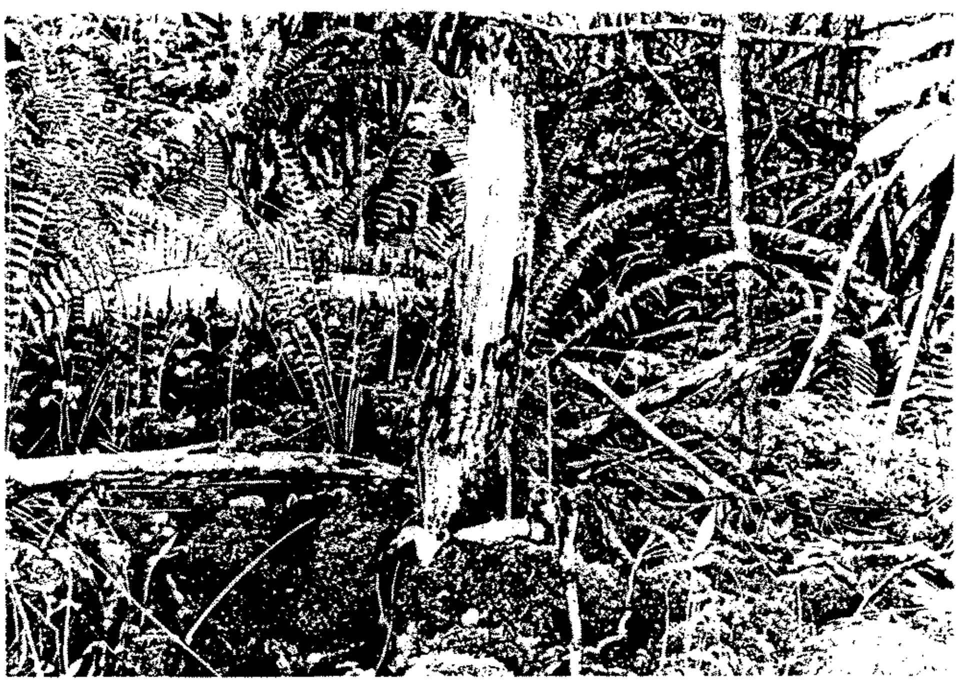


Figure 19 Site 50-10-35-18919 Feature E, view to East showing railroad tie used as fence post, *in situ*.

1.3 m. Only the northeast corner of this mound is somewhat collapsed.

No artifacts or midden were observed at Feature F. The feature is in fair condition. The excavation potential is poor.

Site 50-10-35-18919, Feature G

Feature G is located 10.0 m SE of Feature F and consists of a roughly rectangular section of modified outcrop. The feature measures 4.0 m northeast-southwest by 2.1 m northwest-southeast and is constructed of stacked and piled boulders and cobbles. The feature abuts the outcrop to the northwest. The southeast side of the feature is a vertical face with a maximum vertical height of 1.0 m. The feature is in poor condition and no artifacts or midden were observed. The excavation potential is poor.

Site 50-10-35-18919, Feature H

Feature H is located 9.0 m northeast of Feature G and consists of a small, roughly rectangular section of modified outcrop. The feature measures 1.8 m northeast-southwest by 1.9 m northwest-southeast and is constructed of stacked and piled boulders and cobbles. The feature abuts the outcrop to the north. The south side of the feature is a vertical face with a maximum vertical height of 0.9 m. The feature is in poor condition and no artifacts or midden were observed. The excavation potential is poor.

Site 50-10-35-18919, Feature I

Feature I is located 8.5 m northwest of Feature H and consists of a section of outcrop that has been modified by the stacking and piling of boulders and cobbles. The modification is built around the north half of a natural depression in the bedrock. The modification is 8.0 m long and varies in width from 0.75 to 1.5 m. The surface of the feature is uneven but level. The south side of the feature (the interior of the natural depression) has vertical facing measuring 1.0 m high. The feature is in fair condition. No artifacts or midden were observed. The excavation potential is poor.

Site 50-10-35-18919, Feature J

Feature J is located 13.0 m southeast of Feature G. Feature J consists of a section of outcrop that has been modified by stacked boulders and cobbles on its north and south sides (Figure 20). The feature measures 9.0 m north-south by 6.3 m east-west. The north side of the feature has vertical facing measuring 1.3 m high. The south side of the feature is somewhat collapsed and mounded. No midden or artifacts were observed. The feature's condition is fair to poor. Excavation potential is poor.

Site 50-10-35-18919, Feature K

Feature K is located 3.0 m northeast of Feature J and consists of a small rectangular mound of stacked and piled boulders and cobbles (Figure 21). The feature measures 1.6 meters square and has a maximum vertical height of 0.6 m. No vertical facing, midden or artifacts were observed. The feature is in fair condition. The excavation potential is poor.

Site 50-10-35-18919, Feature L

Located 6.0 m northeast of Feature K, Feature L consists of a roughly rectangular section of modified outcrop. The feature measures 3.6 m northeast-southwest by 11.1 m northwest-southeast and is constructed of stacked and piled boulders and cobbles. The feature abuts the outcrop to the northeast. The southwest side of the feature is a vertical face with a maximum vertical height of 1.3 m. The feature is in poor condition and no artifacts or midden were observed. The excavation potential is poor.

Site 50-10-35-18919, Feature M

Located 7.0 m east of Feature L, Feature M consists of a roughly circular section of modified outcrop. The feature measures 3.0 m in diameter, and is constructed of stacked and piled boulders and cobbles. The feature is built on top of the outcrop and has a maximum vertical height of 1.15 m. No vertical facing was observed. A length of metal wire, embedded in Feature M, extends to the northeast end of Feature E, the wall segment. This is the same fencing wire observed in association with Feature E further southeast along the wall segment. Feature M is in poor condition. The excavation potential is poor.

Figure 20 Site 50-10-35-18919 Feature J, view to north.

Figure 21 Site 50-10-35-18919 Feature K, view to west.

Site 50-10-35-18919, Feature N

Feature N is located 4.5 m southeast of Feature M and consists of an oval-shaped area of modified outcrop. The feature measures 3.6 m north-south by 2.4 m east-west and has a maximum vertical height of 0.7 m. No vertical facing was observed. Like Feature M, a length of fencing wire was found in association with Feature N. Feature N is in poor condition. The excavation potential is poor.

Site 50-10-35-18919, Feature O

Feature O is located 13.0 m west of Feature A, adjacent to Road Alignment B survey stake 233 + 00. This feature consists of an irregularly shaped mound constructed of stacked and piled boulders and cobbles. It measures 2.8 m northwest-southeast by 1.4 m northeast-southwest and has a maximum vertical height of 0.65 m. The southwest side of the feature is disturbed by tree growth. The other sides of the feature are faced. No artifacts or midden were observed specifically with Feature 0, however, two rotted railroad cross-ties were noted directly west of the feature. Feature O is in fair to poor condition and excavation potential is poor.

Site 50-10-35-18919, Feature P

Located 3.0 m north of Feature O, Feature P consists of a roughly rectangular section of modified outcrop. The feature measures 3.4 m north-south by 1.4 m east-west and is constructed of stacked and piled boulders and cobbles. The feature abuts the outcrop to the east. The south, west, and north sides of the feature are vertical faces, ranging from 1.2 to 1.4 m high. The feature is in good condition and no artifacts or midden were observed. The excavation potential is poor.

Site 50-10-35-18919, Feature Q

Feature Q is located 8.5 m west of Feature P and consists of a roughly rectangular platform constructed of stacked boulders and cobbles. The feature measures 4.2 m northwest-southeast by 2.4 m northeast-southwest and has a maximum vertical height of 1.4 m. The feature is well faced on all sides except the northwest, which is partially tumbled. The platform surface is rough boulders and cobbles, but is level. No artifacts or midden were observed in association with the platform, however, two rotting railroad cross-ties were observed near the feature. Feature Q is in good condition. Excavation potential is poor.

Testing Results of Feature Q

Excavation was undertaken in Feature Q to test for the presence of cultural materials that might aid in assigning an age (specific) and function to the feature. Feature Q was selected for excavation because its size, method of construction, and state of preservation represent (in form) several other platforms recorded in the project area.

A 1.0 by 1.5 m test trench was excavated in the northwest end of the platform. The excavation reached a maximum depth of 1.12 m below the platform surface, terminating at the underlying pahoehoe bedrock. Two distinct strata were encountered in the excavation. Stratum I is made up of the boulders and cobbles of the platform construction fill. This stratum is 105 cm thick. No internal structure was evident in the platform fill. The stones were jumbled together in an unstable manner. Stratum I contained organic material, including fresh leaves, roots, twigs, and kukui nut endocarps. No artifacts or midden were found in this layer.

Stratum II consists of a cobbly silty clay loam (Munsell 10YR 2/2, very dark brown) organically enriched, with friable texture. This sediment is the layer of material that has filtered down through the platform since its construction. It has filled-in the lowest levels of the rocks as it accumulated. The upper 5 cm of stratum II contained kukui nut endocarps, roots, and fresh leaves--indicating material is accumulating in the feature rapidly. Stratum II begins at approximately 100 cm below the platform surface and is 12 cm thick. No midden or artifacts were observed in this layer. In sum, excavation results confirm a field clearing origin, age, and function for Feature Q.

Site 50-10-35-18919, Feature R

Feature R is located 12.0 m south-southwest of Feature O on top of a bedrock outcrop. Feature R is a well-formed circular mound measuring 2.1 m in diameter and standing 0.7 m high. The perimeter of the mound is well faced. No artifacts or midden were observed. The feature is in fair condition and excavation potential is poor.

Testing Results of Feature R

Excavation in Feature R allowed us to test for the presence (and kind) of cultural material, to assess the feature's age, form of construction, and function. Feature R was selected for excavation because its size, method of construction, and state of preservation are representative (in form) of many the features recorded in the project area.

A 1.0 meter square test pit was excavated in the northeast side of the mound. The excavation reached a maximum depth of 0.85 m below the platform surface, terminating at the underlying pahoehoe bedrock. Two distinct strata were encountered in the excavation. Stratum I is made up of the boulders and cobbles of the platform construction fill. This stratum is 65 to 85 cm thick. No internal structure was evident in the construction. The stones were jumbled together in an unstable manner. Stratum I contained organic material, including fresh leaves, roots, twigs, and kukui nut endocarps. No artifacts or midden were found in this layer.

Stratum II consists of a cobbly silty clay loam (Munsell 10YR 2/2, very dark brown) organically enriched, with friable texture. This sediment has filtered down through the platform since its construction. It has buried the lowest levels of rock with recent accumulation as indicated by fresh leaves and other organic debris. Stratum II begins at approximately 65 cm below the platform surface and is a maximum 8 cm thick. No midden or artifacts were observed in this layer. Again, excavation results confirm the recent origin of this feature, and support a clearing mound functional designation.

Site 50-10-35-18919, Feature S

Feature S is located 4.0 m northwest of Feature P and consists of a roughly rectangular section of modified outcrop. The feature measures 3.0 m northwest-southeast by 0.8 m northeast-southwest and is constructed of stacked and piled boulders and cobbles. The feature abuts the outcrop to the northeast. The southwest side of the feature is a vertical face measuring 1.0 m high. The feature is in fair condition and no artifacts or midden were observed. The excavation potential is poor.

Site 50-10-35-18919, Feature T

Feature T is located 4.0 m west of Feature R and consists of a natural channel-like depression between two raised areas of outcrop. The depression runs north-south and has been modified by the stacking and piling of boulders and cobbles along its sides. Feature T measures 22.0 m north-south by 8.0 m east-west. Several of the modified areas along Feature T are faced. Other areas are mounded with piled boulders and cobbles. The feature is in poor condition and no artifacts or midden were observed. Excavation potential is poor.

Site 50-10-35-18919, Feature U

Feature U consists of a roughly rectangular platform. It is located 4.0 m west of Feature T and measures 7.0 m north-south by 3.0 m east-west. Its sides are well constructed vertical faces measuring between 1.0 and 1.3 m high. The surface of the platform is rough boulders and cobbles, but level. No artifacts or midden were observed. The feature is in good condition. Excavation potential is poor.

Site 50-10-35-18919, Feature V

Feature V is a roughly circular mound located 5.5 m southeast of Feature R. The mound measures 1.6 m in diameter, stands 1.4 m high, and is constructed of stacked boulders and cobbles. The mound's perimeter is well faced. No artifacts or midden were observed. The feature is in fair condition and the excavation potential is poor.

Site 50-10-35-18919, Feature W

Feature W is located 7.0 m northwest of Feature Q and consists of a roughly rectangular-shaped mound. The mound measures 1.4 m square and has a maximum vertical height of 0.8 m. The perimeter of the mound is well faced except in the southwest and southeast corners, where the feature is somewhat tumbled. No artifacts or midden were observed. The feature is in fair condition. Excavation potential is poor.

Site 50-10-35-18919, Feature X

Located 4.8 m southwest of Feature W, Feature X is a roughly rectangular-shaped mound measuring 1.0 m north-south by 1.6 m east-west. The west, south, and east sides of the mound are well faced with a maximum vertical height of 1.0 m. The feature is in fair to poor condition. No artifacts or midden were observed. Excavation potential is poor.

Site 50-10-35-18919, Feature Y

Feature Y is an oval-shaped mound located 6.0 m west of Feature X. It measures 1.8 m northeast-southwest by 1.1 m northwest-southeast and has a maximum vertical height of 0.95 m. The perimeter of the mound is well faced. The feature is in fair condition. No artifacts or midden were observed. Excavation potential is poor.

Site 50-10-35-18919, Feature Z

Feature Z is located 12.0 m southwest of Feature Q and consists of a roughly rectangular mound measuring 2.0 m northeast-southwest by 1.0 m northwest-southeast. The west end of the mound is well faced with a maximum vertical height of 1.05 m. The east end is collapsed. The feature is in poor condition. No artifacts or midden were observed. Excavation potential is poor.

Site 50-10-35-18919, Feature AA

Feature AA is located 8.0 m southeast of Feature Z and consists of a roughly rectangular-shaped section of modified outcrop. The feature measures 4.0 m northeast-southwest by 1.9 m northwest-southeast and is constructed of stacked and piled boulders and cobbles. The feature abuts the outcrop to the south. The north side of the feature is a vertical face measuring 1.0 m high. The feature is in fair condition and no artifacts or midden were observed. The excavation potential is poor.

Testing Results for Feature AA

Excavation in Feature AA was undertaken to test for the presence (and kind) of cultural material, to assess the feature's age, form of construction, and function. Feature AA was selected for excavation because its size, method of construction, and state of preservation are representative (in form) of many other features recorded in the project area.

A 1.0 meter square test pit was excavated in the southwest corner of the feature. The excavation reached a maximum depth of 1.82 m below the platform surface, terminating in a stratum of undisturbed weathered bedrock. Three distinct strata were encountered in the excavation.

Stratum I is made up of the boulders and cobbles of the feature construction fill. This stratum is 150 cm thick. At a depth of 90 cm a level bedrock surface was reached. However, a hole approximately 80 cm in diameter led to a small lava "bubble" beneath this surface. The stratum I construction fill material had been placed inside this opening during construction of the feature. When stratum I was completely removed the interior of low lava bubble could be seen. The subsequent strata were excavated from inside this small, low, lava bubble, which turned out to be only approximately 30 cm high.

No internal structure was observed in the feature fill. The stones were jumbled together in an unstable manner. Stratum I contained large quantities of organic material, including fresh leaves, roots, and twigs. No artifacts or midden were observed in this layer.

Stratum II consists of an organically enriched, cobbly silty clay loam (Munsell 10YR 2/2, very dark brown) with friable texture. This sediment has filtered down through the feature since its construction. It has filled the lowest levels of the feature with recent accumulation. Stratum II begins at approximately 145 cm below the feature surface and is 10-20 cm thick. Stratum II contained large amounts of fresh leaves and the only artifact found was a modern plastic bandage that was uncovered at a depth of 162 cm. Material appears to wash-in and filters through the feature rapidly.

Stratum III was encountered at approximately 165 cm below feature surface. Stratum III consists of a cobbly silty clay loam (Munsell 10YR 4/3, brown). This sediment is the natural C horizon. No organic material, artifacts, or midden were observed in this stratum. Excavation continued to a depth of 182 cm below the platform surface to ensure the excavation had reached culturally sterile (and undisturbed) decomposing bedrock.

In summary, the only artifact observed in association with the feature was a modern plastic "band-aid" brand bandage. The absence of other materials, along with the context of the feature, again points to the historic origin of the construction as a clearing mound that could have served some secondary function.

Site 50-10-35-18919, Feature BB

Feature BB is a modified outcrop consisting of a few stones piled on top of a pahoehoe outcrop. This modest feature is located 8.0 m west-southwest of Feature AA. It measures 1.50 m north-south by 80 m east-west. This feature is in poor condition. No artifacts or midden were observed. The feature has no excavation potential.

Site 50-10-35-18919, Feature CC

Feature CC is located 6.5 m southwest of Feature Y and consists of a linear section of modified outcrop. The feature measures 0.5 m northeast-southwest by 2.0 m northwest-southeast and is constructed of stacked and piled boulders and cobbles. The feature abuts the outcrop to the southwest. The northeast side of the feature is a vertical face with a maximum vertical height of 0.8 m. The feature is in poor condition and no artifacts or midden were observed. The excavation potential is poor.

Site 50-10-35-18919, Feature DD

Feature DD is a roughly rectangular-shaped section of modified outcrop located 8.5 m northwest of Feature CC. The feature measures 1.5 m northeast-southwest by 1.4 m northwest-southeast and is constructed of stacked and piled boulders and cobbles. The feature abuts the outcrop to the south. The northwest and northeast sides of the feature are vertical faces measuring 9.0 m high. The feature is in poor condition and no artifacts or midden were observed. The excavation potential is poor.

Site 50-10-35-18919, Feature EE

Feature EE is located 5.0 m southwest of Feature DD and consists of a linear section of modified outcrop. The feature measures 0.6 m northeast-southwest by 3.4 m northwest-southeast and is constructed of stacked and piled boulders and cobbles. The feature abuts the outcrop to the southwest. The northeast side of the feature is a vertical face with a maximum vertical height of 1.10 m. The feature is in poor condition and no artifacts or midden were observed. The excavation potential is poor.

Site 50-10-35-18919, Feature FF

Feature FF is a roughly rectangular-shaped pile of stones that fill in a portion of a natural channel-like depression in the pahoehoe bedrock. It is located 6.0 m northwest of Feature U. The feature measures 2.0 m northeast-southwest by 1.7 m northwest-southeast. The single course of stones fills the depression to the level of surrounding land surface. This modest feature is in poor condition. No artifacts or midden were observed. The feature has no excavation potential.

Site 50-10-35-18919, Feature GG

Feature GG is located 5.0 m west of Feature U and consists of a linear section of modified outcrop. The feature measures 6.4 m northeast-southwest by 1.4 m northwest-southeast and is constructed of stacked and piled boulders and cobbles. The feature abuts the outcrop to the northwest. The southeast side of the feature is a vertical face that ranges in height from 1.0 to 1.35 m. The feature is in fair condition and no artifacts or midden were observed. The excavation potential is poor.

Site 50-10-35-18919, Feature HH

Feature HH is located 5.5 m southwest of Feature GG and consists of a linear section of modified outcrop. The feature measures 4.2 m north-south by 0.5 m east-west and is constructed of stacked and piled boulders and cobbles. The feature abuts the outcrop to the west. The east side of the feature is a vertical face that ranges in height from 1.0 to 1.15 m. The feature is in fair condition and no artifacts or midden were observed. The excavation potential is poor.

Site 50-10-35-18919, Feature II

Feature II is located 13.5 m northwest of survey stake 231 + 81.81, approximately 20 m southwest of Feature EE. Feature II consists of a linear section of modified outcrop. The feature measures 5.0 m northwest-southeast by 0.5 m northeast-southwest and is constructed of stacked and piled boulders and cobbles. The feature abuts the outcrop to the southwest. The northeast side of the feature is a vertical face that measures 0.9 m high. The feature is in poor condition and no artifacts or midden were observed. The excavation potential is poor.

Site 50-10-35-18919, Feature JJ

Feature JJ is located 6.5 m northwest of survey stake "curve P.I. '7-C'", approximately 20 m southwest of Feature II. Feature JJ consists of a linear section of modified outcrop. The feature measures 2.0 m northwest-southeast by 0.5 m northeast-southwest and is constructed of stacked and piled boulders and cobbles. The feature abuts the outcrop to the southwest. The northeast side of the feature is a vertical face that measures 0.9 m high. The feature is in poor condition and no artifacts or midden were observed. The excavation potential is poor.

State Site #:	50-10-35-18920
Survey Site #:	10
# of Features:	8
Areal Extent:	140.0 m northeast-southwest by 30.0 m northwest-southeast
Probable Age:	Historic
Probable Function:	Land clearance

Site 50-10-35-18920 is located between survey stakes 137 +00 and 145 +00 on the *mauka* portion of Road Alignment 2. The eight features of the site consist entirely of mounds constructed of piled boulders and cobbles. All the features are in a poor state of preservation.

The surrounding topography is undulating, sloping gently to the east. There is evidence of soil erosion caused by heavy rains. The vegetation is predominantly strawberry guava, which forms a low canopy. There is also ti, low ferns, and ginger.

Site 50-10-35-18920 is located on land that was formerly under sugarcane cultivation. All the features of the site are remnants of the extensive field clearing that was part of plantation sugar production. The documentation of these features is complete. No further work is recommended.

Site 50-10-35-18920, Feature A

Feature A, the southeasternmost of the site, is a roughly rectangular mound measuring 4.0 m east-west by 6.0 m north-south. It is constructed of piled boulders and cobbles and shows no vertical facing. Feature A has a maximum vertical height of 1.1 m. It is in poor condition. No artifacts or midden were observed and excavation potential is poor.

Site 50-10-35-18920, Feature B

Feature B is located 30 m northeast of Feature A. This roughly circular mound measures 2.5 m north-south by 3.5 m east-west. It is constructed of piled boulders and cobbles and shows no vertical facing. Feature B is in poor condition and has a maximum vertical height of 0.9 m. No artifacts or midden were observed and excavation potential is poor.

Site 50-10-35-18920, Feature C

Feature C, located 8.0 m northeast of Feature B, consists of a circular mound measuring 2.5 m east-west by 3.0 m north-south. It is constructed of piled boulders and cobbles and shows no vertical facing. Feature A has a maximum vertical height of 1.2 m. It is in poor condition. No artifacts or midden were observed. The excavation potential is poor.

Site 50-10-35-18920, Feature D

Feature D is located 10.0 m northeast of Feature C. This roughly circular mound measures 2.5 m north-south by 3.5 m east-west. It is constructed of piled boulders and cobbles and shows no vertical facing. Feature D is in poor condition and has a maximum vertical height of 1.0 m. No artifacts or midden were observed and excavation potential is poor.

Site 50-10-35-18920, Feature E

Feature E, located 30.0 m northeast of Feature B, is another circular mound. It measures 3.0 m in diameter and is constructed of piled boulders and cobbles. It shows no vertical facing. Feature A has a maximum vertical height of 1.0 m. It is in poor condition and no artifacts or midden were observed. The excavation potential is poor.

Site 50-10-35-18920, Feature F

Located 7.0 m north of Feature E, Feature F is a roughly circular mound measuring 2.3 m north-south by 2.8 m east-west. It is constructed of piled boulders and cobbles and shows no vertical facing. Feature B is in poor condition and has a maximum vertical height of 1.1 m. No artifacts or midden were observed and excavation potential is poor.

Site 50-10-35-18920, Feature G

Feature G is located 8.0 m northeast of Feature C. This roughly circular mound measures 2.7 m north-south by 8.1 m east-west. It is constructed of piled boulders and cobbles and shows no vertical facing. Feature G is in poor condition and has a maximum vertical height of 1.0 m. No artifacts or midden were observed. Excavation potential is poor.

Site 50-10-35-18920, Feature H

Feature H, located 8.0 m northeast of Feature B, is another circular mound. It measures 3.0 m north-south by 2.5 m east-west and is constructed of piled boulders and cobbles. no vertical facing was observed. Feature H has a maximum vertical height of 1.1 m. It is in poor condition and no artifacts or midden were observed. The excavation potential is poor.

State Site #:	50-10-35-18921
Survey Site #:	11
# of Features:	5
Areal Extent:	110.0 m east-west by 50.0 m north-south
Probable Age:	Historic
Probable Function:	Land clearance

Site 50-10-35-18921 is located between survey stakes 63 + 00 and 70 + 00 of Alternative Alignment 1. The five features of the site consist of mounds, terraces, and a wall segment--all constructed of piled boulders and cobbles. The features are in fair to poor condition.

The surrounding topography is a gentle slope. The vegetation at the site includes mango trees, ti, ginger, ferns, and 'ohi'a trees. The most predominant plant is strawberry guava which forms a low canopy. The vegetation cover is mixed, very dense in places and fairly open in others.

Site 50-10-35-18921, according to historic maps, is located in land that was formally under commercial sugarcane cultivation. The features of site 50-10-35-18921 represent this historic agricultural activity. These features are the primarily clearing mounds, field boundaries, and possibly foundations for cane loading platforms and water tanks that were part of field activities. This site is significant for its information content regarding this historic period and it is recommended for additional data recovery where excavation is possible.

Site 50-10-34-18921, Feature A

Feature A is an irregular-shaped mound located at survey stake 63 + 00. The Feature measures 4.0 m northeast-southwest by 12.0 m northwest-southeast, has a maximum vertical height of 0.6 m, and is constructed of piled boulders and cobbles. No vertical facing was observed and the feature is crude in its construction. The feature is in poor condition. No artifacts or midden were observed. Excavation potential is poor.

Site 50-10-34-18921, Feature B

Feature B is a linear terrace constructed of stacked and piled boulders and cobbles. The Feature is located 75.0 m east of Feature A along the bank of an intermittent drainage. Feature B measures 25.0 m east-west by a maximum 3.0 m north-south and has a maximum vertical height of 1.4 m (measured from the base of the drainage). No vertical facing was observed and the feature is in poor condition. No artifacts or midden were observed and excavation potential is poor.

Site 50-10-35-18921, Feature C

Located 8.0 m east of Feature B, Feature C is a linear mound. The mound measures 10.5 m northwest-southeast by 2.5 m northeast-southwest and has a maximum vertical height of 0.8 m. This low stone alignment is partially tumbled. No artifacts or midden were observed. The feature is in fair condition. Excavation potential is poor.

Site 50-10-35-18921, Feature D

Feature D is located 15.0 m east of Feature C and consists of a curvilinear wall segment and a recent earthen excavation. The wall segment forms an L-shape that measures 12.0 m long by 2.0 m wide. It is constructed of piled boulders and cobbles and has a maximum vertical height of 0.9 m. The feature is not faced and is partially tumbled. The earthen excavation is rectangular measuring 2.8 on a side. It has regular, vertical sides (appearing to have been recently formed) and is 1.5 m deep. This excavation appears to have been made to hold a water tank. No artifacts or midden were observed in association with Feature D. Feature D is in fair to poor condition. Excavation potential is poor.

Site 50-10-34-18921, Feature E

Feature E is a linear terrace constructed of stacked and piled boulders and cobbles. The Feature is located 30.0 m east of Feature C. Feature E measures 16.0 m east-west by 2.0 m north-south and has a maximum vertical height of 0.4 m. No vertical facing was observed and the feature is in poor condition. No artifacts or midden were observed and excavation potential is poor.

Summary of Archaeological Findings

Our field survey records in detail 11 sites (complexes of features in spatial association), comprising 88 individual features within or closely adjacent to the alternative road alignments of the project area. Historical research (discussed above), including early and later historic documentary sources, Land Commission Awards, analysis of maps, and interviews corroborates the field evidence of the historic origin for all of the structures recorded. Original, intentionally conservative speculations that prehistoric structures might exist in the project area are clearly not supported by the evidence.

In terms of the field archaeology, over the course of our intensive mapping and documentation of the features it was evident that the features shared similar methods of form, construction, and location in areas with arable soil. We also observed while crawling over the features, pulling tape and making measurements, a significant lack of construction stability. Regardless of feature form, state of preservation, and size--in many instances the stacked and piled boulders and cobbles tended to shift, reflecting their instability. This was true of the well constructed, vertically faced platforms, whose edges could not support weight or movement, as well as the mounds of more crude construction. This lack of stability was substantiated by the subsurface testing. In the five test excavations the construction fill was jumbled with no internal structure. This unstable construction contrasts with indigenous Hawaiian architecture, where stable, weight bearing vertical faces and stable mounds, often with paving stones, etc., are the norm.

Additional aspects of the field evidence confirm the historic origin of the structures, and not features that represent indigenous Hawaiian architecture. It is especially significant that no definitive prehistoric artifacts, or the usual activity area features (i.e., non-portable artifacts), such as paving stones or pebble paving (*ʻiliʻili*), hearths or earth ovens are found in, or associated with these features. Such features are common components of prehistoric Hawaiian sites. Furthermore, numerous historic artifacts were recorded in (indeed embedded in some features), or near several features. As already described, these include artifacts such as railroad ties, fencing and barbed wire, etc.

The *potential* evidence for prehistoric activity in the area comes from excavation of Site -18915, Feature H. In this feature we recovered three volcanic glass fragments (non-diagnostic debitage, less than 1.5 cm in maximum dimensions) beneath the structure in a stratigraphic context clearly predating its construction (see above). These pieces may point to some Hawaiian use of the area (as described by McEldowney 1979 using the earliest historic sources, see above), potentially for agriculture as early sources would suggest. It is also possible that in this relatively high energy floodplain, artifacts can be fluvial sediments transported and redeposited by natural agents--a problem for archaeologists in many parts of the world. In short, like modern materials found, ancient ones could be in secondary depositional context. The complete lack of prehistoric portable artifacts on the surface or in the features themselves is consistent with an historic origin, age, and use of the sites.

Archaeological Comparisons

Examination of documented prehistoric sites in Hawai'i reveals that the structures in the project area share little in the way of construction methods, form, variability of components, and importantly, context at the scale of feature relationships and location. The structures recorded in detail do not resemble sites of prehistoric age--sites best known by archaeologists in Hawai'i.

As archaeological field work increases in the Hilo area, it is becoming clear that where commercial sugarcane cultivation occurred, stacked and faced stone features are common. For example, Smith (1992) describes "several stacked stone walls and linear mounds... well made, often faced, and reaching a height of 1 meter" and large stone mounds that are "generally faced, as high as 1.5 meters, and tend to be round or ovoid in planview" with diameters ranging from two to three meters. These features are found in an area of former sugarcane cultivation in a parcel at Kawili and Kapi'olani Streets, not far from project area lands. He notes the soil substrate as Keaukaha extremely rocky muck, the same as in parts of the project area. Also in the Hilo area, Spear (1992) reports linear mounds (similar in form to those in the project area) along Waianuenue Avenue. He determined that these features were historic in age, and resulted from activities associated with sugarcane or cattle pasture use. Similar sites in Hilo sugarcane land have been recorded by other archaeologists (e.g., Goodfellow 1991; Goodfellow and Fager 1992).

In numerous locations around the islands, archaeologists have documented remarkably similar stacked and faced stone features in areas of former sugarcane cultivation. For example, in a recent detailed historical and archaeological study in Kohala, Erkelens and Athens (1993) describe several clearing mounds in land previously under commercial sugarcane cultivation. They excavated four of these mounds as a check against local informants who identified the recent origin of the features as field clearing mounds. Concerning these clearing mounds, Erkelens and Athens (1993:46) write that they:

> consisted of a loosely stacked wall, approximately a meter in height, which kept the pile of interior rock contained within. Although a stacked wall may at first seem an unlikely construction component for an informal mound, it allows a cart or drag sled to be pulled up close to the edge of the pile. Subsequently, rock does not have to be lifted far to be added to the pile. The end result is sometimes *a pile with a depression in the center* (emphasis added).

This description, especially of mounds with depressions in the center, fits many features in the Pu'ainako project area. Similarly, in their work in Kohala and ours in Hilo, knowledgeable informants have identified the presence, form, and function of rock clearing mounds. Informants and historic sources have described their place in early labor-intensive forms of sugarcane cultivation. The dual function--rock field clearing and potential loading platform--discussed by Erkelens and Athens (1993) fits the variability documented for the features in the project area.

Conclusions

Detailed historical and archaeological investigations have been completed as an inventory level survey of alternative alignments for the Pu'ainako Road Extension project. As discussed above, this work has included a review of previous archaeological work in the region, an historical literature and documents search, a Land Commission Award search, analysis of historic maps, in-depth interviews with knowledgeable local informants, intensive field recording of all sites/features, and excavation of representative features in the project area.

Our objective at this stage of work is to provide a complete inventory of the archaeological resources in the project area, determine site function and significance, and make recommendations for historic preservation, and where needed, recommend measures to mitigate the impact of construction to historic resources. These objectives were set to satisfy all historic preservation regulatory review requirements in consultation with Dr. Ross Cordy and Kanalei Shun of the State Historic Preservation Division, Department of Land and Natural Resources (SHPD-DLNR).

Diverse lines of complementary evidence discussed in this report places the archaeological structural remains of the Pu'ainako Road Extension project firmly within the historic period. However, while some prehistoric use of the area *may* have occurred, its vestige remains difficult to document.

An exhaustive review of the earliest accounts of Hilo (McEldowney 1979) provides a clear picture of traditional settlement, land use, and community patterning. Hawaiian habitation, formal religious worship, intensive irrigated agriculture, and fishponds were concentrated along, or near the shoreline. Land Commission Awards from around 1848 confirm this pattern, and show that Hawaiian occupation and land use was along the coast, and not in the project areas. The LCA evidence reveals continuity between ancient and early historic times in Hilo.

Above the Coastal Settlement zone was an upland, largely non-irrigated agricultural zone. This upland zone is known to have had scattered swiddens and groves of economic tree crops, as well as huts for temporary use. The kind of activity synthesized by McEldowney (1979) for this zone would not produce any clear archaeological signature. Only subtle evidence might exist and be detected, such as isolated artifacts or paleoenvironmental indications of land use. For example, volcanic glass discovered in one excavation in the project area suggests possible evidence of ancient Hawaiian activity in the area. However, it is not associated with the surface structures. Instead, if subtle evidence of Hawaiian use of the area exists, it will likely be found only in sparse and unpredictable spatial distributions. Such evidence will be associated with depositional environments, and may be discovered (almost "at random") with subsurface test excavations. The significance of such evidence is restricted to its potential information content (Criterion D), as other historic preservation criteria would not apply.

Historical research on Hilo (see especially Kelly et al. 1981) shows the development of land use, including the advent of commercial sugarcane cultivation over vast areas as early as the late 1870s. Sugarcane was planted and harvested by hand by immigrant labor, at first predominantly Chinese. This land use suggests that the archaeological features of the project area date to the late nineteenth, and early twentieth century. Some of the features seem to have been present by the 1920s, a time recalled in informant interviews. Stone clearing mounds, that served additional, secondary functions, would grow by accretion as fields continued to be cultivated for sugarcane. Railroads, water tanks, loading platforms, temporary flumes, boundaries of cane and pasture land, and later conversion of sugarcane land to pastures will add their mark to the stone structural evidence, sometimes in complex and ambiguous ways. In sum, the structures and artifacts recorded in the project area date from about 1880 to 1950. These remains reflect the historically documented land use of the project area.

Significance

Large portions of the Pu'ainako Street Extension project are free of archaeological resources. In some cases, very recent, mechanized sugarcane cultivation has destroyed any sites that may once have existed on those lands. In other locations, such as the 1881 lava flow, or upland areas of rainforest vegetation, no historic or prehistoric sites were found.

The archaeological structures (data summarized in Table 2) documented in the inventory survey are plantation-era in origin, dating to the late nineteenth and early twentieth century. In terms of historic preservation significance criteria, many of the sites are significant for their information content (Criterion D). Other sites in the project area will not provide any further information on the history of the region, and are according to the criteria used, no longer significant. Where sites are "no longer significant" or "no further work" is recommended, it is because adequate data have been collected with the level of work conducted for this study. The significance and recommendations for each site are listed in Table 2, and discussed in the text above.

Additional historical and archaeological research on several of the sites could provide information on the early plantation history of the Waiakea Mill lands of Hilo.

Recommendations

All other considerations being equal, the Pu'ainako Road extension alignments with the fewest archaeological features should be selected for development. This would minimize the loss of the plantation-era sites documented in this report. While this study provides detailed documentation of the archaeological remains and their historical context, additional data recovery is recommended as impact mitigation. Once the alternative alignment set is determined, a data recovery program should be devised in consultation with the State Historic Preservation Division. This data recovery program could include additional excavation of a representative sample of features, where such potential exists. This additional excavation may yield further information on the content and specific function of features in early plantation activities. As discussed above, excavation (as part of the data recovery program) could potentially yield isolated traces of prehistoric use of the area, presumably for dryland agriculture. This would yeild information important to the prehistory of the area, if such evidence exists. A data recovery program could also include continued historic research, focused on interviews and archival sources to inform on the diversity of field activities and the specific function (i.e., beyond their use as field clearing mounds) of features.

Table 2. Summary of Site Data, Significance, and Recommendations.

Site#	Feat.#	Structural class	Formal class	Max. areal dim.(sq.m)	Fac-ing?	Function	Prob. age	Signif-icance	Recom-mendation
18911		Complex				Agriculture	H	D	DR
	A	Terrace	Curv-linear	276	Y	Retainwall	H		
	B	Mound	Linear	43	N	Clearing	H		
	C	Mod.outcrp	Linear	20.5	Y	Clearing	H		
	D	Mound	Rect.	84	N	Clearing	H		
	E	Mound	Irregular	56	Y	Clearing	H		
	F	Terrace	Linear	132	Y	Retainwall	H		
	G	Mound	Rect.	96	N	Clearing	H		
	H	Terrace	Linear	64	Y	Retainwall	H		
	I	Terrace	Curv-linear	99	Y	Retainwall	H		
	J	Mound	Irregular	22.5	Y	Clearing	H		
	K	Mound	Irregular	96.5	N	Clearing	H		
18912		Mound	Irregular	54	Y	Agriculture	H	D	DR
18913		Mound	Rect.	29	Y	Agriculture	H	NLS	NFW
18914		Complex				Agriculture	H	D	DR
	A	Platform	Rect.	34	Y	Clear/Found.	H		
	B	Platform	Rect.	60	Y	Clear/Found.	H		
	C	Mound	Irregular	25	N	Clearing	H		
	D	Mound	Irregular	34.5	Y	Clearing	H		
	E	Terrace	Linear	55	Y	Retwall/Found.	H		
	F	Platform	Rect.	66	Y	Clear/Found.	H		
	G	Mod.outcrp	Irregular	1092	Y	Clearing	H		
	H	Mod.outcrp	Curv-linear	62.5	Y	Clearing	H		
18915		Complex				Agriculture	H	D	DR
	A	Enclosure	Oval	112.5	Y	Clear/Found.	H		
	B	Terr/mound	Linear	20	Y	RR bed	H		
	C	Platform	Rect.	42	Y	Clear/Found.	H		
	D	Mound	Rect.	3.5	N	Clearing	H		
	E	Platform	Rect.	42	Y	Clear/Found.	H		
	F	Platform	Rect.	46	Y	Clear/Found.	H		
	G	Mound	Rect.	13	N	Clearing	H		
	H	Platform	Oval	45	Y	Clear/Found.	H		
	I	Mound	Irregular	29.5	Y	Clearing	H		
18916		Complex				Agriculture	H	D	DR
	A	Platform	Rect.	45	Y	Clear/Found.	H		
	B	Terr/wall	Curv-linear	217.5	Y	Retainwall	H		
18917		Complex				Agriculture	H	D	DR
	A	Wall seg.	Linear	13	N	Clearing	H		
	B	Mound	Rect.	9	Y	Clearing	H		
	C	Mound	Rect.	20.5	Y	Clearing	H		
18918		Complex				Pasture	H	D	DR
	A	Mod.outcrp	Irregular	3.5	Y	Clearing	H		
	B	Mod.outcrp	Rect.	1.5	Y	Clearing	H		
	C	Mound	Oval	8.5	Y	Clearing	H		
	D	Mod.outcrp	Irregular	15.5	Y	Enclosure	H		

Site#	Feat.#	Structural class	Formal class	Max. areal dim.(sq.m)	Fac-ing?	Function	Prob. age	Signif-icance	Recom-mendation
18919		Complex				Agriculture	H	D	DR
	A	Mod.outcrp	Irregular	490	Y	Clear/Found.	H		
	B	Mod.outcrp	Rect.	15	Y	Clear/Found.	H		
	C	Mod.outcrp	Curv-linear	15.5	Y	Clearing	H		
	D	Mound	Rect.	2	Y	Clearing	H		
	E	Wall	Linear	81.5	Y	Boundary	H		
	F	Mod.outcrp	Curv-linear	10	Y	Clearing	H		
	G	Mod.outcrp	Rect.	7	Y	Clearing	H		
	H	Mod.outcrp	Irregular	3	Y	Clearing	H		
	I	Mod.outcrp	Curv-linear	12	Y	Clearing	H		
	J	Mod.outcrp	Irregular	18	Y	Clearing	H		
	K	Mound	Rect.	2	N	Clearing	H		
	L	Mod.outcrp	Rect.	30	Y	Clearing	H		
	M	Mod.outcrp	Circular	23	Y	Clearing	H		
	N	Mod.outcrp	Oval	14	N	Clearing	H		
	O	Mound	Irregular	4	Y	Clearing	H		
	P	Mod.outcrp	Rect.	5	Y	Clearing	H		
	Q	Platform	Rect.	11	Y	Clear/Found.	H		
	R	Mound	Circular	4	Y	Clearing	H		
	S	Mod.outcrp	Rect.	3	Y	Clearing	H		
	T	Mod.outcrp	Irregular	72	Y	Clearing	H		
	U	Platform	Rect.	21	Y	Clear/Found.	H		
	V	Mound	Circular	2.5	Y	Clearing	H		
	W	Mound	Rect.	2.5	Y	Clearing	H		
	X	Mound	Rect.	2	Y	Clearing	H		
	Y	Mound	Oval	2	Y	Clearing	H		
	Z	Mound	Rect.	2	Y	Clearing	H		
	AA	Mod.outcrp	Rect.	7.5	Y	Clear/Found.	H		
	BB	Mod.outcrp	Irregular	2	Y	Clearing	H		
	CC	Mod.outcrp	Linear	1.5	Y	Clearing	H		
	DD	Mod.outcrp	Irregular	2	Y	Clearing	H		
	EE	Mod.outcrp	Irregular	3	Y	Clearing	H		
	FF	Mod.outcrp	Rect.	3.5	N	Clearing	H		
	GG	Mod.outcrp	Linear	8	Y	Clearing	H		
	HH	Mod.outcrp	Linear	3.5	Y	Clearing	H		
	II	Mod.outcrp	Linear	1.5	Y	Clearing	H		
	JJ	Mod.outcrp	Linear	2	Y	Clearing	H		
18920		Complex				Agriculture	H	NLS	NFW
	A	Mound	Rect.	20	N	Clearing	H		
	B	Mound	Circular	8.5	N	Clearing	H		
	C	Mound	Circular	7.5	N	Clearing	H		
	D	Mound	Circular	8.5	N	Clearing	H		
	E	Mound	Circular	9	N	Clearing	H		
	F	Mound	Circular	6.5	N	Clearing	H		
	G	Mound	Circular	8.5	N	Clearing	H		

Site#	Feat.#	Structural class	Formal class	Max. areal dim.(sq.m)	Fac-ing?	Function	Prob. age	Signif-icance	Recom-mendation
	H	Mound	Circular	7.5	N	Clearing	H		
18921		Complex				Agriculture	H	D	DR
	A	Mound	Irregular	48	N	Clearing	N		
	B	Terrace	Linear	50	N	Clearing	N		
	C	Mound	Linear	35	N	Clearing	N		
	D	Wall seg.	Curv-linear	24	N	Clear/Found.	N		
	E	Terrace	Linear	32	N	Clearing	N		

Significance criteria codes (from *Code of Federal Regulations*, 36 CFR Part 60; these criteria are used by Hawai'i DLNR-SHPD):

A Site reflects major trends in the history of the state or nation

B Site is associated with the lives of persons significant in our past

C Site is an excellent example of a site type

D Site may be likely to yield information important in history or prehistory

E Site has cultural significance (Native Hawaiian, or other ethnic group)

Recommendation codes:

DR Additional data recovery (excavation, etc.) as mitigation

Other codes:

NFW No further work required in mitigation phase

NLS No longer signficant (in terms of historic preservation criteria)

Finally, once a road alignment has been selected and a data recovery phase completed, monitoring by an experienced archaeologist should accompany initial clearing and earthwork activities. Monitoring would assure that no unexpected finds are lost with initial construction activities.

Bibliography

American Association of University Women (AAUW)
1989 *The Hilo March: A guided tour through historic Hilo*. A.A.U.W.

Barrera, W.
1991 *Archaeological Survey of Proposed Wailuku River Hydroelectric Facilities*. Report, State Historic Preservation Division Library.

1986 *Wailuku River Hydroelectric Project: Archaeological Reconnaissance*. Report, State Historic Preservation Division Library.

Best, G. M.
1978 *Railroads of Hawaii: Narrow and standard gauge common carriers*. Golden West Books, San Marino.

Bonk, W. J.
1979 *An Archaeological Survey of a Portion of Hawaiian Home Lands of Panaewa, Tract 1, Waiakea, South Hilo, Hawaii*. Report, State Historic Preservation Division Library.

1979 *An Archaeological Survey of a Portion of Hawaiian Home Lands of Panaewa, Tract 1, Waiakea, South Hilo, Hawai'i*. Report, State Historic Preservation Division Library.

Borthwick, D., J. Collins, W. H. Folk, and H. H. Hammatt
1993 Archaeological Survey and Testing of Lands Proposed for Research and Technology Lots at the University of Hawaii at Hilo (TMK 2-4-01:40 and 157). Report, State Historic Preservation Division Library.

Buchanan-Banks, J., and J. Lockwood
1982 Geologic map of the Alenaio-Waipahoehoe Stream area, South Hilo District, Hawaii. Open-file Map, U.S. Geological Survey.

Ching, F., and C. Stauder
1974 *The Archaeology of South Hilo, Hawai'i: Archaeological reconnaissance and preliminary historical investigation of the proposed 2& 1/2 mile alignment (alt. A) between Keauhou and the South Hilo-Puna Boundary*. Report, State Historic Preservation Division Library.

Conde, J. C.
1971 *Narrow Gauge in a Kingdom: The Hawaiian Railroad Company, 1878-1897*. Glenwood Publishers, Felton.

1975 *Sugar Trains Pictorial*. Glenwood Publishers, Felton.

Cordy, Ross
1986 *Parcel Assessment--Waiakea, South Hilo, Hawai'i*. Report, State Historic Preservation Division Library.

Cox, D.
1983 *Reconnaissance Of Historic Resources for the Laupahoehoe Navigation Improvements Project, Laupahoehoe Point, Hawai'i*. Report, State Historic Preservation Division Library.

1983 *Archaeological Reconnaissance of the Wailuku River and Honolii Stream Hydropower Study Areas, Punahoa, South Hilo, Hawai'i*. Report, State Historic Preservation Division Library.

Cuddihy, L. W., and C. P. Stone
1990 *Alteration of Native Hawaiian Vegetation: Effects of humans, their activities and introductions*. University of Hawaii Cooperative National Park Resources Studies Unit, Honolulu.

Ellis, W.
1963 *Journal of William Ellis*. Honolulu Advertiser Publishing Co., Ltd, Honolulu.

Erkelens, C., and J. S. Athens
1993 Archaeological Inventory Survey, Kohala Plantation Village, North Kohala, Hawai'i. Report, State Historic Preservation Division Library.

Goodfellow, S. T.
1991 Archaeological Inventory Survey Noelani Gardens Project: Land of Puueo, South Hilo District, Island of Hawaii (TMK:3-2-6-2:1,2). Report, State Historic Preservation Division Library.

Goodfellow, S. T., and M. Fager
1992 *Archaeological Inventory Survey Kaumana Property: Land of Ponahawai, South Hilo District, Island of Hawaii (TMK:3-2-5-03:27)*. Report, State Historic Preservation Division Library.

Haun, A.
1986 *Archaeological Reconnaissance Survey of Proposed Boundary Fences and Cabin Site At Hakalau Forest National Wildlife Refuge, Island of Hawai'i*. Report, State Historic Preservation Division Library.

Hawaiian Sugar Planters' Association
1926 *Story of Sugar in Hawaii*. Hawaiian Sugar Planters' Association, Honolulu.

Hommon, R.
1982 *An Aerial Cultural Resources Reconnaissance of Two Areas Near Pohakuloa Training Area, Island of Hawai'i*. Report, State Historic Preservation Division Library.

Jensen, P. M.
1991 Archaeological Inventory Survey Komohana Golf Course: Lands of Ponahawai and Punahoa 1-2 South Hilo District, Island of Hawaii (TMK:3-2-3-44:09). Report, State Historic Preservation Division Library.

Kam, W.
1983 *Unrecorded Heiau on State Land, Waiakea, South Hilo, Hawai'i Island*. Report, State Historic Preservation Division Library.

Kelly, M., and S. Athens
1982 *Archaeological and Historical Studies for the Alenaio Stream Flood Damage Reduction Study, Hilo, Hawai'i; Report 1: Background history; Report 2: Cultural Resources Reconnaissance*. Report, State Historic Preservation Division Library.

Kelly, M., B. Nakamura, and D. B. Barrere
1981 *Hilo Bay: A chronological history; Land and water use in the Hilo Bay area, Island of Hawai'i*. Bernice Puahi Bishop Museum Press, Honolulu.

Kennedy, J.
1991 *Archaeological Inventory Report Located at Pu'ueo, Island of Hawai'i; Revised November 1991*. Report, State Historic Preservation Division Library.

1992 *Archaeological Inventory Final Report; Located at Pu'ueo on the Island of Hawai'i; Revised July 1992*. Report, State Historic Preservation Division Library.

Lockwood, J., and J. Buchanan-Banks
1981 Preliminary Geologic report for the Alenaio Stream Flood Damage Reduction Study area, Hilo, Hawaii. Open-file Report 81-791, U.S. Geological Survey.

McEldowney, H.
1979 *Archaeological and Historical Literature Search and Research Design: Lava flow control study, Hilo, Hawai'i*. Report, State Historic Preservation Division Library.

Moniz, J.
1992 Historical and archaeological synthesis of land use and settlement patterns Waiakea Ahupua'a, Hilo, Hawaii. Report, State Historic Preservation Division Library.

Nagata, R.
1985 *Letter Report: Field Inspection of Cave Site, Fodder Growing Project, Waiakea, South Hilo, Hawai'i*. Report, State Historic Preservation Division Library.

Pietrusewsky, M. P.
1989 *Human Remains Found at Wailoa Bridge, Renovation Project Site No. 50-10-35-11, 115, Lihiwai Street*. Report, State Historic Preservation Division Library.

Rosendahl, M.
1988 *Archaeological Reconnaissance Survey for EIS, Hilo Judiciary Complex Sites, Hilo, District of South Hilo, Island of Hawai'i*. Report, State Historic Preservation Division Library.

1988 *Archaeological Reconnaissance Survey for Environmental Impact Statement (EIS), Hilo Wastewater Treatment Facility Site, Land of Waiakea, District of South Hilo, Island of Hawai'i*. Report, State Historic Preservation Division Library.

1988 *Archaeological Reconnaissance Survey For Environmental Impact Statement (EIS) Proposed Irradiation Plant Site*. Report, State Historic Preservation Division Library.

Rosendahl, M. L. and T., Lawrence
1988 *Archaeological Reconnaissance Survey for Environmental Impact Statement (EIS), Proposed Irradiation Plant Site, Land of Waiakea, District of South Hilo, Island of Hawai'i*. Report, State Historic Preservation Division Library.

Rosendahl, M., and P. Rosendahl

1988 *Archaeological Survey for Environmental Impact Statement (EIS), Honolii Hydroelectric Project Area, Lands of Kikala and Paukaa, District of South Hilo, Island of Hawai'i.* Report, State Historic Preservation Division Library.

Rosendahl, P. H.

1981 *Archaeological Reconnaissance Survey of the Eucalyptus Biomass Farm Site, Puueo, South Hilo, Island of Hawai'i.* Report, State Historic Preservation Division Library.

1989 *Letter Report: Mauluanui Fence Line Survey, Hakalau Forest National Wildlife Refuge, Island of Hawai'i.* Report, State Historic Preservation Division Library.

Rosendahl, P., and J. Head

1992 *Archaeological Field Inspection, Paukaa Development Parcel, Land of Paukaa, South Hilo, Hawai'i.* Report, State Historic Preservation Division Library.

Rosendahl, P., and L. Kalima

1991 *Historical Research: Old Government Road, Hawai'i Tropical Botanical Garden Project Area, Land of Onomea, South Hilo, Hawai'i.* Report, State Historic Preservation Division Library.

Sinoto, A.

1975 *Archaeological Reconnaissance Survey of the Wailuku-Alenaio Watershed Project, Hilo, Island of Hawai'i.* Report, State Historic Preservation Division Library.

1978 *Archaeological Reconnaissance Survey of Proposed Kaumana Springs Wilderness Park, Hilo, Island of Hawai'i.* Report, State Historic Preservation Division Library.

Smith, M.

1988 *Wailoa Bridge Renovation Project, Site No. 50-10-35-11, 115.* Report, State Historic Preservation Division Library.

1991 *Site inspection of the University of Hawaii-Hilo perimeter road alignment, Research and Technology Park Phase I, Waiakea, South Hilo, Hawaii (TMK: 3-2-4-01:7).* Memorandum, State Historic Preservation Division Library.

1991 *Field Inspection for State Land Disposition of the Proposed Department of Water Supply Office Site in Hilo, Waiakea Homesteads, South Hilo, Hawaii.* Memorandum, State Historic Preservation Division Library.

1992 *Field Inspection for State Land Disposition of the Proposed Department of Water Supply Office Site in Hilo, Waiakea Cane Lots, Waiakea, South Hilo, Hawaii Island.* Memorandum, State Historic Preservation Division Library.

Smith, M., and P. Tourtellottee

1988 *Wailoa Bridge Renovation Project, Site 50-10-11, 115, Burial Removal from Lihiwai Street, Waiakea, South Hilo, Hawai'i.* Report, State Historic Preservation Division Library.

Spear, R.

1992 *An Archaeological Inventory Survey for the H.C.E.O.C. Project, Hilo, Island of Hawai'i.* Report, State Historic Preservation Division Library.

Stokes, J. F.
1991 *Heiau of the Island of Hawai'i: A historical survey of native Hawaiian temple sites*. Bishop Museum Press, Honolulu.

Thrum, T. G.
1907a Heiau and heiau sites throughout the Hawaiian islands. *Hawaiian Almanac and Annual for 1908.*

1907b Tales from temples. Part II. *Hawaiian Almanac and Annual for 1908.*

Vandercook, J. W.
1934 *King Cane: The story of sugar in Hawaii.* Harper & Brothers Publishers, New York.

Walker, A. T.
1991 *Archaeological Field Inspection, Hawai'i Tropical Botanical Garden Project Area: Land of Onomea, South Hilo, Hawai'i.* Report, State Historic Preservation Division Library.

Walker, S.
1990 *Archaeological Subsurface Test Excavations for Alenaio Stream Flood Damage Reduction Measures, Hilo, Hawai'i Island.* Report, State Historic Preservation Division Library.

Wickler, S.
1992 *Archaeological and Paleoenvironmental Investigations, Alenaio Stream Flood Control Project, Hilo Hawai'i.* Report, State Historic Preservation Division Library.

Appendix F

PRELIMINARY DRAINAGE

CALCULATIONS

PUAINAKO STREET WIDENING

KOMOHANA STREET TO KILAUEA STREET

in

Hilo, County of Hawaii, Hawaii

Prepared For:

The County of Hawaii
Department of Public Works
Hilo, Hawaii

Prepared By:

Okahara & Associates, Inc.
200 Kohola Street
Hilo, Hawaii, 96720

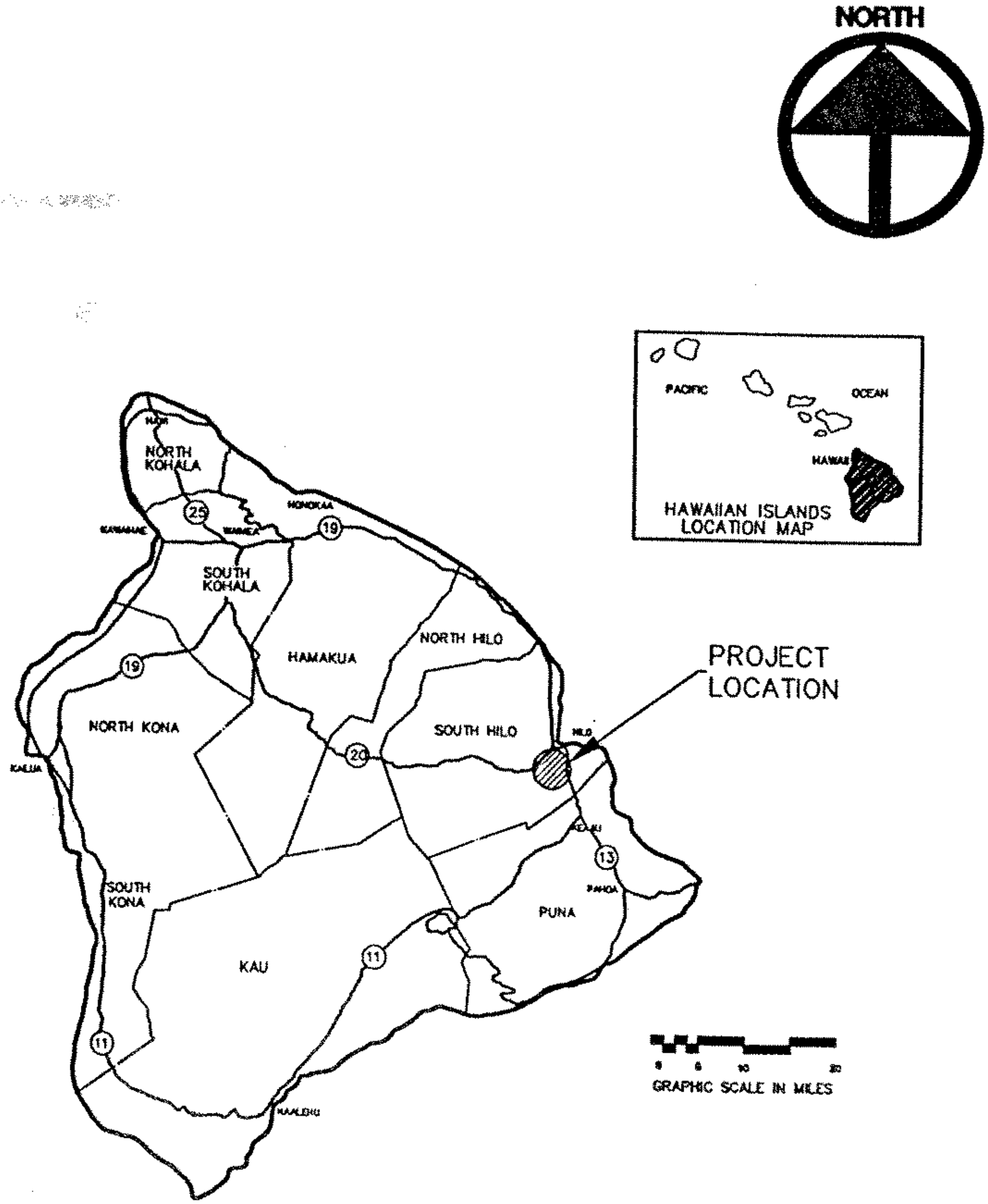
December 1, 1992

TABLE OF CONTENTS

TABLE OF CONTENTS (CONTINUED)

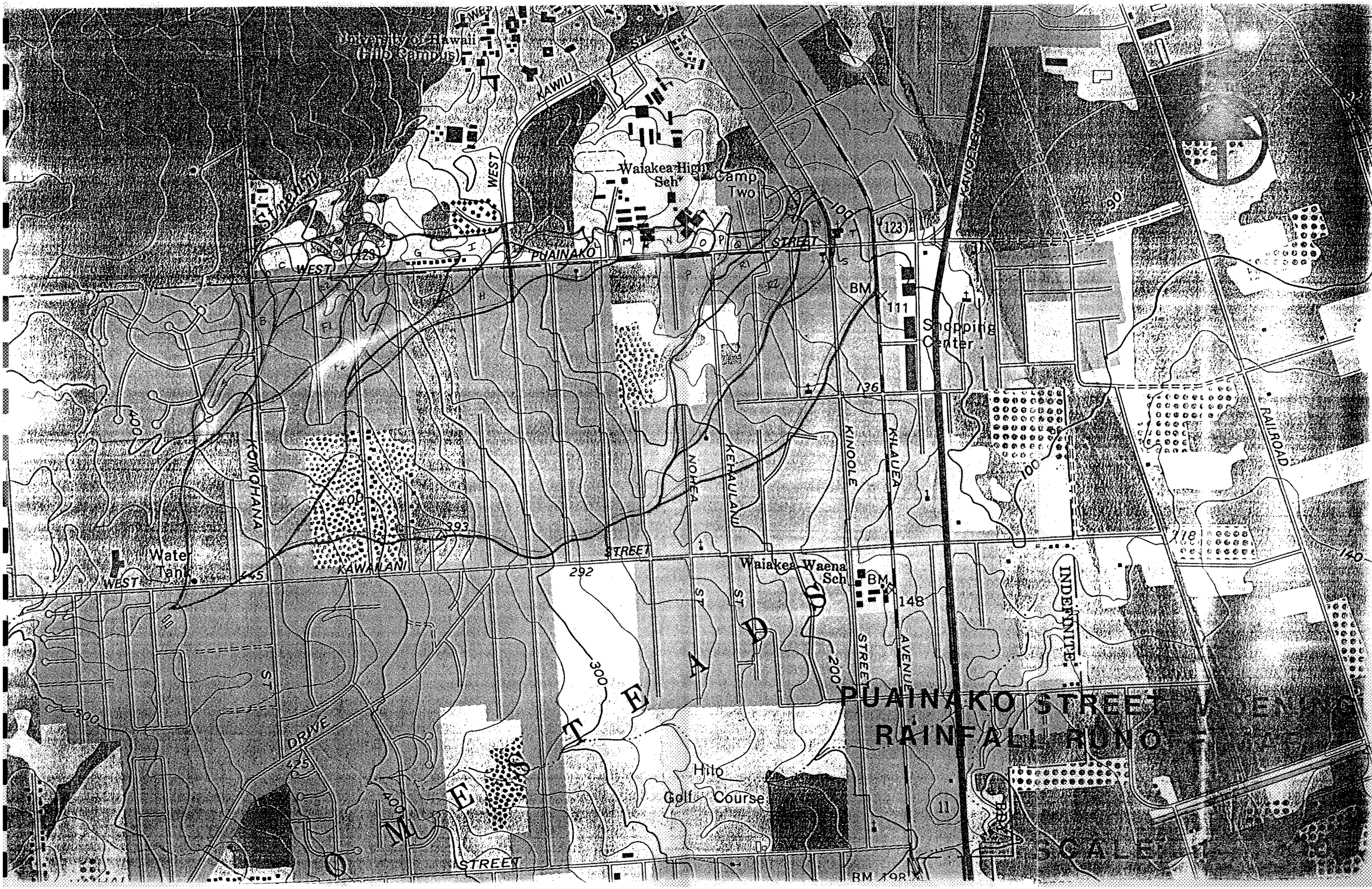
INTRODUCTION

The Puainako Street Widening roadway plan, prepared for the County of Hawaii Department of Public Works, is a preliminary plan for the widening of the existing Puainako Street in Hilo, Hawaii. At this time Puainako Street is a two lane urban arterial from Kanoelehua Avenue to Komohana Street approximately 1.5 miles long. The proposed widening would add an additional two lanes to the existing roadway from Kilauea Avenue to Kawili Street and create a four lane roadway from Kawili Street to Komohana Street. The construction activities for the widening would include tree removal, clearing and grubbing, excavation and embankment to construct the roadway prism, paving the roadway, construction of a median strip, construction of curbs, gutters and sidewalks, lawn and landscaping and the construction of drainage facilities. This report is a presentation and discussion of the preliminary investigation, findings, recommendations and conclusions for the roadway drainage concerns. The information contained in this report is for preliminary discussion only. As the design progresses and more data becomes available it will be necessary to revise these calculations and recommendations.



TITLE	**PROJECT LOCATION MAP** COUNTY OF HAWAII, STATE OF HAWAII	FIGURE **1**
PROJECT	PUAINAKO STREET EXTENSION HILO, HAWAII	DATE 9/1/92

91003F2



University of Hawaii (Hilo Campus)
KAWILI
WEST
Waiakea High Sch
Camp Two
123
PUAINAKO
STREET
BM 111
Shopping Center
136
KOMOHANA
KAWAILANI
STREET
NOHEA
KEHAULANI
KINOOLE STREET
KILAUEA AVENUE
INDEFINITE
RAILROAD
Water Tank
292
393
Waiakea Waena Sch
BM 148
DRIVE
Hilo Golf Course
11
BM 198
PUAINAKO STREET
RAINFALL

HYDROLOGIC METHODOLOGY

The methodology used to estimate rainfall runoff and address the other drainage concerns with in the project vicinity are as follows:

1. A base map was prepared showing the approximate location of all roadways, property lines and easements.
2. Existing topographic features were added to the base map, taken from a number of sources. 5' contours, existing houses, buildings, pavement and vegetation / ground cover were taken from aerial photographs and contour maps prepared by R.M. Towill Corporation. Existing features not covered in these sources were supplemented from maps prepared by U.S.G.S. and actual field surveys. Existing flood hazard zones were taken from the Flood Insurance Rate Maps prepared by the Federal Emergency Management Agency.
3. The major drainage paths, streams and rivers within the project limits were delineated and identified.
4. Where the proposed roadway traverses natural drainage paths or flood hazard zones it was proposed to construct culverts to pass the rainfall runoff flows beneath the roadway.
5. It was noted the construction of the roadway pavement would add additional impervious surface area within the project limits. This additional impervious ground cover was expected to increase the amount of rainfall runoff within the project limits. It was proposed to construct a series of drainage structures such as drywells, retention / detention ponds or percolation ponds to inject any increase in runoff from the site into the ground. That is attempts would be made to balance or make equal the preconstruction and post construction rates of runoff and volume of runoff leaving the project limits. To develop these preconstruction and post construction runoff rates and volumes, ambiguous design point were chosen down gradient of the project limits along all the natural drainage paths which traversed the project limits. These points were strategically located as to include the entire limits of the roadway construction within the rainfall runoff tributary areas to the design points. The expected rainfall runoff to each of the points was then calculated using either the rational method or the soil conservation service method (S.C.S. TR-55). The rational method was used for all drainage areas 100 acres in area or less. The S.C.S. method was used for all areas 100 acres in area or more. These runoff rates and volumes represented the expected "preconstruction runoff". A second base map was prepared showing the location and limits of the proposed roadway and the rainfall runoff to the design points was recalculated. These runoff rates and volumes represented the "post-construction runoff". In areas where the runoff showed an increase, structures were designed to inject the

RATIONAL METHOD

$Q = CIA$

Where:

Q = Peak runoff in c.f.s.

C = Coefficient of runoff -- depends on drainage characteristics of watershed area. Coefficient is dimensionless.

I = Average rainfall intensity for a storm duration causing the entire drainage area to contribute to Q; this duration equals Tc

Where:

Tc = Time of concentration in minutes; minimum tc = 5 min.

L = Length of Tc travel route in ft.

S = Slope of watershed area in ft. / ft.

1. Rainfall Intensities taken from "Technical Paper 43, Rainfall Atlas of the Hawaiian Islands"; U.S. Department of Commerce, Weather Bureau.

2. Runoff coefficients taken from Table 1, County of Hawaii D.P.W. "Storm Drainage Standards", dated October 1970.

3. Design storm frequency = 50 year recurrence interval.

4. Reference, Rational method; ASCE Manual of Practice #37.

5. Tc; Taken from Plate 5, County of Hawaii D.P.W. "Storm Drainage Standards", dated October, 1970.

increase in runoff into the ground within the associated tributary areas within the project limits.

6. n areas where the proposed roadway crosses natura drainage paths, culverts were proposed to pass the expected runoff flow beneath the roadway. The tributary area to each of the required structures was delineated and the "post-construction" runoff to each of the culverts calculated using either the rational or S.C.S. method as described above. The design storm for these culverts was a storm having a frequency of return of 50 years or less.
7. In areas where the proposed roadway crosses flood hazard zones it was proposed to construct culverts to pass the flows below the proposed roadway. These culverts were sized similar to those at drainage path crossings but the design storms these culverts where sized for was a storm having a frequency of return of 100 years or less. In these areas where the proposed roadway crosses flood hazard zones it was also proposed to replicate flood storage volume in areas where flood plane is proposed to be filled. This would insure that the existing flood storage volume, within the project limits, would be maintained. These volumes would be calculated in the final design using the average end area method commonly used in earthwork quantity calculations.

SOIL CONSERVATION SERVICE (S.C.S. TR-55) METHOD

$$Q = \frac{(P-Ia)}{(P-Ia)+S}$$

Where:

Q = runoff (in.)
P = Rainfall (in.)
S = Potential Maximum retention after runoff begins (in.)
Ia = initial abstraction (in.)

$Ia = 0.2S$

$S = 1000/CN - 10$

Where: CN = Curve Number; dependent on soil characteristics and ground cover type.

Tc = Tc sheet flow + Tc shallow concentrated flow + Tc channel flow. (See, "Erosion and Sediment Control Guide for Urbanizing Area in Hawaii.",. Soil Conservation Service, for more detail discussion of methodology.)

Design storms calculated for 10, 50 and 100 year recurrence interval.

OVERALL ALIGNMENT HYDROLOGY

The present drainage patterns of the area the proposed alignment traverses is as follows; In the area between Komohana Street and Kilauea Street, rainfall which falls to the south & southwest of Puainako Street flows north / northeast overland through primarily residential areas. Along the south side of Puainako Street from Komohana Street to Kawili Street there exists a earth / rock drainage channel which intercepts the flow and directs it down gradient to a large drainage channel which runs along the west side of Kawili Street which eventually ends in Waiakea Pond. There are a number of existing drywells along the south side of Puainako Street that currently inject some of the runoff into the ground. The existing channel is relatively shallow and very irregular in cross section. Where driveways or side streets cross over the existing channels culverts have been installed to pass the flows. These culverts vary widely in cross section, size and configuration. Although the channel and drainage structures may be adequate for smaller flows it is expected these structures will be inadequate to pass the flows associated with the project design storm. It is expected the runoff to the south / southwest of Puainako Street will cross over the Puainako Street roadway and enter the project limits during the design year storm. Throughout the length of the proposed roadway alignment there are a number of natural drainage paths where the flows are expected to converge and transform into channel flow. In the area between Komohana Street and Kawili Street these drainage paths flow toward the Waiakea Flood Control Channel. In the area between Kawili Street and Waiakea Intermediate School the flows are expected to flow through a wooded area toward Waiakea High School and into the drainage channel which runs along the north / northwest side of Kawili Street. In the area between Waiakea Intermediate School and Lokahi Street the flows are directed by means of an open and closed drainage system located on the school parcel toward an intermittent stream which runs toward the north and passes to the north / northwest of the residential area on Lokahi Street and eventually ends in Waiakea Pond. In the area between Lokahi Street and Kinoole Street the natural drainage paths intercept the flows and direct it toward an intermittent stream which flows toward Kinoole Street. Upon inspection where this stream intersects Kinoole Street it appears the culverts required to pass this flow beneath Kinoole Street is either completely blocked by sediment or nonexistent. This concern requires further investigation. In the area between Kinoole Street and Kilauea Street the runoff is directed to a single drywell to the northwest of the Kilauea / Puainako Street intersection.

The proposed roadway alignment was delineated and the tributary drainage areas, to each of the required drainage structures or culverts, were determined, identified and labeled "A" through "T". The corresponding quantity of runoff for each of the subareas was calculated using the Rational method or Soil Conservation Service method and the structures sized accordingly. Due to the fact that only preliminary design calculations were required, no effort was made to design minor roadside ditches, and preliminary drainage construction costs do not reflect these potential construction costs.

CULVERT HYDRAULIC DESIGN METHODOLOGY

DESIGN CRITERIA

1. Tm = 50 Years Design Storm Frequency of Return

2. $1.5D \leq Hi < Hmax$
   A. Hi = Inlet Headwater
   B. D = Diameter of Culvert
   C. Hmax = Vertical Distance between invert of culvert and bottom of pavement subgrade.

3. Minimum Culvert Diameter (inside)
   Dmin. = 24"

4. Minimum Culvert Slope
   Smin. = 0.5%

5. Pipe Class
   Class III

6. Entrance Loss coefficient
   Ke = 0.50

7. Mannings coefficient of Roughness
   Concrete Pipe: N = 0.013

8. Assumed Tailwater
   Tw = Diameter of Pipe

9. Culvert Lengths
   Taken from Preliminary Sketch Plans

10. Minimum Velocity of Flow
    Vmin = 2-1/2 Ft./Sec.

11. Maximum Velocity of Flow at Culvert Outlet
    Vmax = 5 Ft./Sec.

    IF: $5 < V \leq 18$ Ft./Sec.

Channel at outlet of culvert will be lined.

IF: $V > 18$
Energy dissipators will be provided

12. Maximum Velocity of Flow in all Channels
    Unlined Channels Vmax = 5.0 Ft./Sec.
    Lined or Rock channels Vmax = 15 Ft./Sec.

13. Design Equations and Parameters

Quick TR-55 Ver.5.46   S/N:
Executed: 01:52:08   12-10-1992

>>>>> I-D-F Curve <<<<<

PUAINAKO STREET WIDENING
KOMOHANA STREET TO KILAUEA STREET
HILO, COUNTY OF HAWAII, HAWAII

Recurrence Frequency = 50

DURATION minutes	INTENSITY inches/hour
1	24.00
2	23.03
3	19.97
4	18.05
5	16.68
6	15.65
7	14.82
8	14.14
9	13.57
10	13.07
11	12.64
12	12.26
13	11.92
14	11.61
15	11.33
16	11.08
17	10.84
18	10.63
19	10.43
20	10.24
21	10.07
22	9.90
23	9.75
24	9.61
25	9.47
26	9.34
27	9.22
28	9.10
29	8.99
30	8.88

OUTLET CONTROL DESIGN EQUATIONS

D	=	Diameter of Culvert
Q	=	Q Total / Number of Culvert Barrels (CFS)
TW	=	Tailwater (Ft.)
dc	=	Critical Depth (see attached)
ho	=	Tw or $\frac{(dc + D)}{2}$ (Whichever is greater)
H	=	Headwater
H	=	$[1 + Ke + (29n^2L) / R^{1.33}]\ V^2 / 2g$
EL_{ho}	=	Elevation of Headwater Outlet Invert + H + ho

Inlet control design equations.

UNSUBMERGED [1]

$$\text{Form (1)} \quad \frac{HW_i}{D} = \frac{H_c}{D} + K\left[\frac{Q}{AD^{0.5}}\right]^M - 0.5S\ ^{2} \qquad (A)$$

$$\text{Form (2)} \quad \frac{HW_i}{D} = K\left[\frac{Q}{AD^{0.5}}\right]^M \qquad (B)$$

SUBMERGED [3]

$$\frac{HW_i}{D} = c\left[\frac{Q}{AD^{0.5}}\right]^2 + Y - 0.5S\ ^{2} \qquad (c)$$

Definitions

HW_i	Headwater depth above inlet control section invert, ft
D	Interior height of culvert barrel, ft
H_c	Specific head at critical depth ($d_c + V_c^2/2g$), ft
Q	Discharge, ft^3/s
A	Full cross sectional area of culvert barrel, ft^2
S	Culvert barrel slope, ft/ft
K,M,c,Y	Constants from table 9

NOTES:
1 Equations (A) and (B) (unsubmerged) apply up to about $Q/AD^{0.5} = 3.5$.
2 For mitered inlets use +0.7S instead of -0.5S as the slope correction factor.
3 Equation (c) (submerged) applies above about $Q/AD^{0.5} = 4.0$.

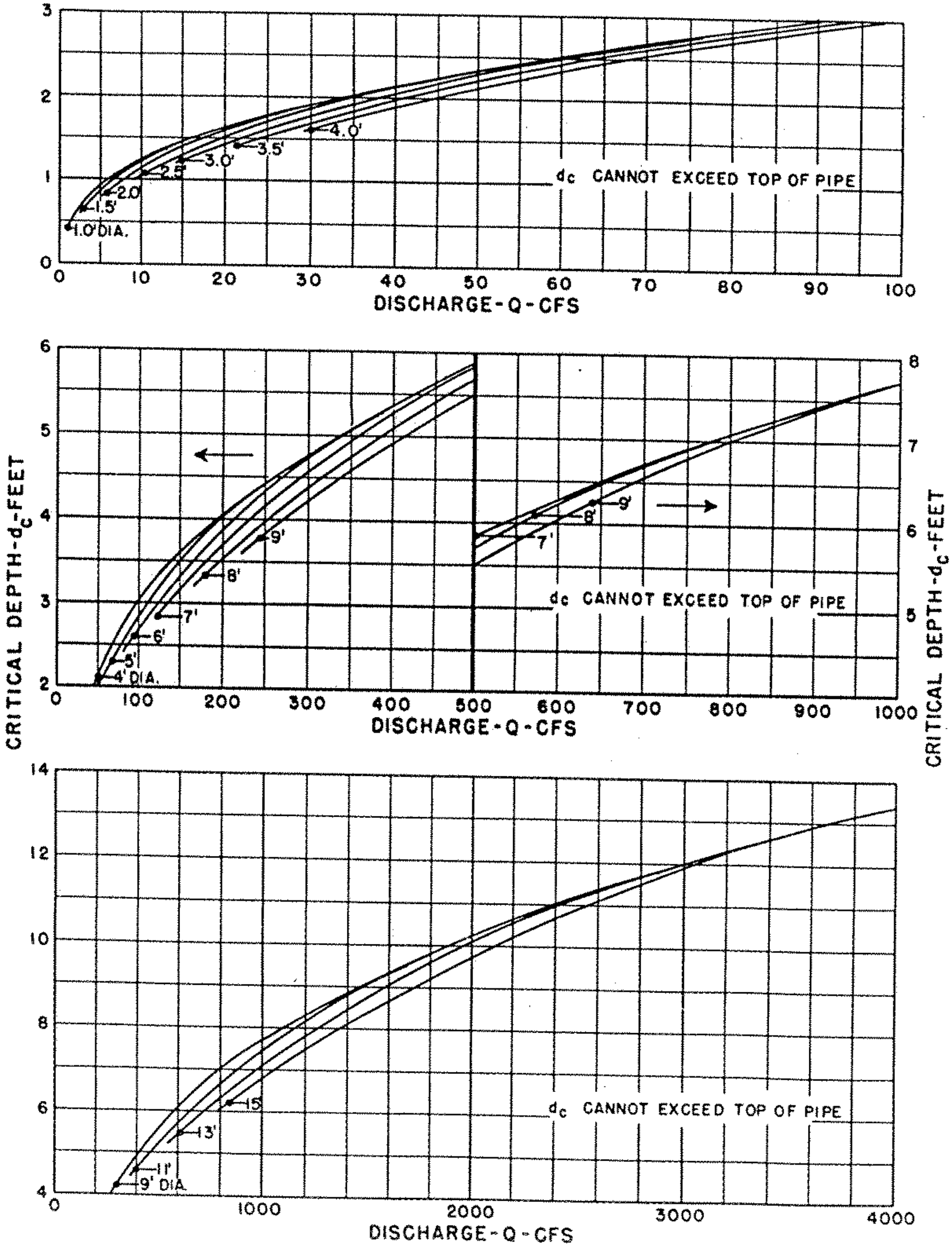
Taken from: "Hydraulic Design of Highway Culverts"
FHWA REPORT NO.: FHWA-IP-85-15
HYDRAULIC DESIGN SERIES NO. 5
September 1985

Table 9

Constants for inlet control design equations.

CHART NO.	SHAPE AND MATERIAL	NOMOGRAPH SCALE	INLET EDGE DES[illegible]TION	UNSUBMERGED EQUATION FORM	UNSUBMERGED K	UNSUBMERGED M	SUBMERGED c	SUBMERGED Y	References
1	Circular	1	Square edge w/headwall	1	0.0098	2.0	0.0398	0.67	(56) (57)
	Concrete	2	Groove end w/headwall		.0078	2.0	.0292	.74	(56) (57)
		3	Groove end projecting		.0045	2.0	.0317	.69	(56) (57)
2	Circular	1	Headwall	1	.0078	2.0	.0379	.69	(56) (57)
	CMP	2	Mitered to slope		.0210	1.33	.0463	.75	(57)
		3	Projecting		.0340	1.50	.0553	.54	(57)
3	Circular	A	Beveled ring, 45° bevels	1	.0018	2.50	.0300	.74	(57)
		B	Beveled ring, 33.7° bevels*		.0018	2.50	.0243	.83	(57)
8	Rectangular	1	30° to 75° wingwall flares	•	.026	1.0	.0385	.81	(56)
	Box	2	90° and 15° wingwall flares	1	.061	0.75	.0400	.80	(56)
		3	0° wingwall flares		.061	0.75	.0423	.82	(8)
9	Rectangular	1	45° wingwall flare d=.0430	2	.510	.667	.0309	.80	(8)
	Box	2	18° to 33.7° wingwall flare d=.0830		.486	.667	.0249	.83	(8)
10	Rectangular	1	90° headwall w/3/4" chamfers	2	.515	.667	.0375	.79	(8)
	Box	2	90° headwall w/45° bevels		.495	.667	.0314	.82	(8)
		3	90° headwall w/33.7° bevels		.486	.667	.0252	.865	(8)
11	Rectangular	1	3/4" chamfers; 45° skewed headwall	2	.522	.667	.0402	.73	(8)
	Box	2	3/4" chamfers; 30° skewed headwall		.533	.667	.0425	.705	(8)
		3	3/4" chamfers; 15° skewed headwall		.545	.667	.04505	.68	(8)
		4	45° bevels; 10°-45° skewed headwall		.498	.667	.0327	.75	(8)
12	Rectangular	1	45° non-offset wingwall flares	2	.497	.667	.0339	.803	(8)
	Box	2	18.4° non-offset wingwall flares		.493	.667	.0361	.806	(8)
	3/4" chamfers	3	18.4° non-offset wingwall flares 30° skewed barrel		.495	.667	.0386	.71	(8)
13	Rectangular	1	45° wingwall flares - offset	2	.497	.667	.0302	.835	(8)
	Box	2	33.7° wingwall flares - offset		.495	.667	.0252	.881	(8)
	Top Bevels	3	18.4° wingwall flares - offset		.493	.667	.0227	.887	(8)
16-19	C M Boxes	1	90° headwall	1	.0083	2.0	.0379	.69	(57)
		2	Thick wall projecting		.0145	1.75	.0419	.64	(57)
		3	Thin wall projecting		.0340	1.5	.0496	.57	(57)

CHART 1



BUREAU OF PUBLIC ROADS

JAN. 1964

CRITICAL DEPTH
CIRCULAR PIPE

CONCLUSIONS / RECOMMENDATIONS

In order to insure proper drainage of the area within the vicinity of the proposed roadway alignment, it is recommended the proposed drainage structures as designed within and as shown on the enclosed hydrologic plans, be provided as a minimum effort. In the final design stage it is recommended that the drainage study include a preconstruction hydrologic study and a post construction study. If the study indicates any increase in runoff, it is recommended a series of drainage structures be designed to temporarily store or percolate into the ground any increase in rainfall runoff. The design of these structures is not included as part of this study due to the fact that the design of these structures requires detailed topographic information which is not yet available. The structures might include drywells, detention ponds, retention ponds and percolation ponds.

As the design progresses and more data becomes available it will be necessary to revise these calculations and recommendations to incorporate more precise data.

It is also recommended that a detailed flood study be conducted in the areas of any flood hazard zone crossings. A flood zone determination and study is necessary to locate the actual limits of flood plane and determine the expected flood water elevations. This information would then be incorporated into the design of the flood plane crossing to determine the best design, and at the same time used to evaluate upstream areas for potential flood damages. Flood plane management strategies would include sizing culverts at the crossings to allow the passage of the 100 year design storm and to prevent any increase in flood water elevation or limits of inundation. This would also include replicating flood storage volumes in areas where the flood plane is proposed to be filled. This would insure that the existing flood storage volume, within the project limits, would be maintained.

During the construction grading and earthwork, provisions should be made to minimize the potential for soil erosion, and measures taken to minimize the amount of sediment that leaves the construction limits. Soil erosion and sediment control standard management practices, as described in the "Erosion and Sediment Control Guide for Hawaii", prepared by the Soil Conservation Society of America, Hawaii Chapter, dated March 1981, could be implemented. These management measures would include:

1. Timing of construction activities, such as grading or the installation of culverts, during periods of minimum rainfall.

2. Limiting the amount of surface area graded at any given time to reduce the area subject to potential erosion.

3. Constructing temporary drainage ditches to divert runoff away from areas susceptible to soil erosion.

4. Implementing the use of soil erosion protective materials, such as mulch or geotextiles, on areas where soils have a high potential for erosion, until permanent provisions, such as lawns and grasses can be developed. Lawns and grassing should be installed as soon as grading operations permit, to minimize the amount of time soils are exposed to possible erosion.

5. Sediment management could include the use of sedimentation basins to collect sediment which enters runoff waters. Geotextiles such as siltation fencing could be utilized to minimize the amount of sediments which would leave the site to collect in drainage structures and natural drainage paths.

The final design and recommendations should conform to the following design standards where they are determined applicable:

1. "Storm Drainage Standards", Department of Public Works, County of Hawaii, State of Hawaii, dated October 1970.

2. "Erosion and Sediment Control, Guide for Hawaii", U.S.D.A. Soil Conservation Service, in cooperation with the Hawaii Associaton of Soil and Water Conservation Districts, and the Soil Conservation Society of America, Hawaii Chapter, dated March 1981.

3. "Hawaii Administrative Rules", Department of Health, Chapters 11-55, sec. 34, as revised as of October 1992.

4. "County of Hawaii Ordinances Chapter 27", County of Hawaii, State of Hawaii.

CALCULATIONS NOT INCLUDED DUE TO LENGTH, HOWEVER A COPY OF THE CALCULATIONS ARE AVAILABLE FOR REVIEW AT THE OFFICE OF:

OKAHARA & ASSOCIATES, INC.
200 KOHOLA STREET
HILO HAWAII 96720
PHONE: 961-5527

PRELIMINARY DRAINAGE CALCULATIONS

PUAINAKO STREET EXTENSION

ALTERNATIVE ROADWAY ALIGNMENT #1

in

Hilo, County of Hawaii, Hawaii

Prepared For:

The County of Hawaii
Department of Public Works
Hilo, Hawaii

Prepared By:

Okahara & Associates, Inc.
200 Kohola Street
Hilo, Hawaii, 96720

December 1, 1992

TABLE OF CONTENTS

INTRODUCTION

The Puainako Street widening and extension plan, prepared for the County of Hawaii Department of Public Works, is a preliminary plan for the widening and extension of the existing Puainako Street in Hilo, Hawaii (see fig. 1). At this time, Puainako Street is a two lane urban arterial from Kanoelehua Avenue to Komohana Street approximately 1.5 miles long. The proposed extension would lengthen the roadway by 4.6 miles, extending it to Kaumana Drive in the vicinity of the Country Club Drive / Kaumana Drive intersection. Due to the lack of design and construction funds it was proposed to divide the project into two distinct phases and design and construct each phase as funds became available. The portion of the project from Kilauea Street to Komohana Street was identified and designated as the "Lower Phase". The portion of the project from Kaumana Drive to Komohana Street was identified and designated as the "Upper Phase". This preliminary drainage report is a summary and discussion of the initial investigations, findings, proposals and recommendations for the drainage issues associated with the "Upper" portion of the project. The information contained in this report is for preliminary discussion only and the information contained within will need to be revised as more accurate data becomes available.

In the preliminary stages of the design of the "Upper" portion of the project, two alternative roadway alignments were considered and each studied in detail. This report is concerned with the drainage issues associated with proposed roadway alignment # 1. (See Figure 2).

The construction activities for the extension of the roadway would include tree removal, clearing and grubbing, excavation, embankment construction, paving of the roadway and shoulders, lawn / vegetation replication and the construction of drainage facilities.

The proposed roadway typical section will be crowned to shed water and prevent standing water on the roadway. This runoff will be collected in roadside ditches and drainage structures (i.e.: drywells, retention ponds and / or detention ponds) and disposed of by both infiltrating it into the ground and discharging it into the natural drainage paths. The paving of the roadway will increase the amount of impervious surface area within the project limits. Attempts will be made to dispose of any increase in runoff associated with the increase in impervious area through the utilization of drywells and percolation ponds.

Roadway alternative alignments 1 & 2 traverse a number of intermittent streams. These streams are believed to be tributaries to an isolated flood plane located in the tracts of land "Kukuau 1" and "Kukuau 2". This flood plane was mapped as shown on the "Flood Insurance Rate Map", as part of the National Flood Insurance Program, prepared by the Federal Emergency Management Agency and as duplicated and shown within. (See Figure 3).

At locations where the proposed roadway crosses a stream or obvious drainage path, culverts will be installed to permit the runoff to pass beneath the roadway. The culverts will be sized to allow the passage of the normal or base flow of the stream along with the runoff associated with the design rain storm. The design storm will have a frequency of return of 50 years or less. In the final design stage, the proposed culverts will be checked against a design storm having a frequency of return of 100 years and recommendations made based upon their performance.

In locations where the proposed roadway crosses flood hazard zones, measures will be taken to prevent changes in the flood water patterns. A flood zone determination and study is necessary to locate the actual limits of the flood plane and determine the expected flood water elevations. This information is required to insure sound flood plane management and construction practices within the flood hazard areas. Flood water elevation and flow characteristics would be integrated into the design of flood zone crossings to determine the best design, and at the same time, evaluating upstream areas for potential flood damages. Flood plane management strategies would include sizing culverts at the flood plane crossings, to allow the passage of 100 year frequency of return flood waters and to prevent any increase in the flood water elevations or limits of inundation. This could also include replicating flood storage volumes in areas where flood plane is proposed to be filled to maintain the existing volume of storage for flood waters within the project limits. In any such case, acceptable flood plane management measures shall be implemented to prevent any alterations in the flood patterns within the project limits in accordance with the applicable sections of Chapter 27 of the County of Hawaii Ordinances.

During the construction grading and earthwork, provisions will be made to minimize the potential for soil erosion and measures will be taken to minimize the amount of sediment that leaves the construction limits. Soil erosion and sediment control standard management practices, as described in the "Erosion and Sediment Control Guide for Hawaii", prepared by the Soil Conservation Society of America, Hawaii Chapter, dated March 1981, shall be implemented. These management measures could include:

1. Timing construction activities, such as grading or the installation of culverts, during periods of minimum rainfall.

2. Limiting the amount of surface area graded at any given time to reduce the area subject to potential erosion.

3. Constructing temporary drainage ditches to divert runoff away from areas susceptible to soil erosion.

4. Implementing the use of soil erosion protective materials such as mulch or geotextiles on areas where soils have a high potential for erosion, until permanent provisions, such as lawns and grasses can be developed. Lawns and grassing shall be installed as soon as grading operations permit, to minimize the amount of time soils are exposed to possible erosion.

5. Sediment management could include the use of sedimentation basins to collect sediment which enters runoff waters. Geotextiles such as siltation fencing could be utilized to minimize the amount of sediments which would leave the site to collect in drainage structures and streams.

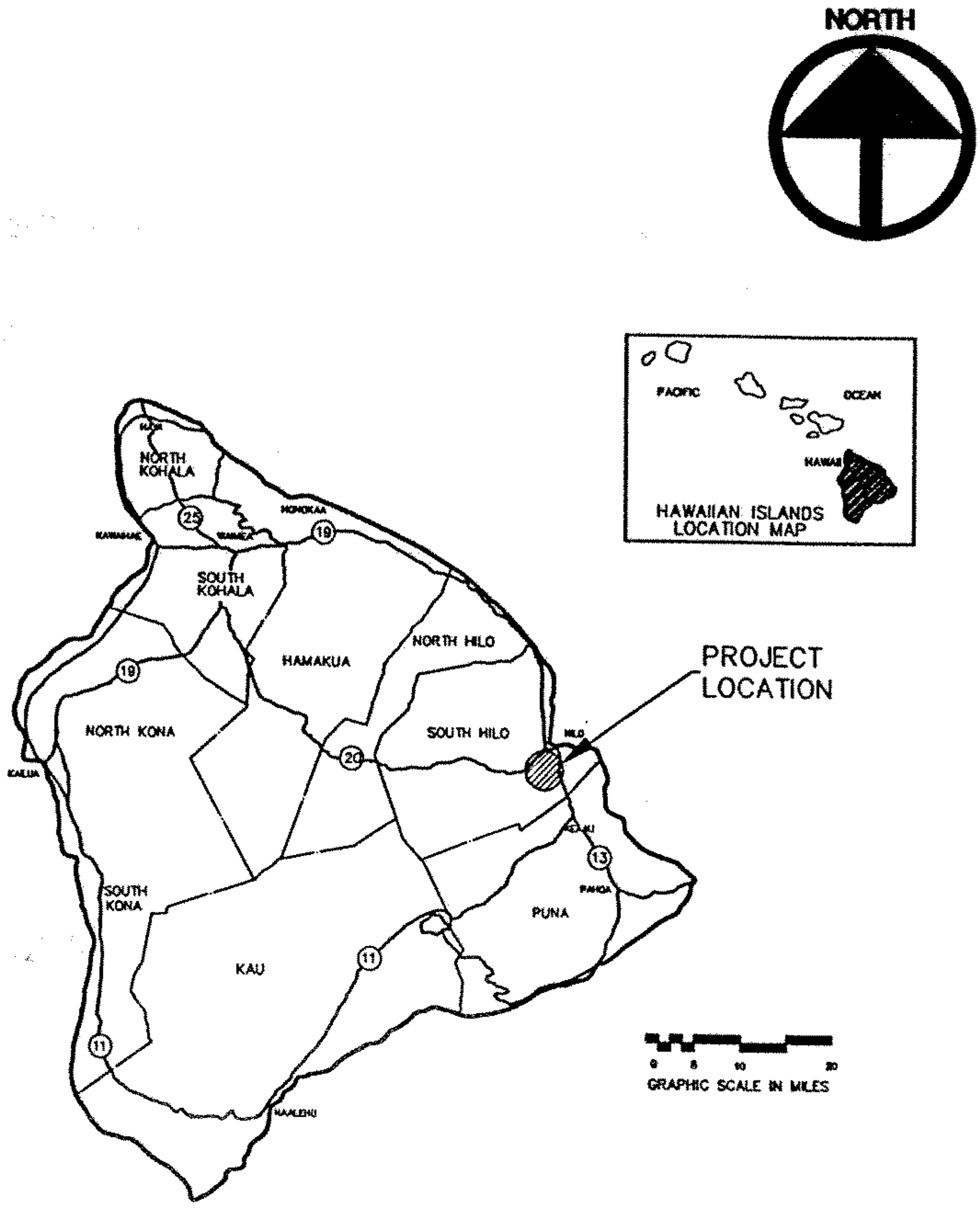
The final design and recommendations shall conform to the following design standards where they are determined applicable:

1. "Storm Drainage Standards", Department of Public Works, County of Hawaii, State of Hawaii, dated October 1970.

2. "Erosion and Sediment Control, Guide for Hawaii", U.S.D.A. Soil Conservation Service, in cooperation with the Hawaii Association of Soil and Water Conservation Districts, and the Soil Conservation Society of America, Hawaii Chapter, dated March 1981.

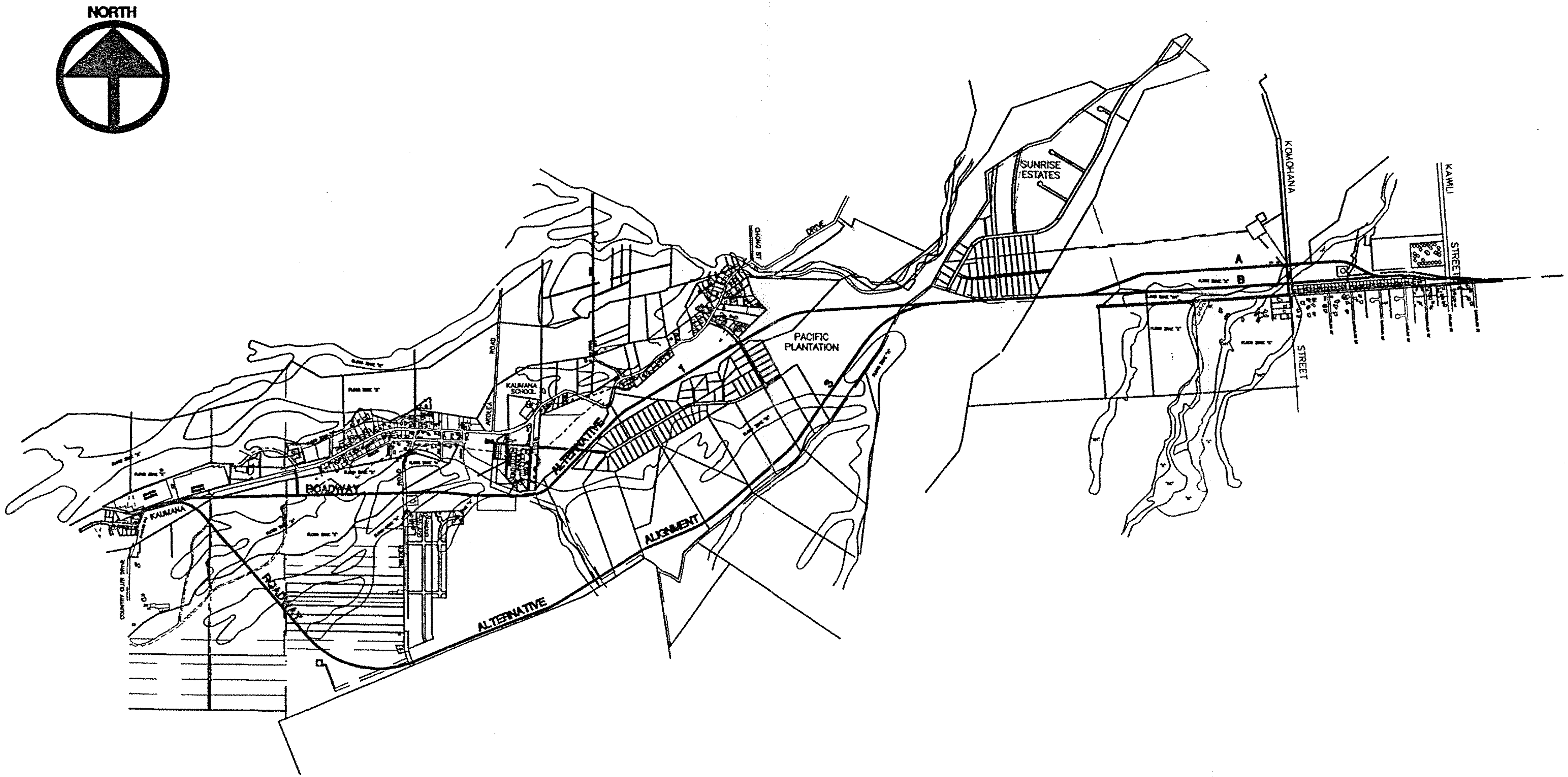
3. "Hawaii Administrative Rules", Department of Health, Chapters 11-55, sec. 34, as revised as of October 1992.

4. "County of Hawaii Ordinances Chapter 27", County of Hawaii, State of Hawaii.



TITLE **PROJECT LOCATION MAP** COUNTY OF HAWAII, STATE OF HAWAII	FIGURE 1
PROJECT **PUAINAKO STREET EXTENSION HILO, HAWAII**	DATE 9/1/92

91003F2



TITLE **ALTERNATIVE ROADWAY ALIGNMENTS**
COUNTRY CLUB DRIVE TO KOMOHANA STREET

FIGURE **2**

PROJECT PUAINAKO STREET EXTENSION
HILO, HAWAII

DATE 9/1/92

SCALE: 1"=2000'

91003F3

HYDROLOGIC METHODOLOGY

RATIONAL METHOD

$Q = CIA$

Where:

Q = Peak runoff in c.f.s.

C = Coefficient of runoff -- depends on drainage characteristics of watershed area. Coefficient is dimensionless.

I = Average rainfall intensity for a storm duration causing the entire drainage area to contribute to Q; this duration equals Tc

Where:

Tc = Time of concentration in minutes; minimum tc = 5 min.

L = Length of Tc travel route in ft.

S = Slope of watershed area in ft. / ft.

1. Rainfall Intensities taken from "Technical Paper 43, Rainfall Atlas of the Hawaiian Islands"; U.S. Department of Commerce, Weather Bureau.

2. Runoff coefficients taken from Table 1, County of Hawaii D.P.W. "Storm Drainage Standards", dated October 1970.

3. Design storm frequency = 50 year recurrence interval.

4. Reference, Rational method; ASCE Manual of Practice #37.

5. Tc; Taken from Plate 5, County of Hawaii D.P.W. "Storm Drainage Standards", dated October, 1970.

SOIL CONSERVATION SERVICE (S.C.S. TR-55) METHOD

$$Q = \frac{(P\text{-}Ia)}{(P\text{-}Ia)+S}$$

Where:

Q = runoff (in.)
P = Rainfall (in.)
S = Potential Maximum retention after runoff begins (in.)
Ia = initial abstraction (in.)

$Ia = 0.2S$

$S = 1000/CN - 10$

Where: CN = Curve Number; dependent on soil characteristics and ground cover type.

Tc = Tc sheet flow + Tc shallow concentrated flow + Tc channel flow. (See, "Erosion and Sediment Control Guide for Urbanizing Area in Hawaii.",. Soil Conservation Service, for more detail discussion of methodology.)

Design storms calculated for 10, 50 and 100 year recurrence interval.

CULVERT HYDRAULIC DESIGN METHODOLOGY

DESIGN CRITERIA

1. Tm = 50 Years Design Storm Frequency of Return

2. $1.5D \leq Hi < Hmax$
   A. Hi = Inlet Headwater
   B. D = Diameter of Culvert
   C. Hmax = Vertical Distance between invert of culvert and bottom of pavement subgrade.

3. Minimum Culvert Diameter (inside)
   Dmin. = 24"

4. Minimum Culvert Slope
   Smin. = 0.5%

5. Pipe Class
   Class III

6. Entrance Loss coefficient
   Ke = 0.50

7. Mannings coefficient of Roughness
   Concrete Pipe: N = 0.013

8. Assumed Tailwater
   Tw = Diameter of Pipe

9. Culvert Lengths
   Taken from Preliminary Sketch Plans

10. Minimum Velocity of Flow
    Vmin = 2-1/2 Ft./Sec.

11. Maximum Velocity of Flow at Culvert Outlet
    Vmax = 5 Ft./Sec.

    IF: $5 < V \leq 18$ Ft./Sec.

Channel at outlet of culvert will be lined.

IF: $V > 18$
Energy dissipators will be provided

12. Maximum Velocity of Flow in all Channels
    Unlined Channels $V_{max} = 5.0$ Ft./Sec.
    Lined or Rock channels $V_{max} = 15$ Ft./Sec.

13. Design Equations and Parameters

OUTLET CONTROL DESIGN EQUATIONS

D	=	Diameter of Culvert
Q	=	Q Total / Number of Culvert Barrels (CFS)
TW	=	Tailwater (Ft.)
dc	=	Critical Depth (see attached)
ho	=	Tw or $\frac{(dc + D)}{2}$ (Whichever is greater)
H	=	Headwater
H	=	$[\, I + Ke + (29n^2L) / R^{1.33]}\, V^2 / 2g$
EL_{ho}	=	Elevation of Headwater Outlet Invert + H + ho

Inlet control design equations.

UNSUBMERGED [1]

Form (1) $$\frac{HW_i}{D} = \frac{H_c}{D} + K\left[\frac{Q}{AD^{0.5}}\right]^M - 0.5S\ ^{2} \qquad (A)$$

Form (2) $$\frac{HW_i}{D} = K\left[\frac{Q}{AD^{0.5}}\right]^M \qquad (B)$$

SUBMERGED [3]

$$\frac{HW_i}{D} = c\left[\frac{Q}{AD^{0.5}}\right]^2 + Y - 0.5S\ ^{2} \qquad (c)$$

Definitions

HW_i	Headwater depth above inlet control section invert, ft
D	Interior height of culvert barrel, ft
H_c	Specific head at critical depth ($d_c + V_c^2/2g$), ft
Q	Discharge, ft^3/s
A	Full cross sectional area of culvert barrel, ft^2
S	Culvert barrel slope, ft/ft
K,M,c,Y	Constants from table 9

NOTES:
1. Equations (A) and (B) (unsubmerged) apply up to about $Q/AD^{0.5} = 3.5$.
2. For mitered inlets use +0.7S instead of -0.5S as the slope correction factor.
3. Equation (c) (submerged) applies above about $Q/AD^{0.5} = 4.0$.

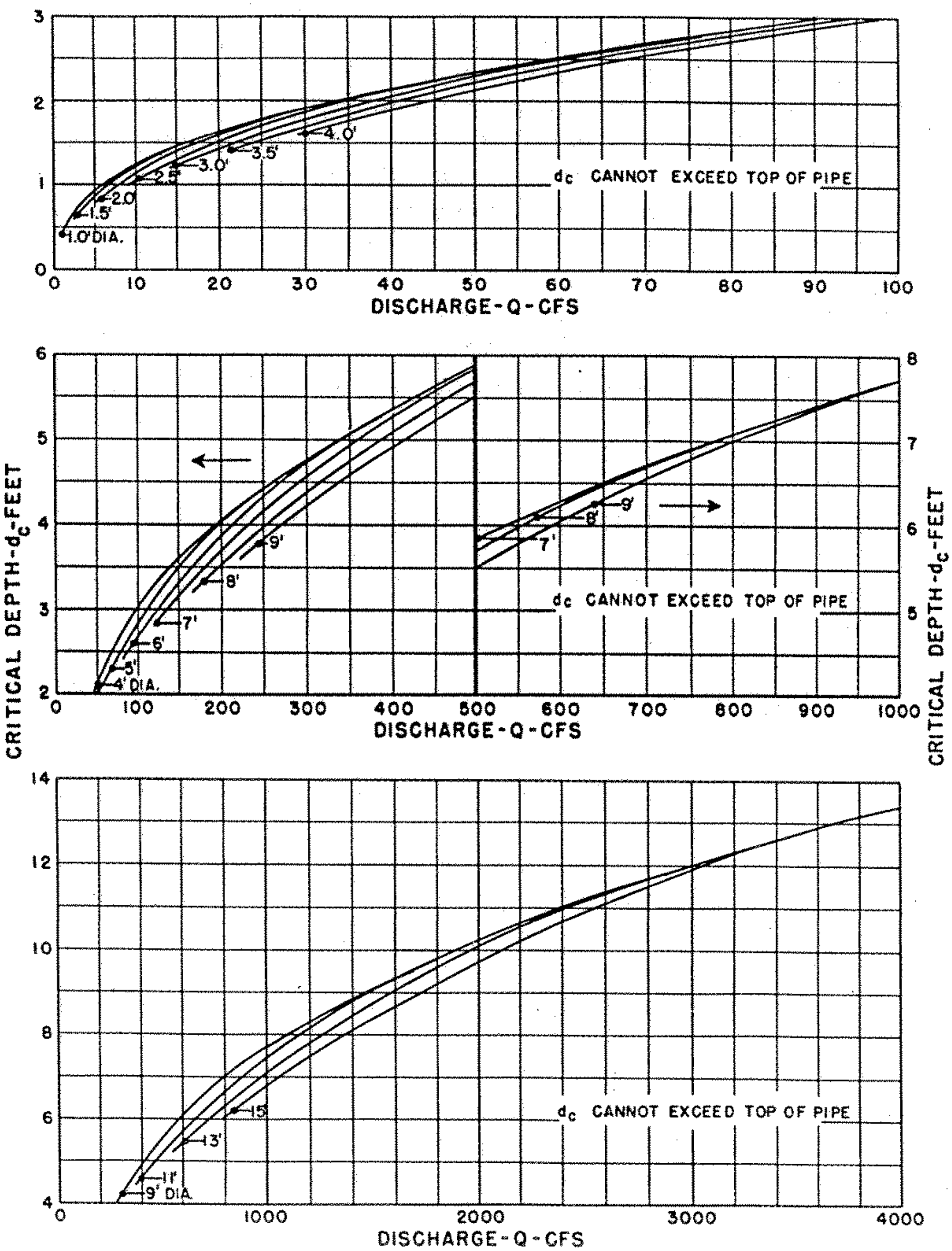
Taken from: "Hydraulic Design of Highway Culverts"
FHWA REPORT NO.: FHWA-IP-85-15
HYDRAULIC DESIGN SERIES NO. 5
September 1985

Table 9

Constants for inlet control design equations.

CHART NO.	SHAPE AND MATERIAL	NOMOGRAPH SCALE	INLET EDGE DESCRIPTION	UNSUBMERGED EQUATION FORM	UNSUBMERGED K	UNSUBMERGED M	SUBMERGED c	SUBMERGED Y	References
1	Circular Concrete	1	Square edge w/headwall	1	0.0098	2.0	0.0398	0.67	(56) (57)
		2	Groove end w/headwall		.0078	2.0	.0292	.74	(56) (57)
		3	Groove end projecting		.0045	2.0	.0317	.69	(56) (57)
2	Circular CMP	1	Headwall	1	.0078	2.0	.0379	.69	(56) (57)
		2	Mitered to slope		.0210	1.33	.0463	.75	(57)
		3	Projecting		.0340	1.50	.0553	.54	(57)
3	Circular	A	Beveled ring, 45° bevels	1	.0018	2.50	.0300	.74	(57)
		B	Beveled ring, 33.7° bevels*		.0018	2.50	.0243	.83	(57)
8	Rectangular Box	1	30° to 75° wingwall flares	-	.026	1.0	.0385	.81	(56)
		2	90° and 15° wingwall flares	1	.061	0.75	.0400	.80	(56)
		3	0° wingwall flares		.061	0.75	.0423	.82	(8)
9	Rectangular Box	1	45° wingwall flare d=.0430	2	.510	.667	.0309	.80	(8)
		2	18° to 33.7° wingwall flare d=.0830		.486	.667	.0249	.83	(8)
10	Rectangular Box	1	90° headwall w/3/4" chamfers	2	.515	.667	.0375	.79	(8)
		2	90° headwall w/45° bevels		.495	.667	.0314	.82	(8)
		3	90° headwall w/33.7° bevels		.486	.667	.0252	.865	(8)
11	Rectangular Box	1	3/4" chamfers; 45° skewed headwall	2	.522	.667	.0402	.73	(8)
		2	3/4" chamfers; 30° skewed headwall		.533	.667	.0425	.705	(8)
		3	3/4" chamfers; 15° skewed headwall		.545	.667	.04505	.68	(8)
		4	45° bevels; 10°-45° skewed headwall		.498	.667	.0327	.75	(8)
12	Rectangular Box 3/4" chamfers	1	45° non-offset wingwall flares	2	.497	.667	.0339	.803	(8)
		2	18.4° non-offset wingwall flares		.493	.667	.0361	.806	(8)
		3	18.4° non-offset wingwall flares 30° skewed barrel		.495	.667	.0386	.71	(8)
13	Rectangular Box Top Bevels	1	45° wingwall flares - offset	2	.497	.667	.0302	.835	(8)
		2	33.7° wingwall flares - offset		.495	.667	.0252	.881	(8)
		3	18.4° wingwall flares - offset		.493	.667	.0227	.887	(8)
16-19	C M Boxes	1	90° headwall	1	.0083	2.0	.0379	.69	(57)
		2	Thick wall projecting		.0145	1.75	.0419	.64	(57)
		3	Thin wall projecting		.0340	1.5	.0496	.57	(57)

CHART 1



BUREAU OF PUBLIC ROADS

JAN. 1964

CRITICAL DEPTH
CIRCULAR PIPE

OVERALL ALIGNMENT HYDROLOGY

The present drainage pattern of the area the roadway alternative alignment #1 traverses is as follows: In the areas between Country Club Drive and Wilder Road, rainfall which falls to the south & south-west of the alignment flows north northeast overland through primarily old cane fields overgrown with dense grass and brush. This runoff eventually makes it's way in to one of the two existing streams that converge at Wilder Road and pass beneath Wilder Road through two existing 8' diameter C.M.P. culverts. In the area between Wilder Road and Pacific Plantation Subdivision, rainfall which falls to the south & southwest of the alignment flows north / northeast overland through residential areas and into undeveloped areas and eventually into the existing stream which flows to the east / southeast. Rainfall which falls to the north of the alignment flows overland through some residential areas, but mainly through undeveloped land to the stream which flows east / southeast.

In the area between Kilua Road and Edita Street, runoff which falls to the north & northwest of the alignment flows overland through undeveloped land (mainly scrub and brush) into the Pacific Plantation Subdivision.

In the area between Edita Street and Sunrise Ridge Subdivision, rainfall which falls to the north of the alignment flows overland through scrub and dense woods eastward where it eventually enters the Waipahoehoe Stream which flows to the northeast. Rainfall which falls to the south of the alignment flows northeast / east overland through dense woods where it eventually enters the existing flood control channel / Waiakea Stream which flows to the northeast and passes beneath the Komohana Street bridge.

It is proposed to construct a series of drainage structures along the alignment to allow the existing drainage patterns to remain with as little disturbance as possible due to the roadway construction. The proposed rainfall runoff quantities will be estimated using the Rational Method, as described herein. The proposed drainage structure will be sized so as to allow the passage of runoff from a design storm with a 50- year or less return interval.

The proposed roadway alignment was delineated and the tributary drainage areas, to each required drainage structure or culvert, were determined, identified (19 total) and labeled "A" through "S". The corresponding quantity of runoff for each of the 19 subareas was calculated using the Rational Method, or Soil Conservation Service method, and the structures sized accordingly. The sub basins A through L drain via intermittent stream into an isolated flood plane located on the tracts of Land Kukuau 1 and Kukuau 2. The runoff waters are believed to flow down to the low point within this flood plane, located about 2,500 ft. east northeast of the existing Edita St. cul-de-sac / intersection. Whether the flow leaves this flood plane through subsurface caverns or spills over and flows down gradient overland has yet to be determined (see attached map entitled "Approximate Limits 100 Yr. Flood Zone, Puainako St. Extension, Hilo, Hawaii". Sub basins M and N are believed to drain overland into the Alenaio (Waipahoehoe) Stream and eventually into the Waiakea Stream Tributary No. 3 and Waiakea Stream, and eventually into Waiakea Pond. Due to the fact that only preliminary designs were required, no effort was made to design minor roadside ditches, and preliminary drainage construction cost estimates do not include these potential construction costs.

In addition to the preliminary design of the proposed roadway culverts, the existing 8′ diameter C.M.P. and the 5′ diameter R.C.P. culverts along Wilder Road were checked for adequate capacity to ensure proper drainage of the proposed roadway.

CALCULATIONS NOT INCLUDED DUE TO LENGTH, HOWEVER A COPY OF THE CALCULATIONS ARE AVAILABLE FOR REVIEW AT THE OFFICE OF:

OKAHARA & ASSOCIATES, INC.
200 KOHOLA STREET
HILO HAWAII 96720
PHONE: 961-5527

CONCLUSIONS / RECOMMENDATIONS

In order to insure proper drainage of the area within the vicinity of the proposed roadway alignment, it is recommended the proposed drainage structures as designed within and as shown on the enclosed hydrologic plans, be provided as a minimum effort. In the final design stage it is recommended that the drainage study include a preconstruction hydrologic study and a post construction study. If the study indicates any increase in runoff, it is recommended a series of drainage structures be designed to temporarily store or percolate into the ground any increase in rainfall runoff. The design of these structures is not included as part of this study due to the fact that the design of these structures requires detailed topographic information which is not yet available. The structures might include drywells, detention ponds, retention ponds and percolation ponds.

As the design progresses and more data becomes available it will be necessary to revise these calculations and recommendations to incorporate more precise data.

It is also recommended that a detailed flood study be conducted in the areas of any flood hazard zone crossings. A flood zone determination and study is necessary to locate the actual limits of flood plane and determine the expected flood water elevations. This information would then be incorporated into the design of the flood plane crossing to determine the best design, and at the same time used to evaluate upstream areas for potential flood damages. Flood plane management strategies would include sizing culverts at the crossings to allow the passage of the 100 year design storm and to prevent any increase in flood water elevation or limits of inundation. This would also include replicating flood storage volumes in areas where the flood plane is proposed to be filled. This would insure that the existing flood storage volume, within the project limits, would be maintained.

During the construction grading and earthwork, provisions should be made to minimize the potential for soil erosion, and measures taken to minimize the amount of sediment that leaves the construction limits. Soil erosion and sediment control standard management practices, as described in the "Erosion and Sediment Control Guide for Hawaii", prepared by the Soil Conservation Society of America, Hawaii Chapter, dated March 1981, could be implemented. These management measures would include:

1. Timing construction activities, such as grading or the installation of culverts, during periods of minimum rainfall.

2. Limiting the amount of surface area graded at any given time to reduce the area subject to potential erosion.

3. Constructing temporary drainage ditches to divert runoff away from areas susceptible to soil erosion.

4. Implementing the use of soil erosion protective materials, such as mulch or geotextiles, on areas where soils have a high potential for erosion, until permanent provisions, such as lawns and grasses can be developed. Lawns and grassing should be installed as soon as grading operations permit, to minimize the amount of time soils are exposed to possible erosion.

5. Sediment management could include the use of sedimentation basins to collect sediment which enters runoff waters. Geotextiles such as siltation fencing could be utilized to minimize the amount of sediments which would leave the site to collect in drainage structures and natural drainage paths.

The final design and recommendations should conform to the following design standards where they are determined applicable:

1. "Storm Drainage Standards", Department of Public Works, County of Hawaii, State of Hawaii, dated October 1970.

2. "Erosion and Sediment Control, Guide for Hawaii", U.S.D.A. Soil Conservation Service, in cooperation with the Hawaii Association of Soil and Water Conservation Districts, and the Soil Conservation Society of America, Hawaii Chapter, dated March 1981.

3. "Hawaii Administrative Rules", Department of Health, Chapters 11-55, sec. 34, as revised as of October 1992.

4. "County of Hawaii Ordinances Chapter 27", County of Hawaii, State of Hawaii.

Both alternative roadway alignments 1 & 2 cross a number of intermittent streams and F.I.R.M. flood hazard zones. Alternative 1 makes a large flood zone crossing southeast of Kilua Rd. This is at a point where a large number of the streams and isolated flood ways converge. The roadway culvert at this point would need to be designed to pass the combined flows of each of the flood ways which converge at this point. It is expected, crossing at this point, a very large culvert or even a bridge structure would be required to pass the design year flow. Alignment 1 also crosses four more independent flood ways in the vicinity of Wilder Rd. These crossings are the tributary streams and flood ways to the previously mentioned crossing. Since these crossings are up gradient and crossings would be made independently, the flows for which the culverts are designed are expected to be much smaller. Alternative roadway alignment 2 crosses a F.I.R.M. flood hazard zone to the southeast of Pacific Plantation subdivision. Of all the alternative roadway alignments studied, this crossing was the one located at the lowest elevation within the isolated flood plain of Kukuau. This point is the furthest down gradient of any other crossings and is expected to have the largest storm runoff flow rate. It is expected for a crossing at this point, a very large culvert or even a bridge structure would be required to pass the design year storm flow. Alignment 2 makes four additional flood zone crossings, one to the east of Wilder Rd. and three to the southeast of Country Club Dr. The three crossings to the southeast of Country Club Dr. are located at the highest elevations of any proposed crossings. Since these points are the farthest up-gradient, these crossings are expected to have the smallest flows of any proposed crossings. The culverts required to pass the flows at these crossings would be expected to be the smallest, and in turn the least expensive. It is expected, alignment #2 would require a large concrete channel be constructed to the south of Wilder Road to intercept offsite runoff and prevent runoff from crossing the roadway. This channel adds a high additional cost to alignment #2.

In general, the two alternative alignments would require about the same number of flood zone crossings. It is the magnitude of the larger crossing that each of the proposed alignments makes which sets the two alternatives apart from a hydrologic standpoint. Alignment 1's crossing is to the southeast of Kilua Rd. and alignment 2's crossing is to the east of Pacific Plantation subdivision. It is expected the crossing for alignment 2 would be far more expensive to construct than the crossing for alignment 1 southeast of Kilua Rd. Alignment 2 also has a high cost associated with the required concrete channel south of Wilder Road. It is therefore recommended, from a hydraulic/hydrologic and an economical standpoint, that alternative 1 be chosen as the preferred alignment. (See attached cost estimate).

DRAINAGE COST SUMMARY

ROADWAY CULVERTS

Culvert I.D.	Q'ty	Size	Cost	Sub Total	Total
1	2	78" dia. R.C.P. L=150	98,300.00		
2	1	42" dia. R.C.P. L=75	11,700.00		
3	5	148" x 93" Steel Arch L=75	317,000.00		
4	1	24" dia. R.C.P. L-75	7,000.00		
5	1	Existing	0.00		
6	1	Existing	0.00		
7	1	24" dia. R.C.P. L=75	7,000.00		
8	4	188" x 116" Steel Arch L=120	371,000.00		
9	1	42" dia. R.C.P. L=150	16,800.00		
10	1	30" dia. R.C.P. L=120	9,900.00		
11	1	42" dia. R.C.P. L-65	11,000.00		
12	1	24" dia. R.C.P. L=150	9,000.00		
13	1	24" dia. R.C.P. L=150	9,000.00		
14	1	24" dia. R.C.P. L=75	7,000.00		
15	1	24" dia. R.C.P. L=75	7,000.00		
16	1	24" dia. R.C.P. L=75	7,000.00		
17	1	24" dia. R.C.P. L=75	7,000.00		
18	1	27" dia. R.C.P. L=75	7,300.00		
SUBTOTAL				$902,800.00	
SAY				$903,000.00	

MAJOR ROADSIDE CHANNELS

Location	Size	Cost	Subtotal	
STA. 38+00 -> 46+00	20'x5'x800' |_|	385,450.00		
STA. 70+50 -> 75+50	20'x5'x500' |_|	240,500.00		
STA. 75+50 -> 82+00	20'x10.5'x650' _/	672,750.00		
STA. 145+00 -> 180+00	to be determined	725,000.00		
SUBTOTAL			$2,023,700.00	

DRYWELLS

Description	Q'ty	Cost	Subtotal	
Drywells	115	8,000.00	920,000.00	
TOTAL				$2,943,700.00
GRAND TOTAL				$3,846,700.00
SAY				$3,850,000.00

PRELIMINARY DRAINAGE CALCULATIONS

PUAINAKO STREET EXTENSION

ALTERNATIVE ROADWAY ALIGNMENT #2

in

Hilo, County of Hawaii, Hawaii

Prepared For:

The County of Hawaii
Department of Public Works
Hilo, Hawaii

Prepared By:

Okahara & Associates, Inc.
200 Kohola Street
Hilo, Hawaii, 96720

December 1, 1992

TABLE OF CONTENTS

INTRODUCTION

The Puainako Street widening and extension plan, prepared for the County of Hawaii Department of Public Works, is a preliminary plan for the widening and extension of the existing Puainako Street in Hilo, Hawaii (see fig. 1). At this time, Puainako Street is a two lane urban arterial from Kanoelehua Avenue to Komohana Street approximately 1.5 miles long. The proposed extension would lengthen the roadway by 4.6 miles, extending it to Kaumana Drive in the vicinity of the Country Club Drive / Kaumana Drive intersection. Due to the lack of design and construction funds it was proposed to divide the project into two distinct phases and design and construct each phase as funds became available. The portion of the project from Kilauea Street to Komohana Street was identified and designated as the "Lower Phase". The portion of the project from Kaumana Drive to Komohana Street was identified and designated as the "Upper Phase". This preliminary drainage report is a summary and discussion of the initial investigations, findings, proposals and recommendations for the drainage issues associated with the "Upper" portion of the project. The information contained in this report is for preliminary discussion only and the information contained within will need to be revised as more accurate data becomes available.

In the preliminary stages of the design of the "Upper" portion of the project, two alternative roadway alignments were considered and each studied in detail. This report is concerned with the drainage issues associated with proposed roadway alignment # 2 (see fig. 2).

The construction activities for the extension of the roadway would include tree removal, clearing and grubbing, excavation, embankment construction, paving of the roadway and shoulders, lawn / vegetation replication and the construction of drainage facilities.

The proposed roadway typical section will be crowned to shed water and prevent standing water on the roadway. This runoff will be collected in roadside ditches and drainage structures (i.e.: drywells, retention ponds and / or detention ponds) and disposed of by both infiltrating it into the ground and discharging it into the natural drainage paths. The paving of the roadway will increase the amount of impervious surface area within the project limits. Attempts will be made to dispose of any increase in runoff associated with the increase in impervious area through the utilization of drywells and percolation ponds.

Roadway alternative alignments 1 & 2 traverse a number of intermittent streams. These streams are believed to be tributaries to an isolated flood plane located in the tracts of land "Kukuau 1" and "Kukuau 2". This flood plane was mapped as shown on the "Flood Insurance Rate Map", as part of the National Flood Insurance Program, prepared by the Federal Emergency Management Agency and as duplicated and shown within (see fig. 3).

At locations where the proposed roadway crosses a stream or obvious drainage path, culverts will be installed to permit the runoff to pass beneath the roadway. The culverts will be sized to allow the passage of the normal or base flow of the stream along with the runoff associated with the design rain storm. The design storm will have a frequency of return of 50 years or less. In the final design stage, the proposed culverts will be checked against a design storm having a frequency of return of 100 years and recommendations made based upon their performance.

In locations where the proposed roadway crosses flood hazard zones, measures will be taken to prevent changes in the flood water patterns. A flood zone determination and study is necessary to locate the actual limits of the flood plane and determine the expected flood water elevations. This information is required to insure sound flood plane management and construction practices within the flood hazard areas. Flood water elevation and flow characteristics would be integrated into the design of flood zone crossings to determine the best design, and at the same time, evaluating upstream areas for potential flood damages. Flood plane management strategies would include sizing culverts at the flood plane crossings, to allow the passage of 100 year frequency of return flood waters and to prevent any increase in the flood water elevations or limits of inundation. This could also include replicating flood storage volumes in areas where flood plane is proposed to be filled to maintain the existing volume of storage for flood waters within the project limits. In any such case, acceptable flood plane management measures shall be implemented to prevent any alterations in the flood patterns within the project limits in accordance with the applicable sections of Chapter 27 of the County of Hawaii Ordinances.

During the construction grading and earthwork, provisions will be made to minimize the potential for soil erosion and measures will be taken to minimize the amount of sediment that leaves the construction limits. Soil erosion and sediment control standard management practices, as described in the "Erosion and Sediment Control Guide for Hawaii", prepared by the Soil Conservation Society of America, Hawaii Chapter, dated March 1981, shall be implemented. These management measures could include:

1. Timing construction activities, such as grading or the installation of culverts, during periods of minimum rainfall.

2. Limiting the amount of surface area graded at any given time to reduce the area subject to potential erosion.

3. Constructing temporary drainage ditches to divert runoff away from areas susceptible to soil erosion.

4. Implementing the use of soil erosion protective materials such as mulch or geotextiles on areas where soils have a high potential for erosion, until permanent provisions, such as lawns and grasses can be developed. Lawns and grassing shall be installed as soon as grading operations permit, to minimize the amount of time soils are exposed to possible erosion.

5. Sediment management could include the use of sedimentation basins to collect sediment which enters runoff waters. Geotextiles such as siltation fencing could be utilized to minimize the amount of sediments which would leave the site to collect in drainage structures and streams.

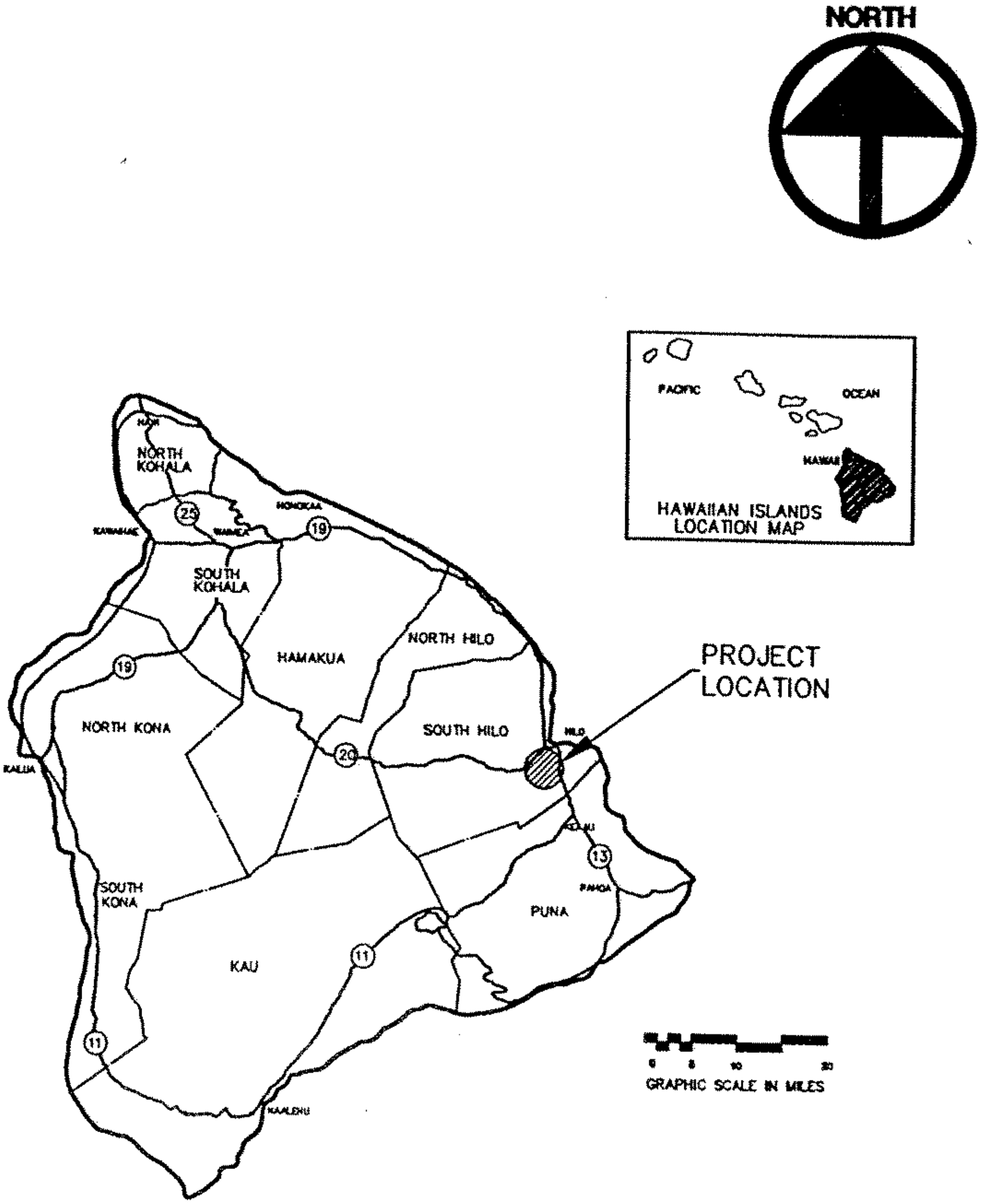
The final design and recommendations shall conform to the following design standards where they are determined applicable:

1. "Storm Drainage Standards", Department of Public Works, County of Hawaii, State of Hawaii, dated October 1970.

2. "Erosion and Sediment Control, Guide for Hawaii", U.S.D.A. Soil Conservation Service, in cooperation with the Hawaii Association of Soil and Water Conservation Districts, and the Soil Conservation Society of America, Hawaii Chapter, dated March 1981.

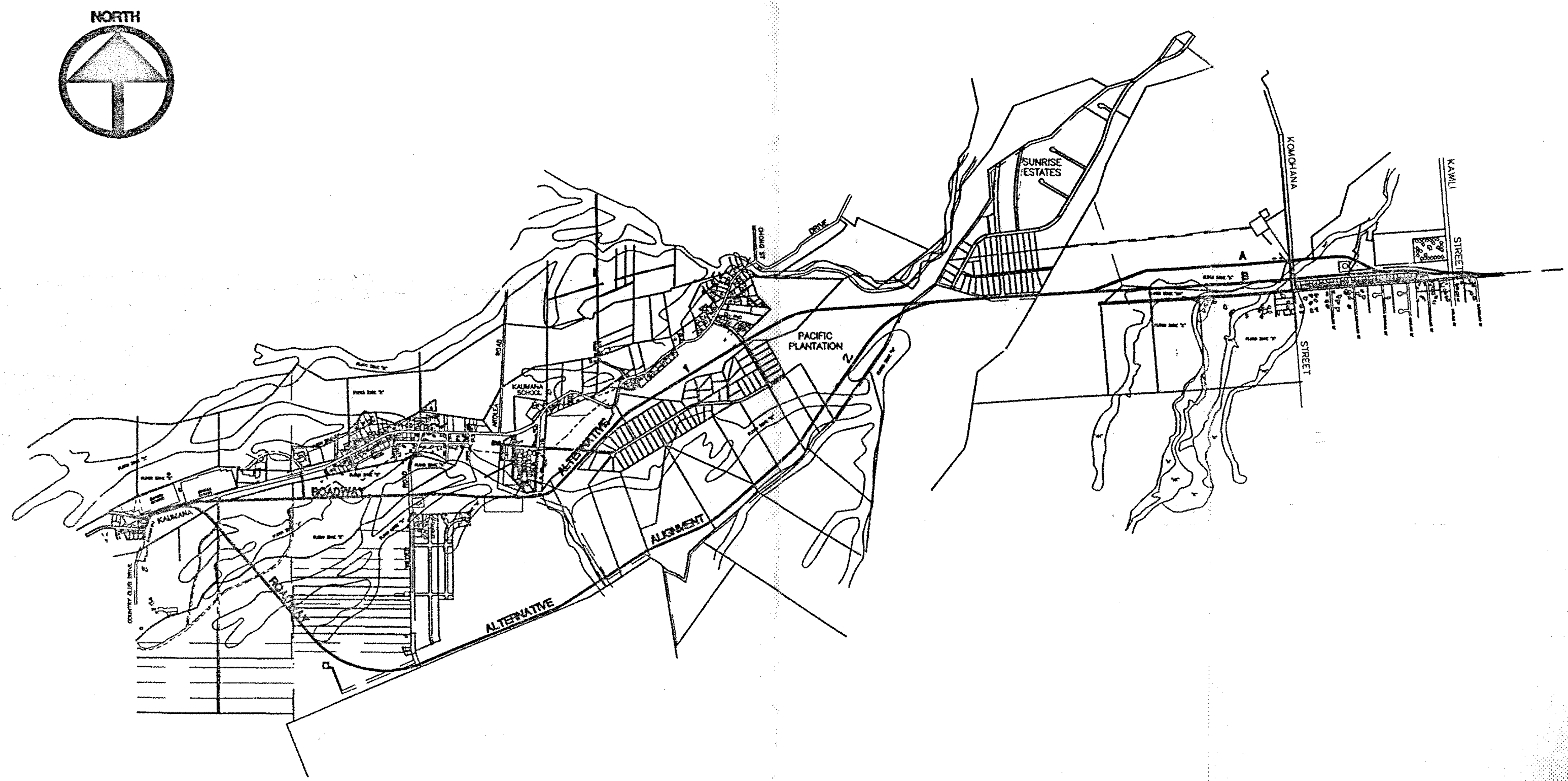
3. "Hawaii Administrative Rules", Department of Health, Chapters 11-55, sec. 34, as revised as of October 1992.

4. "County of Hawaii Ordinances Chapter 27", County of Hawaii, State of Hawaii.



TITLE **PROJECT LOCATION MAP** COUNTY OF HAWAII, STATE OF HAWAII	FIGURE **1**
PROJECT PUAINAKO STREET EXTENSION HILO, HAWAII	DATE 9/1/92

91003F2



TITLE **ALTERNATIVE ROADWAY ALIGNMENTS** COUNTRY CLUB DRIVE TO KOMOHANA STREET	FIGURE **2**
PROJECT PUAINAKO STREET EXTENSION HILO, HAWAII	DATE 9/1/92

SCALE: 1"=2000'

91003F3

HYDROLOGIC METHODOLOGY

RATIONAL METHOD

$Q = CIA$

Where:

Q = Peak runoff in c.f.s.
C = Coefficient of runoff -- depends on drainage characteristics of watershed area. Coefficient is dimensionless.
I = Average rainfall intensity for a storm duration causing the entire drainage area to contribute to Q; this duration equals Tc

Where:

Tc = Time of concentration in minutes; minimum tc = 5 min.
L = Length of Tc travel route in ft.
S = Slope of watershed area in ft. / ft.

1. Rainfall Intensities taken from "Technical Paper 43, Rainfall Atlas of the Hawaiian Islands"; U.S. Department of Commerce, Weather Bureau.

2. Runoff coefficients taken from Table 1, County of Hawaii D.P.W. "Storm Drainage Standards", dated October 1970.

3. Design storm frequency = 50 year recurrence interval.

4. Reference, Rational method; ASCE Manual of Practice #37.

5. Tc; Taken from Plate 5, County of Hawaii D.P.W. "Storm Drainage Standards", dated October, 1970.

SOIL CONSERVATION SERVICE (S.C.S. TR-55) METHOD

$$Q = \frac{(P\text{-}Ia)}{(P\text{-}Ia) + S}$$

Where:

Q = runoff (in.)
P = Rainfall (in.)
S = Potential Maximum retention after runoff begins (in.)
Ia = initial abstraction (in.)

$Ia = 0.2S$

$S = 1000/CN - 10$

Where: CN = Curve Number; dependent on soil characteristics and ground cover type.

Tc = Tc sheet flow + Tc shallow concentrated flow + Tc channel flow. (See, "Erosion and Sediment Control Guide for Urbanizing Area in Hawaii.",. Soil Conservation Service, for more detail discussion of methodology.)

Design storms calculated for 10, 50 and 100 year recurrence interval.

CULVERT HYDRAULIC DESIGN METHODOLOGY

DESIGN CRITERIA

1. Tm = 50 Years Design Storm Frequency of Return

2. 1.5D $\leq$ Hi $<$ Hmax
   A. Hi = Inlet Headwater
   B. D = Diameter of Culvert
   C. Hmax = Vertical Distance between invert of culvert and bottom of pavement subgrade.

3. Minimum Culvert Diameter (inside)
   Dmin. = 24"

4. Minimum Culvert Slope
   Smin. = 0.5%

5. Pipe Class
   Class III

6. Entrance Loss coefficient
   Ke = 0.50

7. Mannings coefficient of Roughness
   Concrete Pipe: N = 0.013

8. Assumed Tailwater
   Tw = Diameter of Pipe

9. Culvert Lengths
   Taken from Preliminary Sketch Plans

10. Minimum Velocity of Flow
    Vmin = 2-1/2 Ft./Sec.

11. Maximum Velocity of Flow at Culvert Outlet
    Vmax = 5 Ft./Sec.

    IF: $5 < V \leq 18$ Ft./Sec.

Channel at outlet of culvert will be lined.

IF: $V > 18$

Energy dissipators will be provided

12. Maximum Velocity of Flow in all Channels

    Unlined Channels Vmax = 5.0 Ft./Sec.

    Lined or Rock channels Vmax = 15 Ft./Sec.

13. Design Equations and Parameters

OUTLET CONTROL DESIGN EQUATIONS

D	=	Diameter of Culvert
Q	=	Q Total / Number of Culvert Barrels (CFS)
TW	=	Tailwater (Ft.)
dc	=	Critical Depth (see attached)
ho	=	Tw or $\frac{(dc + D)}{2}$ (Whichever is greater)
H	=	Headwater
H	=	[I + Ke + (29n^{2}L) / R$^{1.33]}$ V^2 / 2g
EL_{ho}	=	Elevation of Headwater Outlet Invert + H + ho

UNSUBMERGED [1]

Inlet control design equations.

$$\text{Form (1)} \quad \frac{HW_i}{D} = \frac{H_c}{D} + K\left[\frac{Q}{AD^{0.5}}\right]^M - 0.5S^{2} \qquad \text{(A)}$$

$$\text{Form (2)} \quad \frac{HW_i}{D} = K\left[\frac{Q}{AD^{0.5}}\right]^M \qquad \text{(B)}$$

SUBMERGED [3]

$$\frac{HW_i}{D} = c\left[\frac{Q}{AD^{0.5}}\right]^2 + Y - 0.5S^{2} \qquad \text{(C)}$$

Definitions

HW_i	Headwater depth above inlet control section invert, ft
D	Interior height of culvert barrel, ft
H_c	Specific head at critical depth ($d_c + V_c^2/2g$), ft
Q	Discharge, ft^3/s
A	Full cross sectional area of culvert barrel, ft^2
S	Culvert barrel slope, ft/ft
K,M,c,Y	Constants from table 9

NOTES: [1] Equations (A) and (B) (unsubmerged) apply up to about $Q/AD^{0.5} = 3.5$.
[2] For mitered inlets use +0.7S instead of -0.5S as the slope correction factor.
[3] Equation (C) (submerged) applies above about $Q/AD^{0.5} = 4.0$.

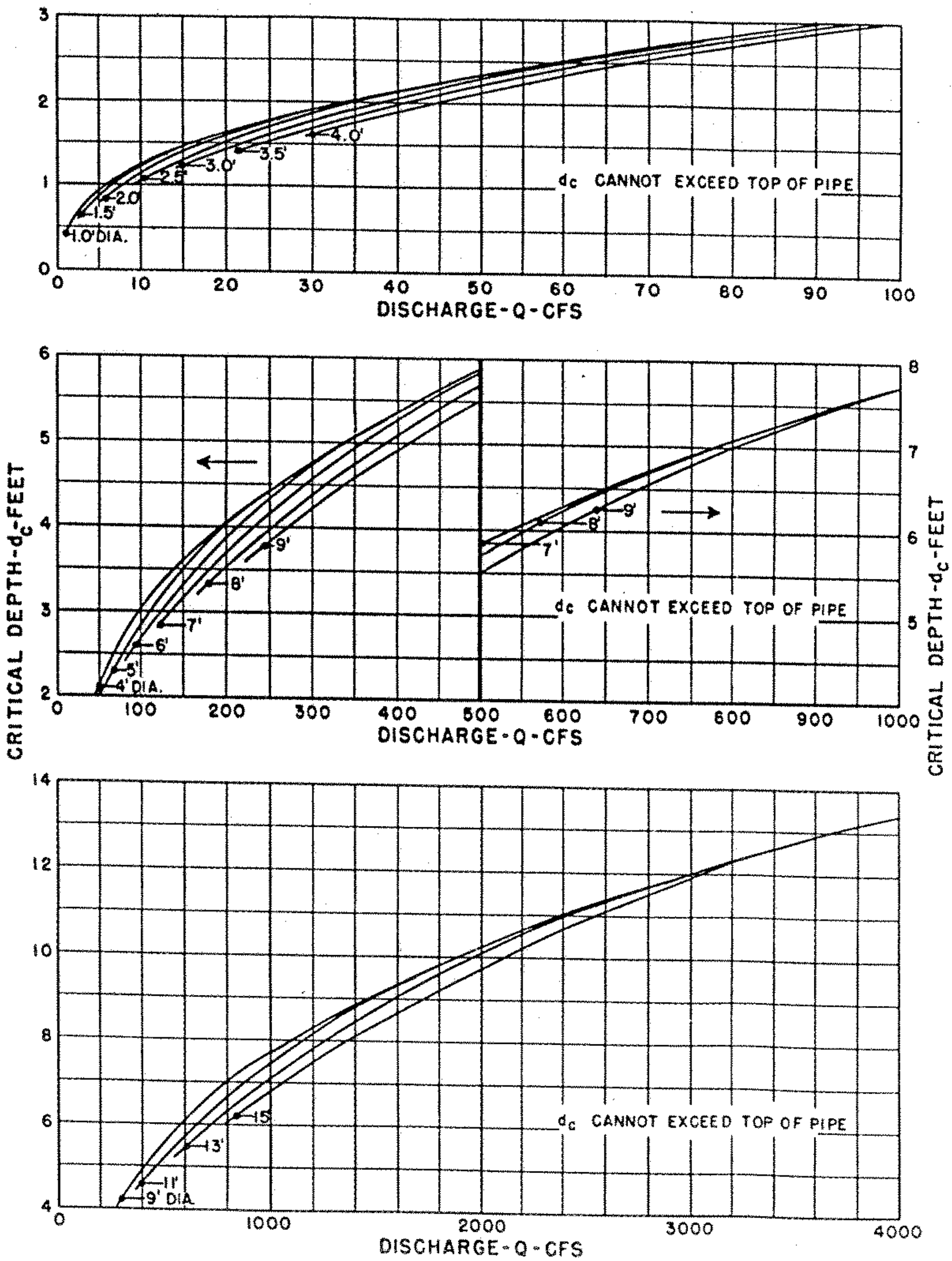
Taken from: "Hydraulic Design of Highway Culverts"
FHWA REPORT NO.: FHWA-IP-85-15
HYDRAULIC DESIGN SERIES NO. 5
September 1985

Table 9

Constants for inlet control design equations.

CHART NO.	SHAPE AND MATERIAL	NOMOGRAPH SCALE	INLET EDGE DES[illegible]TION	UNSUBMERGED EQUATION FORM	UNSUBMERGED K	UNSUBMERGED M	SUBMERGED c	SUBMERGED Y	References
1	Circular Concrete	1	Square edge w/headwall	1	0.0098	2.0	0.0398	0.67	(56) (57)
		2	Groove end w/headwall		.0078	2.0	.0292	.74	(56) (57)
		3	Groove end projecting		.0045	2.0	.0317	.69	(56) (57)
2	Circular CMP	1	Headwall	1	.0078	2.0	.0379	.69	(56) (57)
		2	Mitered to slope		.0210	1.33	.0463	.75	(57)
		3	Projecting		.0340	1.50	.0553	.54	(57)
3	Circular	A	Beveled ring, 45° bevels	1	.0018	2.50	.0300	.74	(57)
		B	Beveled ring, 33.7° bevels*		.0018	2.50	.0243	.83	(57)
8	Rectangular Box	1	30° to 75° wingwall flares	-	.026	1.0	.0385	.81	(56)
		2	90° and 15° wingwall flares	1	.061	0.75	.0400	.80	(56)
		3	0° wingwall flares		.061	0.75	.0423	.82	(8)
9	Rectangular Box	1	45° wingwall flare d=.0430	2	.510	.667	.0309	.80	(8)
		2	18° to 33.7° wingwall flare d=.0330		.486	.667	.0249	.83	(8)
10	Rectangular Box	1	90° headwall w/3/4" chamfers	2	.515	.667	.0375	.79	(8)
		2	90° headwall w/45° bevels		.495	.667	.0314	.82	(8)
		3	90° headwall w/33.7° bevels		.486	.667	.0252	.865	(8)
11	Rectangular Box	1	3/4" chamfers; 45° skewed headwall	2	.522	.667	.0402	.73	(8)
		2	3/4" chamfers; 30° skewed headwall		.533	.667	.0425	.705	(8)
		3	3/4" chamfers; 15° skewed headwall		.545	.667	.04505	.68	(8)
		4	45° bevels; 10°-45° skewed headwall		.498	.667	.0327	.75	(8)
12	Rectangular Box 3/4" chamfers	1	45° non-offset wingwall flares	2	.497	.667	.0339	.803	(8)
		2	18.4° non-offset wingwall flares		.493	.667	.0361	.806	(8)
		3	18.4° non-offset wingwall flares 30° skewed barrel		.495	.667	.0386	.71	(8)
13	Rectangular Box Top Bevels	1	45° wingwall flares - offset	2	.497	.667	.0302	.835	(8)
		2	33.7° wingwall flares - offset		.495	.667	.0252	.881	(8)
		3	18.4° wingwall flares - offset		.493	.667	.0227	.887	(8)
16-19	C M Boxes	1	90° headwall	1	.0083	2.0	.0379	.69	(57)
		2	Thick wall projecting		.0145	1.75	.0419	.64	(57)
		3	Thin wall projecting		.0340	1.5	.0496	.57	(57)

CHART 1



BUREAU OF PUBLIC ROADS

JAN. 1964

CRITICAL DEPTH
CIRCULAR PIPE

OVERALL ALIGNMENT HYDROLOGY

The present drainage pattern of the area the roadway alternative alignment #2 traverses is as follows. In the area between Country Club Drive and Wilder Road, rainfall which falls to the south & southwest of the alignment flows north / northeast overland through primarily old cane fields overgrown with dense grass and brush. This runoff eventually makes it's way in to one of the two existing streams that converge at Wilder Road and pass beneath Wilder Road through two existing 8' Diameter C.M.P. culverts. In the area between Wilder Road and Pacific Plantation Subdivision, rainfall which falls to the south & southwest of the alignment flows north / northeast overland through dense woodland areas and into undeveloped areas and eventually into the existing stream which flows to the east / southeast. Rainfall which falls to the north of the alignment flows overland through some residential areas but mainly undeveloped land to the stream which flows east / southeast.

In the area between Edita Street and Sunrise Ridge Subdivision, rainfall which falls to the north of the alignment flows overland through scrub and dense woods eastward where it eventually enters the Waipa-hoehoe Stream which flows to the northeast. Rainfall which falls to the south of the alignment flows northeast / east overland through dense woods where it eventually enters the existing flood control channel / Waiakea Stream which flows to the northeast and passes beneath the Komohana Street bridge.

It is proposed to construct a series of drainage structures along the alignment to allow the existing drainage patterns to remain with as little disturbance as possible due to the roadway construction. The proposed rainfall runoff quantities will be estimated using the Rational Method, as described herein. The proposed drainage structure will be sized as to allow the passage of runoff from a design storm with a 50- year or less return interval.

The proposed roadway alignment was delineated and the tributary drainage areas, to each required drainage structure or culvert, were determined, identified (19 total) and labeled "A" through "S". The corresponding quantity of runoff for each of the 19 subareas was calculated using the Rational Method and the structures sized accordingly.

The proposed roadway alignment was delineated and the tributary drainage areas, to each required drainage structure or culvert, were determined, identified (19 total) and labeled "A" through "S". The corresponding quantity of runoff for each of the 19 subareas was calculated using the Rational Method, or Soil Conservation Service method, and the structures sized accordingly. The sub basins A through L drain via intermittent stream into an isolated flood plane located on the tracts of Land Kukuau 1 and Kukuau 2. The runoff waters are believed to flow down to the low point within this flood plane, located about 2,500 ft. east northeast of the existing Edita St. cul-de-sac / intersection. Whether the flow leaves this flood plane through subsurface caverns or spills over and flows down gradient overland has yet to be determined (see attached map entitled "Approximate Limits 100 Yr. Flood Zone, Puainako St. Extension, Hilo, Hawaii". Sub basins M and N are believed to drain overland into the Alenaio (Waipahoehoe) Stream and eventually into the Waiakea Stream Tributary No. 3 and Waiakea Stream, and eventually into Waiakea Pond. Sub basins O through S are believed to flow overland into the Waiakea Stream Tributary No. 3 and Waiakea Stream, and eventually into Waiakea Pond. Due to the fact that only preliminary designs were required, no effort was made to design minor roadside ditches, and preliminary drainage construction cost estimates do not include these potential construction costs.

In addition to the preliminary design of the proposed roadway culverts, the existing 8′ diameter C.M.P. and the 5′ diameter R.C.P. culverts along Wilder Road were checked for adequate capacity to ensure proper drainage of the proposed roadway.

CALCULATIONS NOT INCLUDED DUE TO LENGTH,
HOWEVER A COPY OF THE CALCULATIONS ARE
AVAILABLE FOR REVIEW AT THE OFFICE OF:

OKAHARA & ASSOCIATES, INC.
200 KOHOLA STREET
HILO HAWAII 96720
PHONE: 961-5527

CONCLUSIONS / RECOMMENDATIONS

In order to insure proper drainage of the area within the vicinity of the proposed roadway alignment, it is recommended the proposed drainage structures as designed within and as shown on the enclosed hydrologic plans, be provided as a minimum effort. In the final design stage it is recommended that the drainage study include a preconstruction hydrologic study and a post construction study. If the study indicates any increase in runoff, it is recommended a series of drainage structures be designed to temporarily store or percolate into the ground any increase in rainfall runoff. The design of these structures is not included as part of this study due to the fact that the design of these structures requires detailed topographic information which is not yet available. The structures might include drywells, detention ponds, retention ponds and percolation ponds.

As the design progresses and more data becomes available it will be necessary to revise these calculations and recommendations to incorporate more precise data.

It is also recommended that a detailed flood study be conducted in the areas of any flood hazard zone crossings. A flood zone determination and study is necessary to locate the actual limits of flood plane and determine the expected flood water elevations. This information would then be incorporated into the design of the flood plane crossing to determine the best design, and at the same time used to evaluate upstream areas for potential flood damages. Flood plane management strategies would include sizing culverts at the crossings to allow the passage of the 100 year design storm and to prevent any increase in flood water elevation or limits of inundation. This would also include replicating flood storage volumes in areas where the flood plane is proposed to be filled. This would insure that the existing flood storage volume, within the project limits, would be maintained.

During the construction grading and earthwork, provisions should be made to minimize the potential for soil erosion, and measures taken to minimize the amount of sediment that leaves the construction limits. Soil erosion and sediment control standard management practices, as described in the "Erosion and Sediment Control Guide for Hawaii", prepared by the Soil Conservation Society of America, Hawaii Chapter, dated March 1981, could be implemented. These management measures would include:

1. Timing construction activities, such as grading or the installation of culverts, during periods of minimum rainfall.

2. Limiting the amount of surface area graded at any given time to reduce the area subject to potential erosion.

3. Constructing temporary drainage ditches to divert runoff away from areas susceptible to soil erosion.

4. Implementing the use of soil erosion protective materials, such as mulch or geotextiles, on areas where soils have a high potential for erosion, until permanent provisions, such as lawns and grasses can be developed. Lawns and grassing should be installed as soon as grading operations permit, to minimize the amount of time soils are exposed to possible erosion.

5. Sediment management could include the use of sedimentation basins to collect sediment which enters runoff waters. Geotextiles such as siltation fencing could be utilized to minimize the amount of sediments which would leave the site to collect in drainage structures and natural drainage paths.

The final design and recommendations should conform to the following design standards where they are determined applicable:

1. "Storm Drainage Standards", Department of Public Works, County of Hawaii, State of Hawaii, dated October 1970.

2. "Erosion and Sediment Control, Guide for Hawaii", U.S.D.A. Soil Conservation Service, in cooperation with the Hawaii Association of Soil and Water Conservation Districts, and the Soil Conservation Society of America, Hawaii Chapter, dated March 1981.

3. "Hawaii Administrative Rules", Department of Health, Chapters 11-55, sec. 34, as revised as of October 1992.

4. "County of Hawaii Ordinances Chapter 27", County of Hawaii, State of Hawaii.

Both alternative roadway alignments 1 & 2 cross a number of intermittent streams and F.I.R.M. flood hazard zones. Alternative 1 makes a large flood zone crossing southeast of Kilua Rd. This is at a point where a large number of the streams and isolated flood ways converge. The roadway culvert at this point would need to be designed to pass the combined flows of each of the flood ways which converge at this point. It is expected, crossing at this point, a very large culvert or even a bridge structure would be required to pass the design year flow. Alignment 1 also crosses four more independent flood ways in the vicinity of Wilder Rd. These crossings are the tributary streams and flood ways to the previously mentioned crossing. Since these crossings are up gradient and crossings would be made independently, the flows for which the culverts are designed are expected to be much smaller. Alternative roadway alignment 2 crosses a F.I.R.M. flood hazard zone to the southeast of Pacific Plantation subdivision. Of all the alternative roadway alignments studied, this crossing was the one located at the lowest elevation within the isolated flood plain of Kukuau. This point is the furthest down gradient of any other crossings and is expected to have the largest storm runoff flow rate. It is expected for a crossing at this point, a very large culvert or even a bridge structure would be required to pass the design year storm flow. Alignment 2 makes four additional flood zone crossings, one to the east of Wilder Rd. and three to the southeast of Country Club Dr. The three crossings to the southeast of Country Club Dr. are located at the highest elevations of any proposed crossings. Since these points are the farthest up-gradient, these crossings are expected to have the smallest flows of any proposed crossings. The culverts required to pass the flows at these crossings would be expected to be the smallest, and in turn the least expensive. It is expected, alignment #2 would require a large concrete channel be constructed to the south of Wilder Road to intercept offsite runoff and prevent runoff from crossing the roadway. This channel adds a high additional cost to alignment #2.

In general, the two alternative alignments would require about the same number of flood zone crossings. It is the magnitude of the larger crossing that each of the proposed alignments makes which sets the two alternatives apart from a hydrologic standpoint. Alignment 1's crossing is to the southeast of Kilua Rd. and alignment 2's crossing is to the east of Pacific Plantation subdivision. It is expected the crossing for alignment 2 would be far more expensive to construct than the crossing for alignment 1 southeast of Kilua Rd. Alignment 2 also has a high cost associated with the required concrete channel south of Wilder Road. It is therefore recommended, from a hydraulic/hydrologic and an economical standpoint, that alternative 1 be chosen as the preferred alignment. (See attached cost estimate).

DRAINAGE COST SUMMARY

ROADWAY CULVERTS

Culvert I.D.	Q'ty	Size	Cost	Sub Total	Total
1	1	30" dia. R.C.P. L = 75	10,620.00		
2	3	72" dia. R.C.P. L = 75	57,405.00		
3	1	48" dia. R.C.P. L = 75	12,403.00		
4	3	137" X 87" R.C. ARCH L = 75	154,000.00		
5	1	36" dia R.C.P. L=75	10,861.00		
6	4	84"dia. R.C.P. L = 75	84,540.00		
7	1	42" dia R.C.P. L=75	11,668.00		
8	1	30" dia. R.C.P. L = 75'	9,120.00		
9		BRIDGE L = 75'±	562,500.00		
10	1	60" dia. R.C.P. L = 75	15,178.00		
11	1	27" dia. R.C.P. L = 75	7,241.00		
12	1	24" dia. R.C.P. L = 250	11,676.00		
13	1	24" dia. R.C.P. L = 75	6,863.00		
14	1	24" dia. R.C.P. L = 75	6,863.00		
15	1	24" dia. R.C.P. L = 75	6,863.00		
16	1	24" dia. R.C.P. L = 75	6,863.00		
17	1	27" dia. R.C.P. L =75	7,241.00		
SUB TOTAL				$981,904.00	
SAY				$982,000.00	

MAJOR ROADSIDE CHANNELS

Location	Size	Cost	Subtotal	
STA. 52+00 --> 68+00	10'x6.5' _/	731,850.00		
STA. 68+00 --> 100+00	20'x8' |_|	1,848,890.00		
STA. 145+00 --> 180+00	TO BE DETERMINED	725,000		
SUBTOTAL			$3,305,740.00	

DRYWELLS

Description	Q'ty	Cost	Subtotal	
Drywells	115	8,000.00	920,000.00	
TOTAL				$5,207,704.00
SAY				$5,208,000.00

Appendix G

TRAFFIC REPORT

FOR THE PROPOSED

PUAINAKO STREET EXTENSION

by

Traffic Management Consultant
Randall S. Okaneku, P.E., Principal
1188 Bishop Street, Suite 1907
Honolulu, Hawaii 96813

September 2, 1992

TECHNICAL REPORT
FOR THE PROPOSED
PUAINAKO STREET EXTENSION

I. INTRODUCTION

A. Purpose and Scope

The purpose of this technical report is to present the preliminary findings of the work in progress, relative to the traffic study for the Puainako Street Extension. The scope of this study includes:

1. Description of the proposed project.
2. Description of the study area.
3. Evaluation of existing roads.
4. Analysis of existing peak hour traffic conditions.
5. Discussion of State Department of Transportation long range travel forecast.

B. Background

The "Island of Hawaii Long Range Highway Plan" (IHLRHP), May 1991, was prepared for the State Department of Transportation (DOT) and County of Hawaii Departments of Public Works and Planning, in cooperation with the U.S. Department of Transportation, Federal Highways Administration. The purpose of the study was to identify major highway corridors that would require roadway improvements to accommodate traffic demands projected for the Year 2010. The widening of Puainako Street, between Kilauea Street and Komohana Street, and the extension of Puainako Street, from Komohana Street to Kaumana Drive are ranked Nos. 17 and 19 on Tier 1 of the priority listing.

C. Project Description

The proposed project is located in South Hilo, Hawaii. The proposed road improvement consists of three components: the widening of the existing Puainako Street between Kilauea Street and Anela Street; and the realignment of Puainako Street between Anela Street and Komohana Street, north of its existing alignment; and the extension of Puainako Street from Komohana Street to Kaumana Drive, near Country Club Road. Figures 1 and 2 shows the proposed project alternative alignments.

II. EXISTING CONDITIONS

A. Study Area

The study area is situated along the existing and proposed alignment of Puainako Street and on Kaumana Drive. The land uses along Puainako Street are primarily residential with numerous driveways accessing directly onto Puainako Street. A concentration of commercial activities is located at the east end of Puainako Street, including the Prince Kuhio Plaza. Another significant land use activity, relative to traffic, is the Waiakea Intermediate and Elementary Schools, located on the north side of Puainako Street between Anela Street and Kinoole Street.

B. Area Roadway System

Puainako Street is a two lane, two way collector street between Kilauea Avenue and Komohana Street, running in the east-west directions. Between Kilauea Avenue and Kanoelehua Avenue, Puainako Street is a four lane, two way roadway. Sight distances are restricted on sections of Puainako Street, because of the rolling vertical alignment. Puainako Street is signalized at its intersections with Kanoelehua Avenue, Kilauea Street, Kinoole Street, and Iwalani/Kawili Street; and is stop-controlled at Komohana Street.

Kanoelehua Avenue is the primary arterial highway in the project vicinity. Kanoelehua Avenue is a four lane divided highway, and is fully channelized at its intersection with Puainako Street. Kanoelehua Avenue is the continuation of Mamalahoa Highway, the island's "belt" highway.

2A

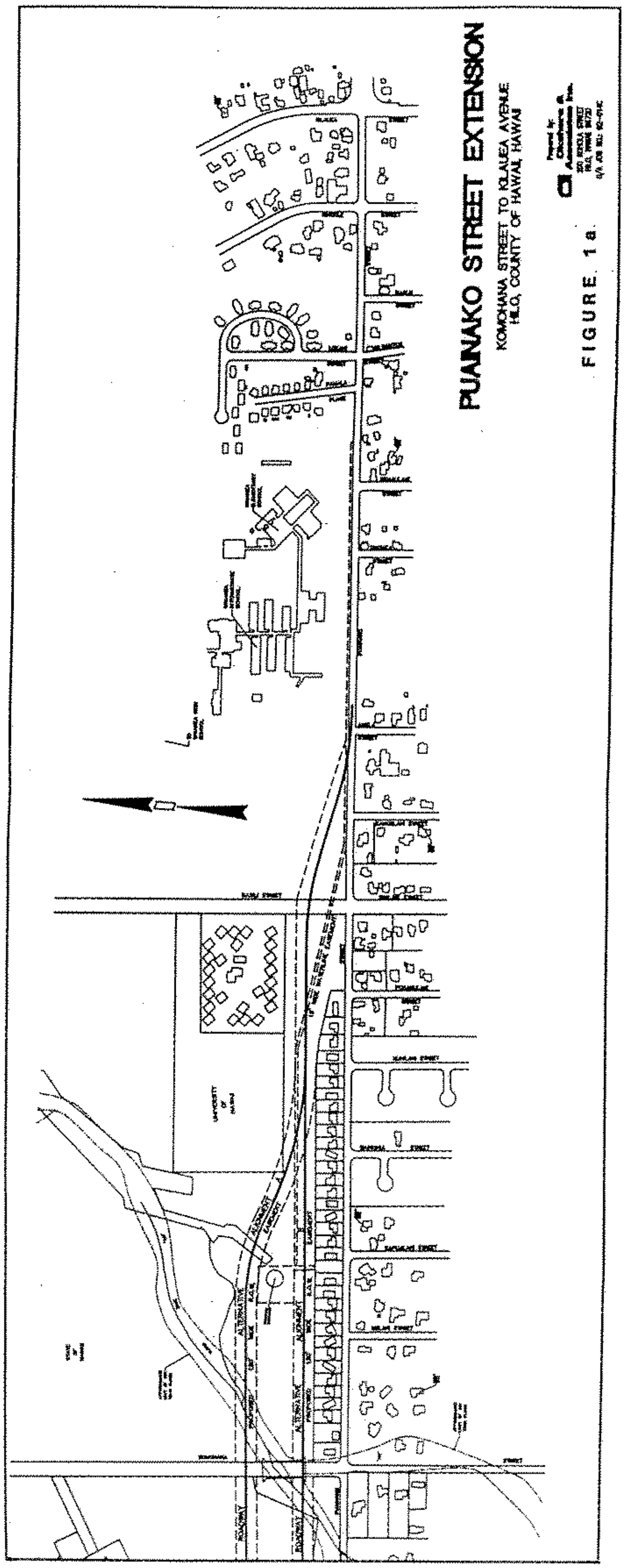


Figure 1 - Puainako Street Widening and Realignment

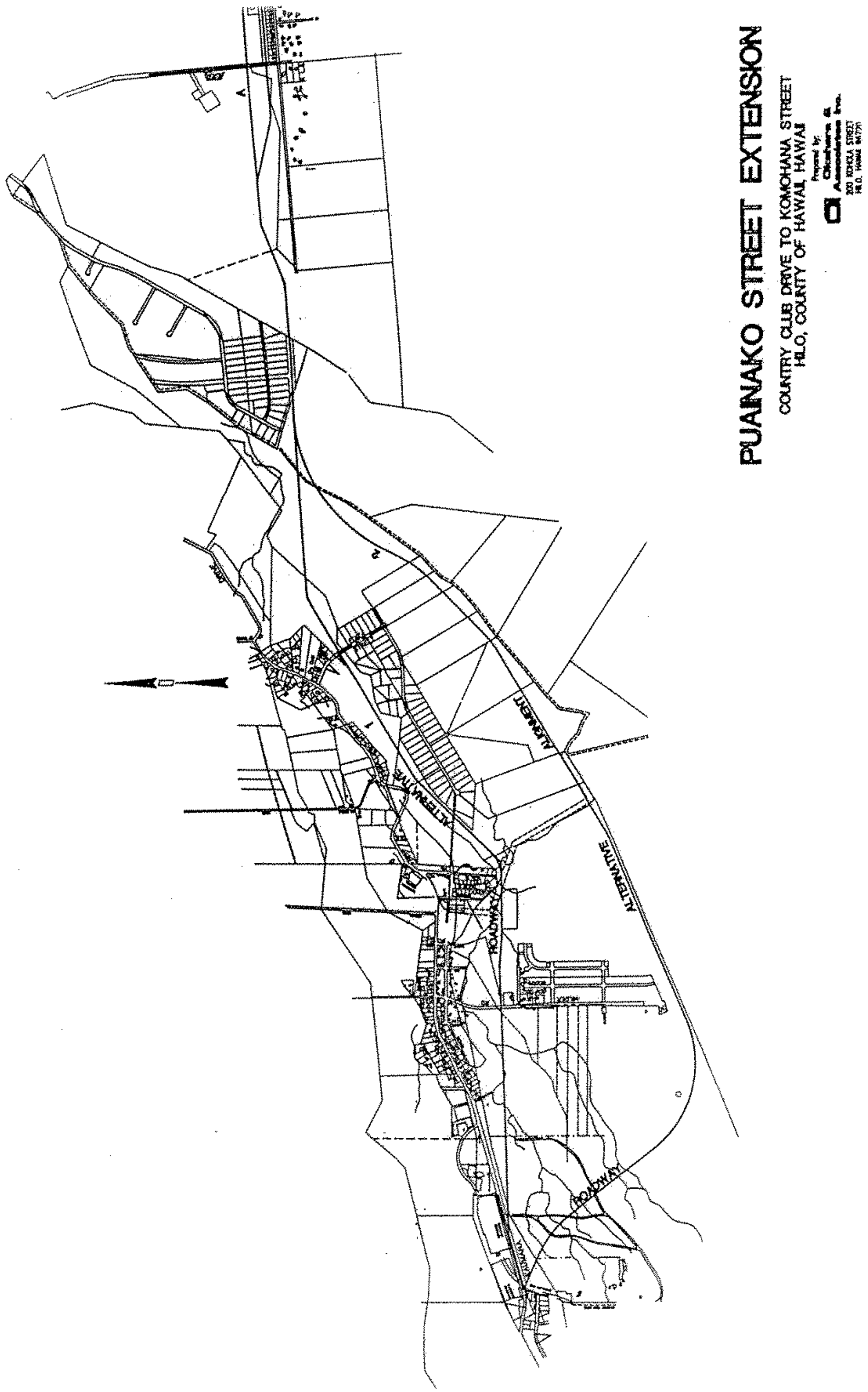


Figure 2 - Puainako Street Extension

Kaumana Drive is a two lane, two way roadway with a curvilinear horizontal alignment and rolling vertical alignment. Kaumana Drive the continuation of Saddle Road, which connects East and West Hawaii. At the makai end, Kaumana Drive connects to Waianuenue Avenue, which passes Hilo High School and terminates at the Hilo Bayfront Highway.

The traffic circulation system in the project vicinity is a grid network comprised of major east-west streets such as Puainako Street, Kawailani Street, and Haihai Street; and major north-south streets such as Komohana Street, Iwalani/Kawili Street, Kinoole Street, and Kilauea Street. Several north-south local roads connect Puainako Street and Kawailani Street to the south, such as Anela Street.

C. Traffic Volumes and Operating Conditions

1. General

a. Traffic Count Data Collection

The field investigation was conducted in May and June 1992, while school was in session. Manual traffic count surveys were conducted from 6:30 AM to 8:30 AM and from 4:00 PM to 6:00 PM at the following intersections:

i. Puainako Street and Kanoelehua Avenue

ii. Puainako Street and Kilauea Street

iii. Puainako Street and Kinoole Street

iv. Puainako Street at Anela Street (AM peak hour only)

v. Puainako Street at Waiakea Intermediate School Driveways (AM peak hour only)

vi. Puainako Street at Waiakea Elementary School Driveways (AM peak hour only)

vii. Puainako Street and Iwalani/Kawili Streets

viii. Puainako Street and Komohana Street

ix. Kaumana Drive and Kilua Street

x. Kaumana Drive and Kaumana Elementary School Driveways

Additional traffic data were obtained from the State DOT. Table 1 shows the State DOT 1992 24-hour and peak hour traffic volumes. (Note: State DOT traffic count survey was conducted in late June, when school was out of session.)

Table 1. State DOT 1992 Traffic Survey Data

Roadway Section	24-Hour Volumes	AM Peak Hour Volumes	PM Peak Hour Volumes
Puainako Street W of Kanoelehua Avenue	20,456	1,114	1,661
Puainako Street E of Kilauea Street	18,535	1,130	1,513
Puainako Street Between Kilauea St and Kinoole St	14,266	814	1,302
Puainako Street W of Kinoole Street	8,650	590	728
Puainako Street E of Iwalani/Kawili Streets	7,133	449	591
Puainako Street W of Iwalani/Kawili Streets	8,812	709	912
Puainako Street E of Komohana Street	6,489	542	507

b. Capacity Analysis Methodology

The highway capacity analysis performed for this study is based upon procedures presented in the "Highway Capacity Manual" (HCM), Special Report 209, Transportation Research Board, 1985 and the "Highway Capacity Software", Federal Highways Administration.

Level of Service (LOS) is "defined as a qualitative measure describing operational conditions within a traffic stream". A number of factors are included in determining LOS such as: speed, delay, vehicle density, freedom to manuever, traffic interruptions, driver comfort, and safety. LOS "A", "B", and "C" are considered satisfactory levels of service. LOS "D" is generally considered a "desirable minimum" operating level of service. LOS "E" is an undesirable condition and LOS "F" is an unacceptable condition.

"Volume-to-capacity" (v/c) ratio is another measure indicating the relative traffic demand to the road's traffic carrying ability. A v/c ratio of 0.50 indicates that the traffic demand is utilizing 50% of the roadway's capacity.

Another level of analysis, relating traffic volumes to intersection capacity, is presented in the HCM as the "planning analysis" method. Three categories are used: "under capacity", "near capacity", and "over capacity". Under capacity conditions indicate that the critical traffic volumes would virtually always be below the intersection's capacity. Over capacity conditions indicate that the intersection capacity will be exceeded in most cases and the intersection would require geometric improvements. Near capacity conditions requires engineering judgment as to whether or not intersection improvements would be required, especially when critical traffic volumes approach over capacity conditions. The purpose of this analysis is to determine the adequacy of intersection geometrics, i.e., number of through and turning lanes required, under given traffic demands. The planning method is a broad measure of traffic operations at an intersection, where the details of the traffic signal design and operation, intersection geometrics and vehicle type distribution of traffic are not available.

2. AM Peak Hour Traffic Analysis

The AM peak hour of traffic generally occurs between 7:00 AM and 8:00 AM. The intersection of Puainako Street and Iwalani/Kawili Street operates at over capacity conditions during the AM peak hour. The mauka bound approach of Puainako Street at Komohana Street operates at LOS "F". The makai bound approach operates at LOS "D". Figure 3 shows the existing AM peak hour volumes and results of the capacity analysis at the major intersections on Puainako Street.

Puainako Street, between Kinoole Street and Iwalani/Kawili Street, is congested during the AM peak hour, resulting in poor operations on the side streets and access driveways. Anela Street operates at LOS "D". The left turn movements from the Waiakea Elementary and Intermediate Schools exit driveways both operate at LOS "E". Vehicles on the east bound Puainako Street turn left to the school entrance driveways from the through traffic lane. This results in queuing on Puainako Street, and occasionally results in "grid-lock" conditions. This occurs when vehicles turning left to the school driveways queues the east bound traffic back to next exit driveway, blocking exiting vehicles turning left from the school driveways to east bound Puainako Street. The other intersections in the study area operate satisfactorily. Figure 4 shows the AM peak hour traffic volumes on Puainako Street, fronting the Waiakea Elementary and Intermediate Schools.

Kaumana Drive operates at LOS "D" during the AM peak hour. Side streets and driveways operate satisfactorily. Figure 5 shows the AM peak hour traffic volumes and results of the capacity analysis on Kaumana Drive.

3. PM Peak Hour Traffic Analysis

The PM peak hour generally occurs between 4:15 PM and 5:15 PM. The intersection of Kanoelehua Avenue and Puainako Street operates at near capacity conditions during the PM peak hour. The intersection of Puainako Street and Kinoole Street also operates at near capacity conditions. The mauka bound approach of Puainako Street at Komohana Street operates at LOS "E". The makai bound approach operates at LOS "D" during the PM peak hour. The other intersections in the study area operate satisfactorily. Figure 6 shows the existing PM peak hour volumes and results of the capacity analysis at the major intersections on Puainako Street.

Kaumana Drive operates at LOS "D" during the PM peak hour. Side streets and driveways operate satisfactorily. Figure 7 shows the PM peak hour traffic volumes and results of the capacity analysis on Kaumana Drive.

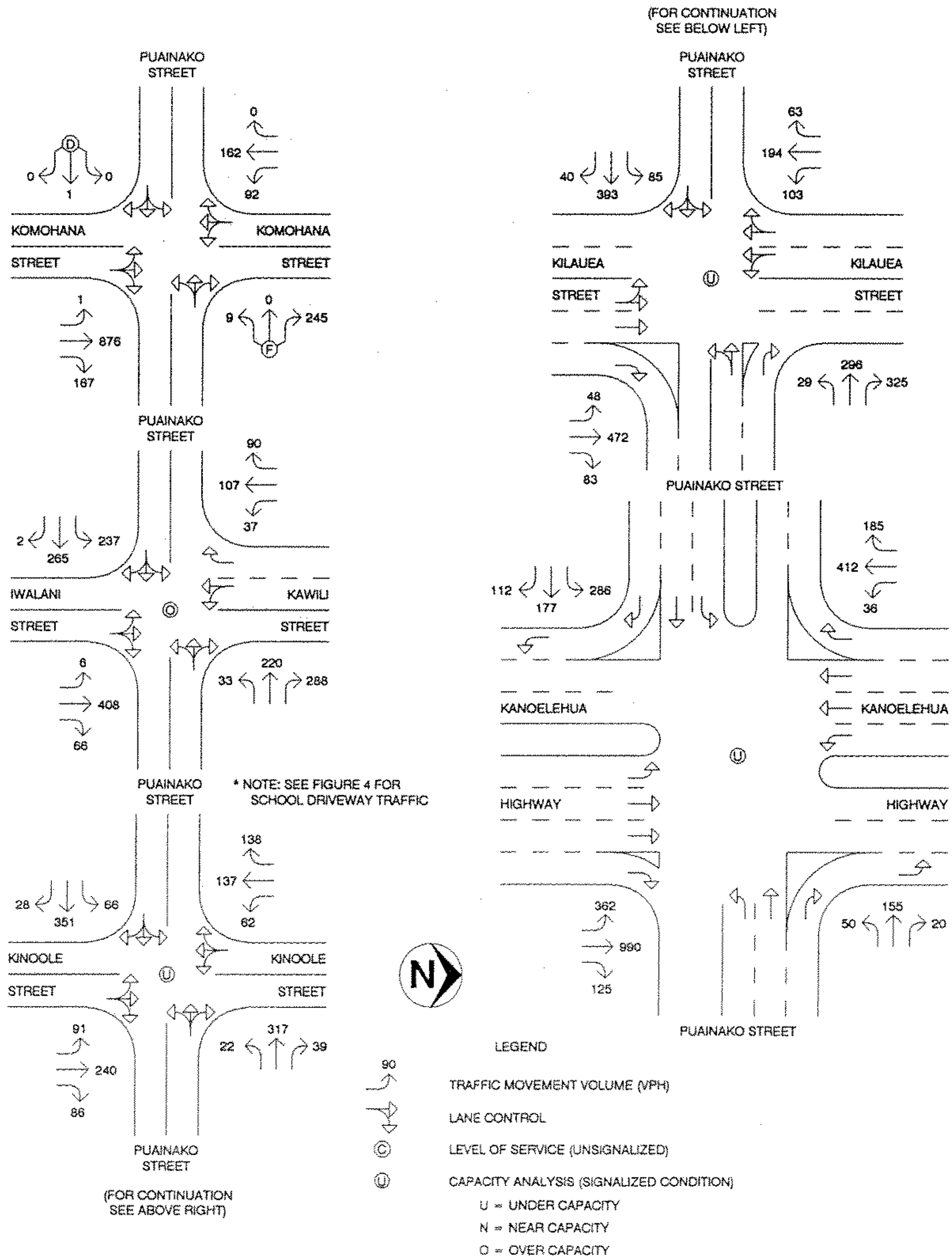


Figure 3 - Existing AM Peak Hour Traffic - Puainako St

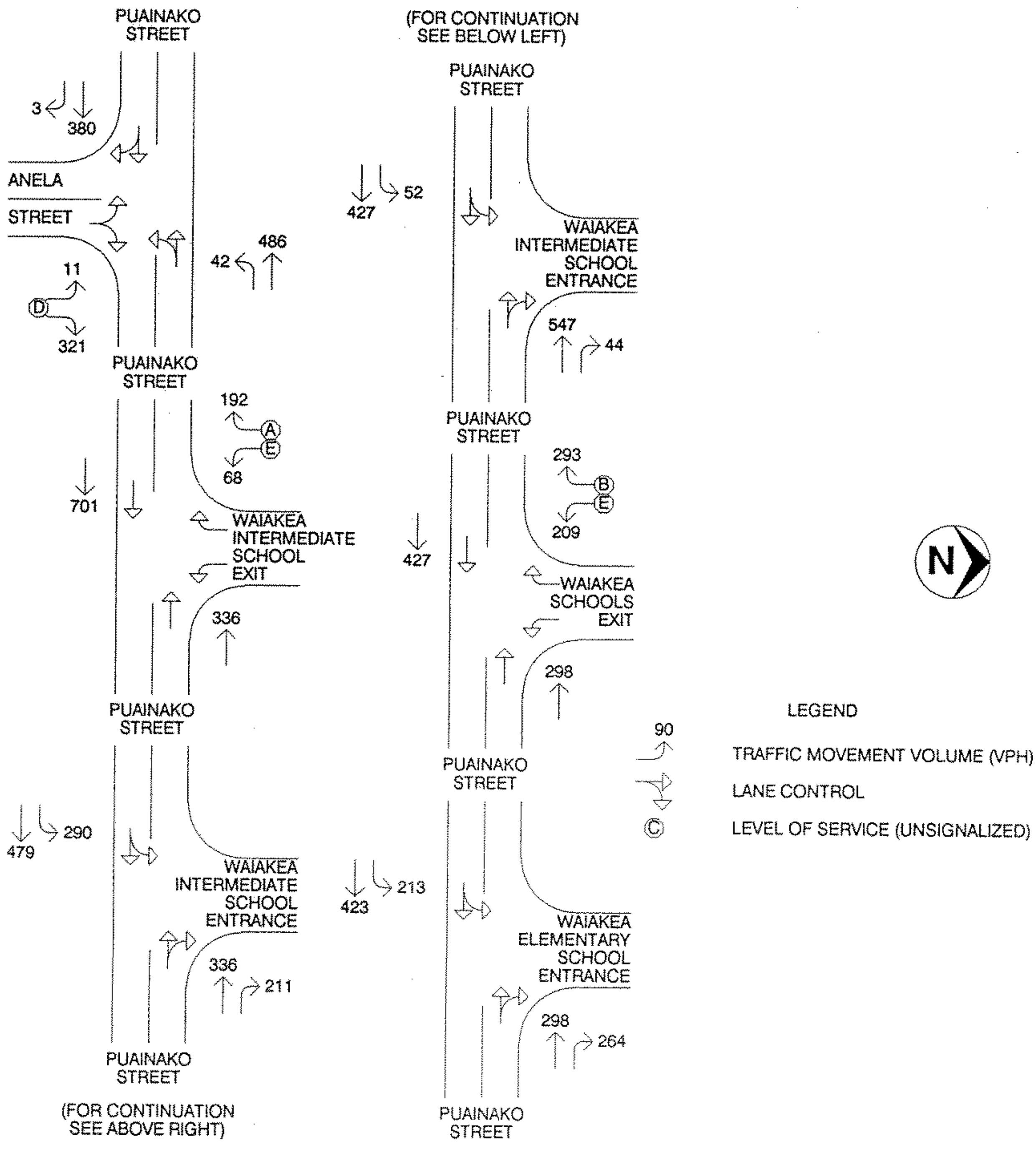
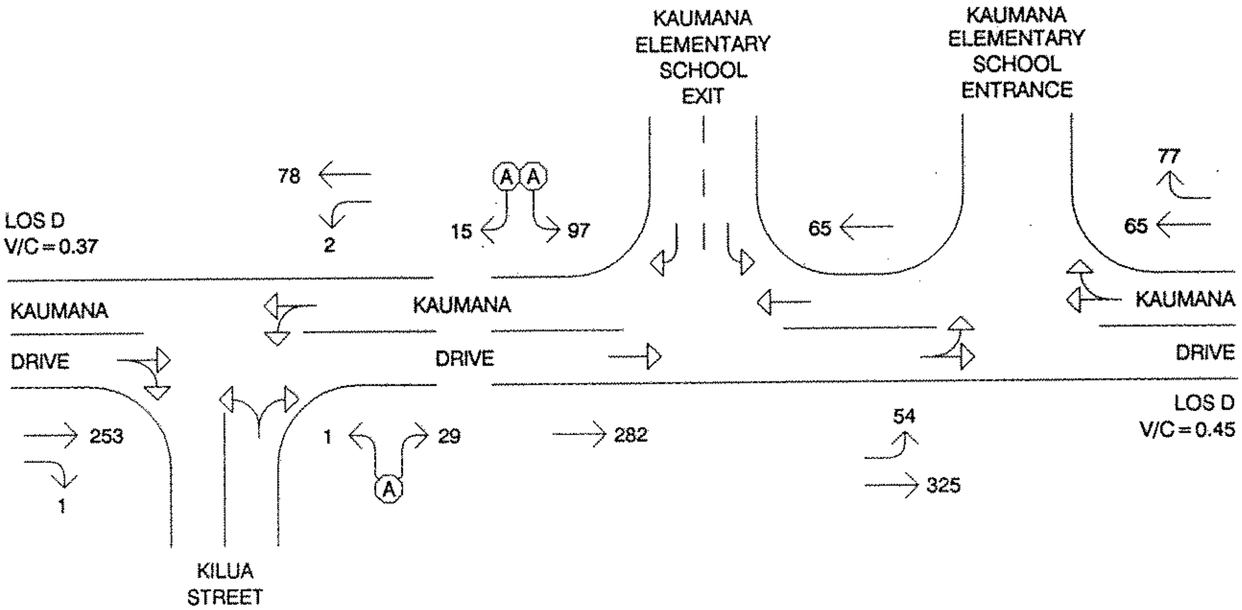
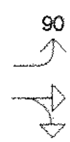


Figure 4 - Existing AM Peak Hour - Waiakea Schools Access





LEGEND

90	TRAFFIC MOVEMENT VOLUME (VPH)
	LANE CONTROL
C	LEVEL OF SERVICE (UNSIGNALIZED)
LOS	LEVEL OF SERVICE (TWO LANE HIGHWAY)
V/C	VOLUME-TO-CAPACITY RATIO (TWO LANE HIGHWAY)

Figure 5 - Existing AM Peak Hour Traffic - Kaumana Drive

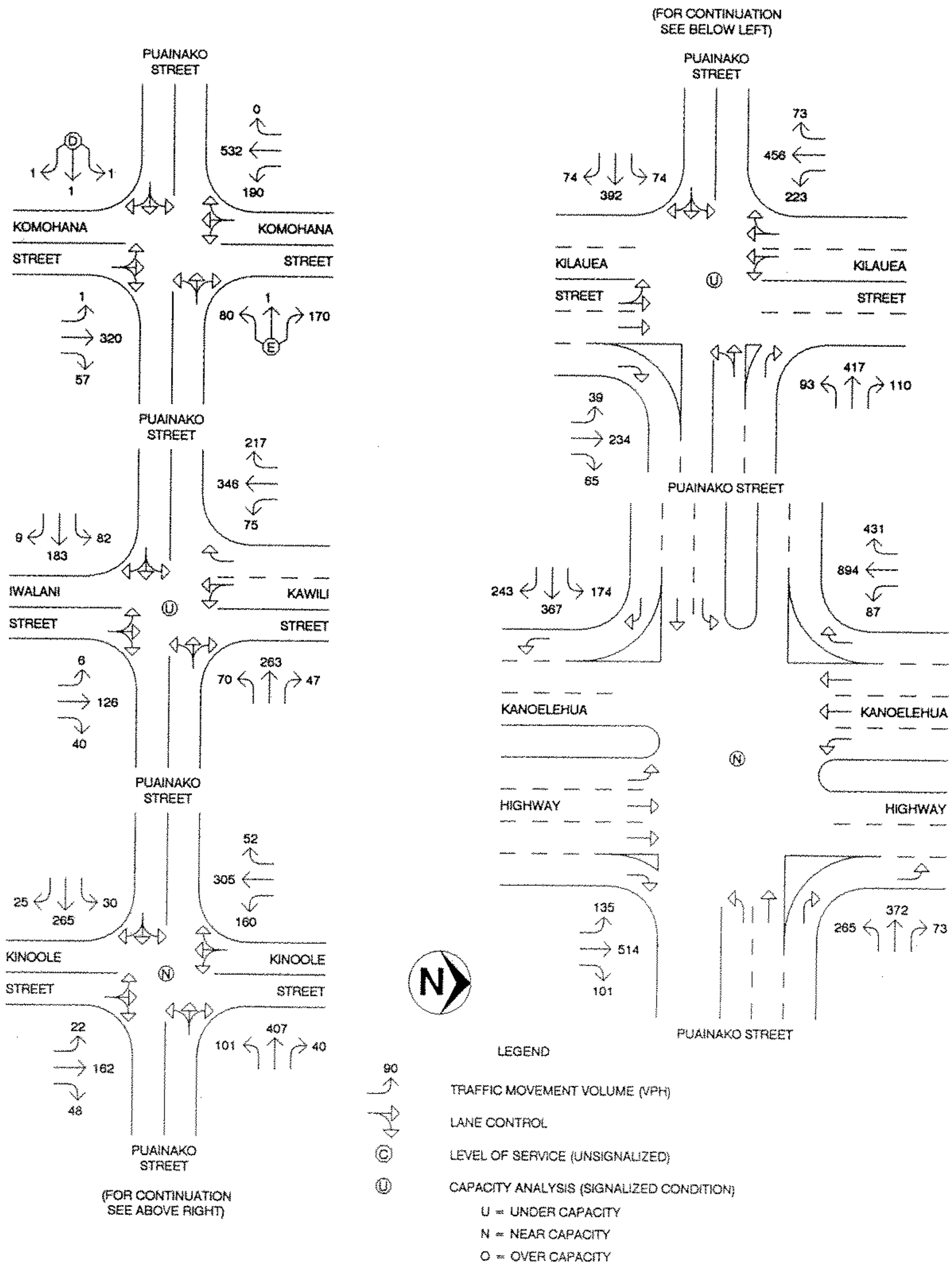
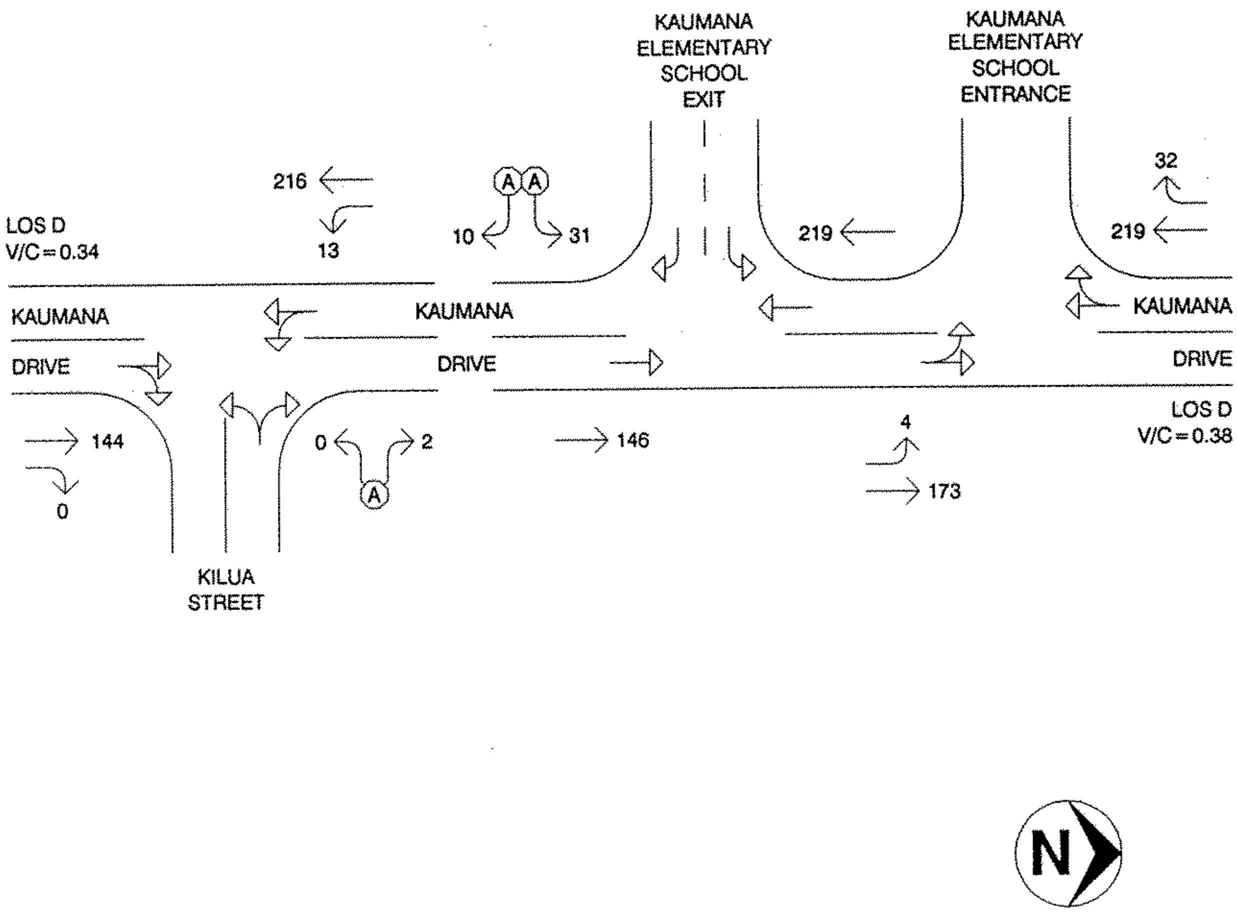


Figure 6 - Existing PM Peak Hour Traffic - Puainako St



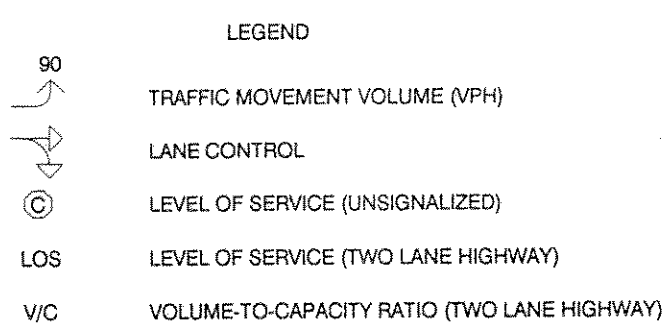


Figure 7 - Existing PM Peak Hour Traffic - Kaumana Drive

III. PROJECTED TRAFFIC

A. Long Range Travel Forecast

The State DOT travel forecast, presented in IHLRHP, is based upon the existing road network and proposed improvements to Saddle Road as well as Puainako Extension. The IHLRHP also proposes the extension of Kawailani Street, which would intersect with the Puainako Street Extension and terminate at Kaumana Drive, makai of the Puainako Street junction.

The improved network would improve access by reducing travel distances and travel times, which would result in inducing travel between East and West Hawaii. Table 2 shows the existing (1992) and projected average daily traffic (ADT) for Puainako Street and Kaumana Drive.

Table 2. State DOT Traffic Forecasts

Puainako Street Section	1992 ADT	2010 ADT Without Improvements	2010 ADT With Improvements
From Kanoelehua Avenue To Kilauea Street	20,456	27,300	29,800
From Kilauea Street To Kinoole Street	14,266	15,400	23,500
From Kinoole Street To Komohana Street	6,489-8,812	11,100	19,500
From Komohana Street To Kawailani Street Extension	---	---	23,400
From Kawailani Street Extension To Saddle Road (Kaulana Drive)	---	---	8,600

IV. FINDINGS

The proposed Puainako Street Extension, combined with the future improvement of Saddle Road is expected to encourage travel between East and West ~~Maui~~ Hawaii. The IHLRHP estimates an increase of 8,000 trips per day on the improved Saddle Road. Puainako Street is expected to experience a similar increase of about 8,000 trips per day as a result of the proposed road extension. The proposed Puainako Street Extension is expected to accommodate the increase in traffic to the Year 2010. There are two areas of concern on the existing Puainako Street. The first being between Kinoole Street and Anela Street, and the second being the proximity of Kilauea Street and Kinoole Street intersections.

The school access points on north side of Puainako Street, between Kinoole Street and Anela Street, coupled with the numerous driveways on the south side of Puainako Street, would restrict the effectiveness of improved Puainako Street. The proposed road widening would include a raised median, which would restrict road side access to right-turn-in and right-turn-out only. Median openings would be provided, at proper spacings, to allow U-turns. Motorists, desiring to turn left from driveways and minor streets, would instead turn right then make a U-turn at the nearest median opening. The existing grid network also provides the motorist with option to select alternate routes. The restricted access on Puainako Street at local street intersections would discourage the use of local roads by through traffic, and thereby reduce the traffic volumes on the local residential streets.

The intersection spacing on Puainako Street, between Kilauea Street and Kinoole Street, limits the vehicle storage between the two intersections. Separate turning lanes may be required to minimize the queuing between the Kilauea Street and Kinoole Street intersections on Puainako Street. Traffic signal coordination, between the Kilauea Street and Kinoole Street intersections, would mitigate the queuing, however it may restrict the through capacity on Puainako Street.

Appendix H

PUAINAKO STREET EXTENSION

SOCIAL IMPACT ASSESSMENT

STUDY REPORT

Prepared by

Alton M. Okinaka
University of Hawaii at Hilo

November 2, 1992

PUAINAKO STREET EXTENSION SOCIAL IMPACT STATEMENT

To investigate the likely social impact of the Puainako Street Extension we conducted a study. This involved four subsections of data collection from populations likely to be affected by the proposed project. The four sections included the residents of upper Kaumana, residents of Waiakea Homestead and Waiakea Uka, parents of students attending Waiakea Elementary School or Waiakea Intermediate School, and residents of the affected portion of Puainako Street. Due to the differing nature of the composition and size of each of these populations, different sampling and contact strategies were used for each.

SAMPLING

For the upper Kaumana residents it was decided that a random mailing to households would be most appropriate due to the large size of this population. To this end a listing of houses with mail boxes on streets in upper Kaumana (from above Akolea Road up to 2849 Kaumana Drive) was gathered from drive-bys. From this listing a random selection of streets was made, with a random sample from each street, dependent on the length (or number of listings) of each street. A total sample of 99 households was determined (approximately 35% of the houses listed). The mailing consisted of an introductory letter explaining the purpose of the survey, a copy of a map indicating the alternative routes being considered at the time for the extension between Komohana Street and the intersection with Kaumana Drive, a copy of the questionnaire, and a self addressed--stamped envelope. After an initial two week period a follow up mailing was repeated to households that had not yet responded. A total of 58 questionnaires were returned.

For the Waiakea Homestead and Waiakea Uka neighborhoods a similar strategy was used as for the Kaumana residents. A total sample of 180 was selected. The mailing included an introductory letter, questionnaire, and self addressed--stamped envelope. No map was included. After the follow up mailing a total of 106 questionnaires were returned.

For the parents of students attending Waiakea Elementary School and Waiakea Intermediate School, the principals at both schools were contacted and asked to supply a list of parents who dropped off, or picked up, their children at the schools. This was done with the permission and support of the Superintendent of the Hawaii County School District, Dr. Alan Garson. Names, addresses and phone numbers (for those parents with listed phone numbers) were supplied by each principal. Although complete lists were requested so that a random sampling could be made, the principals at each school supplied only short lists so that a random sample could not be made. A total of 60 parents from the lists supplied were chosen for inclusion (this included all 25 of the parents listed from Waiakea Elementary School and 35 of the

50 parents listed from Waiakea Intermediate School). The parents were contacted first through a mailing that included an introductory letter explaining the project's purpose and informing them that they would be contacted by interviewers. The parents were then contacted by interviewers over the phone and times were scheduled for interviews. 47 interviews were completed.

For the residents of Puainako Street, a two stage data gathering process was chosen. An initial mailing with an introductory letter, a map of the alternative routes for the extension between Kilauea Avenue and Komohana Street, a short (one page) questionnaire, a self addressed--stamped envelope, and a list of open meeting times was sent to 61 households. Residents were asked to attend one of the meetings (three were set up for those living on the south side of Puainako below the Kawili intersection, and three others for those living on the north side above the Kawili intersection) and bring the short questionnaire with them. If they could not attend any of the meetings they were requested to mail the short questionnaire back. The meetings were explained as a chance for them to provide input into their concerns about the project and any mitigation measures they would like to see included if the proposed project was to occur. Only six households attended the meetings (one from the south side and five from the north side). Including the mailed questionnaires 15 were returned.

FINDINGS

I. Overall perceived need for the project.

One question was used with every group. This question asked the respondents to rate the seriousness of the need for the project on a scale of one to five, with one indicating "Not at all serious" to five being "Extremely serious". The results are indicated in Table 1. The responses suggest that there is overall support for the project from all of the groups studied. Support was strongest from the Kaumana group and weakest among those living on Puainako Street. Still, for all groups more than 50% indicated that the need for the project was either a four or five on a five point scale, suggesting that they all feel the project is necessary for the community.

Table 1. Perceived need for Puainako Extension.

	Kaumana	Waiakea	Parents	Residents
1-Not at all serious	1 (1.72%)	9 (8.82%)	7 (14.89%)	1 (7.14%)
2	1 (1.72%)	9 (8.82%)	2 (4.26%)	3 (21.43%)
3	8 (13.79%)	25 (24.51%)	11 (23.40%)	2 (14.29%)
4	14 (24.14%)	17 (16.67%)	13 (27.66%)	4 (28.57%)
5-Extremely serious	34 (58.62%)	42 (41.18%)	14 (29.79%)	4 (28.57%)
Total	58 (100.00%)	102 (100.00%)	47 (100.00%)	14 (100.00%)

II. Kaumana

Of the 58 households responding to the survey, 48 indicated they owned their home, and 8 reported renting (2 failed to answer this question). This suggests there is a stable population whose characteristics are not likely to change quickly.

For the households in Kaumana we asked them to list the number of drivers within certain age ranges. The majority of drivers (69%) were in the 26-55 age group. Overall, 2 households reported no drivers, 11 with one, 34 with two, 8 with three, 2 with four, and 1 household with 5 drivers. This gave us a total of 116 drivers in the 58 households.

We also asked the respondents to list how many members of the household worked in certain districts. We summed the numbers for the Hilo Industrial Area, Puainako, and South Hawaii County, as these areas would all be easier to access via the extension once it is completed. This gives us a rough estimate of daily usage for employment. 33 households had no one working in these areas, 18 had one person, and 7 reported two members working in these areas. This would give us 32 people out of the 58 households likely to use the road daily to get to places of employment.

Of the households responding, 2 reported having children attending a school on Puainako Street, and an additional 10 reported household members attending a school just off of Puainako. These cases would also add to the daily usage of the extension.

66% of the households reported shopping in the Puainako area more than once a week, with another 27% reporting once a week usage. 17% report more than once a week shopping in the Hilo Industrial area and another 23% reporting once a week usage. This indicates 93% of the households using the road at least once a week to shop in the Puainako area and 40% in the Industrial area.

When asked about how often household members drive to these areas for purposes other than work, school, or shopping, 92% indicated going to Puainako at least once a week, and 56% at least once a week to the Industrial area.

When asked about how often members of their household would use the two sections of Puainako Street to be altered in the proposed project, only 3.5% indicated they would never use the section between Komohana and Kaumana, and 5.4% indicated they would never use the section between Kilauea and Komohana. By contrast 75.4% indicated they would use the upper portion more than 2-3 times a week, and 57.1% indicated they would use the lower portion more than 2-3 times a week.

These results strongly suggest that the residents of Upper Kaumana will greatly benefit from, and make use of, the new extension.

An item that we felt might concern the Kaumana residents was whether they felt the extension might encourage more development in the Kaumana area. 95% responded that the extension would cause more development in the Kaumana area, but very few mentioned this as an objection to the project.

Two open ended questions were included at the end of the survey to provide the respondents a chance to relate their general impressions about the project. The first asked for what they perceived as the benefits to the project, while the second asked for their objections to the project.

Only two of the 58 respondents did not mention something in the benefits. The responses were fairly uniform in mentioning the reduction in traffic on Waianuenue, safer driving conditions, and time savings. Five mentioned the addition of an evacuation--alternative route for emergencies as a safety feature.

Only nine respondents mentioned objections to the project, three citing environmental concerns, and four objecting to development. The other two concerned the choice of alternative routes and access/traffic patterns that might result.

Overall the Upper Kaumana residents are strongly in favor of the project, the majority of whom will use the extension on a regular basis. The major benefits are seen to be the easing of traffic on Kaumana Drive/Waianuenue Avenue with a safer and quicker route. An additional benefit mentioned is the addition of a second access route to Kaumana/Hilo for emergencies. Feelings are mixed about additional developments resulting from the extension in Kaumana. Most feel there will be additional development in Kaumana as a result, a few object to this, while other see this as a benefit.

III. Waiakea

Among the residents of Waiakea Homestead/Waiakea Uka, 97 reported owning their home, seven reported renting, and two did not answer the question. This indicates a fairly stable population with 93% homeowners.

None of the households reported having no drivers in the household. The average number of drivers was 2.36 per household, with a range from one driver to six drivers each.

While we did collect information about how many members of the household were employed in each area, and how often members of the household drove to each area for shopping or other reasons, this information is not as useful for this group as it was for the Kaumana residents. Alternate routes may be used to get to any area that would not involve residents of Waiakea using Puainako Street. The only exception to this is for those who have students at the two schools on Puainako Street. When asked to list the schools members of their households attended, a total of 31 entries included schools on Puainako Street, with another 25 just off of Puainako Street. This would indicate about 25% of the households (taking into account that some households would have students at two such schools and hence be repeated) need to drive into the Puainako area to drop off or pick up students.

Frequency of expected use by household member of the lower portion of the extension (between Kilauea Avenue and Komohana Street), upper portion of the extension (between Komohana Street and Kaumana Drive), and the Saddle Road are reported in Table 2.

Table 2. Frequency of expected use of portions of roadwayby Waiakea residents.

	Never	Less than once/week	Once/week	2-3 times per week	More than 3 times per week
Lower portion	2 (1.90)	8 (7.62)	9 (8.57)	28 (26.67)	58 (55.24)
Upper portion	10 (9.52)	51 (48.57)	13 (12.38)	9 (8.57)	22 (20.95)
Saddle Road	42 (40.00)	57 (54.29)	4 (3.81)	1 (0.95)	1 (0.95)

These results suggest that for the Waiakea Homestead/Waiakea Uka residents, usage of the portion of Puainako being widened in the proposal will be heavy, with 55% expecting to use the road more than three times per week, and 90% expecting to use this portion at least once per week. Only 21% expect to use the extension portion between Komohana Street and Kaumana Drive more than three times a week, but 41% expect to use it at least once per week. This usage can not be attributed to planned usage of the Saddle Road (only 5% expect to use the Saddle Road at least once per week) but suggests use to visit people in the Upper Kaumana area. As such the residents of the Waiakea Homestead/Waiakea Uka area would seem to benefit most from the widening of the lower portion of Puainako Street, with 90% reporting some regular usage. The extension to Kaumana Drive would seem to benefit the 41% who expect to get some regular usage out of it.

As with the Upper Kaumana residents we asked the Waiakea Homestead/Waiakea Uka residents open ended questions about what they perceived to be the benefits and objections to the proposed project.

Many residents of Waiakea note that the proposed project will ease congestion in the Kaumana Drive/Waianuenue Avenue area, as well as providing for safer driving conditions. These are pointed out as primarily benefits to the people who live in Kaumana and/or Saddle Road users. Four respondents also noted the need for a second evacuation and emergency route to and from the Kaumana area. Six respondents noted that this project has been discussed for a long time, and suggest it is overdue. Other clear benefits listed are the potential for increased developments along the extension route and greater access for Waiakea residents to the Kaumana/Saddle Road areas.

Opinion about the effect on the traffic in the Puainako Street area was mixed. While 25 respondents reported the opinion that traffic congestion on Puainako Street/Komohana Street would be eased, and another 23 suggested traffic flow improvement without a specification of where, there were also twelve who reported the opinion in the objection section that the proposed changes would increase the amount of traffic enough to create more of a problem in these areas. So while a greater proportion (45%) feel there will be an easing of traffic flow, there is a group (11%) who feel the traffic increase will create more of a jam.

Other concerns listed fell into two categories of details of the new roadway (11 respondents) and the construction period (12 respondents). The concerns over details of the project included traffic control at the major intersections, noise and property protection for current Puainako Street residents, and safety precautions for school children. Concern over the timing of the project dealt with how long the project would take, construction near the schools timed to occur while school is not in session, and arrangements for traffic flow during construction.

Three respondents did note concern over where the new extension would connect with Kaumana Drive, suggesting that a connection at Country Club Road would be too high to be convenient for most people either planning to visit residents in Kaumana or for Kaumana residents driving into Hilo. They prefer a route that connects at, or to, Wilder Avenue.

Three respondents did question the priority for this project, suggesting that other projects should have higher priorities and that the costs for this project might not justify the expense.

IV. Parents of students at Waiakea Elementary School or Waiakea Intermediate School

We requested of the schools a list of parents who dropped off or picked up their children at the schools for the sampling. We questionned whether the parents did drop off or pick up their children. 45 indicated they did so, and two indicated they did not. This provides us with a sample of people who face the traffic on Puainako daily during the school year and are most likely to be familiar with the problems and needs associated with traffic on this street.

A question asked the parents to rate the degree of safety in the current traffic arrangements on Puainako Street on a one to ten scale, with one being "Very Safe" and ten being "Very Dangerous". Responses covered the full range from one to ten, with a mean of 5.3 and a standard deviation of 2.188. The median response (15 out of 47 or 32%) was a five. This would indicate that the parents recognize some safety concerns but do not consider the current arrangements to be a serious problem from a safety perspective.

A follow up question asked the parents for the two most important problems with the current arrangements. The responses dealt primarily with the amount of traffic creating a problem, and the difficulties involved in making turns into the schools and onto Puainako Street. Much of this involved the difficulties posed in making left turns and how this also created blockages for traffic. Three parents also mentioned there being too many streets intersecting onto Puainako Street creating additional traffic interruptions. Four parents also noted the need for better arrangements for students to cross the street, citing needs for crosswalks, crossing guards, lights, and/or a pedestrian overpass. Speeding problems and safer walkways for children were also mentioned.

The parents were also questioned as to whether they felt left turns into or out of the side streets along the impacted portion of Puainako Street (with the exceptions of Kilauea, Kinoole, Kawili/Iwalani, and Komohana) should be made illegal during rush hours. Responses to this were evenly split with 24 in favor of turns being made illegal and 23 against.

The parents were also asked to rank order three possible alternatives for improving traffic arrangements. The three alternatives were to put traffic lights in front of each school, to put in left turn only lanes for each school, and to provide a drop off area across the street with a pedestrian overpass. The highest ranked option was the turn only lanes, with 18 ranking it number one, 26 ranking it number two, and only three people ranking it number three. For the traffic lights in front of the school 16 ranked it number one, 10 ranked it number two and 21 ranked it number three. The drop off area and overpass was ranked number one by 13, number two by 11 and number three by 23.

When asked for other suggestions for improving the flow of traffic, eight parents suggested one way traffic arrangements during peak hours, five suggested more lanes and/or lights, three suggested police or other traffic control officers, three suggested bike or pedestrian pathways between Waiakea Intermediate and Waiakea High School, and one suggested having entry and exit lanes for the schools on different streets. Three parents also made comments about improving traffic flow on the school grounds by providing larger parking/drop off areas, making parents move to the head of the drop off area to do their drop offs, and changing where bus drop offs are. One parent also suggested increasing the bus pick up/drop off service to include more students.

In two questions about the traffic flow and traffic congestion, 81% felt the project will increase traffic flow in front of the schools, but 67% felt there would be an easing of the traffic congestion. This may reflect a realistic appraisal by most parents, that the changes will mean more traffic passing along Puainako Street, but most seem to feel that this will still result in less congestion due to the added lanes.

36% of the parents felt that the project would affect the operation of the schools located on Puainako Street. In a follow up question as to how the schools' operation might be affected, four indicated it would affect operations during construction, 11 indicated concerns over increased traffic loads and/or speeding which can create additional safety risks and difficulties with turns into or out of the school, three with reduced space for drop offs/pick ups, and three felt that congestion would be reduced in front of the schools.

Responses to the open ended question on benefits indicated the 27 parents felt there would be an easing of traffic congestion and/or safer conditions and 15 felt that the project would benefit the Kaumana community especially. A few noted that the benefits needed careful consideration in the details of the project that would provide safer conditions for the children along the roadway and for making left turns into and out of the schools. The benefits for the Kaumana community and for people traveling to Kaumana were felt to be a mixture of time saving, easing of congestion along the current route, and safer driving conditions. Two respondents noted greater opportunities for housing developments as a potential benefit. A few noted that this project was overdue.

Objections to the project fell into a wide range of categories. 13 felt there would be an increase in either the volume of traffic or traffic congestion from the changes. In addition three parents felt the changes would result in more speeding along Puainako Street. Four noted concerns about Noise/safety conditions for local residents. While four also noted concerns about the property rights and living conditions for the Puainako Street residents. Two of these noted a preference for Alternative "A" as this would have less impact on the residents. Four parents expressed a need to consider other roads that could have greater impacts on improving traffic conditions. Two were concerned about traffic merging arrangements at the branching off of the new section near the Kawili Street intersection. Seven expressed concern over the timing of the project so as to minimize impact to the schools and traffic, suggesting work in the summer and on weekends. Two felt the cost unjustified and one expressed a belief that there would be poor planning based on experience with prior projects. The variety of responses to the objections suggest there is no dominant reason for opposition to the project, but that concern with the details of traffic control mechanisms and noise/safety measures will need to be addressed.

Overall the parents indicate support for the project, with most recognizing a need for the project, and believing that the changes will result in an easing of traffic congestion in the currently congested area of Puainako Street, as well as benefits in access to the Upper Kaumana area. Concerns expressed are primarily in the details of traffic control at intersections and the schools, the noise/safety control features, and in the arrangements made during construction for timing and traffic.

<u>Residents of Puainako Street</u>

Of the 15 responses from Puainako Street residents, 14 report owning their home, with one household renting. As in the other samples this indicates a stable population unlikely to experience rapid or sudden changes.

13 households felt their property values would change as a result of the project, with nine expecting a decrease and four expecting an increase in property values. The other two households felt their property values would not change.

Residents were also asked to rate the importance of four possible features that could be included in the project, on a scale of one to five, with one representing "Not at all important" and five representing "Very important". The four features were sidewalks, reduced speed limits, a blocking wall and/or hedge, and driveway access to the new roadway. Strongest support was for the blocking wall/hedge, with 14 rating it a five and one rating it a three. Sidewalks were second with ten rating it a five, one rating it a four, two rating it a three and two rating it a two. Reduced speed limit was third with eight rating it a five, two rating it a four, four rating it a three, and one rating it a one. Reactions were least positive for driveway access with four rating it a five, one rating it a four, six rating it a three, and four rating it a one. It would seem that a blocking wall/hedge is seen as an essential feature for the residents on the north side of Puainako Street for whom the realigned portion of Puainako Street will pass directly behind their property with the old alignment continuing to front their property. Sidewalks are also seen as very important and is compatible with the blocking wall/hedge.

An open ended question was included as to what the Puainako Street residents saw as the potential hazards of the project. Many residents expressed concern over more than one issue. The breakdown is as follows; six reported concern over noise/air pollution around their homes, four with safety for pedestrians and children, four with flood control, four with speeding, two with increased traffic congestion, two with lowering of property values, one with need for better street lighting, and one with timing and traffic arrangements during construction. Many of these potential problems can be dealt with in the details of planning and construction. The use of a blocking wall/hedge and sidewalks in the widening/extension is likely to deal with much of the concern over noise pollution, safety, and flooding, as well as protecting property values.

In the meetings with residents much the same concerns were raised. The three broad categories of concerns were with noise/safety, flooding, and traffic arrangements for access and merging traffic. The concern over noise from the roadway and safety precautions for the children playing was felt to have the best solution in a blocking wall that would provide a noise and light barrier providing the street residents with protection from noise pollution and greater privacy. It would also provide a physical barrier that would prevent accidents from children wandering out onto the street or cars veering off the road onto their property. This was stressed by four of the households as a first priority. Flooding concern stemmed from two sources. One was arrangements for the flood control channel that crosses Komohana Street right at where one of the alternative routes would also cross Komohana Street. As this is at the uphill end of the strip of housing affected, a blockage here could result in flooding for all of the houses involved. The second flooding concern stemmed from the new roadway running behind the row of houses on the north side of Puainako Street. If the road is graded to be a steady rise (safer for motorists and pedestrians) instead of being like the current road that has dips dues to uneven features of the terrain and the need for intersections with cross streets, for some houses the new roadway may be higher than their property and their is some concern that they may get runoff from the roadway behind their houses. The other concern is for how the merger of the branching roadway with the old section of Puainako Street will be handled, and how this will affect their access to the lower (eastern) portion of Puainako Street. One resident expressed concern for the safety of motorists in merging traffic, but also was concerned that they would still be able to drive straight down Puainako Street to get to the stores and back. The residents of Puainako Street recognized the need for the extension, and many noted that they knew about the possibility when they bought their current homes. They were chiefly concerned about arrangements to minimize the negative impacts on their safety and current living arrangements.

PROBABLE COST ESTIMATE

Project: Puainako Street (Komohana St. to Kaumana Dr.) Alternate No. 2 (5.1 mi.)
Engineer: Tim Nicholson Date Prepared: July 8, 1992

Item No.	Description	Quantity	Unit	Unit Cost	Extension
0000	Land Acquisition (140 width)	2,864,397	sf	0.30	859,319.10
0001	Clearing and Grubbing	50	ac	4,500.00	225,000.00
0002	Excavation & Embankment	200,000	cy	15.00	3,000,000.00
0003	Subbase	25,300	cy	39.00	986,700.00
0004	Base Course	9,200	cy	45.00	414,000.00
0005	A.C. Pavement	9,700	ton	65.00	630,500.00
0006	Drainage Structures	1	ls	3,300,000.00	3,300,000.00
0007	Signalization (Komohana St.)	1	ls	350,000.00	350,000.00
0008	Construct Bridge over Waia-kea Flood Channel	10000	sf	150.00	1,500,000.00
0009	Signs & Delineators	1	ls	18,000.00	18,000.00
0010	Striping	68,000	lf	.80	54,400.00
0011	Guard Rail	8,300	lf	40.00	332,000.00
0012	Erosion Control, Grasses	777,000	sf	.30	233,100.00
0013	Traffic Control	1	ls	100,000.00	100,000.00
0014	Mobilization / Demobilization	1	ls	500,000.00	500,000.00
0015	Relocate Existing Utilities	1	ls	200,000.00	200,000.00
0016	Retaining Walls	1	ls	250,000.00	250,000.00
0017	Intersection Widening @ Wild-er, Edita, Saddle Road	1	ls	400,000.00	400,000.00
0018	Miscellaneous Fencing, Delin-eators	1	ls	150,000.00	150,000.00
TOTAL					**13,503,019.10**
CONTINGENCY (@15%)					**2,025,452.87**
GRAND TOTAL					**15,528,471.97**
SAY					**15,530,000.00**

PROBABLE COST ESTIMATE

Project: Upper Puainako Street (Komohana St. to Kaumana Dr.) Alternate No. 1 (4.6 ml.)
Engineer: Tim Nicholson Date Prepared: July 8, 1992

Item No.	*Description*	*Quantity*	*Unit*	*Unit Cost*	*Extension*
0000	Land Acquisition	2,000,000	sf	0.30	600,000.00
0001	Clearing and Grubbing	45	ac	4,500.00	202,500.00
0002	Excavation & Embankment	185,000	cy	15.00	2,775,000.00
0003	Subbase	22,800	cy	39.00	889,200.00
0004	Base Course	8,250	cy	45.00	371,250.00
0005	A.C. Pavement	8,720	ton	65.00	566,800.00
0006	Drainage Structures	1	ls	3,850,000.00	3,850,000.00
0007	Signalization	1	ls	350,000.00	350,000.00
0008	Construct Bridge over Waia-kea Flood Channel	10000	sf	150.00	1,500,000.00
0009	Signs & Delineators	1	ls	16,000.00	16,000.00
0010	Striping	61,000	lf	.80	48,800.00
0011	Guard Rail	7,500	lf	40.00	300,000.00
0012	Erosion Control, Grasses	700,000	sf	.30	210,000.00
0013	Traffic Control	1	ls	100,000.00	100,000.00
0014	Mobilization / Demobilization	1	ls	500,000.00	500,000.00
0015	Relocate Existing Utilities	1	ls	200,000.00	200,000.00
0016	Retaining Walls	1	ls	300,000.00	300,000.00
0017	Intersection Widening @ Wild-er, Edita, Saddle Road	1	ls	400,000.00	400,000.00
0018	Miscellaneous Fencing, Deli-neators	1	ls	150,000.00	150,000.00
TOTAL					**13,329,550.00**
CONTINGENCY (@15%)					**1,999,432.50**
GRAND TOTAL					**15,328,982.50**
SAY					**15,330,000.00**

14. Intersection Improvement with Signal Subtotal a. Kilauea Ave. . . . . 1000000.00 b. Kinoole St. . . . . . 1000000.00 c. Iwalani / Kawili Intersections . . . . . 950000.00 d. Waiakea Elem. Ingress & Egress . . 800000.00	1	Budget	3750000.00	3,750,000.00
15. Minor Street Improvements without Signals Subtotal a. Maikai St. . . . . 75000.00 b. Lokahi St. . . . . 150000.00 c. Pamala St. . . . . 75000.00 d. Kehaulani St. . . . . . 100000.00 e. Nohea St. . . . . 75000.00 f. Anela St. . . . . 100000.00 g. Kanoelani St. 100000.00	1	Budget	675000.00	675,000.00
16. Widening of Existing Komohana St. Bridge & Road	1	ls	1500000.00	1,500,000.00
SUBTOTAL				12,596,250.00
15% CONTINGENCY				1,889,437.50
GRAND TOTAL				**14,485,687.50**
SAY				**$14,500,000.00**

PROBABLE CONSTRUCTION COST ESTIMATE

PUAINAKO EXTENSION FROM KOMOHANA TO KILAUEA AVENUE

O/A Job No. 92014 **Sheet 1 of 2** **Date: 6/17/92**

	ITEM DESCRIPTION	*QUAN-TITY*	*UNIT*	*UNIT COST*	*TOTAL COST*
1.	Land Acquisition	100000	sf	varies	1,250,000.00
2.	2" AC (48" wide) with 4" Base & 6" Subbase	7750	lf	94.00	728,500.00
3.	Concrete curb & gutter (both sides)	7750	lf	36.00	279,000.00
4.	Concrete Curb (both sides, island median)	7750	lf	22.00	170,500.00
5.	6" Topsoil (60' wide)	7750	lf	56.00	434,000.00
6.	10' Wide Concrete Sidewalk (both sides)	7750	lf	27.00	209,250.00
7.	Excavation / Embankment	90000	cy	15.00	1,350,000.00
8.	Reconstruct a portion of the Existing Waterline and Lateral including Fire Hydrants	1	Budget	350000.00	350,000.00
9.	Relocate Poles where neces-sary	1	Budget	250000.00	250,000.00
10.	Retaining Walls	1	Budget	400000.00	400,000.00
11.	Drainage Structures, Intake Structures & Drywells with Cul-verts	1	Budget	700000.00	700,000.00
12.	Misc. Items: fencing, barri-cades, etc.	1	Budget	250000.00	250,000.00
13.	Traffic Control	1	Budget	300000.00	300,000.00

I. Typical Cross Section Elements (see fig. 8):

1. Right-of-way width: 120' (ref. [5] p. R-33)
2. Number of lanes: 2 both directions
3. Lane width: 12' (ref. [1] p. 9-4)
4. Shoulder treatment: 6" aggregate subbase with seal coat type III (ref. [5] p. R-34)
5. Shoulder width: 10' (ref. [1] p. 9-4)
6. Typical roadway crown: 2.0% (ref. [1] p. 9-4)
7. Left turn pocket width: 12' (ref. [1] p. 9-4)

Design Criteria (Upper Puainako).

a. Proposed Roadway Classification: Rural Principal Arterial (ref. [2] p. 10)

b. Design Vehicle: WB50 (ref. [1] p. 9-2)

c. Design Year: 2010 (ref. [10])

d. Average Daily Traffic (ADT): 23,400 veh. (ref. [10])

e. Peak Hourly Volume (PHV): 3,510 veh./hr. (15% of ADT assumed)

f. Design Hourly Volume (D.D.H.V.): 2,106

g. Design Speed: 45 (ref. [1] p. 9-12)

h. Operating Speed: 40

i. Proposed Level of Service: C (ref. [1] p. 9-12)

j. Vertical Alignment:
   1. Terrain Type: Mountainous
   2. Maximum grade: 9.0% * (ref. [1] p. 9-3)
   3. Minimum grade: 0.5% (ref. [1] p. 9-12)
   4. Maximum Superelevation: 6.0% (ref. [1] p. 4-14)

k. Horizontal Alignment:
   1. Minimum Radius: 679' (700' used) (ref. [1] p.4-22)
   2. Maximum Degree of Curvature: 9 (ref. [1] p.4-22)
   3. Minimum Stopping Sight Distance: 400' (ref. [1] p.4-4)
   4. Minimum Passing Signt Distance: 16,500 (ref. [1] p. 4-3)

* == Exceeds referenced design criteria

4. Maximum Superelevation: N/A (ref. [1] p. 9-13)

i. Horizontal Alignment
1. Minimum Radius: 825' (ref. [1] p. 4-13)
2. Stopping Sight Distance: 325' (ref. [1] p. 4-4)
3. Minimum Passing Sight Distance: N/A
4. Minimum Cul-de-sac Radius: 45' (ref. [4] sec. 23-48-a)
5. Minimum Pavement Radius: 40' (ref. [2] p. 22)
6. Minimum Corner Radius: 20' (ref. [4] sec. 23-45-b)]

j. Typical Cross Section Elements (see fig. 7)
1. Right-of-way Width: 120' (ref. [5] p. R-33)
2. Number of Lanes: 2 (each way)
3. Lane Width: 12' (ref. [1] p. 9-13)
4. Shoulder Treatment: Concrete Curb and Gutter (ref. [5] p. R-33)
5. Gutter Width: 2' (ref. [5] p. R-33)
6. Typical Center Median Width: 44' (ref. [5] p. R-33)
   Minimum Center Median Width: 20'
   (Providing one 12' wide left turn lane each direction)
7. Sidewalk Width: 10'
8. Typical Roadway Crown: 2.0% (ref. [1] p. 9-13)
9. Left Turn Pocket Width: 12' (ref. [1] p. 9-14)

Design Criteria (Lower Puainako).

a. Proposed Roadway Classification: Urban Minor Arterial (ref. [2] p. 14)

b. Design Vehicle: WB40

c. Design Year: 2010 (ref. [10])

d. Traffic Volume Data:

Puainako St. Section	*State D.O.T/ Forecasts (Vehicles)*			*A.M. Peak Hourly Volume*	*P.M. Peak Hourly Volume*	*Peak 30th Hourly Volume Factor*	*Design Hourly Volume*	*Directional Distribution*		*D.D. H.V. (P.c. p.h.)*
	1992 A.D.T.	*2010 A.D.T.- With-out Improve-ments*	*2010 A.D.T. With Improv-ments*					*am*	*pm*	
Kanoelehua Ave. to Kilauea St.	20,456	27,300	29,800							
Kilauea St. to Kinoole St.	14,266	15,400	23,500							
Kinoole St. to Komohana St.	6,489 - 8,812	11,100	19,500							

e. Design Speed: 40 (ref. [1] p. 9-11)
Current Posted Speed: 35
Current Posted Speed at School Zone: 25

f. (Speed limit will be reduced to 25 m.p.h. within the school zone along Puainako St. with the use of signs and flashing beacons.) (ref. "Dept. of Transportation, State of Hawaii)

g. Proposed Level of Service: C (ref. [1] p. 9-11)

h. Vertical Alignment
1. Terrain type: Level
2. Maximum grade: 8.0% (ref. [1] p. 9-13)
3. Minimum grade: 0.5% (ref. [1] p. 9-12)

PRELIMINARY ENGINEERING DESIGN AND COSTS SUMMARY

FOR PUAINAKO WIDENING AND EXTENSION

by

Okahara and Associates
200 Kohola Street
Hilo, Hawaii 96720

December 7, 1992

Appendix I

7. Do you think the project of widening and extending Puainako Street will increase traffic flow on Puainako Street in front of the schools? _____ Yes _____ No

8. Do you think widening Puainako Street to four lanes between Komohana and Kinoole will ease traffic congestion?
_____ Yes _____ No

9. Do you think the widening of Puainako Street will affect the operation of Waiakea Elementary or Intermediate School?
_____ Yes _____ No

   If yes, how?

10. What do you think would be the major benefits to the Puainako Street Extension Project?

11. What would be your major objections to the Puainako Street Extension Project?

Puainako Street Extension Project interview schedule for parents of students attending Waiakea Intermediate School or Waiakea Elementary School.

1. Do you drop off or pick up your children at school?
   _____Yes _____No

2. How safe would you consider the current traffic arrangements at Waiakea Elementary and Intermediate Schools rated on a one to ten scale, with one being very safe and ten being very dangerous?

Very safe									Very dangerous
1	2	3	4	5	6	7	8	9	10

3. In your opinion what are two of the most important problems concerning the current traffic arrangements on Puainako Street?

4. How serious is the need for the Puainako Street Extension Project?

Not at all				Very serious
1	2	3	4	5

5. Should left turns into or out of the side streets intersecting Puainako Street in between Kinoole Street and Kawili/Iwalani Street be illegal during rush hours? _____Yes _____No

6. Please rank order the following alternatives for handling the traffic for dropping off and picking up students at Waiakea Elementary and Intermediate Schools, with one being your first choice and three being your last choice.

_____ Traffic light in front of each school operating during peak hours.
_____ Turn only lanes for left turns at each school.

_____ A drop off area across the street with a pedestrian overpass for students to use.

Do you have any other suggestions for improving the flow of traffic along Puainako Street in front of the schools?

PUAINAKO STREET RESIDENTS

1. Do you own or rent your home? _____Own _____Rent

2. How serious is the need for the Puainako Street Extension Project? (Please circle the number that represents your opinion)

Not at all				Extremely serious
1	2	3	4	5

3. Do you think the Puainako Street Extension Project will affect the value of the property where you are now residing?
   _____Yes _____No

   If yes, will it increase or decrease your property value?
   _____Increase _____Decrease

4. Assuming the route currently being recommended, which passes directly in back of the properties on the Hamakua side of Puainako Street between Kawili and Komohana, is used, please rate the importance of having each of the following features added to the new roadway along that section. (Please circle the number that represents your opinion for each feature)

	Not at all				Very Important
Sidewalks	1	2	3	4	5
Reduced speed limits	1	2	3	4	5
A blocking wall and/or hedge	1	2	3	4	5
Driveway access to the new road	1	2	3	4	5

5. What are the potential hazards that you think will need to be dealt with in the planning and execution of the proposed widening and extension of Puainako Street?

7. How often would members of your household use the new extension between Komohana and Kaumana Drive?

More than 3 times a week	2-3 times a week	Once a week	Less than once a week	Never

8. How often would members of your household use the widened portion of Puainako Street between Komohana and Kilauea Avenue?

More than 3 times a week	2-3 times a week	Once a week	Less than once a week	Never

9. Do you think the Puainako Street Extension Project will cause more development in Kaumana?

____ Yes ____ No

10. How serious is the need for the Puainako Street Extension Project?

Not at all — Extremely serious

1 2 3 4 5

11. What do you feel would be the benefits or advantages to the Puainako Street Extension Project?

12. What objections would you have to the Puainako Street Extension Project?

KAUMANA RESIDENTS

Survey on the impact of the Puainako Street Extension Project.

1. Do you rent or own your home? ____Rent ____Own

2. How many drivers of each age group reside in your household?

____15-18
____19-25
____26-55
____56 and older

3. How many people residing in your household are employed in each of the following districts?

____Downtown Hilo
____Hilo Industrial Area
____Puainako
____Southern Hawaii County (Puna, Volcano, Kau, etc.)
____Northern Hawaii County (Hamakua, Laupahoehoe, etc.)
____West Hawaii County (Kailua, Kealakekua, etc.)

4. How often do you shop in each of the following districts?

	More than once a week	Once a week	Less than once a week	Never
Downtown Hilo	____	____	____	____
Puainako/Prince Kuhio Plaza	____	____	____	____
Keaau	____	____	____	____
Hilo Industrial Area	____	____	____	____

5. Please list the schools members of your household drive to.

1)______________________
2)______________________
3)______________________
4)______________________

6. How often do members of your household drive to the following districts (other than for work, shopping, or school)?

	More than once a week	Once a week	Less than once a week	Never
Keaukaha	____	____	____	____
Downtown Hilo	____	____	____	____
Hilo Industrial	____	____	____	____
Puainako	____	____	____	____
Southern Hawaii	____	____	____	____
Northern Hawaii	____	____	____	____
West Hawaii	____	____	____	____

7. How often would members of your household use the new extension between Komohana and Kaumana Drive?

More than 3 times a week	2-3 times a week	Once a week	Less than once a week	Never

8. How often would members of your household use the widened portion of Puainako Street between Komohana and Kilauea Avenue?

More than 3 times a week	2-3 times a week	Once a week	Less than once a week	Never

9. How often would members of your household use the Saddle Road?

More than 3 times a week	2-3 times a week	Once a week	Less than once a week	Never

10. How serious is the need for the Puainako Street Extension Project?

Not at all				Extremely serious
1	2	3	4	5

11. What do you feel would be the benefits or advantages to the Puainako Street Extension Project?

12. What objections would you have to the Puainako Street Extension Project?

WAIAKEA RESIDENTS

Survey on the impact of the Puainako Street Extension Project.

1. Do you rent or own your home? ____Rent ____Own

2. How many drivers of each age group reside in your household?

____15-18
____19-25
____26-55
____56 and older

3. How many people residing in your household are employed in each of the following districts?

____Downtown Hilo
____Hilo Industrial Area
____Puainako
____Southern Hawaii County (Puna, Volcano, Kau, etc.)
____Northern Hawaii County (Hamakua, Laupahoehoe, etc.)
____West Hawaii County (Kailua, Kealakekua, etc.)

4. How often do you shop in each of the following districts?

	More than once a week	Once a week	Less than once a week	Never
Downtown Hilo	____	____	____	____
Puainako/Prince Kuhio Plaza	____	____	____	____
Keaau	____	____	____	____
Hilo Industrial Area	____	____	____	____

5. Please list the schools members of your household drive to.

1) ______________________
2) ______________________
3) ______________________
4) ______________________

6. How often do members of your household drive to the following districts (other than for work, shopping, or school)?

	More than once a week	Once a week	Less than once a week	Never
Keaukaha	____	____	____	____
Downtown Hilo	____	____	____	____
Hilo Industrial	____	____	____	____
Puainako	____	____	____	____
Southern Hawaii	____	____	____	____
Northern Hawaii	____	____	____	____
West Hawaii	____	____	____	____

Summary findings

In all four samples taken there was a recognition of the need for the project, and in general support for its utility. The major benefits are seen to be in a second access route to Upper Kaumana and Saddle Road, and the possible easing of congestion along Kaumana Drive, Waianuenue Avenue, Komohana Street, and Puainako Street. Secondary potential benefits would seem to be in the potential for improving safety along Puainako Street and improving arrangements for traffic into and out of Waiakea Elementary School and Waiakea Intermediate School.

Primary concerns deal with the increase in traffic volume with the changes, and how this could affect the flow of traffic in the area, along with attendant problems of safety for pedestrians and noise/air pollution. Secondary concerns are for the impact on school traffic in the drop off/pick up zones and for the current residents of Puainako Street who might be affected in their property rights/values and quality of life factors in their homes. Another concern that needs to be addressed in the project planning is the timing of the construction to take into account the demands on the affected roads being heaviest during the school year, so that construction should make provisions for traffic routing, and is timed to occur as much as possible when school is not in session.

Solutions to the potential problems are seen in the provision in planning of adequate facilities and features that would mitigate or minimize risks/hazards. These include a blocking wall/hedge for the Puainako Street residents on the north side between Kawili Street and Komohana Street, left turn lanes and/or street lights at the schools, and adequate traffic control at the major intersections. With adequate foresight and provisions for the details of the project, there are very few anticipated problems and a greater likelihood that the potential benefits will be realized to their maximum.