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STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
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HONOLULU, HAWAII 96813-5097

IN REPLY REFER TO:

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March 6, 2001

OFC. OF ENV. QUALITY CONTROL

TO: GENEVIEVE SALMONSON, DIRECTOR
OFFICE OF ENVIRONMENTAL QUALITY CONTROL

FROM: BRIAN K. MINAAI
DIRECTOR OF TRANSPORTATION

SUBJECT: FINAL ENVIRONMENTAL ASSESSMENT
HAWAII BELT ROAD, KUPAPAULUA BRIDGE WIDENING,
DISTRICT OF HAMAKUA, ISLAND OF HAWAII
FEDERAL-AID PROJECT NO. BR-019-2(38)

The Department of Transportation has reviewed the Final Environmental Assessment (FEA) for the subject project and has determined that a Finding of No Significant Impact (FONSI) is warranted for the project. This determination was made after extensive review of the comments received on the draft environmental assessment that was published in the August 23, 2000 issue of the OEQC Environmental Notice. Findings and reasons supporting this determination are described in the FEA.

Please publish a notice of availability for the Final Environmental Assessment in the March 23, 2001 issue of the Environmental Notice.

Enclosed is a completed OEQC Publication Form, four copies of the FEA, and the project summary on disk.

If you have any questions regarding the project, please call Emilio Barroga, Jr., Project Manager, of our Highways Division at 692-7546.

Enclosure

# FINAL ENVIRONMENTAL ASSESSMENT

for

2001-03-23-HI-FEA

## HAWAII BELT ROAD
## KUPAPAULUA BRIDGE WIDENING

District of Hamakua, Island of Hawaii
Project No. BR-019-2 (38)

Prepared Pursuant to Chapter 343,
Hawaii Revised Statutes (HRS)

and

Hawaii Administrative Rules, Title 11, Chapter 200

by the

State Of Hawaii Department Of Transportation
Highways Division

March 2001

# Hawaii Belt Road
# Kupapaulua Bridge Widening
# District of Hamakua
# Island of Hawaii
# Project No. BR-019-2(38)

## Final Environmental Assessment

Prepared Pursuant to Chapter 343, Hawaii Revised Statutes (HRS)

and Hawaii Administrative Rules, Title 11, Chapter 200

by the

State of Hawaii Department of Transportation

Highways Division

MAR 0 4 2001

Date of Approval

Brian K. Minaai, Director
State of Hawaii Department of Transportation

The proposed improvements which are the subject of this Environmental Assessment include the construction of structural and widening improvements on and along an existing bridge on the Hawaii Belt Road, Highway No. 19. No by-pass road will be considered. The existing bridge will remain open and in use as the improvements are constructed. The Hawaii Department of Transportation has issued a Finding of No Significant Impact (FONSI) for this project.

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## LIST OF FIGURES

## I. PROJECT SUMMARY

| | |
|---|---|
| PROPOSING AGENCY: | State of Hawaii<br>Department of Transportation<br>Highways Division |
| PROJECT NAME: | Hawaii Belt Road<br>Kupapaulua Bridge Widening<br>Project No. BR-019-2(38) |
| PROJECT LOCATION: | The project site is located on the Hawaii Belt Road in the vicinity of the 31-mile marker in the Hamakua District, Island of Hawaii, State of Hawaii. |
| NATURE OF DEVELOPMENT: | The proposed improvements which are the subject of this Environmental Assessment include the construction of structural and widening improvements on and along an existing bridge on the Hawaii Belt Road, Highway No. 19. No by-pass road will be considered. The existing bridge will remain open and in use as the improvements are constructed. |
| SCOPE OF PROJECT: | The project proposes to construct bridge widening and seismic rehabilitation of the existing historic Kupapaulua Bridge. Permanent highway right-of-way acquisition is also anticipated. |
| ESTIMATED COST: | Approximately $14,000,000 to $16,000,000. |

## II. AGENCY DETERMINATION

A. Finding of No Significant Impact (FONSI)

Pursuant to Hawaii Administrative Rules Title 11 Chapter 200, the State of Hawaii Department of Transportation anticipates that the proposed action is not likely to have a significant impact upon the environment.

B. Evaluation of Significance Criteria.

The project impacts have been evaluated against the 13 significance criteria contained in Section 11-200-12 of the Hawaii Administrative Rules. The following numbered items cite each of the 13 particular significance criteria then provide the State of Hawaii Department of Transportation's evaluation for the criteria.

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

The project does not involve an irrevocable commitment to loss or destruction of any natural or cultural resources.

- An archaeological inventory survey conducted for this project has determined that the project will not cause impact upon archaeological sites. A copy of the archaeological inventory survey report is contained in Appendix A.

- An aquatic and avian species assessment conducted for this project has determined that the project will not cause adverse impacts upon native avian and aquatic species. A copy of the avian and aquatic assessment report is contained in Appendix B.

- A botanical survey conducted for this project has determined that the project will not cause significant negative impact upon botanical resources. A copy of the botanical survey report is contained within Appendix C.

- Since the existing Kupapaulua Bridge is eligible for listing in the National Register of Historic Places, the Department of Transportation consulted with the State Historic Preservation Officer and the Federal Highway Administration concerning the bridge widening and seismic rehabilitation. As a result of the consultations, the project has been determined to adversely affect upon the existing bridge and a Memorandum of Agreement has been executed. A copy of the Memorandum of Agreement is contained within Appendix D.

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

The project does not curtail the range of beneficial uses of the environment.

- When completed, the bridge widening and seismic rehabilitation will improve, not curtail, vehicle, bicycle, and pedestrian safety.

- When completed, the bridge widening and seismic rehabilitation will not cause significant negative impact to recreational, agricultural, or other uses of the Kupapaulua Gulch or adjacent areas.

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

The project does not conflict with the State's long-term environmental policies or goals and guidelines as expressed in Chapter 344, HRS nor with any revisions thereof and amendments thereto, court decisions, or executive orders.

- In brief, the State's environmental policy is to conserve the natural resources and enhance the quality of life. The project is consistent with this environmental policy in that the project: (a) Has examined whether the project causes impacts to natural, cultural, or historic resources; (b) Has determined that the project does not cause any significant negative impact to such natural, cultural, or historic resources, and; (c) Will enhance the quality of life by improving public safety through construction of the bridge improvements.

- The project is consistent with the Department of Transportation's Statewide Transportation Improvement Program and is not in conflict with any revisions, amendments, court decisions, or executive orders therefor.

4. Substantially affects the economic or social welfare of the community or State.

The project does not substantially affect the economic or social welfare of the community or the State.

- The project is a localized safety improvement project which may create limited temporary construction employment, but generally has insubstantial effect upon economic or social welfare.

- The project has no effect upon potential development, land use policies, and social programs in the existing community.

5. Substantially affects public health.

The project does not substantially affect public health.

- Effects to air quality are anticipated to be minimal and are not anticipated to affect public health. The construction activities are anticipated to generate minimal dust, noise, and other aerial emissions.

- Effects to water quality are anticipated to be negligible and are not anticipated to affect public heaith. The construction activities are not being performed within any surface waters and are not causing discharges into any surface waters. Erosion control measures will be implemented to minimize potential soil runoff.

- Effects to public traffic are anticipated to be minimal and mitigated through implementation of construction work zone traffic control.

- After the construction is completed, the bridge widening and seismic rehabilitation will not cause effects to public health.

6. Involves substantial secondary impacts, such as population changes or effects upon public facilities.

The project does not involve substantial secondary impacts, such as population changes or effects upon public facilities.

- The project is a localized safety improvement project.

- The proposed project does not cause population changes, effects upon public facilities, or other substantial secondary impacts.

7. Involves a substantial degradation of environmental quality.

The project does not involve a substantial degradation of environmental quality.

- Temporary noise, dust, and traffic impacts generated by the construction activities will not cause a substantial degradation of environmental quality.

- After the construction is completed, the bridge widening and seismic rehabilitation will not cause a substantial degradation of environmental quality.

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

The project does not have a cumulative considerable effect on the environment and does not involve a commitment for larger actions.

- The temporary noise, dust, and traffic impacts generated by the construction activities are not anticipated to have a considerable effect upon the environment. These temporary impacts will cease when the construction is completed.

- The project is a localized safety improvement project and does not commit larger actions.

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

The project does not substantially affect any rare, threatened, or endangered species, or its habitat. Studies performed for the project have determined that there are no rare, threatened, or endangered species, or their habitats, existing within the project area.

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

The project does not detrimentally affect air or water quality or ambient noise levels.

- The project is not anticipated to cause detrimental effects to air quality. The construction activities are not anticipated to cause significant dust or other aerial emissions. Dust control measures will be implemented to minimize dust emissions. Construction machinery will be properly equipped and maintained to minimize exhaust emissions.

- The project is not anticipated to cause detrimental effects to water quality. The construction activities are not being performed within any surface waters and are not causing discharges into any surface waters. The project contractor will be required to provide erosion control measures such as barriers or other control methods to retain excavation material from entering the stream.

- The project is not anticipated to cause detrimental effects to ambient noise levels. The construction activities are not anticipated to generate noise levels significantly exceeding the ambient noise of the highway traffic. The project site is remotely located and there are no dwellings, institutions, or businesses within the vicinity which may be adversely affected by construction noise.

- After the construction is completed, the bridge widening and seismic rehabilitation will not detrimentally affect air or water quality or ambient noise levels.

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

The project does not affect and is not likely to suffer damage by being located in an environmentally sensitive area.

- The project is not located within a State Conservation District or a County Special Management Area.
- The project is not located within a flood plain. The project is located outside of the 100-year flood plain as identified in the current Flood Insurance Rate Map.
- The proposed seismic rehabilitation construction intends to mitigate the effects of seismic activity upon the bridge structure.

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

The project does not substantially affect scenic vistas or viewplanes.

- The project location is not identified within State or County plans or studies for scenic vistas or viewplanes including the West Hawaii View Study or the County of Hawaii General Plan.
- After the construction is completed, the bridge widening and seismic rehabilitation has no effect upon the scenic vista or viewplane of the Kupapaulua Bridge or of the project area.

13. Requires substantial energy consumption.

The project does not require substantial energy consumption.

- The project construction does not require substantial amounts of energy for the construction activities and will have minimal effect upon energy consumption.
- After the construction is completed, the bridge widening and seismic rehabilitation will have no effect upon energy consumption.

## III. PROJECT DESCRIPTION

### A. Purpose and Need for the Proposed Action

The project proposes to widen the existing Kupapaulua Bridge to add new road shoulders and to construct seismic rehabilitation to strengthen the existing bridge structure and increase its seismic resistance. These purposes and the respective needs are described below:

Purpose 1. Construct widening of the existing bridge. Widen the existing bridge to add new 8-foot wide road shoulders and new bridge railings along both sides of the highway lanes. The new road shoulders and new bridge railings will improve safety for public traffic, including vehicles, bicycles, and pedestrians, traveling upon the bridge.

Need 1. The bridge widening is needed because the existing bridge is presently not wide enough to provide any road shoulders.

This lack of road shoulders compromises traffic safety upon the bridge. The absence of road shoulders precludes motorists from turning out of the highway lane(s) in times of emergencies, evasive maneuvers, or for stalled vehicles or other mechanical problems.

The absence of road shoulders also causes safety hazards as bicycles share the highway lanes with automobiles. Since the automobiles are traveling at highway speeds which are much greater than the bicycle speeds, this forced sharing of the vehicle lanes causes safety hazards for both motorists and bicyclists. The addition of the new road shoulders would allow the bicyclists to travel within those shoulders and would eliminate the forced lane sharing and attendant hazards.

The existing bridge provides a pedestrian sidewalk on only one side (the mauka side) of the bridge, thus causing pedestrians to cross the highway lanes to access the mauka sidewalk. Pedestrians are observed upon the bridge along both the mauka and makai sides, as the bridge is a good vantage point for viewing the coastline and the ocean. In crossing the highway lanes and/or standing upon the bridge, the pedestrians' actions cause a significant potential for pedestrian-automobile accidents. The addition of new road shoulders along both the mauka and the makai sides of the bridge will reduce the potential for such pedestrian-automobile accidents.

Purpose 2. Construct seismic rehabilitation for the existing bridge. Rehabilitate the existing bridge superstructure and substructure to conform to current standards for seismic resistance. Rehabilitate the structure also to sustain the increased loads caused by the widening of the bridge, the addition of the new road shoulders, and the greater weights of present day automobiles, buses, trucks, and trailers.

Need 2. The existing bridge was initially constructed in 1935, approximately 65 years ago, and was designed according to the seismic criteria of the 1930's. Present day seismic criteria are more stringent than that of the 1930's.

The seismic rehabilitation is needed to upgrade the bridge structure to meet present day seismic criteria and to sustain the increased loading induced by the bridge widening, new road shoulders, and present day vehicles.

The seismic rehabilitation is also needed to protect the Kupapaulua Bridge against damage due to seismic events and to maintain the transportation function of the Hawaii Belt Road through such seismic events. Since the bridge conveys the public traffic using the sole primary arterial highway (Hawaii Belt Road) serving the Big Island's Hamakua Coast, the ability of the bridge to withstand seismic events is necessary to serve the transportation needs of the communities through this area.

## B. Project Location

The Kupapaulua Bridge is located immediately north of the mile 31 post within the Hamakua District of the County of Hawaii. The bridge is located on the Hawaii Belt Road approximately 3/4-mile west of the Hamakua and North Hilo District Boundary. The project area consists of portions of Tax Map Key Parcels: 4-1-001: 3 and 5, and Tax Map Key Parcels: 4-1-002: 1, 4 and 11. Refer to accompanying Figures 1, 2 and 3 on pages 13, 14 and 15 for the project location.

## C. Description of the Proposed Action

The existing Kupapaulua Bridge is a multi-span structure crossing over the Kupapaulua Gulch with a central open-spandrel concrete arch and five concrete deck/girder spans. It spans a distance of 217 feet with a rise of fifty feet from the spring line of the arch. The total length of the bridge is 353 feet from abutment to abutment. At the lowest elevation of the gulch, the bridge deck stands approximately 120 feet above the gulch floor. Presently, the bridge consists of two eleven-foot wide travel lanes with a single five-foot wide concrete sidewalk and molded concrete railings.

The existing 29 foot 11 inch wide bridge is proposed to be widened to approximately 44 feet to accommodate two 12-foot wide travel lanes and two 8-foot wide shoulders. The existing molded concrete railings are proposed to be replaced with American Association of State Highway and Transportation Officials (AASHTO) approved Jersey-type barriers. Metal railings extending 4 feet 6 inches above the bridge deck are proposed to be added on the concrete barriers to conform to bicycle traffic requirements.

The proposed bridge will be designed in accordance with the 1994 AASHTO LRFD Bridge Design Specifications and subsequent interim standards. The bridge and approaches will have a design speed of 60 miles per hour and have a posted speed limit of 55 miles per hour.

The proposed modifications should not affect current drainage patterns for Kupapaulua Stream. Although this is an intermittent stream, which only appears to flow during heavy rainfall, mitigation measures will be evaluated to prevent debris and pollutants from entering the streambed.

1. Structural Improvements

   Profiles and a cross section of the existing bridge and the proposed improvements are provided in *Figures 4, 5 and 6. In conformance with the* current AASHTO design specifications and increased loads due to widening of the existing bridge, all sections of the existing open-spandrel arches and piers will be increased in size by building up with new concrete and reinforcing steel. New footings bearing on drilled shaft foundations will be added at each end of the central open-spandrel arch span. The girder spans on each end of the arch span are proposed to be modified such that the existing bridge deck bears on new structural fill material. New reinforced concrete retaining walls are proposed extending from the existing abutments to the new abutments located at each end of the arch span.

2. Roadway Improvements

   New concrete fill is proposed to be added to raise the existing deck surface a minimum of 3 inches to provide a smooth riding surface and allow surface water to drain properly.

3. Construction Methodology and Access

   Construction activities will likely extend outside of the existing right-of-way so that construction equipment can access areas affected by the new work. Four parcels for the right-of-way construction have been planned for use during the construction of the bridge improvements These areas are located on both sides of the road and bridge on both the east and west ends. Each area consists of approximately 1-acre and will be used for access of construction

equipment and to provide a work buffer area. Preliminary plans for these construction areas are shown in Figures 7 & 8. Excavation within the right-of-way will be by hand or machine. Negotiations with the respective landowners for acquisition and purchase of these right-of-way parcels are scheduled for year 2000.

Existing traffic patterns will be maintained throughout the duration of the construction as much as practicable. However, the speed limit through the construction zone will be reduced and occasionally traffic may be stropped for the movement of construction equipment and/or construction activities. Traffic will be limited to a single lane during construction hours. Traffic is anticipated to be open to both lanes after construction hours. There is a possibility that temporary traffic signals may be used during construction.

D. Estimated Schedule and Costs

The schedule for construction of the project is subject to the availability of construction funding and is preliminarily estimated to be:

| | |
|---|---|
| Tentative start of construction | 2002 |
| Tentative duration of construction | 12 months |

The construction cost is estimated to be between $14 million and $16 million.

E. List of Permits and Approvals

A comprehensive list of agencies having jurisdiction over this project's planning, environmental documentation, design, construction and post-construction aspects was consulted for permitting and/or approval requirements. In many cases, these agencies were consulted with early in this project's conceptual development stage to facilitate a smooth permit approval process. The following major permits and the status of each permit are as follows:

Federal Permits

- Department of the Army Permit, U.S. Army Corps of Engineers
  Status: Not required. See letter in Section VII of this document.

State of Hawaii Permits

- Water Quality Certification, Department of Health, Clean Water Branch
  Status: Not required. See letter in Section VII of this document.

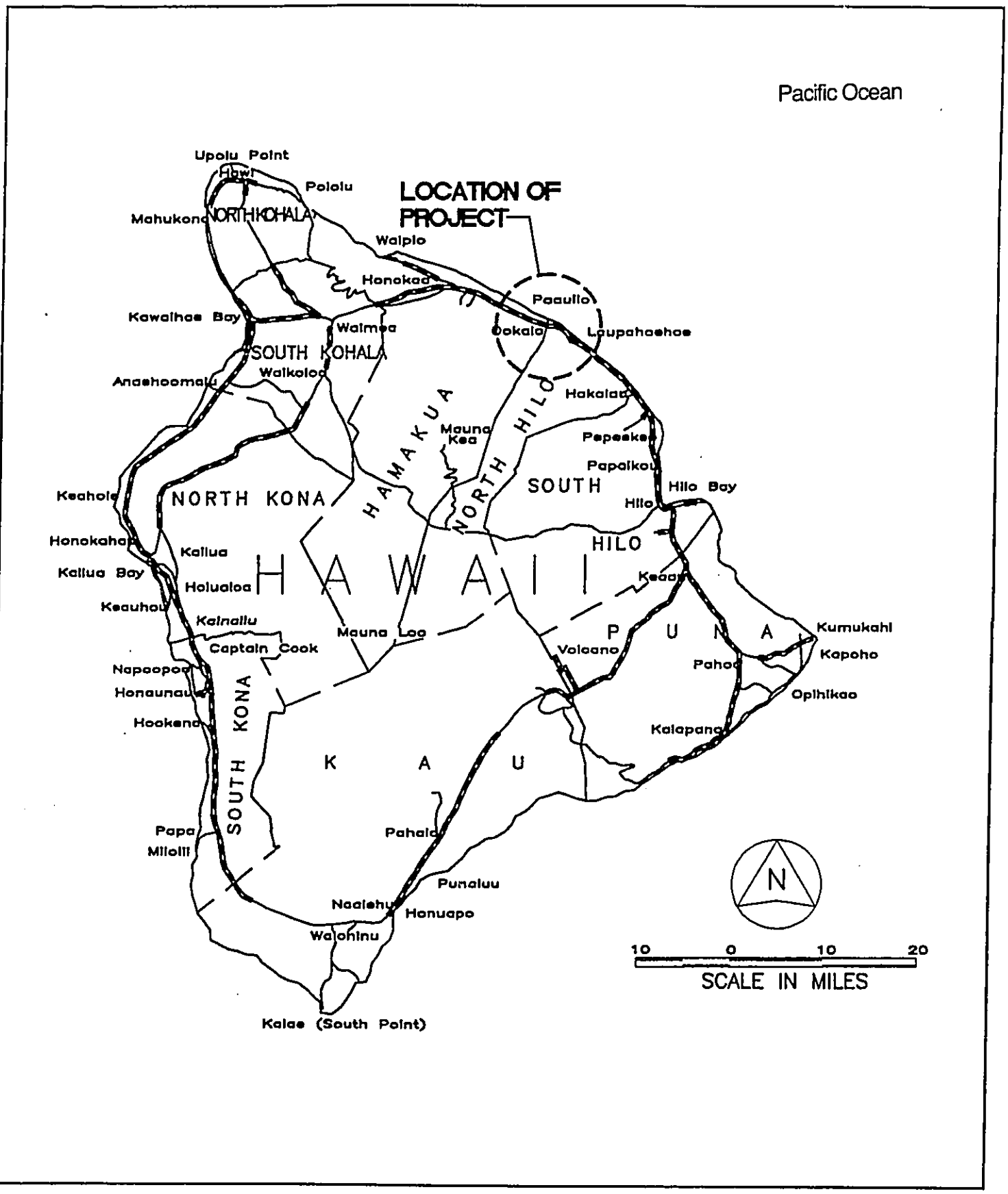
- Stream Channel Alteration Permit, Department of Land and Natural Resources, Commission on Water Resource Management
  Status: Not required. See letter in Section VII of this document.

- Hawaii Coastal Zone Management Program Federal Consistency Certificate, Department of Business, Economic Development & Tourism, Office of Planning
  Status: Not required. See letter in Section VII of this document.

Hawaii County Permits

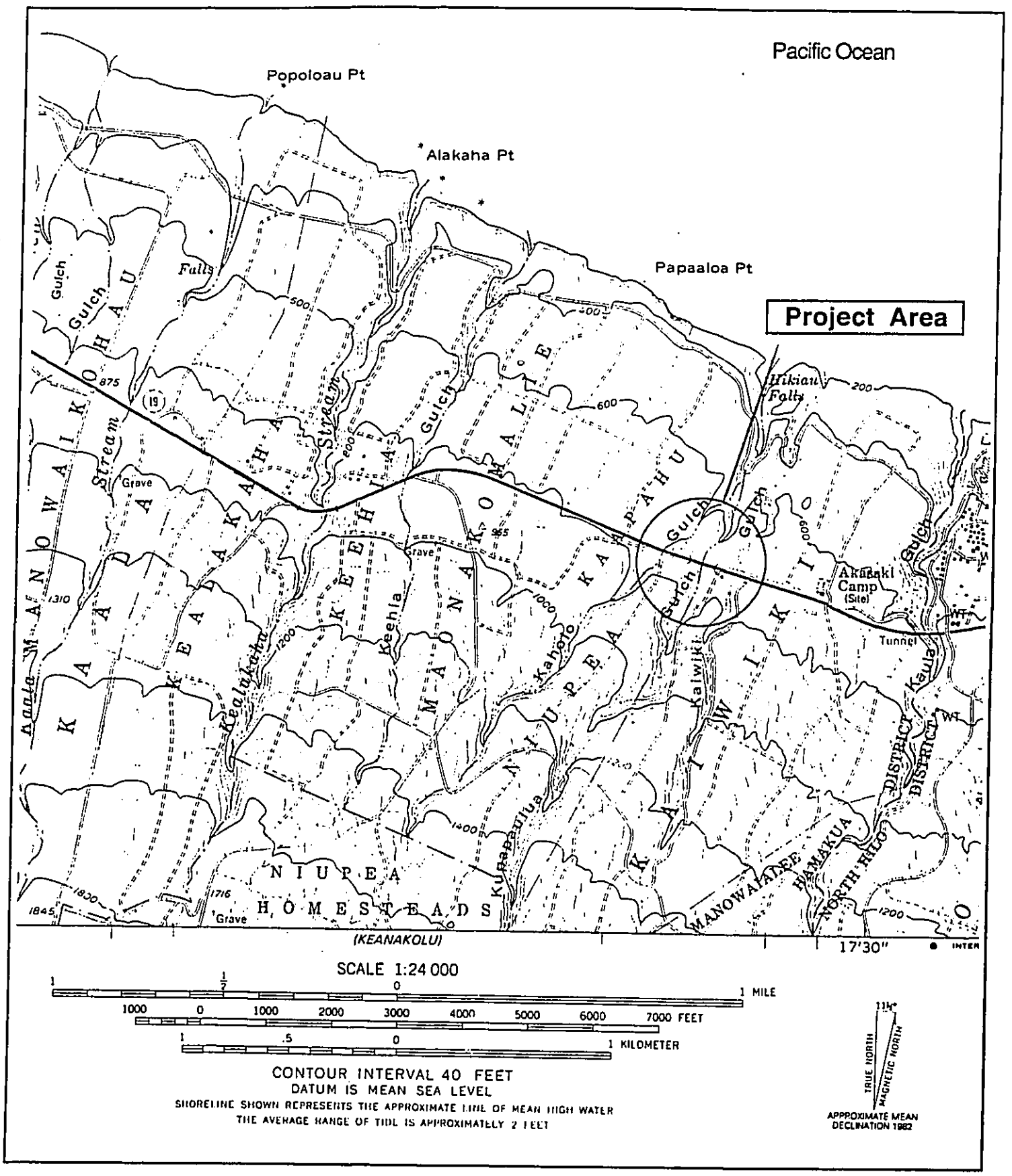
- Building Permit, Department of Public Works, Building Division
  Status: Permit required prior to construction.

- Grubbing, Grading Excavation and Stockpiling Permit, Department of Public Works, Engineering Division
  Status: Permit required prior to site clearing and construction.



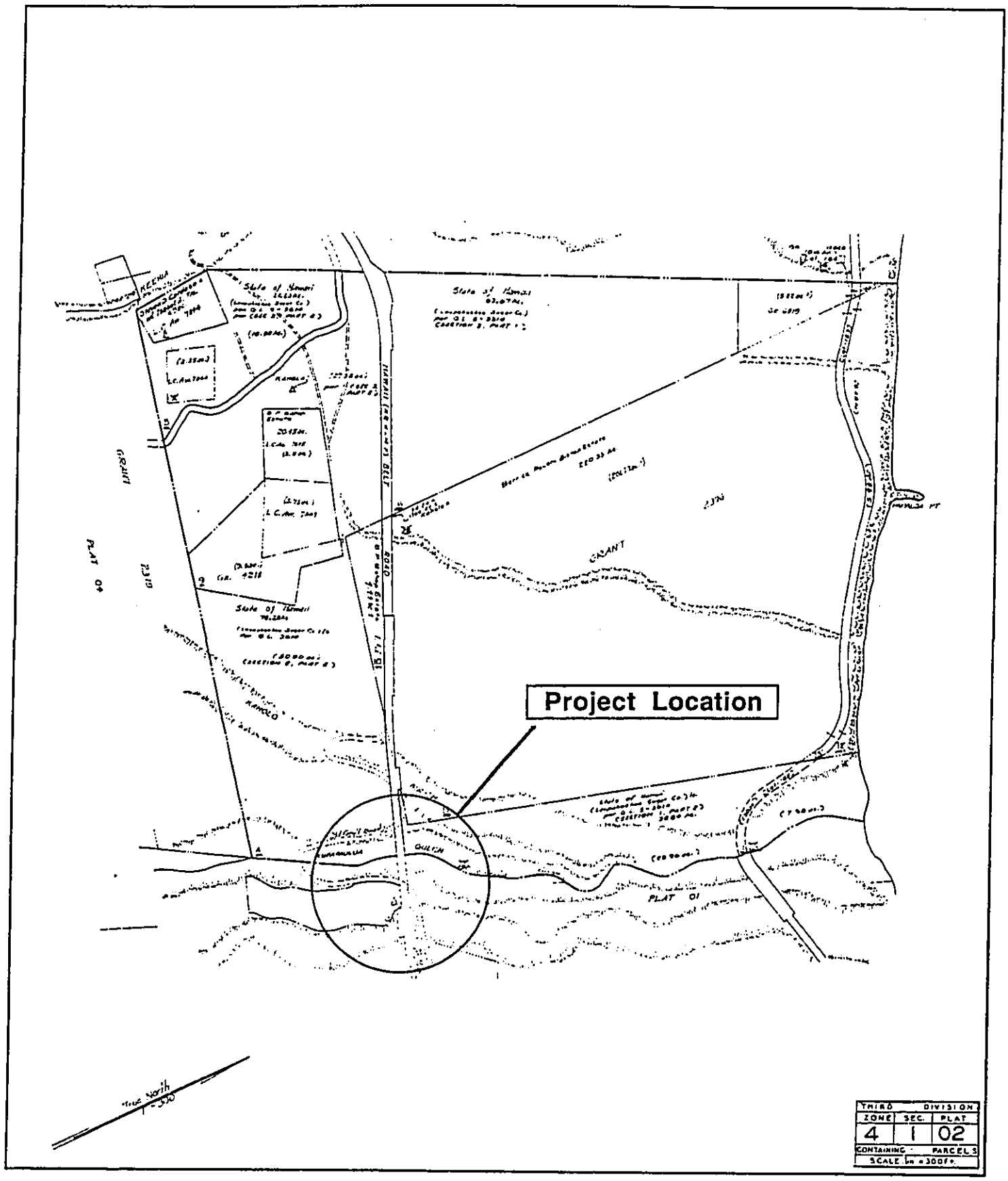

Hawaii Belt Road
Kupapaulua Bridge Widening
March 2001

**Figure 1**
**Island Map**
Final Environmental Assessment



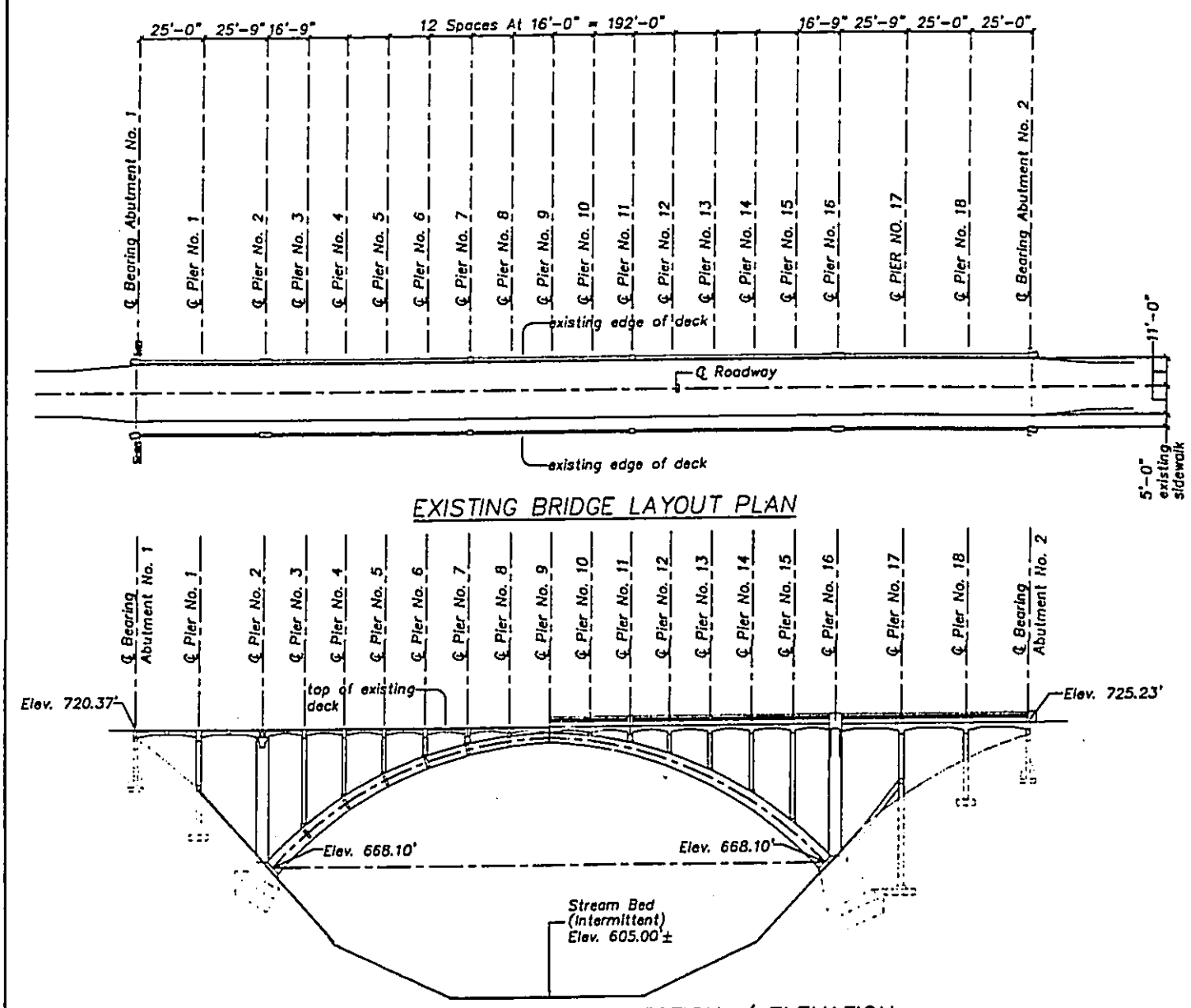

Hawaii Belt Road
Kupapaulua Bridge Widening
March 2001

**Figure 2**
**Area Map**
Final Environmental Assessment




Hawaii Belt Road
Kupapaulua Bridge Widening
March 2001

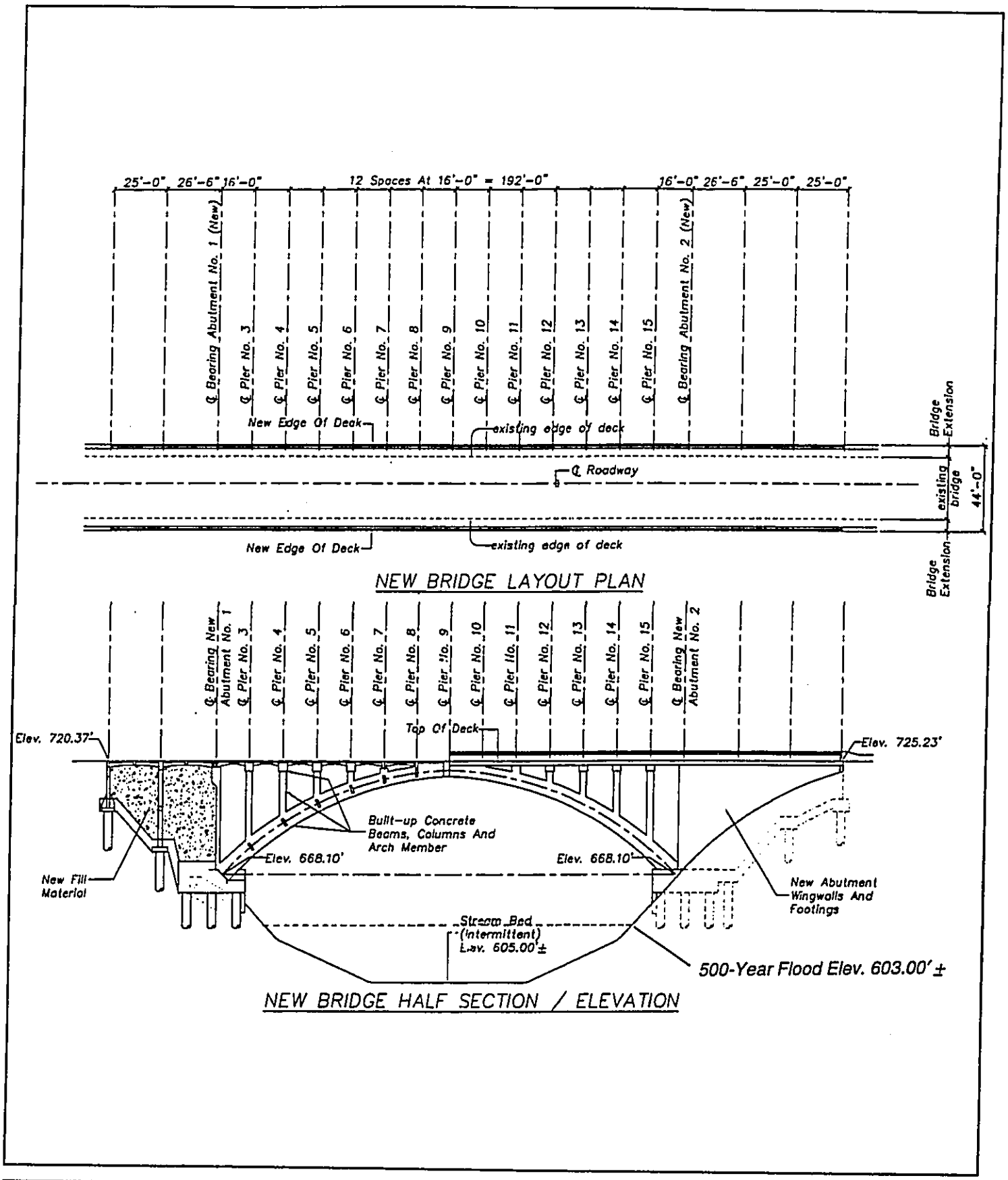
**Figure 3**
**Tax Map**
Final Environmental Assessment




EXISTING BRIDGE LAYOUT PLAN

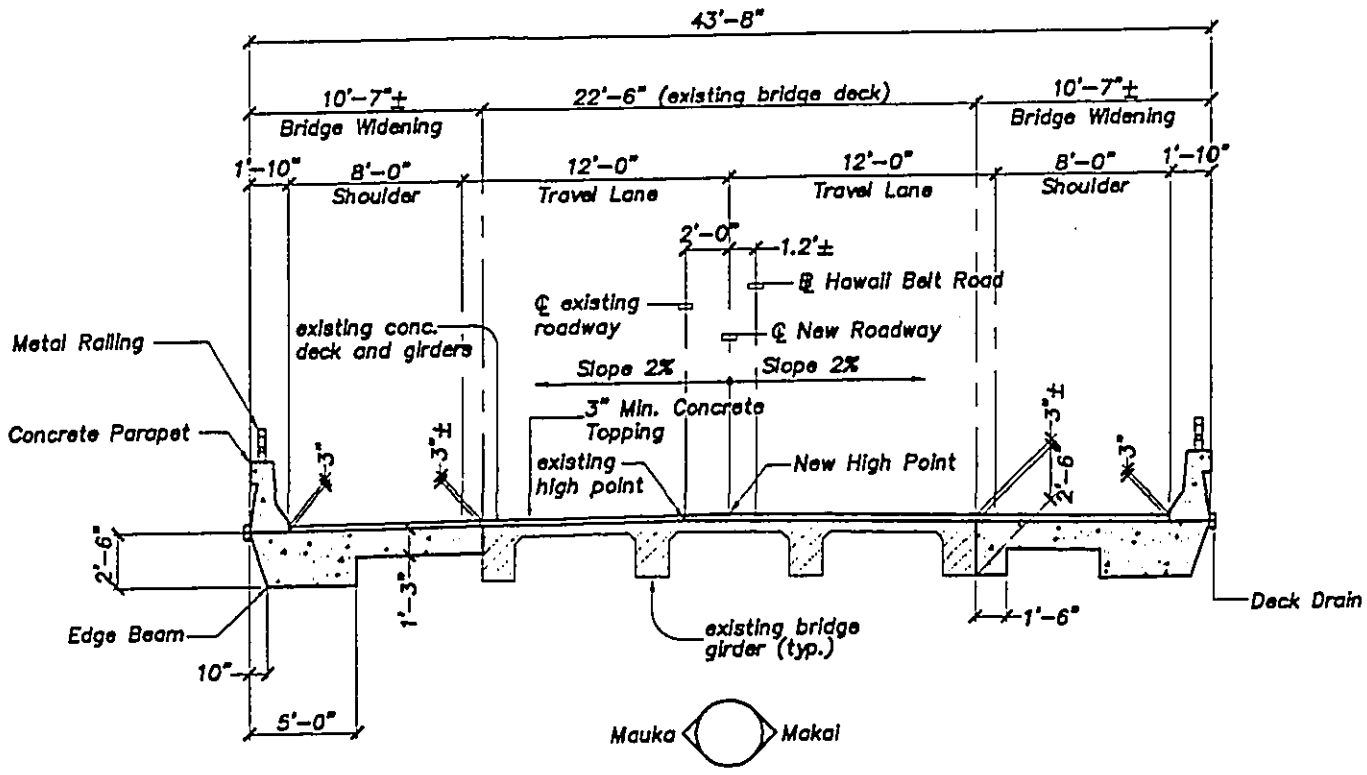



EXISTING BRIDGE HALF SECTION / ELEVATION




Hawaii Belt Road
Kupapaulua Bridge Widening

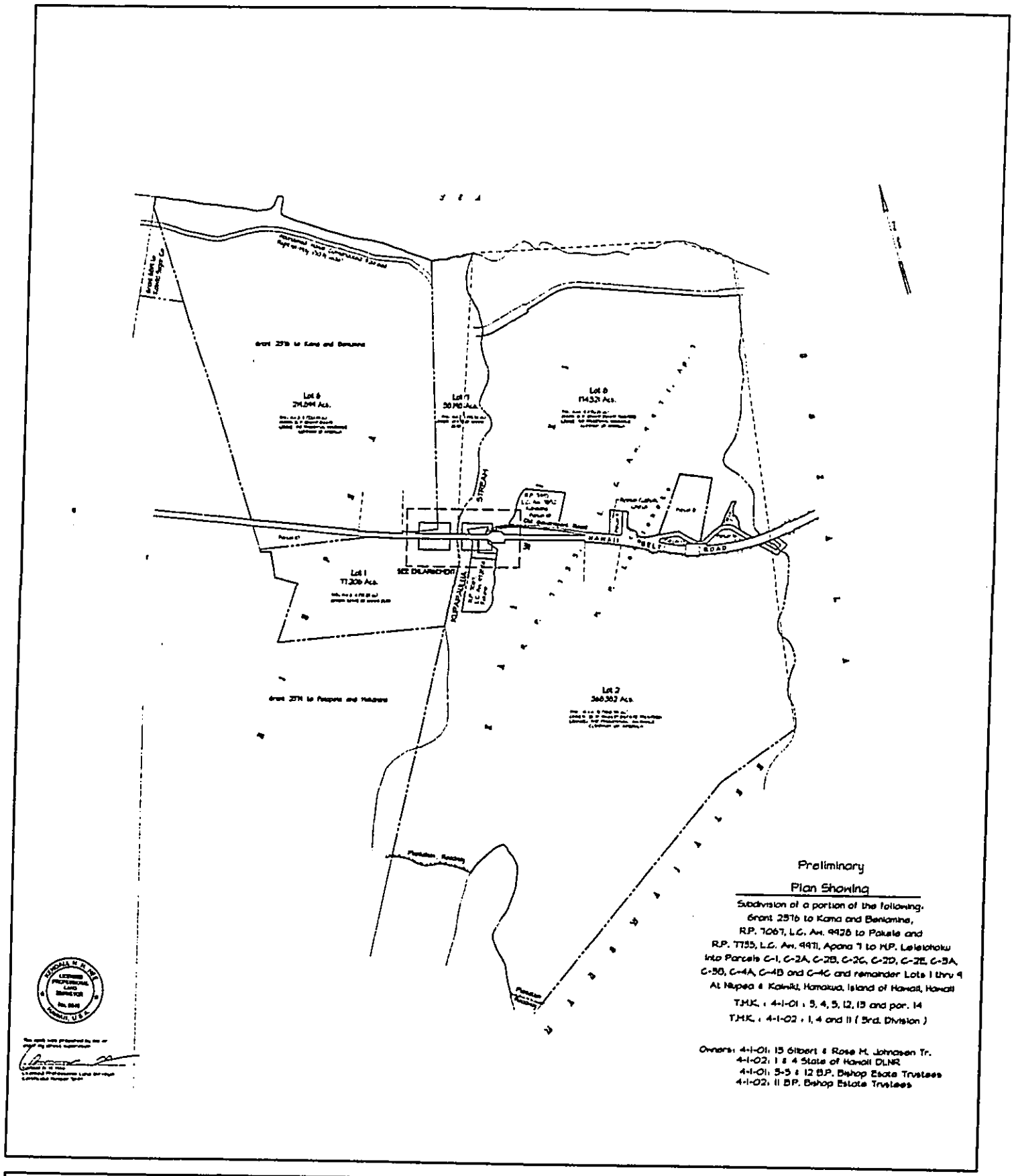
**Figure 5**
**Proposed Bridge Profile**
Final Environmental Assessment




TYPICAL NEW DECK SECTION

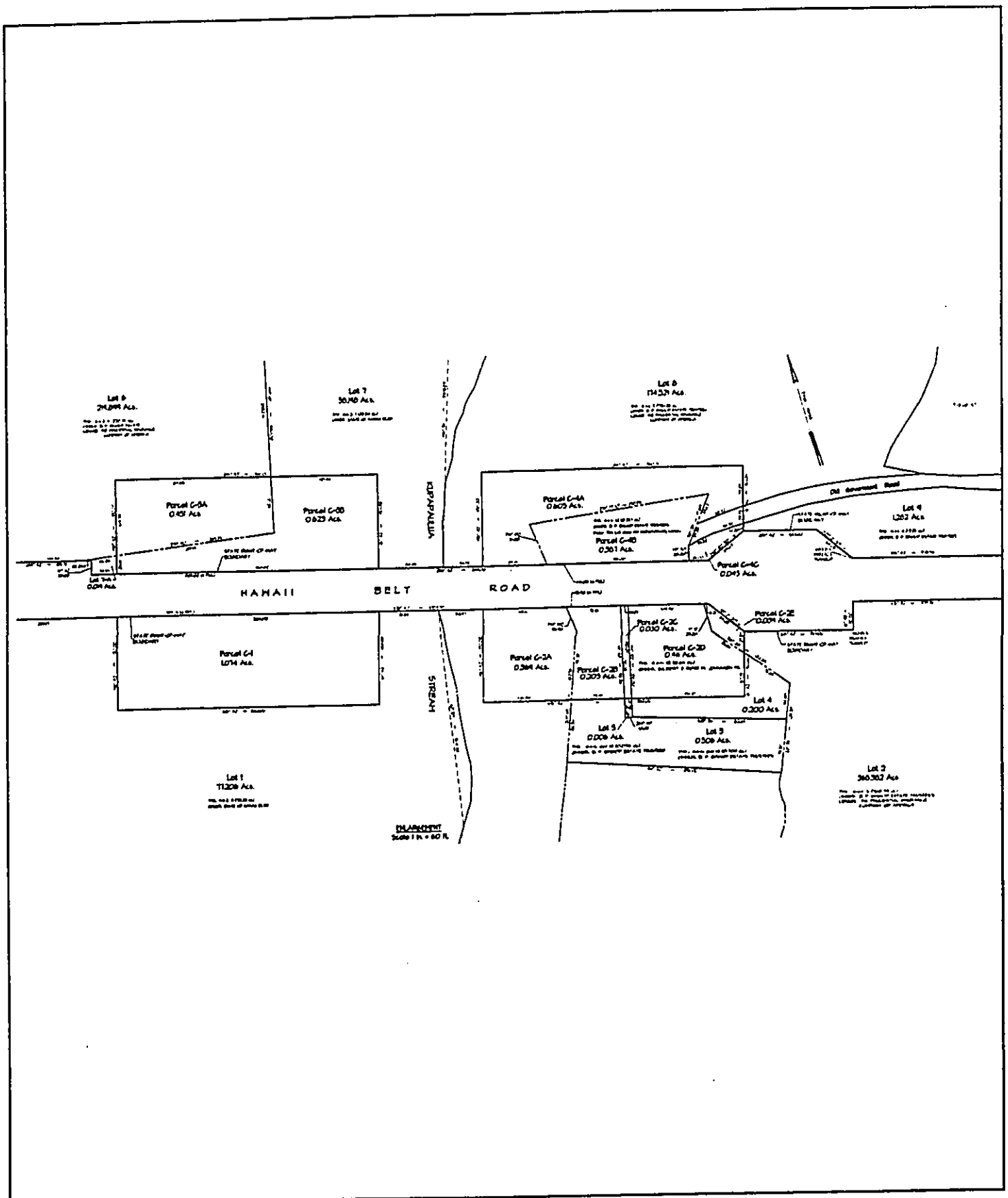
Hawaii Belt Road
Kupapaulua Bridge Widening
March 2001

**Figure 6**
**Bridge Cross-Section**
Final Environmental Assessment




Hawaii Belt Road
Kupapaulua Bridge Widening
March 2001

**Figure 7**
**Construction Area Map**
Final Environmental Assessment




Hawaii Belt Road
Kupapaulua Bridge Widening
March 2001

**Figure 8**
**Right-of-Way Parcel Plan**
Final Environmental Assessment

## IV. AFFECTED ENVIRONMENT, POTENTIAL IMPACTS AND MITIGATIVE MEASURES

### A. Impacts to the Physical Environment

#### 1. Surrounding Land Uses

The proposed project site is located along the Hawaii Belt Road Highway (Route 19) 1.5 miles west of Ookala along the north coast of Hawaii, west of Hilo Town.

No significant long-term impacts to the surround area will result from the implementation of the proposed project. Temporary impacts will occur to access and staging areas during the construction period. These impacts will not have and social or economic impact. Physical alterations resulting from construction such as clearing of shrubbery are expected to return to their natural condition after construction is completed.

#### 2. Topography and Geology

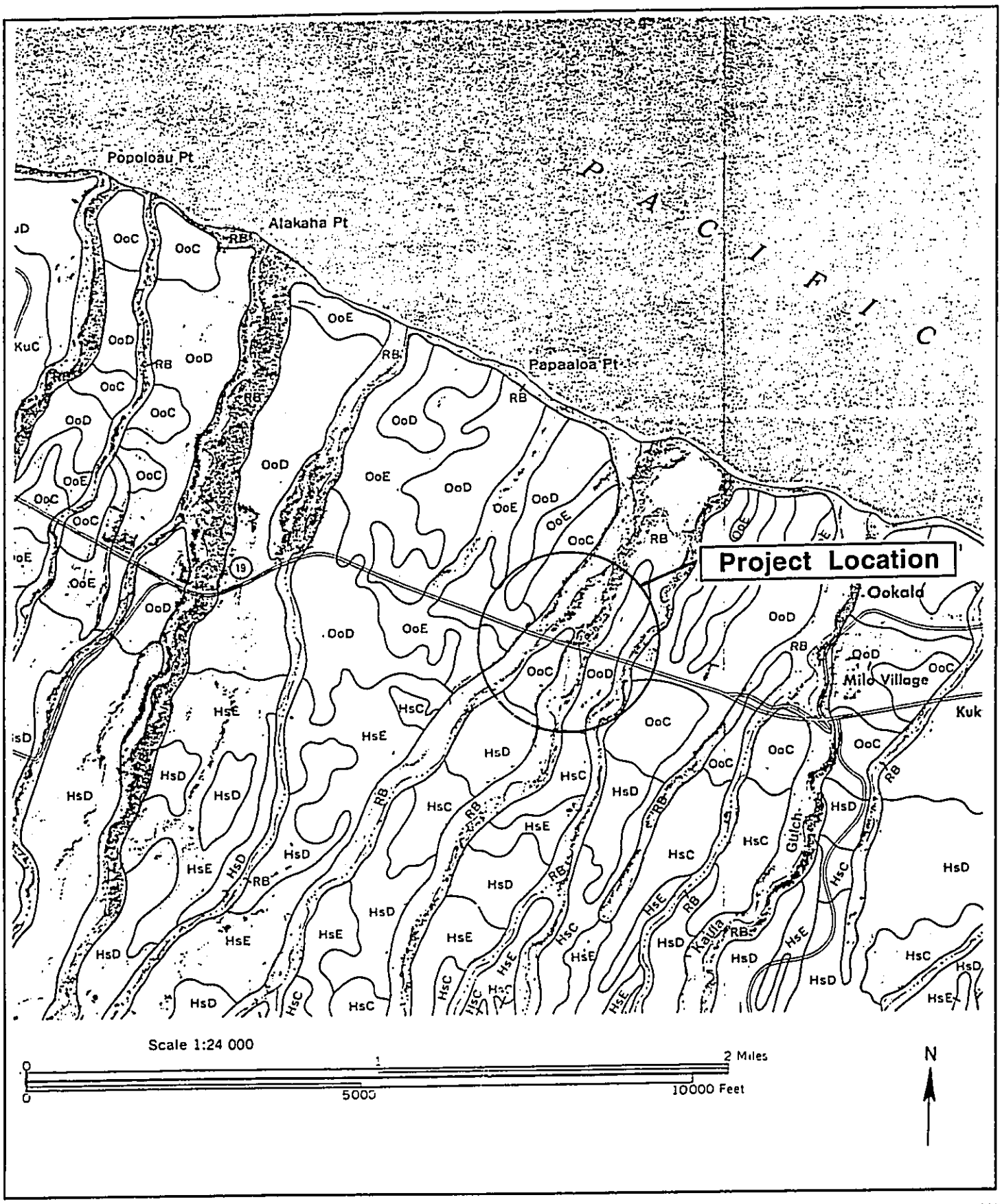
The existing two-lane bridge crosses over Kupapaulua Gulch and intermittent stream. The side slopes of the gulch drop down steeply to the gulch floor and streambed. The surrounding area consists of fallowed or unusable agriculturally zoned lands.

#### 3. Soils

According to the Soil Survey of Hawaii Island of Hawaii, State of Hawaii by the United States Department of Agriculture Soil Conservation Service, Sheet 22, the project site consists of two distinct types of lands: classification RB, rough broken lands and classification OoD, Ookala silty clay loam. Each type is summarized below.

The area beneath the bridge structure consists of rough broken lands (RB) that are considered a miscellaneous land type that consists of very steep, precipitous land broken by many intermittent drainage channels. It occurs primarily in gulches, and the slope is dominantly 35 to 70 percent. The soil material ranges from very shallow to very deep.

The approach areas of the bridge contain Ookala Series soils that consist of well-drained silty clay loams that formed in volcanic ash. These soils are gently sloping to steep. They occupy coastal areas on Mauna Kea at elevations ranging from near sea level to 1,000 feet and receive rainfall from 90 to 120 inches annually. The Ookala silty clay loam, 12 to 20 percent slopes (Ood) generally have a surface layer of dark reddish-brown silty clay




Hawaii Belt Road
Kupapaulua Bridge Widening
March 2001

**Figure 9**
**Soils Map**
Final Environmental Assessment

loam about 12 inches thick. The subsoil is dark-brown to dark yellowish-brown silty clay loam about 43 inches thick. This is underlain by very dark grayish-brown, partly weathered Aa lava fragments.

4. Hydrology and Flood Zone

According the National Flood Insurance Program Flood Insurance Rate Map, the project site is located in Zone X, an area determined to be outside of the 500-year flood plain. The streambed located below the bridge is intermittent and is located approximately 63-feet below the base points of the bridge arch.

5. Wetlands

There are no known wetlands as defined by soil and vegetation types in the proposed project site. The project site is also located outside of the Special Management Area.

6. Flora and Fauna

Pacific Aquatic & Environmental, Inc. (PAE) conducted a flora analysis for the proposed site and right-of-way access parcels and found that the intermittent stream within the areas of the proposed new bridge structure, is dominated largely by introduced species. None of the plants found during the field studies is a threatened or endangered species; nor is any plant considered a species of concern (U.S. Fish and Wildlife Service, 1997). All of the plants can be found in similar environmental habitats throughout the Hawaiian Islands.

Pacific Aquatic Environmental, Inc. (PAE) also conducted a biological assessment of Kupapaulua Gulch for the Kupapaulua Bridge Environmental Assessment. These surveys assessed native aquatic and endangered bird species that may occur in areas potentially affected by the Kupapaulua Bridge construction project. PAE concluded, " Native endangered species are not impacted by the proposed project since it is a very remote possibility that native forest birds such as Iiwi, Apapane, or others still inhabit this low elevation area. "

PAE also concluded that in the area downstream from the main Hawaii Belt Road to the ocean, Kupapaulua Gulch was determined to be intermittently flowing, with no permanent aquatic habitat. Because the stream channel was dry, no native stream fish, crustaceans, mollusks, or aquatic insects were observed. Therefore, no adverse impacts are expected due to the construction of the Kupapaulua Gulch Highway Bridge.

7. Historic and Archaeological Resources

An archaeological inventory survey was conducted by Pacific Legacy, Inc. in the vicinity of the Kupapaulua Bridge, Hamakua, Hawaii. In the Executive Summary of the survey, Dr. Paul Cleghorn concludes that none of the archaeological resources found at Kupapaulua Gulch appear to be significant based on any of the National Historic Register of Historic Places significance criteria. The Kupapaulua Bridge itself is historic and has been fully documented and is discussed in detail in Appendix D, E and F.

8. Air Quality

Presently, the traffic volume on the Kupapaulua Highway consists of residents of northeastern Hamakua Coast; some commercial traffic occasional tourist trips to and from Hilo to Honokaa. Traffic was not observed to be heavy and the impact from vehicular emissions is not considered major in terms of negative air quality values.

During the construction phase, the air quality from construction equipment, i.e. generators, front-end loaders, material delivery trucks and miscellaneous onsite equipment will create some additional air quality degradation from construction equipment emissions and from fugitive dust. These impacts are temporary in nature and should cease upon completion of the proposed improvements.

9. Noise Environment

Negative impact from noise generation due to construction will not be major in terms of impact. There are no residential areas located in the immediate proximity of the proposed project site. Pockets of residential units are in the general vicinity, but are not close enough to be adversely affect by construction noise.

10. Scenic and Open Space Resources

Due to the nature of the proposed bridge design, there will be a minimal and insignificant impact on scenic and open space resources. The bridge will widen the existing bridge, and will not be obtrusive. No designated scenic view locations are located in the project area.

B. Social and Community Impacts

1. Population

The population for the town of Ookala in 1980 was 401 residents according to the Census Bureau. This does not include transients, visitors, and other

temporary non-residents. The proposed action is not expected to contribute to any population change within the vicinity.

2. Economy

The project will contribute positively to the economy in terms of construction-related employment and the sale of goods and services. Wages, sales taxes, secondary and tertiary spending will also positively affect the economy.

3. Police, Fire and Medical Services

Police service for the project area is provided by patrols from the Lapahoehoe Station and Fire Protection Service is provided by the Kolekole and Hakalau Stations. Both Police and Fire Departments indicated that emergency service response times would not be affected by the proposed improvements.

4. Recreational Resources

Recreational services will not be affected by the proposed project.

5. Educational Resources

No impacts on educational resources are expected due to the implementation of this proposed project.

6. Cultural Resources

The proposed project will not have any impact on cultural resources. The project is located over a dry stream bed which provides makai to mauka access to the upper reaches of the valley but access will not be restricted during the construction period. Access to the valley from the bridge itself is not possible due to the steep slopes located immediately after the bridge approaches. The immediate area is not known to serve as a significant cultural resource.

C. Infrastructure and Utilities Impacts

1. Roadways

Roadways will be impacted during the construction phase with intermittent lane closures anticipated due to transport of materials, heavy equipment and required work areas. Typical work zone traffic controls will be employed to minimize traffic impact.

2. Bicycle and Pedestrian Access

The existing bridge provides a single elevated 5-foot wide pedestrian sidewalk along the northern side of the bridge. This elevated walk along with the low non-conforming rail results in a dangerous walkway condition. Because no shoulders are provided, stalled or impaired vehicles also do not have an area to pull aside to allow traffic to pass.

Two 8-foot wide shoulders are proposed for the improved bridge. This will allow bicyclist and pedestrians to travel in both directions without sharing the same travel lane with automobiles. Extended railings will further improve safety. The proposed improvements will also widen the vehicular lanes from 11-feet to 12-feet providing an additional margin of safety when pedestrians or bicyclist are passed. The resultant widening also provides a pullover area when necessary in emergency situations.

3. Drainage

Drainage will not be significantly impacted on a long-term basis, but could experience temporary construction related impacts. No work is anticipated within the streambed of the gulch.

4. Existing Utility Systems

According to the County of Hawaii Department of Public Works and Department of Water Supply, no sewer or water lines are located on the bridge.

Electrical power lines are located adjacent to the bridge alignment to south and are currently being evaluated for possible relocation to allow construction activities to proceed without any impact to electrical service. Telephone lines are located to the north of the project site and are also being evaluated for relocation.

## V. RELATIONSHIP TO GOVERNMENTAL PLANS AND POLICIES

The proposed project is located within a rural area that is generally undeveloped and fallowed. Policy and land use plans for the vicinity call for general agricultural uses that may include crop cultivation or pasture lands. No urban uses were observed within the immediate vicinity of the project site.

A. State Land Use

The project area is designed as "Agriculture" on the State Land Use Commission Land Use Boundary Map.

B. Coastal Zone Management and Special Management Areas

The project site is not located within the Special Management Area according the Planning Department land use maps. The project is also not located within a sensitive coastal zone area.

C. County of Hawaii General Plan

The County of Hawaii General Plan designates the project area for "Intensive and Extensive Agricultural Land".

D. County of Hawaii Zoning

The project area is also zoned as A-40a on the County Zoning Map. This designation is provided to land areas of 40-acres or more to be used for general agriculture.

E. Applicable Governmental Permits and Approvals

This document is prepared in compliance with Chapter 343 Hawaii Revised Statutes and Title 200 Administrative Rules which require that any Agency Action that involves the use of State Lands or Funds shall be subject to the Environmental Assessment or Environmental Impact Statement Regulations. The proposed action involves the use of both State lands and funds.

No discretionary permits will be required for the proposed project since it will occur entirely outside of the stream bed area. Correspondence from the following agencies confirm that no stream related permits will be required.

1. U.S. Army Corps of Engineers - Sec. 404 Clean Water Act Permit
2. State Dept. of Health - Section 401 Clean Water Act Permit
3. State Dept. of Land & Natural Resources - Stream Channel Alteration Permit (SCAP)
4. Office of State Planning - Coastal Zone Management Certification (CZM)

The U.S. Army Corps of Engineers Section 404 Permit is not required because the project will not occur within the stream. The State Dept. of Health Section 401 permit is required for projects requiring the Section 404 Permit. Coastal Zone Management Certification is required only when a U.S. Army Corps of Engineers permit is required, or when special Federal grants are used. The proposed project is an FHWA appropriation and is not subject to CZM review under this criterion. A Department of Land & Natural Resources Stream Channel Alteration Permit is not required since the project will not alter the stream.

Prior to construction, various administrative permits will also be required. These will include but will not be limited to Building Permit, Grubbing and Grading Permit and traffic plans. These are generally the responsibility of the contractor and do not require discretionary approval processes.

F. Historic Preservation

The Kupapaulua Bridge is considered a property eligible for inclusion in the National Register of Historic Places. Alternatives to altering the bridge were considered and the widening alternative was selected. These alternatives are discussed further in Chapter VI of this document.

The selected alternative requires the alteration of the existing bridge, therefore, in coordination with the Hawaii State Historic Preservation Officer, a Memorandum of Agreement was prepared which lists actions required prior to the alteration of the subject bridge. This agreement is attached as Appendix D. Documentation of the existing bridge per the Memorandum of Agreement is attached as Appendix E.

## VI. ALTERNATIVES CONSIDERED

The following alternatives were considered in determining the best course of action to replace or rehabilitate the Kupapaulua Gulch crossing. These alternatives consist of the No Action Alternative, a Rehabilitate and Widen Alternative, a Replacement Over Existing Alignment Alternative and a Replacement Adjacent to Existing Alignment Alternative. These are described in greater detail below.

A. No Action Alternative

The retrofit or replacement of Kupapaulua Bridge is considered essential to the safe and efficient use of the Hawaii Belt Road Highway. The age and design criterion of the existing bridge requires remedial design and construction to bring the bridge up to current construction standards. No Action, which will leave the bridge is in its present condition is not considered a viable alternative and consequently, was not selected.

B. Alternative A: Rehabilitate and Widen Existing Bridge (Selected Alternative)

The existing bridge requires upgrading to conform to current design standards. This upgrade, without the use of a detour road is the preferred alternative based upon cost effectiveness and minimization of environmental impact.

During the preliminary design process, a detour road was considered for the duration of construction. This alternative would use a temporary detour road and temporary detour bridge that would be located north of the existing site at a lower elevation. Subsequent analysis of the alternative determined that bridge improvements could be constructed without the use of a detour road while maintaining traffic flow during the construction period. This would be possible by sequencing construction work to minimize traffic impacts. The alignment is shown in Figure 10 on page 30.

To conform to current design standards, the existing bridge would be widened and existing structural members upgraded. The advantages of this alternative are:

1. Work for the approaches to the bridge would be minimal;
2. No detour road or bridge would be required;
3. The total construction period would be shorter than other alternatives.

The approximate construction cost estimate of this alternative is $14 to $16 million dollars.

C. Alternative B: Demolish Existing Bridge and Replace with a New Bridge

This alternative would entail the demolition of the existing bridge and the construction of an entirely new bridge over the same alignment. Since this would be a completely new structure, a detour road and/or a detour bridge would be required for the entire length of the demolition and construction work.

The detour road proposed under this scenario would be routed to the north and utilize an abandoned cane haul road. This detour alignment is shown in Figure 11 on page 31. The selected road would need to be widened and upgraded to conform to minimum standards. The detour would also require easement over privately owned lands.

A second construction detour alternate would be to construct a temporary detour bridge adjacent and immediately to the south of the existing alignment. This detour alignment is shown in Figure 12 on page 32. This bridge would be removed after the new bridge is completed.

The disadvantages of this alternative are:

1. The historic bridge would be demolished;
2. The public would be inconvenienced with the detour road.

The approximate construction cost estimate of this alternative is $20 million dollars.

D. Alternative C: Construct New Bridge Adjacent to Existing Bridge

This alternative would require realignment of the existing road approaches to the new adjacent bridge location. Another bridge, Kaholo Bridge, is located approximately 400 feet on the Honokaa side to the existing Kupapaulua Bridge. Any realignment will also affect Kaholo Bridge. This would require the new bridges to cross both Kupapaulua and Kaholo Gulches in order to maintain appropriate traffic geometrics. Additional acquisition of rights-of-way would also be required. This alternative is shown in Figure 13 on page 33.

The advantages of this alternative are:

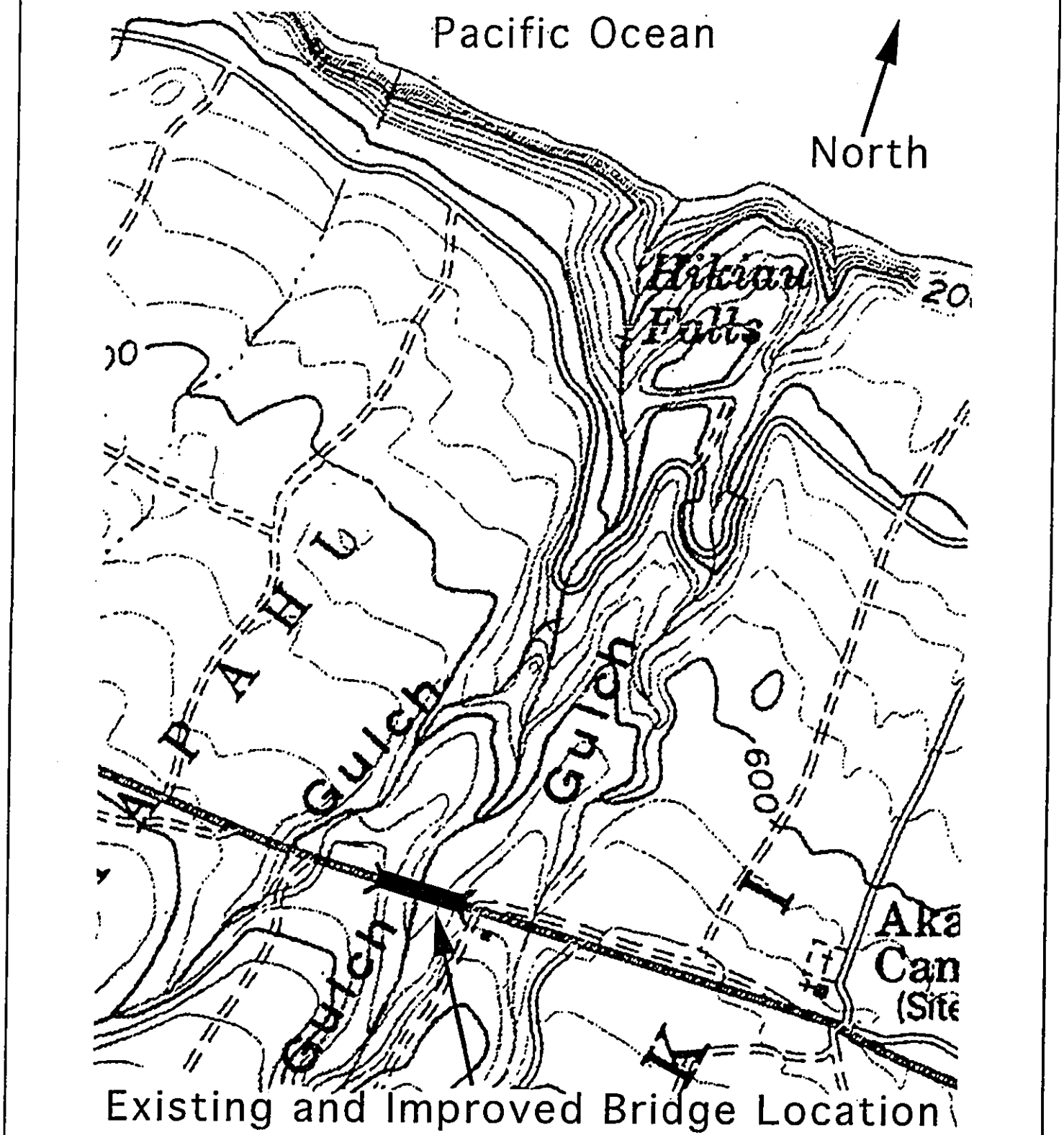
1. The existing historic bridge would be preserved in its present state;
2. This route would least inconvenience the public;
3. The existing Kaholo Bridge will not need to be upgraded or replaced in the near future.

The disadvantages of this alternative are:

1. Additional acquisition of rights-of-way will be required;
2. The existing Kaholo Bridge is not currently scheduled for upgrading or replacement however this alternative will require a costly replacement bridge for safe traffic design;
3. Although the existing historic bridge will be preserved, it is unclear as to who or how it will be maintained since its primary function will be eliminated.

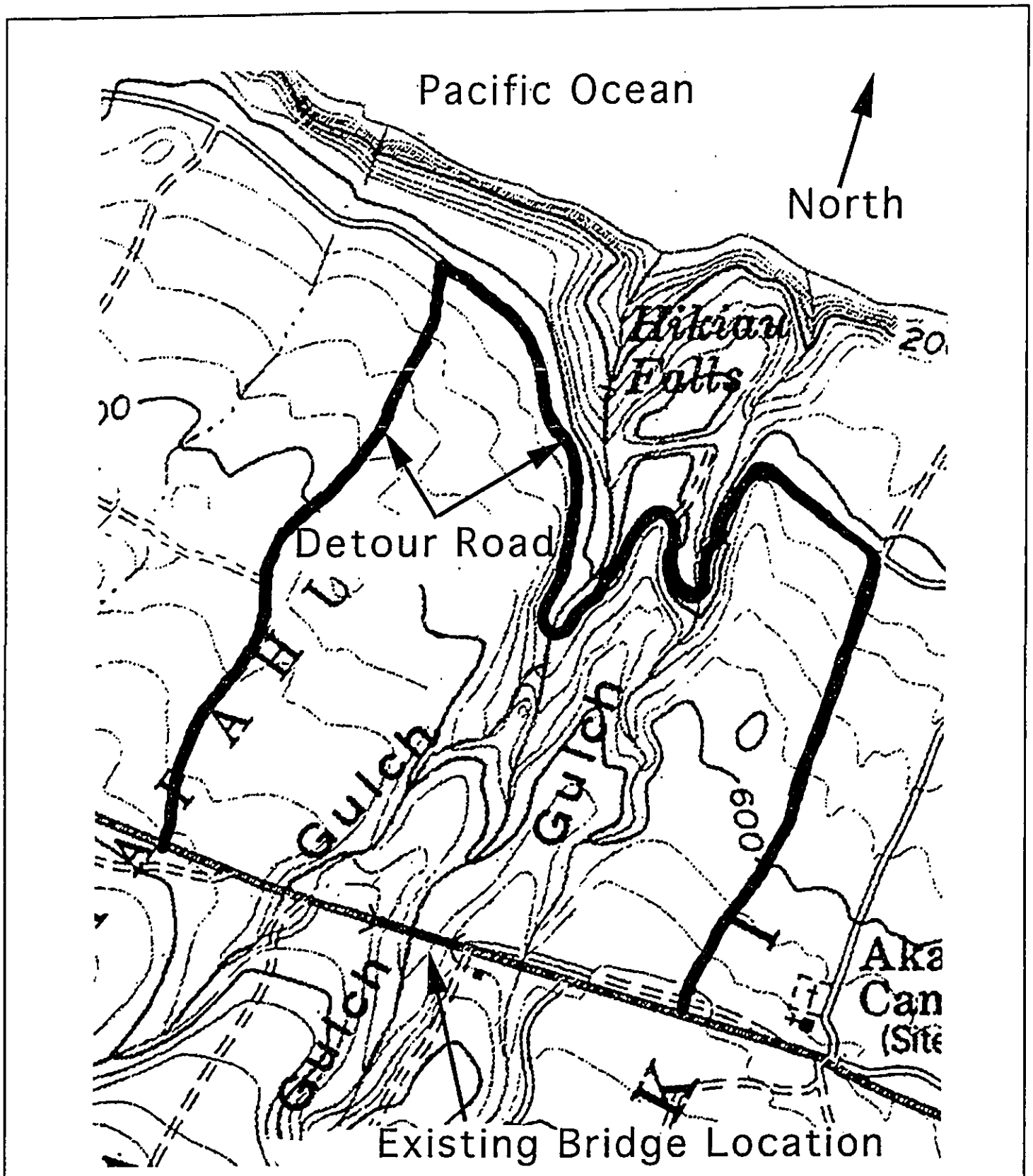
The approximate construction cost estimate of this alternative is $25 million dollars.

Based on an evaluation of these alternatives, it was determined that Alternative A, Rehabilitation and Widening of the Existing Bridge is the preferred alternative since: it does not require the use of a detour road, it will have minimal environmental impact, and is cost effective.



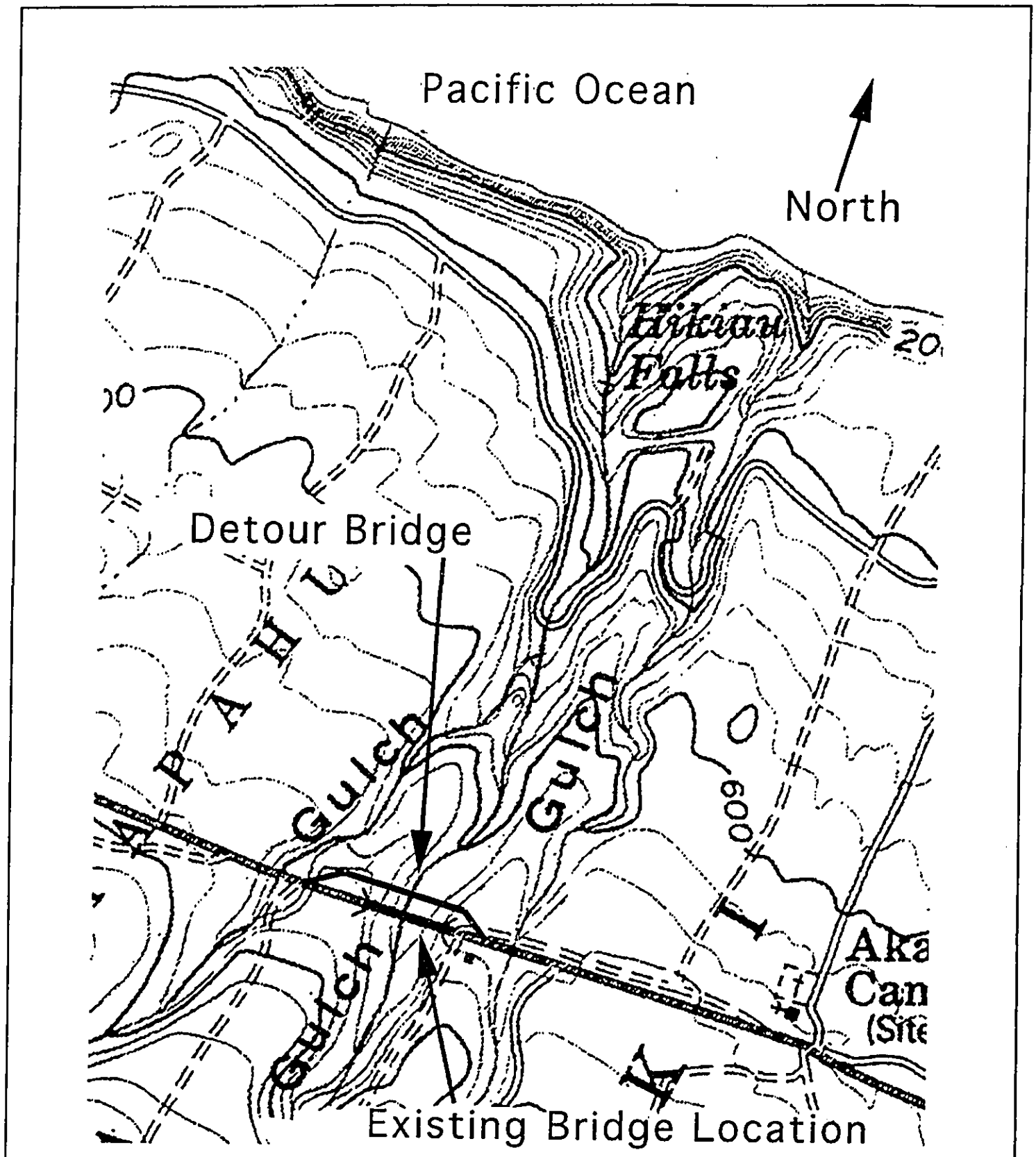

Hawaii Belt Road
Kupapaulua Bridge Widening
March 2001

**Figure 10**
**Alternative A Alignment**
Final Environmental Assessment



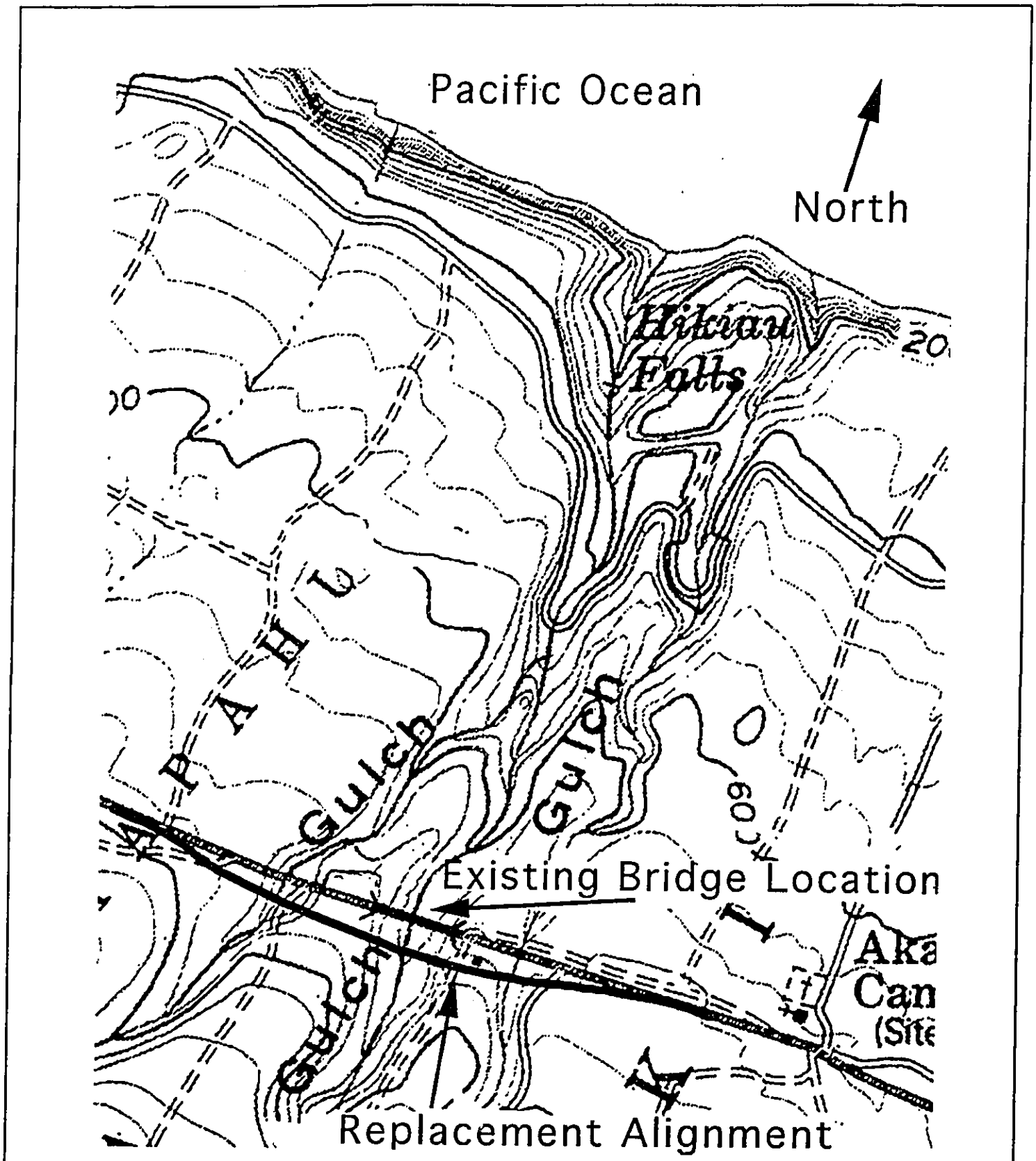

Hawaii Belt Road
Kupapaulua Bridge Widening
March 2001

**Figure 11**
**Alternative B-1 Alignment**
Final Environmental Assessment




Hawaii Belt Road
Kupapaulua Bridge Widening
March 2001

**Figure 12**
**Alternative B-2 Alignment**
Final Environmental Assessment




Hawaii Belt Road
Kupapaulua Bridge Widening
March 2001

**Figure 13**
**Alternative C Alignment**
Final Environmental Assessment

## VII. LIST OF PARTIES CONSULTED DURING THE PREPARATION OF THE ENVIRONMENTAL ASSESSMENT

Agency or Organization

State of Hawaii

- Department of Land and Natural Resources
- State Historic Preservation Division, DLNR
- Office of State Planning

Federal Agencies

- U.S. Department of Agriculture
- U.S. Army Corps of Engineers
- U.S Department of the Interior
  Fish and Wildlife Service

County of Hawaii

- County of Hawaii
  Planning Department
- County of Hawaii
  Department of Public Works
- County of Hawaii
  Department of Parks and Recreation
- County of Hawaii
  Department of Water Supply
- County of Hawaii
  Fire Department
- County of Hawaii
  Police Department

Other Groups

1. Hawaii Electric Light Co. Inc.
   Engineering Dept.

2. GTE Hawaiian Telephone

3. KSBE Bishop Estate

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

REPLY TO
ATTENTION OF

September 9, 1999

Regulatory Branch

Mr. Taeyong M. Kim
Environmental Communications, Inc.
P.O. Box 536
Honolulu, Hawaii 96809

Dear Mr. Kim:

This responds to your request for a Department of the Army (DA) jurisdictional determination for the proposed Kupapaulua Bridge Widening Project, Hamakua District, Hawaii.

Based on the information you provided, I have determined that the proposed project will not impact waters of the U.S. and will not require a DA permit. However, I recommend that best management practices be employed during construction to prevent potential discharges *from* entering waters of the U.S.

Should you have any questions regarding this determination, please contact Peter Galloway of my staff at 438-8416 and refer to file number 990000449.

Sincerely,

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

Copies Furnished:

Clean Water Branch, State of Hawaii Department of Health, P.O. Box 3378, Honolulu, HI 96801-3386
State of Hawaii, Department of Land and Natural Resources, Commission on Water Resource Management, P.O. Box 621 Honolulu, HI 96809

BENJAMIN J. CAYETANO
GOVERNOR OF HAWAII

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

BRUCE S. ANDERSON, Ph.D., M.P.H.
[redacted]
DIRECTOR OF HEALTH

In reply, please refer to
EMD/CWB
10001CEC.99

October 1, 1999

Mr. Taeyong M. Kim
Environmental Communications, Inc.
P.O. Box 536
Honolulu, HI 96809

Dear Mr. Kim:

Subject: Kupapaulua Bridge Widening Project, Hamakua, Hawaii

Reference is made to your September 23, 1999 letter regarding the subject project. Pursuant to Section 401 of the Federal Water Pollution Control Act (commonly known as the Clean Water Act (CWA)), a Water Quality Certification (WQC) is required for "any applicant for a federal license or permit to conduct any activity, including, but not limited to, the construction or operation of facilities which may result in any discharge into the navigable waters of the United States." In general, a WQC is not required if an activity will not result in any discharge or does not require a federal license or permit. Definition of the "discharge" may be found in CWA §502.

Section 342D-50(a) of the Hawaii Revised Statutes (HRS) states that "No person, include any public body, shall discharge any water pollutant into state waters, or cause or allow any water pollutant to enter state waters except in compliance with this chapter, rules adopted pursuant to this chapter, or a permit or variance issued by the director." HRS §342D-50(d) further states that "No person, include any public body, shall violate any rule adopted pursuant to this chapter or any permit or variance issued or modified pursuant to this chapter."

To comply with applicable requirements specified in Chapter 11-54 (entitled Water Quality Standards (WQS)) of the Hawaii Administrative Rules, we recommend that site-specific Best Management Practices (BMPs) shall be deployed. The BMPs shall be designed, implemented, and maintained in a manner to properly isolate and confine the construction activity and to contain and prevent the potential pollutant(s) discharges from adversely impacting the State receiving water quality. An applicable monitoring plan shall also be developed and implemented to insure the adequacy and efficiency of the implemented BMPs and the compliance of HAR 11-54.

A National Pollutant Discharge Elimination System (NPDES) permit issued by the Department of Health (Department) under the authorization of Section 402 of the CWA may be required, if applicable, for certain types of construction related discharge such as the discharge of construction dewatering effluent, hydrotesting effluent ... etc. .

If you have any questions, please contact Mr. Edward Chen, Engineering Section of the Clean Water Branch, at (808) 586-4309.

Sincerely,

DENIS R. LAU, P.E., CHIEF
Clean Water Branch

EC:cr

c: DHSA, Hawaii
Chief, District Environmental Health Program, Hawaii

BENJAMIN J. CAYETANO
GOVERNOR OF HAWAII

TIMOTHY L. JOHNS
CHAIRPERSON

BRUCE S. ANDERSON
ROBERT G. GIRALD
BRIAN C. NISHIDA
DAVID A. NOBRIGA
HERBERT M. RICHARDS, JR

LINNEL T. NISHIOKA
DEPUTY DIRECTOR

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

OCT 15 1999

Mr. Taeyoung Kim
Environmental Communications, Inc.
P. O. Box 536
Honolulu, Hawaii 96809

Dear Mr. Kim:

Kupapaulua Bridge Widening, Hamakua, Hawaii

This is in response to your letter dated September 23, 1999, requesting whether a stream channel alteration permit is required for widening of the Kupapaulua Bridge.

We discussed the Kupapaulua watercourse with the Division of Aquatic Resources and they indicate that the Kupapaulua watercourse does not contain sufficient flow to support instream uses at the location of the Mamalahoa Highway Bridge. Therefore, a stream channel alteration permit will not be required for the proposed bridge widening.

Thank you for your inquiry. If you have any questions regarding this letter please call David Higa at 587-0249.

Sincerely,

LINNEL T. NISHIOKA
Deputy Director

DH:ky

BENJAMIN J. CAYETANO
GOVERNOR
SEIJI F. NAYA, Ph.D.
DIRECTOR
BRADLEY J. MOSSMAN
DEPUTY DIRECTOR
DAVID W. BLANE
DIRECTOR, OFFICE OF PLANNING

# DEPARTMENT OF BUSINESS, ECONOMIC DEVELOPMENT & TOURISM

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

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

Ref. No. P-8309

October 6, 1999

Mr. Taeyong M. Kim
Environmental Communications, Inc.
P.O. Box 536
Honolulu, Hawaii 96809

Dear Mr. Kim:

Subject: Hawaii Coastal Zone Management (CZM) Program Federal Consistency for the Kupapaulua Bridge Widening Project, Hawaii Belt Road, Hamakua District, County of Hawaii

This responds to your letter dated September 23, 1999, requesting confirmation that a CZM federal consistency review for the Kupapaulua Bridge Widening Project is not required. According to the U.S. Army Corps of Engineers letter dated September 9, 1999 (file no. 990000449), a Department of the Army Permit is not required for the project. Also, it is our understanding that the project does not involve federal funding from sources that require CZM consistency review. On this basis, we confirm that a CZM consistency review is not required for this project. In addition, the State Department of Transportation must ensure that all actions undertaken for this project are conducted in a manner consistent with Hawaii's CZM Program as required by Chapter 205A, HRS.

This determination is not an endorsement of the project nor does it convey approval with any other regulations administered by any State or County agency. Thank you for your cooperation in complying with Hawaii's CZM Program. If you have any questions, please call John Nakagawa of our CZM Program at 587-2878.

Sincerely,

David W. Blane
Director
Office of Planning

c: Mr. Peter Galloway, U.S. Army Corps of Engineers, Regulatory Branch
U.S. National Marine Fisheries Service, Pacific Area Office
U.S. Fish and Wildlife Service, Pacific Islands Ecoregion
Department of Health, Clean Water Branch
Department of Land & Natural Resources,
Planning & Technical Services Branch
Commission on Water Resource Management
Department of Transportation, Highways Division
Planning Department, County of Hawaii

## VIII. COMMENTS AND RESPONSES REGARDING THE DRAFT ENVIRONMENTAL ASSESSMENT

Agency or Organization

State of Hawaii

- Department of Health
- Office of Environmental Quality Control
- Office of Hawaiian Affairs

County of Hawaii

- County of Hawaii
  Planning Department
- County of Hawaii
  Department of Public Works
- County of Hawaii
  Department of Water Supply
- County of Hawaii
  Police Department

BENJAMIN J. CAYETANO
GOVERNOR OF HAWAII

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

October 11, 2000

BRUCE B. ANDERSON, Ph.D., M.P.H.
DIRECTOR OF HEALTH

In reply, please refer to
File:

00-171/epo

Mr. Edmund Yoshida
Project Engineer
State of Hawaii
Department of Transportation
Design Branch, Highways Division
601 Kamokila Boulevard
Kapolei, Hawaii 96707

Dear Mr. Yoshida:

Subject: Draft Environmental Assessment
Kupapaulua Bridge Widening
Hawaii Belt Road
Hamakua, Hawaii

Thank you for allowing us to review and comment on the subject project. We do not have any comments to offer at this time.

Sincerely,

GARY GILL
Deputy Director
Environmental Health Administration

c: Environmental Communications, Inc.

BENJAMIN J. CAYETANO
GOVERNOR

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
869 PUNCHBOWL STREET
HONOLULU, HAWAII 96813-5097
Febrary 2, 2001

BRIAN K. MINAAI
DIRECTOR-DESIGNATE

DEPUTY DIRECTORS
GLENN M. OKIMOTO
JADINE Y. URASAKI

IN REPLY REFER TO:
HWY-DS
2.1577

TO: GARY GILL, DEPUTY DIRECTOR
ENVIRONMENTAL HEALTH ADMINISTRATION
DEPARTMENT OF HEALTH

FROM: BRIAN K. MINAAI
DIRECTOR-DESIGNATE OF TRANSPORTATION

SUBJECT: DRAFT ENVIRONMENTAL ASSESSMENT
HAWAII BELT ROAD, KUPAPAULUA BRIDGE WIDENING,
DISTRICT OF HAMAKUA, ISLAND OF HAWAII
FEDERAL-AID PROJECT NO. BR-019-2(38)

Thank you for your comment of October 11, 2000 regarding the draft Environmental Assessment of the subject project. We understand that the Department of Health does not have any comments at this time.

If you have any questions regarding the project, please call Emilio Barroga, Jr. of our Highways Division at 692-7546.

c: Environmental Communications, Inc.
Nishimura, Katayama & Oki, Inc.

BENJAMIN J. CAYETANO
GOVERNOR

STATE OF HAWAII
OFFICE OF ENVIRONMENTAL QUALITY CONTROL
235 SOUTH BERETANIA STREET
SUITE 702
HONOLULU, HAWAII 96813
TELEPHONE (808) 586-4185
FACSIMILE (808) 586-4186

GENEVIEVE SALMONSON
DIRECTOR

September 11, 2000

Mr. Kazu Hayashida, Director
Department of Transportation
869 Punchbowl Street
Honolulu, Hawai'i 96813

Dear Mr. Hayashida:

Subject: Draft Environmental Assessment for the Hawai'i Belt Road, Kupapaulua Bridge Widening, Hamakua, Hawaii

Thank you for the opportunity to review the subject project. We have the following comments.

1. Please consult with Mayor Yamashiro's Advisory Committee on Bicycle and Pedestrian Safety, c/o Mr. Ron Reilly, Chair, P.O. Box 458, Volcano Village, Hi 96785.

2. Please also consult with nearby community groups, if any.

Should you have any questions, please call Jeyan Thirugnanam at 586-4185. Mahalo.

Sincerely,

Genevieve Salmonson
Director

c: Environmental Communications

BENJAMIN J. CAYETANO
GOVERNOR

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

BRIAN K. MINAAI
DIRECTOR-DESIGNATE

DEPUTY DIRECTORS
GLENN M. OKIMOTO
JADINE Y. URASAKI

IN REPLY REFER TO:
HWY-DS
2.1579

February 2, 2001

TO: GENEVIEVE SALMONSON, DIRECTOR
OFFICE OF ENVIRONMENTAL QUALITY CONTROL

FROM: BRIAN K. MINAAI
DIRECTOR-DESIGNATE OF TRANSPORTATION

SUBJECT: DRAFT ENVIRONMENTAL ASSESSMENT
HAWAII BELT ROAD, KUPAPAULUA BRIDGE WIDENING,
DISTRICT OF HAMAKUA, ISLAND OF HAWAII
FEDERAL-AID PROJECT NO. BR-019-2(38)

Thank you for your comment of September 11, 2000 regarding the draft Environmental Assessment of the subject project. We will consult with the Mayor's Advisory Committee on Bicycle and Pedestrian Safety on the proposed improvements. The North Hilo Community Association has been contacted but has not commented on the project.

If you have any questions regarding the project, please call Emilio Barroga, Jr. of our Highways Division at 692-7546.

c: Environmental Communications, Inc.
Nishimura, Katayama & Oki, Inc.

PHONE (808) 594-1888

STATE OF HAWAI'I
OFFICE OF HAWAIIAN AFFAIRS
711 KAPI'OLANI BOULEVARD, SUITE 500
HONOLULU, HAWAI'I 96813

FAX (808) 594-1865

COPY

August 24, 2000

Mr. Edmund Yoshida, P.E.
State of Hawai'i Department of Transportation
Design Branch, Highways Division
601 Kamokila Boulevard
Kapolei, Hawai'i 96707

DEA# 413

Subject: Draft Environmental Assessment for Hawai'i Belt Road Kupapaulua Bridge Widening, District of Hamakua, Island of Hawai'i

Dear Mr. Yoshida,

Thank you for the opportunity to review and respond to the above-referenced document.

At this time, the Office of Hawaiian Affairs has no comments to offer.

If you have any questions, please contact Ken R. Salva Cruz, Policy Analyst, at 594-1847.

Sincerely,

Colin C. Kippen, Jr.
Deputy Administrator

cc: Board of Trustees
Hilo CRS
Environmental Communications, Inc.
OEQC
File

BENJAMIN J. CAYETANO
GOVERNOR

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

February 2, 2001

BRIAN K. MINAAI
DIRECTOR-DESIGNATE

DEPUTY DIRECTORS
GLENN M. OKIMOTO
JADINE Y. URASAKI

IN REPLY REFER TO:
HWY-DS
2.1578

TO: COLLIN C. KIPPEN, JR., DEPUTY ADMINISTRATOR
OFFICE OF HAWAIIAN AFFAIRS

FROM: BRIAN K. MINAAI
DIRECTOR-DESIGNATE OF TRANSPORTATION

SUBJECT: DRAFT ENVIRONMENTAL ASSESSMENT
HAWAII BELT ROAD, KUPAPAULUA BRIDGE WIDENING,
DISTRICT OF HAMAKUA, ISLAND OF HAWAII
FEDERAL-AID PROJECT NO. BR-019-2(38)

Thank you for your comment of August 24, 2000 regarding the draft Environmental Assessment of the subject project. We understand that the Office of Hawaiian Affairs does not have any comments at this time.

If you have any questions regarding the project, please call Emilio Barroga, Jr. of our Highways Division at 692-7546.

c: Environmental Communications, Inc.
Nishimura, Katayama & Oki, Inc.

Stephen K. Yamashiro
*Mayor*

Jiro A. Sumada
*Deputy Chief Engineer*

# County of Hawaii
DEPARTMENT OF PUBLIC WORKS
25 Aupuni Street, Room 202 • Hilo, Hawaii 96720-4252
(808) 961-8321 • Fax (808) 961-8630

September 25, 2000

Mr. Edmund Yoshida
Project Engineer
State of Hawaii Department of Transportation
Design Branch, Highways Division
601 Kamokila Boulevard
Kapolei, Hawaii 96707

SUBJECT: DRAFT ENVIRONMENTAL ASSESSMENT
Hawaii Belt Road Kupapaulua Bridge Widening
Location: Hamakua, Hawaii
TMKs: 4-1-01: 03 & 05 and 4-1-02: 01, 04, & 11

We have reviewed the subject Draft EA forwarded with the letter from Environmental Communications, Inc. dated August 16, 2000 and have the following comment.

1. A grading permit may be required for the subject project in accordance with Chapter 10 - Erosion and Sedimentation Control, of the Hawaii County Code.

Should you have any questions, please call Kelly Gomes of our Engineering Division at 961-8327.

for GALEN M. KUBA, Division Chief
Engineering Division

KG

c: Taeyong M. Kim

BENJAMIN J. CAYETANO
GOVERNOR

BRIAN K. MINAAI
DIRECTOR-DESIGNATE

DEPUTY DIRECTORS
GLENN M. OKIMOTO
JADINE Y. URASAKI

IN REPLY REFER TO:
HWY-DS
2.1574

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

February 2, 2001

Mr. Galen M. Kuba, Chief
Engineering Division
Department of Public Works
County of Hawaii
25 Aupuni Street, Room 202
Hilo, Hawaii 96720-4252

Subject: Draft Environmental Assessment
Hawaii Belt Road, Kupapaulua Bridge Widening,
District of Hamakua, Island of Hawaii
Federal-Aid Project No. BR-019-2(38)

Dear Mr. Kuba:

Thank you for your comment of September 25, 2000 regarding the draft Environmental Assessment of the subject project. We understand that a grading permit will be required for the proposed project in accordance with Chapter 10 – Erosion and Sedimentation Control of the Hawaii County Code. The selected project contractor will be directed to obtain a grading permit prior to the commencement of any project related grading.

If you have any questions regarding the project, please call Emilio Barroga, Jr. of our Highways Division at 692-7546.

Very truly yours,

BRIAN K. MINAAI
Director-Designate of Transportation

c: Environmental Communications, Inc.
Nishimura, Katayama & Oki, Inc.

DEPARTMENT OF WATER SUPPLY • COUNTY OF HAWAII
25 AUPUNI STREET • HILO, HAWAII 96720
TELEPHONE (808) 961-8660 • FAX (808) 961-8657

October 3, 2000

Mr. Edmund Yoshida
State of Hawaii
Department of Transportation
Design Branch
Highways Division
601 Kamokila Boulevard
Kapolei, HI 96707

**DRAFT ENVIRONMENTAL IMPACT STATEMENT (DEIS)**
**HAWAII BELT ROAD, KUPAPAULUA BRIDGE WIDENING**
**HAMAKUA, ISLAND OF HAWAII**
**TAX MAP KEY: 4-1-002**

We have reviewed the subject document and we confirm that none of the Department's water systems are within the project limits.

If you have any questions, please contact our Water Resources and Planning Branch at 961-8665.

Sincerely yours,

Milton D. Pavao, P.E.
Manager

BCM:gms

copy - Environmental Communications, Inc. ✓
Planning Department

BENJAMIN J. CAYETANO
GOVERNOR

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

February 2, 2001

BRIAN K. MINAAI
DIRECTOR-DESIGNATE

DEPUTY DIRECTORS
GLENN M. OKIMOTO
JADINE Y. URASAKI

IN REPLY REFER TO:
HWY-DS
2.1576

Mr. Milton D. Pavao, Manager
Department of Water Supply
County of Hawaii
25 Aupuni Street
Hilo, Hawaii 96720-4252

Subject: Draft Environmental Assessment
Hawaii Belt Road, Kupapaulua Bridge Widening,
District of Hamakua, Island of Hawaii
Federal-Aid Project No. BR-019-2(38)

Dear Mr. Pavao:

Thank you for your comment of October 3, 2000 regarding the draft Environmental Assessment of the subject project. We understand that the project will not affect any of the Department of Water Supply's water systems.

If you have any questions regarding the project, please call Emilio Barroga, Jr. of our Highways Division at 692-7546.

Very truly yours,

BRIAN K. MINAAI
Director-Designate of Transportation

c: Environmental Communications, Inc.
Nishimura, Katayama & Oki, Inc.

Stephen K. Yamashiro
*Mayor*

Virginia Goldstein
*Director*

Russell Kokubun
*Deputy Director*

# County of Hawaii

PLANNING DEPARTMENT
25 Aupuni Street, Room 109 • Hilo, Hawaii 96720-4252
(808) 961-8288 • Fax (808) 961-8742

September 22, 2000

Mr. Edmund Yoshida, Project Engineer
Department of Transportation
Design Branch – Highways Division
601 Kamokila Boulevard
Kapolei, Hawaii 96707

Dear Mr. Yoshida:

**Draft Environmental Assessment (DEA):**
**Hawaii Belt Road Kupapaulua Bridge Widening Project**
**TMK: 4-01-01 & 4-02-02, Hamakua, Hawaii Island**

Thank you for requesting our review and comment on the above DEA. Our comments pertain to the state or county land use laws under the County's jurisdiction that apply to the project site. Generally, the DEA's information is accurate on the topics addressing the State Land Use, Special Management Area (SMA), the County General Plan, and Zoning.

**SMA.** As previously stated in our January 31, 2000 letter to Taeyong Kim, the project's environmental consultant, this project is not within the County's SMA zone and is therefore not subject to SMA criteria.

**State Land Use & County Zoning: Agricultural District.** The project site is in the SLU and the County agricultural district. Pursuant to the State agricultural land use law, the proposed bridge widening and seismic rehabilitation project is a permitted roadway and accessory use. Under the County Zoning Code, the project qualifies as a public use or structure and is therefore a permitted use in any zone district. In addition, since County plan approval (PA) procedures do not apply to projects in the agricultural zone, a PA application is therefore not required.



**County General Plan (GP) Land Use Designation: Intensive/Extensive Agricultural Land.** The project site is designated either intensive or extensive agricultural, according to the Land Use Pattern Allocation Guide (LUPAG) Map.

The GP's agriculture land use policy requires Hawaii County to assist in the development of basic resources for the agriculture industry, and conceivably this would include roads and transportation. Consequently, the proposed bridge improvements are deemed consistent with this policy.

Thank you for requesting our participation to comment on the DEA. Any follow-up to these comments may be made with Earl Lucero of my staff at (808) 961-8288.

Sincerely,

VIRGINIA GOLDSTEIN
Planning Director

EML:pak
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cc: Taeyong Kim, Environmental Communications, Inc.
P.O. Box 536, Honolulu, HI 96809

BENJAMIN J. CAYETANO
GOVERNOR

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

BRIAN K. MINAAI
DIRECTOR-DESIGNATE

DEPUTY DIRECTORS
GLENN M. OKIMOTO
JADINE Y. URASAKI

IN REPLY REFER TO:
HWY-DS
2.1580

February 2, 2001

Mr. Christopher Yuen, Director
Planning Department
County of Hawaii
25 Aupuni Street, Room 109
Hilo, Hawaii 96720-4252

Subject: Draft Environmental Assessment
Hawaii Belt Road, Kupapaulua Bridge Widening,
District of Hamakua, Island of Hawaii
Federal-Aid Project No. BR-019-2(38)

Dear Mr. Yuen:

Thank you for your comments of September 22, 2000 regarding the draft Environmental Assessment of the subject project. It is our understanding that the proposed improvements are generally consistent with applicable regulations. Specifically, the following have been stated:

SMA
The project is not within the County's SMA zone and is not subject to SMA criteria.

State Land Use and County Zoning
The project is a permitted roadway and accessory use under both State and County land use policies.

County General Plan Land Use Designation
The proposed improvements are deemed consistent with the General Plan's agricultural land use policy.

If you have any questions regarding the project, please call Emilio Barroga, Jr. of our Highways Division at 692-7546.

Very truly yours,

BRIAN K. MINAAI
Director-Designate of Transportation

c: Environmental Communications, Inc.
Nishimura, Katayama and Oki, Inc.

Stephen K. Yamashiro
*Mayor*

Wayne G. Carvalho
*Police Chief*

James S. Correa
*Deputy Police Chief*

# County of Hawaii
## POLICE DEPARTMENT

349 Kapiolani Street • Hilo, Hawaii 96720-3998
(808) 935-3311 • Fax (808) 961-2702

September 8, 2000

Mr. Edmund Yoshida
Project Engineer
State of Hawaii Department of Transportation
Design Branch, Highways Division
601 Kamokila Boulevard
Kapolei, Hawaii 96707

Dear Mr. Yoshida:

SUBJECT: REQUEST FOR COMMENTS
DRAFT ENVIRONMENTAL ASSESSMENT
HAWAII BELT ROAD, KUPAPAULUA BRIDGE WIDENING

This acknowledges Mr. Taeyong M. Kim's letter of August 16, 2000, requesting our comments on the above-referenced project.

Staff has reviewed your request and does not foresee any adverse effect should the construction of structural and widening improvements on Kupapaulua Bridge be granted.

Thank you for the opportunity to comment.

Sincerely,

WAYNE G. CARVALHO
POLICE CHIEF

THOMAS J. HICKCOX
ASSISTANT POLICE CHIEF
FIELD OPERATIONS BUREAU

EWR:lk

cc: Mr. Taeyong M. Kim, Environmental Communications, Inc.

BENJAMIN J. CAYETANO
GOVERNOR

BRIAN K. MINAAI
DIRECTOR DESIGNATE

DEPUTY DIRECTORS
GLENN M. OKIMOTO
JADINE Y. URASAKI

IN REPLY REFER TO:
HWY-DS
2.1575

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

February 2, 2001

Mr. Wayne G. Carvalho, Chief
Police Department
County of Hawaii
349 Kapiolani Street
Hilo, Hawaii 96720-3998

Subject: Draft Environmental Assessment
Hawaii Belt Road, Kupapaulua Bridge Widening,
District of Hamakua, Island of Hawaii
Federal-Aid Project No. BR-019-2(38)

Dear Chief Carvalho:

Thank you for your comment of September 8, 2000 regarding the draft Environmental Assessment of the subject project. We understand that the Police Department has reviewed the subject project and does not foresee any adverse effect from the construction and implementation of the proposed Kupapaulua Bridge improvements.

If you have any questions regarding the project, please call Emilio Barroga, Jr. of our Highways Division at 692-7546.

Very truly yours,

BRIAN K. MINAAI
Director-Designate of Transportation

c: Environmental Communications, Inc.
Nishimura, Katayama & Oki, Inc.

# Appendix A

# Archaeological Inventory Survey

# THE RESULTS OF AN ARCHAEOLOGICAL INVENTORY SURVEY AT KUPAPAULUA HĀMĀKUA, HAWAIʻI (TMK 4-1-01)

Prepared by:

Paul L. Cleghorn, Ph.D.

Pacific Legacy, Inc.
332 Uluniu Street
Kailua, Hawaiʻi 96734

Prepared for:

Environmental Communications
81 South Hotel, Suite 211
Honolulu, Hawaiʻi 96813

September 1997

96-P200

## ABSTRACT

This report presents the results of an archaeological inventory survey conducted at Kupapaulua in Hāmākua, Hawai'i. The three gulches of Kaiwi, Kupapaulua, and Kaholo made up the project area. The inventory survey included archival research and a pedestrian survey.

The project are has been extensively modified by sugar cane plantation activities, The three gulches in the project area are extremely steep sided and narrow, none of them contain broad alluvial flats that could have been used for traditional agricultural activities. No prehistoric surface archaeological sites were found in the project area.

It is recommended that no further archaeological work is needed in the project area.

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## LIST OF FIGURES

## 1.0 INTRODUCTION

Under contract to Environmental Communications, Pacific Legacy, Incorporated has completed an archaeological inventory survey at Kupapaulua Bridge, in Hāmākua, Hawai'i (TMK 4-1-01). Specifically, this work consisted of archival research and surface survey. Archival research was conducted prior to fieldwork and aimed to predict the types of historic properties that may be present in the project area and thus direct and focus field research. Field investigations were conducted on 17 July 1997 by the author and assisted by Andrew Tapper. The area surveyed extended from the east side of Kaiwiki Gulch to the west side of Kaholo Gulch along both sides of the Hawaii Belt Road; approximately 40 m on either side of the Hawaii Belt Road were surveyed (Figure 1).

The State of Hawaii Dept. of Transportation is planning to replace the existing bridges across these gulches. The archaeological investigations reported on herein are to fulfill State requirements for the treatment of archaeological resources.

The State Historic Preservation Division (SHPD) generally requires that an archaeological inventory survey be conducted in a project area as part of the permitting process. An archaeological inventory survey is the first step in treating archaeological resources that may be present in a project area. The purpose of an archaeological inventory survey is to determine if potentially significant archaeological resources are present on a specific parcel of land prior to development activities. If potentially significant resources are present, then a set of procedures must be implemented to manage these resources to mitigate any adverse effects of proposed development. These procedures are generally developed in a Historic Preservation Plan (HPP) after the completion of the archaeological inventory survey.

## 1.1 PHYSICAL SETTING

The project area is located within the *ahupua'a* of Niupea and Kaiwiki in the district of Hāmākua on the windward side of the island of Hawai'i. The three gulches of Kaiwiki, Kupapaulua, and Kaholo that dissect the project area are extremely steep sided and densely covered in vegetation (Figures 2 and 3). These three gulches converge into one gulch on the north side of the Hawaii Belt Road and the streams terminate at Hikiau Falls near the coast. Field observations indicated that the steep sides of these gulches are primarily soil covered with no massive exposures of basalt bedrock. The bottoms of these gulches have been scoured by high energy water flow and contain river gravels of cobbles to large boulders (Figure 4). No broad alluvial flats are present in the gulch bottoms, within the project area.

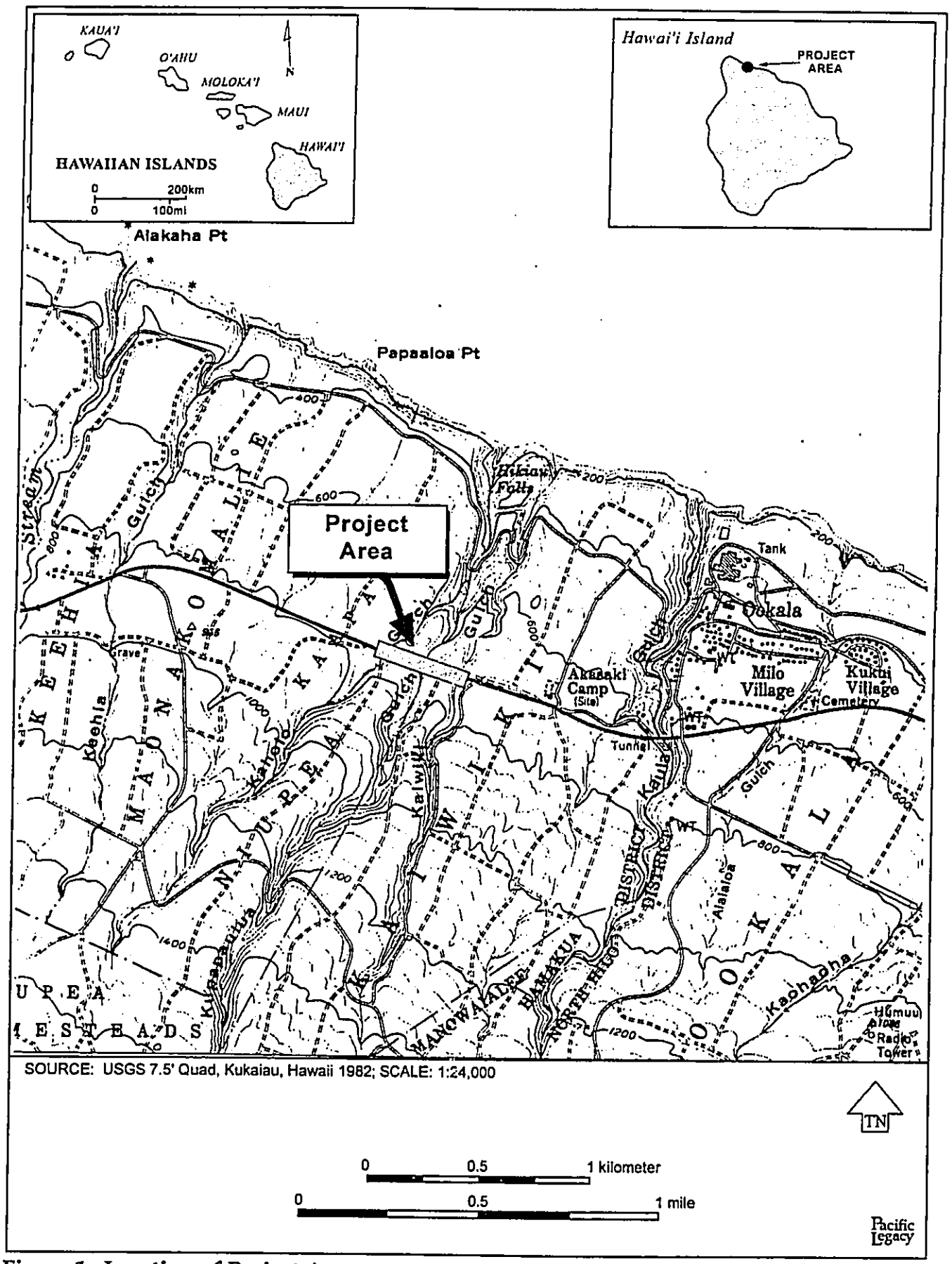


**Figure 1. Location of Project Area.**

Figure 2. West Side of Kupapaulua Gulch, View to West.

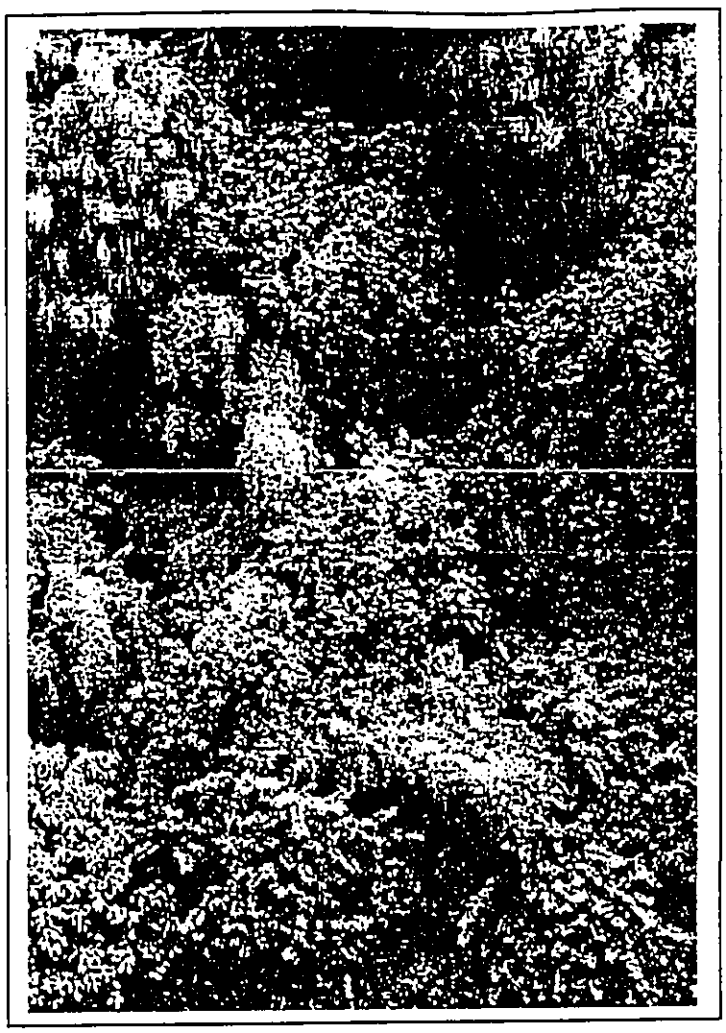

Figure 3. West Side of Kaholo Gulch, View to West.

Figure 4. Bottom of Kaholo Gulch, View to South.

Because the project area is located on the windward side of the island of Hawai'i, its climate is wet, receiving more than 100 inches (2,540 mm) of rain annually. While December to April are the wettest months, all months receive considerable rainfall (Armstrong 1983:63). The area is also relatively warm with a minimum mean of 60-65 degrees Fahrenheit (15.6 - 18.3 degrees Centigrade) and a maximum mean of 70-75 degrees Fahrenheit (21.1 - 23.9 degrees Centigrade) (Armstrong 1983:64). The combination of high rainfall and warm temperatures create lush conditions (Figures 2, 3, and 4).

Vegetation observed in the gulches includes rose apple (*Eugenia* sp.), *hala* (*Pandanus* sp.), *kukui* (*Aleurites moluccana*), African tulip (*Spathodea campanulata*), guava (*Psidium guajava*), ti (*Cordyline terminalis*), iron wood (*Casuarina equisetifolia*), klu (*Acacia catechu*), *hapu'u* (*Cibotium spendens*), *awapuhi* (*Zingiber zerumbet*), and various ferns and grasses.

## 1.2 FIELD METHODS

The project area was surveyed by pedestrian transects. Spacing between the two surveyors ranged from 10-20 m depending on the density of the vegetation (spacing was closer in areas of dense vegetation, and further apart in area of sparse vegetation).

The two bridges across Kupapaulua and Kaholo Gulches were photographed in black-and-white.

No subsurface testing was undertaken.

## 2.0 ARCHIVAL RESEARCH

The records at the State Historic Preservation Office were researched to determine if any archaeological sites have been recorded in the project area or in the vicinity of the project area. The site records, manuscript collection, and computerized map data were examined. No archaeological sites have been recorded in the project area or in the immediate vicinity of the project area.

Sources in the Department of Land and Natural Resources Survey Division and Bureau of Conveyances were also researched.

Most of the land surrounding the project area is owned by the Bernice Pauahi Bishop Estate. Some of this land between the gulches of Kupapaulua and Kaholo was originally granted to Polapola and Makana (Grant 2379; 148 acres), which was later made part of the Bishop Estate. This land was leased to the Laupahoehoe

Sugar Company for the extensive sugar plantation operations that were conducted here. Only two *kuleana* were located in the vicinity of the project area:

> LCA 7852 consisting of ca. 5.6 acres on the north side of the Hawaii Belt Road on the east side of Kaiwiki Gulch was awarded to Kaheana (Award Books n.d.: Book 4, page 641.
>
> LCA 9928 consisting of ca, 5.7 acres of land on the south side of the Hawaii Belt Road between Kaiwiki and Kupapaulua Gulches was awarded to Lakele (Award Books n.d.: Book 4, page 634).

Ross Cordy, in his regional synthesis of the Hāmākua District on the island of Hawai'i (Cordy 1994) produced an overview of land use in Hāmākua. In this work, Cordy points out that little is known archaeologically about this district and that his research is based primarily on archival document investigations. For the purposes of Cordy's analysis, he separates the district of Hāmākua into two region:

> West Hāmākua, along the north slopes of the Kohala Mountains, with its large windward Valleys, including Waipio Valley; and
>
> East Hāmākua, which is made up of three subregions:
>
> > The lower windward slopes of Mauna Kea;
> >
> > The upper slopes of Mauna Kea; and
> >
> > The interior plateau (Saddle) of Pohakuloa and the slopes of Mauna Kea (Cordy 1994:3).

The project area is located within East Hāmākua, along the lower windward slopes of Mauna Kea.

East Hāmākua extends south from Waipio Valley for 21 miles to the Hilo District border. The *ahupua'a* of Niupea and Kaiwiki are the southern-most *ahupua'a* in the District. This region contained 87 of the ca. 100 *ahupua'a* that made up the District of Hāmākua. These *ahupua'a* tended to be small and extend only part-way up the slopes of Mauna Kea, into the *'ōhi'a-koa* forest zone. Only two of the *ahupua'a* extend further inland -- Pā'auahu up onto the northwest slopes of Mauna Kea, and Ka'ohe over the summit of Mauna Kea and up the northern slopes of Mauna Loa.

Cordy divides the region into four zones: sea shore, seaward upland slopes, *'ōhi'a-koa* forest, and gulches (Cordy 1994:61-62). The sea shore in this region consists of a narrow marine bench at the base of the cliffs, that is occasionally wider at gulch

mouths. Marine exploitation was the primary activity taking place here, and Cordy found no references to houses in this zone (Cordy 1994:61).

The seaward upland slopes were used primarily for farming and habitation. Dryland taro was probably the dominant crop, with bananas and sweet potato also being grown. Cordy's research suggests that the houses in this region were large and may have contained multiple families (Cordy 1994:62).

Large communal *heiau* are also present in this zone, though not every *ahupua'a* contained *heiau*. Ellis described seeing a *heiau* in the "Kaura" gulch between the districts of Hāmākua and Hilo (1963:250). Kaula Gulch is located two gulches to the east of Kaiwiki Gulch, just west of O'okala (see Figure 1). Kaula Gulch is the boundary between the districts of Hāmākua and North Hilo (the boundary line runs through the middle of the gulch).

The *'ōhi'a-koa* forest was where natural forest resources were collected. Resources collected included *mamāki* for making tapa, bird catching for feathers, and bark for fish net making. In addition, small plantings of supplemental crops such as taro and bananas may have also been present in this zone. The people collecting forest resources probably used small camp sites for short periods of time. These camp sites may have had thatched shelters and fire hearths.

Most of the gulches in this region very narrow. Cordy found no information regarding housing or cultivation in these narrow gulches (1994:62). Cordy presents archival information he obtained for the small *ahupua'a* of Hō'ea, which is located near Kaiwiki, which is informative regarding the small *ahupua'a* of the region. Hō'ea is very narrow (ca. 0.1 mile wide at the shore), but extends into the *'ōhi'a-koa* forest. Only one *kuleana* award was present in this *ahupua'a* (LCA 3702-B to Nawai) which was in the seaward portion of the uplands, ca. 0.5 mile inland and extending across the entire width of the *ahupua'a*. Farming was the principal activity occurring here, with several dryland plots of taro, sweet potato, and apparently *wauke* being grown here. Nawai probably also had a house here (Cordy 1994:80).

### 2.1 Predictions

The physical settling of the project area, with its steep sided gulches with water scoured bottoms, suggests that there is a low likelihood of any archaeological sites being present in the gulches. The lack of massive rock outcroppings probably precludes the existence of any caves that could have been used for human burials. Finally, the extensive land altering activities associated with the sugar plantation in the area probably destroyed any low rock features that may have been associated with traditional use of the area. The results of the archival research generally

support these suggestions, because no archaeological sites have been recorded in the project area or in the general vicinity.

Cordy (1994:82-83), however, thinks that there is a good possibility that archaeological remains may be present in the region. He is of the opinion that the edges of the gulches, as well as possible areas within sugar cane fields that were excluded from bulldozing may contain archaeological resources.

While we predict that no pre-Contact archaeological sites will be found in the project area, field investigations will pay particular attention to gulch edges.

## 3.0 RESULTS OF FIELD INVESTIGATIONS

No traditional or pre-Contact Hawaiian structures, features, or deposits were found in the project area.

Survey of the areas surrounding gulches indicated that the flat lands surrounding the gulches have been extensively modified in the recent past (Figure 5). These modifications consist of extensive bulldozing associated primarily with sugar cane cultivation and pasturage. The western rim of Kaholo Gulch contains concentrations of cement and concrete containing reinforcing bars. This material appears to be the result of bulldozer push from the adjacent flat land. The eastern rim of Kupapaulua Gulch, north of the Hawaii Belt Road contains the remains of a dilapidated house and camper trailer, and abandoned trucks and various machinery (Figure 6).

The Kupapaulua Bridge is approximately 80 m long and spans Kupapaulua Gulch. Recording of this bridge was limited to photographing the top (Figure 7) and underside (Figure 8) of the structure. The bridge that spans Kaholo Gulch is shorted, measuring approximately 40 m long. It was likewise photographed on the top (Figure 9) and underside (Figure 10).

Kupapaulua Bridge was inventoried, described, and evaluated by Patricia Alvarez in 1987 (1987:163-168; see Appendix 1). This is a concrete multi-span bridge, with an open-spandrel arch and four tee-beam spans. It was designed by William R. Bartels (Territorial Highway Engineer) and built in 1935 with Federal Aid, at a cost of $107,000. It measures 353 by 29.5 feet and is 115 feet above the stream bed. At the time of its construction, Kupapaulua Bridge's arch spanned the longest distance of any bridge in Hawai'I. Kaholo Bridge was not inventoried or described.

## 4.0 SUMMARY AND DISCUSSION

Archival research, the physical setting of the project area, and the intensive large-scale land altering activities associated with sugar cane cultivation resulted in predicting that there was a low likelihood of finding traditional archaeological sites within the project area. Field investigations confirmed this prediction.

The narrow and steep-sided nature of the gulches in the project area precluded their use for traditional agricultural pursuits. The geology of the area and lack of exposed rock outcroppings indicated that caves that could have been used for human burials would not be present here.

The archival research conducted by Ross Cordy (1994) indicated that there was a possibility that archaeological remains could be found in the upland areas between the gulches, especially along the rims of the gulches. Special attention was paid to these areas and no archaeological resources were found. It was shown above that bulldozing occurred right up to the rims of the gulches, so that if there had been any surface archaeological structures, they would probably have been destroyed.

No potentially significant traditional sites or deposits were found in the project area and no further archaeological investigations appear warranted. However there is always the possibility, however remote in this instance, that archaeological resources, including human burials may be encountered during large scale ground altering activities. If any archaeological resources, including human burials are encountered, the contractor must abide by State law (HRS Chapter 6E) and cease excavations in the immediate vicinity of the resource and notify the State Historic Preservation Division at (808) 587-0047.

Figure 5. Bulldozed Area on SE Side of Kaiwiki Gulch, View to South.

Figure 6. Abandoned House on NE Side of Kupapaulua Gulch, View to South.

Figure 7. Top of Kupapaulua Gulch, View to West.

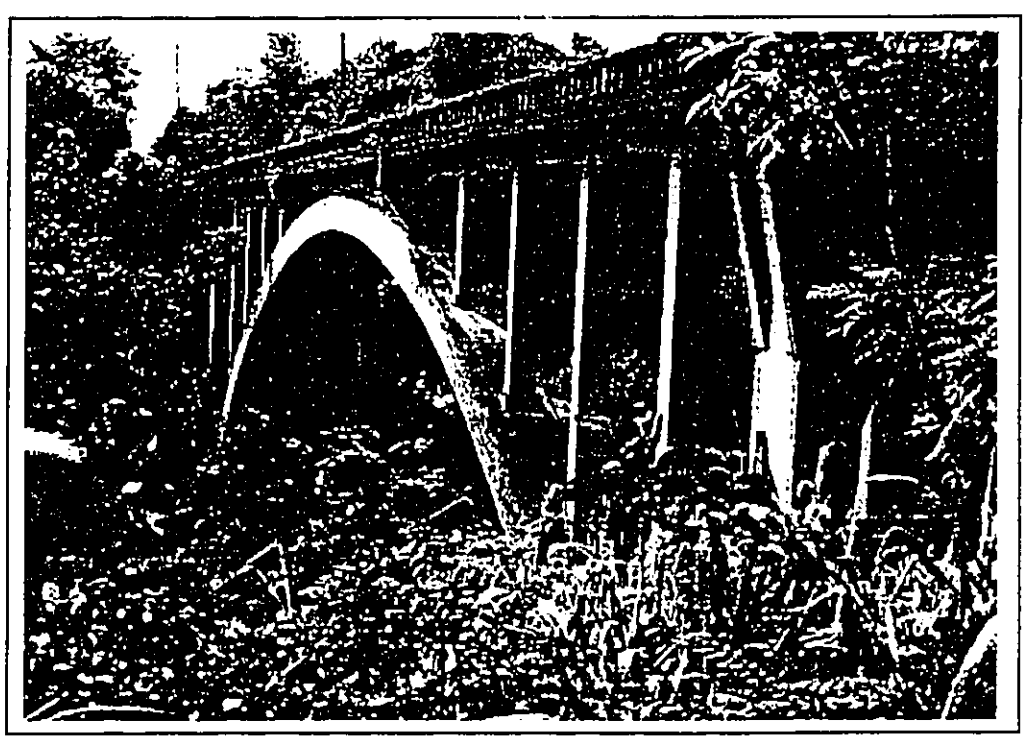

Figure 8. Underside of Kupapaulua Bridge,
View to Southeast.

Figure 9. Top of Kaholo Bridge, View to West.

Figure 10. Underside of Kaholo Bridge,
View to Southwest.

## 5.0 REFERENCES CITED


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# Appendix B

# Aquatic and Avian Species Assessment

# AQUATIC AND AVIAN SPECIES ASSESSMENT OF THE KUPAPAULUA HIGHWAY BRIDGE CONSTRUCTION PROJECT

**Prepared for:**
**State Department of Transportation Highways Division**
**for Environmental Communications**

**Prepared by:**
**Ron Englund and Pat Hart**
**Pacific Aquatic Environmental, Inc.**
**2357 S. Beretania, Suite A-237**
**Honolulu, Hawaii 96826-1499**

**18 July 1997**

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LIST OF TABLES AND FIGURES

## EXECUTIVE SUMMARY

Pacific Aquatic Environmental, Inc. (PAE) conducted a biological assessment of avian and stream species in Kupapaulua Gulch for the Kupapaulua Highway Bridge Environmental Assessment. The only native Hawaiian bird species observed in the area was the Hawaiian Hawk. No adverse impacts are anticipated to occur to Hawaiian Hawks due to the small scale and temporary nature of impacts resulting from the Kupapaulua Highway Bridge construction project. This bridge construction project should not adversely impact nesting or the food supply of the Hawaiian Hawk. Additionally, no adverse impacts are expected for other native forest birds due to the Kupapaulua Highway Bridge construction project. This is because it is a very remote possibility that native forest birds such as Iiwi, Apapane, or others still inhabit this area.

In the area downstream from the main Hawaii Belt Road to the ocean, Kupapaulua Gulch was determined to be intermittently flowing, with no permanent aquatic habitat. Because the stream channel was dry, no native stream fish, crustaceans, mollusks, or aquatic insects were observed. Therefore, no adverse impacts are expected to occur to native stream biota due to the construction on the Kupapaulua Gulch Highway Bridge.

## INTRODUCTION

Pacific Aquatic Environmental, Inc. (PAE) conducted a biological assessment of Kupapaulua Gulch for the Kupapaulua Highway Bridge Environmental Assessment. These surveys assessed native aquatic and endangered bird species that may occur in areas potentially affected by the Kupapaulua Bridge construction project. This report is divided into two sections: one for the avian survey and one for the aquatic survey.

The objectives of the fish and aquatic invertebrate assessment of Kupapaulua Gulch were to 1) describe baseline distribution and abundance of native and introduced fish species, crustaceans, mollusks, and aquatic insects, as well as introduced amphibians, 2) evaluate habitat quality for aquatic biota, and 3) evaluate potential environmental impacts associated with the completion of the Kupapaulua Bridge construction project.

The objectives of the avian species assessment were to 1) determine species composition of native and introduced birds, with an emphasis on Threatened and Endangered species, 2) evaluate habitat quality for native birds, and 3) evaluate potential consequences associated with the completion of the Kupapaulua Bridge construction project.

## STUDY AREA

According to USGS topographic maps, Kupapaulua Gulch originates at approximately 975 m on the northeastern slopes of Mauna Kea and enters the ocean near Ookala,

Hawaii County. Hawaii Belt Road crosses Kupapaulua Gulch at 213 m elevation, with the gulch bottom approximately 30 m below. To assess the impacts of bridge replacement or expansion, Kupapaulua Gulch was surveyed from the old Belt Highway Road upstream to the main Hawaii Belt Road (Figure 1). The gulch below the Kupapaulua Highway Bridge lies in a deeply incised, and heavily vegetated straight valley. The following is a brief description of each avian and aquatic sampling station:

**Station 1 (128 m elevation)**

Station 1 was located immediately upstream of the old Hawaii Belt Road. Kupapaulua Gulch was dry here, and apparently flows only during large storms. Even though sampling occurred during a rainy period no stream flow was observed. Stream gradient was high and the stream substrate consisted of a mix of gravel and large boulders in an incised bedrock channel. Riparian vegetation at this station was predominately kukui (*Aleurites moluccana*), Guinea grass (*Panicum maximum*), common guava (*Psidium guajava*), and yellow ginger (*Hedychium flavescens*).

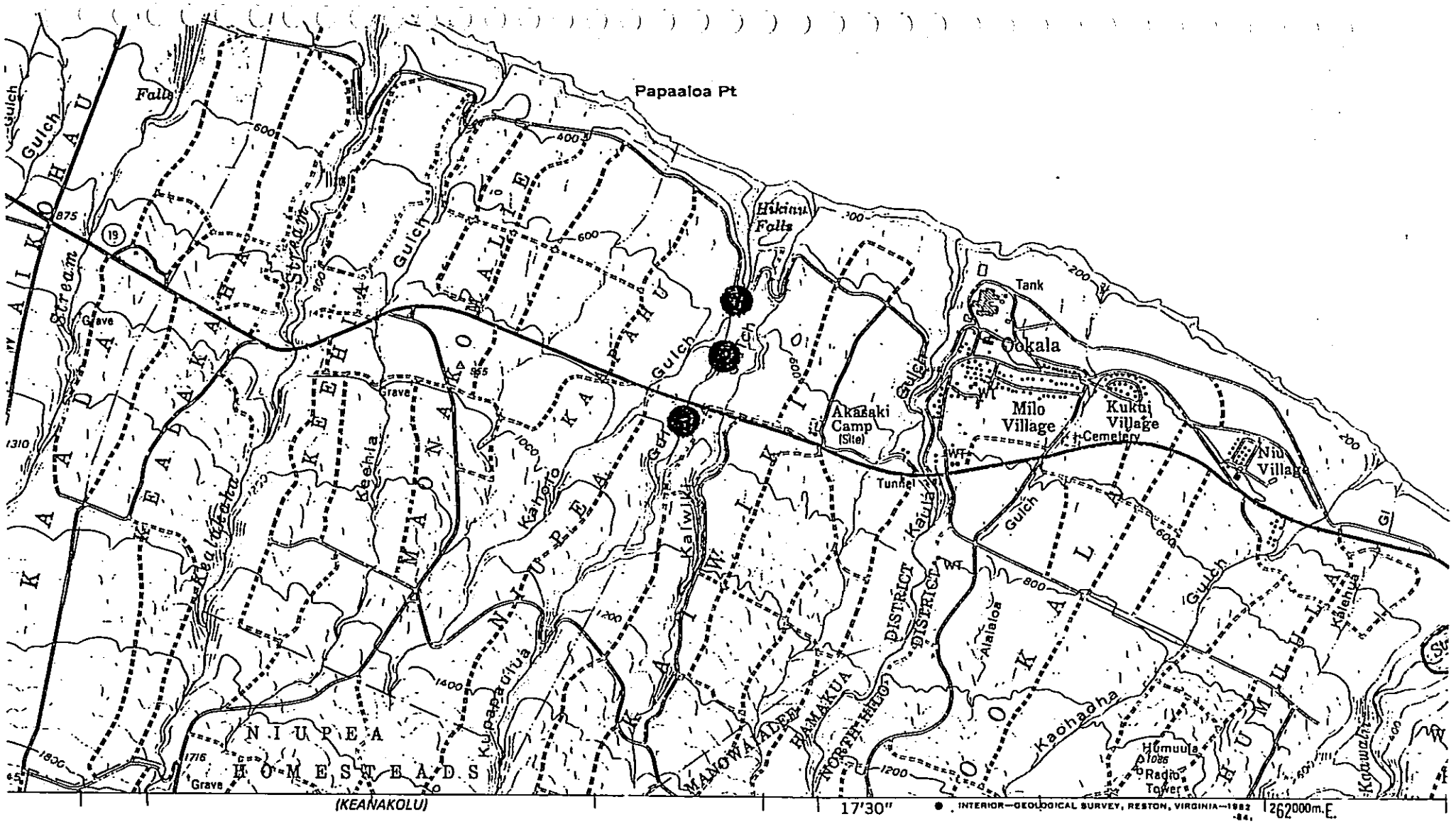
**Station 2 (150 m elevation)**

This station was located approximately 50 m upstream of the confluence of Kaholo and Kupapaulua Gulches. This station was accessed by hiking up the dry stream channel from Station 1. The stream was dry here, and the stream substrate consisted of mainly large boulders mixed in with an even proportion of small and large cobble, and small boulders. Riparian vegetation was similar to that found in Station 1, with the addition of hala (*Pandanus tectorius*) growing almost down to the banks of the dry gulch. An additional bird census station was located between Stations 2 and 3 at an elevation of 160 m. Vegetation was largely the same at this bird census station as at Station 2.

**Station 3 (180 m elevation)**

Station 3 was located in the vicinity of the Hawaii Belt Road bridge that spans Kupapaulua Stream. We assessed habitat directly underneath the Kupapaulua Highway Bridge as well as up and downstream of the bridge. The stream remained dry at this station, and was entirely dry from Station 1 to upstream of Kupapaulua Highway Bridge. No permanent stream pools, springs, rheocrenes, or seeps were observed anywhere between Stations 1 and 3. Stream gradient remained high between Station 2 and 3. Stream substrate consisted of almost all large boulders interspersed with an even mix of gravel, small and large cobble, and small boulders. Riparian vegetation was dominated by kukui, rose apple (*Syzygium jambos*) and common guava.

Figure 1. Sampling stations on Kupapaulua Gulch, Hawaii and during June and July 1997.




SCALE 1:24 000

1 0 1 MILE

1000 0 1000 2000 3000 4000 5000 6000 7000 FEET

1 .5 0 1 KILOMETER

CONTOUR INTERVAL 40 FEET
DATUM IS MEAN SEA LEVEL
SHORELINE SHOWN REPRESENTS THE APPROXIMATE LINE OF MEAN HIGH WATER
THE AVERAGE RANGE OF TIDE IS APPROXIMATELY 2 FEET


QUADRANGLE LOCATION

THIS MAP COMPLIES WITH NATIONAL MAP ACCURACY STANDARDS
FOR SALE BY U. S. GEOLOGICAL SURVEY, DENVER, COLORADO 80225, OR RESTON, VIRGINIA 22092
A FOLDER DESCRIBING TOPOGRAPHIC MAPS AND SYMBOLS IS AVAILABLE ON REQUEST

## METHODS

### Avian Surveys

Surveys of avifauna in Kupapaulua Gulch were conducted for four days in June and July of 1997. Four census stations were set up at approximately 150 m intervals within the gulch between 140 and 200 m in elevation. Fixed plot methods were used, whereby all species seen or heard within a 20 m radius of census stations were recorded. This is a common technique for estimating relative bird density. Special emphasis was placed on detecting native Hawaiian species. The presence of any native bird species in or around the gulch but outside of census areas was also recorded.

### Fish and Aquatic Invertebrates

Field work was conducted during a very wet period of June and July 1997. Data were collected during a period of increased precipitation, allowing us to verify Kupapaulua Gulch flows only intermittently during larger rainstorms. If the stream contained water we would have conducted point counts according to the standard Hawaii Division of Aquatic Resources methods (Baker and Foster 1992). As the stream was dry, point counts were not conducted.

Three representative sampling stations (see STUDY AREA) were established on Kupapaulua Gulch, and aquatic macrofauna (fish, crustaceans, mollusks, and amphibians) was assessed at each station. Sampling stations were established in Kupapaulua Gulch both up and downstream of the Hawaii Belt Road. The entire stream bed was hiked. We started at the cane road bridge (at the confluence of Kaholo and Kupapaulua Gulches) to upstream of the main Kupapaulua Highway Bridge on Hawaii Belt Road. This allowed us to make above-water visual observations of any potentially occurring fish and aquatic insects as we hiked upstream. Hiking also allowed us to ascertain if the stream was truly dry, or contained permanent springs, pools, or rheocrenes (Polhemus et al. 1992). Above-water observations were conducted as we hiked between different sampling stations.

Composition of the riparian vegetation and stream substrate were evaluated at each sampling station. Habitat condition for native aquatic organisms was evaluated both within sampling stations and throughout the sections of stream that we hiked. Altitude at each sampling station was determined by using a combination of USGS topographic maps and a hand-held Casio altimeter. The altitude given at each sampling station (see STUDY AREA) was the starting altitude.

Aquatic insect sampling would have been conducted according to Polhemus (1995). Collections of both immature and adult specimens were attempted with aerial nets, but

as the stream was dry we did not observe any. Visual observations for aquatic insects were conducted as we hiked upstream among sampling stations.

We also emphasized sampling of damselflies and dragonflies (Odonata). Damselflies in the genus *Megalagrion* are currently being studied by the U.S. Fish and Wildlife Service and personnel from the Smithsonian Institution. Twelve species of *Megalagrion* are currently held as candidate Threatened or Endangered species, or Species of Concern on the Federal Register. Moreover, these damselflies give an indication of the relative 'health' of a stream system; they do not typically occur in highly disturbed areas. The number and species of native damselflies observed during hiking in the streambed was also recorded.

## RESULTS AND DISCUSSION

### Avian Surveys

Only one native bird species, the Hawaiian Hawk (*Buteo solitarius*), was noted within the study area. On one occasion a pair was seen circling within 100 meters of the Kupapaulua bridge. On two other occasions an individual bird was seen flying directionally between 200 and 400 meters from the bridge. This bird was not noted within census stations.

Five other bird species, all human introductions to Hawaii, were recorded during this study (Table 1). The Japanese White-eye (*Zosterops japonicus*) was by far the most abundant, followed by the House Finch (*Carpodacus mexicanus*), and Northern Cardinal (*Cardinalis cardinalis*) ( see Figure 2). Common Mynas (*Acridotheres tristis*) and Melodious Laughing Thrushes (*Garrulax canorus*) were also seen in small numbers (Figure 2).

**Table 1. Bird Species Noted in Kupapaulua Gulch , June - July 1997.**

| Bird Species | Threatened and Endangered Status | Geographic Status |
|---|---|---|
| Hawaiian Hawk (*Buteo solitarius*) | Endangered | Native Endemic |
| Melodious Laughing Thrush (*Garrulax canorus*) | None | Introduced |
| Northern Cardinal (*Cardinalis cardinalis*) | None | Introduced |
| Common Myna (*Acridotheres tristis*) | None | Introduced |
| House Finch (*Carpodacus mexicanus*) | None | Introduced |
| Japanese White-eye (*Zosterops japonicus*) | None | Introduced |

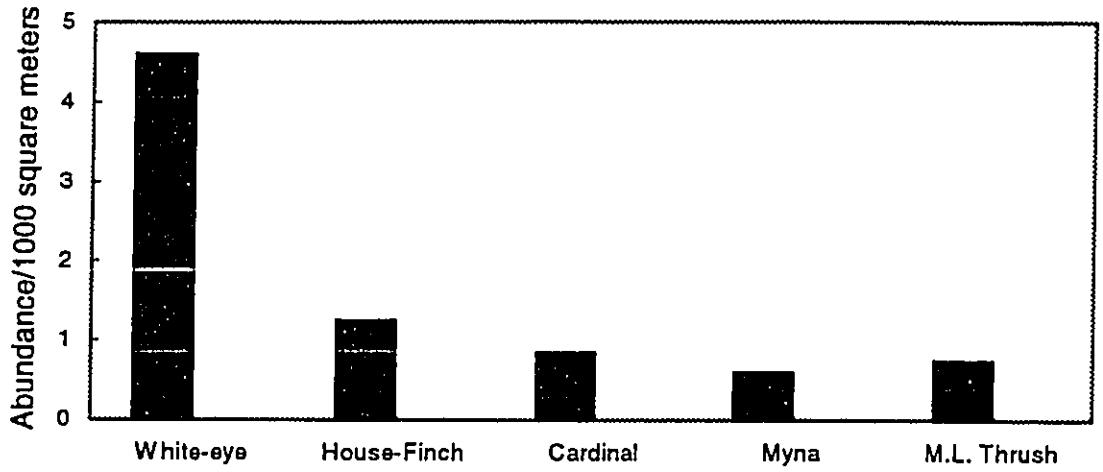



**Figure 2. Relative abundance of introduced landbirds near Kupapaulua Highway Bridge.**

**Native Birds:**

A pair of Hawaiian Hawks, or Io, was found to frequent this area. This hawk is a state and federally listed endangered species that is found only on the island of Hawaii. Io occupy a broad range of habitats from papaya and macadamia nut orchards through virtually all types of forest including ohia rainforest (Scott et al. 1986). They are virtually absent from areas with few or no trees. Io feed on a variety of introduced and native birds, mammals, and insects (Perkins 1903; Tomich 1971). Nests are a platform of sticks, constructed near the tops of large trees. This species has probably adapted better than any other native bird to the introduced flora and fauna that dominate lowland areas. Illegal shooting and harassment at nest-sites are probably the most significant factors affecting the species at present (Griffin 1984). The population was estimated at 1400 - 2500 birds (Griffin 1984). Hawaiian Hawk nesting sites were not observed in any areas near the Kupapaulua Highway Bridge, or near any sampling areas up or downstream of the bridge.

No other native landbirds were seen in the study area. This was expected for two reasons. First, native Hawaiian landbirds are rarely found in areas where the native habitat has been destroyed (Perkins 1903; Berger 1981). The area within and around Kupapaulua gulch reflects over 100 years of severe human degradation. The edges of the gulch were dominated by relict stands of sugarcane, (*Saccharum officinarum*), and Guinea grass, (*Panicum maximum*), while the slope and bottom of the gulch contained mostly introduced rose apple, (*Syzygium jambos*) , and common guava, (*Psidium guajava*). A few large individuals of the native Ohia, (*Metrosideros polymorpha*), were noted, but these trees were not present in sufficient number to support populations of native bird species such as Apapane, (*Himatione sanguinea*), Iiwi (*Vestiaria coccinea*),

or Hawaii Amakihi, (*Hemignathus virens*). It is possible, but very unlikely, that small numbers of any of these species utilize the nectar or arthropod resources of these trees on a short-term, seasonal basis.

The second reason no native landbirds were expected in this area is because this site lies within the low elevation "mosquito zone". Since Hawaiian birds evolved in the absence of mosquitoes, they are highly susceptible to mosquito transmitted diseases such as avian malaria (Warner 1968; van Riper et al. 1986). The presence of mosquitoes below 1500 m elevation on all Hawaiian islands is believed to be a major factor limiting the abundance of lowland native forest bird populations, even in otherwise suitable habitat (van Riper et al. 1986).

**Introduced birds:**

Japanese White-eyes, *Zosterops japonicus*, are the most abundant land birds in the Hawaiian Islands (Scott et al. 1986). They were first introduced from Japan in 1929 to Oahu (Caum 1933), with an introduction to the Big Island in 1937 (Berger 1981). Japanese White-eyes are omnivores, feeding mostly on fruit, nectar, and insects from understory sites (Guest 1973; Conant 1975). These birds occur from sea-level to 3100 m on Hawaii in a broad range of vegetation types, however they tend to be most abundant in lowland areas where introduced species dominate the ground cover. The population of Japanese White-eyes appears to have "exploded" within the past 40 years (Scott et al. 1986).

House Finches, *Carpodacus mexicanus*, were introduced to Hawaii before 1870, probably from San Francisco (Caum 1933). By the 1940's they were well established on all Hawaiian Islands (Munro 1944). House Finches are omnivorous and feed on a variety of seeds, buds, and fruit. They are common in cities, agricultural areas, and most types of forest, from sea-level to 2500 m elevation (Berger 1981). Grasslands and open woodlands appear to be their preferred habitat.

Northern Cardinals, *Cardinalis cardinalis*, were introduced to the Hawaiian Islands in 1929 (Caum 1933) and are well established in introduced and disturbed native forests throughout the islands (Scott et al. 1986). They are natives of North America that frequent hedges, thickets, and open woodlands and feed on seeds, fruits, and insects (Bent 1968). These birds are common from sea - level to 2500 m in a diversity of disturbed habitats.

Common Mynas, *Acridotheres tristis*, were introduced from India in 1865 (Caum 1933) and are common to abundant in most lowland areas except forest interiors. These birds are terrestrial omnivores and occur from sea-level to 2300 m elevation on the island of Hawaii (Scott et al. 1986). They appear to prefer dry woodlands and partly open forests with low shrub cover at low elevations. These birds seldom enter high elevation native forests.

The Melodious Laughing Thrush, *Garrulax canorus*, was a cage-bird liberated during the great 1900 fire in Honolulu (Caum 1933). These babblers are native to southeast Asia. Munro (1944) considered them well established even in the deepest forests. Melodious Laughing Thrushes occur in a wide range of habitats, from very wet forests to dry scrub, and are most abundant in lowland areas with dense understory. On Hawaii, they are found from sea-level to 2900 m elevation.

**Fish and Aquatic Invertebrate Surveys**

Kupapaulua Gulch is an intermittent stream flowing infrequently only during heavy rainstorms. Evidence of this is the many areas of the dry streambed contained large plants that will be washed away with the next large storm. This survey was conducted during a wet period on the Big Island, and many nearby ephemeral gulches and small streams were flowing heavily on 25 June 1997. However, Kupapaulua Gulch was dry even during this wet period. As Kupapaulua Gulch was dry and did not contain any springs, seeps, rheocrenes, or permanent pools we did not find any native or introduced freshwater aquatic biota. The results of this biological assessment indicate that Kupapaulua Gulch from upstream of the main Hawaii Belt Road (19) to the ocean does not maintain enough flow to support fish, mollusks, crustaceans, or aquatic insects.

## ENVIRONMENTAL CONSEQUENCES

**Avian Species (Native Birds):**

No adverse impacts are anticipated to occur to native Hawaiian Hawks due to the small scale and temporary nature of impacts resulting from the Kupapaulua Highway Bridge construction project. This bridge construction project should also not adversely impact nesting or the food supply of the Hawaiian Hawk. Additionally, no adverse impacts are expected for other native forest birds such as Iiwi and Apapane due to the Kupapaulua Highway Bridge construction project. This is because it is a very remote possibility that these birds still inhabit this area.

**Fish and Aquatic Invertebrates**

Because the stream channel is dry, no impacts to native aquatic invertebrates will occur as the result of construction in the area of the current Kupapaulua Gulch Highway Bridge. However, best management practices should be employed during construction to prevent soil erosion into nearshore ocean areas.

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# PHOTOGRAPHIC RECORD

Photo 1: Kupapaulua Gulch at Station 1 (400 ft)

Photo 2: Kupapaulua Gulch at Station 2 (500 ft)

Photo 3: Kupapaulua Gulch at Station 3 (600 ft)

Photo 4: Kupapaulua Gulch at Station 3 (600 ft)

# APPENDIX I - DATA SHEETS

## Pacific Aquatic Environmental - Stream Assessment

(1)

| Stream Kupapaʻu, At old Belt Road | Date 6/25/97 | Time 1434 | Reach | Sample No. | Comments |
|---|---|---|---|---|---|
| Elevation (ft) 400 | Temperature | pH | Personnel England / Hart | | |
| Habitat type Dry Gulch | Sampling method Vis. Obs. | | Area sampled (ft) | | |
| Maximum Depth (ft) | | | | | |

| Substrate | | Percent | Riparian vegetation | | 1) Kukui |
|---|---|---|---|---|---|
| | Silt | | | | 2) Panicum Grass |
| | Sand (1-3 mm) | | | | 3) Lemon Guava |
| | Gravel (3-60 mm) | 15 | | | 4) Ginger |
| | Sm. Cobble (60-150 mm) | | % Canopy 10-40 | | Castor Bean |
| | Lg. Cobble (150-250 mm) | | Flow | Q = w * d * a * 1 / t | a=0.8 rough; 0.9 smooth |
| | Sm. Boulder (250-500 mm) | | Width | Depth | Length / Time |
| | Lg. Boulder (>500 mm) | 35 | | | |
| | Bedrock | 50 | | | |
| | Vegetation | | | | |
| | Organic Matter | | | | |

At Old Belt highway bridge, Waterfalls directly below Old hwy bridge (No water in stream or falls now, despite it being Wet and rainy out), especially at higher elevations, now

| Crustacea | Number | | Fish | Number | Comments/Photos |
|---|---|---|---|---|---|
| *Atyoida bisulcata* | | | *Awaous guamensis* | | - No biota due to stream |
| *M. grandimanus* | | | *Sicyopterus stimpsoni* | | being dry. |
| *M. lar* | | | *Lentipes concolor* | | |
| *P. clarki* | | | *Stenogobius hawaiiensis* | | |
| | | | *Eleotris sandwicensis* | | |
| **Mollusca** | | | *Kuhlia sandvicensis* | | |
| *Neritina granosa* | | | Mullet species | | |
| *Neritina vespertina* | | | Carangidae | | |
| *Erinna newcombi* | | | *Cichlasoma nigrofasciatum* | | |
| Native Lymnaeidae | | | *Sarotherodon melanotheron* | | |
| Thiaridae | | | *Oreochromis mossambicus* | | |
| *Corbicula fluminea* | | | *Gambusia affinis* | | |
| | | | *Poecilia reticulata* | | |
| **Insecta** | | | *Poecilia mexicana* | | |
| *Megalagrion* spp. | | | *Poecilia spp.* | | |
| 1) | | | *Xiphophorus helleri* | | |
| 2) | | | *Micropterus dolomieu* | | |
| *Ischnura ramburi* | | | *Micropterus salmoides* | | |
| *Ischnura posita* | | | *Lepomis macrochirus* | | |
| *Anax junius* | | | **Amphibia** | | |
| *Anax strenuus* | | | *Rana rugosa* | | |
| *Pantala flavescens* | | | *Bufo marinus* | | |
| *Tramea lacerata* | | | *Dendrobates auratus* | | |
| Other Odonata | | | | | |
| Hydropsychidae | | | | | |
| | | | | | |
| | | | | | |

## Pacific Aquatic Environmental - Stream Assessment

| Stream Kupapaulua (2) | Date 7/2 | Time 1115 | Reach | Sample No. | Comments |
|---|---|---|---|---|---|
| Elevation (ft) | Temperature | pH | Personnel England / Hart | | |
| Habitat type - Dry (High Gradient) | Sampling method Visual | | Area sampled (ft) | | |
| Maximum Depth (ft) | | | | | |

| Substrate | | Percent | Riparian vegetation | | |
|---|---|---|---|---|---|
| | Silt | | | 1) Guava | |
| | Sand (1-3 mm) | | | 2) Yellow Ginger | |
| | Gravel (3-60 mm) | | | 3) Annicum gigantum (Grass) | |
| | Sm. Cobble (60-150 mm) | 10 | % Canopy 50-60 | 4) Hala / Kukui | |
| | Lg. Cobble (150-250 mm) | 15 | Flow | Q = w * d * a * l / t | a=0.8 rough; 0.9 smooth |
| | Sm. Boulder (250-500 mm) | 25 | Width | Depth | Length / Time |
| | Lg. Boulder (>500 mm) | 50 | | | |
| | Bedrock | | | | |
| | Vegetation | | | | |
| | Organic Matter | | | | |

# At confluence of Kahale & Kupapaulua, about 75ft. upstream of concrete bridge on dirt road

| Crustacea | Number | | Fish | Number | Comments/Photos |
|---|---|---|---|---|---|
| *Atyoida bisulcata* | | | *Awaous guamensis* | | |
| *M. grandimanus* | | | *Sicyopterus stimpsoni* | | |
| *M. lar* | | | *Lentipes concolor* | | No Biota - Dry Streambed |
| *P. clarki* | | | *Stenogobius hawaiiensis* | | (even though quite wet out). |
| | | | *Eleotris sandwicensis* | | |
| **Mollusca** | | | *Kuhlia sandvicensis* | | |
| *Neritina granosa* | | | Mullet species | | |
| *Neritina vespertina* | | | Carangidae | | |
| *Erinna newcombi* | | | *Cichlasoma nigrofasciatum* | | |
| Native Lymnaeidae | | | *Sarotherodon melanotheron* | | |
| Thiaridae | | | *Oreochromis mossambicus* | | |
| *Corbicula fluminea* | | | *Gambusia affinis* | | |
| | | | *Poecilia reticulata* | | |
| **Insecta** | | | *Poecilia mexicana* | | |
| *Megalagrion* spp. | | | *Poecilia spp.* | | |
| 1) | | | *Xiphophorus helleri* | | |
| 2) | | | *Micropterus dolomieu* | | |
| *Ischnura ramburi* | | | *Micropterus salmoides* | | |
| *Ischnura posita* | | | *Lepomis macrochirus* | | |
| *Anax junius* | | | **Amphibia** | | |
| *Anax strenuus* | | | *Rana rugosa* | | |
| *Pantala flavescens* | | | *Bufo marinus* | | |
| *Tramea lacerata* | | | *Dendrobates auratus* | | |
| Other Odonata | | | | | |
| Hydropsychidae | | | | | |
| | | | | | |
| | | | | | |

## Pacific Aquatic Environmental - Stream Assessment

| Stream Kupapaulua (3) | Date 7/2/97 | Time 1222 | Reach | Sample No. | Comments |
|---|---|---|---|---|---|
| Elevation (ft) 600 | Temperature | pH | Personnel England / Hart | | |
| Habitat type - Dry Streambed | Sampling method Vis. Obs. | | Area sampled (ft) photos 6-7 | | |
| Maximum Depth (ft) | | | | | |

| Substrate | | Percent | Riparian vegetation | | | |
|---|---|---|---|---|---|---|
| | Silt | | 1) See Notes from before (Java Plum) | | | |
| | Sand (1-3 mm) | | 2) African Tulip | | | |
| | Gravel (3-60 mm) | 5 | 3) Avocado | | | |
| | Sm. Cobble (60-150 mm) | 5 | 4) Kukui | | | |
| | Lg. Cobble (150-250 mm) | 5 | % Canopy 25-80 | Archontophoenix (King? Palm) | | |
| | Sm. Boulder (250-500 mm) | 5 | Flow Q = w * d * a * 1 / t | | | a=0.8 rough; 0.9 smooth |
| | Lg. Boulder (>500 mm) | 80 | Width | Depth | Length | Time |
| | Bedrock | | | | | |
| | Vegetation | | | | | |
| | Organic Matter | | | | | |

* Directly Under Kupapaulua Hwy Bridge - Stream is dry.

| Crustacea | Number | | Fish | Number | Comments/Photos |
|---|---|---|---|---|---|
| Atyoida bisulcata | | | Awaous guamensis | | |
| M. grandimanus | | | Sicyopterus stimpsoni | Dry - | No aquatic biota |
| M. lar | | | Lentipes concolor | | observed. |
| P. clarki | | | Stenogobius hawaiiensis | | |
| | | | Eleotris sandwicensis | | |
| **Mollusca** | | | Kuhlia sandvicensis | | |
| Neritina granosa | | | Mullet species | | |
| Neritina vespertina | | | Carangidae | | |
| Erinna newcombi | | | Cichlasoma nigrofasciatum | | |
| Native Lymnaeidae | | | Sarotherodon melanotheron | | |
| Thiaridae | | | Oreochromis mossambicus | | |
| Corbicula fluminea | | | Gambusia affinis | | |
| 2) | | | Poecilia reticulata | | |
| **Insecta** | | | Poecilia mexicana | | |
| Megalagrion spp. | | | Poecilia spp. | | |
| 1) | | | Xiphophorus helleri | | |
| 2) | | | Micropterus dolomieu | | |
| Ischnura ramburi | | | Micropterus salmoides | | |
| Ischnura posita | | | Lepomis macrochirus | | |
| Anax junius | | | **Amphibia** | | |
| Anax strenuus | | | Rana rugosa | | |
| Pantala flavescens | | | Bufo marinus | | |
| Tramea lacerata | | | Dendrobates auratus | | |
| Other Odonata | | | | | |
| Hydropsychidae | | | | | |
| | | | | | |
| | | | | | |

(3)

# Pacific Aquatic Environmental - Stream Assessment

| Stream Kupapaulua-Belt Rd | Date 6/25/97 | Time 1346 | Reach | Sample No. | Comments |
|---|---|---|---|---|---|
| Elevation (ft) 600 | Temperature | pH | Personnel England / Hart | | |
| Habitat type- Dry | Sampling method Visual Obs | | Area sampled (ft) | | |
| Maximum Depth (ft) | | | | | |

| Substrate | Percent | Riparian vegetation | |
|---|---|---|---|
| Silt | | | 1) Java Plum |
| Sand (1-3 mm) | | | 2) African Tulip |
| Gravel (3-60 mm) | | | 3) Avocado |
| Sm. Cobble (60-150 mm) | | % Canopy 50-90 | 4) Kukui |
| Lg. Cobble (150-250 mm) | | Flow | Archontophoenix (King's Palm) |
| Sm. Boulder (250-500 mm) | 15 | Width | Q = w * d * a * 1/t a=0.8 rough; 0.9 smooth |
| Lg. Boulder (>500 mm) | 50 | | Depth |
| Bedrock | 35 | | Length |
| Vegetation | | | Time |
| Organic Matter | | | |

- Just downstream of Kupapaulua Bridge on Main Belt Rd.

| Crustacea | Number | | Fish | Number | Comments/Photos |
|---|---|---|---|---|---|
| *Atyoida bisulcata* | | | *Awaous guamensis* | Dry | Streambed |
| *M. grandimanus* | | | *Sicyopterus stimpsoni* | - No | habitat or biota |
| *M. lar* | | | *Lentipes concolor* | | |
| *P. clarki* | | | *Stenogobius hawaiiensis* | | - Stream is not flowing even |
| | | | *Eleotris sandwicensis* | | though it has been raining today and |
| **Mollusca** | | | *Kuhlia sandvicensis* | | appears to be rainy upslope in the |
| *Neritina granosa* | | | Mullet species | | mountains. |
| *Neritina vespertina* | | | Carangidae | | |
| *Erinna newcombi* | | | *Cichlasoma nigrofasciatum* | | |
| Native Lymnaeidae | | | *Sarotherodon melanotheron* | | |
| Thiaridae | | | *Oreochromis mossambicus* | | |
| *Corbicula fluminea* | | | *Gambusia affinis* | | |
| | | | *Poecilia reticulata* | | |
| **Insecta** | | | *Poecilia mexicana* | | |
| *Megalagrion* spp. | | | *Poecilia spp.* | | |
| 1) | | | *Xiphophorus helleri* | | |
| 2) | | | *Micropterus dolomieu* | | |
| *Ischnura ramburi* | | | *Micropterus salmoides* | | |
| *Ischnura posita* | | | *Lepomis macrochirus* | | |
| *Anax junius* | | | **Amphibia** | | |
| *Anax strenuus* | | | *Rana rugosa* | | |
| *Pantala flavescens* | | | *Bufo marinus* | | |
| *Tramea lacerata* | | | *Dendrobates auratus* | | |
| Other Odonata | | | | | |
| Hydropsychidae | | | | | |
| | | | | | |
| | | | | | |

# Appendix C

# Botanical Survey

# BOTANICAL SURVEY
# KUPAPAULUA BRIDGE PROJECT
# HAMAKUA DISTRICT, ISLAND OF HAWAI'I

by

Winona P. Char

CHAR & ASSOCIATES
Botanical Consultants
Honolulu, Hawai'i

Prepared for: ENVIRONMENTAL COMMUNICATIONS

August 1997

# BOTANICAL SURVEY
# KUPAPAULUA BRIDGE PROJECT
# HAMAKUA DISTRICT, ISLAND OF HAWAI'I

## INTRODUCTION

Kupapaulua Stream Bridge is located on Mamalahoa Highway (Route 19) along the Hamakua coast, west of 'O'okala Town and the North Hilo - Hamakua District boundaries. The bridge is a concrete, T-beam structure constructed in the mid-1930's.

For the botanical field studies, a corridor 600 feet wide, that is, 300 feet mauka and 300 feet makai of the centerline of the existing bridge, was surveyed. The field studies also included the area along the highway on both sides of the bridge abutments. The primary objectives of the survey were to:

1) provide a general description of the vegetation;
2) search for threatened and endangered species as well as species of concern;
3) inventory the flora; and
4) identify areas of potential environmental problems or concerns and propose appropriate mitigation measures.

A team of two botanists conducted the field survey on 15 and 16 July 1997.

## SURVEY METHODS

Prior to undertaking the field survey, a search was made of the pertinent literature to familiarize the principal investigator with other botanical studies conducted in the general area. USGS topographic maps and copies of the 1934 bridge plans were examined

to determine terrain characteristics, access, boundaries, and reference points. Access into Kupapaulua Gulch was down the slopes on the makai, east (Hilo) side.

A walk-through survey method was used. Notes were made on plant associations and distribution, substrate types, drainage, exposure, disturbances, topography, etc. Plant identifications were made in the field; plants which could not be positively identified were collected for later determination in the herbarium (University of Hawai'i, Manoa - HAW), and for comparison with the taxonomic literature.

## DESCRIPTION OF THE VEGETATION

Two general vegetation types are recognized within the study corridor. Mixed forest composed primarily of introduced or alien plant species is found largely in the gulch area, while the more or less level portions of the study site support former sugar cane fields now overgrown with scrub vegetation. The scrub vegetation also occurs alongside the highway where it is infrequently bladed.

A more detailed description of these two vegetation types is presented below. A list of all the plants found during the field studies is given at the end of the report.

### Mixed Forest

On the makai, east (Hilo-side) slopes of the gulch, the forest is composed of rose apple trees (Syzygium jambos), 25 to 40 feet tall. Scattered here and there are taller trees of African tulip (Spathodea campanulata), Chinese banyan (Ficus microcarpa), hala (Pandanus tectorius), avocado (Persea americana), and mango

(Mangifera indica). Closer to the bottom of the gulch, kukui trees (Aleurites moluccana) form fairly large stands. Also occurring along the moister gulch bottom are small stands of mountain apple trees (Syzygium malaccense). Wait-a-bit (Caesalpinia decapetala), a woody vine with numerous spines along its stems, is locally common along the bottom of the gulch.

On the makai, upper west slopes (Honoka'a-side) of the gulch, a dense strawberry guava (Psidium cattleianum) thicket, 12 to 15 feet tall is found. A few native species also occur here; these include trees of neneleau (Rhus sandwicensis), and shrubs of naupaka kahakai (Scaevola sericea) and 'ulei (Osteomeles anthyllidifolia). The upper gulch slopes also support a few trees of 'ohi'a lehua (Metrosideros polymorpha).

On the steeper east slopes, inland (mauka) of the bridge, the vegetation consists of an open guava (Psidium guajava) thicket, 15 to 20 feet tall, with scattered, emergent trees of Java plum (Syzygium cumini), avocado, and silk oak (Grevillea robusta). Across the gulch on the mauka, west slopes, there is a dense ironwood forest (Casuarina cunninghamiana).

The understory vegetation in most places consists of shrubs of night-blooming jasmine or night cestrum (Cestrum nocturnum) and guava. The ground is largely barren soil and leaf litter with scattered patches of plants where the tree cover is less dense. Commonly observed ground cover plants include seedlings of rose apple and guava, 4 to 6 inches tall, and clumps of shampoo ginger (Zingiber zerumbet) and woodfern (Christella parasitica). Under the ironwood forest, there is a thick layer of fallen "needles" and very little else.

Scrub Vegetation

The former sugar cane fields now support dense clumps of Guinea grass (Panicum maximum), and thick mats of molasses grass (Melinis minutiflora) and California grass (Brachiaria mutica). Scattered about are shrubs of guava and patches of weedy species which include Crotalaria micans, partridge pea (Chamaecrista nictitans), indigo (Indigofera suffruticosa), pluchea (Pluchea carolinensis), and Sida rhombifolia.

Along the highway, the vegetation is low and grassy with patches of Guinea grass, California grass, and molasses grass. Herbaceous, largely annual species found here include fireweed (Erechtites valerianifolia), Crassocephalum crepidioides, sensitive plant (Mimosa pudica), hairy spurge (Chamaesyce hirta), maile hohono (Ageratum houstonianum), and smaller grasses such as Glenwood grass (Sacciolepis indica), yellow foxtail (Setaria gracilis), and Indian dropseed (Sporobolus diander).

Where the highway fronts a residence, there are a few ornamental species which include Turk's cap (Malvaviscus penduliflorus) and several color forms of pentas (Pentas lanceolata).

## DISCUSSION AND RECOMMENDATIONS

The vegetation within the study corridor is dominated by introduced or alien species; these are all those plants which were brought to the Hawaiian Islands by humans, intentionally or accidentally, after Western contact, that is, Cook's discovery of the islands in 1778. Of a total of 99 species inventoried during the field study, 80 (81%) species are introduced; 5 (5%) are originally of Polynesian introduction; and 14 (14%) are native. Of the 14 natives, 10 are indigenous, that is, they are native to the Hawaiian Islands and also elsewhere. Four of the natives are

endemic, that is, they are native only to the Hawaiian Islands. These endemic species are: hapu'u (Cibotium glaucum), kilau (Pteridium aquilinum), 'ohi'a lehua (Metrosideros polymorpha), and mamaki (Pipturus albidus).

None of the plants inventoried during the study is a threatened or endangered species; nor is any plant a species of concern (U.S. Fish and Wildlife Service 1997). None of the plants is considered rare or vulnerable (Wagner et al. 1990). All of the plants can be found in similar environmental habitats throughout the Hawaiian Islands.

The proposed bridge replacement project should not have a significant negative impact on the botanical resources. However, it is recommended that areas cleared of vegetation, especially within the gulch, be revegetated as soon as possible to prevent soil loss and discharge of sediments into the stream. Plants already on the project site can be used. These include shrubs of night cestrum and the fast-growing, mat-forming grasses such as California grass and Hilo grass (Paspalum conjugatum).

## LITERATURE CITED


Lamoureux, C.H. 1988. Draft checklist of Hawaiian pteridophytes, "Kupukupu O Hawai'i Ne'i". Lyon Arboretum, University of Hawai'i, Manoa.

St. John, H. 1973. List and summary of the flowering plants of Hawaii. Pacific Tropical Botanical Garden, Lawai, Kauai. Memoir No. 1.

U.S. Fish and Wildlife Service. 1997. U.S. Fish and Wildlife Service species list, plants. May 18, 1997. Pacific Islands Ecoregion Office, Honolulu, HI.

Wagner, W.L., D.R. Herbst, and S.H. Sohmer. 1990. Manual of the flowering plants of Hawai'i. 2 vols. University of Hawai'i Press and B.P. Bishop Museum Press, Honolulu. B.P. Bishop Museum Special Publication 83.

## PLANT SPECIES LIST -- Kupapaulua Bridge, Hamakua, Hawai'i

The following checklist is an inventory of all the plants observed during the field studies. The plants are arranged alphabetically by families within each of four groups: Ferns and Fern Allies, Gymnosperms, Dicots, and Monocots. The taxonomy and nomenclature of the Ferns and Fern Allies follow Lamoureux (1988), while the Gymnosperms (or Conifers) follow St. John (1973). The flowering plants, Dicots and Monocots, are in accordance with Wagner et al. (1990).

For each species, the following information is provided:

1. Scientific name with author citation.
2. Common English and/or Hawaiian name(s), when known.
3. Biogeographic status. The following symbols are used:

E = endemic = native only to the Hawaiian Islands.

I = indigenous = native to the Hawaiian Islands and also elsewhere throughout the Pacific and tropics/subtropics.

P = Polynesian = plants originally of Polynesian introduction prior to Western contact, that is, Cook's discovery of the Hawaiian Islands in 1778.

P? = questionably Polynesian = may be a Polynesian introduction, or possibly introduced in historical times (after 1778).

X = introduced or alien = all those plants brought to the Hawaiian Islands by humans, intentionally or accidentally, after Western contact.

X? = questionably introduced = dates of introduction very early; may possibly be indigenous or of Polynesian introduction.

| Scientific name | Common name | Status |
|---|---|---|
| FERNS & FERN ALLIES | | |
| ADIANTACEAE (Maidenhair fern family) | | |
| Adiantum hispidulum Sw. | Australian maidenhair | X |
| ATHYRIACEAE (Athyrium family) | | |
| Deparia petersenii (Kunze) M. Kato | | X |
| BLECHNACEAE (Blechnum family) | | |
| Blechnum occidentale L. | blechnum | X |
| DICKSONIACEAE (Tree fern family) | | |
| Cibotium glaucum (J. Sm.) Hook. & Arnott | hapu'u, hapu'u pulu | E |
| HYMENOPHYLLACEAE (Filmy fern family) | | |
| Gonocormus minutus (Blume) v.d. Bosch | | I |
| HYPOLEPIDACEAE (Bracken family) | | |
| Pteridium aquilinum var. decompositum (Gaud.) Tryon | kilau, kilau pueo | E |
| NEPHROLEPIDACEAE (Sword fern family) | | |
| Nephrolepis cordifolia (L.) Presl | 'okupukupu, pamoho, ni'ani'au | I |
| Nephrolepis multiflora (Roxb.) Jarrett ex Morton | 'okupukupu, hairy sword fern | X |
| POLYPODIACEAE (Common fern family) | | |
| Phlebodium aureum (L.) J. Sm. | laua'e haole | X |
| Phymatosorus scolopendria (Burm.) Pic.-Ser. | laua'e, lauawa'e | X |
| Pleopeltis thunbergiana Kaulf. | pakahakaha, 'ekaha 'akolea | I |
| PSILOTACEAE (Whisk fern family) | | |
| Psilotum nudum (L.) Beauv. | moa, moa nahele, pipi | I |
| THELYPTERIDACEAE (Woodfern family) | | |
| Christella parasitica (L.) Levl. | woodfern | X |

| Scientific name | Common name | Status |
|---|---|---|
| **GYMNOSPERMS** | | |
| ARAUCARIACEAE (Araucaria family) | | |
| Araucaria columnaris (G. Forst.) Hook. | Cook pine | X |
| TAXODIACEAE (Taxodium family) | | |
| Cryptomeria japonica (L.f.) D. Don | cryptomeria, Japanese cedar, sugi, tsugi | X |
| **FLOWERING PLANTS** | | |
| **DICOTS** | | |
| ACANTHACEAE (Acanthus family) | | |
| Justicia betonica L. | white shrimp plant | X |
| ANACARDIACEAE (Mango family) | | |
| Mangifera indica L. | mango, manako | X |
| Rhus sandwicensis A. Gray | neneleau | E |
| APIACEAE (Parsley family) | | |
| Centella asiatica (L.) Urb. | Asiatic pennywort, pohe kula | X |
| ASTERACEAE (Daisy family) | | |
| Ageratina riparia (Regel) R. King & H. Robinson | Hamakua pamakani, pamakani | X |
| Ageratum conyzoides L. | maile hohono | X |
| Ageratum houstonianum Mill. | maile hohono | X |
| Bidens pilosa L. | Spanish needle, ki, ki nehe | X |
| Conyza bonariensis (L.) Cronq. | hairy horseweed, ilioha | X |
| Crassocephalum crepidioides (Benth.) S. Moore | crassocephalum | X |
| Emilia fosbergii Nicolson | pualele | X |
| Erechtites valerianifolia (Wolf) DC | fireweed | X |
| Pluchea carolinensis (Jacq.) G. Don | pluchea, sour bush | X |
| BEGONIACEAE (Begonia family) | | |
| Begonia hirtella Link | begonia, pikonia | X |
| BIGNONIACEAE (Bignonia family) | | |
| Spathodea campanulata P. Beauv. | African tulip tree | X |

| Scientific name | Common name | Status |
|---|---|---|
| CARYOPHYLLACEAE (Carnation family) | | |
| Drymaria cordata var. pacifica Mizush. | pipili | X |
| CASUARINACEAE (She-oak family) | | |
| Casuarina cunninghamiana Miq. | river-oak casuarina | X |
| CONVOLVULACEAE (Morning glory family) | | |
| Ipomoea cairica (L.) Sweet | koali 'ai, koali | X? |
| CRASSULACEAE (Orpine family) | | |
| Kalanchoe pinnata (Lam.) Pers. | air plant, life plant, 'oliwa ku kahakai | X |
| EUPHORBIACEAE (Spurge family) | | |
| Aleurites moluccana (L.) Willd. | kukui, tutui | P |
| Chamaesyce hirta (L.) Millsp. | hairy spurge, garden spurge | X |
| Chamaesyce hypericifolia (L.) Millsp. | graceful spurge | X |
| Euphorbia heterophylla L. | Mexican fireweed, kaliko | X |
| FABACEAE (Pea family) | | |
| Acacia mearnsii De Wild. | black wattle | X |
| Caesalpinia decapetala (Roth) Alston | wait-a-bit, Mysore thorn, puakelekino | X |
| Canavalia cathartica Thouars | mauna-loa | X |
| Chamaecrista nictitans (L.) Moench | partridge pea, lauki | X |
| Crotalaria assamica Benth. | | X |
| Crotalaria micans Link | | X |
| Desmodium incanum DC | Spanish clover, ka'imi | X |
| Desmodium sp. | | X |
| Indigofera suffruticosa Mill. | indigo, 'iniko | X |
| Mimosa pudica var. unijuga (Duchass. & Walp.) Griseb. | sensitive plant, pua hilahila | X |
| Samanea saman (Jacq.) Merr. | monkeypod | X |
| GOODENIACEAE (Goodenia family) | | |
| Scaevola sericea Vahl | naupaka, naupaka kahakai, beach naupaka | I |

| Scientific name | Common name | Status |
|---|---|---|
| LAMIACEAE (Mint family) | | |
| Hyptis pectinata (L.) Poit. | comb hyptis | X |
| LAURACEAE (Laurel family) | | |
| Persea americana Mill. | avocado, alligator pear | X |
| MALVACEAE (Mallow family) | | |
| Malvaviscus penduliflorus DC | Turk's cap, aloalo pahupahu | X |
| Sida rhombifolia L. | | X |
| MELASTOMATACEAE (Melastome family) | | |
| Clidemia hirta (L.) D. Don | clidemia, Koster's curse | X |
| MELIACEAE (Mahogany family) | | |
| Melia azedarach L. | Chinaberry, pride of India, 'inia | X |
| MORACEAE (Mulberry family) | | |
| Ficus microcarpa L. f. | Chinese banyan | X |
| MYRTACEAE (Myrtle family) | | |
| Metrosideros polymorpha Gaud. | 'ohi'a lehua, 'ohi'a | E |
| Psidium cattleianum Sabine | strawberry guava | X |
| Psidium cattleianum var. littorale (Raddi) Fosb. | waiawi | X |
| Psidium guajava L. | guava, kuawa | X |
| Syzygium cumini (L.) Skeels | Java plum | X |
| Syzygium jambos (L.) Alston | rose apple, 'ohi'a loke | X |
| Syzygium malaccense (L.) Merr. & Perry | mountain apple, 'ohi'a ha | P |
| OXALIDACEAE (Wood sorrel family) | | |
| Oxalis corniculata L. | yellow wood sorrel, 'ihi 'ai | P? |
| PIPERACEAE (Pepper family) | | |
| Peperomia leptostachya Hook. & Arnott | 'ala 'ala wai nui | I |
| POLYGALACEAE (Milkwort family) | | |
| Polygala paniculata L. | | X |

| Scientific name | Common name | Status |
|---|---|---|
| PROTEACEAE (Protea family) | | |
| Grevillea robusta A. Cunn. ex R. Br. | silk oak, 'oka kalika | X |
| ROSACEAE (Rose family) | | |
| Osteomeles anthyllidifolia (Sm.) Lindl. | 'ulei, u'ulei | I |
| Rubus rosifolius Sm. | thimbleberry | X |
| RUBIACEAE (Coffee family) | | |
| Coffea arabica L. | coffee | X |
| Paederia scandens (Lour.) Merr. | maile pilau | X |
| Pentas lanceolata (Forsk.) K. Schum. | pentas | X |
| Spermacoce mauritiana Gideon | | X |
| SOLANACEAE (Nightshade family) | | |
| Cestrum nocturnum L. | night cestrum, 'ala aumoe | X |
| URTICACEAE (Nettle family) | | |
| Pilea microphylla (L.) Liebm. | artillary plant | X |
| Pipturus albidus (Hook. & Arnott) A. Gray | mamaki | E |
| VERBENACEAE (Verbena family) | | |
| Stachytarpheta dichotoma (Ruiz & Pav.) Vahl | owi, oi | X |
| MONOCOTS | | |
| AGAVACEAE (Agave family) | | |
| Cordyline fruticosa (L.) A. Chev. | ti, ki | P |
| ARACEAE (Aroid family) | | |
| Dieffenbachia picta Schott | dieffenbachia | X |
| Philodendron sp. | philodendron | X |
| ARECACEAE (Palm family) | | |
| Archontophoenix alexandrae (F.v. Muell.) H.A. Wendl. & Drude | king palm, Alexandra palm | X |
| COMMELINACEAE (Dayflower family) | | |
| Commelina diffusa N.L. Burm. | honohono | X |

| Scientific name | Common name | Status |
|---|---|---|
| CYPERACEAE (Sedge family) | | |
| Pycreus polystachyos (Rottb.) P. Beauv. | | I |
| PANDANACEAE (Hala family) | | |
| Pandanus tectorius S. Parkinson ex Z | pandanus, hala, pu hala | I |
| POACEAE (Grass family) | | |
| Brachiaria mutica (Forssk.) Stapf | California grass | X |
| Coix lachryma-jobi L. | Job's tears | X |
| Digitaria ciliaris (Retz.) Koeler | crabgrass | X |
| Melinis minutiflora P. Beauv. | molasses grass | X |
| Oplismenus compositus (L.) P. Beauv. | | X |
| Oplismenus hirtellus (L.) P. Beauv. | basket grass, hono-hono kukui | X |
| Panicum maximum Jacq. | Guinea grass | X |
| Paspalum conjugatum Bergius | Hilo grass, mau'u Hilo | X |
| Phyllostachys nigra (Lodd.) Munro | bamboo | X |
| Saccharum officinarum L. | sugar cane, ko | P |
| Sacciolepis indica (L.) Chase | Glenwood grass | X |
| Setaria gracilis Kunth | yellow foxtail | X |
| Setaria palmifolia (J. Konig.) Stapf | palmgrass | X |
| Sporobolus diander (Retz.) P. Beauv. | Indian dropseed | X |
| ZINGIBERACEAE (Ginger family) | | |
| Zingiber zerumbet (L.) Sm. | shampoo ginger, 'awapuhi kuahiwi | P |

# Appendix D

# Memorandum of Agreement

MEMORANDUM OF AGREEMENT
Among the
ADVISORY COUNCIL ON HISTORIC PRESERVATION,
FEDERAL HIGHWAY ADMINISTRATION,
HAWAII STATE HISTORIC PRESERVATION OFFICER and the
STATE OF HAWAII DEPARTMENT OF TRANSPORTATION
Regarding Hawaii Belt Road, Kupapaulua Bridge Widening
Project No. BR-019-2(38)
Hamakua District, Island of Hawaii, State of Hawaii

**WHEREAS**, the Federal Highway Administration (FHWA) has determined that the State of Hawaii Department of Transportation (HDOT) project entitled "Hawaii Belt Road, Kupapaulua Bridge Widening, Project No. BR-019-2(38)" will have an effect upon the Kupapaulua Bridge, a property eligible for inclusion in the National Register of Historic Places, and has consulted with the Hawaii State Historic Preservation Officer (SHPO) pursuant to 36 CFR Part 800, regulations implementing Section 106 of the National Historic Preservation Act (16 U.S.C. 470f); and

**WHEREAS**, the HDOT and the Historic Hawaii Foundation (HHF) have participated in the consultation and have been invited to concur in this Memorandum of Agreement; and

**WHEREAS**, the FHWA, the Hawaii SHPO, the HDOT, and the HHF have considered all alternatives to the bridge widening and seismic rehabilitation construction, including the the "No build" and the "Build a new bridge at a new location without using the existing bridge" alternatives, and have determined that the alternatives are not feasible nor prudent; and

**WHEREAS**, the bridge widening and seismic rehabilitation construction will:

A. Widen the existing bridge. The existing bridge has an overall width of 29 feet 10 inches, consisting of two (2) 11-foot wide vehicle lanes, one (1) 5-foot wide sidewalk, and railings on both sides having a combined width of 2 feet 10 inches. The bridge will be widened to a new width of approximately 44 feet, consisting of two (2) 12-foot wide vehicle lanes, two (2) 8-foot wide road shoulders, and new railings on both sides having a combined width of approximately 4 feet.

B. Rehabilitate the existing bridge superstructure and substructure to conform with current standards for seismic resistance. This seismic rehabilitation construction will increase the seismic capacity of the structure through addition of concrete encased steel reinforcement to existing structural members. The rehabilitation design will retain the approximately 210 feet long single span concrete arch character of the existing structure.

NOW, THEREFORE, the FHWA and the Hawaii SHPO agree that the undertaking shall be implemented in accordance with the following stipulations in order to take into account the effect of the undertaking on historic properties.

## STIPULATIONS

The FHWA will ensure that the following measures are implemented:

1. The Hawaii SHPO is afforded the opportunity to review and comment during the development of the project design. The HDOT shall submit preliminary designs to the Hawaii SHPO for review. The Hawaii SHPO shall provide its comments to the HDOT within thirty (30) days of the submission. The HDOT shall address the Hawaii SHPO comments to the satisfaction of the Hawaii SHPO.

2. Prior to initiation of the bridge widening and seismic rehabilitation construction of the Kupapaulua Bridge, the HDOT shall submit photographic documentation of the existing bridge structure using Historic American Building Survey (HABS) standards to the following agencies: (1) Hawaii SHPO; (2) HABS, Washington, D.C.; (3) University of Hawaii at Manoa, Hamilton Library Hawaiian Collections; (4) FHWA Hawaii Division.

3. The stipulated photographic documentation shall consist of photographs produced on 8-inch by 10-inch fiber-based paper prints from 4-inch by 5-inch Tri-X negatives. Both negatives and prints shall be processed with archival quality control methods. The documentation shall include photographs of upstream and downstream bridge profiles, the Hawaii Belt Road approaches onto the Kupapaulua Bridge from either end of the bridge, and detailed views of the bridge railings, footings, and connections.

4. Xerox on vellums of the original construction plans of the Kupapaulua Bridge shall be submitted to the Hawaii SHPO.

5. Should a party to this agreement object within thirty (30) days to any items submitted pursuant to this agreement, the FHWA shall consult with the objecting party to resolve the objection. If the FHWA determines that the objection cannot be resolved, the FHWA shall request the further comments of the Council pursuant to 36 CFR Section 800.6(b). Any Council comment provided in response to such a request will be taken into account by the FHWA in accordance with 36 CFR Section 800.6(c)(2) with reference only to the subject of the dispute; the FHWA's responsibility to carry out all actions under this agreement that are not the subjects of the dispute will remain unchanged.

6. Any party to this Memorandum of Agreement may request that it be amended, whereupon the parties will consult in accordance with 36 CFR 800 to consider such amendment.

Execution of this Memorandum Of Agreement by the FHWA and the Hawaii SHPO , its subsequent acceptance by the Council, and implementation of its terms shall be evidence that the FHWA has afforded the Council an opportunity to comment on the project entitled "Hawaii Belt Road, Kupapaulua Bridge Widening, Project No. BR-019-2(38)" and its effects on historic properties, and that the FHWA has taken into account the effects of the undertaking on historic properties.

**FEDERAL HIGHWAY ADMINISTRATION**

By: Abraham Wong Date: 4/14/98
ABRAHAM WONG
Division Adminstrator

**HAWAII STATE HISTORIC PRESERVATION OFFICER**

By: for Alan A. Coloma Agaran Date: MAY -6 1998
for MICHAEL D. WILSON
Director, State of Hawaii Department of Land and Natural Resources

**CONCURRED BY:**

**STATE OF HAWAII DEPARTMENT OF TRANSPORTATION**

By: Kazu Hayashida Date: 4/9/98
KAZU HAYASHIDA
Director of Transportation

**HISTORIC HAWAII FOUNDATION**

By: David Scott Date: May 13, 1998
DAVID SCOTT
Executive Director

**ACCEPTED for the ADVISORY COUNCIL ON HISTORIC PRESERVATION**

By: John Fowler Date: 6/12/98
JOHN FOWLER
Executive Director

# Appendix E

# Photographic Documentation

# PHOTOGRAPHIC DOCUMENTATION

*for*

# KUPAPA'ULUA BRIDGE

(Kupapa'ulua Gulch Bridge, Structure Number 001000190306876)

HĀMĀKUA DISTRICT, ISLAND OF HAWAI'I

STATE OF HAWAI'I

*Prepared for:*

STATE OF HAWAI'I
DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION
HONOLULU, HAWAI'I

*Prepared by:*

NISHIMURA, KATAYAMA, OKI & SANTO, INC.
826 Kaheka Street, Suite 302
Honolulu, Hawai'i

October 1998

# INDEX TO PHOTOGRAPHS

| | |
|---|---|
| historic name | KUPAPA'ULUA BRIDGE |
| other names/site number | Kupapa'ulua Gulch Bridge (structure number 001000190306876) |
| street & number | Hawai'i Belt Road (FAP 19) spanning Kupapa'ulua Gulch, 1.50 miles west of 'O'ōkala Access Road |
| city or town | 'O'ōkala |
| vicinity | Hāmākua District |
| county | Hawai'i |
| state | Hawai'i |

David Franzen, Photographer July 7, 1998

Note: All photographs are 8" x 10" enlargements from 4" x 5" negatives.

1. AERIAL VIEW OF UPSTREAM (SOUTH) SIDE OF BRIDGE.
2. AERIAL VIEW OF DOWNSTREAM (NORTH) SIDE OF BRIDGE.
3. AERIAL VIEW OF WESTERN HALF OF BRIDGE FROM DOWNSTREAM SIDE, FACING SOUTHWEST.
4. AERIAL VIEW OF EASTERN HALF OF BRIDGE FROM DOWNSTREAM SIDE, FACING SOUTHEAST.
5. BRIDGE APPROACH FROM EASTERN END, FACING NORTHWEST.
6. BRIDGE APPROACH FROM WESTERN END, FACING SOUTHEAST.
7. OBLIQUE VIEW OF NORTH SIDE OF BRIDGE FROM NORTHWEST END, FACING SOUTHEAST.
8. VIEW OF CONCRETE PIERS FROM BELOW BRIDGE DECK FROM EAST ABUTMENT, FACING NORTHWEST.
9. VIEW OF CONCRETE PIERS FROM BELOW BRIDGE DECK FROM EAST ABUTMENT, FACING NORTHWEST. MEASURING POLE AT NORTH COLUMN OF PIER NO. 1.
10. VIEW BELOW BRIDGE DECK OF COLUMNS, BEAMS, GIRDERS, ARCH RIB, AND UNDERSIDE OF DECK FROM PIER NO. 1, FACING NORTHWEST.

KUPAPA'ULUA BRIDGE
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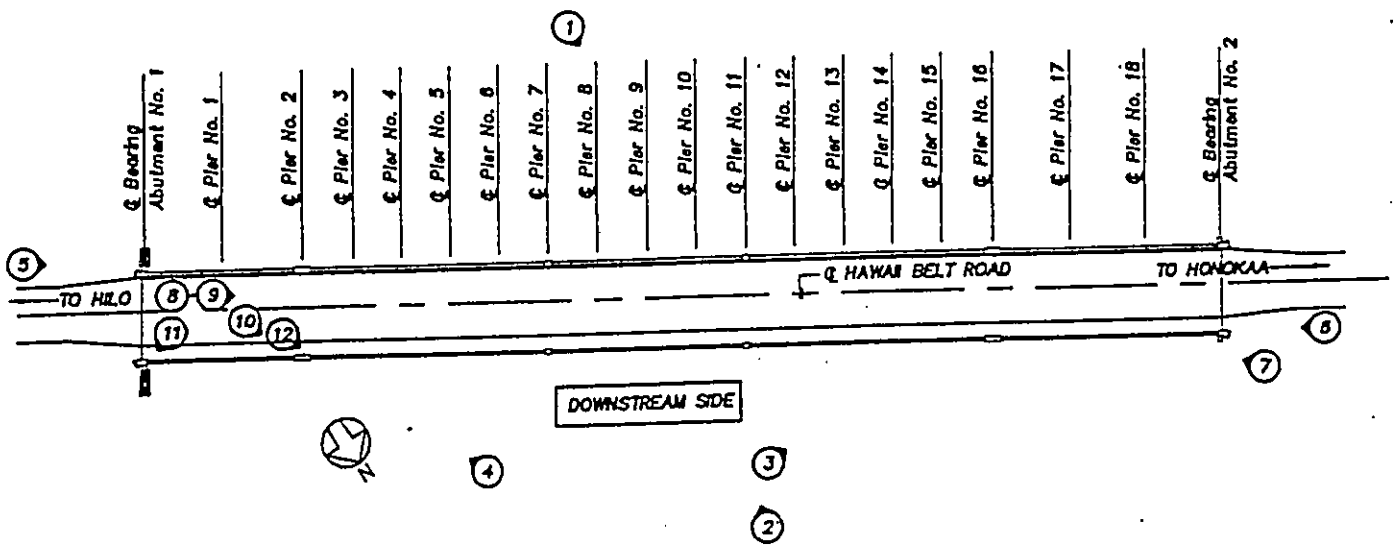
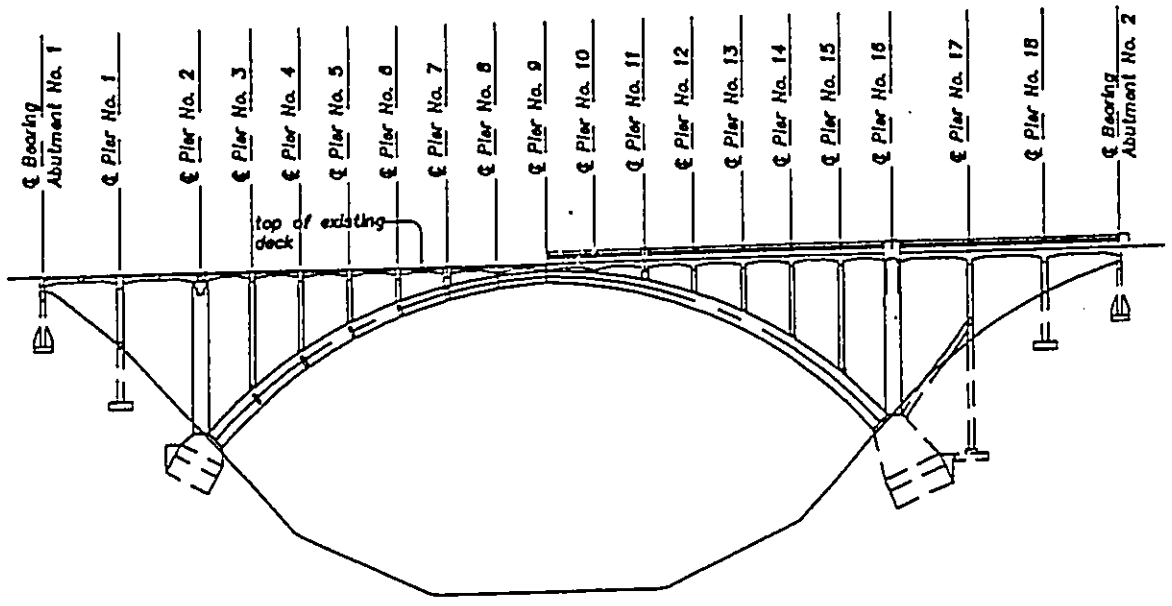
11. VIEW OF EAST ABUTMENT WALL/FOOTING, FACING NORTHEAST.

12. VIEW OF DOWNSTREAM SIDE RAILING DETAIL, FACING NORTHWEST.

KUPAPA'ULUA BRIDGE
INDEX TO PHOTOGRAPHS (Page 3)




BRIDGE PLAN / PHOTO KEY
NOT TO SCALE




BRIDGE HALF SECTION / ELEVATION
NOT TO SCALE

# KUPAPA'ULUA BRIDGE
(Kupapa'ulua Gulch Bridge, Structure Number 001000190306876)

Location: Hawai'i Belt Road (FAP 19) spanning Kupapa'ulua Gulch, 1.50 miles west of 'O'ōkala Access Road, 'O'ōkala, Hāmākua District, Hawai'i County, Hawai'i

U.S.G.S. 7.5 minute Kukaiau, Hawai'i quadrangle
Universal Transverse Mercator (UTM) Coordinates: 7,266,061.65 N
851,693.95 E

Date of Construction: 1935

Engineer: William R. Bartels

Builder: Peter Arioli, Contractor

Present Owner: State of Hawai'i
Department of Transportation, Highways Division
869 Punchbowl Street
Honolulu, Hawai'i 96813

Present Use: Highway bridge

Significance: The Kupapa'ulua Bridge is the last reinforced concrete open-spandrel arch bridge constructed in Hawai'i and marked the end of an era of bridge building. The bridge was a significant element of the Territorial belt road plan and contributed to the economic development of the region. It was designed by William R. Bartels, a German-born engineer, who was responsible for the design of all major Territorial bridge projects between 1932 and his retirement from the Territorial Highway Department in 1956. Kupapa'ulua Bridge is considered one of Bartels' greatest works. The open-spandrel arch span was for a period the longest span in the islands and the most expensive bridge built at the time in the islands.

Report Prepared By: Paul T. Santo
Nishimura, Katayama, Oki & Santo, Inc.
826 Kaheka Street, Suite 302
Honolulu, Hawai'i 96814

Date: October 1998

## I. DESCRIPTION

The Kupapa'ulua Bridge is located on the Hawai'i Belt Road (FAP 19) near the town of 'O'ōkala on the Hāmākua Coast of the island of Hawai'i. The bridge is a multi-span structure crossing over Kupapa'ulua Gulch with a central open-spandrel concrete arch and five concrete deck/girder spans. It was the last open-spandrel arch bridge constructed in the islands. At the time of its construction in 1935, its arch spanned the longest of any bridge in the islands [Alvarez,1987:164]. It spanned a distance of 217 feet with a rise of fifty feet from the spring line of the arch. At the lowest elevation of the gulch, the bridge deck stands approximately 120 feet above the gulch floor.

The bridge is in its original location and is in a rural setting similar to the one it began with. With the exception of minor spalling of concrete on the parapets, the integrity of the structure remains intact. Patricia Alvarez states [Alvarez, 1987:165], "Unfortunately, the arch for which it is noted is not easily viewed." The best view is from the air as shown by photos 1 and 2.

## II. ARCHITECTURAL AND ENGINEERING INFORMATION

The Kupapa'ulua Bridge was designed by William R. Bartels and constructed by Peter Arioli, contractor, at a cost of approximately $107,000 [Alvarez, 1987:163; Spencer Mason Architects (hereafter SMA), 1996:VI-51]. The bridge was constructed in 1935. The bridge consisted of five concrete deck/girder spans and a single central concrete open-spandrel arch. The arch spanned 217 feet with a rise of fifty feet. The total length of the bridge measured 353 feet. The total out to out width of the superstructure measured 29.5 feet with a roadway width of 22 feet and a 5-foot sidewalk on the northern side. The deck of the bridge is approximately 120 feet above the gulch floor at its highest point.

The superstructure consists of a reinforced concrete deck slab with haunched reinforced concrete girders and pier caps. The substructure consists of reinforced concrete piers, an open-spandrel arch, abutments, and footings. The bridge railings are open, molded of reinforced concrete. The bridge name and date of construction are incised on the end posts.

## III. HISTORICAL INFORMATION

The Kupapa'ulua Bridge was constructed along the Hawai'i Belt Road in 1935 by the Territory of Hawai'i to span the deep Kupapa'ulua Gulch and stream. The project utilized Federal-Aid funds allocated for the upgrading of the Hawai'i island belt road system in the 1930s. During this time, the Hawaiian islands witnessed rapid economic and population growth. The population of the islands more than doubled, primarily due to the importation of laborers for the sugar and pineapple plantations, which meant increasing demand for housing, schools, utilities and physical infrastructure [SMA,1996:IV-8]. This bridge as well as the numerous other bridges constructed along the Hawai'i Belt Road played a major role in connecting previously isolated communities with improved modern vehicular roads and bridges. Much of this construction was funded by the U.S. Congress in anticipation of its entry into World War I. Federal aid funded

roads were intended to upgrade existing highways. Belt roads, which circled the island, or roads that linked a seaport to a federal property (such as military bases or national parks) were usually selected for federal aid in Hawai'i [SMA,1996:IV-9].

The Kupapa'ulua Bridge was the last open-spandrel concrete arch bridge constructed in the islands and marked the end of an era of bridge building. The first open-spandrel concrete arch bridge in the islands was the Honoli'i Stream Bridge constructed in 1911. Most of the bridges constructed after 1925 were reinforced concrete tee beam/girder type. The open-spandrel concrete arch type was rare. At the time of construction, the open-spandrel arch span for the Kupap'ulua Bridge was the longest span in the islands. At the cost of $107,000, it was also the most expensive bridge built at that time in the islands.

Kupapa'ulua Bridge was designed by William R. Bartels, a German-born engineer who joined the Territorial Highway Department in 1932. He was responsible for the design of all major Territorial bridge projects between 1932 and his retirement in 1956. His bridges evidence a refined aesthetic sensibility which makes them distinctive from the works of other engineers [SMA,1996:VI-52]. Kupapa'ulua Bridge is considered one of Bartels' greatest works.

## IV. SOURCES

Plans and Drawings

The original drawings for this structure are located at the State of Hawai'i, Department of Transportation, Highways Division office at 869 Punchbowl Street, Honolulu, Hawai'i. The drawings for "Kupapa'ulua Bridge No. 202, Hawai'i Belt Road, N.R.H. No. 14-F" were prepared by the Territorial Highway Department in May 1934. The bridge appears unchanged from this time.

Bibliography

Alvarez, Patricia. *Historic Bridge Inventory and Evaluation: Island of Hawai'i.* Prepared for the State of Hawai'i Department of Transportation Highways Division with the U.S. Department of Transportation Federal Highway Administration, Honolulu, 1987.

Spencer Mason Architects. *State of Hawai'i Historic Bridge Inventory and Evaluation.* Prepared for the State of Hawai'i Department of Transportation Highways Division with the U.S. Department of Transportation Federal Highway Administration, Honolulu, 1996.

## V. PROJECT INFORMATION

This documentation has been prepared in accordance with a Memorandum of Agreement (MOA) regarding the widening and seismic rehabilitation of the Kupapa'ulua Bridge signed by the Advisory Council of Historic Preservation (ACHP), the Federal Highway Administration (FHWA), the Hawai'i State Historic Preservation Officer (SHPO), and the State of Hawai'i Department of Transportation (HDOT) in 1998. The MOA stipulated that prior to initiation of the bridge widening and seismic rehabilitation construction, the HDOT will submit photographic documentation of the existing bridge structure using Historic American Building survey/Historic American Engineering Records (HABS/HAER) standards to the following agencies: (1) SHPO; (2) HABS/HAER, Washington, D.C.; (3) Hamilton Library at the University of Hawai'i at Manoa; and (4) FHWA Hawai'i Division.

The bridge deck is proposed to be widened to approximately 44 feet outside edge to outside edge to accommodate two 12-foot travel lanes and two 8-foot shoulders. The existing molded concrete railings will be replaced with American Association of State Highway and Transportation Officials (AASHTO) approved Jersey-type concrete barriers. In conformance with the current AASHTO design specifications and increased loads due to widening, all sections of existing concrete arches and piers will be increased in size by building up with new concrete and reinforcing steel. New footings bearing on drilled shaft foundations will be added at each end of the central open-spandrel arch span. The girder spans on each end of the arch span are proposed to be modified such that the existing bridge deck bears on new structural fill material. New reinforced concrete retaining walls are proposed extending from the existing abutments to the new abutments located at each end of the arch span.

Project Engineer for HDOT was Edmund Yoshida. The documentation was prepared by Paul Santo of Nishimura, Katayama, Oki & Santo, Inc. The photographer was David Franzen of Franzen Photography.

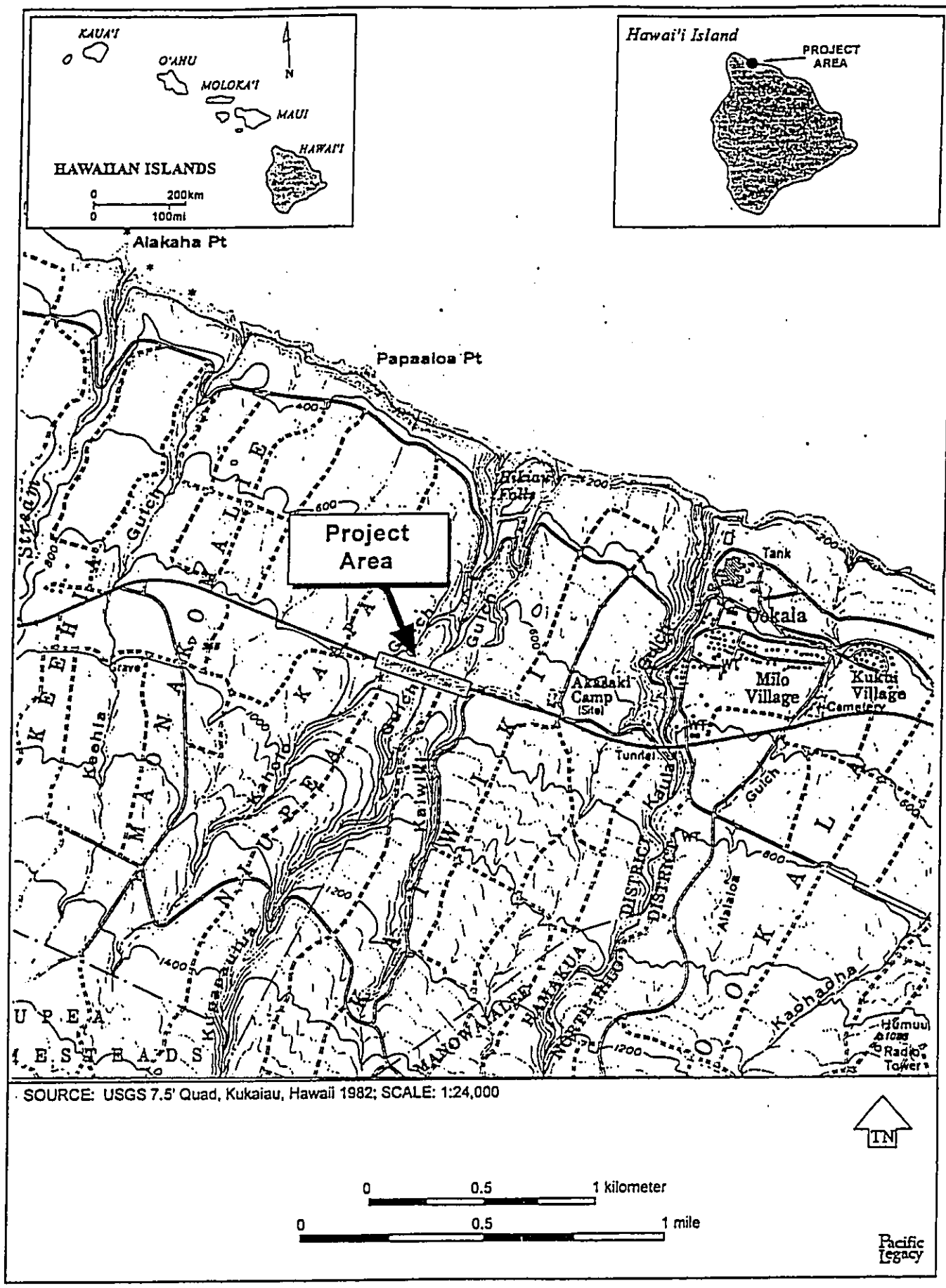
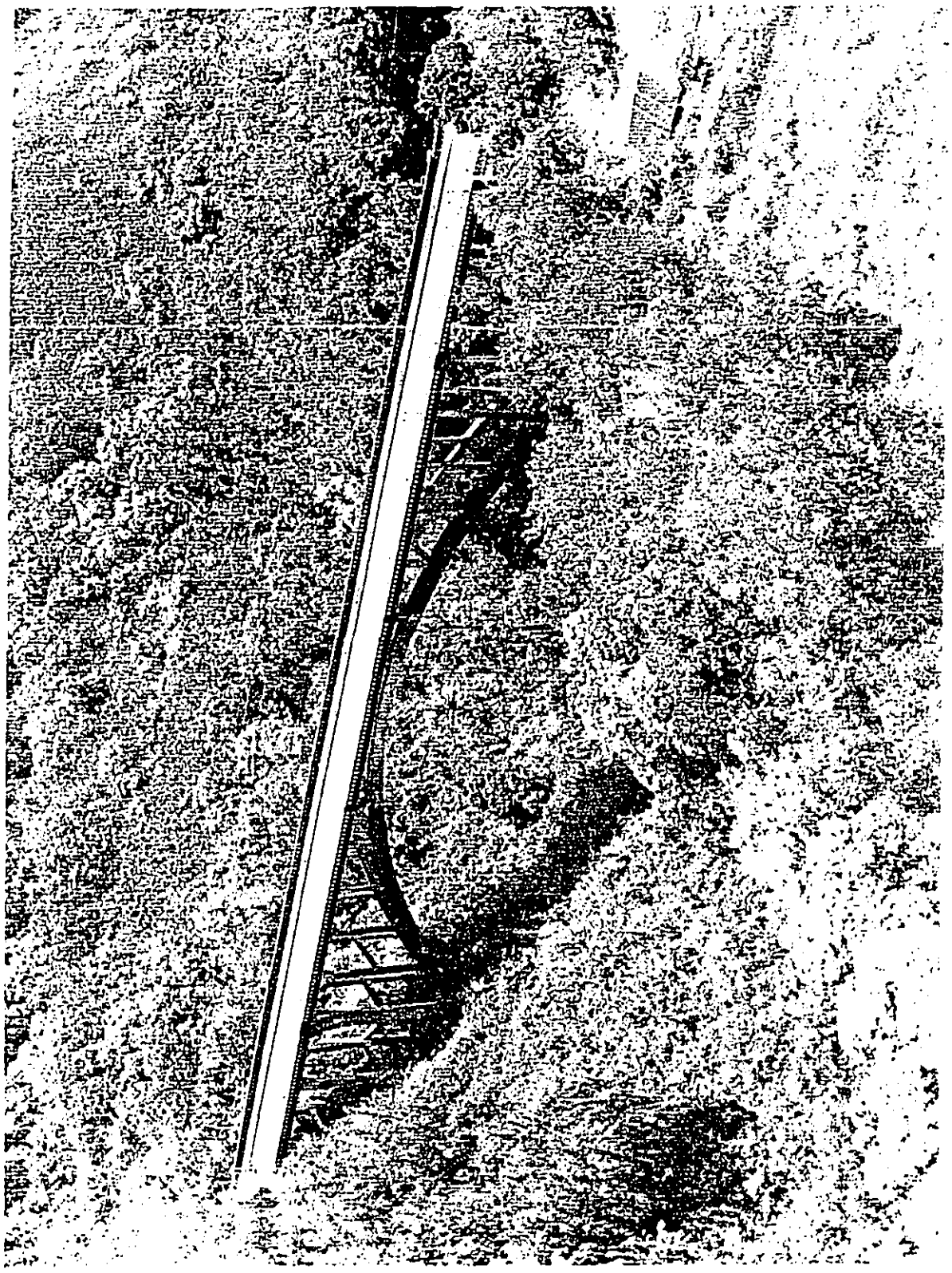
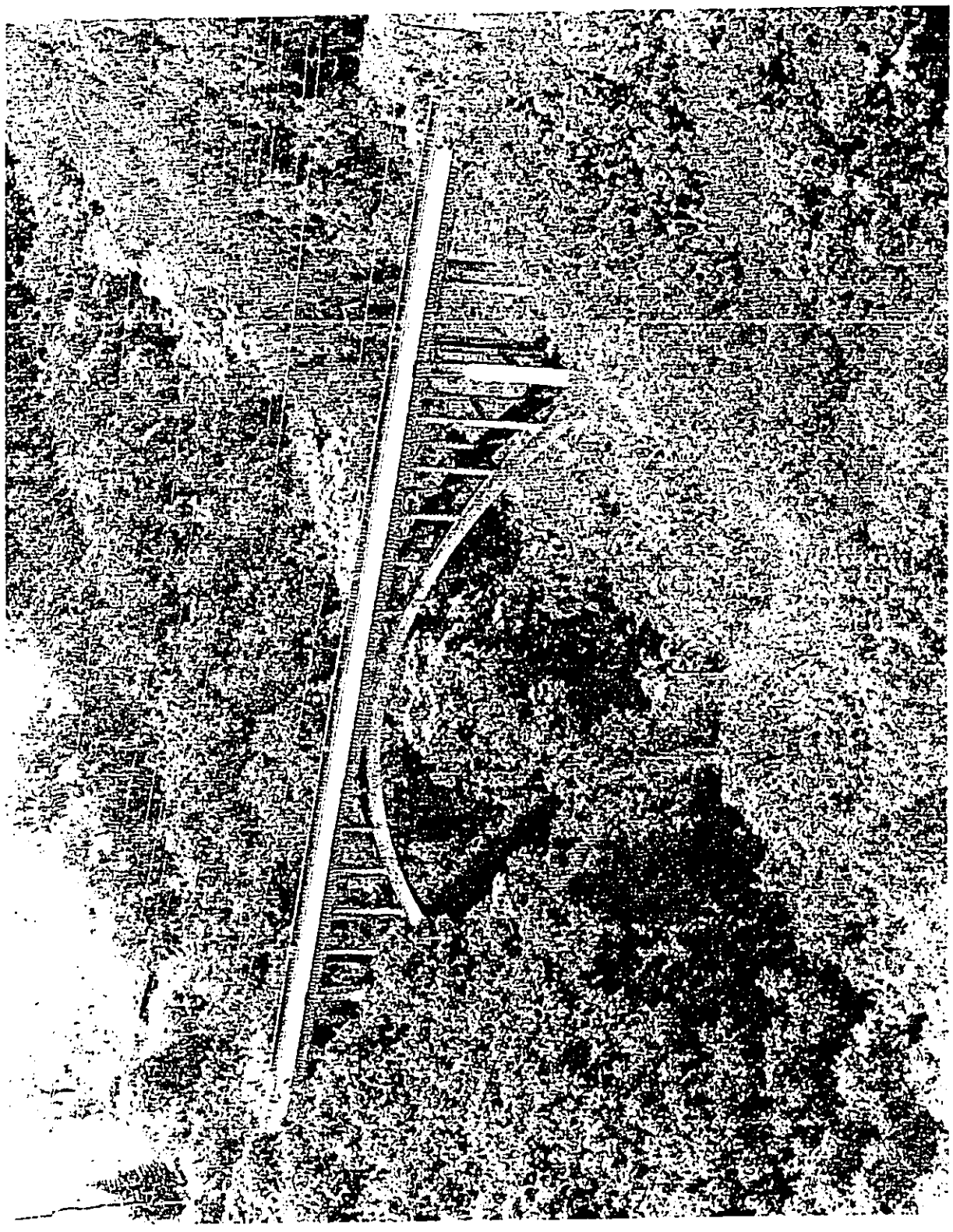


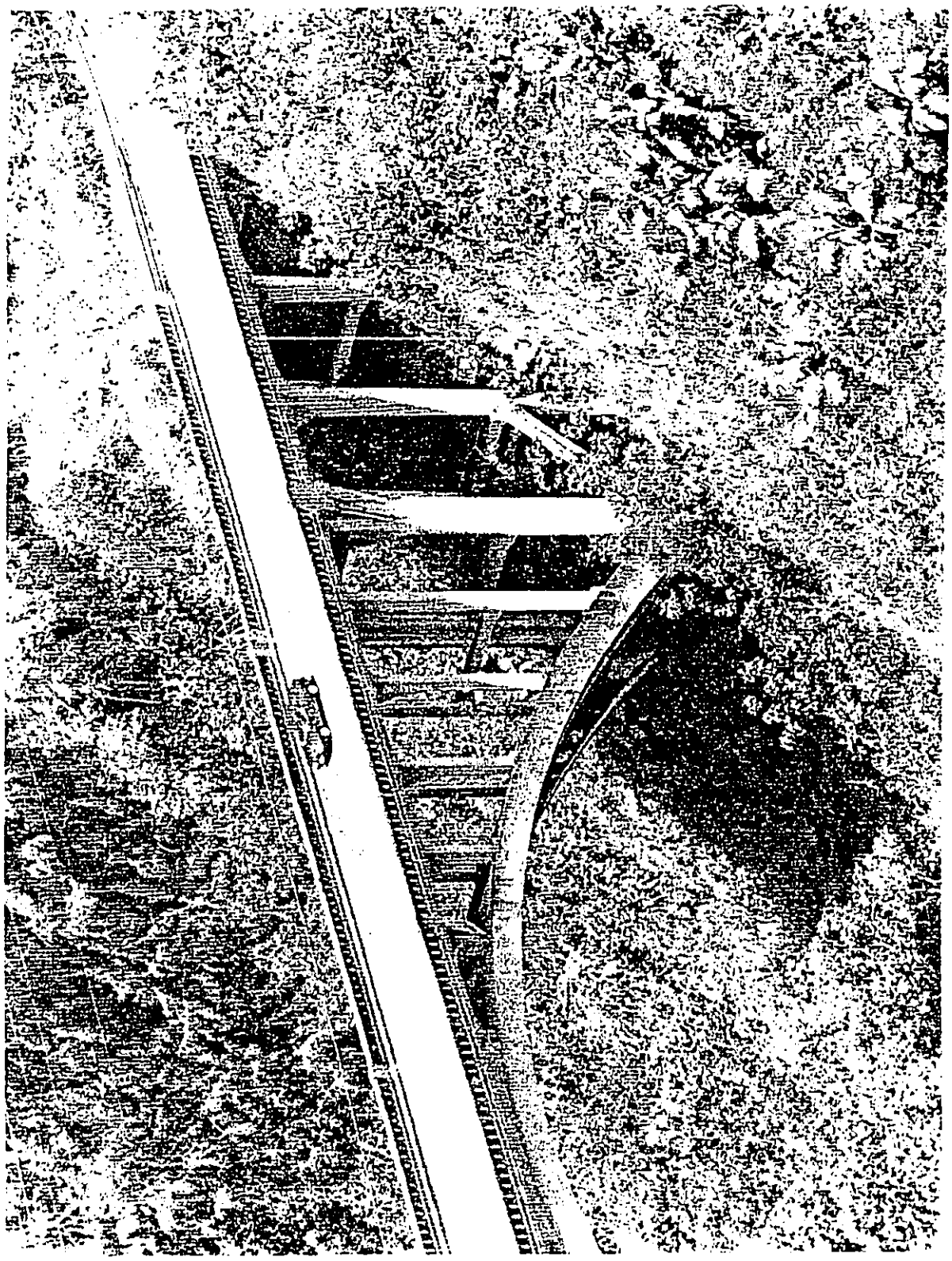

Figure 1. Location of Project Area.



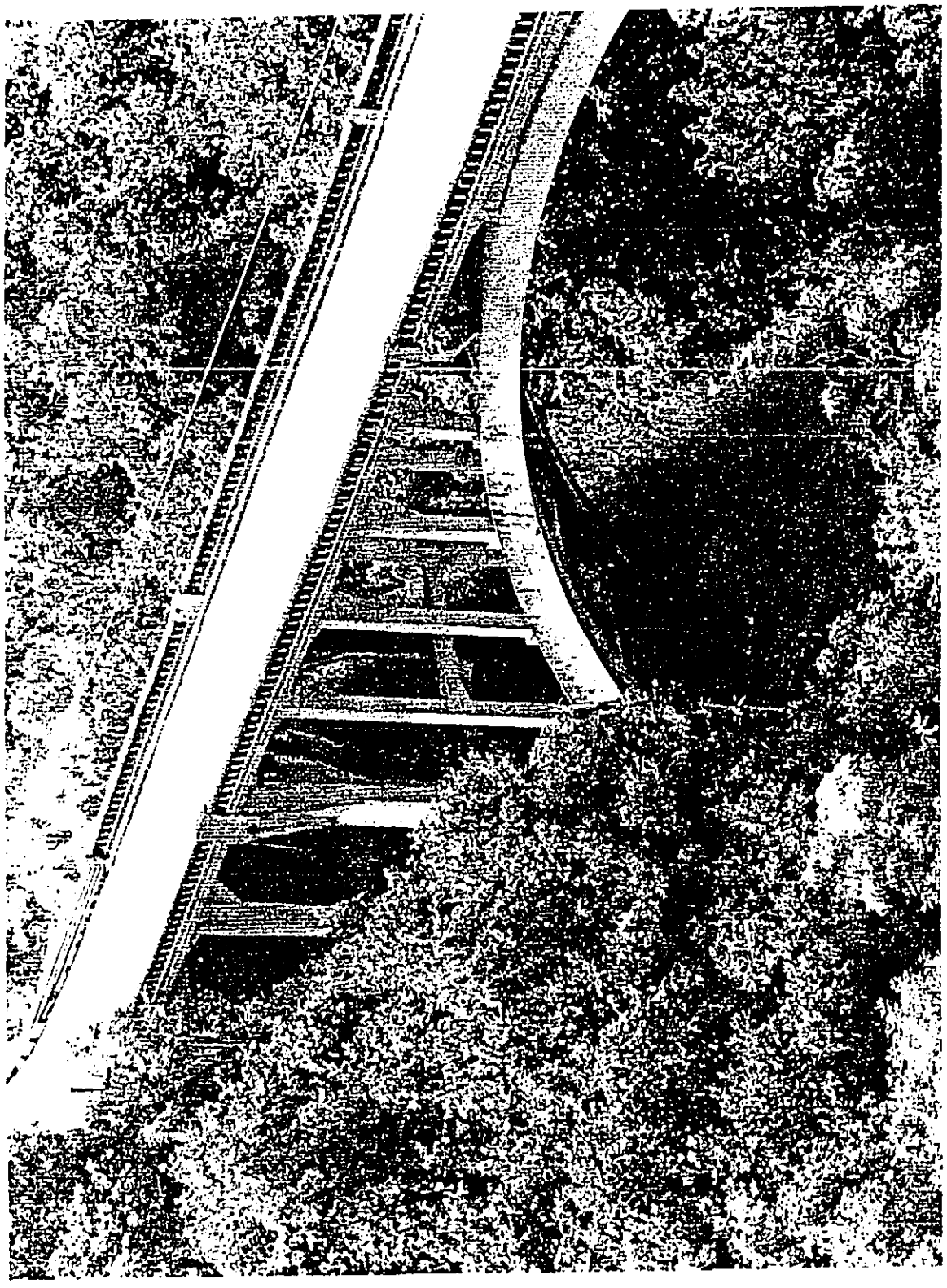
1. AERIAL VIEW OF UPSTREAM (SOUTH) SIDE OF BRIDGE.



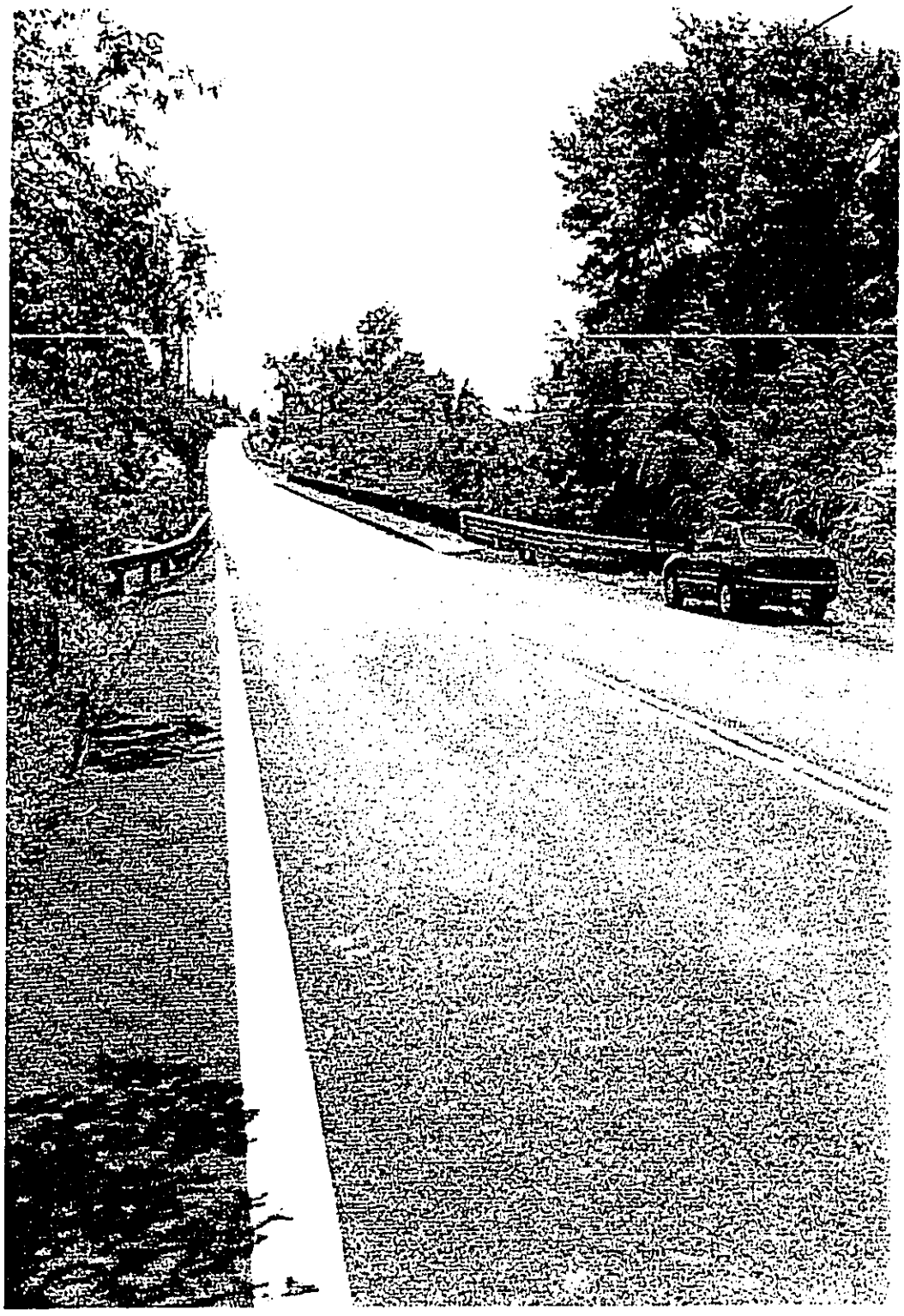
2. AERIAL VIEW OF DOWNSTREAM (NORTH) SIDE OF BRIDGE.



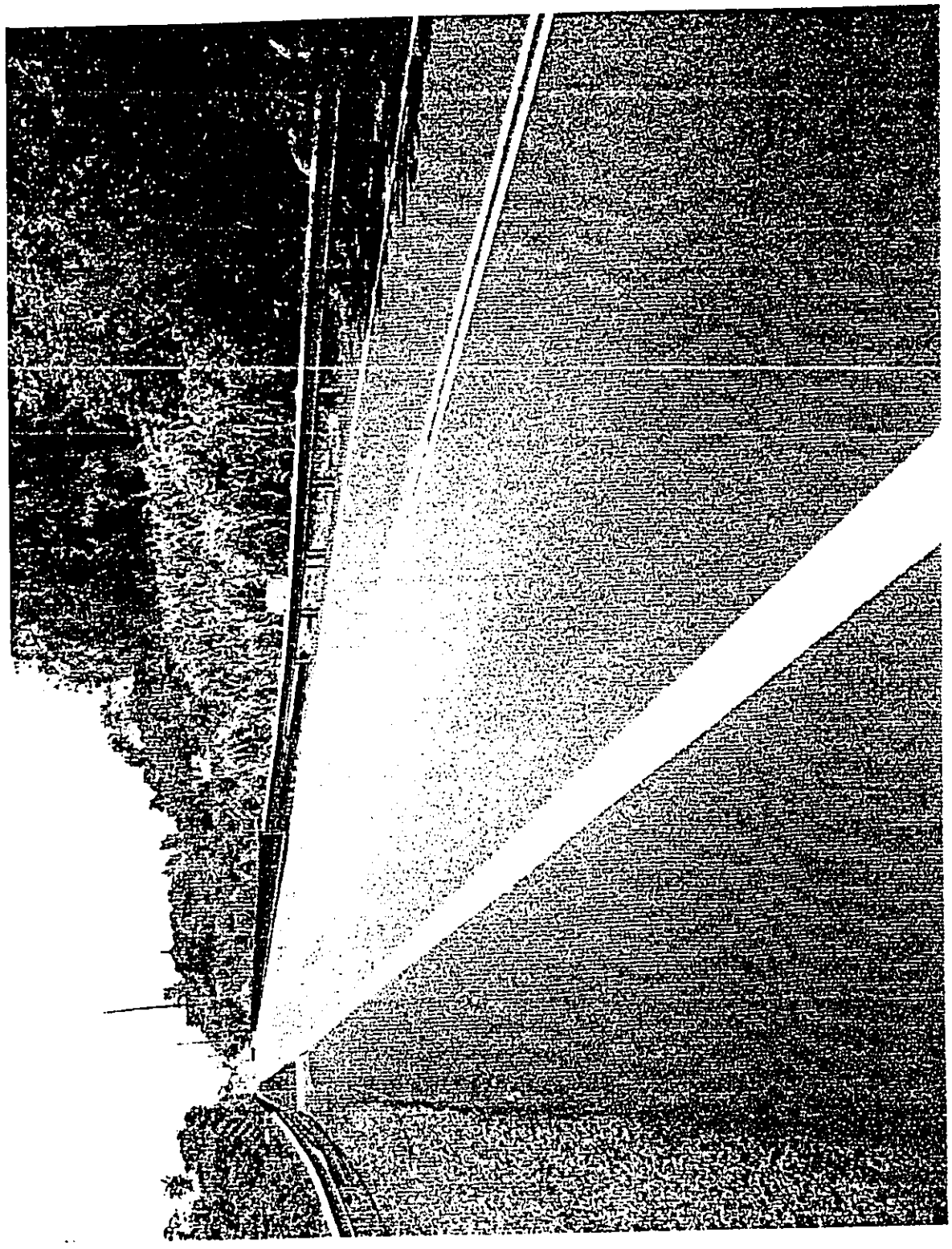
3. AERIAL VIEW OF WESTERN HALF OF BRIDGE FROM DOWNSTREAM SIDE, FACING SOUTHWEST.



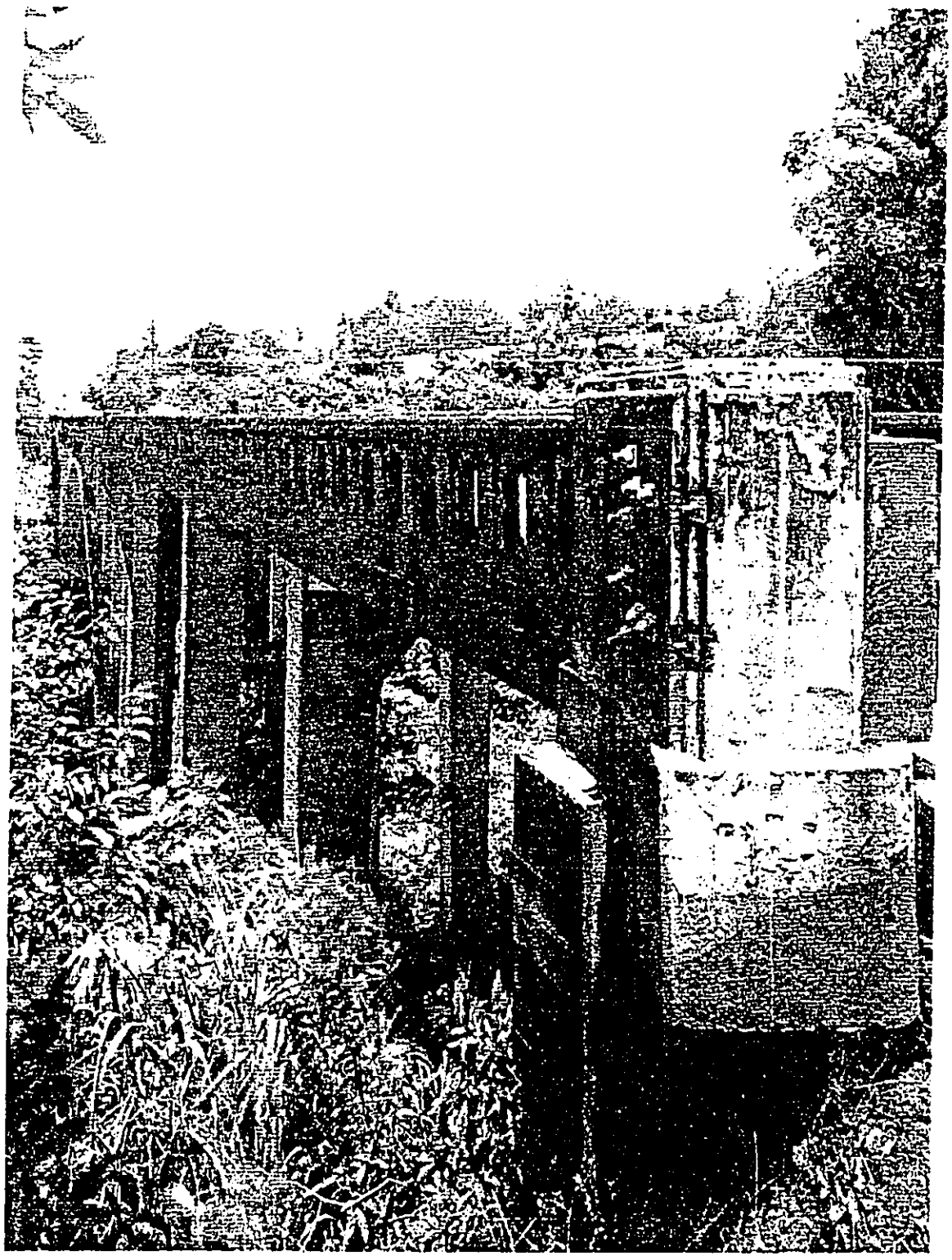
4. AERIAL VIEW OF EASTERN HALF OF BRIDGE FROM DOWNSTREAM SIDE, FACING SOUTHEAST.



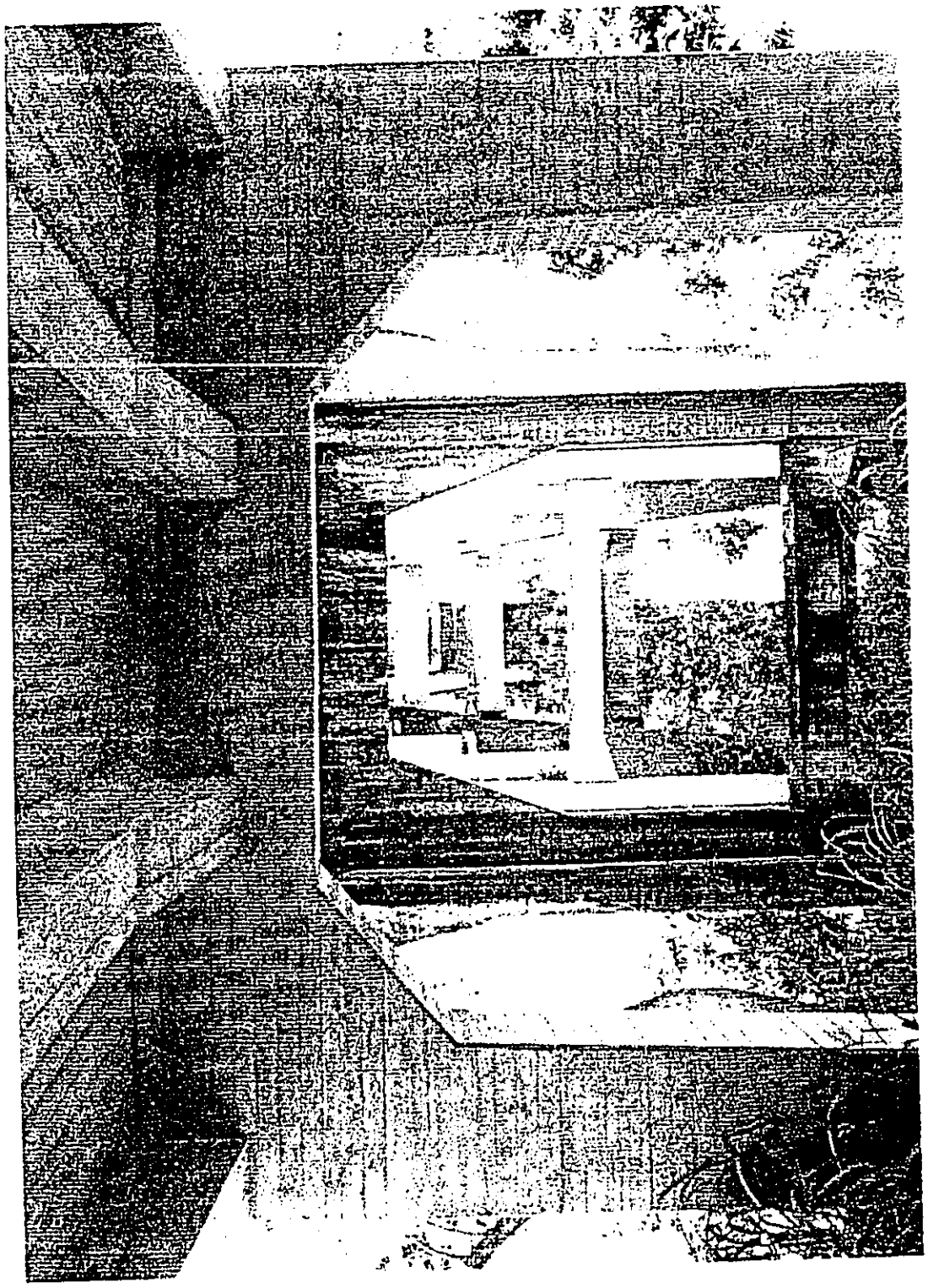
5. BRIDGE APPROACH FROM EASTERN END, FACING NORTHWEST.



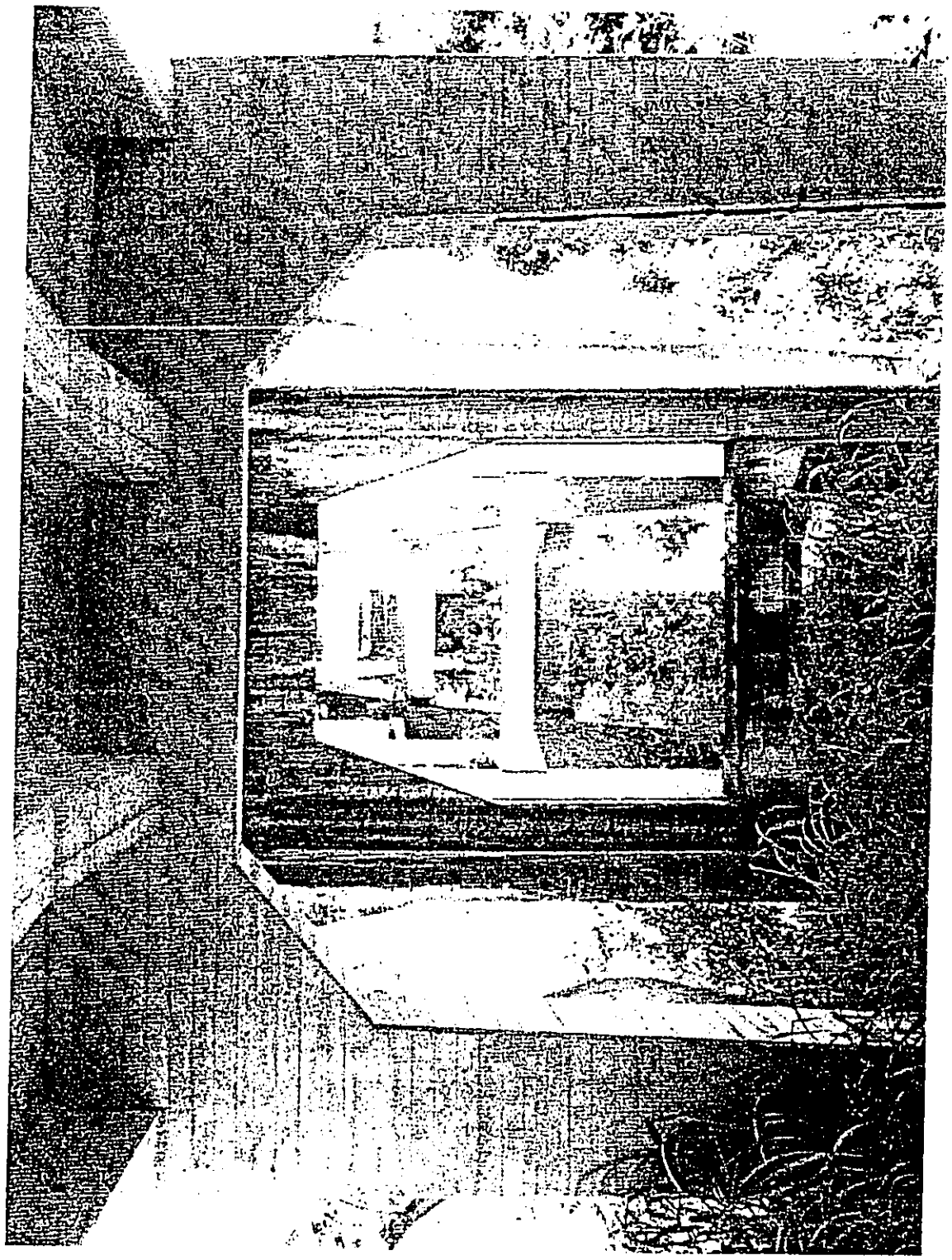
6. BRIDGE APPROACH FROM WESTERN END, FACING SOUTHEAST.



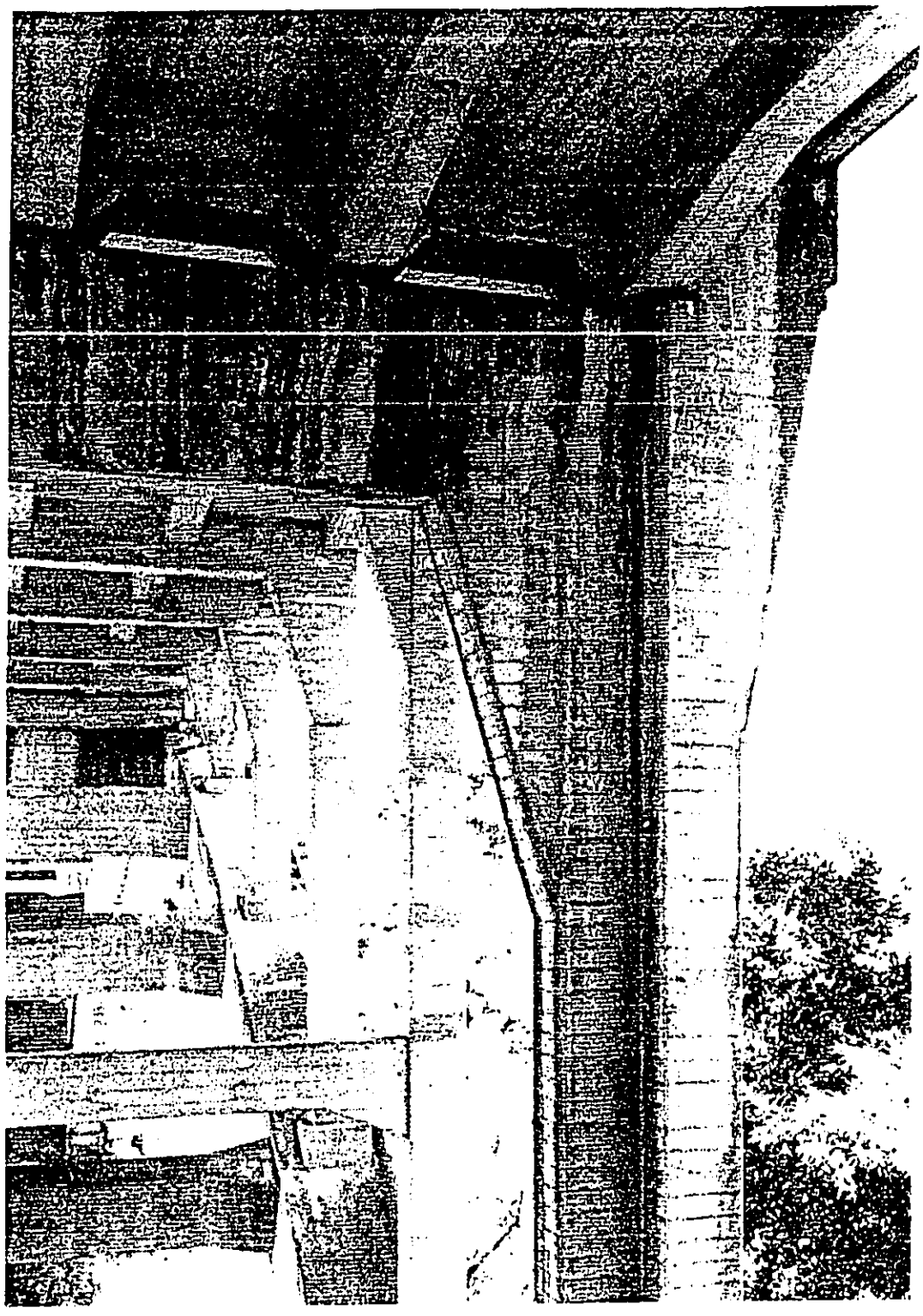
7. OBLIQUE VIEW OF NORTH SIDE OF BRIDGE FROM NORTHWEST END, FACING SOUTHEAST.



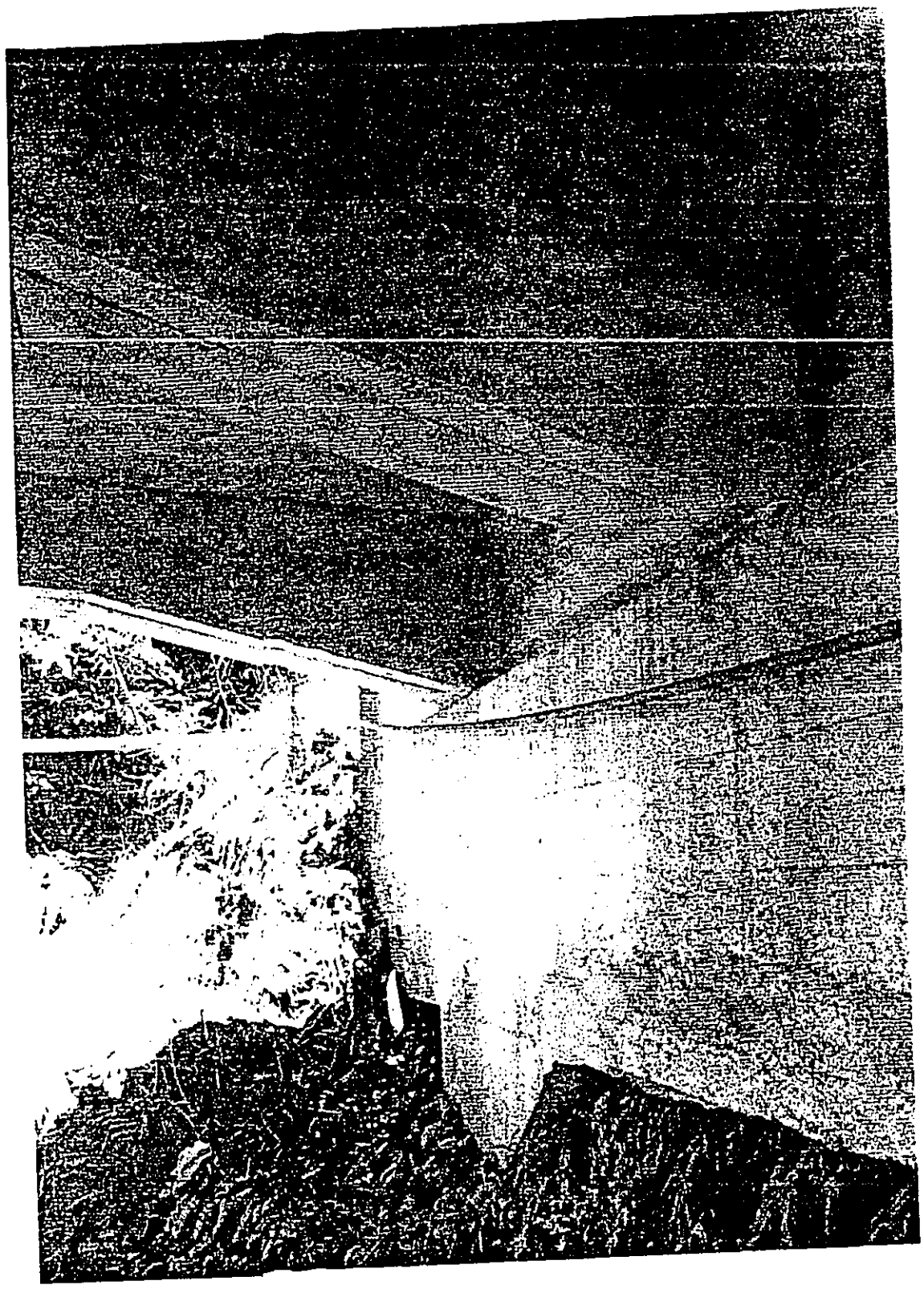
8. VIEW OF CONCRETE PIERS FROM BELOW BRIDGE DECK FROM EAST ABUTMENT, FACING NORTHWEST.



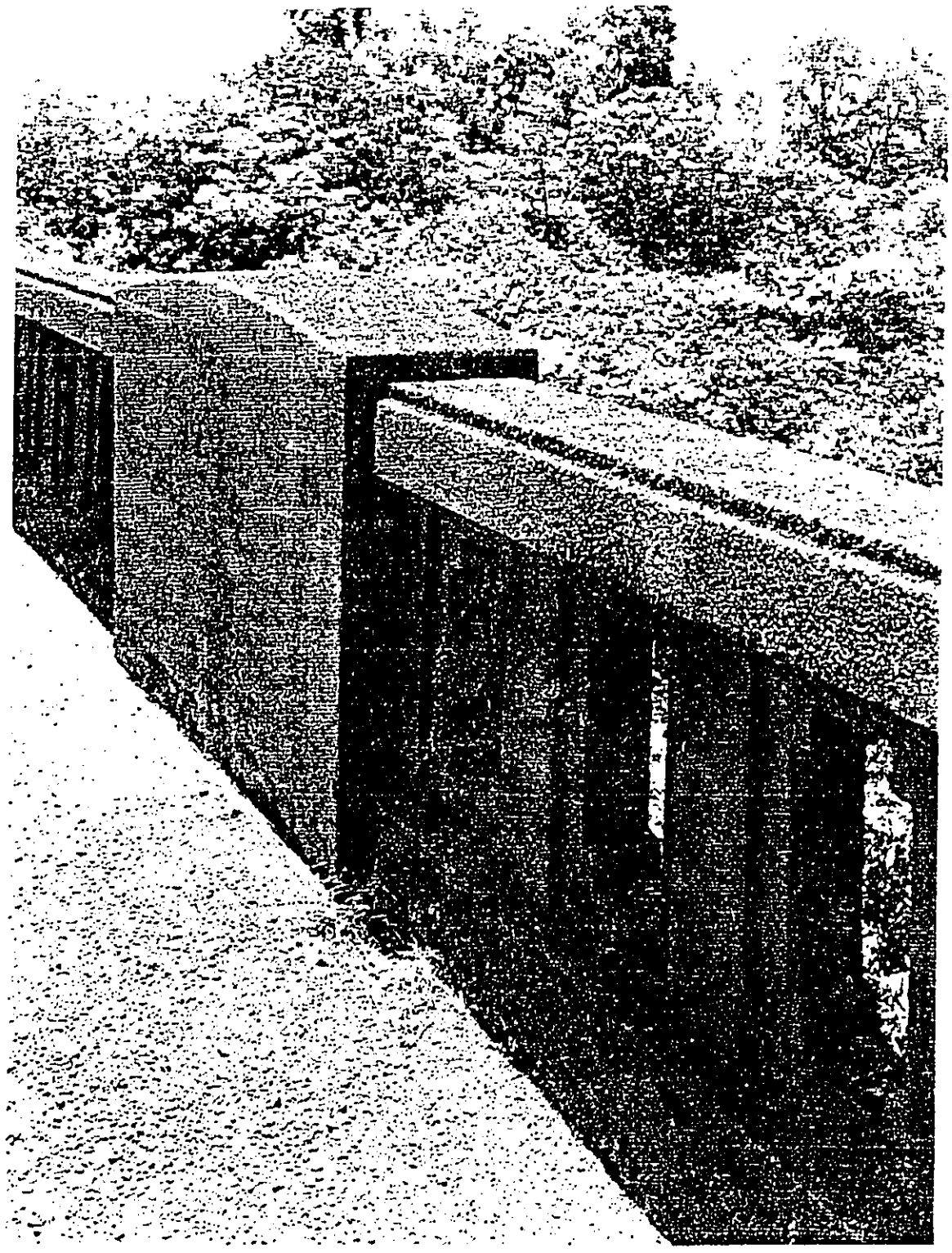
9. VIEW OF CONCRETE PIERS FROM BELOW BRIDGE DECK FROM EAST ABUTMENT, FACING NORTHWEST. MEASURING POLE AT NORTH COLUMN OF PIER NO. 1.



10. VIEW BELOW BRIDGE DECK OR COLUMNS, BEAMS, GIRDERS, ARCH RIB, AND UNDERSIDE OF DECK FROM PIER NO. 1, FACING NORTHWEST.



11. VIEW OF EAST ABUTMENT WALL/FOOTING, FACING NORTHEAST.



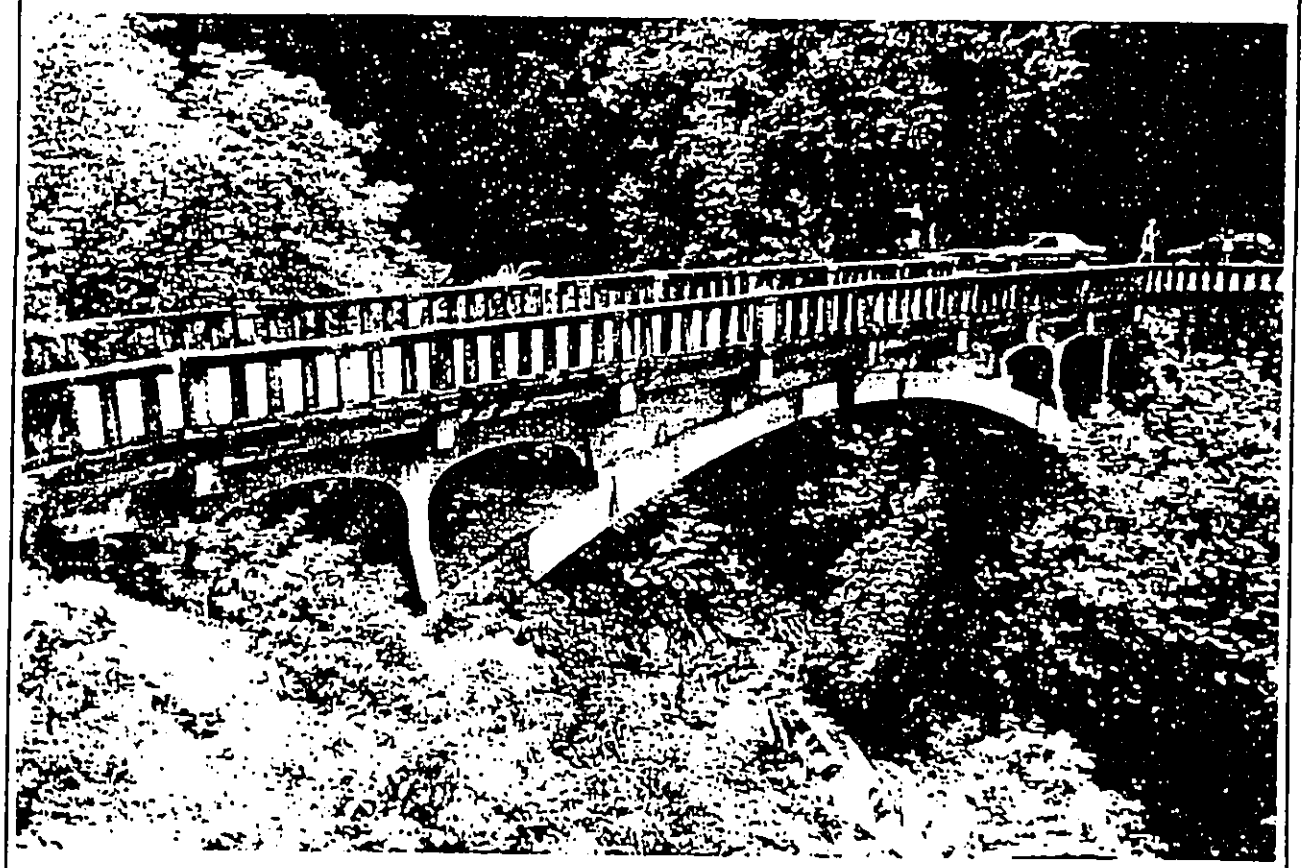
12. VIEW OF DOWNSTREAM SIDE RAILING DETAIL, FACING NORTHWEST.

# Appendix F

# Historic Bridge Inventory and Evaluation

# STATE OF HAWAI'I

# HISTORIC BRIDGE INVENTORY AND EVALUATION



SPENCER MASON ARCHITECTS

DRAFT

May 1996

| | |
|---|---|
| historic name | KUPAPA'ULUA BRIDGE |
| other names/site number | Kupapa'ulua Gulch Bridge (structure number 001000190306876) |
| street & number | Hawai'i Belt Road, 1.5 miles W of 'O'ōkala Access Road |
| city or town | 'O'ōkala |
| vicinity | Hāmākua |
| county | Hawai'i state Hawai'i |

**Narrative Description**

The Kupapa'ulua Bridge carries the Hawai'i Belt Road (FAP 19) across the Kupapa'ulua Gulch on the Hāmākua Coast of the island of Hawai'i. The bridge is a multi-span structure with a central semi-circular open-spandrel arch and five deck girder segments. The first open-spandrel concrete arch bridge in the islands, the Honoli'i Stream Bridge, was constructed in 1911 and spanned 70 feet. The Kupapa'ulua Bridge, built just twenty-five years later, was the last open-spandrel arch bridge constructed in the islands and spanned 217 feet with a rise of fifty feet.

The Kupapa'ulua Bridge is in its original location and has retained its rural setting. The bridge's original arch design and reinforced-concrete materials remain intact, with the exception of minor spalling concrete on the parapets. The bridge is obviously the work of skilled builders, who constructed the structurally complex open-spandrel reinforced-concrete bridge. The workmanship has not been obscured by additions or repairs. The bridge's historic associations, as a prominent product of the Territorial Highways Department and the last open-spandrel concrete arches constructed in the state, is apparent to informed observers; the bridge retains its historic feeling due to its sharp approach, narrow width, and now uncommon structural type.

| | |
|---|---|
| designer/engineer | William R. Bartels |
| builder | Peter Arioli, Contractor |
| construction date(s): | 1935 |
| construction type: | reinforced-concrete open-spandrel arch |
| construction cost: | $107,000[54] |
| span number: | 1 arch / 5 girder spans |
| total length: | 353' |
| max. span(s): | 217' |
| roadway width: | 22' |
| height above stream: | 115' |
| superstructure: | reinforced-concrete deck |
| substructure: | reinforced-concrete arch, haunched girders and piers, and abutments. |
| floor/decking: | asphalt on concrete |
| parapets: | open, molded reinforced-concrete rail |
| other features: | incised bridge name and date of construction on end piers |

**Narrative Statement of Significance**

The Kupapa'ulua Bridge is significant for its contributions to the fields of engineering and transportation in Hawai'i. The open-spandrel arch bridge is eligible under Criterion A for its associations with important public works project initiated by the Territorial government and constructed with federal work relief programs funds during the Depression era. The bridge was a

[54]Patricia Alvarez, *Historic Bridge Inventory and Evaluation: Island of Hawaii*, prepared for the State of Hawai'i, Department of Transportation, Highways Division and the U.S. Department of Transportation, Federal Highways Administration (Honolulu, 1987b), 163.

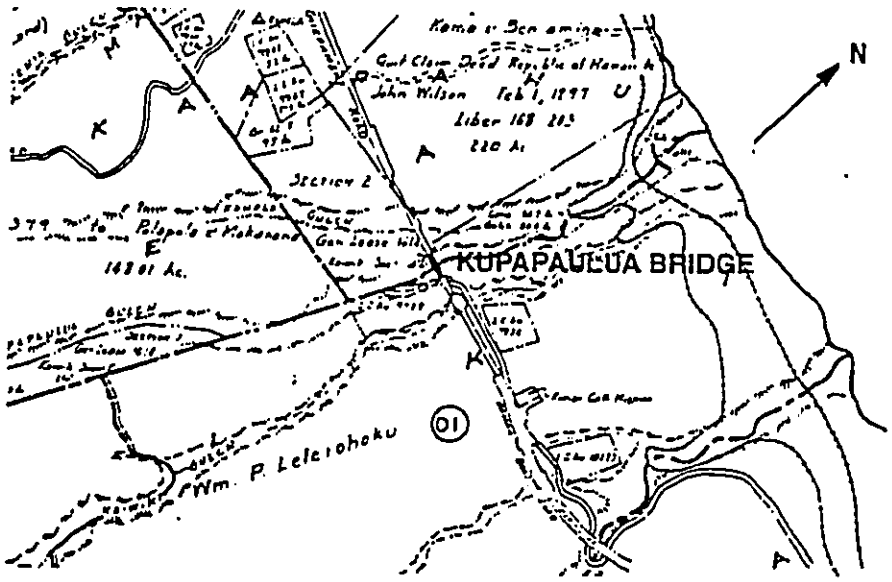
significant element of the Territorial belt road plan and contributed to the economic development of the region. The Kupapa'ulua Bridge is eligible under Criterion C as a representative example of the advances in bridge technology in the early twentieth-century, and as the last open-spandrel concrete arch constructed in the islands. Further, the bridge is representative of the "work of a master": William R. Bartels of the Territorial Highways Department.

Between 1932 and 1958, the Territory of Hawai'i began to construct a modern highway, called the Hawai'i Belt Road (FAP 19), around the island. The new road and a series of large, steel-reinforced concrete bridges straightened out, bisected and bypassed the old government road.

Kupapa'ulua marks the end of an era in bridge building. Kupapa'ulua Bridge clearly demonstrated the development that had taken place in the twenty-four years since the first open-spandrel arch was built at Honoli'i. It was the last open-spandrel arch bridge constructed in Hawai'i and was at one time the longest span in the islands.[55] At the time of its construction in 1935, the structure was the most expensive bridge ever built in the islands.[56] Open-spandrel arch bridges involved long, complicated calculations by hand, and engineers increasingly turned to the simpler concrete tee-beam structures, such as the Honoli'i Highway Bridge built the following year.[57]

Bartels was responsible for the design of all major Territorial bridge projects between 1932 and his retirement from the department in 1956. His bridges evidence a refined aesthetic sensibility which makes them distinctive from the works of other engineers. The Kupapa'ulua Bridge is considered one of Bartels greatest works.[58] The contract for the bridge was won by Peter Arioli, the builders of the first open-spandrel bridge at Honoli'i in 1911.

Sketch Map

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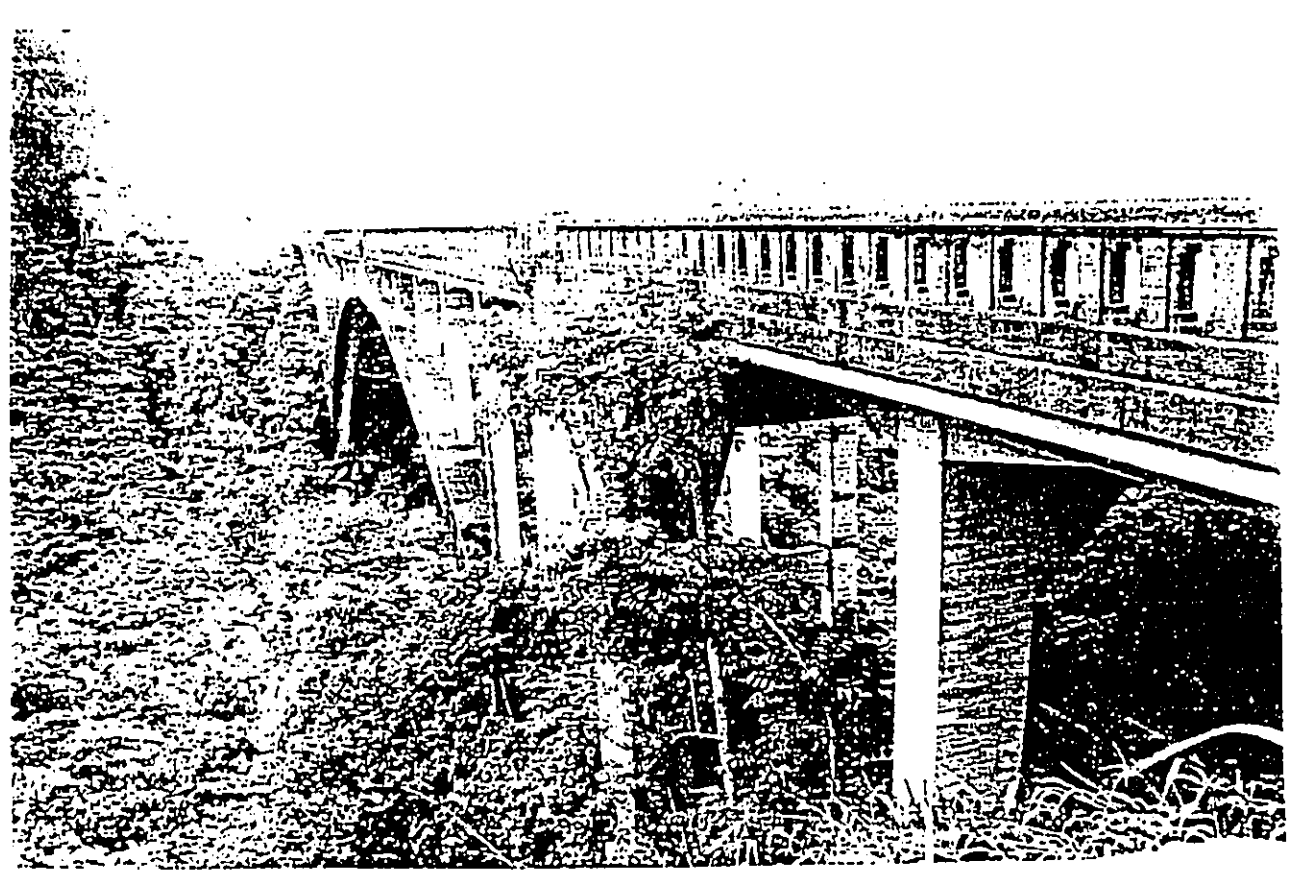
[55]Alvarez (1987b), 164.

[56]Alvarez, "A History of Road and Bridge Development on the Island of Hawaii" in *Historic Bridge Inventory and Evaluation: Island of Hawaii*. Prepared for the State of Hawai'i, Department of Transportation, Highways Division in cooperation with the U.S. Department of Transportation, Federal Highways Administration, (Honolulu, 1987a), 72.

[57]Alvarez (1987b), 72.

[58]"Obituaries," Honolulu Advertiser, (9 October 1969): C3.

Kupapa'ulua Bridge, Hawai'i Island, Hawai'i
Top: Approach; view from S.
Bottom: Substructure; view from SW.



# APPENDIX A:
# BRIDGE RATING MATRICES AND FORMS

STATE OF HAWAII - BRIDGE RATING MATRIX

| Name | Island | Date | Type | Location | Design | Setting | Materials | Workmanship | Feeling | Association | Events | Persons | Type | Period | Construction | Work of master? | Artistic value | Distinq. entity | Info. content | Early engineer'g | represent. type | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CAT I | | | | | | | | | | | | | | | | | | | | | | |
| Anahulu Bridge | O | 1921 | C-A | 7 | 5 | 5 | 7 | 7 | 5 | 5 | 5 | 0 | 5 | 5 | 3 | 5 | 5 | 5 | 0 | 5 | 5 | 84 |
| Hana Highway Historic Bridge District | | | var. | 7 | 7 | 7 | 7 | 5 | 5 | 5 | 5 | 0 | 3 | 5 | 3 | 5 | 3 | 5 | 3 | 5 | 3 | 83 |
| Mamalahoa Highway Historic Bridge District | | | var. | 7 | 7 | 5 | 7 | 5 | 5 | 5 | 5 | 0 | 3 | 5 | 3 | 5 | 3 | 5 | 3 | 5 | 5 | 83 |
| Kashumanu-Naniloa Overpass | M | 1936 | C-F | 7 | 7 | 7 | 7 | 7 | 5 | 5 | 5 | 0 | 3 | 5 | 3 | 5 | 5 | 3 | 0 | 3 | 5 | 82 |
| Karsten Thot Bridge | O | 1934 | S-T | 7 | 7 | 5 | 7 | 7 | 5 | 5 | 3 | 5 | 5 | 5 | 3 | 3 | 0 | 5 | 3 | 0 | 5 | 80 |
| Hanalei River Bridge | K | 1912 | S-T | 7 | 5 | 7 | 3 | 5 | 5 | 5 | 5 | 0 | 5 | 5 | 3 | 5 | 0 | 5 | 3 | 5 | 5 | 78 |
| Wahiawa Bridge | K | 1936 | C-F | 7 | 7 | 7 | 5 | 5 | 3 | 3 | 5 | 0 | 3 | 5 | 5 | 5 | 3 | 3 | 0 | 5 | 5 | 76 |
| Keawe Street-Wailuku River | H | 1938 | C-A | 7 | 5 | 5 | 5 | 7 | 5 | 5 | 5 | 0 | 5 | 5 | 3 | 5 | 5 | 3 | 0 | 0 | 5 | 75 |
| Kalakaua Avenue Bridge | O | 1929 | C-A | 7 | 5 | 5 | 7 | 7 | 5 | 5 | 5 | 3 | 3 | 5 | 0 | 3 | 5 | 5 | 0 | 0 | 5 | 75 |
| Nuuanu Avenue Bridge | O | 1904 | C-A | 7 | 7 | 5 | 5 | 7 | 5 | 3 | 3 | 0 | 5 | 5 | 0 | 5 | 5 | 3 | 3 | 3 | 3 | 74 |
| Lihue Mill Bridge | K | 1936 | S-S | 7 | 7 | 5 | 7 | 5 | 3 | 3 | 3 | 0 | 5 | 3 | 3 | 5 | 3 | 3 | 3 | 3 | 5 | 73 |
| Waioli Stream Bridge | K | 1912 | C-S | 7 | 7 | 5 | 7 | 5 | 5 | 5 | 3 | 0 | 0 | 5 | 3 | 5 | 3 | 5 | 0 | 3 | 5 | 73 |
| Waiale Drive Bridge | M | 1936 | S-S | 7 | 7 | 5 | 7 | 5 | 3 | 3 | 3 | 0 | 5 | 3 | 3 | 5 | 3 | 3 | 3 | 3 | 5 | 73 |
| Hakalau Highway Bridge | H | 1911.53 | S-S | 7 | 0 | 7 | 3 | 5 | 3 | 3 | 5 | 5 | 3 | 5 | 5 | 5 | 3 | 3 | 3 | 3 | 5 | 73 |
| Honolii Highway Bridge | H | 1936 | C-T | 7 | 7 | 7 | 7 | 5 | 3 | 5 | 3 | 0 | 0 | 5 | 3 | 5 | 3 | 3 | 3 | 0 | 5 | 71 |
| Hionomoa Bridge | H | 1938 | C-F | 7 | 7 | 7 | 7 | 5 | 3 | 3 | 3 | 0 | 3 | 3 | 3 | 5 | 3 | 3 | 0 | 3 | 5 | 70 |
| Nanue Highway Bridge | H | 1911.52 | S-G | 7 | 0 | 7 | 3 | 5 | 3 | 3 | 5 | 5 | 3 | 5 | 3 | 5 | 3 | 3 | 3 | 3 | 3 | 69 |
| Paheehee Highway Bridge | H | 1911.50 | S-G | 7 | 0 | 7 | 3 | 5 | 3 | 3 | 5 | 5 | 3 | 5 | 3 | 5 | 3 | 3 | 3 | 3 | 3 | 69 |
| Umauma Highway Bridge | H | 1912 52 | S-G | 7 | 0 | 7 | 3 | 5 | 3 | 3 | 5 | 5 | 3 | 5 | 3 | 5 | 3 | 3 | 3 | 3 | 3 | 69 |
| Kapue Highway Bridge | H | 1911.50 | S-G | 7 | 0 | 7 | 3 | 5 | 3 | 3 | 5 | 5 | 3 | 5 | 3 | 5 | 3 | 3 | 3 | 3 | 3 | 69 |
| Kupapaulua Bridge | H | 1935 | C-A | 7 | 7 | 7 | 7 | 5 | 3 | 3 | 3 | 0 | 3 | 5 | 3 | 5 | 5 | 3 | 0 | 0 | 3 | 69 |
| Lawai Strm Br | K | 1905/29 | C-A | 7 | 5 | 7 | 5 | 3 | 3 | 3 | 3 | 0 | 5 | 3 | 3 | 5 | 3 | 3 | 0 | 5 | 5 | 68 |
| Dale Street Bridge | O | 1937 | C-F | 7 | 7 | 5 | 7 | 5 | 3 | 3 | 3 | 0 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 67 |
| Kealwa Bridge | H | 1937 | C-S | 7 | 7 | 7 | 7 | 5 | 3 | 3 | 3 | 0 | 0 | 5 | 3 | 5 | 3 | 3 | 0 | 0 | 5 | 66 |
| Hanapepe Bridge | K | 1911 | C-G | 7 | 5 | 5 | 5 | 3 | 5 | 5 | 3 | 0 | 3 | 5 | 3 | 5 | 3 | 3 | 0 | 3 | 3 | 66 |
| North King Street-Nuuanu River Bridge | O | 1922 | C-T | 7 | 5 | 7 | 7 | 7 | 3 | 5 | 3 | 0 | 0 | 5 | 0 | 3 | 5 | 3 | 0 | 3 | 3 | 66 |
| Moaula Bridge | H | 1938 | C-F | 7 | 7 | 7 | 7 | 5 | 3 | 3 | 3 | 0 | 3 | 3 | 3 | 5 | 3 | 0 | 0 | 3 | 3 | 65 |
| Koloa Bridge | K | 1928 | C-T | 7 | 7 | 5 | 7 | 5 | 5 | 5 | 3 | 0 | 0 | 5 | 0 | 5 | 3 | 5 | 0 | 0 | 3 | 65 |
| Ainako Stream-Walanuenue Avenue Br | H | 1924 | C-A | 7 | 5 | 5 | 7 | 7 | 5 | 3 | 3 | 0 | 3 | 3 | 0 | 5 | 5 | 0 | 0 | 3 | 3 | 64 |
| Waimea Bridge | K | 1940 | C-T | 7 | 7 | 5 | 5 | 7 | 3 | 3 | 3 | 0 | 0 | 5 | 3 | 5 | 5 | 3 | 0 | 0 | 3 | 64 |
| Nawiliwili Strm Br | K | 1920 | C-G | 7 | 7 | 5 | 7 | 3 | 5 | 5 | 3 | 0 | 3 | 3 | 0 | 5 | 3 | 5 | 0 | 0 | 3 | 64 |
| Auwaiakeakua Bridge | H | 1940 | T-G | 7 | 7 | 7 | 7 | 5 | 3 | 3 | 3 | 0 | 3 | 5 | 0 | 5 | 0 | 3 | 0 | 0 | 5 | 63 |
| Waipa Stream Bridge | K | 1912 | C-S | 7 | 7 | 7 | 7 | 3 | 5 | 5 | 3 | 0 | 0 | 0 | 3 | 5 | 3 | 5 | 0 | 3 | 0 | 63 |
| Alae (Naalae Gulch) Bridge | M | 1933 | C-T | 7 | 7 | 7 | 7 | 5 | 3 | 3 | 3 | 0 | 0 | 5 | 0 | 3 | 5 | 3 | 0 | 0 | 5 | 63 |
| Kealakaha Bridge | H | 1935 | C-T | 7 | 7 | 7 | 7 | 3 | 3 | 3 | 3 | 0 | 0 | 5 | 3 | 5 | 3 | 3 | 0 | 0 | 3 | 62 |
| Waipake Bridge | K | 1921 | C-T | 7 | 7 | 5 | 7 | 7 | 3 | 3 | 3 | 0 | 0 | 3 | 0 | 3 | 5 | 3 | 0 | 3 | 3 | 62 |
| Manowaiopae Homestead-Kilau Stream | H | C. 1930 | T-S | 7 | 7 | 7 | 7 | 5 | 5 | 3 | 3 | 0 | 3 | 5 | 0 | 0 | 0 | 0 | 3 | 3 | 3 | 61 |
| Waimea Bridge | O | 1930 | C-T | 7 | 7 | 7 | 7 | 5 | 3 | 5 | 3 | 0 | 0 | 3 | 0 | 5 | 3 | 0 | 3 | 0 | 3 | 61 |
| Heeia Viaduct | O | 1922 | C-T | 7 | 5 | 5 | 5 | 5 | 3 | 3 | 3 | 0 | 0 | 5 | 3 | 3 | 3 | 5 | 0 | 3 | 3 | 61 |
| Puowaina Drive Bridge | O | 1936 | C-T | 7 | 7 | 7 | 7 | 5 | 3 | 5 | 3 | 0 | 0 | 5 | 3 | 3 | 3 | 0 | 0 | 0 | 3 | 61 |
| Kumu Stream-Waiolama Canal Bridge | H | 1935 | C-G | 7 | 7 | 0 | 7 | 5 | 5 | 5 | 5 | 0 | 0 | 3 | 0 | 0 | 3 | 5 | 5 | 0 | 3 | 60 |
| Ahole Bridge | H | 1934 | C-T | 7 | 7 | 7 | 7 | 5 | 3 | 5 | 3 | 0 | 0 | 3 | 0 | 5 | 5 | 0 | 0 | 0 | 3 | 60 |
| Hanapepe Highway Bridge | K | 1938 | C-T | 7 | 5 | 7 | 5 | 5 | 3 | 5 | 3 | 0 | 0 | 3 | 3 | 5 | 3 | 3 | 0 | 0 | 3 | 60 |
| Hoomana Overpass | K | 1928 | C-S | 7 | 7 | 5 | 7 | 5 | 3 | 3 | 3 | 0 | 5 | 3 | 0 | 0 | 3 | 3 | 3 | 0 | 3 | 60 |
| Waikapu Stream Bridge | M | 1937 | C-S | 7 | 7 | 7 | 7 | 7 | 3 | 3 | 3 | 0 | 0 | 3 | 0 | 5 | 3 | 0 | 0 | 0 | 5 | 60 |
| Kipapa (FDR) Bridge | O | 1933 | C-T | 7 | 7 | 5 | 7 | 5 | 3 | 3 | 3 | 0 | 3 | 3 | 5 | 3 | 0 | 0 | 0 | 3 | 3 | 60 |
| Waiale Gulch Bridge | M | 1934 | C-T | 7 | 7 | 7 | 7 | 5 | 3 | 3 | 3 | 0 | 0 | 3 | 0 | 3 | 5 | 3 | 0 | 0 | 3 | 59 |
| Walalua Twin Bridges | O | 1928 | C-T | 7 | 7 | 5 | 7 | 5 | 3 | 3 | 3 | 0 | 0 | 3 | 0 | 5 | 3 | 5 | 0 | 0 | 3 | 59 |
| Pohakea Stream Bridge | M | 1937 | C-S | 7 | 7 | 7 | 7 | 7 | 3 | 3 | 3 | 0 | 0 | 3 | 0 | 5 | 3 | 0 | 0 | 0 | 3 | 58 |
| | | | | | | | | | | | | | | | | | | | | | | |
| CAT III | | | | | | | | | | | | | | | | | | | | | | |
| Kolekole Highway Bridge | H | 1950 | C-T | 7 | 7 | 7 | 7 | 5 | 3 | 3 | 3 | 0 | 3 | 0 | 3 | 5 | 0 | 0 | 3 | 0 | 0 | 56 |
| Omao Bridge | K | 1934 | C-T | 7 | 7 | 7 | 7 | 5 | 3 | 3 | 3 | 0 | 0 | 3 | 0 | 5 | 0 | 3 | 0 | 0 | 3 | 56 |
| Puukumu Strm Br | K | 1913/20 | C-T | 7 | 7 | 7 | 7 | 3 | 3 | 3 | 3 | 0 | 0 | 3 | 0 | 5 | 0 | 0 | 0 | 3 | 3 | 54 |
| Opaekaa Bridge | K | 1936 | C-T | 7 | 7 | 7 | 7 | 5 | 3 | 3 | 3 | 0 | 0 | 3 | 0 | 5 | 0 | 0 | 0 | 0 | 3 | 53 |
| Waihohonu Stream Bridge | K | 1934 | C-S | 7 | 7 | 7 | 7 | 5 | 3 | 3 | 3 | 0 | 0 | 3 | 0 | 5 | 0 | 0 | 3 | 0 | 0 | 53 |
| North Kahana Bridge | O | 1927 | C-S | 7 | 7 | 5 | 7 | 3 | 3 | 3 | 3 | 0 | 0 | 3 | 0 | 0 | 3 | 3 | 3 | 0 | 3 | 53 |

# Bridge Rating Form

**Bridge Name: Kupapaulua Bridge, Hawaii** **Type: concrete open-spandrel arch**
**Date(s) of Construction: 1935**

## INTEGRITY CRITERIA

### LOCATION:

| | | |
|---|---|---|
| 7 | **Original** | - never moved |
| 5 | Moved without impact | |
| 3 | Moved with minor impact | |
| 0 | Moved with major impact | |

### DESIGN:

| | | |
|---|---|---|
| 7 | **No change to design** | - no significant alterations to bridge |
| 5 | Slight modification to design | |
| 3 | Moderate modification to design | |
| 0 | Substantial change to design | |

### SETTING:

| | | |
|---|---|---|
| 7 | **Original surroundings** | - rural setting unchanged |
| 5 | Slight change | |
| 3 | Moderate change | |
| 0 | Substantial change | |

### MATERIALS:

| | | |
|---|---|---|
| 7 | **Original materials** | - no additions or repairs |
| 5 | Additions or repairs compatible | |
| 3 | Additions or repairs do not detract | |
| 0 | Additions or repairs in detracting materials | |

### WORKMANSHIP:

| | | |
|---|---|---|
| 7 | Substantial evidence of artisans' labor and skill | |
| 5 | **Some evidence of artisans' labor and skill** | - workmanship not obscured by additions or repairs |
| 3 | Moderate repair or damage | |
| 0 | Major damage or modern workmanship | |

### FEELING:

| | | |
|---|---|---|
| 5 | High degree of historic quality | |
| 3 | **Some historic quality** | - due to rail type and setting |
| 0 | No historic quality | |

### ASSOCIATION:

| | | |
|---|---|---|
| 5 | Interpretation easy | |
| 3 | **Interpretation possible by informed observer** | - knowledge in adances in bridge technology needed |
| 0 | No interpretation possible | |

| | |
|---|---|
| 39 | **Integrity Subtotal** |

## OTHER REGISTER CRITERIA

### EVENTS:

| | | |
|---|---|---|
| 5 | Close association with significant event | |
| 3 | **Indirect association with significant event** | - associated with straightening of island belt road |
| 0 | Uncertain or no association with significant event | |

### PERSONS:

| | | |
|---|---|---|
| 5 | Close association with significant person | |
| 3 | Indirect association with significant person | |
| 0 | **Not known to be associated with significant person** | |

# Bridge Rating form (con't.)

**Bridge Name: Kupapaulua Bridge, Hawaii**

| | | |
|---|---|---|
| | **DISTINCTIVE CHARACTERISTICS:** | |
| | **Type:** | |
| 5 | Unique in State or County | |
| 3 | **One of a few in State or County** | - one of four open spandrel arches on island |
| 0 | One of many in State and County | |
| | **Period:** | |
| 5 | **Excellent example of period** | - excellent example of late-period open-spandrel arch |
| 3 | Good example of period | |
| 0 | Not good example or period unknown | |
| | **Method of Construction/Engineering Complexity:** | |
| 5 | Patented Technology or Innovative for time | |
| 3 | **Complex for time** | one 217' span |
| 0 | Standard for time | |
| | **Work of a Master:** | |
| 5 | **Famous designer or builder** | - W.R. Bartels, engineer / Peter Arioli, contractor |
| 3 | Known designer or builder | |
| 0 | Designer and builder unknown | |
| | **High Artistic Value:** | |
| 5 | **Overall design** | - arch design chosen for utility and aesthetics |
| 3 | Some elements of high artistic value | |
| 0 | Overall low artistic value | |
| | ***Distinguishable Entity:*** | |
| 5 | Uniqueness in a characteristic not recognized in other criteria | |
| 3 | **Significance in a characteristic not recognized in other criteria** | - last open-spandrel arch consructed in state - "marks the end of an era in bridge building" |
| 0 | Features common | |
| | **INFORMATION CONTENT:** | |
| 5 | Important information content yielded | |
| 3 | Important information content likely | |
| 0 | **Unlikely to yield information** | - no evidence of earlier bridge or abutments |
| 27 | **Other Register Criteria Subtotal** | |
| | **HAER GUIDELINES** | |
| | **EARLY ENGINEERING STRUCTURE:** | |
| 5 | Earliest example of bridge type in area | |
| 3 | One of earliest examples | |
| 0 | **Not an early example** | - earliest open spandrel arches date from 1911 |
| | **REPRESENTATIVE EXAMPLE OF TYPE:** | |
| 5 | Best example in State or County | |
| 3 | **Good example of bridge type in State or County** | - good example of open-spandrel arch |
| 0 | Not a good representative example | |
| 3 | **HAER Guidelines Subtotal** | |
| | **69/100 TOTAL POINTS** | |

## DETAILED PRESERVATION AND REHABILITATION GUIDELINES

I. Continued Use for Vehicular Purposes

A. Structural Upgrading

1. Identify the structural system and its individual character-defining features

a) The structural system should be evaluated using non-destructive testing techniques, where possible.

b) Passive solutions which adjust the live load by restricting vehicles should be explored, examples include load posting, signaling, and channeling.

c) The structural system should be respected, and its visual characteristics should be retained if modifications are necessary.

(1) The original load-carrying system should be retained, if possible.

(2) The dead load should be reduced by providing a lighter deck system, if possible.

(3) If the load-carrying system must be altered, the character-defining visual qualities of the original structural system should be retained. Modified systems which can be visually minimized include the introduction of structure continuity and other methods of reinforcement.

(4) If visual modifications are necessary, they should be kept as unobtrusive as possible.
(a) Modifications may include changing the configuration of isolated members or the addition of helping structures.
(b) Supplemental members should be added as needed under the deck of the structure, if possible.

2. Modifications should follow the following guidelines

a) Visually intrusive structural modifications should be kept as inconspicuous as possible, and should affect only secondary views, if possible. Consideration should be given to whether there is a primary view.

(1) Bridges which carry highways are seen by roadway travelers from afar, in elevation, and while traveling on the bridge deck. Modifications should be made with this in mind.

(2) Where circumstances are such that the primary view is from below the bridge, such as an overpasses, modifications should be made accordingly.

b) Modifications should be so designed that there is the least possible loss of historic material, and so that the character-defining features are not obscured, damaged, or destroyed.

c) Structural modifications, or helping structures, should be clearly differentiated from the historic bridge. The design should be compatible in terms of mass, materials, scale, and detail.

d) Traffic railings, or safety barriers, should be designed to meet requisite load requirements, and at the same time should be designed and installed so that character-defining features of the bridge are not obscured or damaged.

e) Deteriorated structural elements should be replaced in kind or with a material which duplicates the visual appearance of the original element.

B. Geometric Modifications

1. Evaluate the geometric constraints of the bridge in the context of the overall highway network. Determine realistic needs for geometric parameters in light of connecting highways, projected traffic volumes, accident history, and the proposed nature of future traffic needs.

2. Explore passive (off-bridge) solutions.

   a) Adjust alignment of the approaches, restrict the bridge to one-way traffic, or both.

      (1) Create holding lanes for traffic at the approaches to a one-lane bridge with appropriate provisions for safety.

      (2) Leave the historic bridge in place for one-lane traffic and move a visually compatible historic bridge to an adjacent site to carry the second lane.

      (3) Leave the historic bridge in place for one-lane traffic and construct a visually compatible new bridge on an adjacent site to carry the second lane.

   b) The flow of approaching traffic should be adjusted by restricting vehicles, restricting speed, or installing signs and traffic signals.

   c) Provide sidewalks external to the bridge for pedestrian safety.

   d) The bridge should be widened by cantilevering a new deck from either side of the existing structure, where structurally feasible and aesthetically and historically appropriate.

3. Alter the geometric configuration of the bridge to remedy geometric deficiencies.

   a) To increase the vertical clearance on through bridges, the depth of the portal frames and sway frames should be reduced with minimum possible destruction of historic fabric.

   b) To increase the vertical clearance on grade-separation structures, the superstructure should be raised or the roadway lowered.

   c) To increase the roadway width, some types of structures can be modified (e.g., multigirder, some concrete and stone bridges). Modifications should be designed to be compatible with the original structure.

C. Materials Repair and Maintenance

1. Identify features that are important in defining the overall historic character of the bridge.

2. Historic materials should be repaired, if possible. If replacement of a feature is necessary, it should be replaced in kind or with a compatible substitute material.

a) Masonry Superstructure and Substructure

(1) Drainage and vegetation
(a) Provide proper deck drainage systems which do not damage or promote deterioration of the superstructure or substructure
(b) Remove vegetation growing on bridge superstructure or substructure.

(2) Cleaning
(a) Clean masonry only when necessary to halt deterioration or to remove heavy soiling.
(b) Clean masonry with the gentlest method possible.
(c) Use cleaning method on test patches to determine long-range detrimental effect of cleaning.

(3) Repointing
(a) Remove deteriorated mortar by carefully hand-raking the joints to avoid damaging the masonry.
(b) Duplicate old mortar in strength, composition, color, and texture.
(c) Duplicate old mortar joints in width and joint profile.

(4) Repair of deteriorated sections
(a) Replace extensively deteriorated or missing features in kind or with a compatible substitute material.
(b) Replace masonry sections that are not repairable, in kind, using the same materials or compatible substitute materials. Dismantle deteriorated sections by hand, and with care.
(c) Do not apply nonhistoric coatings, such as stucco, gunite, and sealants, to masonry surfaces as a substitute for repointing and masonry repairs.

b) Metals

(1) Cleaning
(a) Identify metal prior to cleaning and test for gentlest possible cleaning method.
(b) Use the gentlest possible cleaning methods for cast iron, wrought iron, and steel (structural metals found on historic bridges) to remove paint buildup and corrosion. If hand scraping and wire brushing prove ineffective, low pressure dry grit blasting may be used as long as it does not abrade or damage the surface. Test patches should be cleaned to determine damage.

(2) Repaint with colors that are appropriate for the historic bridge.

(3) Replace deteriorated or missing decorative elements in kind or with a compatible substitute material.

c) Wood

(1) Repair historic wood features by patching or reinforcing, using recognized preservation techniques.

(2) Replace in-kind historic wood features which need to be replaced. If replacement in-kind is not possible, substitute materials that are compatible in texture and form, and that convey the same visual appearance as the original.

D. Removal to a Less Demanding Site

1. If possible, seek a less demanding site on the existing transportation system.

2. If possible, find a new owner for the historic bridge among public agencies such as state parks and recreation departments, or county or municipal parks departments, or state tourism agencies.

3. If a new owner cannot be located in the public sector, an owner in quasi-public or nonprofit groups should be sought.

4. If no recipient can be found in public or quasi-public groups, an owner in the private sector may be sought.

5. Ensure that the recipient of the bridge is prepared to maintain it, and rehabilitate it if necessary. A preservation covenant or restriction may be necessary to ensure this.

6. When possible, undertake the selection and preparation of a relocation site in the proximity of the original site.

7. Prior to removal, make a complete and comprehensive inventory of all bridge parts. The parts should be carefully numbered and referenced to the inventory for identification.

8. If possible, remove the bridge without disassembling.

9. If disassembly is necessary, disassemble the bridge in such a manner as to allow for its reassembly.

10. Reassemble the bridge to duplicate its original configuration.

11. Do any required cleaning or repair of the bridge in conformance with previously stated guidelines as appropriate.

II. <u>Continued Use for Non-vehicular Purposes</u>

A. Where feasible the bridge should be retained in a transportation or transportation-related function.

1. While the most feasible transportation use may be to leave the bridge in place as a bicycle or pedestrian crossing, or to move it to a public park or recreation area for the same purpose, other uses and other locations should not be precluded, including ones that involve private ownership.

2. Adaptive use *in situ* will often be the only alternative for masonry or concrete bridges because of their nature or size. However, others are movable, particularly metal and timber trusses. In instances where the features in the immediate vicinity of the bridge have an associative value, preference should be given to adaptive use *in situ*. This is particularly important where the bridge is located within the boundaries of a historic district, or is clearly associated with contemporary transportation or industrial features.

3. In choosing among alternatives, greater consideration should be given to those factors that will enhance or protect the historic bridge than to the specific nature of the adaptive use or its location. Such factors include: provision for maintenance; protection from vandalism; accessibility to the public; and opportunities for interpretation.

4. While an adaptive use may reflect a reduced level of loading, structural adequacy for the new use must still be determined, and rehabilitation undertaken when appropriate.

5. The selection and preparation of an alternative site should be undertaken with sensitivity to the historical use and siting of the bridge.

   a) A bridge that has distinctive features that link it with a particular use should be used in its historical context.

   b) Bridges should not be placed where they are clearly too long or too short for the obstruction that they span, and skews generally should be avoided. New abutments should be of compatible design and clearly distinguishable from the historic bridge.

6. Consistent with safety considerations, the structure itself should be returned to its historic configuration by removing visually obtrusive, non-character-defining elements that may have been added to permit the bridge to serve its present function, but which are not required for the new function. These might include elements added to enhance stiffness or load capacity, or secondary features, such as modern decks and guardrails.

7. Elements which have been added to the bridge over the course of its history and which are determined to be character-defining should not be removed.

8. Missing nonstructural elements of the bridge, including decorative features, that are distinctive of the style, type, or period in which the bridge was built should be replaced if they can be replicated from similar elements that survive on the same or a similar bridge.

B. If it is not feasible to retain the bridge in a transportation-related function, consideration should be given to non-transportation-related uses including public recreational uses, use as interpretive sites or museums, or architectural adaptations that could provide residential, commercial, or educational space.

   1. In such instances, the adaptive use should not obscure or alter the essential elements of the structure that impart its identity and significance as a bridge.

   2. If the bridge is to remain or be moved within a historic district, careful consideration should be given to the compatibility of the proposed use with the architectural and historical character of the historic district.

   3. Items A.1., A.2, and A.7 above are equally applicable to architecturally adaptive uses.

C. If an adaptive use cannot be found, consideration should be given to retaining the bridge either in place or at an alternative location as a historical ruin or monument.

III. Replacement With Mitigation

A. Documentation: The primary criterion in documenting historic bridges is whether the bridge can reveal information critical to understanding and interpreting bridge design, fabrication, engineering, and technology. Documenting bridges can contribute to understanding the development of transportation systems in the United States. Moreover, documentation provides information on the lives and works of individuals and engineers

who contributed to advancing bridge technology. The following guidelines are recommended for documentation of historic bridges:

1. When a bridge has been determined to be eligible for the National Register of Historic Places and all alternatives for preservation are exhausted, the federal and state agencies involved should consult with the appropriate Regional Office of the National Park Service (Western Regional Office in San Francisco) to determine the documentation level required. Generally, the levels of documentation correspond to the level of significance of the bridge as follows:

   a) Documentation Level I for bridges of national significance requires
      (1) measured drawings,
      (2) large-format contemporary photographs,
      (3) photocopies of selected existing drawings (when available),
      (4) historic photographs and illustrations, and
      (5) written data.

   b) Documentation Level II for bridges of state significance requires
      (1) photocopies of selected existing drawings (when available),
      (2) historic photographs and illustrations,
      (3) large-format contemporary photographs, and
      (4) written data.

   c) Documentation Level III for bridges of local significance requires
      (1) dimensioned sketch plans and elevations snowing bridge configuration,
      (2) large-format contemporary photographs, and
      (3) written data.

4. Individuals compiling documentation should be professionally qualified with demonstrable experience in bridge history and in documenting historic bridges.

5. Documentation should focus on the existing bridge and should be an accurate record of existing conditions supplemented by information obtained from reliable secondary sources with documentary limitations clearly stated.

6. Documentation should be prepared in such a manner as to permit the independent verification of information.

7. Documentation should be prepared on materials that are readily reproducible, durable, and of standard sizes that meet accession and archival requirements of the Library of Congress.

8. Documentation should be clearly and concisely presented.

B. Storage and/or Salvage: If storage and/or salvage are part of the mitigation required for the bridge, additional consideration is necessary after Documentation, above, has been completed.

   1. The goal of salvaging parts or all of the historic bridge should be identified in order to determine appropriate treatment.

   2. If future use of the bridge is anticipated, a comprehensive inventory of all bridge parts should be completed. The bridge parts should be carefully numbered and referenced to the inventory for identification.

3. If future use of the entire bridge is anticipated, the bridge should be dismantled with care in such a way as to allow reassembly. The bridge parts should be stored in a place where they will be protected from deterioration.

4. If only portions of the bridge will be salvaged, those portions should be removed with care and stored or delivered to the new owner.

5. Guidelines included in Section I-D: Removal to a Less Demanding Site, may be applicable.

IV. Special considerations for Bridges Located in Historic Districts

A. In consultation with the State Historic Preservation Officer (SHPO), designated historic districts and their important characteristics should be identified.

1. Identify features which are important in defining the overall historic character of the district.

2. Identify character-defining features of the historic bridge and its relationship to the buildings, streetscapes, and landscapes in the historic district.

B. The treatment to be given historic bridges should be established with reference to the Priority Levels presented in the section on Standards and Guidelines for the Treatment of Historic Bridges.

1. If the bridge is a historic bridge and/or contributing structure within the designated historic district, rehabilitation options may include:

Priority I: Continued Use for Vehicular Purposes, or
Priority II: Continued Use for Non-vehicular Purposes

2. When the bridge cannot be upgraded adequately for continued vehicular use and the site precludes other uses, the historic bridge may need to be replaced. This alternative may require replacement with mitigation, including documentation.

3. In addition to the evaluation of appropriate treatments for the historic bridge, the design of the replacement bridge should include consideration of the new bridge's compatibility within the historic district.

C. New bridges built in existing historic districts, whether replacement bridges or not, should be designed to be compatible with the character of the historic district in which they are located.

1. The design and construction of the new or replacement bridge should be compatible with the bridge site and the historic character of the district in terms of size, scale, design, materials, color, and texture.

2. The design of the new or replacement bridge should preserve the historic relationship between the bridge, its site, and the buildings adjacent to it.

3. The design of the new replacement bridge should retain the historic relationship between the overall bridge siting and streetscape and landscape features in the district.

4. If the historic substructure is sound, the replacement bridge should incorporate it as part of the new bridge.