

DEPARTMENT OF WATER

County of Kauai

"Water has no Substitute - Conserve It!"

December 6, 1999

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OFFICE OF ENVIRONMENTAL QUALITY CONTROL

Ms. Genevieve Salmonson
State of Hawaii
Office of Environmental Quality Control
235 South Beretania Street, Suite 702
Honolulu, HI 96813


Dear Ms. Salmonson:

Subject: Finding of No Significant Impact (FONSI) for Improvements to Kokolau Tunnel and Pipeline, TMK: (4) 3-4-06: por 12, Lihue, Kauai, Hawaii

The Department of Water has reviewed the comments received during the 30-day public comment period that began on October 23, 1999 for the subject Environmental Assessment. We have determined that this project will not have significant environmental effects and are issuing a FONSI. Please publish this notice in the December 23, 1999 OEQC Environmental Notice. ✓

We have enclosed a completed OEQC Publication Form and four copies of the final EA. Please call the Project Engineer, William Eddy, at (808) 245-5412 if you have any questions.

Sincerely,


for Ernest Y.W. Lau
Manager and Chief Engineer

WE
Enclosures
c: SSFM Engineers, Inc.

DEC 23 1999

FILE COPY

1999-12-23-KA-PEA-

FINAL ENVIRONMENTAL ASSESSMENT

FOR

***IMPROVEMENTS TO KOKOLAU TUNNEL
AND PIPELINE***

T.M.K. 3-04-06: portion of 12
Lihue, Kauai, Hawaii

December 1999

DEPARTMENT OF WATER
County of Kauai

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AND PIPELINE**

T.M.K. 3-04-06: portion of 12
Lihue, Kauai, Hawaii

December 1999

Prepared For:
DEPARTMENT OF WATER
County of Kauai

Prepared By:

Engineers, Planners, & Project Managers
American Consulting Engineers Council, Member

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FOR
IMPROVEMENTS TO KOKOLAU TUNNEL
AND PIPELINE

T.M.K. 3-04-06: portion of 12
Lihue, Kauai, Hawaii

December 1999

Proposing Agency:
Department of Water
County of Kauai
4398 Pua Loke Street
Lihue, Kauai, Hawaii 96766

Responsible Official:


Ernest Y. W. Lau

Date:

12/6/99

Department of Water, Manager & Chief Engineer

Prepared By:



Engineers, Planners, & Project Managers
American Consulting Engineers Council, Member

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CHAPTER 1 INTRODUCTION

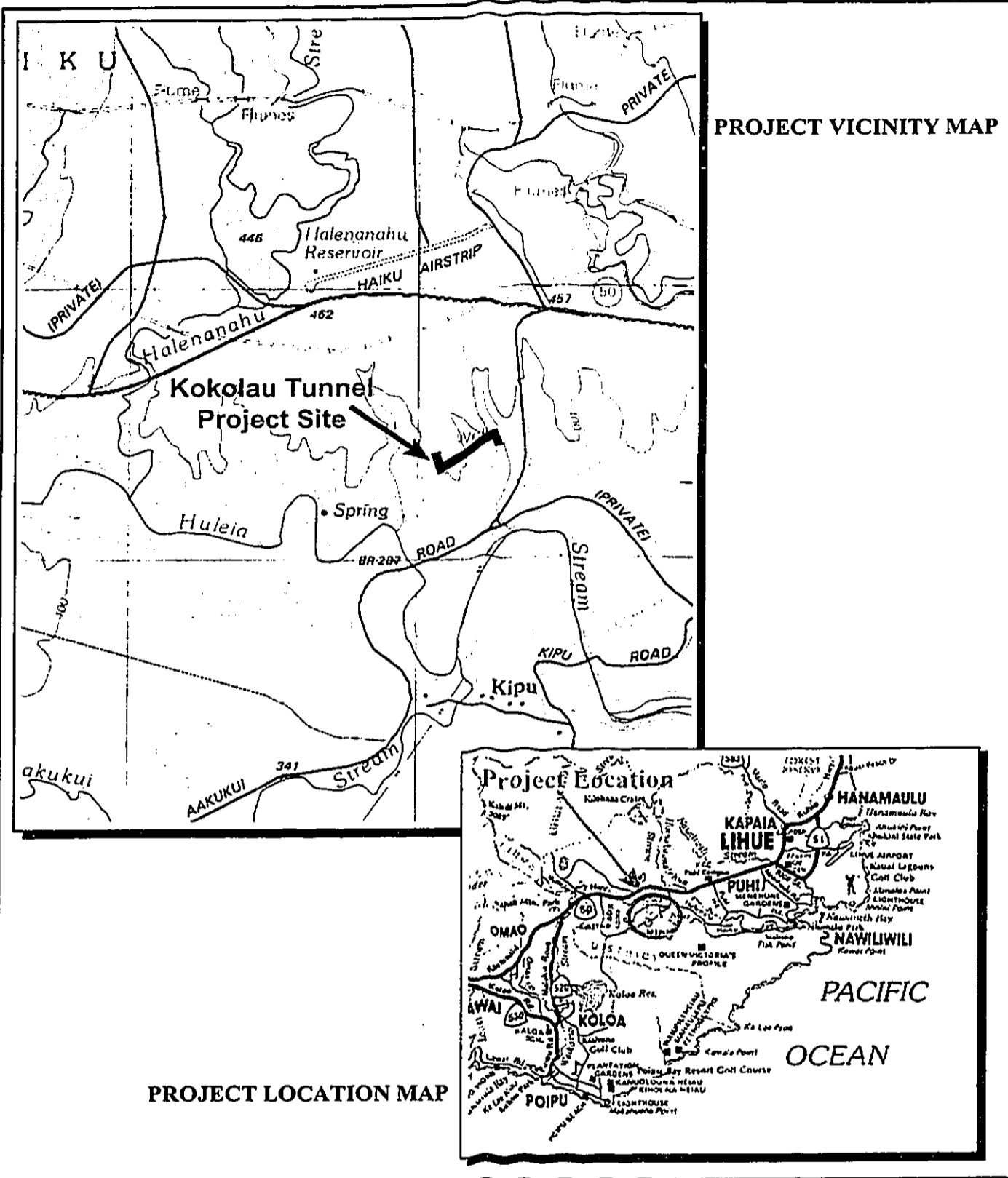
1.1 PURPOSE FOR ENVIRONMENTAL ASSESSMENT

The County of Kauai, Department of Water is proposing the Improvements To Kokolau Tunnel And Pipeline project. This project involves the renovation and other improvements to the Kokolau Tunnel and associated waterline, which are parts of the County's Lihue water system. This project is located in the Lihue district of the island of Kauai. Construction of this project would involve the use of County funds, therefore, this project is subject to the State's environmental review process.

This Final Environmental Assessment (Final EA) was prepared to address the probable impacts associated with proposed improvements to this existing water system on the surrounding environment. A Draft EA was prepared and published in the October 23, 1999 issue of *The Environmental Notice*. This document was prepared in conformance to the regulatory and documentation requirements prescribed under Chapter 343, Environmental Impact Statements, Hawaii Revised Statutes (HRS) and Title 11, Chapter 200 (Environmental Impact Statement Rules) of the State Department of Health's Administrative Rules.

1.2 PROJECT BACKGROUND

The Kokolau Tunnel is an approximately 1,550 foot unlined water development tunnel located about two miles west of the town of Puhi. This Puhi community is part of the County's Lihue district located in the southeast portion of the island of Kauai. A project location and vicinity map is provided under Figure 1.1. The Tax Map Key for the Kokolau Tunnel site and waterline to be improved is (4) 3-4-06: portion of parcel 12. Figure 1.2 shows the project site in relation to this Tax Map. A summary of pertinent project related information is provided on Table 1.1.

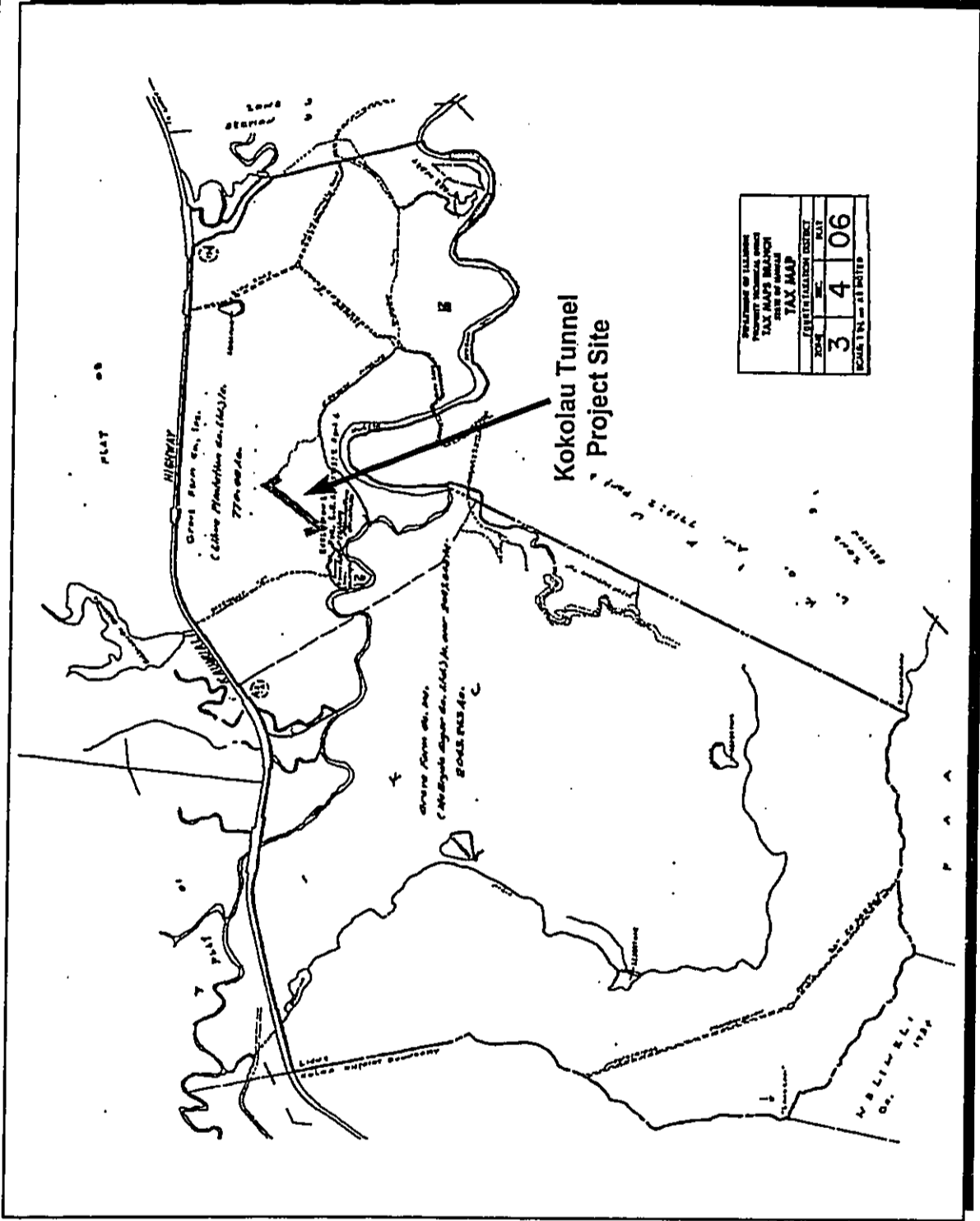


PROJECT VICINITY AND LOCATION MAP

Figure 1.1



County of Kauai, Department of Water
 Improvements To Kokolau Tunnel And Pipeline



Tax Map Of Project Site

Figure 1.2

County of Kauai, Department of Water
Improvements To Kokolau Tunnel And Pipeline

Source: Bureau of Conveyance
State of Hawaii



Table 1.1 Summary Information

Project Name:	Improvements To Kokolau Tunnel And Pipeline
Applicant:	Department of Water County of Kauai 4398 Pua Loke Street Lihue, Kauai, Hawaii 96766 Contact: Mr. William Eddy, Project Engineer
Agency's Consultant:	SSFM Engineers, Inc. 501 Sumner Street, Suite 502 Honolulu, Hawaii 96817 Contact: Mr. Ronald A. Sato, AICP, Project Planner
Accepting Agency:	Department of Water, County of Kauai
Project Description:	Renovate the Kokolau Tunnel by enlarging and stabilizing portal entrances with concrete flooring, roof, and walls, and installing a metal door. Install a new 16-inch waterline section routed from Portals No. 2 and 3 along the existing access road and cane haul road to connect with the existing County system. The present 12-inch waterline located at Portal No. 5 would be abandoned. The dirt access road would be paved.
Project Location:	The Kokolau Tunnel is located near the Puhi community of the Lihue district. The project site is situated on a ridge south (makai) of Kaumualii Highway, and about 2 miles west of Puhi town.
Existing Use:	The Kokolau Tunnel was developed as a source for domestic water use around 1929, and is presently part of the Lihue Water System. This water source is currently not being used due to present structural and sedimentation problems with the tunnel. A 12-inch waterline from this tunnel was used to transport water down the mountain ridge to a 15-inch waterline routed along an existing cane haul road to the Department of Water's "Grove Farm Tank."
Land Ownership:	Grove Farm Company. Property leased to Amfac Land Company, Ltd. (Lihue Plantation).
Tax Map Key:	(4) 3-04-06: portion of 12
Land Area:	Parcel 12 encompasses 770 acres, however, the tunnel project involves area less than one (1) acre.
State Land Use:	Agricultural
County General Plan:	Portions within both Open (O) and Agriculture (A) in Lihue Planning Area.
County Zoning:	Open District (O)
SMA District:	Not Within District.

Since its initial development, the Kokolau Tunnel has been used by the Department of Water to supply a portion of domestic potable water for their Lihue Water System. However, portions of this tunnel have since collapsed and become unusable over the years. In 1996, the Department of Water decided to discontinue its use as part of the Lihue Water System pending improvements. As a result, the Department is proposing this project to renovate and improve this tunnel to allow for the reuse of its water. Other associated improvements involve modifications to the existing waterline from this tunnel.

1.2.1 Land Use Classifications And Designations

The project site and immediate area is designated as "Agricultural District" under the State's Land Use District Boundary Map (Koloa, Map K-8).

Under the Kauai County's General Plan, the Kokolau Tunnel project site is designated "Open" (O) with surrounding areas designated "Agriculture" (A).

Under the applicable zoning map under the Kauai County's Comprehensive Zoning Ordinance, the project site is zoned "Open" (O) district. Discussion with the County Planning Department determined that the proposed improvements would be permitted under this zoning district because it would be considered repair and maintenance work of existing facilities.

1.2.2 Technical Studies

Technical studies were conducted by the following subconsultants to assist in the preparation of this environmental document. Copies of these technical studies are included in the Appendices of this document.

1. Appendix C Geotechnical Investigation - Masa Fujioka and Associates.
2. Appendix D Archaeological Assessment - Cultural Surveys Hawaii.

CHAPTER 2 PROJECT DESCRIPTION

2.1 PROJECT LOCATION AND VICINITY

The Kokolau Tunnel is located near the Puhi community of the County's Lihue district. This project area is about 2 miles west of the town of Puhi and 4 miles away from the central business district of Lihue. As previously shown on Figure 1.1, this tunnel is situated on a mountainous ridge about 1,500 feet south (makai) of Kaumualii Highway. The Tax Map Key for this area is Fourth Division, 3-04-06: portion of 12.

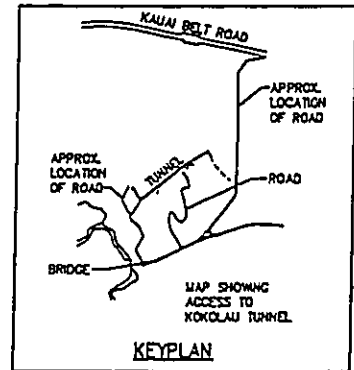
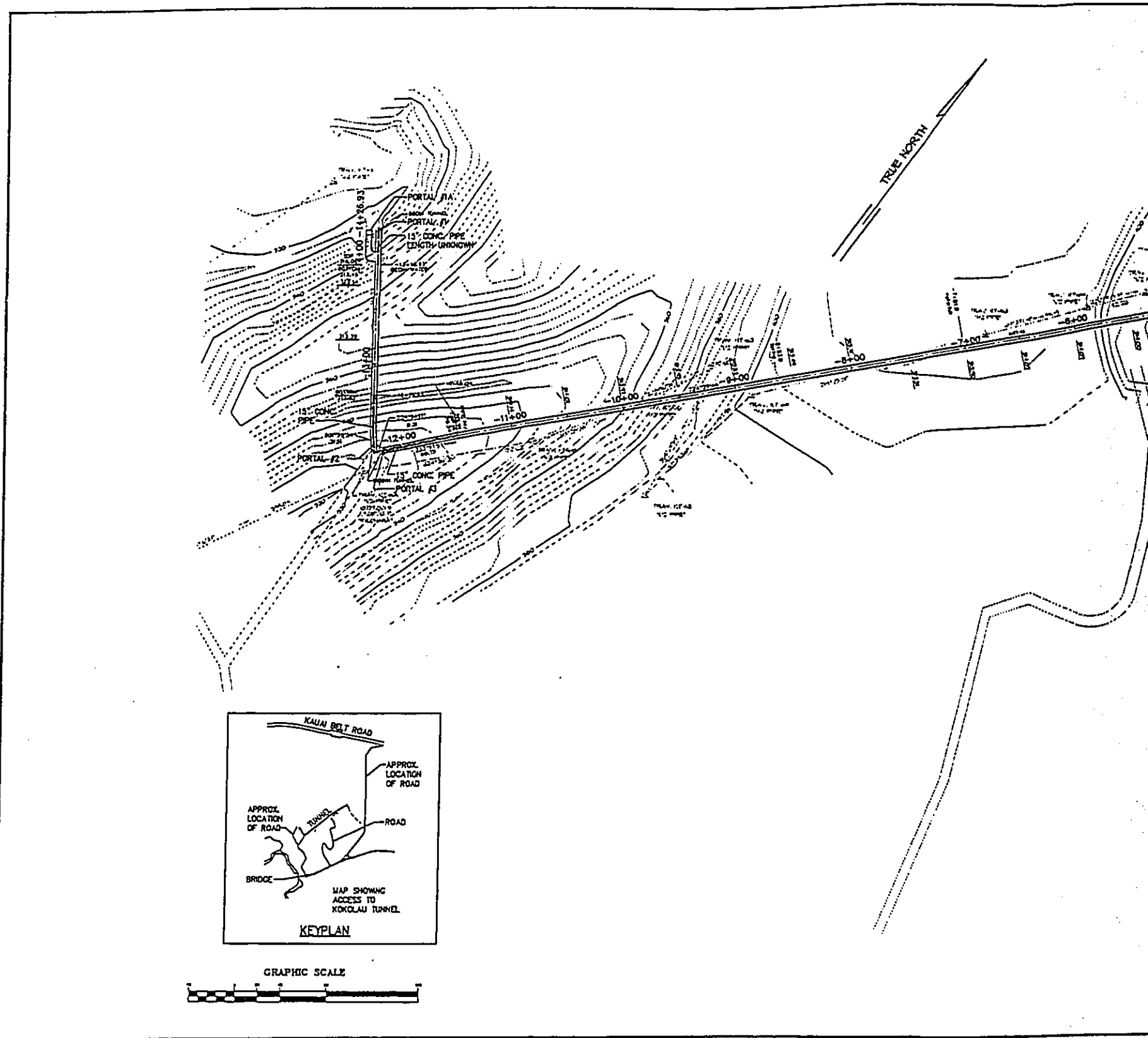
2.2 EXISTING AND SURROUNDING USES

The Kokolau Tunnel and immediate surrounding area are presently undeveloped. The tunnel site encompasses an area of less than one acre. A primary cane haul road is present and routed in an east-west direction at the base of the mountain. Two other cane haul roads are routed up this mountain to agricultural fields and the highway from this primary cane haul road. Surrounding uses consist of undeveloped land overgrown with various vegetation along with active sugar cane fields.

2.2.1 Description Of Kokolau Tunnel

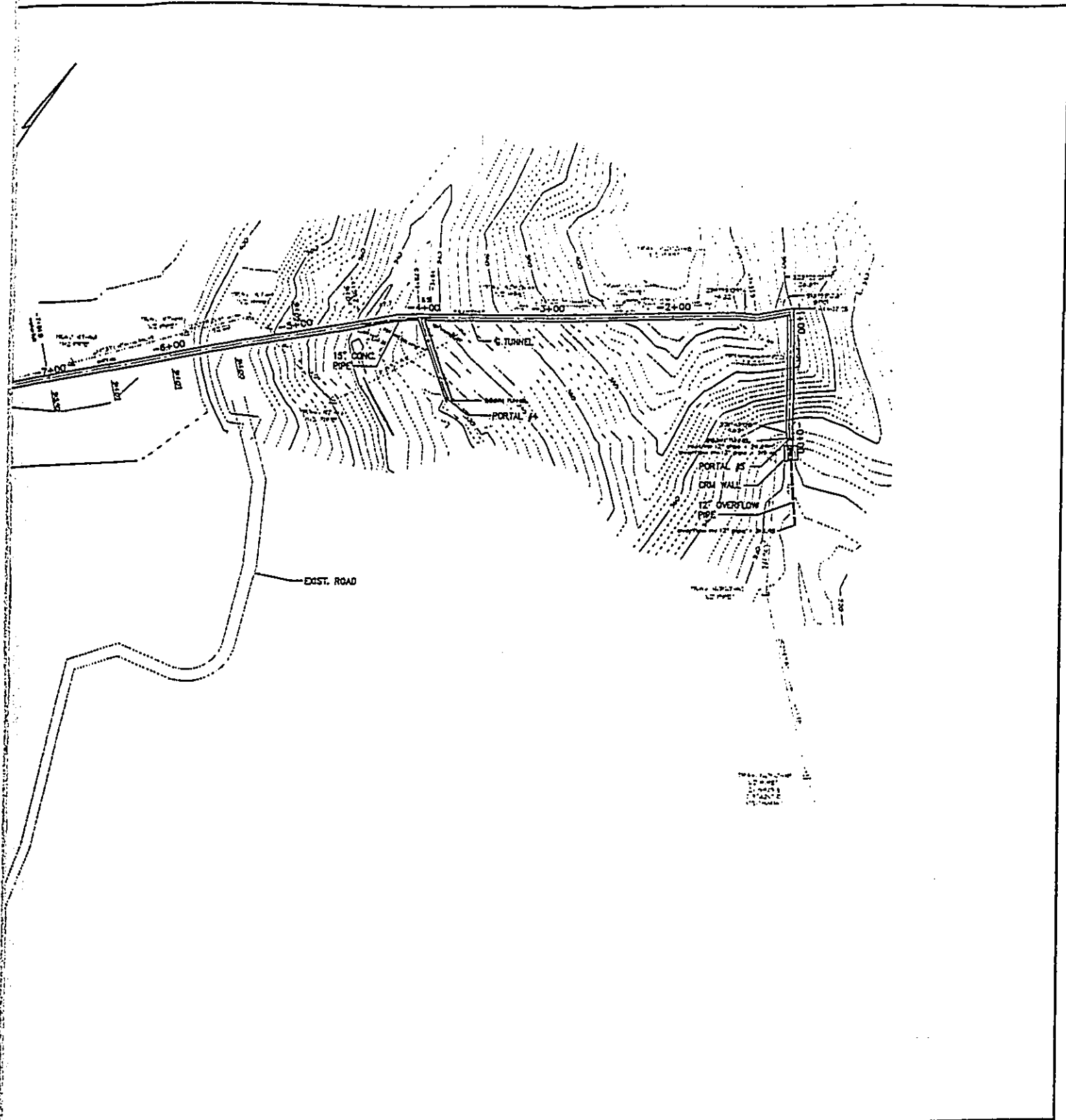
The Kokolau Tunnel is an approximately 1,550-foot unlined water development tunnel situated on a mountain ridge at an elevation of about 300 feet mean sea level (msl). This tunnel intercepted former springs in a tributary on the north side of Huleia Valley during its construction in 1929. The aquifer occurs in lava flows that are probably from the Kilohana vent. The aquifer may be perched on a nearly-horizontal red soil layer which is several feet below the tunnels in formerly observed exposed road cuts (MFA 1999). Figure 2.1 graphically shows this tunnel and identifies existing portals.

As shown on Figure 2.1, this tunnel complex has a shape of a reversed "Z." It has a main tunnel segment about 1,200 feet long generally running in a west to east direction along two ridge peaks on this mountain. A short tunnel segment located on the western end generally runs in a south to north direction for about 200 feet further up the ridge. Two other short tunnel segments are located on the eastern end running in a north to south direction ranging from about 500 to 1,000 feet long. There are a total of six entrances into this tunnel complex which are identified as Portals No. 1, 1A, 2, 3, 4, and 5. These portals are identified on Figure 2.1, and photos of these entrances are provided in Appendix A of this document.



KOKOLAU TUNNEL EXISTING LAYOUT PLAN

County of Kauai, Department of Water
 Improvements To Kokolau Tunnel And Pipeline



YOUT PLAN

Source: SSFM Engineers, Inc.

Figure 2.1



Portals No. 1 and 1A are located at the top of the short tunnel segment situated on the western end. Portals No. 2 and 3 are located at the western end of the main 1,200-foot long tunnel. Portal No. 4 is located at the end of the short tunnel segment on the eastern portion of the main tunnel. Portal No. 5 is located at the southern end of the short tunnel segment situated at the eastern end of the tunnel.

2.2.2 Kokolau Tunnel Lithology

Several lithologies are present within the tunnel system. Koloa volcanics (massive basalt¹, slightly weathered basalt, and fractured basalt) are present throughout the majority of this tunnel. The Koloa basalts within the tunnel generally appear to be structurally stable (MFA 1999).

The Koloa volcanics are generally present in the core regions and lower one-third of the walls of the tunnel, but they are also present to the top of tunnel walls in some areas. Saprolites² and clayey silts are present above the Koloa volcanics, and are often present in portions of the tunnel nearer the portals and in the upper one-third to one-half of the tunnel walls.

There are collapsed portions of the tunnel which occur in areas of clayey silt and heavily weathered saprolite. Several clinker³ zones are also present in the tunnels, and appear to be associated with the major water-bearing zones. While these zones are comprised of poorly lithified deposits they appear to be relatively stable (MFA 1999). Greater discussion of the tunnel's hydrogeology is provided in Chapter 3.

2.2.3 Existing Waterline And Access Roads

The Kokolau tunnel supplies water which currently travels in a west to east direction. As a result, an existing 12-inch waterline is provided at Portal No. 5. This waterline is routed down the mountain in a southeast direction before connecting with a waterline routed along the existing cane haul road (refer to Figure 2.2). Appendix A includes photos of this cane haul road. Due to sedimentation concerns and structural problems associated with the tunnel, this water source is currently not being used for the County's domestic water supply.

A dirt access road is presently used by Department of Water staff for vehicular access to the tunnel. This winding access road begins at the cane haul road and travels up the mountain in a northern direction up to the area of Portals No. 2 and 3.

¹ Basalt: A dark colored igneous rock composed primarily of calcic plagioclase and pyroxene.

² Saprolite: A soft, earthy, clay-rich thoroughly decomposed rock formed in place by chemical weathering of igneous or metamorphic rocks, especially in humid or tropical or subtropical regions.

³ Clinker: A rough, jagged fragment of lava.

Another minor dirt access road is also present on the mountain to provide access to Portals No. 1 and 1A. This road begins from a stretch of the main access road, and travels in northern direction up to Portals No. 1 and 1A.

2.3 DESCRIPTION OF PROJECT

The Department of Water is proposing renovation of the Kokolau Tunnel to allow for its water source to be returned to domestic water service as part of the Lihue Water System. These improvements would generally involve improving portal entrances, installing a new section of waterline from the tunnel, and paving the existing dirt access road. Planned improvements are discussed in greater detail below, and a Site Plan is shown on Figure 2.2.

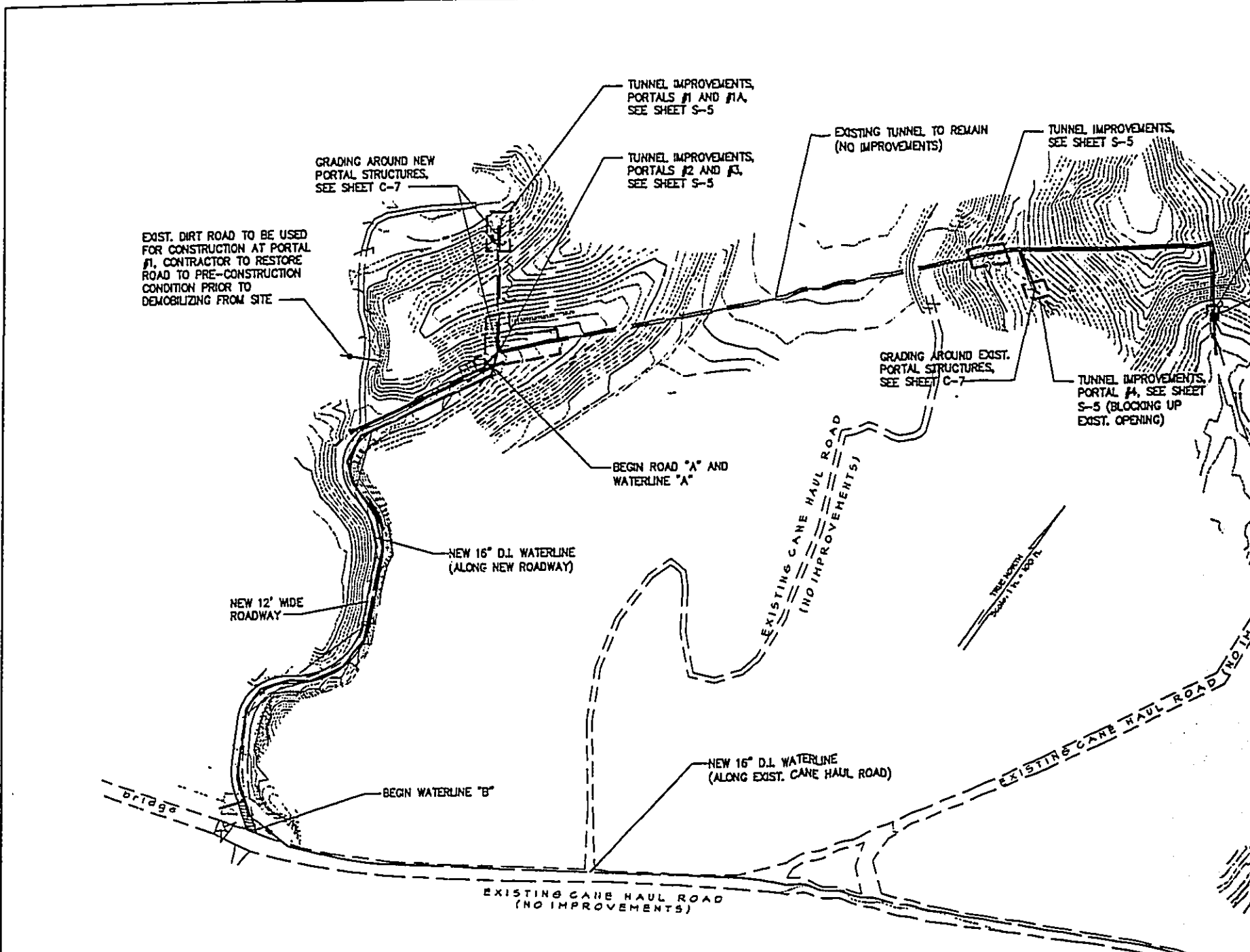
2.3.1 Tunnel Improvements

Improvements proposed for the tunnel are generally limited to the area around tunnel entrances. Portal 1A is not needed, and would be permanently sealed by excavating portions of the entrance and then backfilling it with material to close the entrance.

At Portal No. 1, the soil above the tunnel entrance would be excavated to expose the interior of the tunnel. This excavation would extend within the tunnel until basaltic rock is reached which may be between 30 and 40 feet inside. An existing 15-inch concrete pipe at the portal entrance would also be removed.

Construction of the portal structure and the segment of tunnel excavated up to the basalt would then occur. Figure 2.3 shows a typical section of the types of improvements to occur. This portal structure would have concrete roof, walls, and flooring, a partially louvered hollow metal door about 3 feet wide by 6 feet tall, concrete steps leading up to the door, and an aluminum lift-out flood panel with frame. Water in this segment of the tunnel would be directed in a southern direction towards Portal No. 3. Once the portal structure is completed, the tunnel entrance would be backfilled to original elevations, and excavated areas would be landscaped. Figure 2.4 shows a typical landscape plan for these portals.

Portals No. 2 and 3 would be replaced to create a new single tunnel entrance situated near the general area of Portals No. 2 and 3. This new portal would serve as the new main entrance into the tunnel. Portal No. 2 would be excavated about 60 feet in the tunnel up to the basaltic rock. A concrete box culvert would be constructed, and the existing portal entrance would be closed off. The concrete culvert would allow water flow from the area near Portal No. 1 to continue towards the new tunnel entrance.



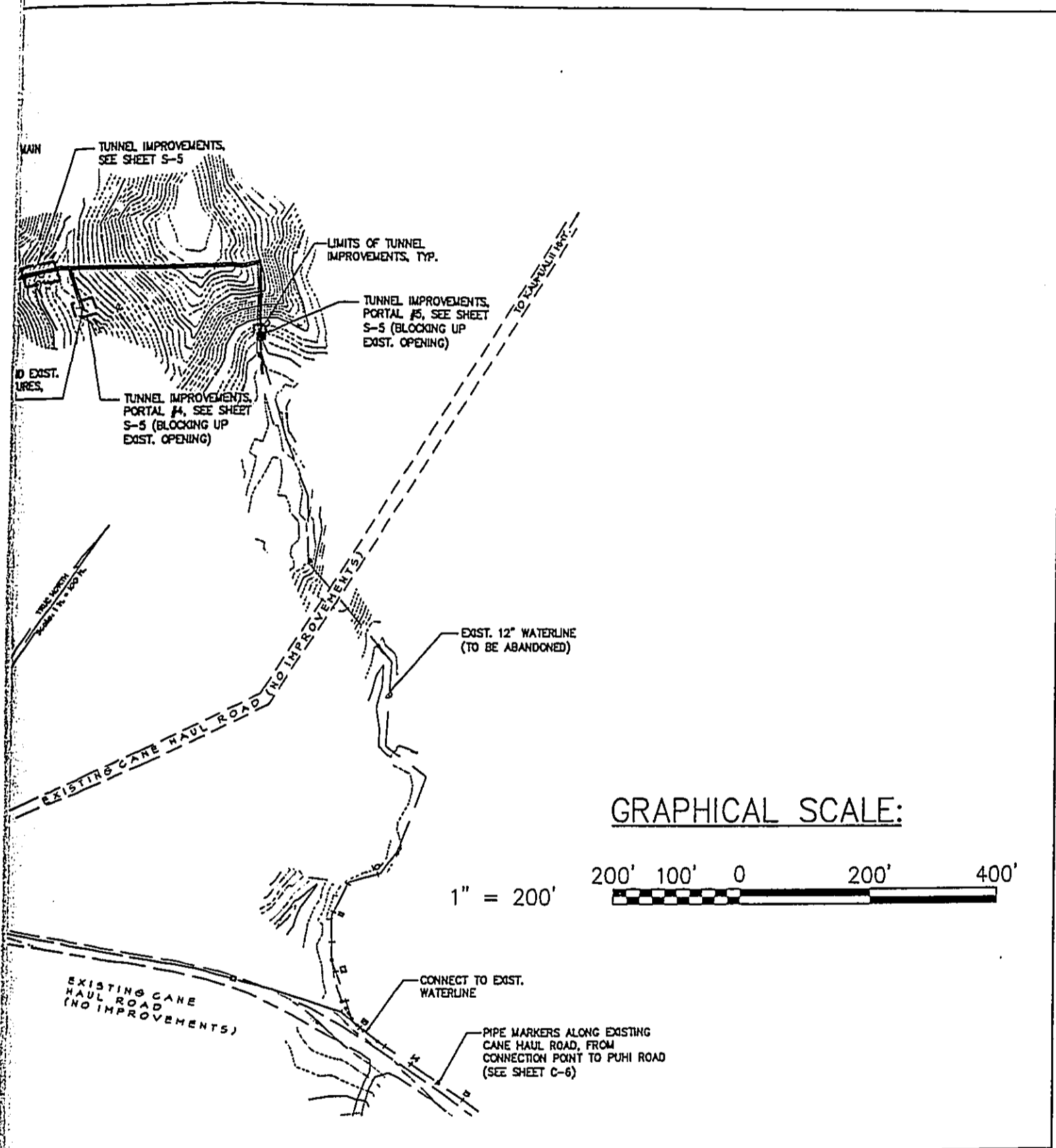
GENERAL SITE PLAN

SCALE: 1" = 200'

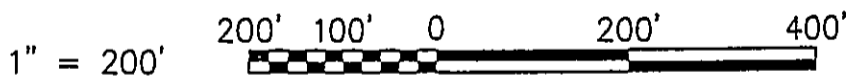
EARTHWORK SUMMARY:
(FOR GRADING PERMIT PURPOSES ONLY)


	PORTAL NO. 1, 1A, 3, AND 4	ROADWAY	TUNNEL IMPROVEMENTS	TOTAL
AREA TO BE GRADED	0.04 ACRES	0.48 ACRES	0.28 ACRES	0.80 ACRES
EXCAVATION	58 CY	623 CY	9250 CY	9931 CY
EMBANKMENT	75 CY	220 CY	0 CY	295 CY

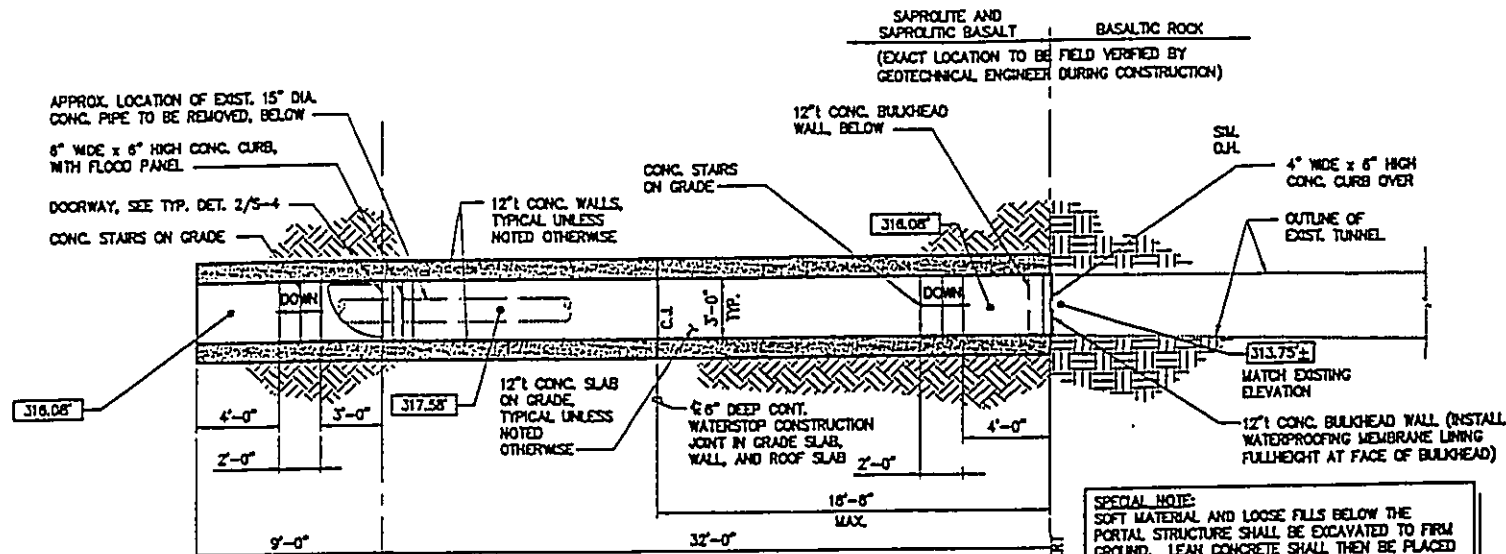




GRAPHICAL SCALE:



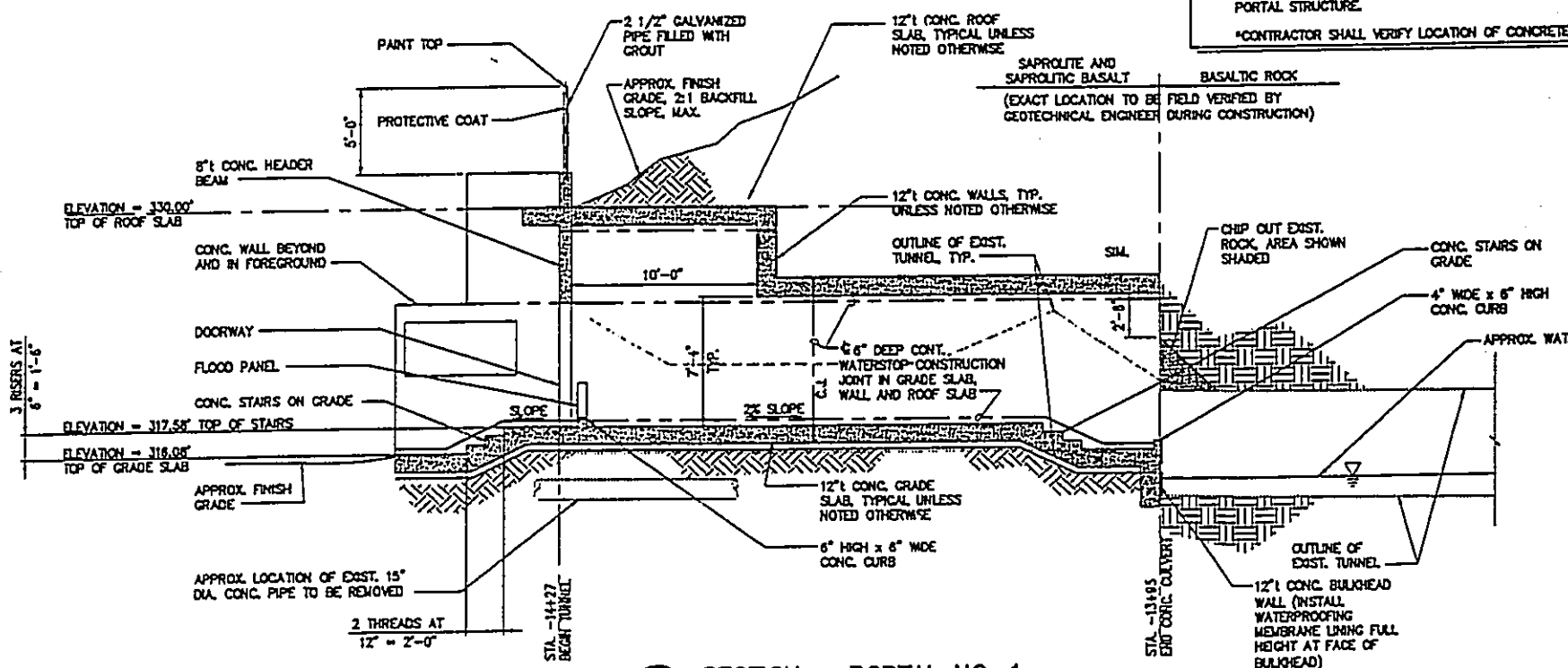
 CONSULTING ENGINEERS 501 Sumner Street, Suite 502 Honolulu, Hawaii 96817	KOKOLAU TUNNEL ENVIRONMENTAL ASSESMENT		FIGURE 2.2
	SCALE: AS NOTED	DATE: OCTOBER 1999	



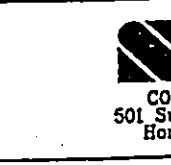
1 GROUND FLOOR PLAN - PORTAL NO. 1
NOT TO SCALE

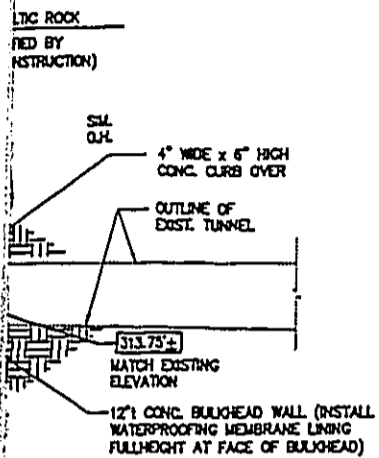
SPECIAL NOTE:
SOFT MATERIAL AND LOOSE FILLS BELOW THE PORTAL STRUCTURE SHALL BE EXCAVATED TO FIRM GROUND. LEAN CONCRETE SHALL THEN BE PLACED IMMEDIATELY IN THE EXCAVATED AREAS TO FORM A LEVEL SURFACE FOR THE STRUCTURE.

CONCRETE PIPE NOTES:
1. EXISTING 15" DIA. PIPE BENEATH THE NEW PORTAL SLAB SHALL BE CUT & REMOVED AND PLUGGED 5' FROM THE PORTAL STRUCTURE.
*CONTRACTOR SHALL VERIFY LOCATION OF CONCRETE



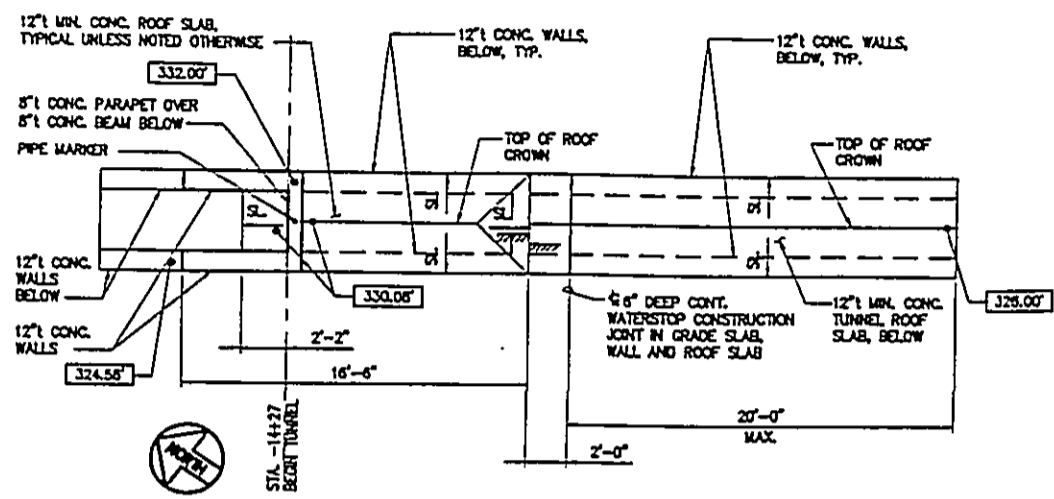
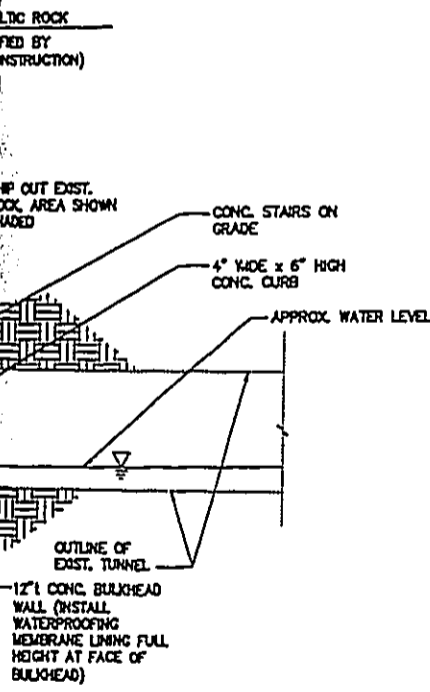
A SECTION - PORTAL NO. 1
NOT TO SCALE





GENERAL NOTE:
ALL MATERIAL AND LOOSE FILLS BELOW THE
NEW STRUCTURE SHALL BE EXCAVATED TO FIRM
GROUND. LEAN CONCRETE SHALL THEN BE PLACED
EVENLY IN THE EXCAVATED AREAS TO FORM A
FLAT SURFACE FOR THE STRUCTURE.

CONCRETE PIPE NOTES:
EXISTING 15" DIA. PIPE BENEATH THE NEW PORTAL SLABS
SHALL BE CUT & REMOVED AND PLUGGED 5" FROM NEW
PORTAL STRUCTURE.
CONTRACTOR SHALL VERIFY LOCATION OF CONCRETE PIPE.



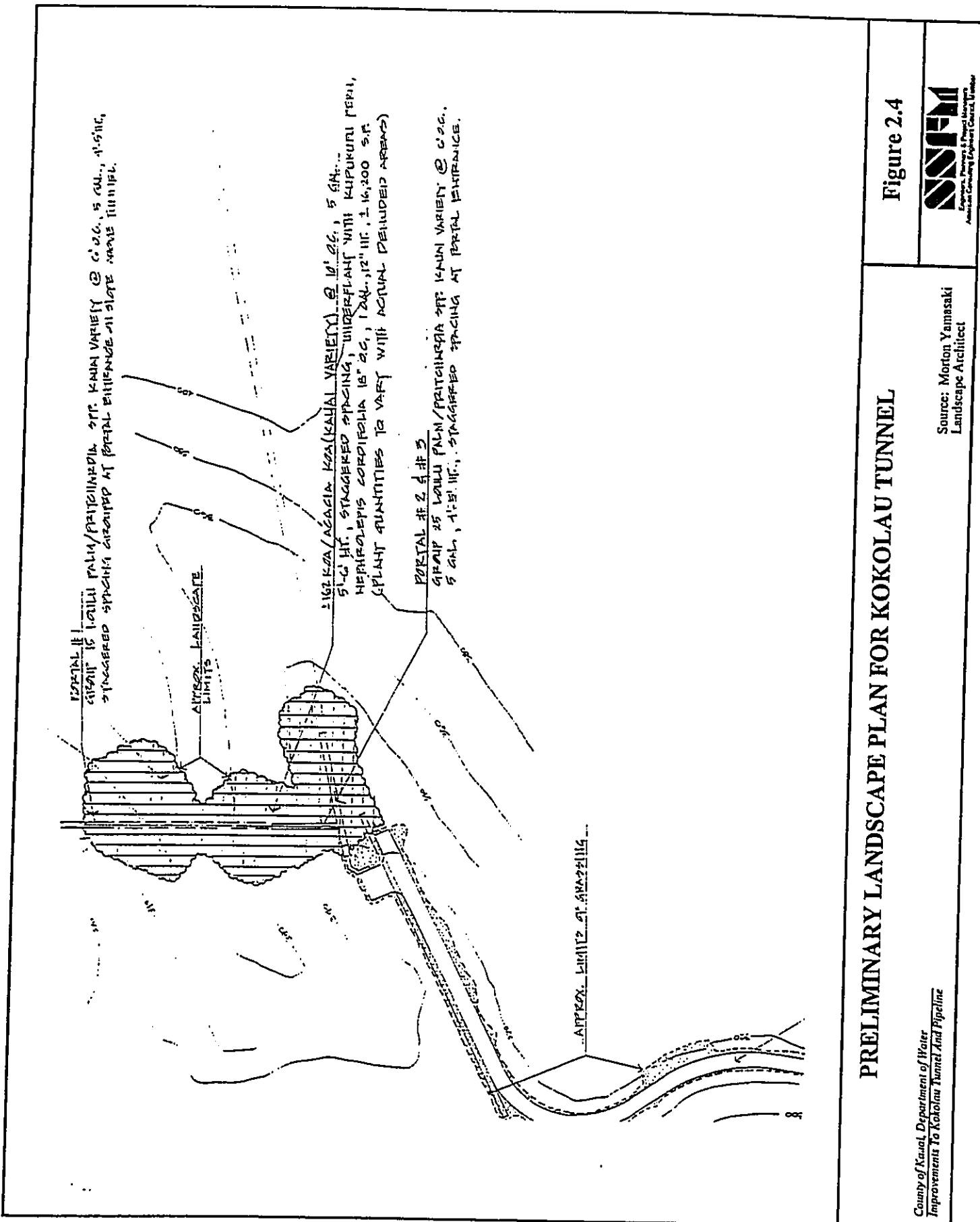
2 ROOF PLAN - PORTAL NO. 1
NOT TO SCALE

SSFM
CONSULTING ENGINEERS
501 Summer Street, Suite 502
Honolulu, Hawaii 96817

KOKOLAU TUNNEL
ENVIRONMENTAL ASSESSMENT
PORTALS NO. 1 PLANS AND SECTION

SCALE: AS NOTED DATE: OCTOBER 1999

FIGURE
2.3



PRELIMINARY LANDSCAPE PLAN FOR KOKOLAU TUNNEL

Figure 2.4

County of Kauai, Department of Water
 Improvements To Kokolau Tunnel And Pipeline

Source: Morton Yamsaki
 Landscape Architect



Portal No. 3 would be similarly excavated about 120 feet into the tunnel up to the basaltic rock before a concrete box culvert can then be constructed. The new portal entrance created would have a metal door, flood panel, steps leading down into the tunnel, a sump pit, and a concrete culvert. A new 16-inch waterline would also be constructed to transport water along the dirt access road. Figure 2.5 shows a typical section of improvements at this new portal.

A new bulkhead wall would be constructed in the tunnel just before reaching the tunnel segment leading to Portal No. 4. This wall would dam the water flow in the tunnel segment extending eastbound from Portal No. 3. This would reverse the flow of water in the tunnel from its current west to east movement. Water from this tunnel would then be routed in a new east to west direction towards the new 16-inch waterline located at the new main portal entrance created. Once these portal structures are completed, the tunnel entrances would be backfilled to original elevations, and excavated areas would be landscaped.

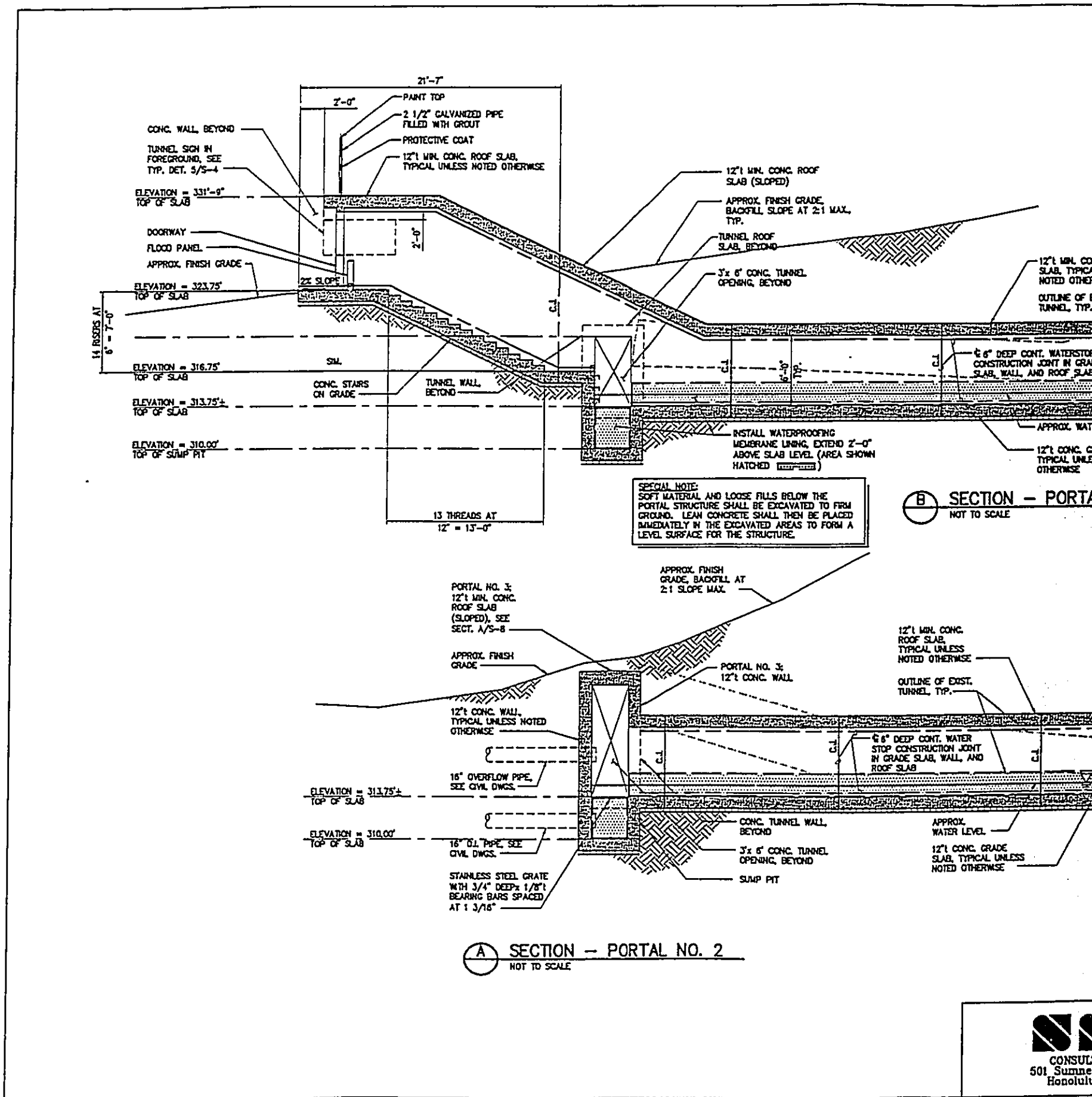
As previously described, the portion of the tunnel located near Portal No. 4 is collapsing and the tunnel entrance is being overgrown with vegetation. As a result, this tunnel entrance would be permanently sealed by excavating portions of the entrance and then backfilling it with material to close the entrance.

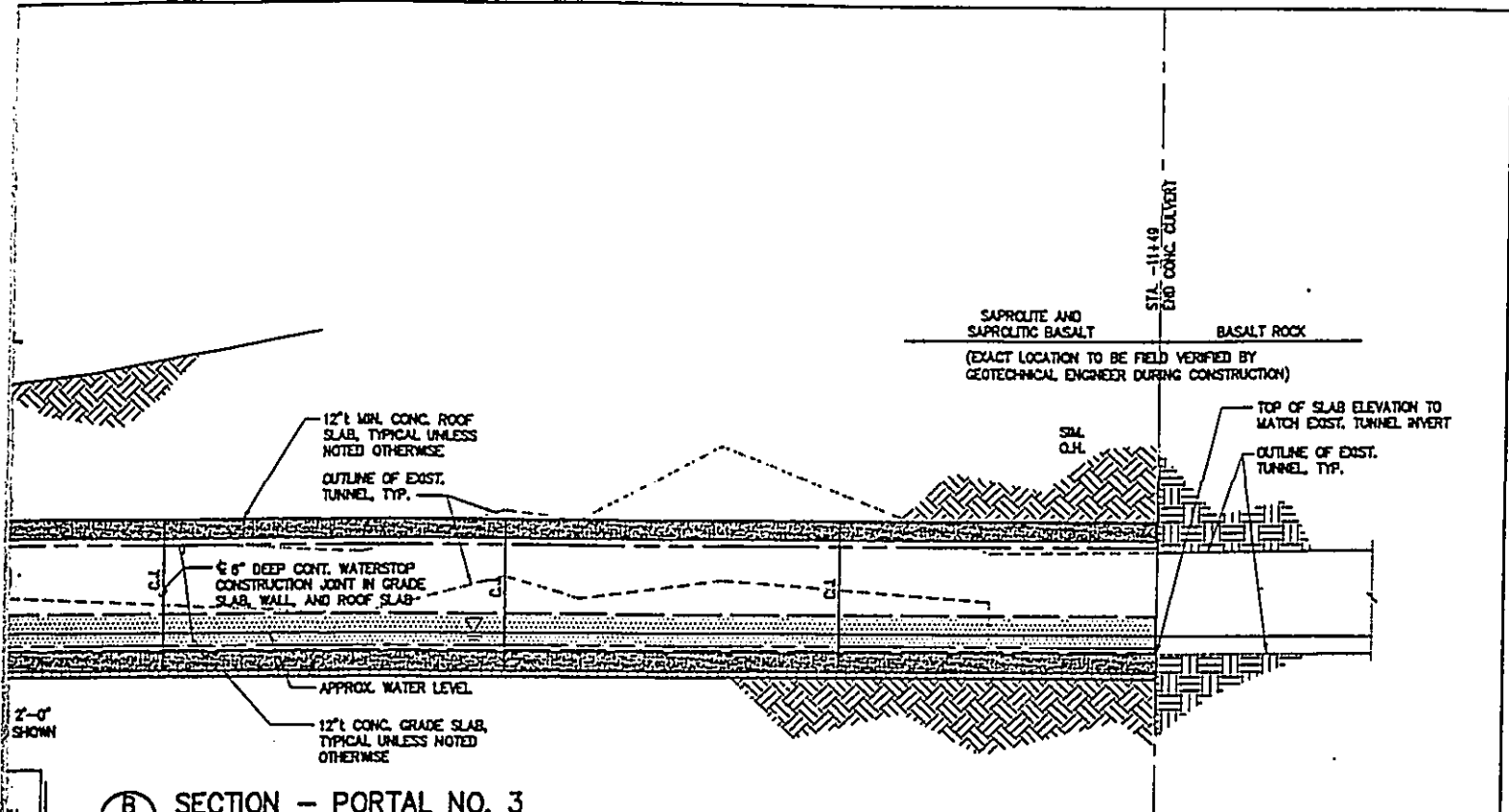
At Portal No. 5, this entrance would be improved by adding a new metal door. By redirecting the water flow in the tunnel, the existing 12-inch waterline located at Portal No. 5 would be abandoned. Once all of these tunnel improvements have been completed, the tunnel would be chlorinated and the chlorinated water disposed of in an appropriate manner.

2.3.2 Waterline And Access Road Improvements

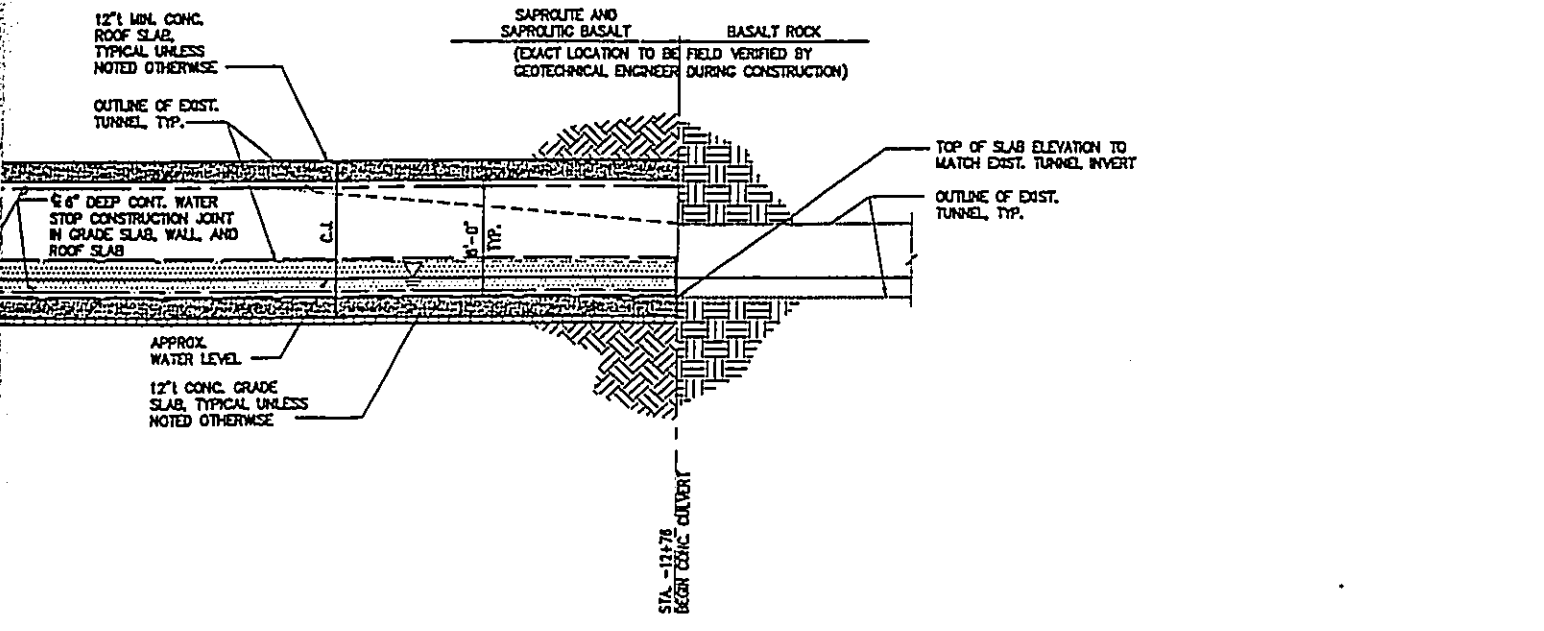
A new 16-inch waterline would be constructed to transport water from the tunnel to the existing waterline located along the cane haul road. This new waterline would begin at Portal No. 3 and be routed along the dirt access road. At this access road's intersection with the cane haul road, another segment of this waterline would be routed along the cane haul road before connecting back to the existing waterline. Figure 2.2 (Site Plan) previously showed the location of this new waterline.


The access road would be improved to a width of 12-feet, and would be paved with asphalt. Other minor improvements would include a vehicle turnaround area at the top near Portal No. 3, a concrete retaining wall, and a rip rap and concrete swale.





B SECTION - PORTAL NO. 3
NOT TO SCALE



 CONSULTING ENGINEERS 501 Sumner Street, Suite 502 Honolulu, Hawaii 96817	KOKOLAU TUNNEL ENVIRONMENTAL ASSESMENT PORTALS NO. 2 AND 3 SECTIONS		FIGURE 2.5
	SCALE: AS NOTED	DATE: OCTOBER 1999	

2.3.3 Property Ownership

The Tax Map Key for this project area is the Fourth Division, 3-04-06: portion of 12. The landowner of this property is Grove Farm Company, Inc., and this parcel 12 is 770.00 acres. However, this property is currently leased to Amfac Land Company. There is a current easement along the present Kokolau Tunnel and existing waterline route.

Easements for the new waterline segments and main access road to be improved would be obtained by the Department of Water from the landowner for this project. Consultation with a representative from Grove Farm Company, Inc. indicated that they would appropriately cooperate with the County in providing these easements.

2.3.4 Vehicular Access Into Property

Vehicular access to the Kokolau Tunnel project site will continue to be via the existing privately-owned cane haul road off of Kaunualii Highway. This cane haul road would continue to be privately-owned, thus, access to the project area would continue to be restricted.

From this cane haul road, the existing dirt access road would be paved. This improved access road would serve as the direct vehicular access to the tunnel near Portals No. 2 and 3. The existing dirt access road from Portal No.2 and 3 leading north (mauka) to Portals No. 1 and 1A would remain as is.

2.3.5 Development Schedule And Estimated Costs

The Department of Water plans to initiate construction of this project next year (year 2000). Construction bids are planned to be solicited in January or February with awarding of the construction project planned to occur in February. It is estimated that construction of this project should be completed within one year. Thus, the improvements should be completed in late 2000 or early 2001. The estimated construction cost for this project is \$1.1 million.

2.3.6 Listing Of Required Permits

There are no discretionary land use approvals required from the State or County such as a zone change, State land use district boundary amendment, or Special Management Area Use permit for the proposed project.

The following ministerial permits listed would be required for this water system improvement project.

1. NPDES Permit (State of Hawaii, Department of Health)

2. Well Completion Report (State of Hawaii, Commission of Water Resource Management, DLNR).
3. Grading Permit (County of Kauai, Public Works Department) Note: An exemption from this permit would likely be pursued as applicable under County Ordinance.
4. Building Permit if necessary (County of Kauai, Public Works Department).

2.4 NEED FOR PROJECT

Structural and sedimentation problems have resulted in Kokolau Tunnel being removed from service. These problems have created the need for the improvements proposed under this project which involve the renovation of this tunnel water system. A summary of these problems is provided below along with greater discussion of problem areas.

1. Weathering and water flow during storm periods are causing the partial collapse and deterioration of tunnel portal entrances to the point of nearly blocking these entrances.
2. Tunnel roof and the areas of this tunnel adjacent to the portal entrances are partially collapsed due to heavy soil development in these areas.
3. The clinker zone within the tunnel will need to be supported most notably in the areas of high water flow.
4. The total collapse of the tunnel may overload the reinforced concrete pipe in the tunnel causing a blockage of the pipe along with access to and repair of the pipe.
5. Red clay is present adhering to the tunnel walls at areas in contact with the water flowing through the tunnel. This condition would allow this clay to be carried into the water supply system.
6. During heavy rain, water from a nearby stream may carry sediment into the tunnel system through Portal No. 1 and possibly Portal No. 1A increasing sedimentation problems.
7. Fill material located at portal entrances and at the base of the tunnel are contributing to the sedimentation problem associated with this tunnel.

2.4.1 Collapsed Zones Of Tunnel

Several collapsed zones are present within the tunnel system, and these areas have several characteristics in common. The thickness of the overburden in these areas is generally low (approximately 7 to 20 feet). The material in the upper portion of the tunnel at these locations varies from heavily weathered saprolite to saprolite that has weathered completely to form a clayey silt. Figure 2.6 graphically shows these collapsed areas along with other geotechnically weak zones.

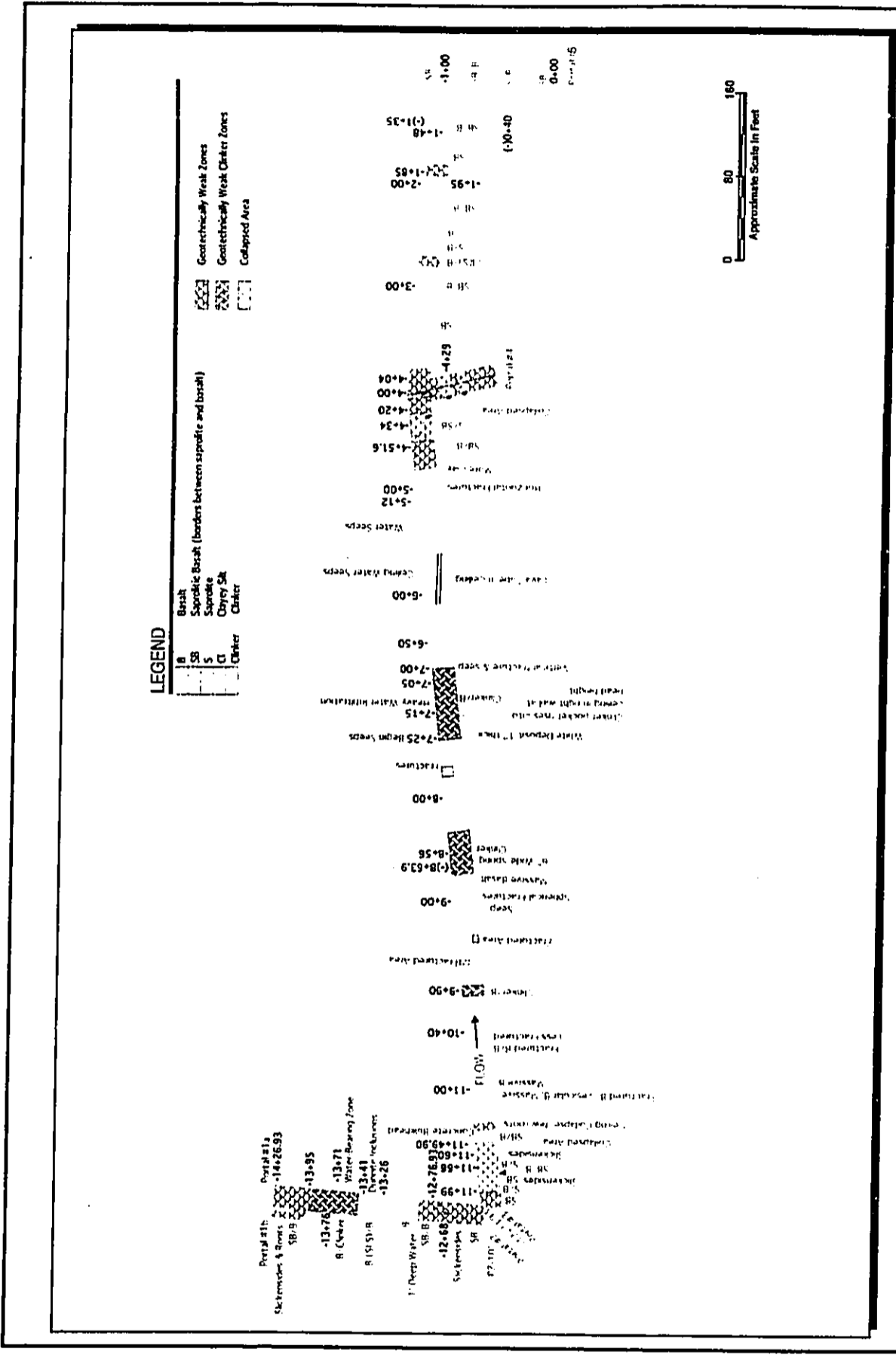


Figure 2.6

KOKOLAU TUNNEL AREAS OF CONCERN



Source: Masa Fujioka & Associates

County of Kauai, Department of Water
Improvements To Kokolau Tunnel And Pipeline

Heavy root growth is also generally present in these areas. The roots may provide a pathway for infiltration from precipitation and add to the instability of the zone. In the collapsed portions, several feet of overburden above the original ceiling (up to about 6 feet) have collapsed falling to the floor. This has created a ceiling that is higher than the original tunnel and a resulting floor higher than original. In these areas, water is generally directed through a concrete Hume reinforced concrete pipe resulting in uninterrupted water flow.

2.4.2 Collapsing Of Tunnel Portals

At the entrances of all portals to the tunnel (total of six entrances), the original basalt has been deeply weathered by natural causes to clayey silt or saprolite. This deep weathering has caused a partial collapse of the tunnel roof and sides of all entrances. Within the first 25 to 60 feet of all tunnel entrances, the roof is partially collapsed, slickensides⁴ are present, and numerous tree roots were observed. The tree roots indicate that the ground surface is near the ceiling of the tunnel. Penetration of these roots through the tunnel roof is a partial contributor to the collapse of the roof in these areas.

Portal No. 1 is located close to an intermittent stream which is a tributary to Huleia Stream. This tributary stream bed and the base of this portal are approximately the same level. These conditions could possibly allow for stream water to flow into the tunnel through this portal during periods of high water if not blocked. Currently, sand bags are located at this portal entrance. The base of Portal 1A is located several feet higher than this tributary stream bed, but it may also be subject to flows of stream water. Exposed surface conditions at Portals No. 1 and 1A consist of basaltic rock, unweathered saprolite, and partly weathered saprolite. Debris that included boulders and roots were also observed at the bottom of Portals No. 1 and 1A.

Exposed surface soil conditions at Portals No. 2 and 3 consist of saprolite that has weathered to clayey silt. The surface soils at these entrances fall apart under slight disturbances of the materials. Heavy roots were also noted at these locations. Heterogeneous fills including cobbles and decayed vegetation were observed in the bases of Portals No. 2 and 3. The fill in these locations appeared to be soft, and had a thickness about 1.5 feet or more. About 3 to 5 feet of stockpiled materials were also observed outside of these portals.

Saprolite and reddish brown clayey site were observed on the surface at Portal No. 4. The base of this portal also contains some debris including roots and boulders. Exposed surface soil conditions at Portal No. 5 consist of clayey silt.

⁴ Slickenside: A polished and striated rock surface that results from friction along a fault plane.

2.4.3 Sedimentation And Clinker Zone Concerns

Sedimentation was also observed at the base along most of the tunnel structure. Sediments deposited in the base of the tunnel had been cleared from one side and deposited to the other side to maintain water flow during low water flow. This clearing likely occurred in the past as part of maintenance work for the tunnel. Heterogeneous fills were observed at most of the portals. These fills consist of boulders and soils that have fallen from the ceiling of the tunnel, decomposed vegetation, gravel, sand, and silt.

Most interior portions of the tunnel are marked by fractured to massive basalt, but it also contains clinker zones that are the most copious water producing areas. The basalt is hard and very stable except for the clinker areas where the clinkers are loose and can be easily extracted. The massive basalt sections of the tunnel appear to be very stable with little or no weathering or deterioration. Conversely, the clinker zone is less stable with numerous clinkers having fallen out leaving parts of these zones with little support.

2.5 PROJECT OBJECTIVES

Due to the various problems and concerns associated with the Kokolau Tunnel, the use of this water for domestic service has been stopped by the Department of Water. The County's project objective is to restore use of water supplied by this tunnel system to help meet existing and future demands for potable water service from their Lihue Water System.

As a result, the Department of Water is proposing the improvements described under this project to renovate the tunnel and allow for the water to be restored into service. This project would also secure tunnel entrances making it easier and safer for periodic inspection and maintenance by Department of Water staff.

2.6 ALTERNATIVES CONSIDERED

Alternatives to the proposed improvements of the Kokolau Tunnel consist of: 1) performing no improvements to the tunnel (No Action Alternative), and 2) creating new wells in the area to replace the water source from the Kokolau Tunnel.

2.6.1 No Action Alternative

This alternative would consist of leaving the Kokolau Tunnel as is. Consequently, no improvements to the tunnel structure would be performed. Under this alternative, the water source presently flowing through this tunnel would continue to not be utilized in the County's Lihue Water System.

Due to structural problems with the tunnel, it is likely that further collapsing of the tunnel segments around portal areas would result over time. These conditions would make it difficult and unsafe for Department of Water staff to enter the tunnel or conduct future maintenance or improvements to the tunnel. As a result, it is probable that this water source would need to be partially abandoned, or significantly higher construction costs would be needed in the future for renovation due to further deterioration of the tunnel system. This alternative was therefore eliminated from further consideration because it would not effectively meet the County's objective of renovating this water tunnel to restore use of its water source for domestic service.

2.6.2 Well Development Alternative

This alternative would involve constructing another well to provide water source for the Lihue Water System thereby replacing the water source from the Kokolau Tunnel. Other exploratory wells have been pursued in the Lihue district, however, the water flows from these sites in some cases were not adequate to provide a suitable water supply. Drilling exploratory wells have also been very costly, and involve much fiscal risk since these efforts cannot assure beneficial results leading to a viable well.

Other cost factors also make this alternative less desirable for the County. A new well established would require pumps and electrical facilities to operate the well facilities, whereas, the existing tunnel is a gravity source which does not require pumping. Extending utility service to a new pump site along with the costs for constructing the new facility would also be considerable. Other cost items include land acquisition and construction new waterlines to connect the well to the existing water system.

Consequently, this alternative was eliminated from further consideration because it would not allow the County to achieve their project objectives. The costs and risks involved in pursuing a new well also makes this alternative less cost effective than renovating the existing Kokolau Tunnel. In addition, the Kokolau Tunnel already has waterlines established connecting this water source to the County's system.

CHAPTER 3 AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

This chapter describes the existing surrounding environment in the vicinity of the project site. The probable environmental impacts associated with the construction and operation of the water system improvements are discussed, and mitigative measures are identified if necessary.

3.1 PHYSICAL ENVIRONMENT

This section describes the existing physical environment and resources present in the vicinity of the project site.

Climate

The island of Kauai has a total land area of about 553.3 square miles, and is the fourth largest island in the Hawaiian chain. The climate of this island is predominantly mild and equitable throughout the entire year. This climate is due to the island's location on the northern fringe of the tropics within the belt of cooling northeasterly trade winds (CWRM 1990). The humidity on Kauai is generally within the 60 to 80 percent range with average relative humidity varying from 74.0 to 77.5 percent (Department of Geography 1998).

The climate in the Puhi community is similar to that of the general Lihue district which is predominantly warm with moderate rainfall. The average annual daily temperatures in this area range between 62 and 85 degrees Fahrenheit with an average annual temperature of 75.6 degrees. The average annual rainfall recorded at a station in Puhi is about 63 inches with most rainfall normally occurring during the winter months (NOAA 1999).

The predominate surface wind occurring in the Lihue district is the prevailing trade winds from the northeast direction which usually dominate from April to November. Winds from the south are infrequent occurring only a few days a year and mostly in the winter associated with "Kona" storms. Wind speeds in this district is generally in the 13 to 24 miles per hour range (Department of Geography 1983).

3.1.1 Topography And Soils

Topography

The Kokolau Tunnel generally runs between the high points of two fairly steep sloping mountain ridges. This tunnel extends from one ridge point a short distance up to another ridge

point. The natural elevation of this ridge ranges from a low of about 320 feet mean sea level (MSL) to a high of about 415 feet MSL. The figure showing the General Site Plan of this project provided an indication of the elevation and topography of this tunnel and overall project area.

The present dirt access road is routed up one side of a ridge from the existing cane haul road following the ridges contour as shown on previous figures. The elevation of road begins at about 300 feet MSL up to about 320 feet MSL near tunnel Portals No. 2 and 3.

Soils

The island of Kauai consists of a single great shield volcano that is deeply eroded and partly veneered with much later volcanics. The bedrock beneath the project site has been regionally mapped as Koloa Volcanic Series basalts. Kilohana and older Koloa lavas, cinder and tuff cones, ash beds, and associated sedimentary deposits of the Pleistocene Koloa Volcanic Series filled an ancient valley floor. Aa and Pahoehoe flows of basalt flowed over highly weathered rocks of the Pliocene Waimea Canyon Volcanic Series.

Based upon the U.S. Department of Agriculture, Soil Conservation Service's (SCS) *Soil Survey of Islands of Kauai, Oahu, Maui, Molokai, and Lanai, State of Hawaii*, the soils in the project area belong to the Kapaa-Pooku-Halii-Makapali series soils. Typically found on uplands, these soils are generally deep, moderately well to well drained, and have a fine textured or moderately fine textured subsoil (SCS 1972).

The SCS's soil maps for the project area indicate that the following soil types are present near the Kokolau Tunnel and access road: 1) Kapaa silty clay, 8 to 15 percent slopes (KkC) and 15 to 25 percent slopes (KkD), and 2) Rough Broken Land (rRR). The Rough Broken Land (rRR) consists of very step land broken by numerous intermittent drainage channels. These soils are variable, and are 20 to more than 60 inches deep over soft weathered rock. In most places it is not stony, and occurs in gulches and on mountainsides. The slope is usually 40 to 70 percent, runoff is rapid, and geologic erosion is active (SCS 1972).

The Kapaa Series consists of well-drained soils on uplands. These soils developed in material weathered from basic igneous rock, and are present on broad ridges and uplands. In a representative profile, this surface layer is dark yellowish-brown silty clay about 14 inches thick. The subsoil was yellowish-red and reddish-brown silty clay which had a subangular blocky structure. The Kapaa silty clay, 8 to 15 percent slopes (KkC), has slow to medium runoff, and the erosion hazard is slight to moderate. The Kapaa silt clay, 15 to 25 percent slopes (KkD) has medium runoff and moderate erosion hazard (SCS 1972).

Probable Impacts From Construction Activity And Mitigative Measures

Construction of the project would inevitably result in some land disturbing activities contributing to some soil erosion. Such activities affecting the tunnel portals would involve minor grading and backfilling to widen entrances and allow for concrete roofs and floorings to be installed. Soft material and loose fills below the portals would also be excavated to firm the ground before concrete slabs are provided. Installation of the new waterline would involve trenching along the access road and existing cane haul road to connect with the current waterline. Minor excavation would occur along the existing dirt access road to allow for concrete swales and rip rap swales to be constructed along this road prior to its paving with asphalt.

These construction activities would improve the structure of tunnel portal areas, and is intended to reduce sedimentation and structural problems. Landscaping is also planned around tunnel portals to restore vegetation in the area and further help minimize erosion. Reducing current structural and sedimentation problems would subsequently improve the quality of the water allowing for its reuse in the Lihue Water System.

Soil erosion from construction activities on surrounding areas should not result in a significant impact on the surrounding environment. The surrounding area of the Kokolau Tunnel and waterline consist predominantly of undeveloped land, sugar cane crops, and fallow agricultural fields. Grading and excavation activities would also be somewhat minor due to the nature of this project thereby reducing soil erosion impacts. As a result, an erosion control plan is presently not being incorporated into the project's design. However, the contractor would be required to implement measures to minimize erosion. Such measures would include the use of silt fencing, and other measures would be determined as necessary.

Other typical short-term impacts associated with construction-related activities are not expected to have a significant impact on the surrounding environment. Such impacts typically involve dust, noise, and traffic disturbances along surrounding roadways. Due to the location of this project site being situated within an undeveloped area, construction noise should not have an impact on noise sensitive resources such as schools and residences. Fugitive dust is expected to be minimal because construction activities would involve relatively minor grading and excavation activities, and there are no urbanized areas in the immediate vicinity of the project that could be negatively impacted.

Finally, traffic disturbances on surrounding roadways should be minimal since this project would not require a large number of construction workers contributing to increased traffic congestion during peak hours. Some construction equipment (ex. backhoe, bulldozer, etc.)

would be required, however, the transport of these equipment are not expected to significantly affect traffic. To minimize traffic congestion, their transport to and from the site could be conducted during non-peak hour periods.

Construction activities would need to comply with pertinent Administrative Rules of the State Department of Health such as Title 11, Chapter 46 (Community Noise Control), and Chapter 60 (Air Pollution Control). However, these construction activities are expected to easily comply with these regulations.

3.1.2 Natural Hazards

This section addresses only those natural and urban-related hazards applicable to the project site. Of the potential natural hazards, only earthquakes, hurricane, and flooding hazards are applicable to the Kokolau Tunnel and waterline project site. These natural hazards are addressed below. There are no other potential urban-related hazards applicable to the project site such as airport clear zones, nuisances, or other industrial waste or hazards issues.

Earthquake Hazards

Although difficult to predict, an earthquake of sufficient magnitude causing structural or other property damage to the project may occur in the future. However, except for the island of Hawaii, the Hawaiian Islands are not situated in a highly seismic area subject to numerous earthquakes (Macdonald et al. 1983). Most of the earthquakes that have occurred were volcanic earthquakes causing little or no damage. Moreover, the seismic risk classification of the island of Kauai is generally low with a rating of Zone 1.

Earthquakes in the Hawaiian Islands are primarily associated with volcanic eruptions resulting from the inflation or shrinkage of magma reservoirs beneath which shift segments of the volcano (Macdonald et al. 1983). Oahu is periodically subject to episodes of seismic activity of varying intensity. Available historical data indicates that the number of major earthquakes occurring on Kauai have generally been less and of lower magnitude compared with other islands such as Hawaii (DBEDT 1998, Furumoto, et al. 1973). However, earthquakes cannot be predicted with any degree of certainty or avoided, and an earthquake of sufficient magnitude (greater than 5 on the Richter Scale) may cause damage to the tunnel structure, waterlines, and other accessory structures.

Although the possibility of earthquakes on Kauai have been lower than other islands, potential damage to constructed structures and waterlines may occur from an earthquake of sufficient magnitude. However, damages to these structures will be minimized by following appropriate County water system standards. Improvements to the access road would similarly

comply with Hawaii standard specifications and design requirements for roads and public works construction. Thus, the risk of potential damage to these tunnel and waterline improvements proposed will not be more than other existing land uses or infrastructure facilities in the Lihue district and island of Kauai.

Hurricane Hazards

The three major elements of a hurricane making it hazardous are: 1) strong winds and gusts, 2) large waves and storm surge, and 3) heavy rainfall (FEMA 1993). Of these three, the Kokolau Tunnel project area could only be affected by strong winds and heavy rainfall. The site's location is well inland away from the shoreline and relative high (about 300 feet msl) in elevation making impacts from large waves and storm surge extremely unlikely. Impacts associated with heavy rainfall are addressed later under flooding.

A hazard mitigation report prepared by the Federal Emergency Management Agency after Hurricane Iniki in 1992 determined that nine hurricanes approached within 300 nautical miles (about one day's travel time) of the Hawaiian Island's coastlines between 1970 and 1992 (FEMA 1993). Most hurricanes affecting the islands have focused on Kauai. Based upon a tracking of hurricanes since 1950, there appears to be no geographical or meteorological reasons why hurricanes miss the other islands but tend to steer toward Kauai (FEMA 1993).

A hurricane of significant strength and high winds passing close to the island could cause structural damages to the Kokolau Tunnel. However, the potential for damages to this tunnel would be far less than that for residences and buildings in other urbanized areas of the Lihue district. The tunnel structure is underground, and tunnel portals would be improved with concrete structures and metal doors which are less susceptible to damage than other urban structures. The new waterline installed would also be underground and not susceptible to damage from high winds.

To minimize potential damages, the tunnel portals, access road, and waterline improvements would be designed and constructed in conformance to applicable County building codes and standards. Thus, the risk of potential damage from high winds should not be more than for other existing water system developments in the Lihue district and island-wide.

3.1.3 Tsunami Inundation And Flooding

A review of the Flood Insurance Rate Map (Community Panel Number 150002 0185C, dated March 1987) for the Puhi area determined that the Kokolau Tunnel project area is located in Zone X. This zone represents areas determined to be outside the 500-year flood plain.

As a result, the project site is not situated in an area which has been subject to inundation by a tsunami or a 100-year flood. Nor have surrounding areas in the immediate vicinity been subject to these hazards. The tunnel site is located on a fairly steep mountain ridge at an elevation of about 300 feet msl, thus, flooding of the area near this tunnel would not likely occur.

An intermittent tributary stream to the Huleia Stream (perennial) is located near Portals No. 1 and 1A of the Kokolau Tunnel. During periods of heavy rain, surface water runoff from this tributary stream overflows to the surrounding area and would enter Portals No. 1 and possibly 1A. To mitigate this existing condition, Portal 1 would be improved and sealed with a metal door to keep water from this tributary out of the tunnel. Portal No. 1A would be permanently closed to also keep water overflowing the tributary stream from entering the tunnel. These improvements to the tunnel portals should not have a significant impact on occasions when water overflows the tributary stream.

3.1.4 Air Quality

The project's potential impact on air quality in the surrounding vicinity would be limited to short-term impacts associated with construction activity. There would be no long-term impacts on air quality since this water system improvement project would not generate air pollutants and would not increase traffic and resulting carbon monoxide pollutants.

Short-term construction impacts would be associated with fugitive dust emissions from soil excavation and grading activities. The amount of fugitive dust emitted is difficult to quantify, but is expected to be minimal due to the types of improvements proposed. Grading activities would only occur in small areas near tunnel entrances, and excavation activities would predominantly be for the installation of the new waterline along the access road and cane haul road.

State air pollution controls prohibit visible emissions of fugitive dust from construction activities at the property line. Construction activities for this project should not result in visible emissions at the property line since these activities are not expected to generate significant amounts of fugitive dust. Since this project site is located in an undeveloped area surrounded by agricultural land, fugitive dust emitted would not affect urbanized areas located considerable distances away.

As a result, a dust control plan would not be necessary for this project since construction activities are expected to adequately comply with State air pollution controls. However, some measures which may be considered to minimize fugitive dust could consist of establishing a frequent watering program of affected areas, limiting areas which are disturbed at any given

time, and appropriately timing landscaping activities early in the construction schedule to control dust.

3.1.5 Noise

The project's impact on the acoustical environment in the surrounding vicinity would be limited to short-term impacts associated with construction activity. There would be no long-term impacts on the acoustical environment since this project simply involves improvements proposed for the County's water system, and there are no sensitive land uses in the immediate vicinity such as schools, hospitals, or residences. The nearest residences are located in the town of Puhi about two miles away.

Construction activities would inevitably generate some amount of noise, however, these noise levels are not expected to be significant and would be relatively short-term. The actual noise levels generated would be dependent upon the construction methods and equipment employed. If necessary, earthmoving equipment, such as a backhoe and diesel powered trucks, would probably be the noisiest equipment used during construction.

Under the State Department of Health's Community Noise Control regulations (Title 11, Chapter 46, HAR), the maximum permissible sound levels for construction activities in Class C (agriculture) zoned districts is 70 dBA during both daytime (7:00 a.m. to 10:00 p.m.) and nighttime hours. These construction activities are not expected to exceed the State Department of Health's allowable property line noise limits because the property on which the tunnel is located is quite large. If necessary, a permit would be obtained from this department to allow these activities. Specific permit restrictions for construction activities are:

- No permit shall allow construction activities creating excessive noise before 7:00 a.m. and after 6:00 p.m. of the same day.
- No permit shall allow construction activities that create excessive noise before 9:00 a.m. and after 6:00 p.m. on Saturdays.
- No permit shall allow construction activities which exceed the allowable noise levels on Sundays and on holidays.

3.1.6 Visual Resources

The proposed improvements to the Kokolau Tunnel and new waterline are not expected to have an impact on existing visual resources in the surrounding area. There are no existing viewing points for the public in the vicinity of the project since it is located on a mountain ridge within undeveloped area surrounded by fallow agricultural land. The property is privately-owned, thus, public access is restricted.

Tunnel improvements would be limited to portal entrances and areas within the tunnel. Consequently, there would be no new buildings or tall structures constructed that would alter existing views of the surrounding area from Kaumualii Highway or other major roadways. Waterline improvements would similarly be located underground, and thus not have any impact on views of the surrounding area.

3.1.7 Hydrogeological Resources

There are several types of general groundwater bodies on Kauai which are fresh basal water, brackish basal water, dike-confined water, and perched water. The most extensive is the basal freshwater lens that floats on sea water under much of the island. Caprock sources are also found on the island. Less widespread is dike-confined water, or "dikes", which are groundwater restrained between impermeable vertical rock structures. Another type is perched water which is groundwater held up, or "perched," on horizontal impermeable beds such as volcanic ash (CWRM 1990).

Aquifer systems in the State of Hawaii have been classified into various hydrological units. The Kokolau Tunnel is located in the Hanamaulu Aquifer System of the Lihue Aquifer Sector, and is assigned an Aquifer Code of 20102. Within this aquifer system, the principal groundwater resources on which the Kokolau Tunnel is situated were identified to be fresh basal water and perched water.

Kokolau Tunnel Hydrogeology

The Lihue Aquifer Sector consists of one aquifer system that is fully saturated to the surface in much of the aquifer basin. This condition exists because of the low permeability of the Koloa Volcanics. Streams drain and control much of the upper part of the basin, and play an important part in shaping the water table in the southern portion of this Lihue Basin. Because of the low regional horizontal hydraulic conductivity and high influx of water in the southern portion of the Lihue Basin, rocks will become completely saturated nearly to the surface, and the variably saturated/unsaturated condition is unlikely to develop (MFA 1999).

The hydraulic gradient of groundwater at the project site is presumed to be east to southeast (toward the ocean). The project site is also located above the Underground Injection Control (UIC) line. The major water-bearing zones within the Kokolau tunnel system are found in clinker zones. These water-bearing zones are graphically shown on Figure 3.1. The "waterfall" area of the tunnels is the major source of water supply for this system, and is located within a clinker zone. (MFA 1999)

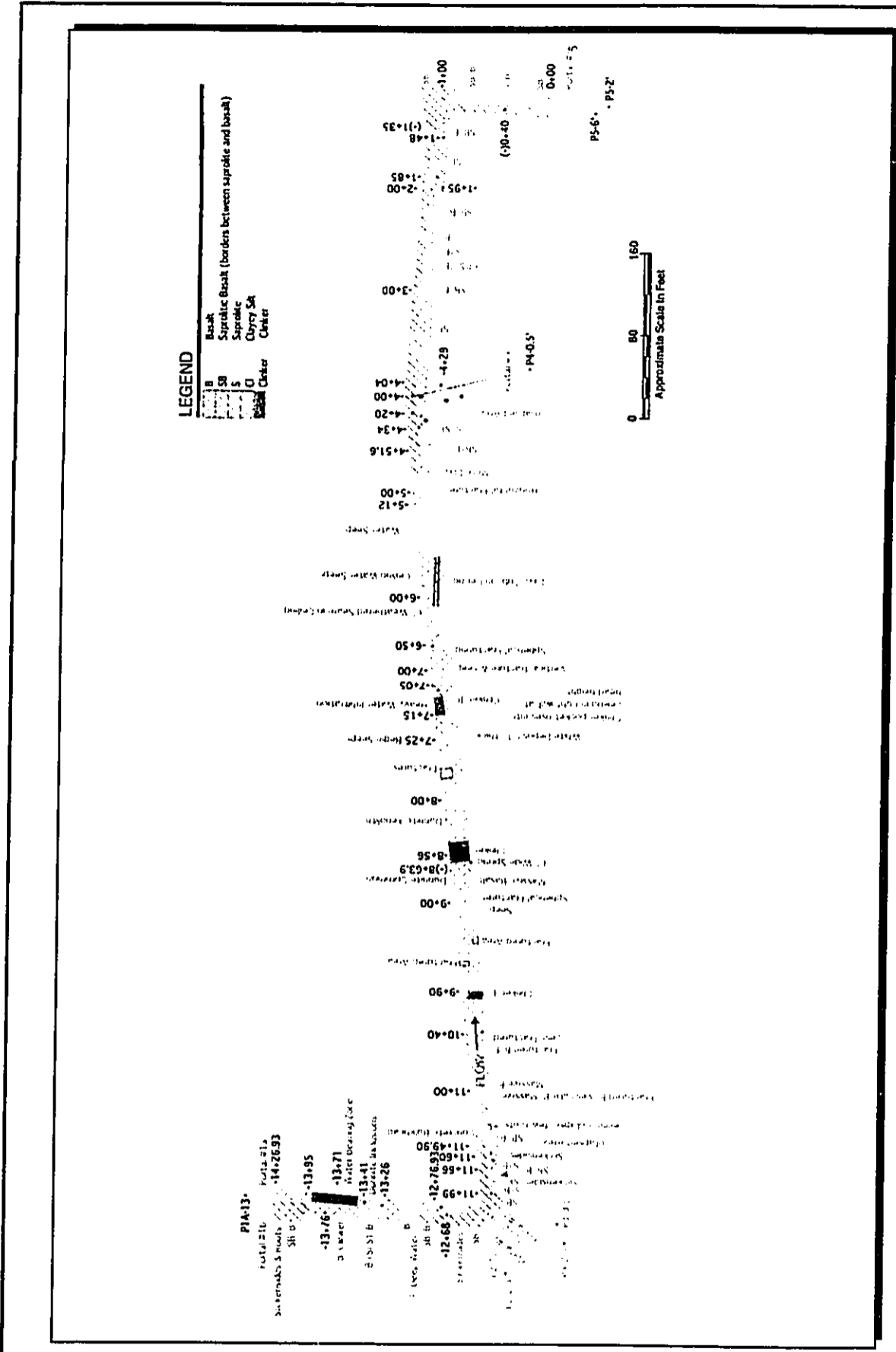


Figure 3.1



Source: Masa Fujioka & Associates

KOKOLAU TUNNEL SITE PLAN

County of Kauai, Department of Water
Improvements TO Kokolau Tunnel And Pipeline

The majority of the water in this zone is infiltrating from the top half of the tunnel located on the northwestern side of the tunnel. A small, six-inch-wide spring is located at the base of the tunnel on the southeastern wall as previously shown on Figure 3.1. Several other water-bearing zones and seeps of apparently lesser magnitude generally occur in areas of fractured Koloa basalt as shown on this figure (MFA 1999).

The total yield of the Kokolau development was reported at 700,000 gallons per day. County Department of Water records for 1981 through 1993 indicated yields of 500,000 to 720,000 gpd. Up to 600,000 gallons of the daily yield is attributed to the largest spring (waterfall area of tunnel). Based upon reports prepared on the water quality, it also appears that the tested groundwater quality is good with all constituents and concentrations being below Federal and State maximum contamination levels.

Probable Impacts And Mitigative Measures

The renovation of the Kokolau Tunnel will not increase the amount of water currently produced by this tunnel complex. There would also be no effect on nearby streams. Proposed improvements are not expected to have a significant negative impact on present groundwater resources of the aquifer system or the hydrogeology of the tunnel. The structural improvements proposed are intended to renovate the tunnel to prevent further collapsing, sedimentation problems, and deterioration. These improvements would subsequently improve the water quality allowing for its reuse within the County's Lihue Water System. Thus, the project serves as a form of mitigation to address the existing hydrogeologic problems associated with the tunnel.

3.1.8 Historic And Archaeological Resources

An archaeological assessment was conducted by Cultural Resources Hawaii (CSH). A copy of this report is included in Appendix D of this document. This assessment included: 1) historical research to construct a history of land use and to determine if archaeological sites have been recorded on or near this property, and 2) field inspection of the project area to identify any surface archaeological features and to assess the potential impact to such sites.

Historical Research

Background research of *Mahele* records showed that the lower reaches of the Huleia River, southeast of the project area, was a center of Hawaiian habitation and agriculture. However, no Land Commission Awards or applications were known within about 1.0 mile of the project area. This was indicative of traditional occupation patterns where permanent residences and agricultural activity were relatively dense where the flood plain of the Huleia River was broad.

There was no reference to land use of the Kokolau Tunnel project area other than for pasturage prior to the development of sugarcane infrastructure in the 1860s. During a reconnaissance survey, no surface prehistoric archaeological sites were observed in the Kokolau Tunnel area, and none are believed to likely exist in the immediate vicinity.

Grove Farm Plantation's 3rd Ditch

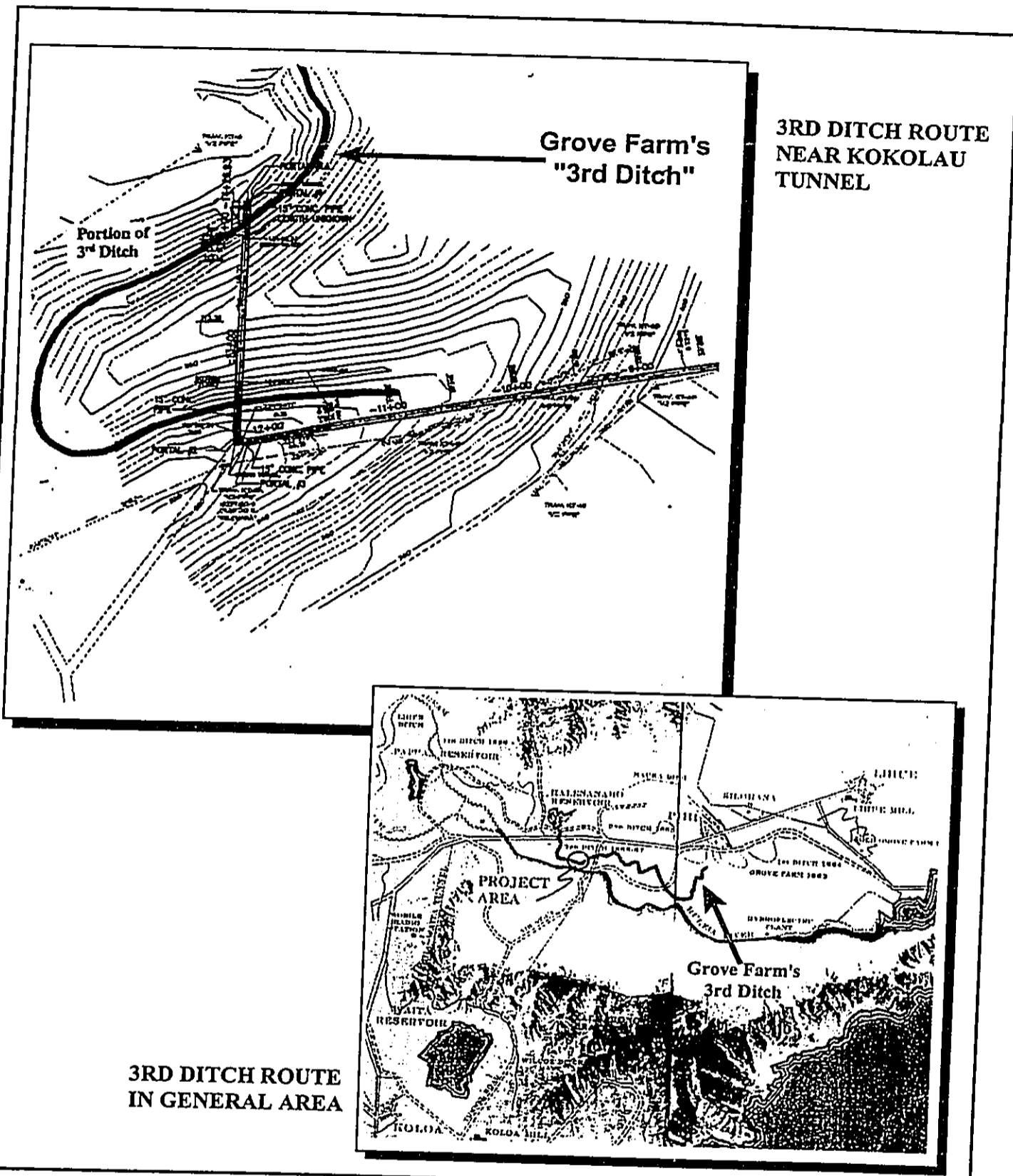
In the mid-1860s, several major irrigation ditch projects were undertaken within the Haiku Ahupuaa by George N. Wilcox for Grove Farm Plantation. Mr. Wilcox was a major figure in Hawaii's history as a sugar planter, philanthropist, and prime minister of the Kingdom of Hawaii. Mr. Wilcox was an irrigation enthusiast, and promoted a number of ditches (1st through 4th Ditch, Lihue Ditch, Mauka Ditch, etc.) as part of the Grove Farm plantation infrastructure.

The "1st Ditch" was developed in 1863, but initially failed to bring water to the fields. With western commerce between Koloa and Lihue increasing during the second half of the 19th century, this irrigation infrastructure was developed further. A "2nd Ditch" was completed in 1865, and a "3rd Ditch" was begun in 1866 and completed in 1867.

This 3rd Ditch overlies portions of the Kokolau Tunnels, and is shown on Figure 3.2. This ditch started at the "Halenanaho" (properly "Halenanahu") Reservoir mauka of Kaunualii Highway, then headed south crossing the highway, and finally ran roughly parallel with the Huleia Stream towards the core Grove Farm fields. This 3rd Ditch has been designated State Site #50-30-11-1563. This 3rd Ditch was extremely important to the development of the sugar industry on Kauai. However, it has lost its historic integrity and has no outstanding engineering or architectural features. No particular importance is accorded to this 3rd Ditch. This Ditch has been inactive for many decades, has been previously cut in many places by erosion and construction activities, and has no chance of being revitalized in its former alignment.

As a result, this site was suggested by CSH to be significant under Significance Criterion⁵ "D" for Historic Preservation since it was likely to yield information important in history only. Furthermore, the archaeological assessment report (Appendix D) prepared was suggested to adequately document this ditch so that it may be declared no longer significant. Therefore, this archaeological assessment study recommended that an assessment of "no longer significant" was applicable for this Grove Farm 3rd Ditch.

⁵ Under the historic preservation compliance process, a significance evaluation is conducted for each site found. These sites must meet one or more of the criterion of the Hawaii and national Registers of Historic Places which range from A to E. Criterion D is applied for sites that have yielded or is likely to yield information important for research on prehistory or history. Nearly all Hawaiian sites contain some important information.



3RD DITCH ROUTE
NEAR KOKOLAU
TUNNEL

3RD DITCH ROUTE
IN GENERAL AREA

GROVE FARM'S "3RD DITCH" ROUTE

Figure 3.2

County of Kauai, Department of Water
Improvements To Kokolau Tunnel And Pipeline

Source: Cultural Surveys Hawaii



Background History Of Kokolau Tunnel

This tunnel was actually excavated between July 25, 1928 and February 29, 1929. This tunnel complex appears to have been known first by the name "Tunnel 9." Another account of this tunnel indicated that it was excavated to intercept the water flowing from springs at an altitude of 300 feet in a tributary to Huleia Stream. The aquifer is lava flows of the Koloa volcanic series, and the water apparently is perched on a red soil.

Conceptually, the Kokolau Tunnel is in fact three tunnels (Tunnel No. 1 through Tunnel No.3) interconnected in the shape of a reverse letter "Z" with a total of 6 entrances (Portals 1, 1A, 2 to 5). The tunnel itself is unremarkable, and is simply bare rock for most of its length. Four of the portals (1, 1A, 2, and 3) are simply holes in ridges.

One portal, Portal No. 4, has a concrete masonry "window-frame" improvement, and an associated water course which appears to be in part man-made. Portal No. 5 is faced with a fairly large entrance of cut "blue-rock" basalt. This Kokolau Tunnel has been designated State Site #50-30-11-1562. Based upon coordination with the State Historic Preservation Division (SHPD), this tunnel complex has been determined to be significant under criterion "C"⁶ as an excellent example of water tunnel site type.

Probable Impacts And Mitigative Measures

Two sites of note were observed in the archaeological/historical review and field inspection of the project site conducted. These sites were State Site 50-30-11-1562, the Kokolau Tunnel system built in 1928-1929, and State Site 50-30-11-1563, the remnants of Grove Farm's 3rd Ditch constructed for the plantation in 1866-1867.

Proposed plans for the renovation of Kokolau Tunnel will adversely impact two to three small sections (30 meter stretches) of the 3rd Ditch as well as change the appearance of portions of the tunnel system. However, no particular importance was accorded to this 3rd Ditch, and it was determined to be no longer significant based upon coordination with SHPD. The rationale for this recommendation in the archaeological study was that: 1) the ditch was mundane without distinctive architectural or historical merit; 2) there were believed to be hundreds of miles of similar former ditch alignments on the island of Kauai, and 3) the Ditch has been inactive for many decades, has been previously cut in many places by erosion and construction activities, and has no chance of being revitalized in its former alignment.

⁶ Criterion C is applied for sites that are an excellent example of a type of site. Examples might be good examples of walled prehistoric fields or good examples of dwelling and canoe houses.

In coordination with the SHPD's architectural staff, it has been determined that this entire tunnel complex is significant under criterion "C" as an excellent example of water tunnel site type. Through consultation with the SHPD, concurrence has been reached that the proposed tunnel improvement plans are appropriate because of concerns for public health and safety, and because the plans proposed will have virtually no adverse impact on the most visually impressive portals constructed.

The SHPD has recommended photo-documentation utilizing HABS/HAER standards (4x5 negatives, 8x10 photographs on fiber based paper, archivally processed) of Portals No. 4 and 5 to further complete mitigation in advance of altering these structures. The SHPD has further requested consultation regarding the specific nature of the closure of Portal No 5 in advance of the closure. The configuration of Portal No. 5 is such that closure with minimal impact to the integrity of the entrance should be quite easily accomplished with present plans.

Appropriate coordination will be conducted between the Kauai County Department of Water and the SHPD prior to actual construction of improvements. This will include performing the recommended photo documentation of Portals No. 4 and 5 prior to construction.

3.2 BIOLOGICAL ENVIRONMENT

This section describes the existing biological environment and riparian resources present in the vicinity of the project site.

3.2.1 Botanical Resources

Vegetation within the project area consists of wild cane grass (*Saccharum spontaneum*), norfolk island pine (*Araucaria excelsa*), hau, (*Hibiscus tiliaceus*), African tulip (*Spathodea campanulata*), guava (*Psidium guajava*), eucalyptus (*Eucalyptus spp.*), and thimbleberry (*Rubus rosifolius*). Sparse stands of ti (*Cordyline fruticosa*) and banana (*Musa sp.*) were noted, and a single hala tree (*Pandanus tectorius*) was said to have been in the area (CSH 1999).

The proposed improvements are not expected to have a significant impact on botanical resources since endangered or threatened plant species are not believed to be present. Renovation of the Kokolau Tunnel would involve the removal of existing vegetation around portal entrances. Removal of this vegetation is needed to enlarge portal entrances and construct concrete structures near these entrances to prevent further collapsing and deterioration of the tunnel. To mitigate this minor impact, a landscaping plan (discussed in Chapter 2) was prepared to address revegetation of portal entrances.

Installation of a new waterline along the existing dirt access road and portion of the cane haul road would involve excavation of some vegetation along these roadways. The amount of vegetation removed should be minor and confined to the narrow paths necessary for installing the waterline, and for improving and paving of the access road. Consequently, these activities should only have a minor impact on existing vegetation in the area and should not disrupt the overall botanical character of the surrounding area.

3.2.2 Avifauna And Fauna

Avifaunal species which may typically inhabit the project site and immediate area would include common species such as the cardinal, dove, Indian mynah bird, and egret. Consultation with the Kauai District of the Division of Forestry and Wildlife, DLNR, indicated that the only possible endangered wildlife species that may be in the area is the Hawaiian Moorhen. This species occupies almost every small stream and drainage in the lower elevations of the island at one time or another, and is quite solitary and opportunistic. Fauna species present in the surrounding area would typically consist of feral dogs and cats, and wild chickens.

Consultation with the Division of Forestry and Wildlife indicated that the scope of the project appears to be low in impact to exposed stream areas, and would likely have minimal if any impact on any Moorhen that may be in the area. Consequently, this department does not believe that there is any likelihood of negative impacts to native, threatened or endangered wildlife due to the improvements planned. Field surveys of the tunnel area on different occasions also found that the tributary stream in this area was either dry or only had small isolated ponds of standing water. Consequently, the presence of the Moorhen at this tributary stream should be low.

3.2.3 Riparian Resources

The Huleia Stream is a major perennial stream located in the Puhī area of the Lihue district. In the area of the project site, this stream generally runs in a southeast direction from Kaumualii Highway towards the ocean. This stream is situated about 1,000 feet south (makai) of the Kokolau Tunnel.

A tributary stream to this Huleia Stream is present in the area of the tunnel. This tributary stream generally begins further north of the project site higher up the mountain, and runs in a southeast direction towards the Kokolau Tunnel before turning southwest away from the tunnel. This tributary approaches fairly close to Portals No. 1 and 1A before turning away. Field surveys conducted of the tunnel on separate occasions by the geotechnical consultant and SSFM observed that this tributary was either dry or had standing water in a small area of the stream. Consequently, this tributary appears to be an intermittent stream.

There are no other riparian resources known to be present in the immediate vicinity of the project site such as wetlands. Proposed improvements will not increase the amount of water currently produced by the tunnel, therefore, there should be no change in nearby stream flows.

Proposed improvements to Kokolau Tunnel and installation of the new waterline section should not have a significant impact on the tributary stream or Huleia Stream. A possible concern raised with the Kauai District's Division of Forestry and Wildlife, DLNR, was the disposition of spoils from excavation activities being washed into the Huleia Stream. It is anticipated that relatively minor amounts of soil erosion and debris removal could occur due to the relatively small areas of grading and excavation likely to occur for portal entrances and waterline installation. As a result, construction activities are not expected to impact the intermittent stream located in the area of the tunnel system nor the Huleia Stream. To minimize impacts, the contractor would be required to implement necessary measures such as silt fencing to contain debris.

3.3 ECONOMIC AND SOCIAL FACTORS

The section discusses the project's probable impact on economic and fiscal factors. Due to the nature of improvements proposed for this water system project, impacts would primarily be associated with construction-related activities.

3.3.1 Economic Factors

The projected construction cost for planned improvements to the Kokolau Tunnel and new waterline extension is estimated to be \$1.1 million. As a result this construction project would create several construction jobs over the anticipated one-year construction period.

Direct construction jobs would typically consist of on-site laborers, tradesmen, mechanical operators, supervisors, etc. These new jobs would generate additional personal income for construction workers. Personal income is defined as the wages paid to the direct construction workers or operational employees associated with a development.

Direct construction jobs generated by the project was estimated based upon the projected construction budget of \$1.1 million. Review of statewide data on construction costs, jobs, and wages during the 1990's indicated construction wages represented about 35 percent of the construction budget. The average annual construction wage for full-time job was estimated to be \$44,950 inflated to 1999 dollars. Consequently, improvements constructed for the Kokolau Tunnel and waterline is projected to generate about eight direct construction jobs over the construction period.

Direct construction jobs created would also stimulate indirect and induced employment within other industries on the island. Indirect and induced employment was estimated using multipliers obtained from the State Department of Business Economic Development and Tourism's (DBEDT) 1992 State input-output study (DBEDT 1997). Using this multiplier, the 8 direct construction jobs generated would stimulate another estimated 10 jobs.

In terms of personal income, the 8 direct construction jobs created would subsequently generate about \$359,600 in new income for workers based upon the \$44,950 average annual wage (in 1999 dollars). Using DBEDT's income multiplier, another approximately \$313,000 in indirect and induced income would also be stimulated in the economy resulting in about \$672,600 of total income generated from the project's construction.

3.3.2 Fiscal Factors

Fiscal impacts were evaluated by estimating the State tax revenue generated by construction of this water project. County revenues are primarily limited to property tax revenues, and thus should have minimal if any change from this project. This project would not generate any new in-migrant residents to the County of Kauai. Thus, there would not be any effect on State and County operational expenditures for public services. As a result, the discussion of impacts are limited to effects on State tax revenues.

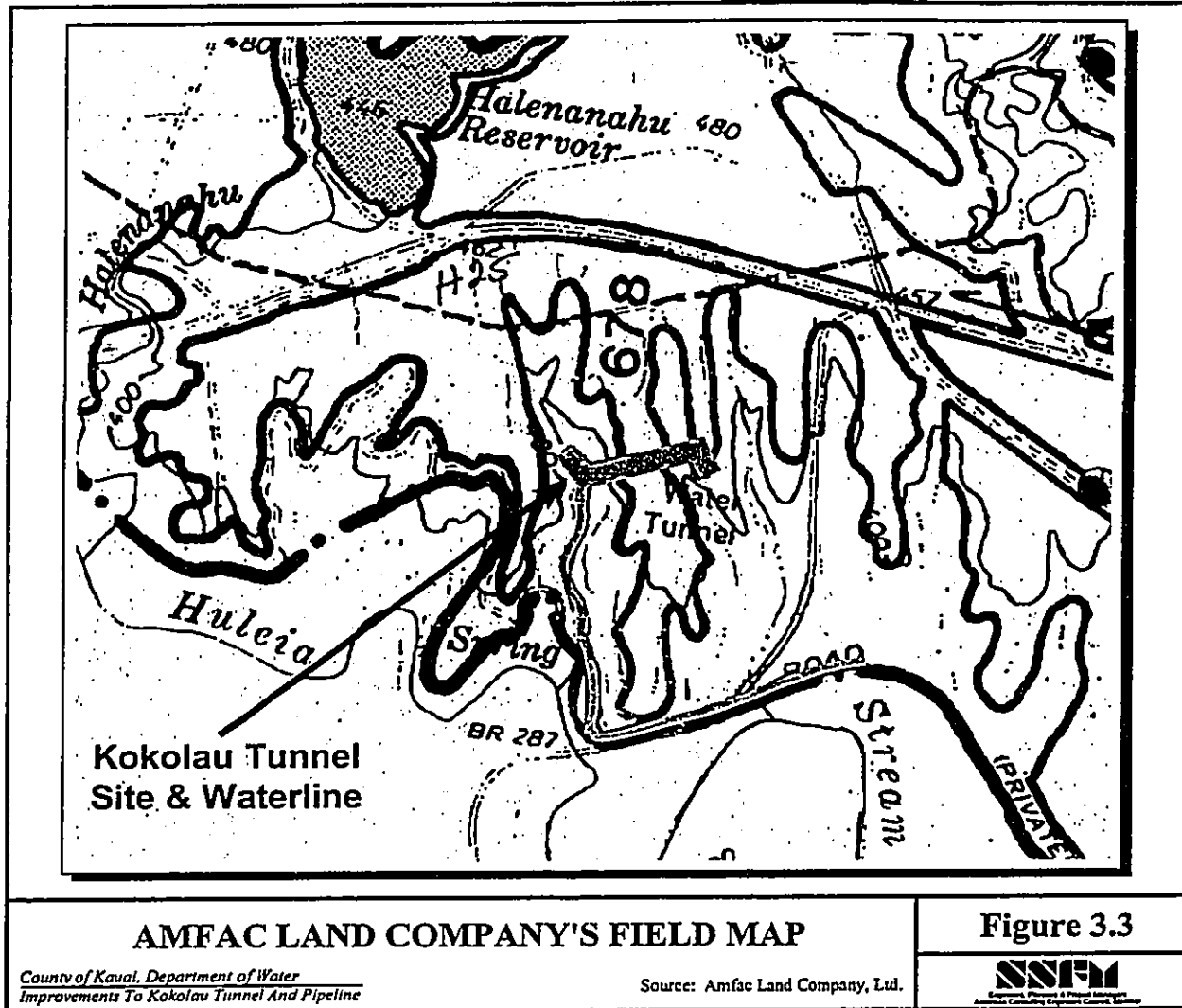
Tax revenue sources for State government would be composed primarily of general excise taxes (GET) on development costs and construction materials, and corporate income tax. In addition, GET taxes on indirect and induced income spent stimulated by the spending of direct income are also included in determining total new revenues to the State.

It was assumed that all construction jobs would be filled with existing residents. A 0.5 percent tax is payable to the State from contractors on all wholesale materials purchased, while an additional 4 percent general excise tax is also payable on the total development costs. Information predominantly from *The State of Hawaii Data Book 1997* (DBEDT 1998), and *Construction in Hawaii 1998* (Bank of Hawaii 1998) were used in estimating State revenues.

Using the planned construction budget of \$1.1 million with wholesale construction material estimated to be about 40 percent of the budget, the total GET revenue generated would be about \$42,000. The GET revenue generated by the spending of direct, indirect, and induced construction income was estimated to be about \$13,100. State income tax from construction wages would generate about \$20,700, and other excise taxes and corporate tax were estimated to generate about \$5,000. Consequently, the total State revenue estimated to be generated from construction of the project in 1999 dollars is \$80,800.

3.3.3 Agricultural Lands

Early consultation efforts were conducted with both Grove Farm Company, Inc. (landowner of surrounding area) and Amfac Land Company, Ltd. (lessee) to identify potential concerns and impacts of the proposed tunnel renovation project on existing sugar cane production or surrounding agricultural lands. It was determined that the Kokolau Tunnel is located under Field No. 678 of Amfac's agricultural land. Figure 3.3 graphically shows this field in relation to the tunnel.



This field generally encompasses the area from Kaunualii Highway south (makai) towards to the tunnel up to the existing cane haul road as shown on Figure 3.3. This field is presently being used for sugar cane cultivation, and discussion with Amfac representatives indicated that this field is planned for harvesting in May 2000.

Present cane haul roads in the area of the Kokolau Tunnel are also currently used by Amfac trucks for sugar cane operations. These cane haul roads include one located east of the tunnel generally routed down the mountain side, and the second cane haul road travelling in an east to west direction at the base of the mountain from the County's dirt access road.

Probable Impacts And Mitigation

The proposed improvements to the Kokolau Tunnel, new waterline, and paving of the County's dirt access road are not expected to result in a significant impact on Amfac's sugar cane harvesting and operations. The Kokolau Tunnel portals are located on steeper areas of the mountain away from flatter land areas used by Amfac for their sugar cane operations.

The segment of the tunnel crossing the sugar cane field is located underground. Thus, improvements to this tunnel section would not affect sugar cane crops or operations. There are also no sugar cane growing in the immediate area of tunnel portals. As a result, construction activities are not expected to result in the destruction of sugar cane crops or unreasonably interfere with harvesting operations.

The installation of new waterline sections and paving of the access road are similarly not expected to result in the destruction of sugar cane crops. Appropriate coordination between the Department of Water and Amfac would occur to prevent construction activities from negatively interfering their sugar cane operations. Such coordination efforts could consist of proper communication and notification as to the planned dates of various phases of construction activity to avoid conflicts and minimize disruptions to sugar cane operations.

In the event that some sugar cane crops do need to be removed due to tunnel renovation or other related improvements, appropriate compensation from the County would have to be provided to Amfac for lost crop. Discussion with an Amfac representative indicated that compensation would need to be determined using the Alexander Grant Formula.

3.3.4 Social Impact Factors

The improvements planned to the Kokolau Tunnel and new waterline are not expected to change the existing resident population in the Puhi community or the Lihue district. This project is a County initiated water system improvement project. There are no new residential units or visitor units associated with this project, and no in-migration of individuals to reside within the County would result. As a result, there should be no impact on the existing resident population.

This water system improvement project would also not change or alter the character of the Puhi community or the character of the more urbanized Lihue district. This project site is located in an undeveloped area surrounded primarily with agricultural land. Consequently, this project would not change agricultural uses in the surrounding area or have a significant impact on surrounding urbanized land uses. Improvements to the Kokolau tunnel would improve this water system, and allow the County to return to utilizing this water system.

3.4 INFRASTRUCTURE FACILITIES

The section discusses the project's probable impact on infrastructure facilities serving the project site and surrounding area. Due to the nature of improvements proposed for this water system project, most of the impacts would be associated with construction-related activities.

3.4.1 Water Supply

The Department of Water has divided the island of Kauai into 13 water service districts which somewhat correspond to existing hydrologic systems. The Kokolau Tunnel is part of the Lihue Water System serving the areas from Hanamaulu to Puhi (CWRM 1990).

Within the Hanamaulu Aquifer System, domestic potable water supplied for the Lihue Water System is comprised of several wells and a few tunnels. Water well sources consist of Kilohana Wells A, B, C, F, G, and I, Puhi Wells 1, 2, and 3, Kalepa Ridge Well, and Old Grammar School Well. The Garlinghouse Tunnel and Kokolau Tunnel make up the tunnel systems within the Hanamaulu Aquifer System (Fukunaga & Associates 1999). The Kokolau Tunnel system is currently not in use due to the existing problems discussed in Chapter 2.

The estimated pump capacity for these water sources, including Kokolau Tunnel, is 6.379 million gallons per day (mgd). In 1996, the domestic potable water consumption supplied by this system was 2.74 mgd (Fukunaga & Associates 1999).

The proposed renovation plans for the Kokolau Tunnel and new waterline section should not have a significant negative impact on the existing Lihue Water System. The improvements planned are intended to renovate the Kokolau Tunnel so that its water source can be restored for domestic use within the Lihue Water System. The improvements would not increase the capacity of water production from this tunnel complex. Restoring this water source would return between 500,000 and 700,000 gpd of water to the County water system. Thus, the project would have a beneficial impact on the County's water system.

3.4.2 Wastewater Treatment

The project site is presently undeveloped of normal urbanized land uses such as residences and businesses, thus, there are no existing wastewater facilities on the site nor are there any wastewater being generated from the project site.

Proposed improvements would not involve the construction of any wastewater facilities, nor would they require the need for any. Therefore, there would continue to be no wastewater generated from the site. As a result, the project would not have an impact on existing county wastewater facilities serving the Puhi community and surrounding area.

3.4.3 Drainage

There is presently no County drainage facilities located at the Kokolau Tunnel and along the dirt access road or cane haul road. Because this general area is absent of urban land uses, drainage facilities have not been provided at the project site and in the immediate vicinity. Surface water runoff in the area subsequently follows the existing natural drainage patterns established by the area's topography. Surface water runoff generally flows in a southern direction down the mountain somewhat following the existing tributary stream.

The renovations planned for the Kokolau Tunnel should not have an impact on existing drainage patterns and runoff volumes because improvements proposed would be concentrated at portal entrances and within the tunnel. The new waterline sections planned to be routed along the dirt access road and cane haul road should not alter current drainage patterns or runoff volumes since it would be located underground. Paving of the existing dirt access road would create an impervious surface, however, this should have minimal change on the overall existing drainage patterns and runoff volumes occurring at the project site.

3.4.4 Solid Waste

The Kokolau Tunnel project site is undeveloped, and the surrounding area is absent of urbanized uses such as residences and businesses. Therefore, there are no solid wastes being generated from this project site or in the immediate area.

Construction of the water system improvements will generate some solid waste typical of normal construction-related activities. The volume of these solid wastes is expected to be minimal due to the nature of improvements planned. Construction-related solid wastes generated will be a short-term impact, and consist primarily of vegetation, rocks, and other debris created from clearing, excavation, and grading activities around the tunnel portals and installation of the new waterline sections. The Department of Water would consult with Grove Farm Company, Inc. to determine the feasibility of disposing this material on the property which encompasses a total of 770 acres. Otherwise, the contractor will be required to properly dispose of all debris generated from the project site due to these activities.

3.4.5 Transportation Facilities

Kaumualii Highway is a State-owned and operated highway providing vehicle access to the Puhi community. This highway is a two-laned undivided roadway in the vicinity of the project site. The nearest County road is Kipu Road which connects with Kaumualii Highway about a half-mile away from the project site, and travels in a southern (makai) direction from the highway.

Access to the Kokolau Tunnel is currently from an existing cane haul road which connects with Kaunualii Highway further west of Kipu Road. Direct access to the tunnel site is from a dirt road leading from this cane haul road. Access to the site is only permitted to County staff for maintenance purposes.

The proposed improvements would include paving this dirt access road used by County personnel. No other improvements are planned to the existing cane haul road, and access to the site would continue to be restricted to County Department of Water staff for periodic inspections and maintenance activities. Consequently, there should be no impacts to traffic along Kaunualii Highway. The project would not generate any additional traffic on this highway during the morning and afternoon peak periods.

3.5 PUBLIC FACILITIES AND UTILITIES

The section discusses the project's probable impact on public facilities and utilities serving the project site and surrounding area. Due to the nature of improvements proposed for this water system project, impacts would primarily be associated with construction-related activities.

3.5.1 Electrical And Communication Facilities

There are currently no electrical or communication facilities serving the Kokolau Tunnel site. Under the proposed improvements, there would continue to be no electrical and communication facilities serving the tunnel and site. As a result, the project should have no impact on electrical or communication facilities serving the Puhi community and Lihue district.

Permanent electrical and communication facilities are not necessary for the Kokolau Tunnel since this tunnel only provides a gravity-flow source of water for the County's water system. Periodic service and maintenance of the tunnel would be performed by Department of Water staff during the day, and would subsequently not require electrical facilities. Similarly, communication between the department and staff conducting inspections of the site can be performed using more cost effective communication equipment such as cellular telephones.

3.5.2 Educational Facilities

Educational facilities in the general vicinity and Lihue district consist of Wilcox Elementary School, Kauai Intermediate and High School, and Kauai Community College. A new intermediate school facility (Kauai Intermediate School) is under construction and is planned to open in the fall of the year 2000. This school site is located across from the Kilohana Wilcox Plantation Estate between the towns of Puhi and Kilohana. When completed, intermediate students (grade 6th to 8th) from Kauai Intermediate and High School would relocate to the new facility providing additional space at the high school.

The only potential impact on these school facilities from the project would be associated with short-term construction-related activities. However, these activities are not expected to have an impact due to the project site's location a considerable distance away from these facilities. Kauai Community College is the closest facility to the project site about two miles away. Furthermore, the limited grading, excavation, and construction work planned are not expected to generate significant noise, fugitive dust, or traffic that may impact these facilities. Consequently, the improvements to the Kokolau Tunnel and waterline should not have any short or long-term impact on these school facilities or the educational activities conducted at these campuses.

3.5.3 Police And Fire Protection

Police and fire protection service of the Puhi area is provided by the Lihue Police Station and Lihue Fire Station both of which are located in the central core of the Lihue business district.

The improvements proposed are not expected to have an impact on the police and fire departments' ability to provide adequate protection services to the Puhi community and Lihue district. Police staff would not be required to direct traffic during construction activities since it would be confined to the Kokolau Tunnel and cane haul road area. Once the project is completed, there would be no persons or business activities occurring at the site which may require the need for police or fire protection services.

3.5.4 Recreational Facilities

There are no recreational facilities located in the immediate vicinity of the Kokolau Tunnel and project area. The nearest recreational facility is Puhi Park located near the Kauai Community College over two miles away from the project site. Consequently, short-term construction activities and long-term use of the tunnel for water production associated with the project should have no impact on recreational facilities.

3.5.5 Medical Facilities

There are no medical facilities located in the immediate vicinity of the Kokolau Tunnel and project area. The nearest major medical facility is the Wilcox Memorial Hospital located in the central business district area of the Lihue district. Consequently, short-term construction activities and long-term use of the tunnel for water production associated with the project should have no impact on medical facilities.

CHAPTER 4 AGENCY CONSULTATION

Consultation with various State and County government agencies, landowners, and elected officials were conducted to obtain their comments and concerns associated with the project. These consultation efforts included the distribution of the Draft EA for this project to various parties for their review. Early consultation efforts during preparation of the Draft EA consisted of correspondence of project information, telephone conversations with appropriate staff or representatives, and follow-up correspondence of items discussed.

4.1 DRAFT EA COMMENTS

The Draft EA was published in the October 23, 1999 issue of the State Office of Environmental Quality Control's *The Environmental Notice* initiating a 30-day public comment period which ended on November 22, 1999. Copies of this Draft EA were distributed to the following parties for review and comments. Those parties which submitted comments are indicated by a "▶" next to them. Comment letters received from these parties along with corresponding response letters are included in Appendix B.

Federal And State Agencies

- ▶ Department of Agriculture
- ▶ Department of Education
- ▶ Department of Health
- ▶ Department of Land and Natural Resources (DLNR)
- ▶ Department of Transportation
- ▶ Land Use Commission, DBEDT
- ▶ Office of Environmental Quality Control, Dept. of Health
- ▶ Office of Hawaiian Affairs
- ▶ Office of Planning, DBEDT
- ▶ State Historic Preservation Division, DLNR
- ▶ U.S. Army Engineer Division, Pacific Ocean

Kauai County Agencies

- ▶ Department of Public Works
- ▶ Planning Department
- ▶ Fire Department

Kauai County Agencies (continued)

Police Department
Transportation Agency

Elected Officials

State Senator, The Senate
State Representative, The House of Representatives
Chair, Kauai County Council

Other Parties & Libraries

Amfac Land Company, Ltd., Kauai Division
Grove Farm Company, Inc.
Lihue Public Library

4.2 EARLY CONSULTATION FOR DRAFT EA

Early consultation efforts during preparation of the Draft EA consisted of correspondence of project information, telephone conversations with appropriate staff or representatives, and follow-up correspondence of items discussed. Comments received from these parties are summarized below with appropriate responses indicated. Copies of response letters received from these parties are included in Appendix B.

4.2.1 Consultation With State Agencies

Clean Water Branch, Department of Health

- *Suggested that the Army Corps of Engineers (COE) should be contacted to identify whether a Federal permit is required for this project.*
- *If a COE Federal permit is required, then a Section 401 Water Quality Certification would be required from their office.*
- *If the project involves discharges into State waters, a NPDES general permit is required for the activity. These discharges involve: 1) storm water runoff associated with construction activities that result in the disturbance of equal to or greater than five acres of total land area; 2) construction dewatering effluent; and 3) hydrotesting effluent.*
- *Their department requires that Notice of Intents for NPDES general permits be submitted 30 days before the discharge is to occur.*

A Federal Permit from the Army Corps of Engineers is not expected for this project at this time, thus, a Section 401 Water Quality Certification would also not be required. A copy of this Draft EA would be provided to the COE during the 30-day Comment Period for their review. Various portions of construction activities planned are likely to require a NPDES general permit due to dewatering. Notice of Intent forms for this activity would be submitted at the appropriate time at least 30 days prior to the discharge.

Commission of Water Resource Management (CWRM), DLNR

- *CWRM staff indicated that a well permit would not be required for the improvements planned to the tunnel. Work proposed would be considered maintenance and repair work, and the improvements would not expand the tunnel or increase the capacity of water flow.*
- *A Well Completion Report would need to be submitted to the CWRM after construction completion. This report would provide the CWRM with information for their files on the existing tunnel and renovation improvements constructed.*
- *No other concerns were expressed associated with the proposed improvements.*

A Well Completion Report with appropriate Plans would be completed and submitted to the Commission of Water Resource Management after tunnel renovations are completed.

Division of Forestry and Wildlife, Kauai District, DLNR

- *They do not believe that there is any likelihood of negative impacts to native, threatened or endangered wildlife due to the improvements planned.*
- *The division does not normally survey such areas as the Kokolau Tunnel site during their semi-annual waterbird censuses. Based upon their staff's knowledge of the area and habitat it provides, the only possible endangered wildlife species that may be in the area is the Hawaiian Moorhen. This species occupies almost every small stream and drainage in the lower elevations of the island at one time or another, and is quite solitary and opportunistic.*
- *The scope of the project appears to be low in impact to exposed stream areas, and would likely have minimal if any impact on any Moorhen which may be in the area.*
- *The only area of possible concern would be the disposition of spoils from excavation activities at portal entrances or access road improvements. However, there should be no problem as long as excavated material is properly placed so that it is not washed into the Huleia Stream.*
- *They are relatively certain that there are no listed endangered plants in the vicinity of the tunnel complex.*

Construction activities are not expected to impact an intermittent stream located in the area of the tunnel system nor the Huleia Stream. Field surveys of the tunnel area on different occasions determined that this tributary stream was either dry or only had small isolated ponds of standing water. Consequently, the presence of the Moorhen at this tributary stream should be low. However, construction activities are not expected to occur near this tributary stream, and should not impact this stream's bed. Quantities of excavated material would be small, and appropriate measures would be taken by the contractor to ensure that this material is not washed into Huleia Stream.

Historic Preservation Division, Kauai District, DLNR

- *The draft archaeological assessment report was reviewed by the Historic Preservation Division, and they concurred with the ditch system was significant for its information on the association with Grove Farm as an early example of an irrigation system.*
- *They also believe it no longer retains its historic integrity as noted in the assessment report and an earlier inventory done of plantation irrigation systems.*
- *Regarding the Kokolau Tunnel, the recommended treating the entire tunnel as one site, and this system is significant under Criterion C.*
- *Construction plans was determined to have no adverse affect to the ditch since its history is well documented, and it no longer retains its identity.*
- *They believe proposed improvements to portions of the tunnel system will have an adverse effect on this site. They concur that Portal No. 5 is the most character defining feature of the tunnel, and concur with its preservation with the addition of a door for safety reasons.*
- *They believe the assessment report alone is not adequate mitigation for the effect on the tunnel. Adequate historic documentation and a map of the tunnel has been done. They also recommend photo-documentation utilizing HABS/HAER standards (4x5 negatives, 8x10 photographs on fiber based paper, archivally processed) of Portals No. 4 and 5 to further complete mitigation. This should be submitted to their office prior to demolition work or addition of the door.*
- *The correct site numbers for the ditch and tunnel were provide to replace the initial numbers mistakenly provided.*

The archaeological assessment report included in this Draft EA has already incorporated the corrected site numbers for the tunnel and ditch. This archaeological report would also be revised to reflect the division's recommended significance criterion for the Kokolau Tunnel.

Appropriate coordination with the Historic Preservation Division would be conducted to provide the necessary photo documentation of Portals No. 4 and 5 to complete their recommended mitigation.

Land Use Commission, DBEDT

- *Responded that the project site is located within the State Land Use Agricultural District.*
- *They had no further comments at this time.*

Their comment that the project site is located within the State Land Use Agricultural District is consistent with our information included in this report.

4.2.2 Consultation With County Agencies

Planning Department

- *The project is located in the Open District zoning, and is designated Agricultural under the State Land Use District Boundary map.*
- *No permits would be required from this department for the improvements planned.*
- *The project site is located outside the County's Special Management Area.*
- *There are many projects in Lihue that are unable to proceed due to water capacity deficiencies. Would the project help to increase the capacity of the Lihue water system to help the Lihue area?*

The Open District zoning along with the Agricultural District classification under the State Land Use District Boundary Map are consistent with the information included in this document. The project would not increase the water capacity associated with the County's Lihue water system. Water from this tunnel system was used for domestic service for many years before it had to be discontinued in 1996 due to the current problems necessitating the improvements proposed under this project. Consequently, this renovation project would allow for this water source to be restored to use within the Lihue water system.

Public Works Department

- *A grading permit is required for activities resulting in more than 100 cubic yards of material.*
- *Public Works Department can issue an exemption from a grading permit for County projects under Ordinance 695. This exemption is subject to:*
 - 1) *Work being conducted within a government controlled area; and*
 - 2) *Work is overseen by a County agency (Department of Water for this project).*

- *The County agency would be responsible for ensuring that appropriate erosion controls measures are implemented by the contractor to minimize erosion and impacts.*
- *A letter from Department of Water to Public Works would be necessary requesting the exemption from a grading permit.*
- *A concern regarding the disposal of material from grading and trenching activities was raised because the disposal method implemented may warrant a grading permit.*
 - 1) *If material is disbursed on the site, then a grading permit would not be needed provided that grading does not alter natural drainage patterns.*
 - 2) *If material greater than 100 cubic yards is disposed of at another site, then a grading permit would be necessary for this particular site receiving the excess material.*

An exemption from a Grading Permit would be pursued by the Department of Water at the appropriate time. Work would be overseen by the Department of Water, and appropriate measures implemented by the contractor to minimize erosion. Material from construction activities should be small, and is intended to be disbursed on the property because it is quite large. Appropriate coordination with Grove Farm Company, Inc. would be conducted to determine a suitable method and location for disbursing this material on the property.

4.2.3 Consultation With Other Parties

Grove Farm Company, Inc.

- *No major concerns were expressed associated with this project.*
- *The representative did want to have an opportunity to inspect the tunnel site and route of the new waterline at a later time when appropriate.*
- *Grove Farm Company, Inc. would work with the Department of Water in establishing needed easements for the new sections of waterline.*
- *Grove Farm Company, Inc. would work with the Department of Water in addressing the possible disposal of trenched or excavated material on the site. This can be determined when more details and finalized construction plans are available.*
- *Grove Farm Company, Inc. would like Amfac Land Company consulted as necessary to ensure that the project does not unreasonably interfere with their operations.*

The Department of Water would arrange for a joint field survey of the tunnel site and waterline route with appropriate representative(s) of Grove Farm Company, Inc. This would be arranged at a later date possibly early next year when construction plans are more

finalized. The Department of Water would appropriately coordinate with Grove Farm Company, Inc. in arranging for obtaining necessary easements, and pursuing the possible disposal of material on the site. Coordination and consultation with Amfac Land Company, Ltd. has been conducted during the preparation of this Draft EA.

Amfac Land Company, Ltd.

- *It is believed the project should have little impact upon the operations of The Lihue Plantation Company, Ltd.*
- *The eastern segment of the new waterline section to be installed would be routed along a section of a main cane haul road that has heavy traffic when they are harvesting cane in the area.*
- *They would like appropriate coordination conducted with their company to minimize the effect of the project's construction activities with their harvesting operations.*
- *If construction activities would result in removal of sugar cane crops, they would be subject to compensation for crop damages determined using the "Alexander Grant" formula.*
- *They were not clear how work on the eastern end of the tunnel would be accessed under this project. If access is from the south, there shouldn't be a conflict with their operations.*
- *If access would be using the cane field roads, the contractor needs to coordinate with plantation personnel. The field is scheduled for harvest in May 2000 and planting soon thereafter, thus, access during those periods would be difficult.*

Appropriate coordination between the Department of Water and Amfac Land Company, Ltd. would occur to prevent construction activities from negatively interfering with their sugar cane operations. Such coordination efforts could consist of proper communication and notification as to the planned dates of various phases of construction activity to avoid conflicts and minimize disruptions to sugar cane operations.

The new section of waterline routed along the cane haul road to connect with the existing water system should not result in unreasonable interference with movements of cane trucks. Access to the tunnels along with most of the major renovation work would occur on the western end of the tunnel utilizing the County's existing access road, so conflicts with cane operations should be minimized. Work on the portals (No. 4 and 5) at the eastern end of the tunnel would be somewhat light, thus, these activities should also not cause significant conflicts with their operations. However, appropriate coordination would

be conducted with Amfac to identify access areas and construction activities to avoid potential conflicts.

Construction activities are not expected to result in the removal of sugar cane crop. However, in the event that some sugar cane crops do need to be removed, appropriate compensation from the County would be provided to Amfac for lost crop.

CHAPTER 5 FINDINGS AND ANTICIPATED DETERMINATION

To determine whether a proposed action may have a significant effect on the environment, the Approving Agency needs to consider every phase of the action, the expected primary and secondary consequences, cumulative effect, and the short- and long-term effects. The Approving Agency's review and evaluation of the proposed action's effect on the environment would result in a determination whether: 1) the action would have a significant effect on the environment, and an Environmental Impact Statement Preparation Notice should be issued, or 2) the action would not have a significant effect warranting a Finding Of No Significant Impact (FONSI).

This chapter discusses the results of the environmental assessment conducted, which included review and comments on the Draft EA, of the proposed improvements to the Kokolau Tunnel in relation to the 13 Significance Criteria prescribed under the State Department of Health's Administrative Rules Title 11, Chapter 200. The purpose of this assessment was to consider the "significance" of potential environmental effects which includes the sum of effects on the quality of the environment along with the overall and cumulative effects. The resulting findings are discussed below for each criteria.

5.1 PRELIMINARY FINDINGS

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

The proposed improvements would not result in the irrevocable commitment to loss or destruction of any natural or cultural resource. As discussed in Chapter 3 of this Draft EA, the improvements are intended to renovate the Kokolau Tunnel to restore its water source to the Lihue Water System. Improvements to the tunnel would be limited to portal entrances, and would thus not destroy this natural resource. Waterline improvements would be located underground along the current access road and cane haul road, and would not cause the irrevocable loss or destruction of existing vegetation.

In terms of archaeology, two sites observed were designated State Site 50-30-11-1562 for the Kokolau Tunnel system, and State Site 50-30-11-1563 for the remnants of Grove Farm's 3rd Ditch. Both of these sites were assessed to be significant under Historic Preservation criterion, and the archaeological report prepared adequately documents these sites which included coordination efforts with Historic Preservation staff.

No particular importance was accorded to this 3rd Ditch, and it was suggested that it be determined to be "no longer significant" as discussed in Chapter 3. It was determined that the tunnel complex was significant under criterion "C" as an excellent example of water tunnel site type. Concurrence with SHPD was reached that the proposed tunnel improvement plans are appropriate because of concerns for public health and safety, and because the plans proposed will have virtually no adverse impact on the most visually impressive portals constructed.

Appropriate coordination will be conducted between the Kauai County Department of Water and the SHPD prior to actual construction of improvements as requested by SHPD. This will include performing the recommended photo documentation of Portals No. 4 and 5 prior to construction. Therefore, the tunnel improvements would not result in the irrevocable commitment to loss or destruction of this archaeological resource.

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

The project would not curtail the range of beneficial uses of the surrounding environment. The Kokolau Tunnel project site had been used by the County as a source of water for domestic use for many years. The improvements would not change this intended use, and would restore use of the water. Installation of the new waterline section would similarly not curtail the use of the area since the waterlines would be located underground. Surrounding areas are undeveloped and would remain as such with the project.

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 improvements proposed under this project would not conflict with the State's long-term environmental policies or goals and guidelines as expressed in Chapter 344, HRS. This Draft EA addressed the probable environmental impacts associated with the project which would be primarily associated with short-term construction activities. Consequently, the project would be consistent in conserving natural resources in the area, especially the tunnel, and enhancing the quality of life for residents on Kauai by restoring an important source of domestic water.

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

As discussed under Chapter 3, section 3, the project would not have any significant negative impacts on the economic structure of the Lihue district or the social welfare of the nearby Puhi community. The project would create a short-term minor economic benefit generating construction jobs and personal income. Improvements planned are limited to

the project site and would restore a source of domestic water supply for the County. As a result, there should be no negative impact or change to the overall character of the Puhi community. Construction activities would not significantly or unreasonably disrupt existing agricultural activities occurring in the area, and existing regulatory requirements should adequately address and mitigate any disturbances.

5. *Substantially affects public health.*

The project is not expected to substantially affect public health since it would involve minor improvements to the County's existing water system. Tunnel improvements would address structural and sedimentation problems occurring which would improve the quality of water from the tunnel.

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

The project should not have any secondary impacts on the social environment or infrastructure and public facilities. The project strictly involves only improvements to the existing Kokolau Tunnel, therefore, there would not be any elements of the project contributing to in-migration of residents or additional visitors to the island. The project area is undeveloped and used for agricultural activities, thus, there are no infrastructure facilities or public facilities in the immediate area. Consequently, the project would not affect such facilities.

7. *Involves a substantial degradation of environmental quality.*

The improvements to the Kokolau Tunnel and new waterline section would not involve a substantial degradation to the quality of the surrounding environment. Improvements to the tunnel would be limited and involve relatively minor changes to the natural environment around portal entrances. A landscaping plan would also be implemented to restore vegetation around portal areas after construction. Waterline installation would be within or along the access road and cane haul road limiting impacts on surrounding vegetation.

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

This project only involves the renovation of the Kokolau Tunnel, installation of a new section of waterline, and paving the existing dirt access road. Impacts associated with these improvements were addressed in this document, and are mainly associated with construction activities. Thus, the cumulative impacts of these improvements were considered in assessing environmental impacts, and it was determined that the project would not have a significant effect on the environment. This project does not involve the

commitment for larger actions since it is only intended to restore the use of water from this tunnel.

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

There are no known endangered, threatened, or rare botanical resources in the project area, or faunal and avifaunal species inhabiting the area. Consultation with DLNR's Division of Forestry and Wildlife, Kauai District, indicated that the Hawaiian Moorhen may be in the area since this species occupies almost every stream and drainage in the lower elevations of the island at one time or another. However, they believe the improvements should not have any negative impacts to native, threatened, or endangered wildlife.

The stream tributary in the area is intermittent, and construction activities should not impact this tributary or the Huleia Stream. Appropriate measures would also be taken to minimize materials and debris from entering these streams. Thus, the project is not expected to substantially affect rare, threatened, or endangered species or potential habitat for such species.

10. *Detrimentially affects air or water quality or ambient noise levels.*

The project should not have a detrimentally significant impact on air, water quality, or ambient noise levels. Impacts associated with these factors would be limited to short-term construction activities. However, such impacts are expected to be minor due to the relatively minor amount of grading and excavation proposed. Because the project site and surrounding area are undeveloped, these construction activities should not negatively impact urbanized areas located further away. To further minimize impacts, construction activities would be subject to applicable State regulations as discussed under Chapter 3.

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 Kokolau Tunnel site is not located within an environmentally sensitive area such as a flood plain, tsunami zone, erosion-prone area or geologically hazardous area. Consequently, the project would not be affected by such hazards or impact such environmentally sensitive areas.

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

The proposed improvements would not affect scenic vistas or viewplanes. The project site and surrounding area are privately-owned, thus, access to the Kokolau Tunnel site is restricted. The improvements would be located underground or within the tunnel, therefore, there would be no effect on visual resources in surrounding areas.

13. *Requires substantial energy consumption.*

The project would not require substantial energy consumption since the water system from the Kokolau Tunnel would be gravity fed. No electrical facilities are present on the site or would be required for this project.

5.2 ANTICIPATED DETERMINATION

Based upon the result of the environmental assessment documented in this Final EA along with comments received during the review of the Draft EA, a Finding of No Significant Impact (FONSI) determination is warranted for the Improvements To Kokolau Tunnel And Pipeline project. The preliminary findings supporting this anticipated determination are based upon the previous discussion of the project's affect on the environment in relation to the 13 Significance Criteria.

CHAPTER 6
BIBLIOGRAPHY

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APPENDICES

APPENDIX A

*Photographs Of Project Site
And Surrounding Area*

PHOTO 1A
West View Along Cane Haul Road

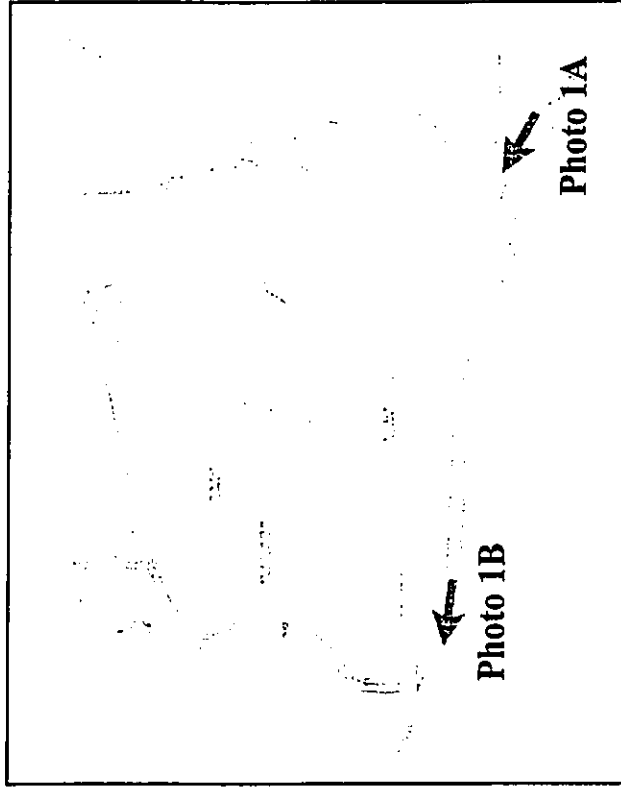


PHOTO 1B
West View Near County Access Road



PHOTOGRAPHS OF PROJECT AREA

Figure A.1

County of Kauai, Department of Water
Improvements to Koloale Tunnel And Pipeline

Source: Esaki Surveying & Mapping, Inc.



PHOTO 2A
North View Along County's Dirt Access Road

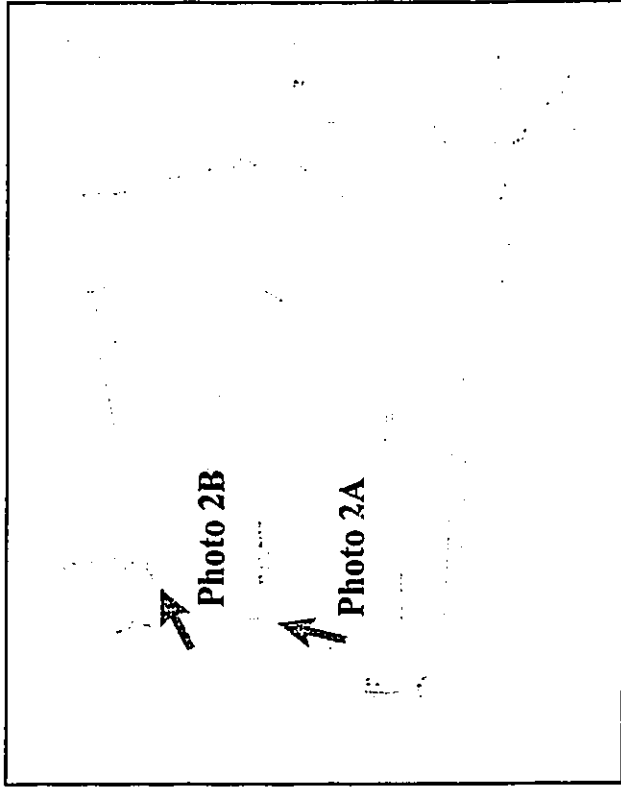


PHOTO 2B
Northeast View Near Kokolau Tunnel



PHOTOGRAPHS OF PROJECT AREA

*County of Kauai, Department of Water
Improvements To Kokolau Tunnel And Pipeline*

Source: Esaki Surveying & Mapping, Inc.

Figure A.2



PHOTO 3A
View Of Portals No. 1 And 1A

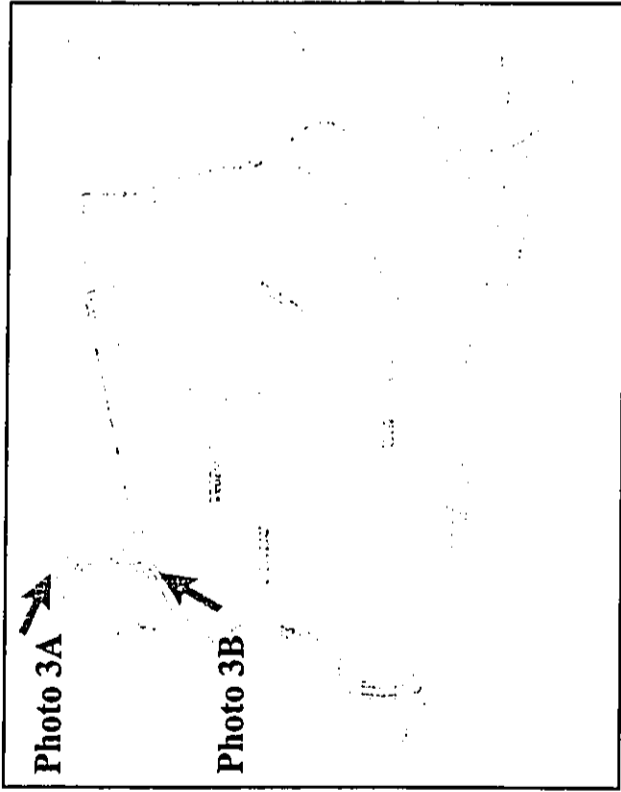


PHOTO 3B
View Of Portals No. 2 And 3



PHOTOGRAPHS OF KOKOLAU TUNNEL PORTALS

Figure A.3

*County of Kauai, Department of Water
Improvements To Kokolau Tunnel And Pipeline*

Source: SSFM Engineers, Inc.



PHOTO 4A
View Of Portal No. 4

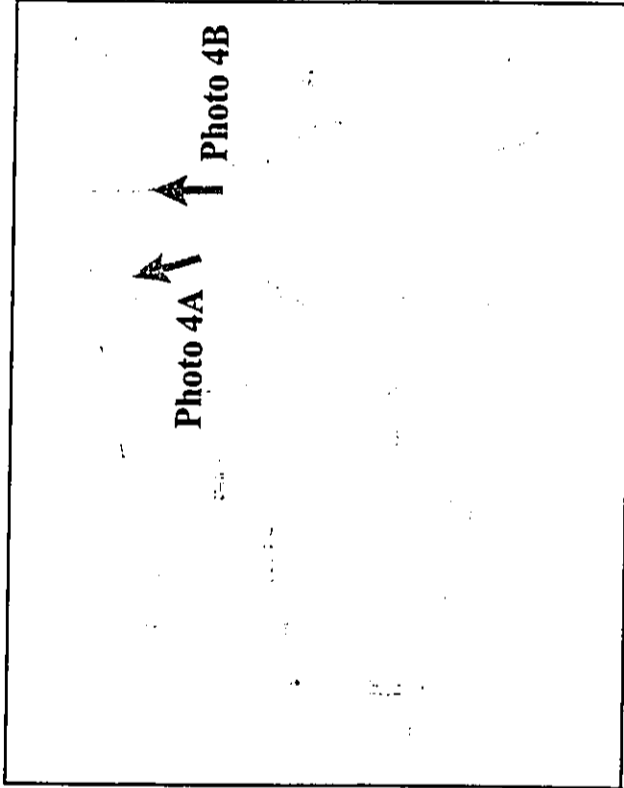
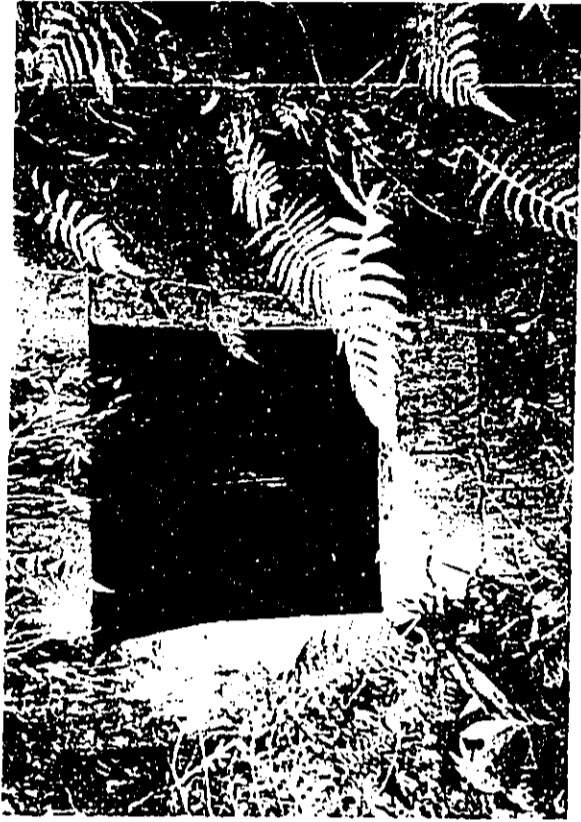


PHOTO 4B
View Of Portal No. 5



PHOTOGRAPHS OF KOKOLAU TUNNEL PORTALS

Figure A.4

*County of Kauai, Department of Water
Improvements To Kokolau Tunnel And Pipeline*

Source: SSFM Engineers, Inc.



APPENDIX B

Comment Letters Received

Draft EA Comment Letters And Responses

BENJAMIN J. CAYETANO
Governor



State of Hawaii
DEPARTMENT OF AGRICULTURE
1428 South King Street
Honolulu, Hawaii 96814-2512

JAMES J. NAKATANI
Chairperson, Board of Agriculture

LETITIA N. UYEHARA
Deputy to the Chairperson

Mailing Address:
P.O. Box 22159
Honolulu, Hawaii 96823-2159

Fax: (808) 973-9613

October 28, 1999

Mr. Ronald A. Sato
SSFM Engineers, Inc.
501 Sumner St., Suite 502
Honolulu, Hawaii 96817

Dear Mr. Sato:

RE: Improvements to Kokolau Tunnel and Pipeline

Thank you for the opportunity to review the above project. The Department of Agriculture supports this project and has no objections or comments at this time.

Sincerely,

JAMES J. NAKATANI
Chairperson, Board of Agriculture

c: Department of Water, County of Kauai
Office of Environmental Quality and Control





SSFM ENGINEERS, INC.

501 Sumner Street, Suite 502
Honolulu, Hawaii 96817
Phone: (808) 531-1308
Fax: (808) 521-7348
Email: projects@ssfm.com

December 8, 1999

SSFM 9870500

Mr. James J. Nakatani, Chairperson
Board of Agriculture
Department of Agriculture
State of Hawaii
1428 South King Street
Honolulu, Hawaii 96814-2512

Dear Mr. Nakatani:

Subject: Kokolau Tunnel and Pipeline Improvements

Thank you very much for your letter dated October 28, 1999 on the Draft EA for the subject project.

We note that your department supports the project, and has no objections or comments on this project at this time. We will include your response letter in the Final Environmental Assessment.

If you have any further questions on this environmental document, please feel free to give me a call at 531-1308. Thank you.

Sincerely,

Ronald A. Sato, AICP
Project Planner

SSFM
Engineers, Planners, & Project Managers
American Consulting Engineers Council, Member

SSFM ENGINEERS, INC.

501 Sumner Street, Suite 502
Honolulu, Hawaii 96817
Phone: (808) 531-1308
Fax: (808) 521-7348
Email: projects@ssfm.com

December 8, 1999

SSFM 9870500

Paul G. LeMahieu, Ph.D.
Superintendent of Education
Department of Education
State of Hawaii
P.O. Box 2360
Honolulu, Hawaii 96804

Dear Dr. LeMahieu:


Subject: Kokolau Tunnel and Pipeline Improvements

Thank you very much for your letter dated November 5, 1999 on the Draft EA for the subject project.

We note that your department has no comment on this project, and will include your response letter in the Final Environmental Assessment.

If you have any further questions on this environmental document, please feel free to give me a call at 531-1308. Thank you.

Sincerely,



Ronald A. Sato, AICP
Project Planner

BENJAMIN J. CAYETANO
GOVERNOR OF HAWAII



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

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

In reply, please refer to:
File:

November 18, 1999

99-225/epo

Mr. Ronald A. Sato
SSFM Engineers, Inc.
501 Sumner Street, Suite 502
Honolulu, Hawaii 96817

NOV 23 1999
J. fs

Dear Mr. Sato:

Subject: Draft Environmental Assessment (DEA)
Improvements to Kokolau Tunnel & Pipeline
Lihue, Kauai
TMK: 3-4-06: por. of 12

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

Safe Drinking Water Branch

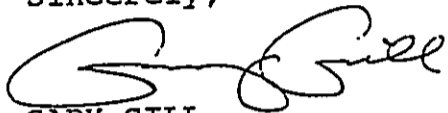
1. Federal and state regulations define a public water system as a system that serves 25 or more individuals at least 60 days per year or has at least 15 service connections. All public water system owners and operators are required to comply with Hawaii Administrative Rules, Title 11, Chapter 11-20, Rules Relating to Potable Water Systems.
2. The SDWB requests notification when the project is completed. In addition, water quality analyses, performed by a laboratory certified in the State of Hawaii would be required to demonstrate compliance with all drinking water standards. Additional tests may be required by SDWB upon review of the information submitted.
3. Section 11-20-30 requires that new or substantially modified distribution systems for public water systems be approved by the Director. However, if the water system is under the jurisdiction of the County of Kauai, the Department of Water will be responsible for the review of the plans.

Mr. Ronald A. Sato
November 18, 1999
Page 2

99-225/epo

If you have any questions concerning these comments, please contact Mr. Mark Yonamine of the Safe Drinking Water Branch at 586-4258.

Sincerely,



GARY GILL
Deputy Director for
Environmental Health

c: OEQC
Kauai Dept. of Water
SDWB

SSFM
Engineers, Planners, & Project Managers
American Consulting Engineers Council, Member

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Email: projects@ssfm.com

December 8, 1999

SSFM 9870500

Mr. Gary Gill, Deputy Director
Department of Health
State of Hawaii
P.O. Box 3378
Honolulu, Hawaii 96801

Dear Mr. Gill:

Subject: Kokolau Tunnel and Pipeline Improvements

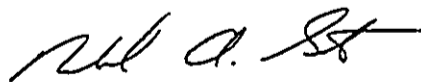
Thank you very much for your letter dated November 18, 1999 on the Draft EA for the subject project. We will include your response letter in the Final Environmental Assessment.

We have the following responses to the comments from your Safe Drinking Water Branch (SDWB).

1. The Kokolau Tunnel and water system improvements planned under this project will comply with Hawaii Administrative Rules, Title 11, Chapter 11-20.
2. Appropriate coordination between the SDWB and the County Department of Water will be performed for this project. Such coordination will consist of notifying the SDWB when the project is completed, and providing them with a copy of the water quality analysis results for their review. In addition, the water quality analysis would be performed by a laboratory certified by the State of Hawaii to comply with drinking water standards.
3. The Kokolau Tunnel and associated water system are under the jurisdiction of the County of Kauai. The County's Department of Water will appropriately review the plans for this project.

If you have any further questions on this environmental document, please feel free to give me a call at 531-1308. Thank you.

Sincerely,



Ronald A. Sato, AICP
Project Planner

BENJAMIN J. CAYETANO
GOVERNOR



KAZU HAYASHIDA
DIRECTOR

DEPUTY DIRECTORS
BRIAN K. MINAAI
GLENN M. OKIMOTO

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

IN REPLY REFER TO:

STP 8.9319

October 28, 1999

Mr. Ronald A. Sato
SSFM Engineers, Inc.
501 Sumner Street, Suite 502
Honolulu, Hawaii 96817

OCT 29 1999
1 ps

Dear Mr. Sato:

Subject: Improvements to Kokolau Tunnel and Pipeline
Draft Environmental Assessment
TMK: 3-04-06: portion of 12

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

The proposal will not impact our State transportation facilities.

We appreciate the opportunity to provide comments.

Very truly yours,

KAZU HAYASHIDA
Director of Transportation

c: Mr. William Eddy, Kauai Department of Water
Ms. Genevieve Salmonson, Office of Environmental Quality Control



Engineers, Planners, & Project Managers
American Consulting Engineers Council, Member

SSFM ENGINEERS, INC.

501 Sumner Street, Suite 502
Honolulu, Hawaii 96817
Phone: (808) 531-1308
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Email: projects@ssfm.com

December 8, 1999

SSFM 9870500

Mr. Kazu Hayashida, Director
Department of Transportation
State of Hawaii
869 Punchbowl Street
Honolulu, Hawaii 96813-5097

Dear Mr. Hayashida:

Subject: Kokolau Tunnel and Pipeline Improvements

Thank you very much for your letter dated October 28, 1999 on the Draft EA for the subject project.

We note that your department supports the project, and has no objections or comments on this project at this time. We will include your response letter in the Final Environmental Assessment.

If you have any further questions on this environmental document, please feel free to give me a call at 531-1308. Thank you.

Sincerely,

A handwritten signature in black ink, appearing to read 'Ronald A. Sato'. The signature is fluid and cursive, written over a white background.

Ronald A. Sato, AICP
Project Planner

BENJAMIN J. CAYETANO
GOVERNOR



ESTHER UEDA
EXECUTIVE OFFICER

STATE OF HAWAII
DEPARTMENT OF BUSINESS, ECONOMIC DEVELOPMENT & TOURISM
LAND USE COMMISSION
P.O. Box 2359
Honolulu, HI 96804-2359
Telephone: 808-587-3822
Fax: 808-587-3827

November 1, 1999

Mr. Ronald A. Sato
SSFM Engineers, Inc.
501 Sumner Street, Suite 502
Honolulu, Hawaii 96817

Dear Mr. Sato:

Subject: Draft Environmental Assessment (DEA) for
Improvements to Kokolau Tunnel and Pipeline,
Lihue, Kauai, TMK 3-4-06: por. 12

We have reviewed the DEA for the subject project and have no additional comments to offer to our previous comments dated September 27, 1999, regarding the subject project.

We appreciate the opportunity to comment on the subject DEA.

Should you have any questions, please feel free to call me or Bert Saruwatari of our office at 587-3822.

Sincerely,

A handwritten signature in cursive script, appearing to read "Esther Ueda".

ESTHER UEDA
Executive Officer

EU:aa

cc: OEQC
County of Kauai Dept. of Water



Engineers, Planners, & Project Managers
American Consulting Engineers Council, Member

SSFM ENGINEERS, INC.

501 Sumner Street, Suite 502
Honolulu, Hawaii 96817
Phone: (808) 531-1308
Fax: (808) 521-7348
Email: projects@ssfm.com

December 8, 1999

SSFM 9870500

Ms. Esther Ueda, Executive Officer
Land Use Commission
Department of Business, Economic Development & Tourism
State of Hawaii
P.O. Box 2359
Honolulu, Hawaii 96804-2359

Dear Ms. Ueda:

Subject: Kokolau Tunnel and Pipeline Improvements

Thank you very much for your letter dated November 1, 1999 on the Draft EA for the subject project.

We note that your department has no additional comments on this project, and will include your response letter in the Final Environmental Assessment.

If you have any further questions on this environmental document, please feel free to give me a call at 531-1308. Thank you.

Sincerely,

A handwritten signature in cursive script, appearing to read 'Ronald A. Sato'.

Ronald A. Sato, AICP
Project Planner



SSFM ENGINEERS, INC.

501 Sumner Street, Suite 502
Honolulu, Hawaii 96817
Phone: (808) 531-1308
Fax: (808) 521-7348
Email: projects@ssfm.com

December 8, 1999

SSFM 9870500

Ms. Genevieve Salmonson, Director
Office of Environmental Quality Control
State of Hawaii
236 South Beretania Street, Suite 702
Honolulu, Hawaii 96813

Dear Ms. Salmonson:

Subject: Kokolau Tunnel and Pipeline Improvements

Thank you very much for your letter dated November 22, 1999 on the Draft EA for the subject project.

We note that your department has no comments on this project, and will include your response letter in the Final Environmental Assessment.

If you have any further questions on this environmental document, please feel free to give me a call at 531-1308. Thank you.

Sincerely,

Ronald A. Sato, AICP
Project Planner

PHONE (808) 594-1888

FAX (808) 594-1865



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

303
✓ PS

October 26, 1999

Mr. Ronald A. Sato
SSFM Engineers, Inc.
501 Sumner Street, Suite 502
Honolulu, Hawaii 96817

EIS #345

Subject: Draft Environmental Assessment for Improvements to Kokolau Tunnel
and Pipeline; TMK 3-04-06: portion of 12; Lihue, Kaua'i, Hawaii

Dear Mr. Sato,

Thank you for the opportunity to review the above-referenced draft. At this time, the Office of Hawaiian Affairs has no comment on this project. 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
Kaua'i CAC
Department of Water, County of Kaua'i
OEQC



Engineers, Planners, & Project Managers
American Consulting Engineers Council, Member

SSFM ENGINEERS, INC.

501 Sumner Street, Suite 502
Honolulu, Hawaii 96817
Phone: (808) 531-1308
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December 8, 1999

SSFM 9870500

Colin C. Kippen, Jr., Deputy Administrator
Office of Hawaiian Affairs
State of Hawaii
711 Kapiolani Boulevard, Suite 500
Honolulu, Hawaii 96813

Dear Mr. Kippen:

Subject: Kokolau Tunnel and Pipeline Improvements

Thank you very much for your letter dated October 26, 1999 on the Draft EA for the subject project.

We note that your department has no comments on this project, and will include your response letter in the Final Environmental Assessment.

If you have any further questions on this environmental document, please feel free to give me a call at 531-1308. Thank you.

Sincerely,

Ronald A. Sato, AICP
Project Planner



**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

Ref. No. P-8343

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

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

October 29, 1999

10/29/99
Lps

Dear Project Manager:

Subject: Environmental Assessment and Environmental Impact Statement Reviews

For your information, the Hawaii Coastal Zone Management (CZM) Program is no longer routinely reviewing environmental assessment and environmental impact statement reports. If there are any questions, please call John Nakagawa of our CZM Program at (808) 587-2878.

Sincerely,

David W. Blane
Director
Office of Planning



Engineers, Planners, & Project Managers
American Consulting Engineers Council, Member

SSFM ENGINEERS, INC.

501 Sumner Street, Suite 502
Honolulu, Hawaii 96817
Phone: (808) 531-1308
Fax: (808) 521-7348
Email: projects@ssfm.com

December 8, 1999

SSFM 9870500

Mr. David W. Blane, Director
Office of Planning
Department of Business, Economic Development & Tourism
State of Hawaii
P.O. Box 2359
Honolulu, Hawaii 96804

Dear Mr. Blane:

Subject: Kokolau Tunnel and Pipeline Improvements

Thank you very much for your letter dated October 29, 1999 on the Draft EA for the subject project.

We note that your Hawaii Coastal Zone Management Program is no longer routinely reviewing environmental assessments and impact statements. We will include your response letter in the Final Environmental Assessment.

If you have any further questions on this environmental document, please feel free to give me a call at 531-1308. Thank you.

Sincerely,

A handwritten signature in black ink, appearing to read 'Ronald A. Sato'.

Ronald A. Sato, AICP
Project Planner

BENJAMIN J. CAYETANO
GOVERNOR OF HAWAII



STATE OF HAWAII

DEPARTMENT OF LAND AND NATURAL RESOURCES

HISTORIC PRESERVATION DIVISION
Kakuhihewa Building, Room 556
801 Kamehaha Boulevard
Kapolee, Hawaii 96707

TIMOTHY E. JOHNS, CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES

DEPUTIES
JANET E. KAWALO

AQUATIC RESOURCES
BOATING AND OCEAN RECREATION
CONSERVATION AND RESOURCES
ENFORCEMENT
CONVEYANCES
FORESTRY AND WILDLIFE
HISTORIC PRESERVATION
LAND
STATE PARKS
WATER RESOURCE MANAGEMENT

November 18, 1999

Mr. Ronald Sato
SSFM Engineers, Inc.
501 Sumner Street, Suite 502
Honolulu, Hawaii 96817

LOG NO: 24444
DOC NO: 9911tm11
Architecture

Dear Mr. Sato:

SUBJECT: **Draft Environmental Assessment (DEA)
Improvements to Kokolau Tunnel and Pipeline Project
TMK: 3-04:006:portion of 12, Lihue, Kauai**

Thank you for your submittal on the above project. We concur with much of this report since it has taken into account our previous comments written to the archaeology firm. However, we have two minor comments.

1. Chapter 5 does not reflect our comments. Both sites are assessed as significant under criterion "D" only with the portal separated out as a separate site significant under criterion "C." Again, we believe the tunnel should be treated as one site.
2. On page 31, it is stated "No particular importance is accorded to this 3rd Ditch." The ditch was extremely important to the development of the sugar industry on Kauai, however, it has lost its historic integrity and it has no outstanding engineering or architectural features.

These are only technical comments and we concur with the overall assessments for treatment and mitigation. Thank you for the opportunity to comment. Should you have further questions, please call Tonia Moy at 692-8030.

Aloha,

DON HIBBARD, Administrator
State Historic Preservation Division

TM:jk

c: Department of Water, County of Kauai, 4398 Pua Loke St., Lihue, HI 96766-5706, Attn.:
Mr. William Eddy
Office of Environmental Quality and Control, Dept. of Health, 235 S. Beretania St.,
Room 702, Honolulu, HI 96813



Engineers, Planners, & Project Managers
American Consulting Engineers Council, Member

SSFM ENGINEERS, INC.

501 Sumner Street, Suite 502
Honolulu, Hawaii 96817
Phone: (808) 531-1308
Fax: (808) 521-7348
Email: projects@ssfm.com

December 8, 1999

SSFM 9870500

Mr. Don Hibbard, Administrator
Historic Preservation Division
Department of Land and Natural Resources
State of Hawaii
Kakuhihewa Building, Room 555
601 Kamokila Boulevard
Kapolei, Hawaii 96707

Dear Mr. Hibbard:

Subject: Kokolau Tunnel and Pipeline Improvements

Thank you very much for your letter dated November 18, 1999 on the Draft EA for the subject project. We will include your response letter in the Final Environmental Assessment.

The Final EA will be revised to reflect that the entire Kokolau Tunnel site be treated as one site, and assigned the significance criterion "C." Page 31 of the Final EA will also be revised to include your statement concerning the 3rd Ditch being important to the development of the sugar industry on Kauai.

We also note your concurrence with the overall assessments for treatment and mitigation associated with this project.

If you have any further questions on this environmental document, please feel free to give me a call at 531-1308. Thank you.

Sincerely,

Ronald A. Sato, AICP
Project Planner



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

REPLY TO
ATTENTION OF

November 23, 1999

Regulatory Branch

✓ RS

Mr. Ronald A. Sato
SSFM Engineers, Inc.
Project Consultant
501 Sumner Street, Suite 502
Honolulu, Hawaii 96817

Dear Mr. Sato:

This responds to your Draft Environmental Assessment for Improvements to Kokolau Tunnel and Pipeline project as agent for the Department of Water, Kauai County. The proposed construction is located at TMK 3-04-06: por. 12. Based on the information provided, activities involving work in waters of the U.S. does not appear to occur; therefore a DA permit is not required at this time. In the future, if the applicant proposes activities in, near or having the potential to affect jurisdictional waters (i.e., Huleia stream and tributaries), consultation should take place with our Regulatory Branch at 438-7701 to determine if a DA permit may be required. Please refer to case file number 200000028. This determination does not obviate the Department of Water, Kauai County from complying with other federal, state, or county permits, certifications or requirements which may be required.

Sincerely,

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

Copies Furnished:

Mr. William Eddy, Department of Water, County of Kauai, 4398 Pua Loke street, Lihue,
Hawaii 96766-5706
Office of Environmental Quality and Control (OEQC), Department of Health, State of Hawaii,
235 South Beretania Street, Room 702, Honolulu, Hawaii, 96813

FILE COPY



SSFM ENGINEERS, INC.

501 Sumner Street, Suite 502
Honolulu, Hawaii 96817
Phone: (808) 531-1308
Fax: (808) 521-7348
Email: projects@ssfm.com

December 8, 1999

SSFM 9870500

Mr. George P. Young, P.E., Chief
Regulatory Branch
Department of the Army
U.S. Army Engineer District, Honolulu
Ft. Shafter, Hawaii 96858-5440

Dear Mr. Young:

Subject: Kokolau Tunnel and Pipeline Improvements

Thank you very much for your letter dated November 23, 1999 on the Draft EA for the subject project. We will include your response letter in the Final Environmental Assessment.

We note your comment that a Department of Army would not be required for the project since construction activities will not occur in waters of the U.S.

Appropriate consultation with your Regulatory Branch will be performed if future Department of Water projects may occur in or have the potential to affect jurisdictional waters necessitating a Department of Army permit. The applicant will be complying with applicable Federal, State, and County permits and agency requirements.

If you have any further questions on this environmental document, please feel free to give me a call at 531-1308. Thank you.

Sincerely,

Ronald A. Sato, AICP
Project Planner



Engineers, Planners, & Project Managers
American Consulting Engineers Council, Member

SSFM ENGINEERS, INC.

501 Sumner Street, Suite 502
Honolulu, Hawaii 96817
Phone: (808) 531-1308
Fax: (808) 521-7348
Email: projects@ssfm.com

December 8, 1999

SSFM 9870500

Mr. Cesar C. Portugal, County Engineer
Department of Public Works
County of Kauai
Mo'ikeha Building, Suite 275
4444 Rice Street
Lihue, Hawaii 96766

Dear Mr. Portugal:

Subject: Kokolau Tunnel and Pipeline Improvements

Thank you very much for your letter dated November 1, 1999 on the Draft EA for the subject project.

We note that your department has no comment on this project, and will include your response letter in the Final Environmental Assessment.

If you have any further questions on this environmental document, please feel free to give me a call at 531-1308. Thank you.

Sincerely,

Ronald A. Sato, AICP
Project Planner



Engineers, Planners, & Project Managers
American Consulting Engineers Council, Member

SSFM ENGINEERS, INC.

501 Sumner Street, Suite 502
Honolulu, Hawaii 96817
Phone: (808) 531-1308
Fax: (808) 521-7348
Email: projects@ssfm.com

December 8, 1999

SSFM 9870500

Mr. Dee M. Crowell, Planning Director
Planning Department
County of Kauai
Kapule Building
4444 Rice Street, Suite 473
Lihue, Hawaii 96766

Dear Mr. Crowell:

Subject: Kokolau Tunnel and Pipeline Improvements

Thank you very much for your letter dated November 5, 1999 on the Draft EA for the subject project, and we greatly appreciate your staff's cooperation on this project.

We note your comment that no permits are required for the work involved, and will include your response letter in the Final Environmental Assessment.

If you have any further questions on this environmental document, please feel free to give me a call at 531-1308. Thank you.

Sincerely,

Ronald A. Sato, AICP
Project Planner

MARYANNE W. KUSAKA
MAYOR



PLANNING DEPARTMENT

DEE M. CROWELL
PLANNING DIRECTOR
SHEILAH N. MIYAKE
DEPUTY PLANNING DIRECTOR
TELEPHONE (808) 241-6677
FAX (808) 241-6699

November 5, 1999

NOV 11 1999

✓

Ronald A. Sato, AICP
SSFM Engineers
501 Summer Street, Suite 502
Honolulu, Hawaii 96817

SUBJECT: Kokolau Tunnel and Pipeline at Huleia, Kauai, Hawaii

Thank you for submitting the Draft Environmental Assessment to our office for comments. As noted in our preliminary comments, no permits are required for the work involved.

Also, thank you for responding to our question regarding the purpose of the project. We concur that the project is an important part of the Lihue water system and support the work being proposed.

Should you have any questions, please feel free to contact Keith Nitta of my staff at 241-6677.

DEE M. CROWELL
Planning Director

FILE COPY



Engineers, Planners, & Project Managers
American Consulting Engineers Council, Member

SSFM ENGINEERS, INC.

501 Sumner Street, Suite 502
Honolulu, Hawaii 96817
Phone: (808) 531-1308
Fax: (808) 521-7348
Email: projects@ssfm.com

December 8, 1999

SSFM 9870500

Mr. Mike Kano, Captain
Fire Prevention Bureau
Fire Department
County of Kauai
Mo'ikeha Building, Suite 295
4444 Rice Street
Lihue, Hawaii 96766

Dear Mr. Kano:

Subject: Kokolau Tunnel and Pipeline Improvements

Thank you very much for your letter dated October 25, 1999 on the Draft EA for the subject project.

We note that your department has no concerns with this project, and believe the improvements will have a positive impact on your department's ability to satisfactorily perform its mission. We will include your response letter in the Final Environmental Assessment.

If you have any further questions on this environmental document, please feel free to give me a call at 531-1308. Thank you.

Sincerely,

A handwritten signature in black ink, appearing to read 'Ronald A. Sato'.

Ronald A. Sato, AICP
Project Planner

Early Consultation Comment Letters

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.
DIRECTOR OF HEALTH

In reply, please refer to:
EMD/CWB

09061PKP.99

September 22, 1999

Mr. Ronald A. Sato, AICP
SSFM Engineers, Inc.
501 Sumner Street, Suite 502
Honolulu, Hawaii 96817

Dear Mr. Sato:

Subject: Improvements to Kokolau Tunnel and Pipeline

The Department of Health has the following comments regarding your submittal dated September 17, 1999:

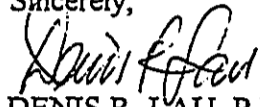
1. The Army Corps of Engineers should be contacted to identify whether a Federal permit (including a Department of Army permit) is required for this project. If it is determined that a Federal permit is required for the subject project, then a Section 401 Water Quality Certification would also be required from our office;
2. If the project involves any of the following discharges into state waters, a NPDES general permit is required for each activity:
 - a. Storm water runoff associated with construction activities, including clearing, grading, and excavation that result in the disturbance of equal to or greater than five (5) acres of total land area;
 - b. Construction dewatering effluent; and
 - c. Hydrotesting effluent.

The Department requires that Notice of Intents for NPDES general permits be submitted thirty days before the discharge is to occur.

Mr. Ronald A. Sato, AICP
September 22, 1999
Page 2

Should you have any questions, please contact Ms. Kris Poentis, Engineering Section of the Clean Water Branch, at 586-4309.

Sincerely,



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

KP:cr

Department of Land and Natural Resources
 Division of Forestry and Wildlife
 Kauai District
 3060 Eiwa St., Room 306
 Lihue, HI 96766-1875
 (808) 274-3433/(808) 274-3438 (Fax)
 email: ttelfer@pixl.com



FILE COPY

September 23, 1999

FAX MEMORANDUM

808-521-7348

1 page only

TO: Ronald Sato, Project Planner, SSFM Engineers, Inc.
 501 Sumner St. Suite 502, Honolulu, HI 96817

FROM: Tom Telfer, District Wildlife Manager *Tom C. Telfer*

SUBJECT: Improvements to Kokolau Tunnel and Pipeline, Kauai

Thank you for sending the information on the subject project.

I have reviewed the background and description of the proposed project, and do not feel that there is any likelihood of there being negative impacts to native, threatened or endangered wildlife as a result of the work to be done.

We do not normally survey such areas as the water tunnel during our semi-annual waterbird censuses, but according to my knowledge of the area, and the habitat it provides, the only possible endangered wildlife species that may be in the area is the Hawaiian Moorhen (*Gallinula chloropus sandvicensis*). That species occupies almost every small stream and drainage in the lower elevations of the island at one time or another, and is quite solitary and opportunistic.

The scope of the project appears to be low in impact to exposed stream areas, and would likely have minimal if any impact on any Moorhen that might be in the area.

The only area of possible concern would be the disposition of the "spoils" of any excavation done at the entrance portals, or during the road widening part of construction. So long as excavated material is properly placed, so as not to be washed into the Huleia Stream drainage, there should be no problem.

Although I am not a botanist, I am relatively certain that there are no listed endangered plants in the vicinity of the tunnel system.

If you should need any additional information, please contact me at the above address.

BENJAMIN J. CAYETANO
GOVERNOR OF HAWAII



STATE OF HAWAII

DEPARTMENT OF LAND AND NATURAL RESOURCES

HISTORIC PRESERVATION DIVISION
Kakuhikawa Building, Room 555
601 Kamehameha Boulevard
Kapolei, Hawaii 96707

TIMOTHY E. JOHNS, CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES

DEPUTIES
JANET E. KAWALO

AQUATIC RESOURCES
BOATING AND OCEAN RECREATION
CONSERVATION AND RESOURCES
ENFORCEMENT
CONVEYANCES
FORESTRY AND WILDLIFE
HISTORIC PRESERVATION
LAND
STATE PARKS
WATER RESOURCE MANAGEMENT

October 6, 1999

Mr. David Shideler
Cultural Surveys Hawaii
733 N. Kalaheo Avenue
Kailua, Hawaii 96734

LOG NO: 24155
DOC NO: 9909NM09

Dear Mr. Shideler:

**SUBJECT: Historic Preservation Review -- Archaeological Assessment
of Proposed Improvement to the Kokolau Tunnel and Pipeline
Puhi, Ha'iku Ahupua'a, Kaua'i, TMK: 3-4-06: por. 12
(Hammatt, Shideler and Medeiros, CSH, 1999)**

Thank you for the submission of the above archaeological report. Two historic sites were identified in the project area. Site 50-30-11-562 (the Kokolau Tunnel system) and site 50-30-11-563 (remnants of Grove Farm 3rd Ditch). The background information on this area is very good and clearly documents the historic use of the area. No prehistoric sites were found. The Kokolau Tunnel was built between 1928-1929 and the ditch system was constructed by George Wilcox in 1866-1867.

We concur that Site 563, the ditch system, is significant for its information on the association with Grove Farm as an early example of an irrigation system. However, we also believe it no longer retains its historic integrity as noted in your study as well as an earlier inventory of plantation irrigation systems done by Carol Wilcox. Regarding Site 562, the Kokolau Tunnel system, we recommend treating the entire tunnel as one site and do not believe it should be partially significant for D only and partially significant under criterion C. Therefore, we believe the entire tunnel system is significant under criterion C as a good example of the irrigation technology of the era.

Construction plans call for extensive damage to the ditch. Since the history is well documented and the ditch no longer retains its identity, we concur that these construction plans will have no adverse affect to significant historic sites. However, we believe the proposed changes to the appearance of portions of the tunnel system will have an adverse effect on historic sites. We concur that Portal #5 is the most character defining feature of the tunnel and we concur with its preservation with the addition of a door for safety reasons.

However, we do not believe this report is adequate mitigation for the adverse effect to the tunnel. Although adequate historic documentation and a map of the tunnel has been done via

D. Shideler

2

this report, we recommend photo-documentation utilizing HABS/HAER standards (4X5 negatives, 8X10 photographs on fiber based paper, archivally processed) of portals #4 and 5 to further complete mitigation. These should be submitted to our office prior to demolition work or addition of the door.

Our staff inadvertently gave you two site numbers that were previously given out after Hurricane Iniki but not documented in our site number log book. We apologize for this inconvenience and mistake. We have now given these sites the following numbers (site 562 = 50-30-11-1562 and site 563 = 50-30-1563). Could you please send us replacement pages where the old site numbers appears? We believe it is only a few pages at the end of the report.

Thank you for the opportunity to comment. If you have any questions, please call Nancy McMahon (on Kauai) at 742-7033 or Tonia Moy (on Oahu) at 692-8030.

Aloha,



for

DON HIBBARD, Administrator
State Historic Preservation Division

NM:amk

BENJAMIN J. CAYETANO
GOVERNOR



ESTHER UEDA
EXECUTIVE OFFICER

STATE OF HAWAII
DEPARTMENT OF BUSINESS, ECONOMIC DEVELOPMENT & TOURISM
LAND USE COMMISSION
P.O. Box 2359
Honolulu, HI 96804-2359
Telephone: 808-587-3822
Fax: 808-587-3827

September 27, 1999

Mr. Ronald A. Sato
SSFM Engineers, Inc.
501 Sumner Street, Suite 502
Honolulu, Hawaii 96817

Dear Mr. Sato:

Subject: Agency Consultation for Draft Environmental Assessment (DEA), Improvements to Kokolau Tunnel and Pipeline, Lihue, Kauai, TMK 3-4-06: por. 12

We have reviewed the project description for the subject DEA forwarded by your transmittal dated September 17, 1999, and find that the proposed project, as represented on Figure 1, is designated within the State Land Use Agricultural District.

We have no further comments to offer at this time. We appreciate the opportunity to comment on the subject project.

Should you have any questions, please feel free to call me or Bert Saruwatari of our office at 587-3822.

Sincerely,

A handwritten signature in cursive script, appearing to read "Esther Ueda".

ESTHER UEDA
Executive Officer

EU:aa


cc: OEQC
County of Kauai Dept. Water

COUNTY OF KAUAI
PLANNING DEPARTMENT
4444 Rice Street, Suite 473, Lihue, Hawaii 96766

M E M O R A N D U M

DATE: September 22, 1999

TO: Ronald A. Sato, AICP

FROM: Keith Nitta 
Planner

SUBJECT: Kokolau Tunnel and Pipeline at Huleia, Kauai, Hawaii
=====

I'll be in meetings throughout the morning so you may not be able to reach me today. As a result, I'm sending you this FAX in case we don't get to talk. Hopefully this will help.

The following are our comments concerning the project:

- a. The project is located in the Open District (O) zoning and is within the Agricultural State Land Use District.
- b. Based on the project description, no permits are required from our office for the work involved.
- c. The project is outside of the County Special Management Area (SMA).
- d. There are many projects in Lihue that are unable to progress due to water capacity deficiencies. Will this project help to increase the capacity of the Lihue water system to help the Lihue area?

Call me if you have any questions at 241-6677.



Amfac Land Company, Limited • Kauai Division

2970 Kele Street • Lihue, Kauai, Hawaii 96766

September 28, 1999

Ronald A. Sato, AICP
SSFM Engineers, Inc.
501 Summer Street, Suite 502
Honolulu, HI 96817-5304

Re: Kokolau Tunnel and pipeline project

Dear Mr. Sato:

Following up on our phone conversation of last week, the above project appears to have little impact upon the operations of The Lihue Plantation Co., Ltd. ("LPCo"), the lessee of the land in question. However, since we do not know the details of the work to be done, and since the tunnel passes under a planted cane field, I thought it best to put my comments of last week in writing to you.

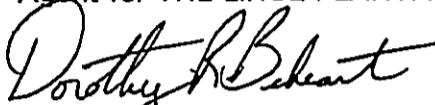
- The easternmost section of the pipeline runs along a section of the main haul cane road that has heavy traffic when we are harvesting cane in the area. The contractor should coordinate with us as to when and how they lay that section of pipeline. I can be the initial contact person.
- If any cane is lost due to this project, LPCo would be entitled to crop damage reimbursement according to the Alexander Grant formula.
- It is not clear from the plans how the work on the eastern end of the tunnel is to be accessed. If the access is from the south there shouldn't be a problem. If it is by way of the cane field ("lihi") roads, the contractor needs to coordinate with plantation personnel. The field is scheduled for harvest in May 2000 and for planting soon thereafter. Access during those periods will be difficult.

Telephone: 808-245-8786 • Facsimile: 808-246-9549

Ronald Sato
Page 2
September 28, 1999

Please feel free to call me at 245-7687 if there is anything you would like to discuss or if you need additional information.

Very truly yours,
AMFAC LAND COMPANY, LTD.,
Agent for THE LIHUE PLANTATION CO., LTD.



Dorothy R. Bekeart
Land Manager

c: Lyle Tabata, LPCo

APPENDIX C

*Revised Consultation Letter Report
Geotechnical Investigation,
Kokolau Tunnel Lihue Water System*

September 1998

Prepared By: Masa Fujioka & Associates



MASA FUJIOKA & ASSOCIATES

A PROFESSIONAL PARTNERSHIP

ENVIRONMENTAL • GEOTECHNICAL • HYDROGEOLOGICAL CONSULTANTS

99-1205 Halawa Valley Street, Suite 302 • Aiea, Hawaii 96701-3281

Phone 808 484-5366 • Fax 808 484-0007

November 9, 1998
MFA Project 98086-012

SSFM Engineers, Inc.
501 Sumner Street, Suite 502
Honolulu, Hawaii 96817

Fax No.: (808) 521-7348

Attention: Mr. Clayton Wong, P.E.

Subject: Revised Consultation Letter Report
Geotechnical Investigation,
Kokolau Tunnel Lihue Water System
Puhi, Kauai, Hawaii

Gentlemen:

We submit four copies of "Revised Consultation Letter Report, Geotechnical Investigation, Kokolau Tunnel Lihue Water System, Puhi, Kauai, Hawaii."

We previously submitted a Pre-Final consultation letter report dated September 15, 1998 for the above project. This revised consultation letter report contains revisions and modifications to our previous letter report based on comments received from SSFM Engineers, Inc. and the Department of Water, County of Kauai.

This letter report presents our field and laboratory investigations, general discussions of the site conditions observed during our field investigation, and general recommendations for the repair of the tunnel. This report also contains a glossary of geologic terms as requested by SSFM Engineers, Inc.

Since several options are under consideration for the repair of the tunnel at this time, no specific design recommendations are included in this report. However, we have provided design parameters and recommendations for specific design options using a memorandum dated September 25, 1998 as requested by SSFM Engineers, Inc. As needed, we will continue to provide design parameters and recommendations for specific design options for the tunnel.

M F A

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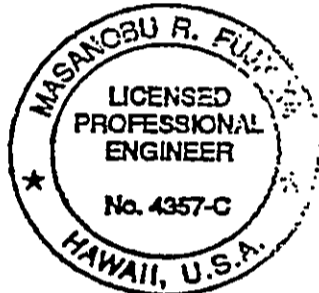
It has been a pleasure performing this assignment for you. If you have any questions regarding this report, please contact us for clarification.

Yours very truly,

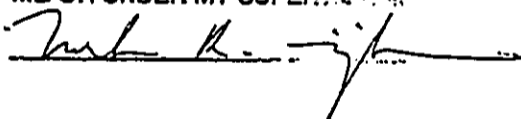
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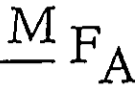


Masanobu R. Fujioka, P.E.
Principal-In-Charge



THIS WORK WAS PREPARED BY
ME OR UNDER MY SUPERVISION





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INTRODUCTION

Masa Fujioka & Associates (MFA) is pleased to present this revised consultation letter report describing our geotechnical investigation for the Kokolau Tunnel Lihue Water System, Puhi, Kauai, Hawaii. The location of the site is shown in Figure 1.

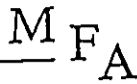
PROJECT BACKGROUND

The Kokolau tunnel is an approximately 1550 foot unlined water development tunnel located approximately one-half mile west of the town of Puhi, in the southeast portion of Kauai (Figure 1). Plans obtained from the County of Kauai indicate a construction date circa 1929. The tunnel is approximately 3 feet wide and six feet high. Portions of the tunnel are known to have collapsed. Water is present at the base of most of the tunnel length.

PURPOSE AND SCOPE OF WORK

The purpose of the geotechnical investigation was to explore rock and soil conditions at the site and provide recommendations regarding geotechnical stability of the tunnel. The following scope of work was performed:

1. A review of the available soils and geologic information for the site was conducted.
2. A geotechnical testing plan (dated June 29, 1998) was prepared and submitted.
3. A geological field exploration of the tunnel (including examination of the tunnel walls) was conducted and a geologic map was prepared to show existing geologic conditions at the site (Figures 2 and 3).
4. During MFA's field work, disturbed and undisturbed soil samples were collected for laboratory examination and bulk rock samples were collected for geological identification purposes.



5. Field strength testing was performed using a Torvane and a Pocket Penetrometer at selected locations along the tunnel.

6. Laboratory testing was conducted on selected soil samples collected during the field investigation. Testing included gradation tests and direct shear tests.

7. Field and laboratory data were analyzed and conclusions and recommendations developed regarding:

- a. geotechnical stability of the tunnel,
- b. sedimentation in the base of the tunnel, and
- c. geotechnical engineering parameters for foundation design and construction of the tunnel repairs.

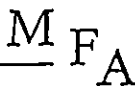
8. Our findings and recommendations are presented in this geotechnical revised consultation letter report, including field and laboratory data.

GEOLOGIC SETTING

Kauai consists of a single great shield volcano, which is deeply eroded and partly veneered with much later volcanics. The site is located on the southeast portion of Kauai, southeast of the Lihue Depression and the Kilohana Crater. The bedrock beneath the site has been regionally mapped as Koloa Volcanic Series basalts (MacDonald, et al, 1983). Kilohana and older Koloa lavas, cinder and tuff cones, ash beds, and associated sedimentary deposits of the Pleistocene Koloa Volcanic Series filled an ancient valley floor. Aa and Pahoehoe flows of basalt flowed over highly weathered rocks of the Pliocene Waimea Canyon Volcanic Series. The total thickness of the Koloa Volcanic Series for this area is unknown because the base is unexposed. Younger sediments of Recent alluvium occur along stream valleys and calcareous sands occur on coastal beaches.

SITE GEOLOGY

The following geologic discussion focuses on the area of the Kokolau development tunnels, with an emphasis of lithology encountered within the



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tunnels themselves. The Kokolau development tunnels intercepted former springs at an elevation of approximately 300 feet above mean sea level (msl) in a tributary on the north side of Huleia Valley during their construction in 1929. The aquifer occurs in lava flows which are probably from the Kilohana vent. The aquifer may be perched on a nearly-horizontal red soil layer which is several feet below the tunnels in formerly observed exposed road cuts (Cox, 1953).

According to the U.S. Soil Conservation Service (Foote et al., 1972), the soils in the area belong to the Kapaa-Pooku-Halii-Makapali series soils. Typically found on uplands, these soils are generally deep, moderately well to well drained, and have a fine textured or moderately fine textured subsoil (Foote et al., 1972). As the tunnel is known to have been constructed through unweathered and partly weathered basaltic rock and saprolite, it is more likely many of the above mentioned soils are present above the tunnel.

Figure 2 is a plan view of the tunnels that shows generalized lithology within the tunnels. Figure 2 shows the strata as well as water-bearing zones, fractured zones, collapsed areas, and clinker zones.

Figure 3 shows a generalized profile of the tunnels at a 2 to 1 vertical exaggeration and is based on an advance sheet from SSFM. The invert of Portal 1 is the highest in elevation (313.4 feet msl), but is less than 1 foot higher than the invert of the lowest portal (#5). Overburden heights range from three feet (at some adits) to approximately 95 feet above the base of the tunnels (Figure 3).

Generalized Lithology

Several lithologies are present within the tunnel system. Koloa volcanics (massive basalt, slightly weathered basalt, and fractured basalt) are present in the majority of the tunnel. The Koloa basalts within the tunnel generally appear to be structurally stable. The Koloa volcanics generally are present in the core regions and lower one-third of the walls of the tunnel, but in some areas are present to the top of the tunnel walls. Saprolites and clayey silts are present above the Koloa volcanics, and are often present in portions of the tunnel nearer the portals and in the upper one-third to one-half of the tunnel walls. The collapsed portions of the tunnel occur in areas of clayey silt and heavily weathered saprolite. Several clinker zones are present in the tunnels, and appear to be associated with the major water-bearing zones.

While these zones are comprised of poorly lithified deposits, they appear to be relatively stable.

Koloa Volcanic Series Basalts

The lower one-third to the entire height of much of the tunnel is comprised of massive to fractured Koloa Volcanic Series basalts. Dunite inclusions are common in the basalt. The Koloa basalts are typically dark gray. Fractured zones within the Koloa volcanics are noted on Figures 2 and 3. Small seeps are associated with some of the fractured zones.

Clinker Zones

Clinker zones were present in several areas of the tunnel and were comprised of loose to poorly lithified lava and reddish brown saprolite fragments. Seeps and water-bearing zones occur most commonly within clinker zones in the tunnels.

Collapsed Zones

Several collapsed zones are present within the tunnel system. These areas have several characteristics in common. The thickness of the overburden in these areas is generally low (approximately 7 to 20 feet). The material in the upper portion of the tunnel at these locations varies from heavily weathered saprolite to saprolite that has weathered completely to form a clayey silt. Heavy root growth is generally present in these areas. The roots may provide a pathway for infiltration from precipitation and add to the instability of the zone. In the collapsed portions, several feet of overburden above the original ceiling (up to approximately 6 feet) have collapsed, creating a ceiling and floor that are both higher than the original tunnel. In these areas, water is generally directed through a concrete Hume™ reinforced concrete pipe, resulting in uninterrupted water flow.

Saprolites, Saprolitic Basalts, and Clayey Silts

Saprolite (weathered volcanics that retain structure of the parent rock and are typically soft and clay-rich) is present in sections of the tunnel. Saprolite commonly occurs in the upper two-thirds to upper one-half of the tunnel and is typically light gray to reddish-brown.



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In areas where collapses have occurred, the saprolites have weathered completely to form clayey silts. Roots up to three inches in diameter are encountered in these zones within the tunnel. The USCS classification for a soil samples taken from the silty clay and saprolite zones were generally ML or SM.

Fill

Heterogeneous fills were observed at most of the portals. These fills consist of boulders and soils which have fallen from the ceiling of the tunnel, decomposed vegetation, gravel, sand, and silt. These fills appear to be soft and have a thickness of more than 1.5 feet.

Stockpiled fill was also noted outside of Portal Nos. 2 and 3. The thickness of this fill appears to be in the range of 3 to 5 feet. This fill may have been stockpiled during backhoe excavation work conducted in 1998 to uncover the tunnel entrances.

Fills were also noted at the base of the tunnel, especially close to the portal entrances.

HYDROGEOLOGY

The hydraulic gradient of groundwater at the site is presumed to be east to southeast (toward the ocean). Groundwater resources in the area are listed as being part of the Hanamaulu aquifer system of the Lihue aquifer sector. According to Izuka and Gingerich (1998), the Lihue Basin consists of one aquifer system that is fully saturated to the surface in much of the basin. This condition exists because of the low permeability of the Koloa Volcanics. Streams drain and control much of the upper part of the basin and play an important part in shaping the water table in the southern Lihue Basin. Because of the low regional horizontal hydraulic conductivity and high influx of water in the southern Lihue Basin, rocks will become completely saturated nearly to the surface and the variably saturated/unsaturated condition is unlikely to develop (Izuka and Gingerich, 1998).

The site is located above the Underground Injection Control (UIC) line (DOH, 1983).



Water-Bearing Strata

The major water-bearing zones within the tunnels are found in clinker zones. The "waterfall" area of the tunnels is the major source of water for the system, and is located within a clinker zone shown from (-)7+05 to (-)7+15 feet on Figure 2. The majority of the water in this zone is infiltrating from the top half of the tunnel, on the northwestern side of the tunnel. A small, six-inch wide spring is located at the base of the tunnel on the southeastern wall at station (-)8+63.9 feet (Figure 2). Several other water-bearing zones and seeps of apparently lesser magnitude are also shown in Figure 2. These zones generally occur in areas of fractured Koloa basalt.

The total yield of the Kokolau development was reported at 700,000 gallons per day (gpd) by Cox (1953). County of Kauai, Department of Water records for 1981 through 1993 indicated yields of 500,000 to 720,000 gpd. Up to 600,000 gallons of the daily yield is attributed to the largest spring (the "waterfall") by Cox (1953).

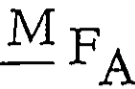
We also reviewed the following documents provided by the County of Kauai, Department of Water:

1. "Laboratory Report for Kauai Water Department" prepared by Montgomery Laboratories (dated November 10, 1995) containing chemical analysis, testing, and report;
2. A Set of "Baseline Data for Water Sources Possibly Under the Influence of Surface Water", testing and reports by the Department of Water from September 13, 1995 to June 24, 1997; and
3. Two sets of "Microscopic Particle Analysis", reports dated February 12, 1997 and June 24, 1997.

Based on review of above reports, it appears that the tested groundwater quality is good with all constitutes sampled below Federal and State Maximum Contamination Levels .

FIELD AND LABORATORY TESTING

During MFA's field investigation, field strength testing were performed using a Torvane and a Pocket Penetrometer at selected locations along the tunnel.



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Disturbed and undisturbed soil samples collected during the field exploration program were tested in the laboratory. Laboratory testing of soil samples included gradation tests and direct shear tests.

Appendix A contains results of field and laboratory testing of soil samples.

Field testing results consisting of Pocket Penetrometer and Torvane test results are presented in Table A1, Appendix A. Pocket Penetrometer test results ranged from 1.5 tsf (weathered saprolite) to greater than 4.5 tsf (unweathered saprolite and basaltic rock) indicating stiff to hard consistency of materials at tested locations. Torvane test results ranged from 0.1 tsf to 0.55 tsf indicating very soft to medium stiff consistency at tested locations. However, it should be noted that field strength testing using Torvane was performed only on weathered saprolite and clayey silt and no Torvane test was performed on unweathered saprolite and basaltic rock.

Laboratory test results for selected soil samples are presented in Table A2 and Figures A1 through A20, Appendix A. Moisture and wet density of tested samples ranged from 40% to 63% and from 80 pcf to 124 pcf respectively. The soil classification of tested soil samples ranged from sandy silt (ML) to silty gravel (GM).

DISCUSSION AND RECOMMENDATIONS

Observed Site Conditions

At the entrances of all portals, the original basalt has been deeply weathered to clayey silt or saprolite. This deep weathering has caused partial collapse of the roof or sides of all entrances. The surface conditions observed in all six portal entrances (Portals 1, 1A, and 2 through 5) are presented in Logs P1 through P5, Appendix A.

Portal No. 1 is located very close to a stream. The stream bed and the base of this portal are approximately the same level. This indicates that the stream water flows into the tunnel through this portal during periods of high water if not blocked (sand bags were observed at the portal). At the time of our field investigation, standing water was noted only in a small area of the stream. The base of Portal No. 1A is located several feet higher than the stream bed.



Exposed surface conditions at Portal Nos. 1 and 1A consists of basaltic rock, unweathered and partly weathered saprolite. Debris including boulders and roots were observed at the bottom of Portal Nos. 1 and 1A.

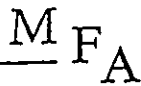
Exposed surface soil conditions at Portal Nos. 2 and 3 consist of saprolite that has weathered to clayey silt. The surface soils at these entrances fall apart under slight disturbances of the materials. Heavy roots were also noted at these locations. Heterogeneous fills including cobbles and decayed vegetation were observed in the bases of portals 2 and 3. The fill in these locations appear to be soft. The fill thickness appears to be more than 1.5 feet. Approximately 3 to 5 feet of stockpiled materials were observed outside of these portals.

Saprolite and reddish brown clayey silt were observed on the surface at Portal No. 4. The base of this portal also contains some debris including roots and boulders. Exposed surface soil conditions at Portal No. 5 consist of clayey silt.

Within the first 25 to 60 feet of all tunnel entrances, the roof is partially collapsed, slickensides were noted, and numerous tree roots were observed. The slickensides are polished surfaces on the clayey silt or saprolite which indicate that ground motion has occurred in these areas, probably from settling and consolidation of the soil overburden over time. The tree roots indicate that the ground surface is near the ceiling of the tunnel and the penetration of the roots through the tunnel roof is a partial contributor to the collapse of the roof in these areas.

Near the -4+00 marker, the tunnel roof is partially collapsed for a distance of about 50 feet with numerous tree roots, which corresponds with an overlying valley at the surface and a thin overburden above the roof of the tunnel. In those sections of the tunnel where the roof is partially collapsed, the floor and ceiling have both been raised. In these sections, a reinforced concrete pipe has been more deeply buried, but appears to have remained intact with no interruption of water flow. In the portion of the tunnel near Portal No. 5, high water marks can be seen on the walls from periods of heavy rain and high flow. In this same portion, a fine coating of red clay can be seen on the walls indicating that heavy sediment loads are being carried during periods of high flow.

Sedimentation was observed at the base along most of the tunnel. It was noted that sediments deposited in the base of the tunnel had been cleared



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from one side and deposited on the other side to maintain water flow during low water flow. It is most likely the above clearing may have been carried out some time in the past as part of maintenance of the tunnel.

Most interior portions of the tunnels are marked by fractured to massive basalt, but also contain clinker zones that are the most copious water producing areas. The basalt is hard and very stable except for the clinker areas where the clinkers are loose and can be easily extracted. The massive basalt sections of the tunnel appear to be very stable with little or no weathering or deterioration. Conversely, the clinker zone is less stable with numerous clinkers having fallen out leaving parts of these zones with little support.

Potential Site Problems Observed

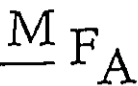
Potential site problems observed during our investigation are as follows:

1. Possible collapse of tunnel at the portal entrances,
2. Possible tunnel roof collapse in those areas adjacent to the portal entrances,
3. Loose areas in the clinker zones,
4. Possible over loading of the reinforced concrete pipe
5. Red clay adhering to the tunnel walls,
6. Possible washout of red clay in the collapsed zones,
7. Stream water flow into the tunnel through Portal No. 1 and possibly through Portal No. 1A during high water,
8. Fill conditions at portal entrances, and
9. Sedimentation at the base of the tunnel.

Geotechnically Weak Zones

The areas of geotechnical concern are as follows:

Portal entrances - In these areas, weathering and water flow during storm periods are causing partial collapse and deterioration of the portal entrances near to the point of blocking the entrances. These areas are shown on Figure 4 - Areas of Concern. Also, fill present at the base of the portal entrances would need to be taken into consideration in design and construction of portal access structures.



Tunnel roof and areas adjacent to the portals - Tunnel roof and the areas of the tunnels adjacent to the portals are partially collapsed due to the heavy soil development in these areas. The areas are composed of soft and unconsolidated reddish brown clayey silt. Tree roots have penetrated completely through these areas and are forcing the soil particles apart and loosening the soil in the roof of the tunnel to the point of collapse. The location of these areas are shown on Figure 4 Areas of Concern and discussed in the recommendations section of this report.

Clinker zones within the tunnels - The clinker zones within the tunnels, notably those in areas of high water flow, will need to be supported. In these areas, there has not been much collapse, but many of the clinkers are loose and unsupported because of deterioration and washout. If these areas are left unmaintained, it is very likely large-scale collapse may occur in the future. If large-scale collapse occurs, water flow may be blocked or hindered to the point of loss of the water supply system. The loose areas in the clinker zones will need to be supported without blocking the water flow through the clinkers. The location of these areas are shown on Figure 4 Areas of Concern and discussed in the recommendations section of this report.

Reinforced concrete water pipe - Reinforced concrete water pipes were observed at five locations within the tunnel. These water pipes were installed primarily in the portions of the tunnel that are in clayey silt and saprolite. Major collapse of the tunnel ceilings are present at two locations; close to Portal No. 3 and close to Portal No. 4. These are the same portions that are currently collapsing. The total collapse of the tunnel may overload the concrete pipe and cause a blockage of the pipe. If this occurs, access to the pipe and repair of the pipe will be blocked as well.

Sedimentation

A coating of red clay was observed on the tunnel walls between -4+00 and Portal #5. This adhered red clay is in contact with the water flowing through the tunnel. During periods of high water flow, this red clay will be carried into the water supply system. In addition, during times of high water flow, sediment is picked up from some of the collapsed areas and carried through the system. Sediments from previous high water flows have been deposited within the tunnel and when water flow increases, this sediment is remobilized and carried through the system.

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We understand from the Department of Water that Portals Nos. 1 and 1A were completely sealed off previously and have only recently been opened up. However, it appears possible that during times of high water flow, sediment may be carried into the tunnel system from the adjoining stream when water levels are above the entrance levels of Portal No. 1. Possible stream water flow into the tunnel through Portal No. 1 (and possibly through Portal No. 1A) during high water should be stopped. This will decrease future sedimentation problems that may be encountered in the water supply system.

Fills located at the portal entrances and the base of the tunnel may also add to the sedimentation problem.

Recommendations concerning geotechnically weak zones

The following recommendations concerning the geotechnically weak zones are made:

1. The area of the portal entrances should be reinforced and protected from further collapse by installing suitable portal entrance structures or a similar systems. This will maintain access to the tunnel system and prevent washout of the sidewalls of the entrances.
2. The tunnel areas adjacent to the portals, some of which are partially collapsed, need to be reinforced and supported. These areas are shown on Figure 4 - Areas of Concern. The areas of concern are:
 - (a) The section from entrance of Portal No. 1 to -13+95,
 - (b) The section from -13+56 to entrance of Portal No. 2,
 - (c) The section from entrance of Portal No. 3 to -11+49,
 - (d) The section from -11+38 to -11+32
 - (e) The entrance of Portal No. 4 to the cross with the main tunnel,
 - (f) The section from -4+80 to -3+95,
 - (g) At section -2+75 for approximately 10 linear feet, and
 - (h) The section from -1+90 to -1+80.

Please note that these station numbers are provided by SSFM Engineers, Inc. as depicted in the figures presented in this report.

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3. The clinker zones within the tunnels will need to be supported to prevent collapse in these areas. These areas are shown on Figure 4 - Areas of Concern. The clinker zones that need to be supported include the following areas:

- (a) From -13+95 to -13+41 between Portal No. 1 and No. 2,
- (b) Approximately 8 linear feet surrounding -9+90,
- (c) From -8+75 to -8+40, and
- (d) From -7+00 to -7+25,

Not all of these areas require support over the entire roof area, but can be partially supported.

4. The overburden on the reinforced concrete water pipe should be kept to a minimum to reduce the risk of damage. Wherever the existing reinforced concrete pipes are to remain for transporting water, remove overburden and reduce to a maximum of one foot of overburden. The areas of overburden removal are shown on Figure 5 - Sediment Concern. At least 6 inches to a foot of overburden should be left over the pipe for protection from falling debris.

Recommendations concerning sedimentation

The following recommendations concerning the sedimentation in the water supply system are made. The recommendations are based on limited preliminary data and should be reviewed following completion of further study of water inflow and infiltration data gathering.

1. Seal the entrances with some kind of door structures, especially Portals No. 1 and 1A, to prevent the flow of sediment laden water into the entrances and into the tunnel. These doors should prevent water flow into the tunnel system, and be fitted and positioned such that water can not flow around the door and into the tunnel system.
2. Extend the pipeline from -4+00 to Portal No. 5 to prevent contact between the water and adhered red clay on the tunnel walls.
3. Remove fills at portal entrances prior to the installation/construction of portal entrance structures and the portal doors.
4. Remove sedimentation at the base of the tunnel.

The above mentioned areas are shown on Figure 5 - Sediment Concern.



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Recommendations for Door Structures

Site preparation will be required for the construction of structures at the portal entrances. Soft materials and loose fills are found at the portals of the tunnels. These materials should be removed prior to the construction of the portal entrance system. These soft materials and fills should be excavated to firm natural ground surface. Excavation should be performed under the technical supervision of a qualified geotechnical engineer. Between portals #2 and #3, care should be taken not to damage the below grade water pipeline.

Because of the potential for water flow during high rainfall periods during construction, we recommend placing lean concrete to fill the excavated areas to form a level surface. Soft materials and loose fills should be excavated to firm ground and lean concrete can be placed immediately in the excavated areas to form a level surface for footings.

Foundation Support - Footings for the portal structure may be constructed on the lean concrete or on firm ground surface in saprolite or basalt. An allowable bearing pressure of 3,000 pounds per square foot (PSF) is recommended for spread footings located on lean concrete or on firm ground surface in saprolite or basalt. A one-third increase in allowable bearing pressure can be used when considering the total of all loads, including wind or seismic forces.

For footings located on or near slopes, the footing should be deepened such that there is a minimum horizontal distance of 5 feet from the edge of the footing to the slope face.

Footings should have a minimum width of 18 inches and should be embedded a minimum of 16 inches below the lowest adjacent exterior grades.

Footing Excavations - All footing excavations should be checked by a geotechnical engineer before placement of steel reinforcement or concrete. Before laying of steel or pouring of concrete, the bottom of all footing excavations should be cleaned of disturbed material or any loose soil that has fallen into the trench.

Lateral Pressures - Lateral loads can be resisted by passive pressure on the faces of footings and by friction along the bases of footings. Lateral pressures on footings in compacted fill material can be computed using a passive equivalent fluid pressure of 300 pounds per square foot per foot of depth

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(PSF/FT). A friction factor of 0.4 may be used for footings on the underlying soil.

Retaining Walls - Foundations for retaining walls should be designed according to the foundation section of this report.

For free-standing retaining walls with level properly draining backfill, the active earth pressure may be assumed as an equivalent fluid pressure of 30 pounds per cubic foot for imported granular material.

For restrained wall conditions, the above active earth pressure should be increased to 50 pounds per cubic foot.

Retaining walls should be backfilled with granular backfill for a lateral distance of 1/2 the wall height behind the wall. This specified backfill and drainage should be clearly indicated on the design drawings. The backfill for the retaining wall should be properly compacted as described in section 7.4. Also, surface drainage should be designed to minimize surface water runoff from entering the backfill area.

Drainage for retaining wall backfill should be accomplished by providing 4-inch diameter weepholes spaced 8 feet on center (horizontally as well as vertically) or by using a minimum 4 inch diameter perforated PVC footing drain pipe. A 2 foot thick layer of crushed gravel (#3 Fine), which is wrapped with geotextile filter fabric, should be placed above the pipe; the crushed gravel shall be continuous from the weephole the full length of the pipe. Geotextile fabric should be SUPAC 4NP, or similar.

The above active pressures do not include surcharge loads (for example: sloping backfill, footings located within a 45 degree plane projected upwards from the footing, hydrostatic pressure). If such conditions occur, the active pressure should be increased accordingly.

PLAN REVIEW AND SERVICES DURING CONSTRUCTION

MFA should review plans and specifications before construction to check for conformance with the intent of our recommendations.



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During construction repairs, we recommend that a geotechnical engineer be retained to monitor the construction work and confirm our assumptions regarding site conditions.

LIMITATIONS

Soil and rock conditions encountered during the field investigation indicate the approximate exposed soil and rock conditions observed at the locations, and may not represent conditions at other locations.

Should surface and/or subsurface conditions, such as expansive soils, cavities, or other conditions differing from those encountered during our investigation, be encountered during construction, MFA should be consulted so that we may review and possibly revise our recommendations.

MFA's services are normally performed, within the limits prescribed by its Clients, with the usual thoroughness and competence of the consulting profession, in accordance with the standard for professional services at the time those services are rendered. No warranty or other representation, either expressed or implied, is included or intended in its proposals, contracts, or reports.

GLOSSARY OF GEOLOGIC TERMS

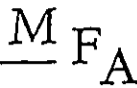
- alluvium: deposits made of loose rocks and minerals produced by mechanical means and made by streams on river beds, flood plains, and alluvial fans.
- ash bed: fine, unworked solid material explosively or aurally ejected from a volcanic vent, and less than 2 mm in diameter. Usually refers to unconsolidated material, but is sometime used for consolidated material (see tuff).
- basalt: a dark colored igneous rock composed primarily of calcic plagioclase and pyroxene. Commonly extrusive in origin.
- calcareous: containing calcium carbonate.
- cinder cone: a conical hill formed by the accumulation of cinders and other pyroclasts around a volcanic vent.
- clay: a detrital material of any composition with a diameter of less than 1/256 mm.
- clinker: a rough, jagged fragment of lava.

SSFM Engineers, Inc.

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- dunnite: a peridotite consisting essentially of olivine, with accessory pyroxene, plagioclase, or chromite.
- fracture: a crack, joint, fault, or other break in rocks.
- inclusion: a fragment of older rock within an igneous rock to which it may or may not be genetically related.
- lava: fluid rock that issues from a volcano or fissure; also, the same material solidified by cooling.
- lithify: to consolidate from loose sediment to a solid rock.
- massive: said of rocks of any origin that are more or less homogeneous in texture or fabric, displaying an absence of flow layering, foliation, cleavage, joints, fissility, or thin bedding.
- Pleistocene: an epoch of the Quaternary period, from 2-3 million years ago to some 8,000 years ago.
- saprolite: a soft, earthy, clay-rich thoroughly decomposed rock formed in place by chemical weathering of igneous or metamorphic rocks, especially in humid or tropical or subtropical regions. Color is red or brown. Characterized by preservation of structures that were present in the unweathered rock.
- seep: a spot where water oozes from the earth as a result of chemical rearrangement of minor constituents within a sediment after its deposition.
- silt: a detrital particle finer than sand and coarser than clay (1/16 to 1/256 mm).
- slickenside: a polished and striated rock surface that results from friction along a fault plane.
- tuff cone: a steep-sided volcanic deposit consisting of consolidated pyroclastic rocks.
- vesicular: said of a aphanitic igneous rock that has numerous small cavities, formed by the expansion of a bubble of gas or steam during solidification of the rock.
- weathering: the destructive process by which rocks are changed on exposure to atmospheric agents at or near the earth's surface, with little or no transport of the loosened or altered material.



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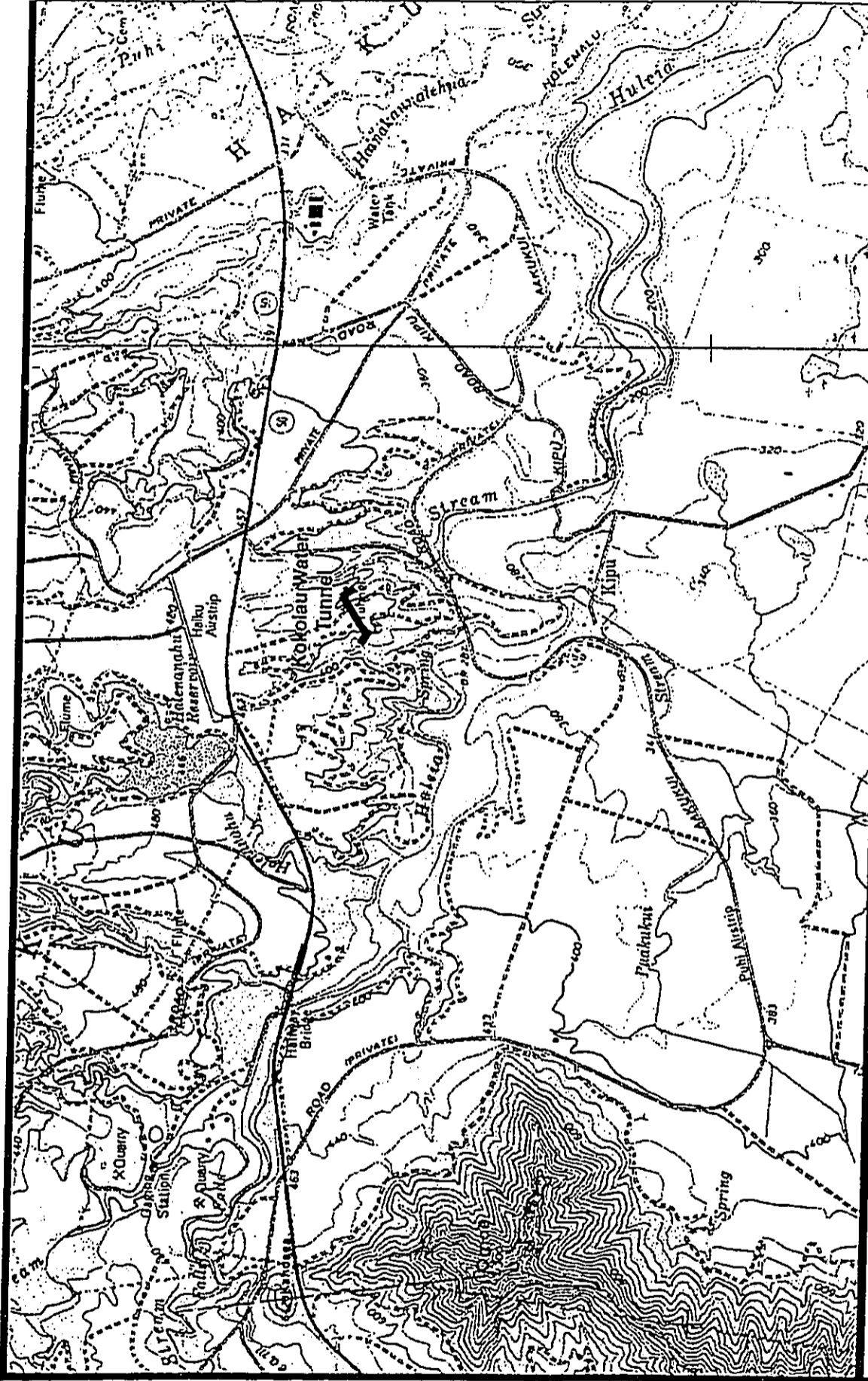
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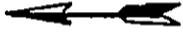

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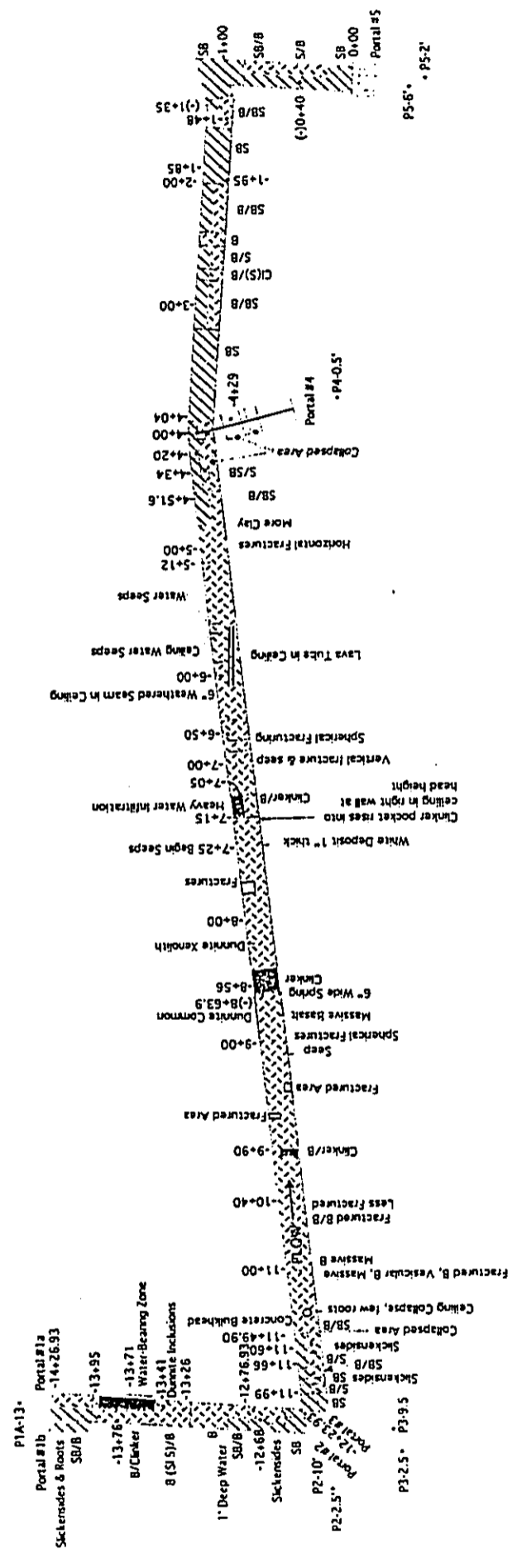
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The following figures and appendix complete this letter report:

- | | |
|------------|--|
| Figure 1 | Map of Area |
| Figure 2 | Site Plan |
| Figure 3 | Cross Sections |
| Figure 4 | Site Plan - Areas of Concern |
| Figure 5 | Site Plan - Sediment Concern |
| Appendix A | Field Investigation and Laboratory Testing |



<p>Base Map: United States Geological Survey 7.5 Minute Series (Topographic), Koloa Quadrangle and Lihue Quadrangle</p> <p>Scale: 1:24,000</p>	<p>North</p> 	 <p>Scale In Feet</p>	<p>Project No. 98086-012</p>		
			<p>Drawn By: BAS</p>		
			<p>Approved By: DRD</p>		
			<p>Date: 06-29-98</p>		
<p>Scale: 1" = 2,000'</p>	<p>Figure 1</p>	<p>Map of Area</p>	<p>Koloiau Water Tunnel</p>	<p>Lihue District, Kauai</p>	
<p>M.F.A. MASA FUJIOKA & ASSOCIATES</p> <p>ENVIRONMENTAL • GEOTECHNICAL • HYDROGEOLOGICAL CONSULTANTS</p>					



Project No. 98086-012

Drawing No.	02
Drawn by: WCS	
Approved by: DDD	
Rev: 04	
Date: 9-16-98	
Scale: 1" = 20'	

Figure 2
SITE PLAN
Kokoua Water Tunnels at Hahaione
Board of Water Supply
Lihue, Kauai, Hawaii

M.F. MASA FUJIOKA & ASSOCIATES
(Incorporated in the State of Hawaii)

LEGEND

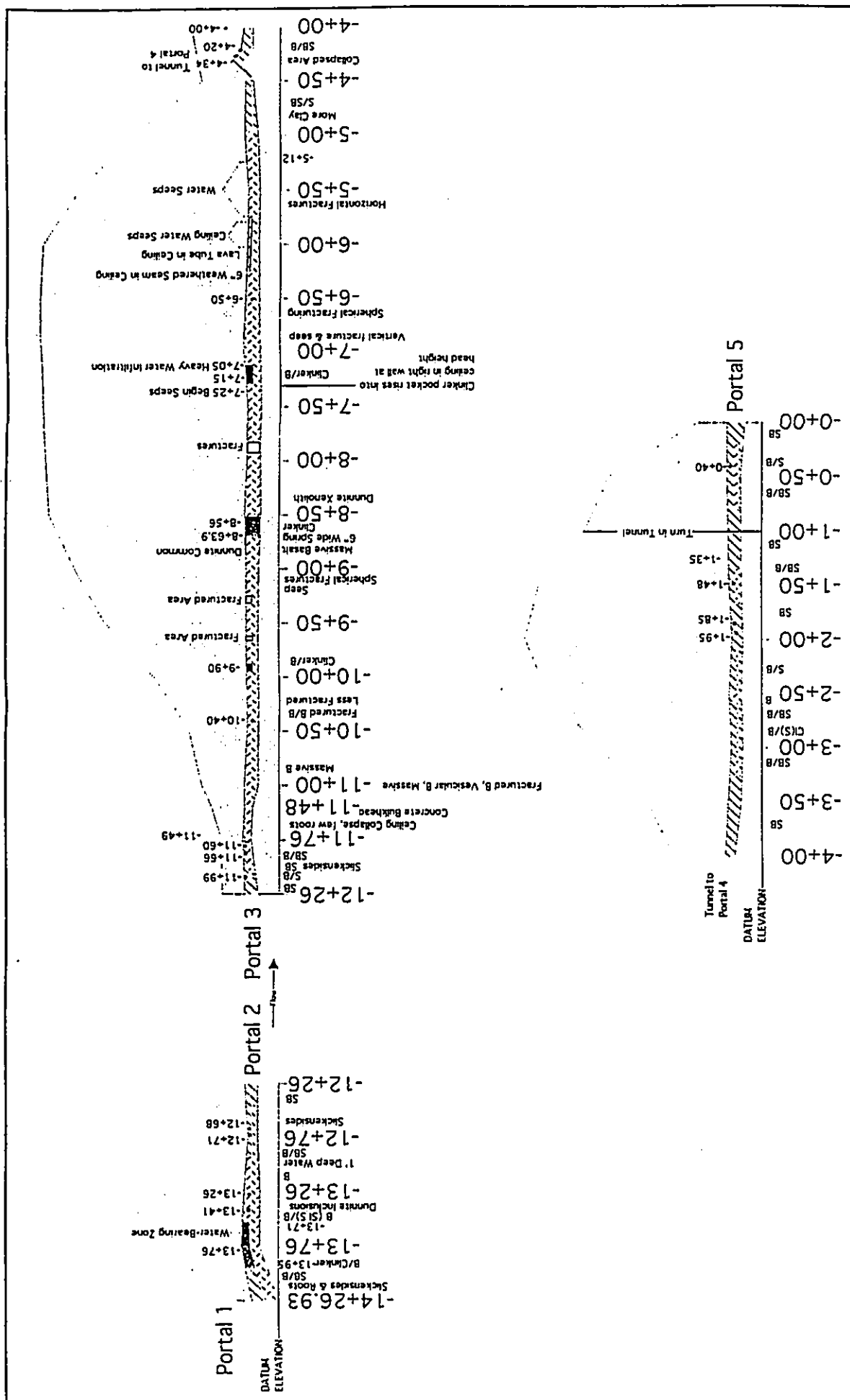
SB	Basalt
S/B	Saprotic Basalt (borders between saprotic and basalt)
S	Saprotic
C	Clayey Silt
C/B	Clinker

1" = 10' 40" Soil or Rock Sample Location, (B)

0 80 160

Approximate Scale in Feet

Modified After: Advanced Worksheet 98-37A.dwg, Dennis M. Esahi



LEGEND

- B Basalt
- SB Sphenitic Basalt (borders between sspirofite and basalt)
- S Sspirofite
- Cl Clayey Silt
- Clinker Clinker

10-40 Soil or Rock Sample Location, ID

Modified After: Advanced Sheet Profile Kakaia Tunnel, SSFM

Figure 3
CROSS SECTIONS
Kakaia Tunnel at Huku
Blair Ferry Tunnel at Huku
Blair Ferry Tunnel at Huku
Lihua, Kauai, Hawaii

Project No: 90066-012
Drawing: 003
Drawn by: WES
Approved by: DFO
Rev: 00
Date: 9-14-99
Scale: 1/1" = 40' V, 1" = 100' H

VERTICAL EXAGGERATION: 2:1
Approximate Scale in Feet

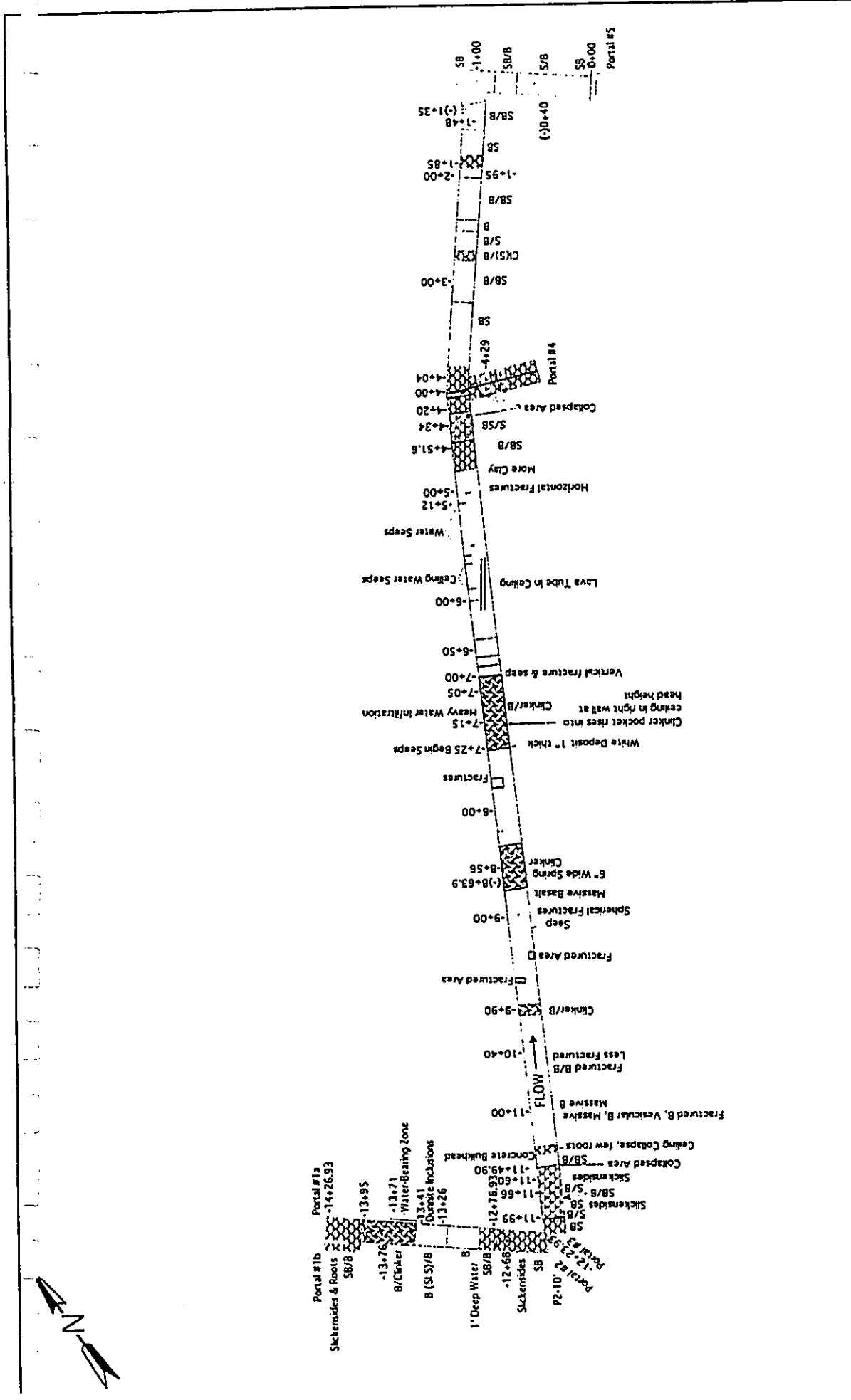


Figure 4
SITE PLAN - Areas of Concern
 Kotou Water Tunnels at Hahaione
 Board of Water Supply
 Lihue, Kauai, Hawaii

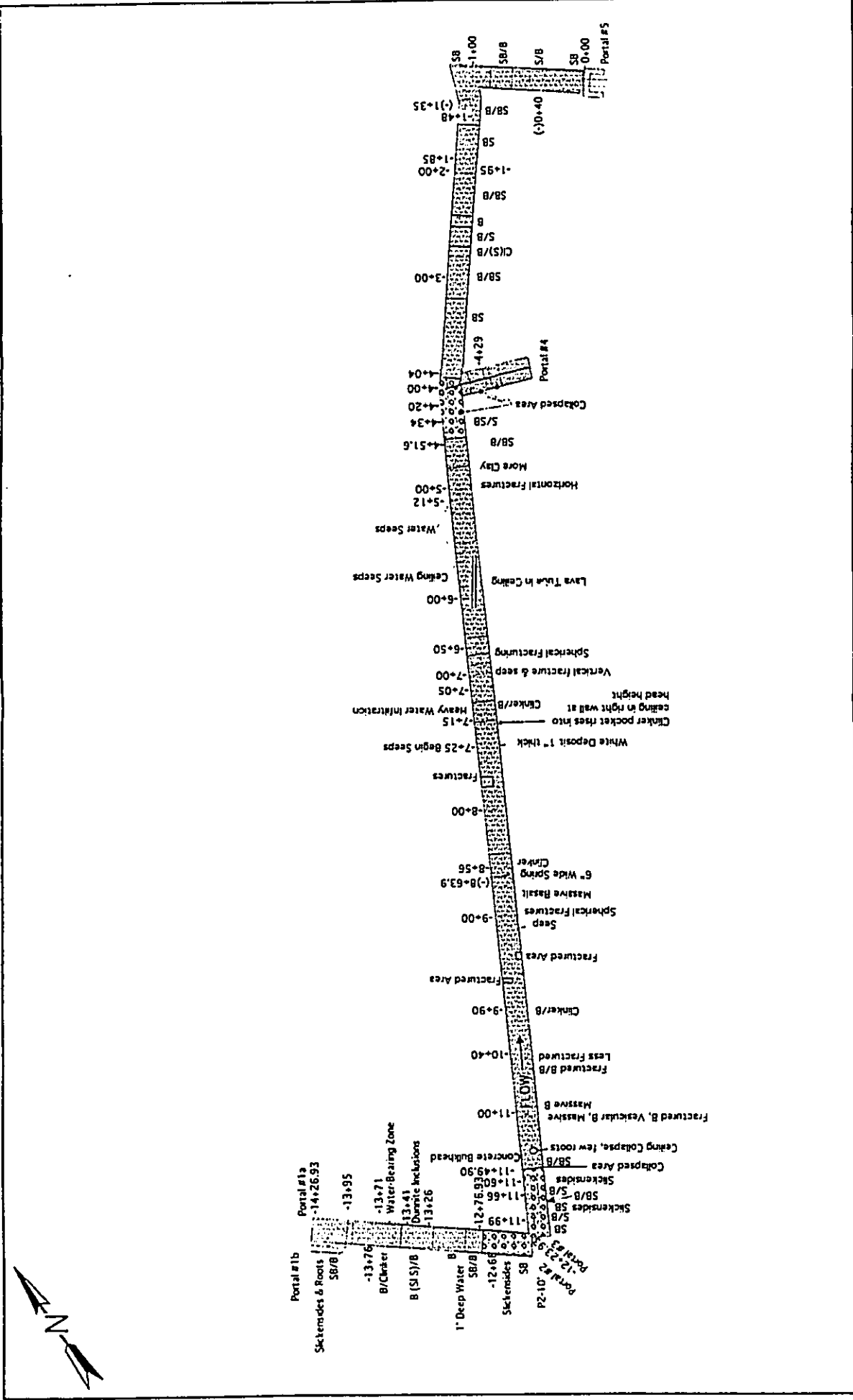
Project No: 98088-012
Drawing No: 04
Drawn by: M335EL
Approved by: DRD
Per: 04
Date: 8.15.98
Scale: 1" = 80'

Modified After: Advanced Worksheet 98-STA.dwg, Dennis H. Easti

LEGEND

	Basalt		Geotechnically Weak Zones
	Saprock		Geotechnically Weak Cinder Zones
	Clayey Silt		Collapsed Area
	Cinder		

0 80 160
 Approximate Scale in Feet



LEGEND

B	Basalt
SB	Saprophytic Basalt (borders between sspirophite and basalt)
S	Sprophite
Cl	Clayey Silt
C	Clinker

[Pattern]	Overburden Areas
[Pattern]	Sediment Areas

Project No. 98086-012
 Drawing No. 005
 Drawn by: MGS
 Approved by: DRD
 Date: 8-12-88
 Scale: 1" = 80'

Figure 5
 SITE PLAN - Sediment Concern
 Koloale Water Tunnel at Habuu
 Board of Water Supply
 Lihue, Kauai, Hawaii

M. F. MASA FUJIOKA & ASSOCIATES
 ENGINEERS, ARCHITECTS, GEOTECHNICAL, HYDROLOGICAL CONSULTANTS

Modified After: Advanced Worksheet 98-57A.dwg, Dennis M. Esalt

Approximate Scale in Feet
 0 80 160

1
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APPENDIX
FIELD INVESTIGATION AND LABORATORY TESTING

APPENDIX A FIELD INVESTIGATION AND LABORATORY TESTING

FIELD INVESTIGATION

The field investigation consisted of a geologic exploration of the tunnel system by three geologists and a geotechnical engineer combined with collection of undisturbed and disturbed soil samples and bulk rock samples. Soil samples were collected for laboratory testing and rock samples were collected for geological identification purposes.

Figures 2 and 3 presents the results our geological exploration program.

Exposed surface conditions at portal entrances were logged and soil samples were collected for laboratory examination. The surface conditions observed at portals are presented in Logs P1 through P5.

Field testing of soil samples consisted of Pocket Penetrometer and Torvane testing to determine the strength properties of soils. Field testing results are presented in Table A1.

Materials encountered were classified according to the Unified Soil Classification System (USCS). Undisturbed soil samples were obtained for inspection, and field and laboratory testing.

LABORATORY TESTING

Physical Properties

Selected samples obtained during the field exploration program were tested to evaluate their physical properties. The tests included moisture and density, gradation tests, and direct shear tests.

Moisture and Density Tests

Moisture and density tests were performed to evaluate moisture and density variations. Results are presented in Table A2.

Gradation Tests

The grain size analysis test was performed in accordance with ASTM C-136 to evaluate the particle size distribution of the sample. Results are presented in Figures A1 through A17.

Direct Shear Test

Direct shear tests were performed to evaluate the soil shear strength, ability to resist deformation, bearing capacity and slope stability. Results are presented in Table A2. Plots of test results are presented in Figures A18 - A20.

- o o -

The following figures are attached and complete this Appendix.

Table A1	Field Testing Results
Table A2	Laboratory Testing Results
Logs P1 - P5	Logs of Exposed Surface Conditions at Portals
Figures A1 - A17	Grain Size Analysis Curves
Figures A18 - A20	Direct Shear Test Plots

TABLE A1
FIELD TESTING RESULTS

Sample Location/ID	Depth (feet)	Pocket Penetrometer (tsf)	Torvane (tsf)
P1-10	10	>4.5	—
P1A-3	3	4.5	0.9
P2-2.5	2.5	2.5	0.4
P2-10	10	1.5	0.1
P3-0.5	0.5	2.0	0.4
P3-2.5	2.5	3.0	0.45
P3-3.5	3.5	4.5	0.55
P3-9.5	9.5	2.0	0.3
P5-3	3	2.0	0.4
P5-3.6	6	2.0	0.4
P5-3.8	8	3.0	0.55
2+27	0	3.0	0.35
2+61	3	4.0	0.3
11+00	Sidewall	>4.5	—
-10+00	Sidewall	>4.5	—
-9+00	Sidewall	>4.5	—
-8+63.9 (spring)	5.5	3.0	—
-8+63.9 (wall)	Sidewall	>4.5	—
-8+00	Sidewall	>4.5	—
-7+00	Sidewall	>4.5	—
-6+00	Sidewall	>4.5	—
-5+00	Sidewall	>4.5	—
-4+34	Sidewall	3.0	0.4
-4+20	1	4.0	—
-4+04	2	2.5	0.45
-4+04, +25', Side Tunnel to Portal No. 4	Sidewall	3.0	0.5
Portal No. 4	3' above floor	>4.5	—
Portal No. 4	5' above floor	2.0	0.35
3+00	Sidewall	>4.5	—
2+00	Sidewall	>4.5	—
-1+85	1	2.5	0.45
1+00	Sidewall	>4.5	—

TABLE A2. SUMMARY OF LABORATORY TEST RESULTS

MOISTURE AND DENSITY TESTS			
LOCATION	DEPTH (FT.) (BTCS)	MOISTURE (%)	WET DENSITY (P.C.F)
-4+04		58	124
-4+29		59	107
-4+34		55	93
P2	10	63	80
P3	2.5	61	83
P3	9.5	52	101
P4	0.5	49	101
P5	2	40	97
P5	6	52	88

DIRECT SHEAR TEST RESULTS

Location	Sample No.	Depth (ft.)	Normal Stress (p.s.f.)	Shear Stress (p.s.f.)	Cohesion (p.s.f.)	Angle of Internal Friction (degrees)
-4+04			932	693	121	31.1
			1580	457		
			2227	1473		
-4+29			932	558	552	1.1
			1580	603		
			2227	582		
-4+34			932	787	269	34.8
			1580	1279		
			2227	2369		
P2 P3 P3 P4 P5 P5	P2-10	10	1580	1353		
	P3-2.5	2.5	932	626		
	P3-9.5	9.5	932	740		
	P4-0.5	0.5	932	549		
	P5-2	2	932	670		
	P5-6	6	932	486		

PROJECT: Kokolau Development Tunnels

JOB NO.: 98086-012

LOG: P1 Portal No. 1

LOCATION: Lihue, Kauai

CLIENT: SSFM

Page 1 of 1

DEPTH (feet)	SAMPLE DATA					SOIL TYPE		SAMPLER: SMI LOGGED BY: SMI SAMPLING METHOD: Slide Hammer HAMMER TYPE: 10-pound		DATE: July 23, 1998 STATIC WATER LEVEL: N/A SURFACE ELEVATION: N/A	
	Density (pct) / Moisture (%)	Pocket Penet./ Torvane (tsf)	Sample Depth (feet)	Sample Number	Sample	Symbols	USCS	SURFACE CONDITIONS: Grass, roots, partially weathered basaltic boulders			
DESCRIPTION											
0							ML	Saprolite (reddish brown clayey SILT), partially weathered boulders in matrix (3 inches to 1 foot exposed). Moist to dry, very stiff to hard.			
5							Boulders	Basaltic boulders, layered, partially weathered, roots.			
10		>4.5/ N.R.	10	P1-10	☒		Basalt	Tunnel begins at 8 feet at 0+00; 10 feet at 0+06.5 feet. Sampling and testing was performed in Saprolite, approximately 2 feet from the side of Portal 1. Massive basaltic rock.			
15			15	TP1-15	☒		GM	Lower limit of tunnel. Some standing water (2' X 2' area) in the stream channel. Heterogeneous Fill (sand, boulders, silt, roots, etc.) at the bottom of channel.			
20											
25											
30											

Note: Depths are relative to the top of the cut slope at portal.

LEGEND:

- Relatively undisturbed sample
- ☒ Disturbed sample
- Sampling attempted, no recovery
- ▣ SPT sample
- ☑ SPT sample, no recovery

NOTE: Depths are represented in feet below ground surface (bgs)

EXPOSED SURFACE CONDITIONS

County of Kauai, Board of Water Supply
Kokolau Development Tunnel
Lihue, Kauai, Hawaii

M_FA MASA FUJIOKA & ASSOCIATES

ENVIRONMENTAL • GEOTECHNICAL • HYDROGEOLOGICAL CONSULTANTS

PROJECT: Kokolau Development Tunnels

JOB NO.: 98086-012

**LOG: P1A
Portal No. 1A**

LOCATION: Lihue, Kauai

CLIENT: SSFM

Page 1 of 1

DEPTH (feet)	SAMPLE DATA					SOIL TYPE		DESCRIPTION
	Density (pcf) / Moisture (%)	Pocket Penet./ Torvane (tsf)	Sample Depth (feet)	Sample Number	Sample	Symbols	USCS	
0								SAMPLER: SMI LOGGED BY: SMI SAMPLING METHOD: Slide Hammer HAMMER TYPE: 10-pound DATE: July 23, 1998 STATIC WATER LEVEL: N/A SURFACE ELEVATION: N/A SURFACE CONDITIONS: Grass, reddish brown clayey SILT, roots.
5							ML	Reddish brown clayey SILT, moist, medium stiff to stiff.
10							ML/Basalt	Saprolite, weathered/partially weathered, dry, stiff to very stiff.
15	4.5/ 0.9	13	P1A- 13				SM	Saprolite/Basaltic rock, partly weathered saprolite. Tunnel begins. Saprolite, partly weathered. Basaltic rock layered in the sides.
20								Lower limit of tunnel. Some debris at the stream channel including basaltic and saprolitic boulders.
25								
30								

Note: Depths are relative to the top of the cut slope at portal.

LEGEND:

- Relatively undisturbed sample
- Disturbed sample
- Sampling attempted, no recovery
- SPT sample
- SPT sample, no recovery

NOTE: Depths are represented in feet below ground surface (bgs)

**EXPOSED SURFACE
CONDITIONS**

County of Kauai, Board of Water Supply
Kokolau Development Tunnel
Lihue, Kauai, Hawaii

M_FA MASA FUJIOKA & ASSOCIATES
ENVIRONMENTAL • GEOTECHNICAL • HYDROGEOLOGICAL CONSULTANTS

PROJECT: Kokolau Development Tunnels

JOB NO.: 98086-012

**LOG: P2
Portal No. 2**

LOCATION: Lihue, Kauai

CLIENT: SSFM

Page 1 of 1

DEPTH (feet)	SAMPLE DATA					SOIL TYPE		SAMPLER: SMI LOGGED BY: SMI SAMPLING METHOD: Slide Hammer HAMMER TYPE: 10-pound		DATE: July 23, 1998 STATIC WATER LEVEL: N/A SURFACE ELEVATION: N/A		
	Density (pct) / Moisture (%)	Pocket Panel / Torvane (ts)	Sample Depth (feet)	Sample Number	Sample	Symbols	USCS	SURFACE CONDITIONS: Reddish brown clayey SILT with roots, moist, medium stiff.				
DESCRIPTION												
0												Reddish brown clayey SILT, medium stiff, moist, roots. Becomes medium stiff to stiff, dry to slightly moist. Abundant fissures; falling apart at the tunnel face.
		2.5 / 0.4	2.5	P2-2.5			ML					
5												Weathered basaltic rock. Top of tunnel at 4.5 feet below grade.
							Basalt					Layered basaltic rock. Partly weathered, with roots.
10	80 / 63	1.5 / 0.1	10	P2-10								Lower limit of tunnel at 9.25 feet below grade. Heterogeneous Fill (silt, basaltic gravel, roots), soft to medium stiff.
							SM					
15												
20												
25												
30												

Note: Depths are relative to the top of the cut slope at portal.

LEGEND:

- Relatively undisturbed sample
- Disturbed sample
- Sampling attempted, no recovery
- SPT sample
- SPT sample, no recovery

NOTE: Depths are represented in feet below ground surface (bgs)

**EXPOSED SURFACE
CONDITIONS**

County of Kauai, Board of Water Supply
Kokolau Development Tunnel
Lihue, Kauai, Hawaii

M_FA MASA FUJIOKA & ASSOCIATES
ENVIRONMENTAL • GEOTECHNICAL • HYDROGEOLOGICAL CONSULTANTS

PROJECT: Kokolau Development Tunnels

JOB NO.: 98086-012

LOG: P3
Portal No. 3

LOCATION: Lihue, Kauai

CLIENT: SSFM

Page 1 of 1

DEPTH (feet)	SAMPLE DATA					SOIL TYPE		SAMPLER: SMI LOGGED BY: SMI SAMPLING METHOD: Slide Hammer HAMMER TYPE: 10-pound		DATE: July 23, 1998 STATIC WATER LEVEL: N/A SURFACE ELEVATION: N/A	
	Density (pcf) / Moisture (%)	Pocket Torvane (ts)	Sample Depth (feet)	Sample Number	Sample	Symbols	USCS	SURFACE CONDITIONS: Slope area. Reddish brown silty SAND, roots, moist.			
DESCRIPTION											
0											
	83/61	2.0/0.4 3.0/0.45 4.5/0.55	0.5 2.5 3.5	P3-0.5 P3-2.5 P3-3.5	☒ ☐ ☒		SM	Reddish brown silty SAND, moist, medium stiff to stiff, roots. Fissures in face, falls apart easily, medium stiff to stiff. Saprolite, partially to fully weathered. Can be broken by hand. Top of tunnel. Sides of tunnel: Saprolite, partially to fully weathered, with pores, layered.			
5											
	101/52	2.0/0.3	9.5	P3-9.5	☐		ML	Lower limit of tunnel. Heterogeneous Fill (silt, gravel, vegetation, etc.). Soft to medium stiff.			
10											
15											
20											
25											
30											

Note: Depths are relative to the top of the cut slope at portal.

LEGEND:

- Relatively undisturbed sample
- ☒ Disturbed sample
- ☐ Sampling attempted, no recovery
- ▣ SPT sample
- ☑ SPT sample, no recovery

NOTE: Depths are represented in feet below ground surface (bgs)

EXPOSED SURFACE CONDITIONS

County of Kauai, Board of Water Supply
Kokolau Development Tunnel
Lihue, Kauai, Hawaii

M_FA MASA FUJIOKA & ASSOCIATES
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PROJECT: Kokolau Development Tunnels

JOB NO.: 98086-012

**LOG: P4
Portal No. 4**

LOCATION: Lihue, Kauai

CLIENT: SSFM

Page 1 of 1

DEPTH (feet)	SAMPLE DATA					SOIL TYPE		DESCRIPTION
	Density (pcf) / Moisture (%)	Pocket Penet./ Torvane (tsf)	Sample Depth (feet)	Sample Number	Sample	Symbols	USCS	
0	101/49	2.0/0.35	0.5	P4-0.5	█		GM	Reddish brown silty GRAVEL with SAND, moist, medium stiff to stiff, roots. Saprolitic boulders; Tunnel begins.
5	>4.5/ N.R.		3.0	P4-3.0	█			
5								Lower limit of tunnel. Roots, boulders, debris.
10								
15								
20								
25								
30								

Note: Depths are relative to the top of the cut slope at portal.

LEGEND:

- █ Relatively undisturbed sample
- ⊗ Disturbed sample
- Sampling attempted, no recovery
- ▣ SPT sample
- ▤ SPT sample, no recovery

NOTE: Depths are represented in feet below ground surface (bgs)

EXPOSED SURFACE CONDITIONS

County of Kauai, Board of Water Supply
Kokolau Development Tunnel
Lihue, Kauai, Hawaii

M_FA MASA FUJIOKA & ASSOCIATES

ENVIRONMENTAL • GEOTECHNICAL • HYDROGEOLOGICAL CONSULTANTS

PROJECT: Kokolau Development Tunnels

JOB NO.: 98086-012

LOCATION: Lihue, Kauai

CLIENT: SSFM

LOG: P5 Portal No. 5

Page 1 of 1

DEPTH (feet)	SAMPLE DATA					SOIL TYPE		DESCRIPTION
	Density (pct) / Moisture (%)	Pocket Penet./ Torvane (tsf)	Sample Depth (feet)	Sample Number	Sample	Symbols	USCS	
0								SURFACE CONDITIONS: Reddish brown SILTY SAND with roots, moist, medium stiff to stiff.
3	97/40	2.0/0.4	3	P5-3	■	●	SM	Reddish brown silty SAND, medium stiff to stiff, moist, roots. Top of tunnel at 5.5 feet below grade. Reddish brown sandy SILT, medium stiff to stiff, moist. Lower limit of tunnel at 7 feet below grade.
6	88/52	2.0/0.4	6	P5-6	■	●	ML	
8		3.0/0.55	8	P5-8	⊗	●		
10								
15								
20								
25								
30								

Note: Depths are relative to the top of the cut slope at portal.

LEGEND:

- Relatively undisturbed sample
- ⊗ Disturbed sample
- Sampling attempted, no recovery
- ▣ SPT sample
- ▤ SPT sample, no recovery

NOTE: Depths are represented in feet below ground surface (bgs)

EXPOSED SURFACE CONDITIONS

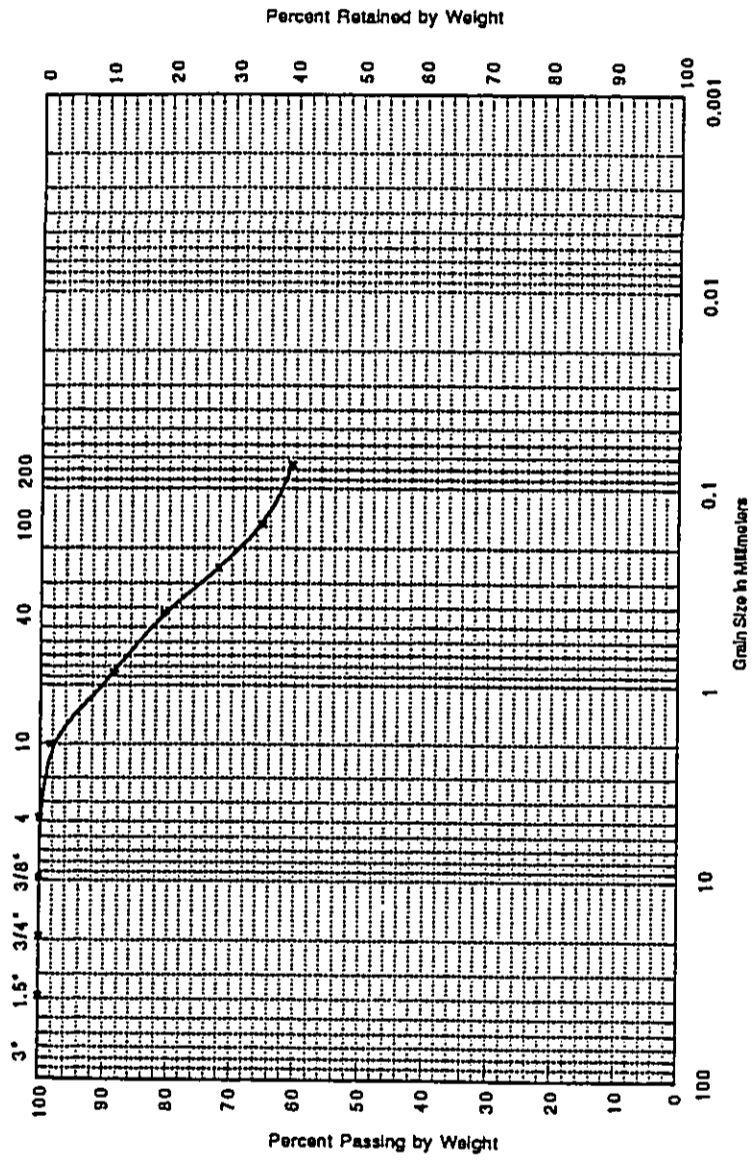
County of Kauai, Board of Water Supply
Kokolau Development Tunnel
Lihue, Kauai, Hawaii

M_FA MASA FUJIOKA & ASSOCIATES
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GRAIN SIZE ANALYSIS

Project: Kokoiu Water Tunnels at Haku
 Job No: 88086-012
 Sample: Brown sandy silt
 Station: 3+24
 Depth:

SOIL CLASSIFICATION: M L



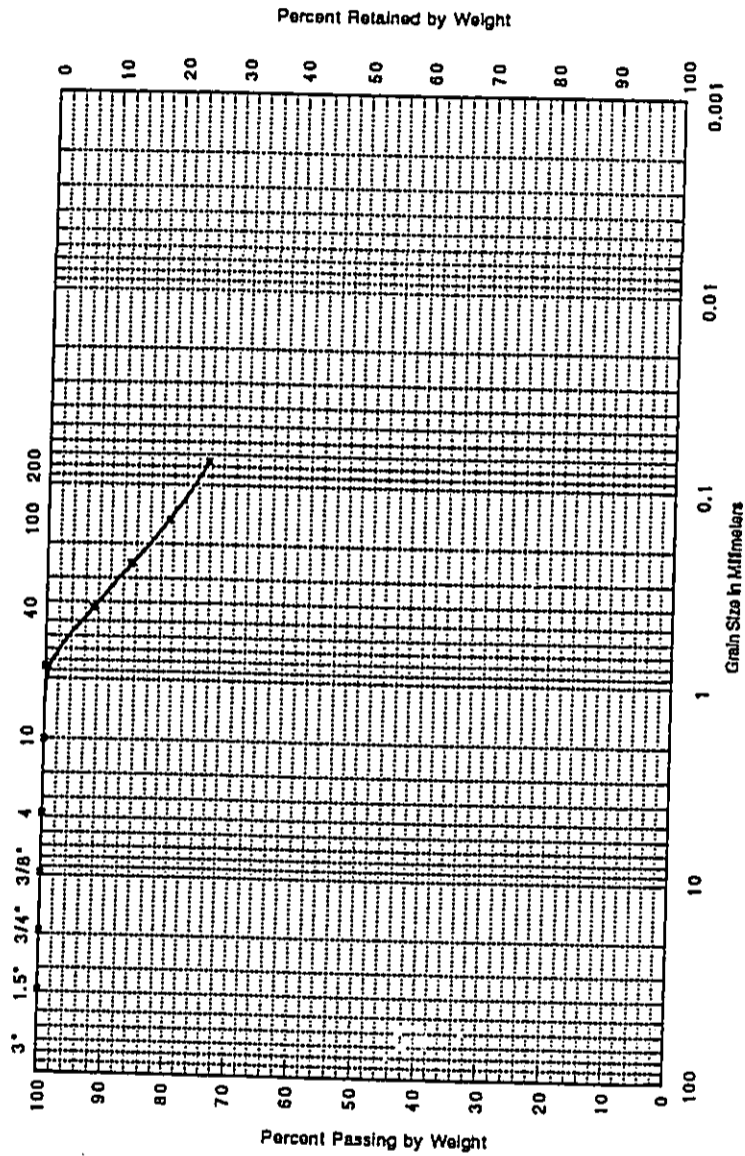
GRAVEL	SAND				SILT	CLAY
	Coarse	Fine	Coarse	Medium		

Figure A1
 MASA FUJIOKA & ASSOCIATES

GRAIN SIZE ANALYSIS

Project Kokoleu Water Tunnel at Hailu
 Job No: 98088-012
 Sample: Brown sandy silt
 Station: -4+04
 Depth:

SOIL CLASSIFICATION: **ML**



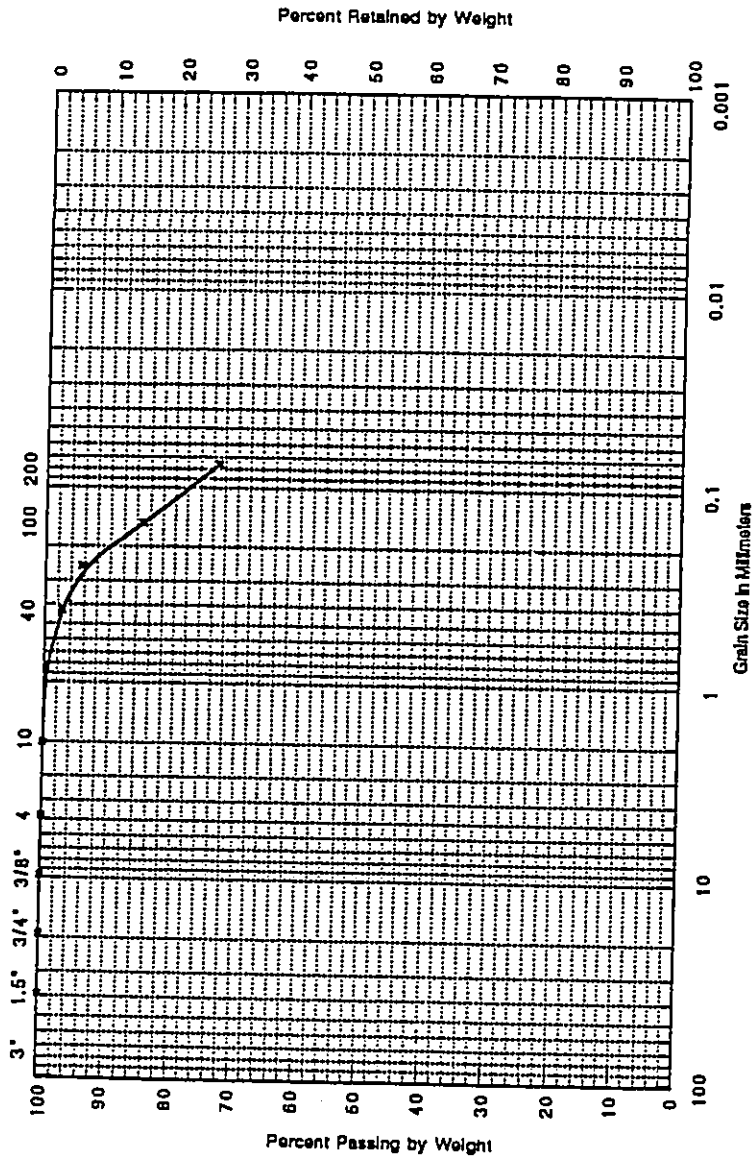
GRAVEL		SAND			SILT		CLAY
Coarse	Fine	Coarse	Medium	Fine			

Figure A2
 MASA FUJIOKA & ASSOCIATES

GRAIN SIZE ANALYSIS

Project: Kokolau Water Tunnels at Haku
 Job No: 98088-012
 Sample: Brown sandy silt
 Station: -4+29
 Depth:

SOIL CLASSIFICATION: M L



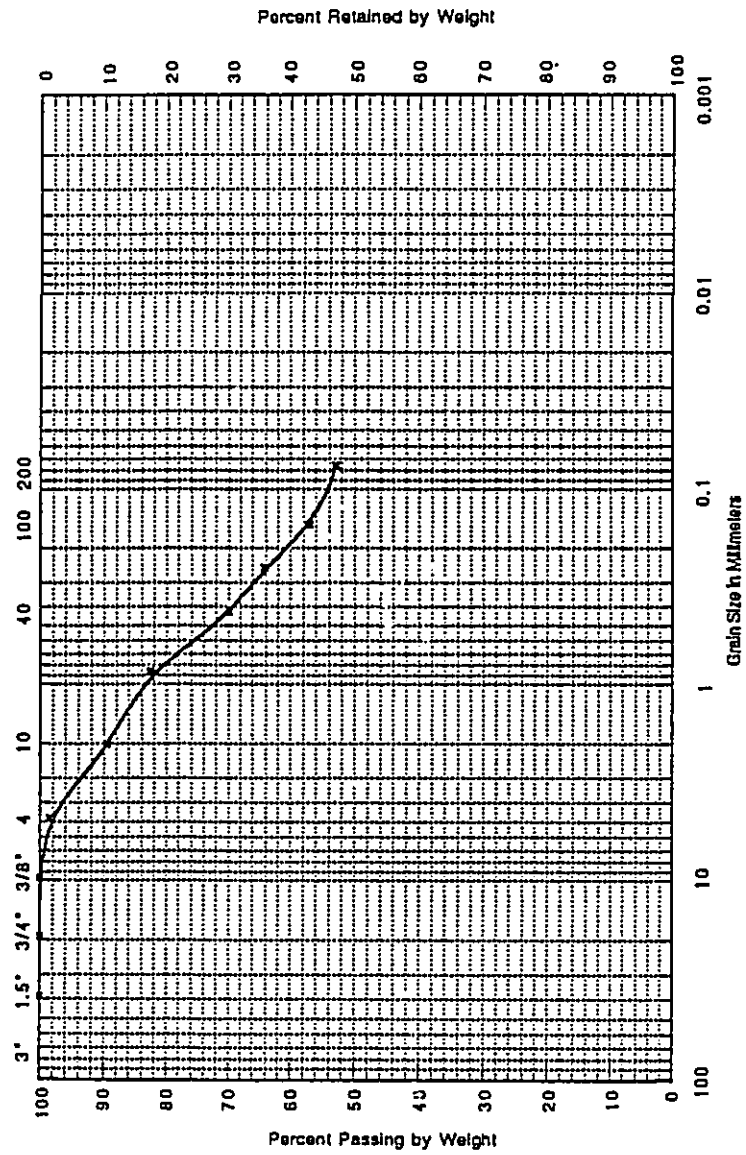
GRAVEL	SAND			SILT	CLAY
	Coarse	Fine	Fine		

Figure A3
 MASA FUJIOKA & ASSOCIATES

GRAIN SIZE ANALYSIS

Project: Kokolau Water Tunnels at Heiaku
 Job No: 88088-012
 Sample: Brown sandy silt
 Station: -1+34
 Depth:

SOIL CLASSIFICATION: M L



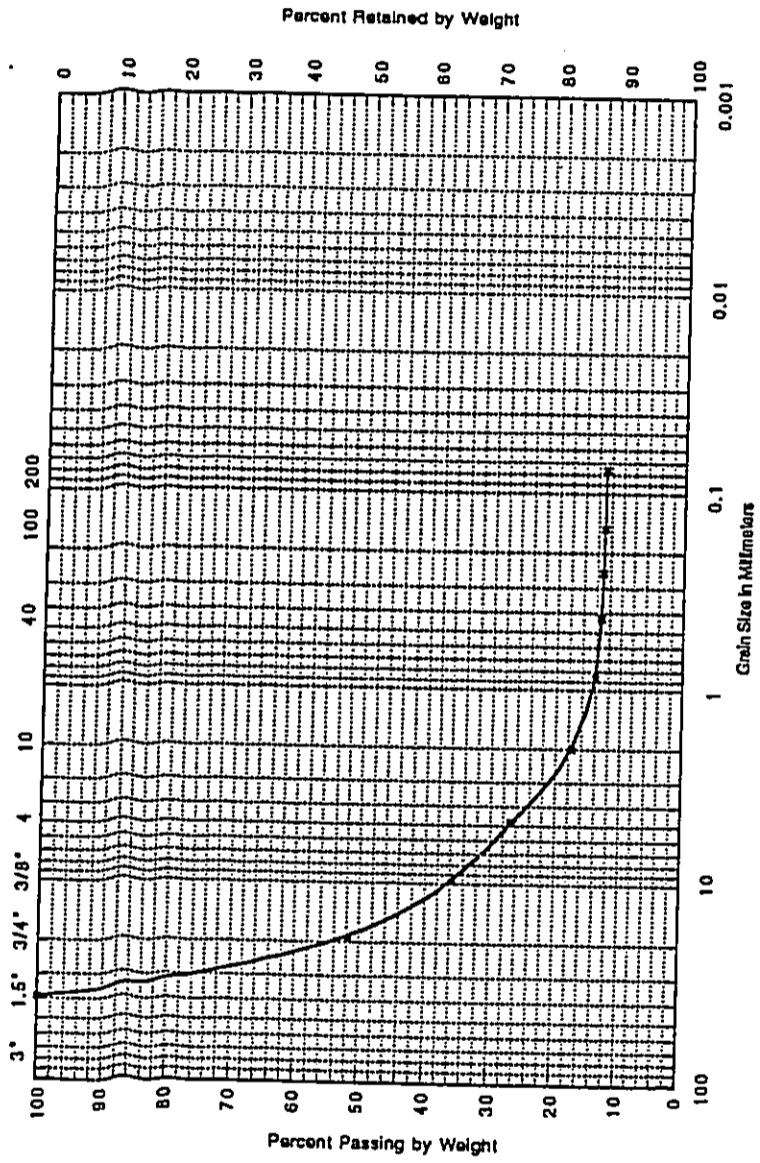
GRAVEL		SAND		SILT		CLAY
Coarse	Fine	Coarse	Medium	Fine		

Figure A4
 MASA FUJIOKA & ASSOCIATES

GRAIN SIZE ANALYSIS

Project: Kokodau Water Tunnels at Hailu
 Job No: 98086-012
 Sample: Silty Gravel (Claybars)
 Station: -7+05 (Water Fall Area)
 Depth:

SOIL CLASSIFICATION: GM



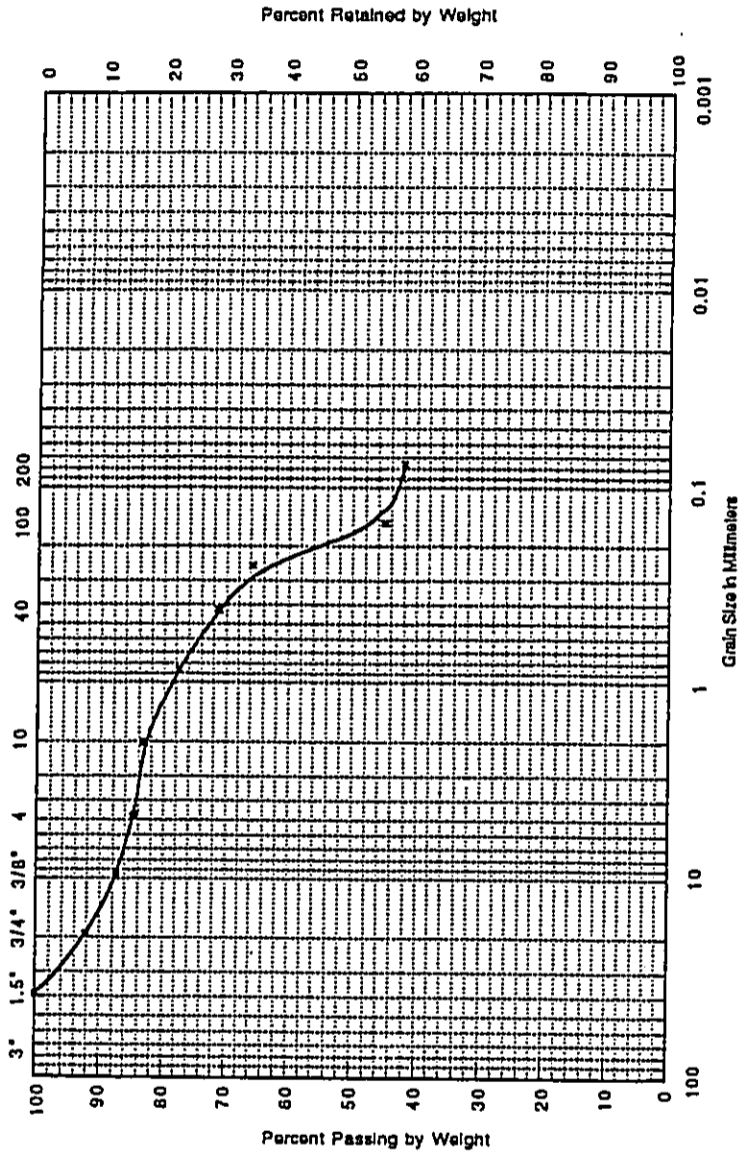
GRAVEL		SAND			SILT		CLAY
Coarse	Fine	Coarse	Medium	Fine			

Figure A5
 MASA FUJIOKA & ASSOCIATES

GRAIN SIZE ANALYSIS

Project: Kokoleau Water Tunnels at Haku
 Job No: 98088-012
 Sample: Brown silty sand w/ gravel
 Station: -11+88
 Depth:

SOIL CLASSIFICATION: S M



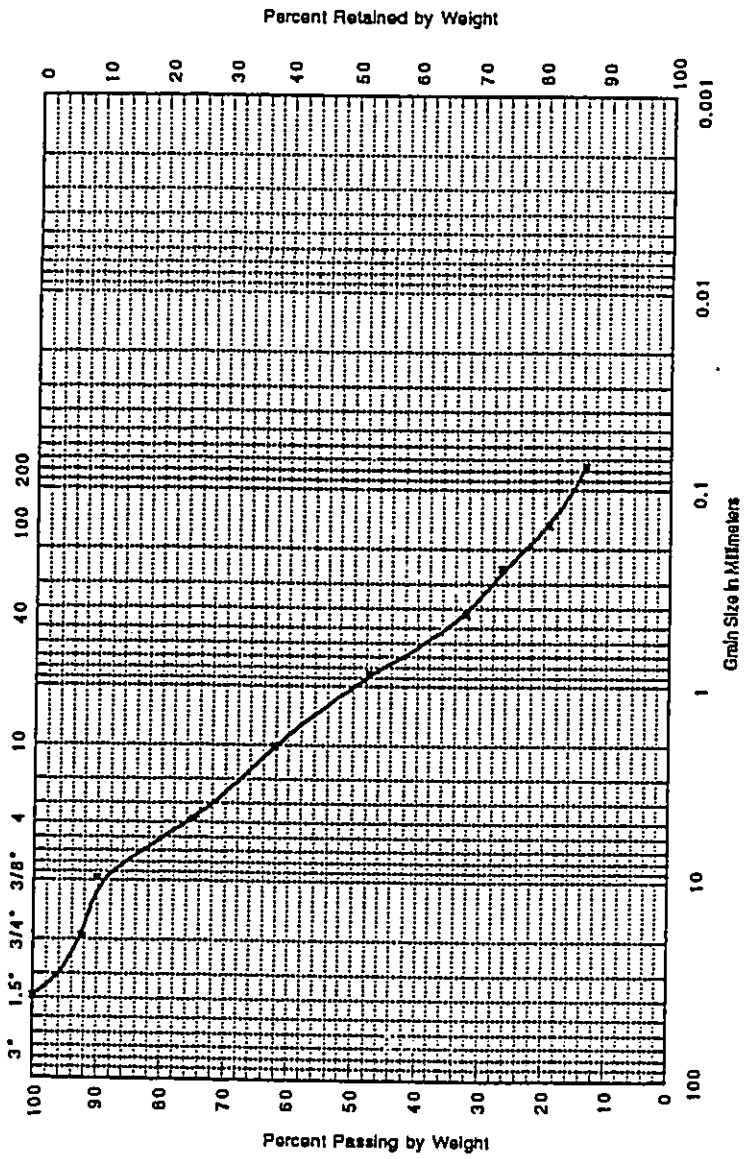
GRAVEL	SAND			SILT	CLAY
	Coarse	Fine	Fine		

Figure A8
 MASA FUJIOKA & ASSOCIATES

GRAIN SIZE ANALYSIS

Project: Kokoiu Water Tunnels at Haku
 Job No: 98086-012
 Sample: Brown silty sand w/ gravel
 Location: P1
 Depth: 10 ft. blocs (below top of cut slope)

SOIL CLASSIFICATION: S M



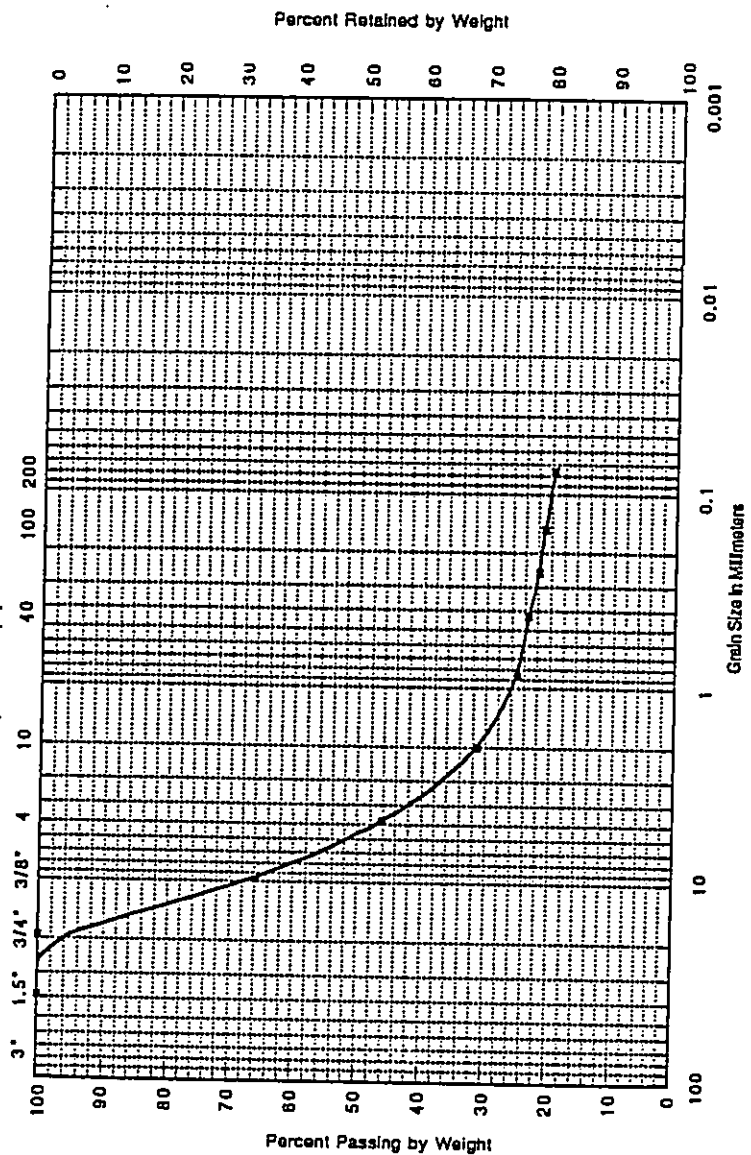
GRAVEL	SAND			SILT	CLAY
	Coarse	Fine	Fine		

Figure A7
 MASA FUJIOKA & ASSOCIATES

GRAIN SIZE ANALYSIS

Project: Kokoiu Water Tunnels at Haku
 Job No: 98088-012
 Sample: Brown silty gravel w/ sand (Saprolite)
 Location: P1
 Depth: 15 ft. blocs (below top of cut slope)

SOL CLASSIFICATION: GM



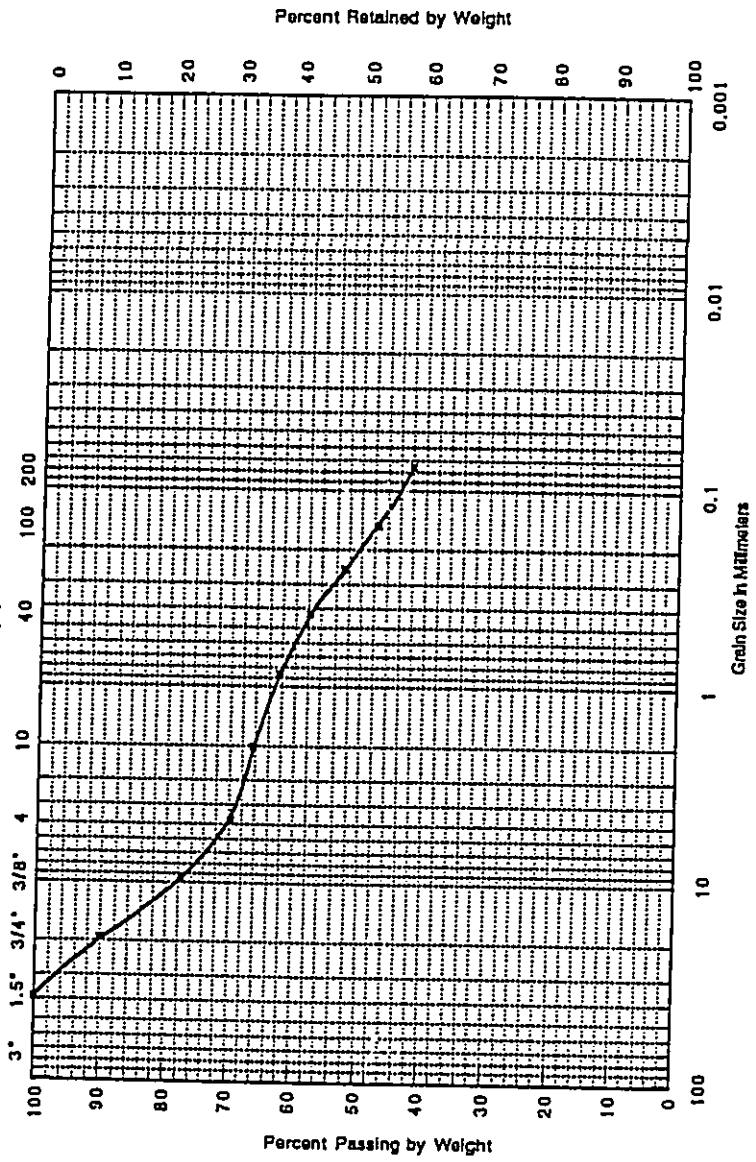
GRAVEL	SAND	SILT	CLAY
Coarse	Medium		
Fine	Fine		

Figure A8
 MASA FUJIOKA & ASSOCIATES

GRAIN SIZE ANALYSIS

Project: Kokoau Water Tunnels at Heiuku
 Job No: 98086-012
 Sample: Brown silty sand w/ gravel (Saprdllie)
 Location: P1A
 Depth: 13 IL blocs (below top of cut slope)

SOIL CLASSIFICATION: SM



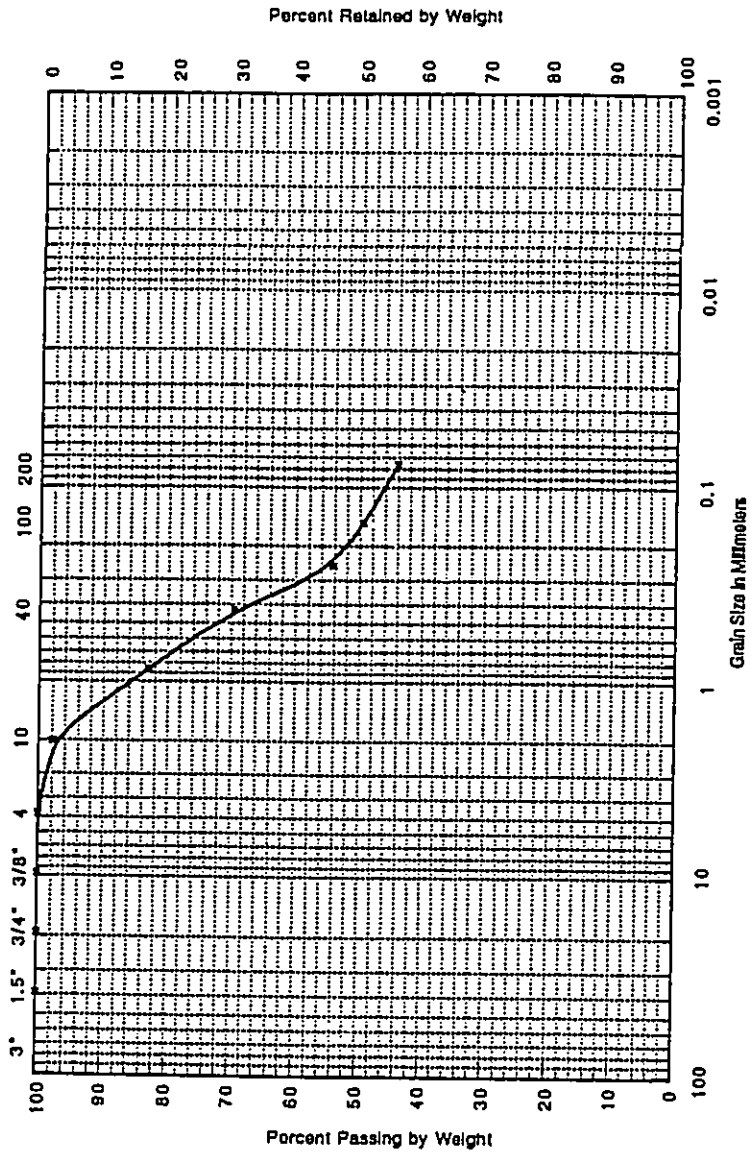
GRAVEL	SAND			SILT	CLAY
	Coarse	Fine	Fine		

Figure A9
 MASA FUJIOKA & ASSOCIATES

GRAIN SIZE ANALYSIS

Project: Kokoleu Water Tunnels at Haku
 Job No: 98088-012
 Sample: Brown silty sand
 Location: P2
 Depth: 10 ft. blocs (below top of cut slope)

SOIL CLASSIFICATION S M



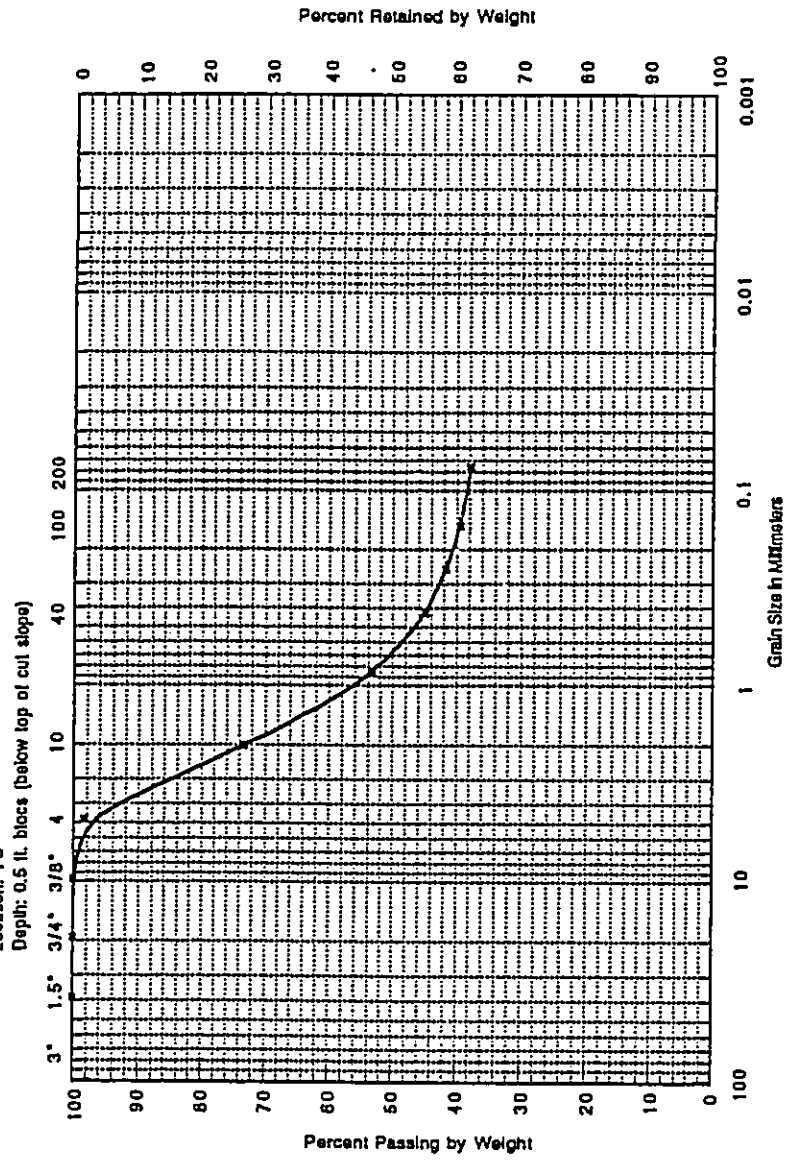
GRAVEL	SAND			SILT	CLAY
	Coarse	Medium	Fine		

Figure A10
 MASA FUJIOKA & ASSOCIATES

GRAIN SIZE ANALYSIS

Project: Kokolau Water Tunnels at Haku
 Job No: 98088-012
 Sample: Brown silty sand
 Location: P3
 Depth: 0.5 ft. below top of cut slope)

SOIL CLASSIFICATION: S.M



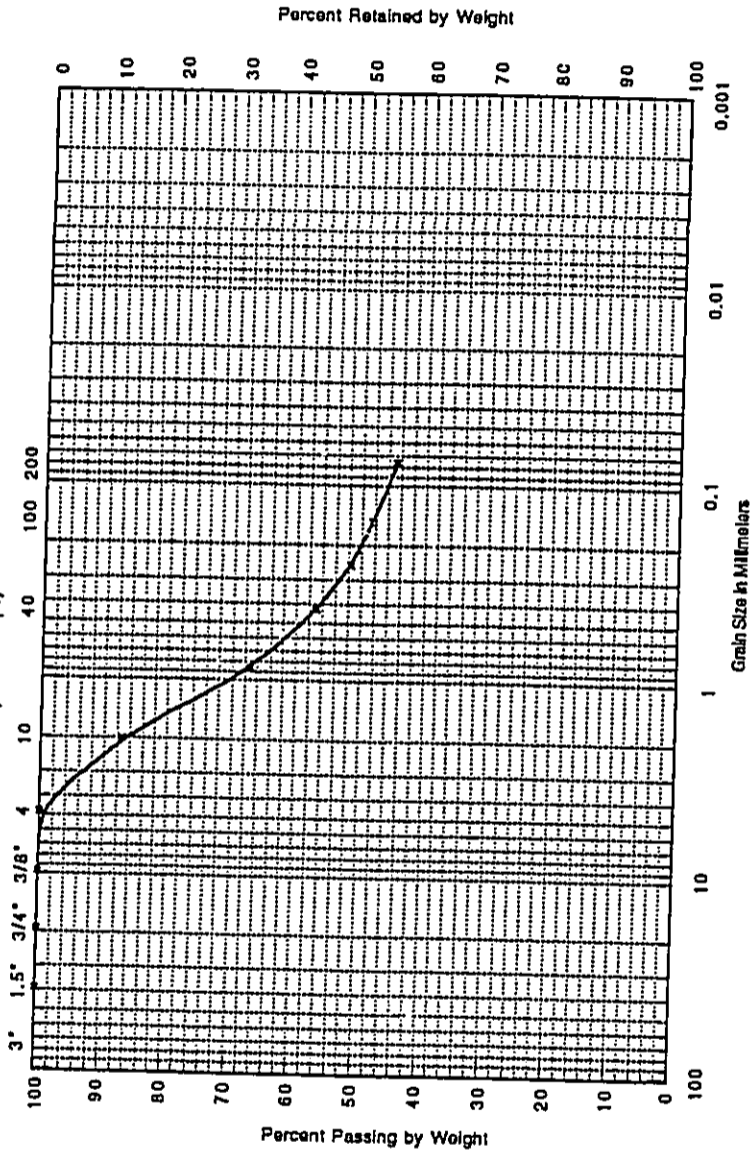
GRAVEL		SAND			SILT		CLAY
		Coarse	Fine	Medium			

Figure A11
 MASA FUJIOKA & ASSOCIATES

GRAIN SIZE ANALYSIS

Project: Kokolau Water Tunnels at Heleku
 Job No: 98088-012
 Sample: Brown silty sand
 Location: P3
 Depth: 2.5 ft. blocs (below top of cut slope)

SOIL CLASSIFICATION: SM



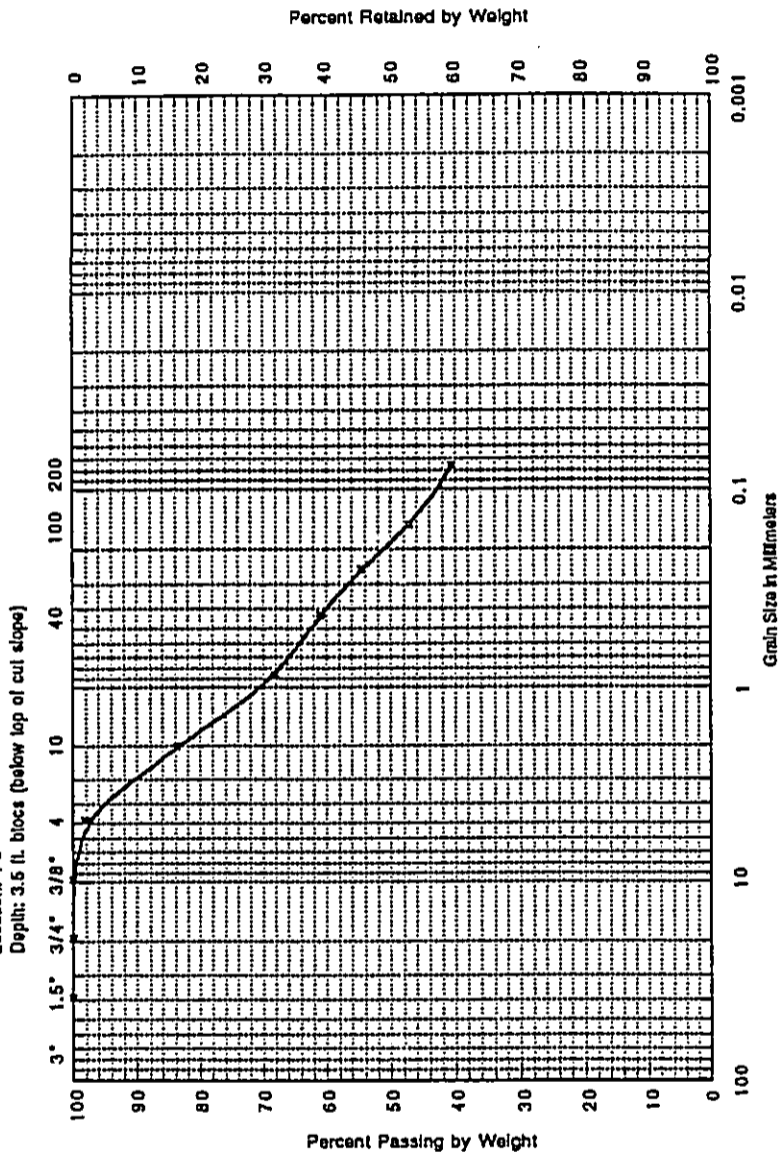
GRAVEL	SAND			SILT	CLAY
	Coarse	Fine	Coarse		

Figure A12
 MASA FUJIOKA & ASSOCIATES

GRAIN SIZE ANALYSIS

Project: Kokoleu Water Tunnels at Hailu
 Job No: 98066-012
 Sample: Brown silty sand
 Location: P3
 Depth: 3.5 ft. below top of cut slope)

SOIL CLASSIFICATION: SM



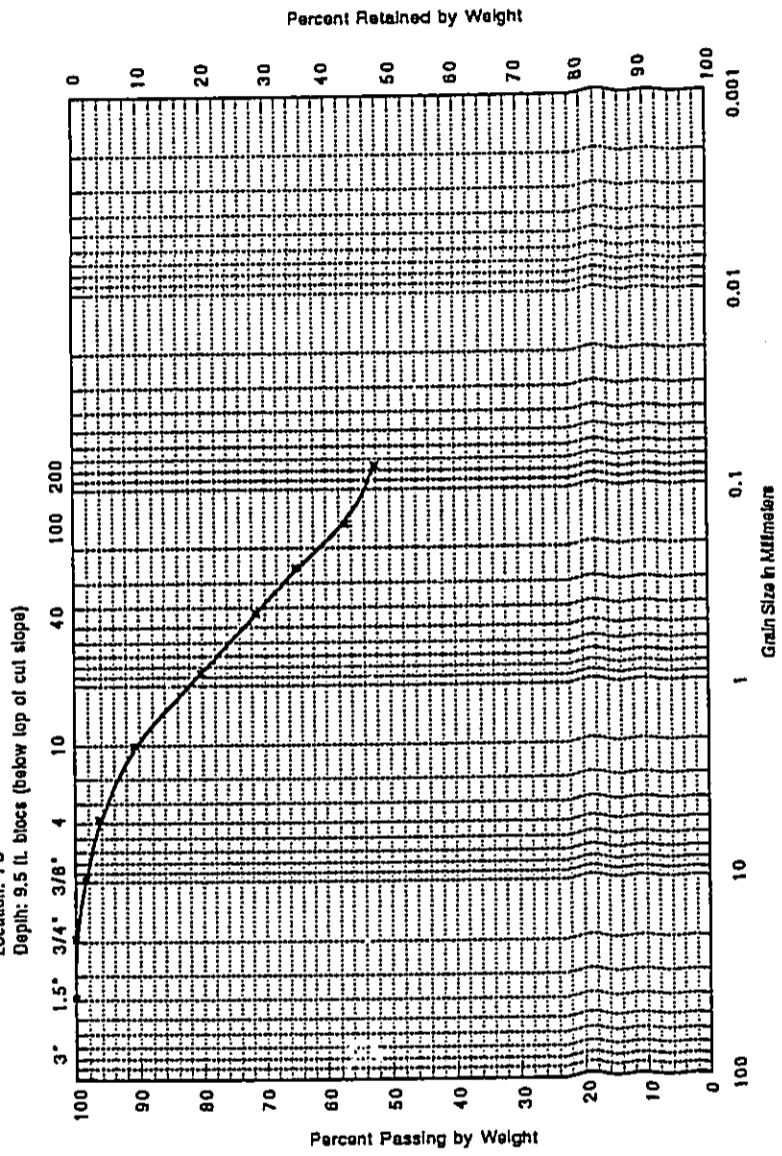
GRAVEL	SAND		SILT	CLAY
	Coarse	Fine		

Figure A13
 MASA FUJIOKA & ASSOCIATES

GRAIN SIZE ANALYSIS

Project: Kokoleu Water Tunnels at Halku
 Job No: 98088-012
 Sample: Brown sandy silt
 Location: P3
 Depth: 9.5 ft. blocs (below top of cut slope)

SOIL CLASSIFICATION: M.L



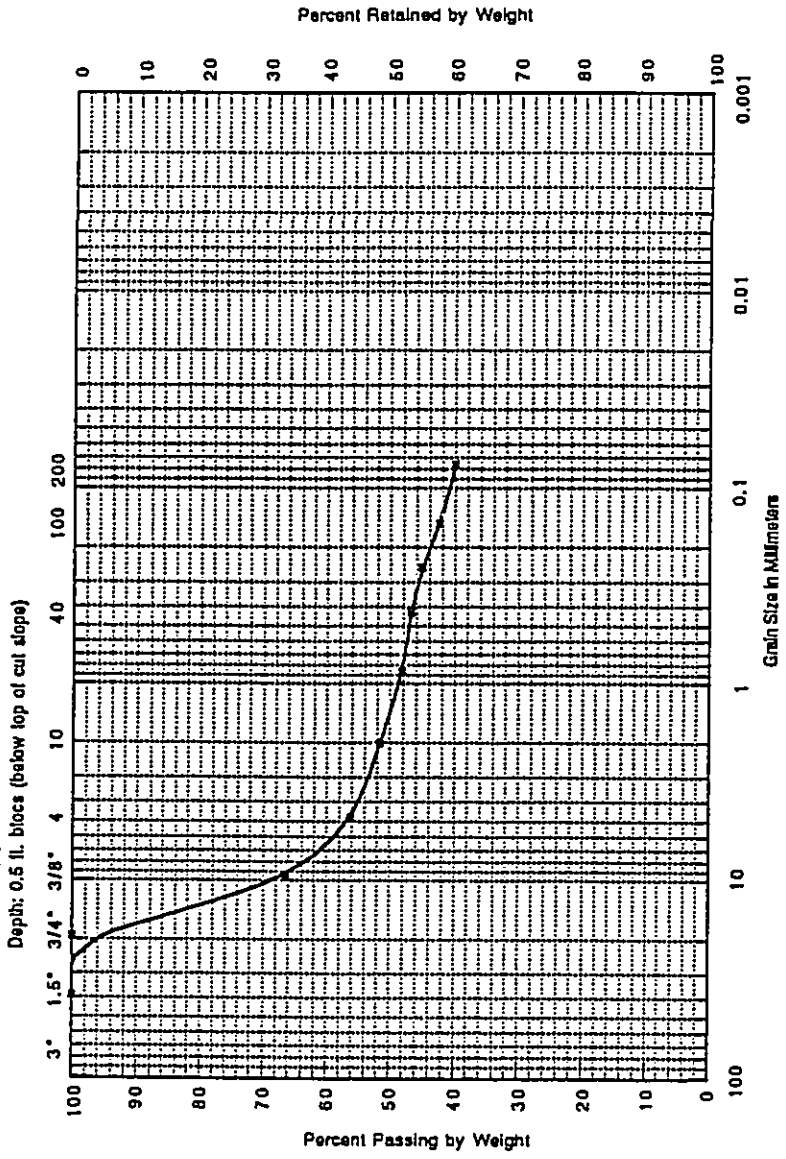
GRAVEL	SAND	SILT	CLAY
Coarse	Coarse		
Fine	Medium		
	Fine		

Figure A14
 MASA FUJIOKA & ASSOCIATES

GRAIN SIZE ANALYSIS

Project: Kokolau Water Tunnels at Haku
 Job No: 98066-012
 Sample: Brown silty gravel w/ sand
 Location: P4
 Depth: 0.5 ft. blocs (below top of cut slope)

SOIL CLASSIFICATION: **GM**



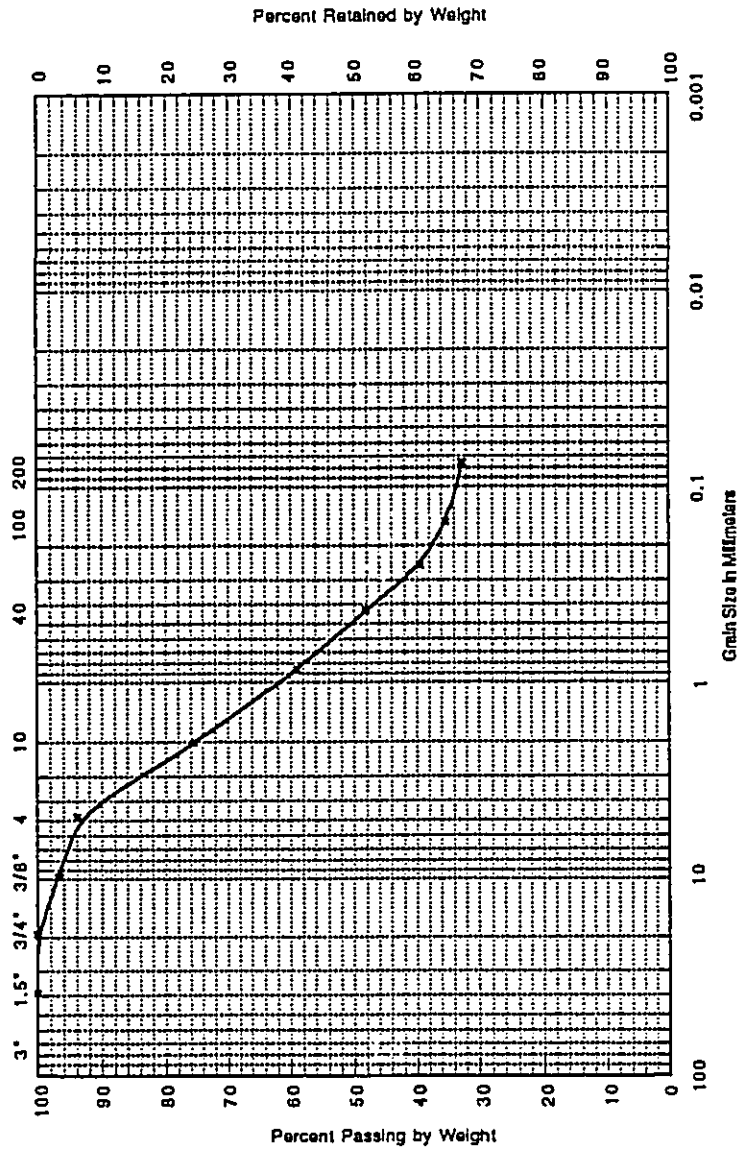
GRAVEL	SAND			SILT	CLAY
	Coarse	Fine	Fine		

Figure A15
 MASA FUJIOKA & ASSOCIATES

GRAIN SIZE ANALYSIS

Project: Kokoleu Water Tunnels at Haiku
 Job No: 88088-012
 Sample: Brown silty sand
 Location: PS
 Depth: 2.0 ft. blocs (below top of cul slope)

SOIL CLASSIFICATION: SM



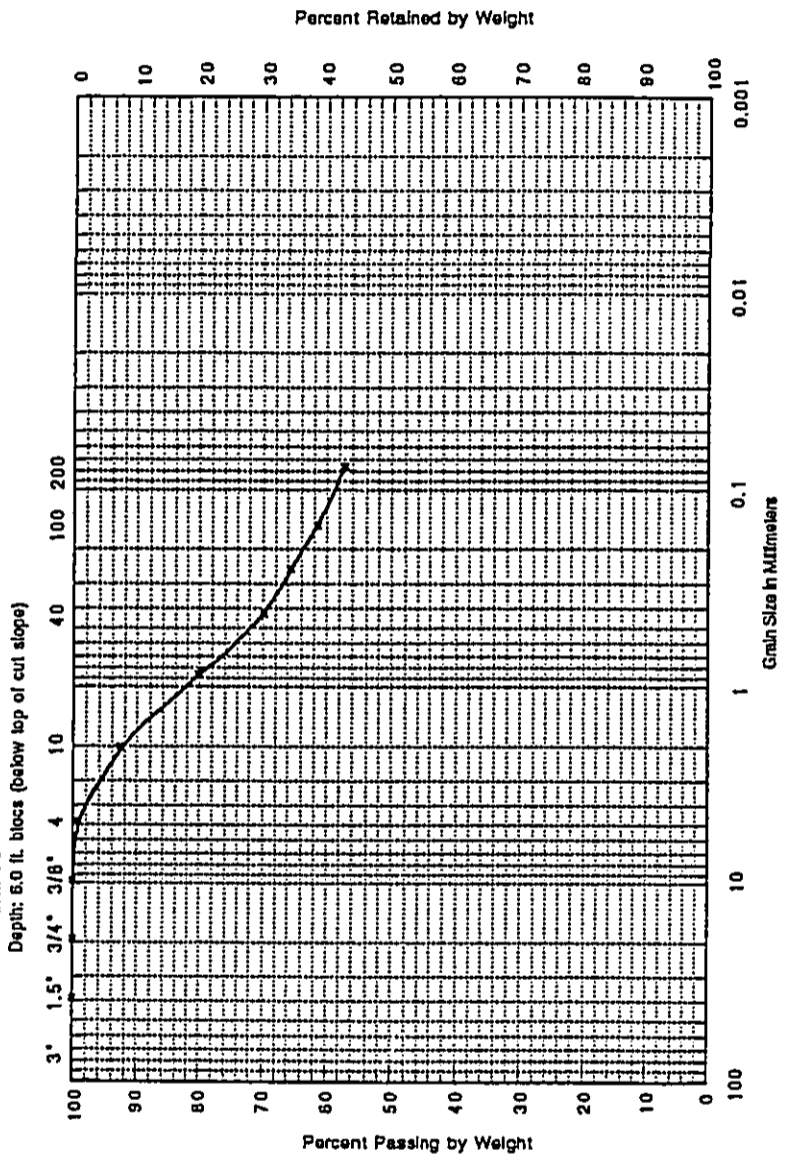
GRAVEL		SAND		SILT		CLAY
Coarse	Fine	Coarse	Medium	Fine		

Figure A16
 MASA FUJIOKA & ASSOCIATES

GRAIN SIZE ANALYSIS

Project: Kohoku Water Tunnels at Haiku
 Job No: 98086-012
 Sample: Brown sandy silt
 Location: P5
 Depth: 6.0 ft. below (below top of cut slope)

SOIL CLASSIFICATION: M L



GRAVEL	SAND			SILT	CLAY
	Coarse	Medium	Fine		

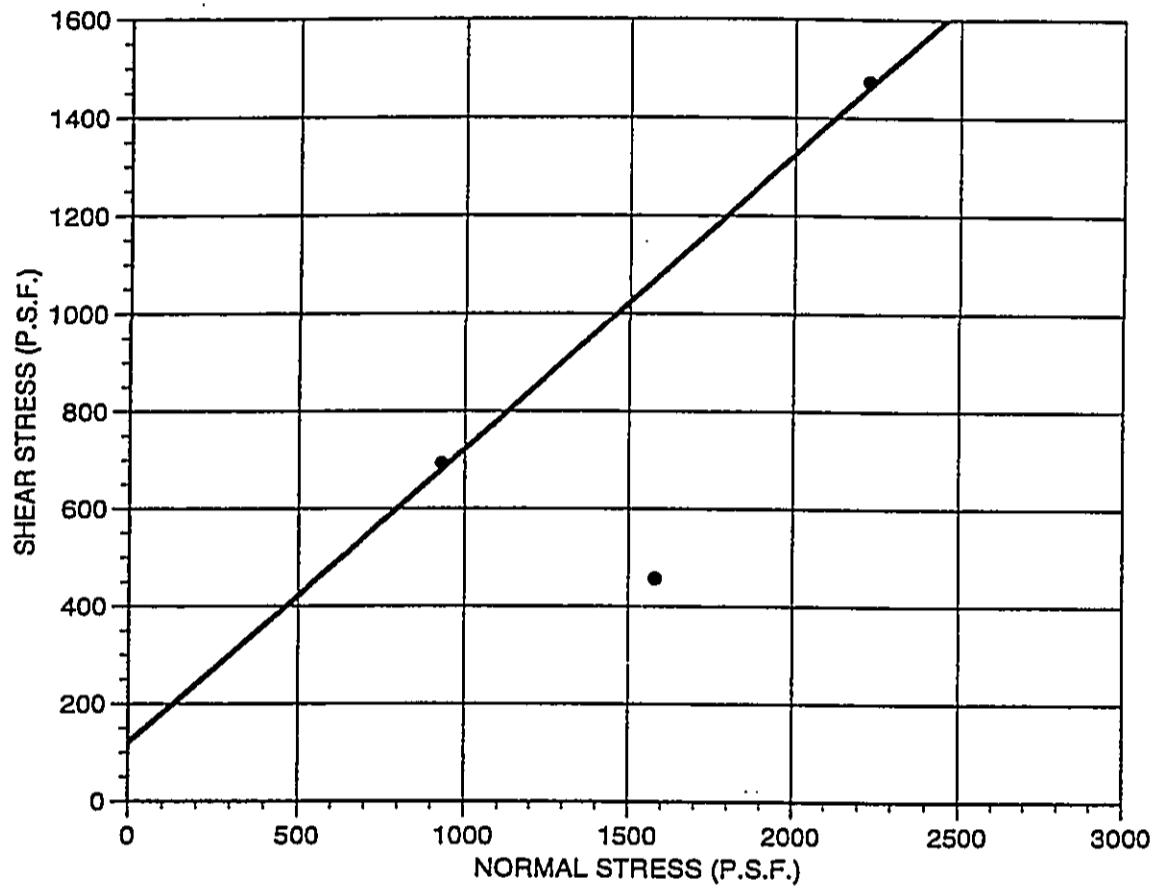
Figure A17
 MASA FUJIOKA & ASSOCIATES

Project: Kokolau Water Tunnels

Job No.: 98086-012

Location: Lihue, Kauai

Station: -4+04



Cohesion = 121 P.S.F.

Angle of Internal Friction = 31.1°

Figure A18

DIRECT SHEAR TEST RESULT
FOR
KOKOLAU WATER TUNNELS SITE

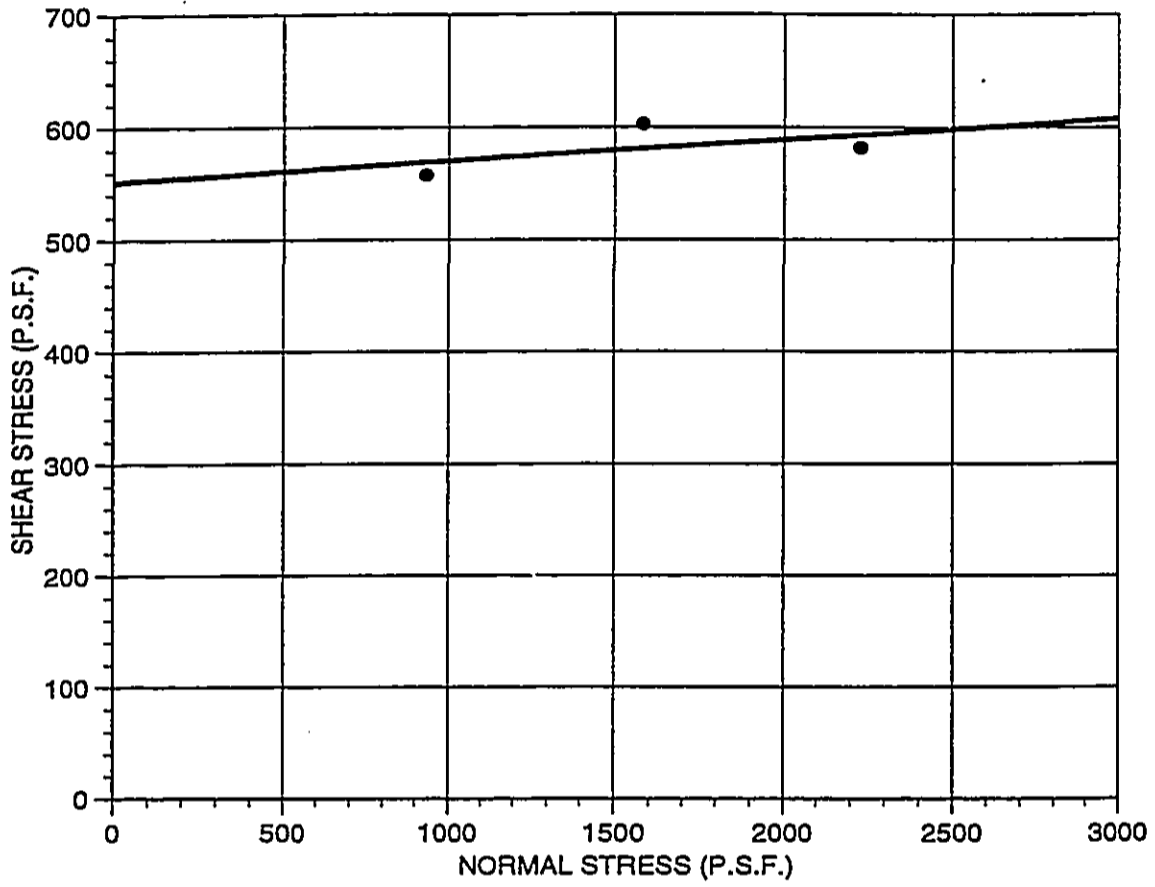
MASA FUJIOKA & ASSOCIATES

Project: Kokolau Water Tunnels

Job No.: 98086-012

Location: Lihue, Kauai

Station: -4+29



Cohesion = 552 P.S.F.

Angle of Internal Friction = 1.1°

Figure A19

DIRECT SHEAR TEST RESULT
FOR
KOKOLAU WATER TUNNELS SITE

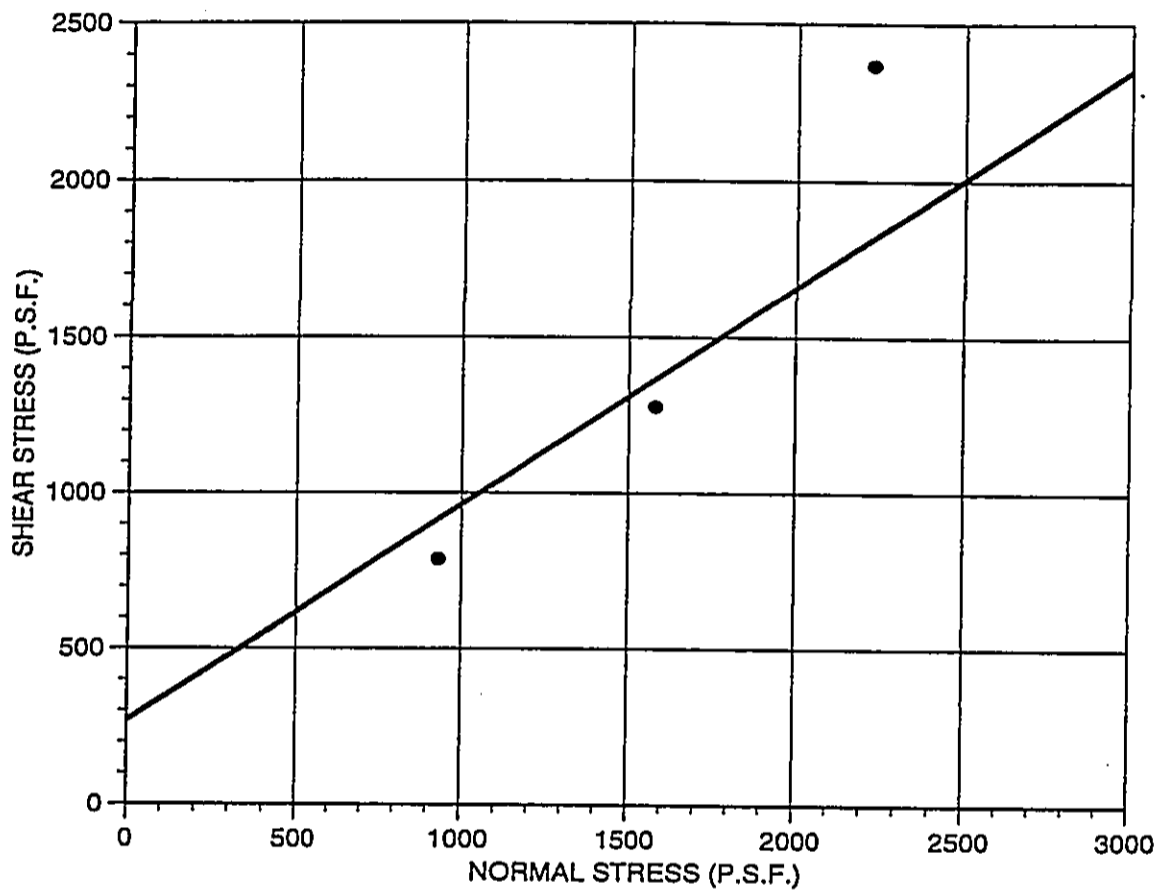
MASA FUJIOKA & ASSOCIATES

Project: Kokolau Water Tunnels

Job No.: 98086-012

Location: Lihue, Kauai

Location: -4+34



Cohesion = 269 P.S.F.

Angle of Internal Friction = 34.8°

Figure A20

DIRECT SHEAR TEST RESULT
FOR
KOKOLAU WATER TUNNELS SITE

MASA FUJIOKA & ASSOCIATES

APPENDIX D

Archaeological Assessment Of Proposed Improvements To The Kokolau Tunnel And Pipeline

September 1999

Prepared By: Cultural Surveys Hawaii

ARCHAEOLOGICAL ASSESSMENT
OF PROPOSED IMPROVEMENTS TO
THE KOKOLAU TUNNEL AND PIPELINE
PUHI, HA'IKŪ AHUPUA'A,
ISLAND OF KAUA'I
(TMK 3-4-06: Por. 12)

by

Hallett H. Hammatt, Ph.D.
David W. Shideler, M.A.
and
Colleen Medeiros, B.A.

Prepared for

SSFm Engineers, Inc.

Cultural Surveys Hawai'i

September 1999

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I. INTRODUCTION

A. Archaeological Assessment Project Description

At the request of SSFM Engineers, Inc., Cultural Surveys Hawai'i has conducted an archaeological assessment for the "Improvements to Kokolau Tunnel and Pipeline Project", including an assessment of the tunnels, the proposed pipeline corridor, and the area surrounding the tunnels. The Kokolau Tunnel is located in Ha'ikū *Ahupua'a*, island of Kaua'i (Figures 1-4). The proposed improvements project includes modifications of existing contiguous water intercept tunnels, and running a new waterline from these tunnels to the existing waterline that runs along a cane haul road. The specifics of the Kokolau Tunnel and Pipeline project impacts are discussed further below.

B. Scope of Work for the Archaeological Assessment

The scope of work includes:

1. Historical research to include study of archival sources, historic maps, Land Commission Awards and previous archaeological reports to construct a history of land use and to determine if archaeological sites have been recorded on or near this property.
2. Field inspection of the project area to identify any surface archaeological features and to investigate and assess the potential for impact to such sites. This assessment will identify any sensitive areas that may require further investigation or mitigation before the project proceeds.
3. Preparation of a report to include the results of the historical research and the fieldwork with an assessment of archaeological potential based on that research, with recommendations for further archaeological work, if appropriate. It will also provide mitigation recommendations if there are archaeologically sensitive areas that need to be taken into consideration.

C. Project Area Description

The project area is located in Puhi, *ahupua'a* of Ha'ikū, District of Līhu'e, island of Kaua'i (TMK 3-4-06: portion of 12) (see Figures 1-4). The landowner of the project area is Grove Farm Company which has owned the parcel since 1881 and leased it for many years before that. The property is currently leased to Amfac Sugar Company (Līhu'e Plantation). The Kokolau Tunnel is located west of the town of Puhi, off Highway 50 (Kaumuali'i Highway), off a cane haul road. The Kokolau Tunnel is situated within a small tributary valley, Kokolau Valley, within the greater Hulē'ia Valley drainage. The tunnel runs under several small ridges, and the portals open into various small valleys in the project area. The Hulē'ia Stream runs just south of the project area.

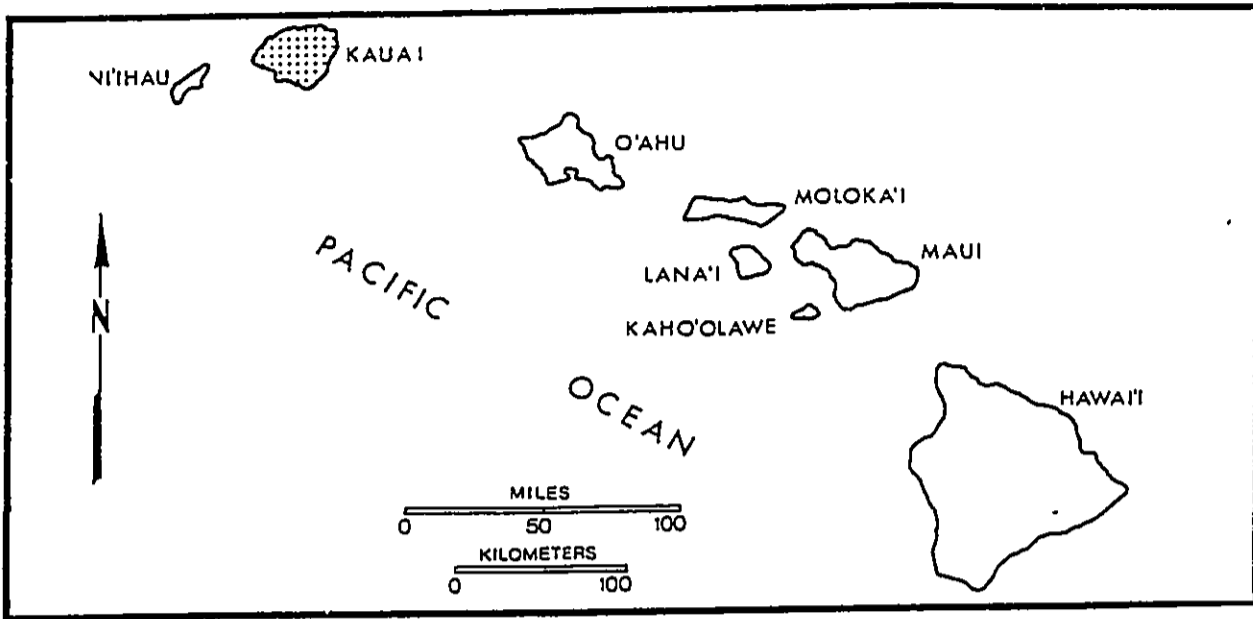


Figure 1 State of Hawai'i

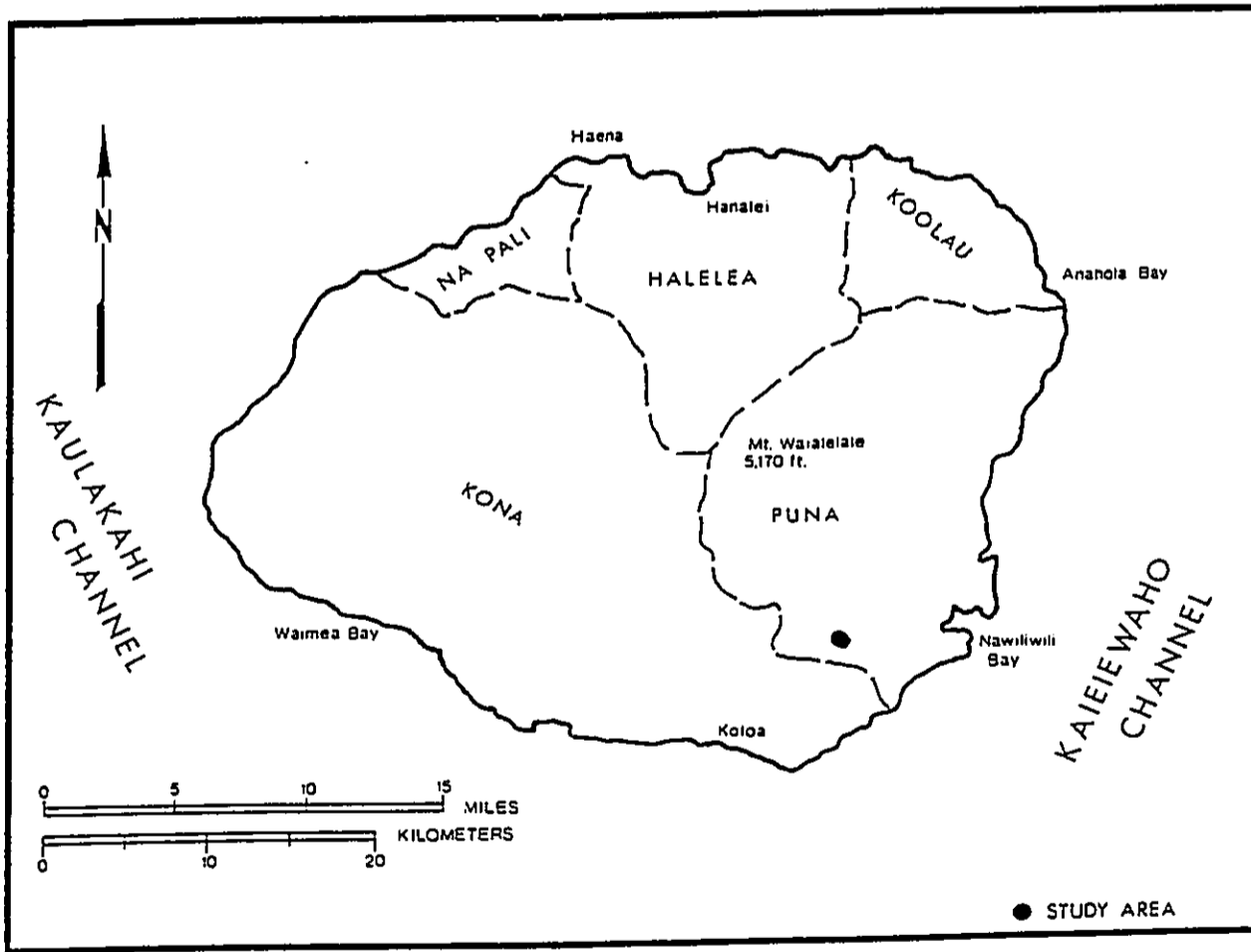


Figure 2 General Location Map, Kaua'i Island

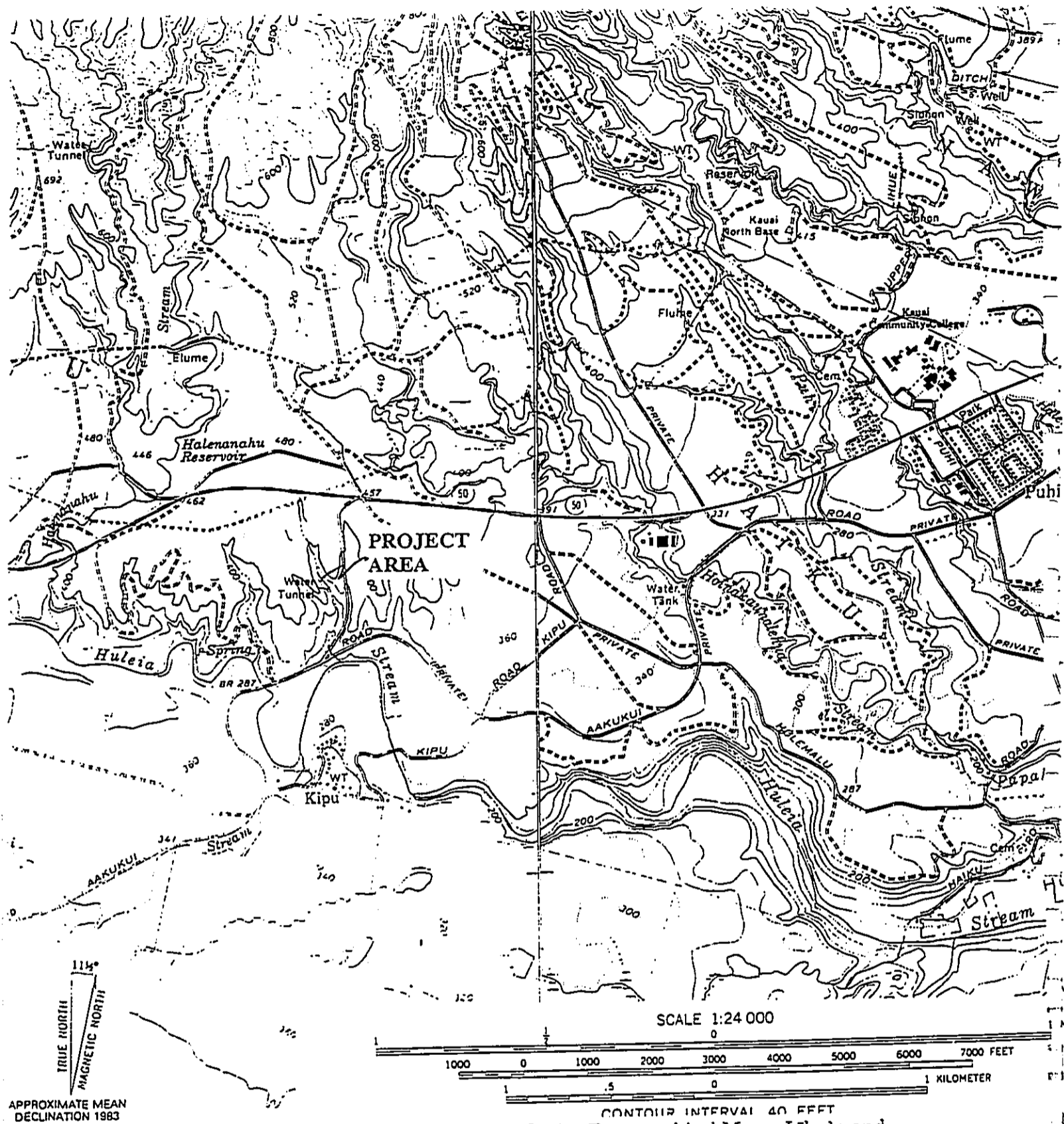


Figure 3

Portion of USGS 7.5 Minute Series Topographical Maps, Lihue and Kōloa Quadrangles, Showing Kokolau Tunnels Project area

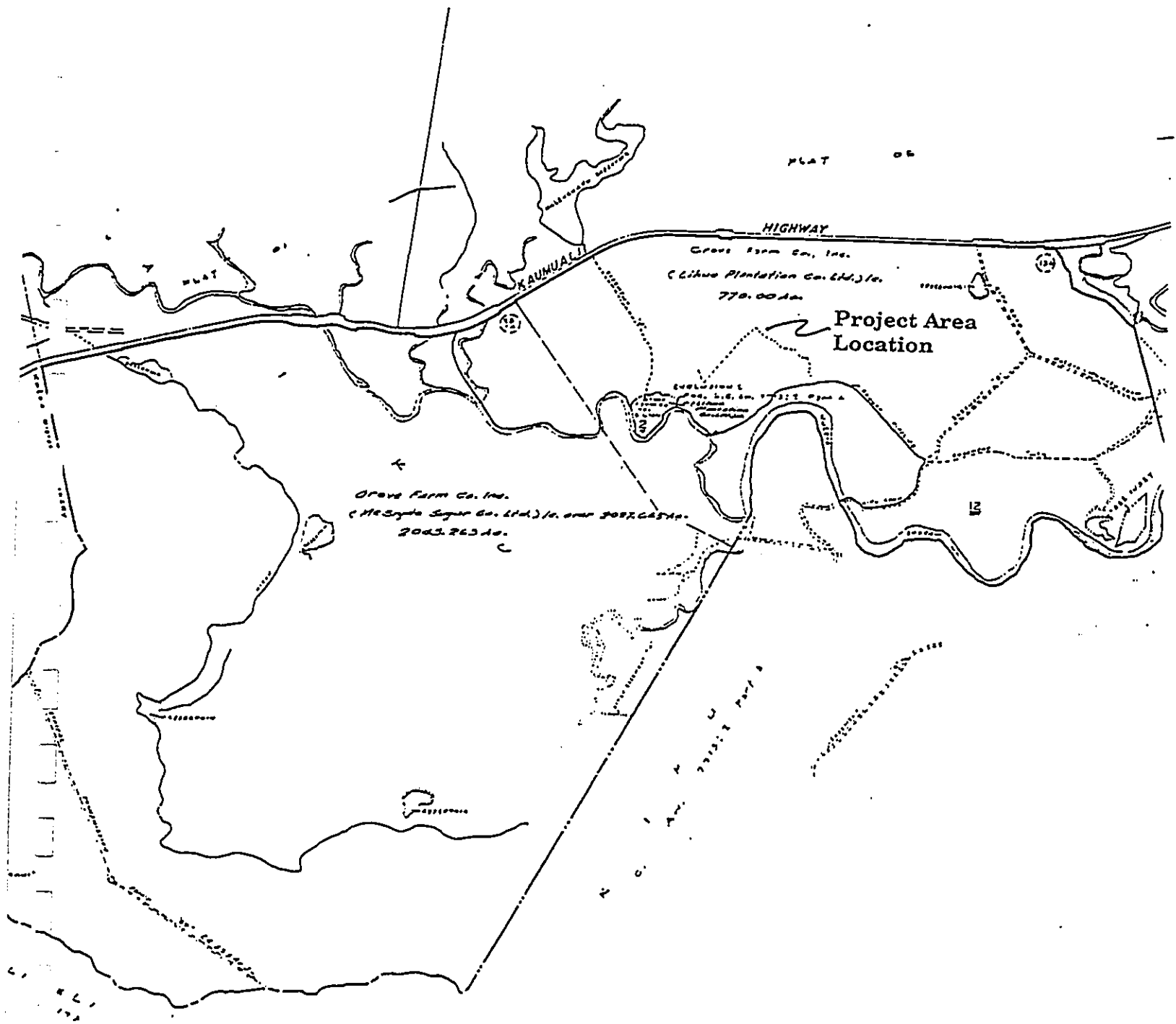


Figure 4 Portion of TMK 3-4-06 Showing Location of the Kokolau Tunnels Project Area

Vegetation within the project area consists of wild cane grass (*Saccharum spontaneum*), norfolk island pine (*Araucaria excelsa*), hau, (*Hibiscus tiliaceus*), African tulip (*Spathodea campanulata*), guava (*Psidium guajava*), eucalyptus (*Eucalyptus spp.*), and thimbleberry (*Rubus rosifolius*). Sparse stands of ti (*Cordyline fruticosa*), and banana (*Musa sp.*) were noted, and a single hala tree (*Pandanus tectorius*) was said to have been in the area.

Several 'auwai (ditches) run along the sides of the ridges in the area, one 'auwai looping over the tunnel that connects portals 1 & 1a to 2 & 3 actually crosses over the tunnel twice. Another stretch of 'auwai was crossed during our descent from a cane field road to Portal # 4. These stretches of 'auwai are all understood as sections of Grove Farm's "3rd Ditch" discussed further in the Cultural and Historical documentation. The 'auwai were overgrown with vegetation and none contained running water.

In addition to the perched ground water collected from the Kokolau Tunnel, other springs have been located in the area. A puddle outside portholes 1 & 1a was believed to be the remnants of a fresh water spring. Another active spring was said to be located further east surrounded by a yellow ginger (*Hedychium flavescens*) patch. Enoka Spring is located a half a mile west of the project area (Macdonald *et al.* 1960: 134).

As indicated by Macdonald *et al.* (1960), three test holes, 7, 8, and 9, are also located in the project area. The Kokolau Tunnel is also referred to as Tunnel 9 and Enoka Tunnel. Test holes 7 and 8 are located just north of test hole 9. Tunnel 8, located further east on Nāwiliwili Stream was excavated in 1935 by the Līhu'e Plantation Co. Another tunnel, the Puhi or Halenāhau Tunnel was said to be located north of the immediate project area, above Highway 50.

D. Natural Setting

The project area is located in the Līhu'e District, on the southeastern quadrant of the island of Kaua'i. Līhu'e is bounded on the east by the Pacific Ocean, and stretches along the shoreline from Wailua to Kawelikoā. Its western border arches from Wēkiu to Mount Wai'ale'ale (elev. 5148 amsl) then continues southward to Kāhili peak (elev. 3089 amsl) and southeastward along Hā'upu ridge (elev. 2297 amsl) to Kawelikoā. Its northeastern border runs from Wailua through Nonou peak (elev. 1241 amsl) and along Kuilau and Kamo'oho'opulu Ridges to Wēkiu peak (elev. 3255 amsl) (Macdonald *et al.* 1960:132 and Juvik and Juvik 1998: 5).

The project area--rising to 300 feet amsl--lie within the Līhu'e depression or basin. Of the area's volcanic history, Macdonald *et al.* (1983) note:

Lava flows of the Kōloa Series cover about half the surface of the eastern part of the island. They form the entire floor of the Līhu'e basin except for two small *capacious* of Waimea Canyon rocks (A'aohoaka hill and Pu'uPilo) that protrude through them west of the gap through which the Wailua River crosses the Kālepa-Nounou Ridge ... The greatest exposed thickness of Kōloa lavas is 650 meters, in the east wall of Hanalei Valley; but they may be even thicker in the Līhu'e basin and along the southern edge of the island, where their base is not exposed. (Macdonald *et al.* 1983:460-461)

Where the highway crosses Hanamā'ulu Gulch, 1.5 kilometers north of Līhu'e, the upper 7.5 meters of lava rests on an ancient soil zone 2 meters thick, which grades downward into much-decomposed Kōloa lava at least 10 meters thick. Even in a favorable climate, such deep weathering must have required a very long time. (*Ibid.*: 463)

High-level water occurs in the Līhu'e basin and is discharged into streams from the west wall of the Nāpali formation, but it occurs in such a way that makes it unfavorable for development. Conversely, water occurring in the Kōloa volcanic series, Līhu'e District, is perched on soil, ash, or dense lava flows. This water is discharged by way of seeps and springs in the valleys carved into the Kōloa volcanic series. This water may occur in "quantities adequate for municipal supplies" (Macdonald *et al.* 1960; 134).

The project area is exposed to the prevailing northeast trade winds generally from 10-20 miles per hour and experiences 60 to 150 inches of rainfall annually, increasing in the more inland (western) localities. The annual average temperature ranges from 75-80° F at Līhu'e airport.

The soils in the area consist of Kolokolo extremely stony clay loam (KUL), Kapa'a silty clay (Kkc) and rough broken land (rRR). KUL is dark brown and found on stream bottoms. Slope ranges from 0-2 percent. Rough broken land (rRR) consists of very steep land broken by frequent intermittent drainage channels. Slope is 40-70 percent, runoff and geologic erosion are both rapid. Rainfall in these area is between 25-200 inches. Kapa'a silty clay is found on 8 to 15 percent slopes, runoff is slow to medium and erosion hazard is slight to moderate. This soil is used for sugar cane, pasture, pineapple, orchards, wildlife habitat, and woodland (Foote *et al.* 1972:62, 75, 118: Sheet 22).

E. Kokolau Tunnel and Pipeline Improvements Project Description

The Kaua'i County Department of Water is proposing renovation of the Kokolau Tunnel to allow for its water source to be returned to domestic water service as part of the Līhu'e Water System. These improvements would generally involve improving portal entrances, installing a new section of waterline from the tunnel, and paving the existing dirt access road (Figures 5 and 6).

Improvements proposed for the tunnel are generally limited to the area around tunnel entrances. Portal 1A would be permanently sealed by excavating portions of the entrance and then backfilling it with material to close the entrance.

At Portal Number 1, the soil above the tunnel entrance would be excavated to expose the interior of the tunnel. The excavation would extend within the tunnel until hard basalt rock is reached which may be between 30 and 40 feet from the entrance. An existing concrete pipe at the portal entrance would also be removed. Construction of the portal structure and the segment of tunnel excavated up to the basalt would then occur. This portal structure would have concrete roof, walls and flooring, a metal door about 3 feet

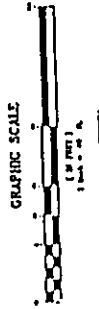
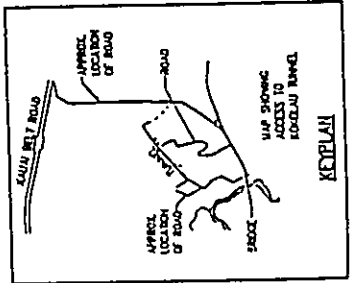
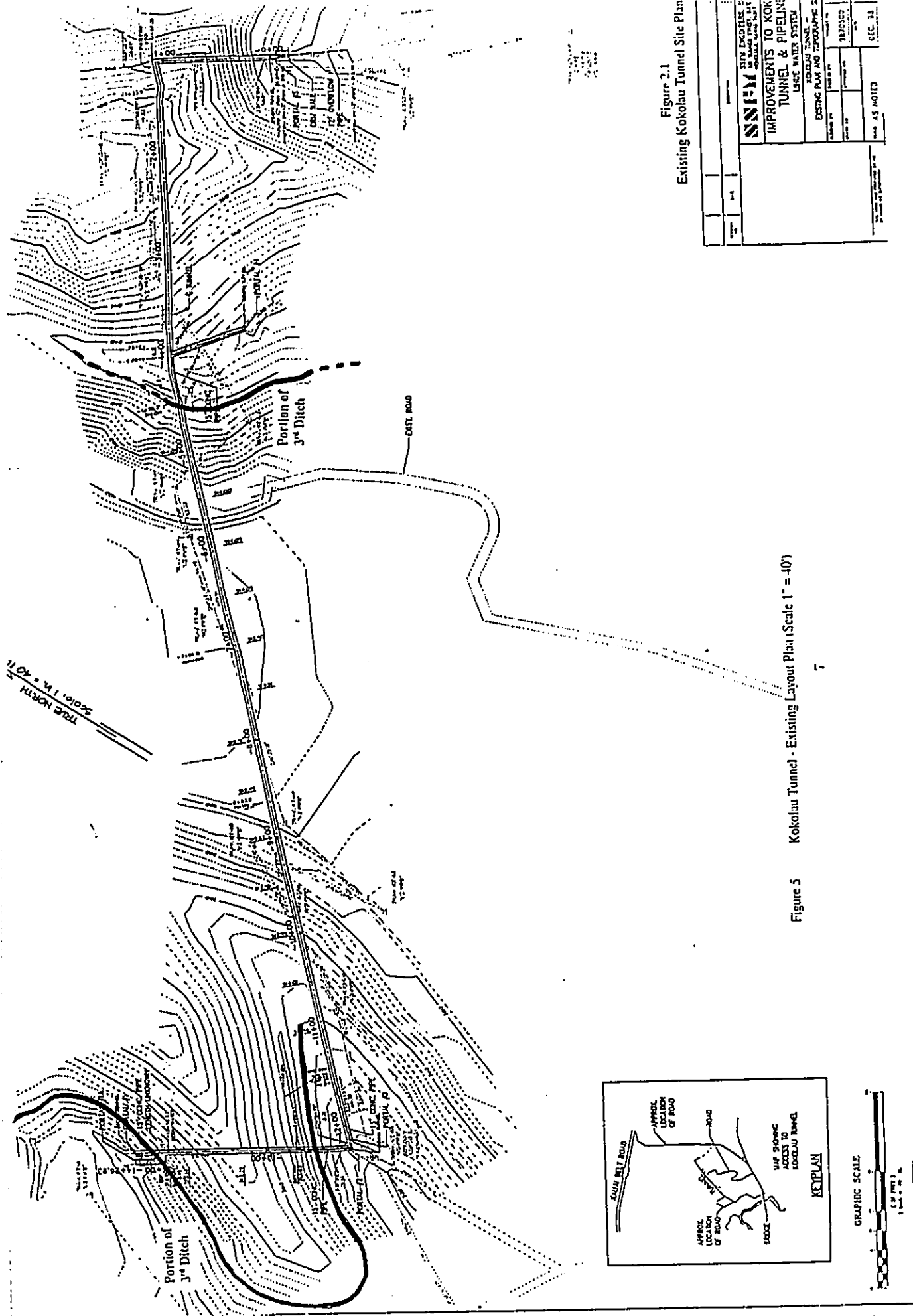
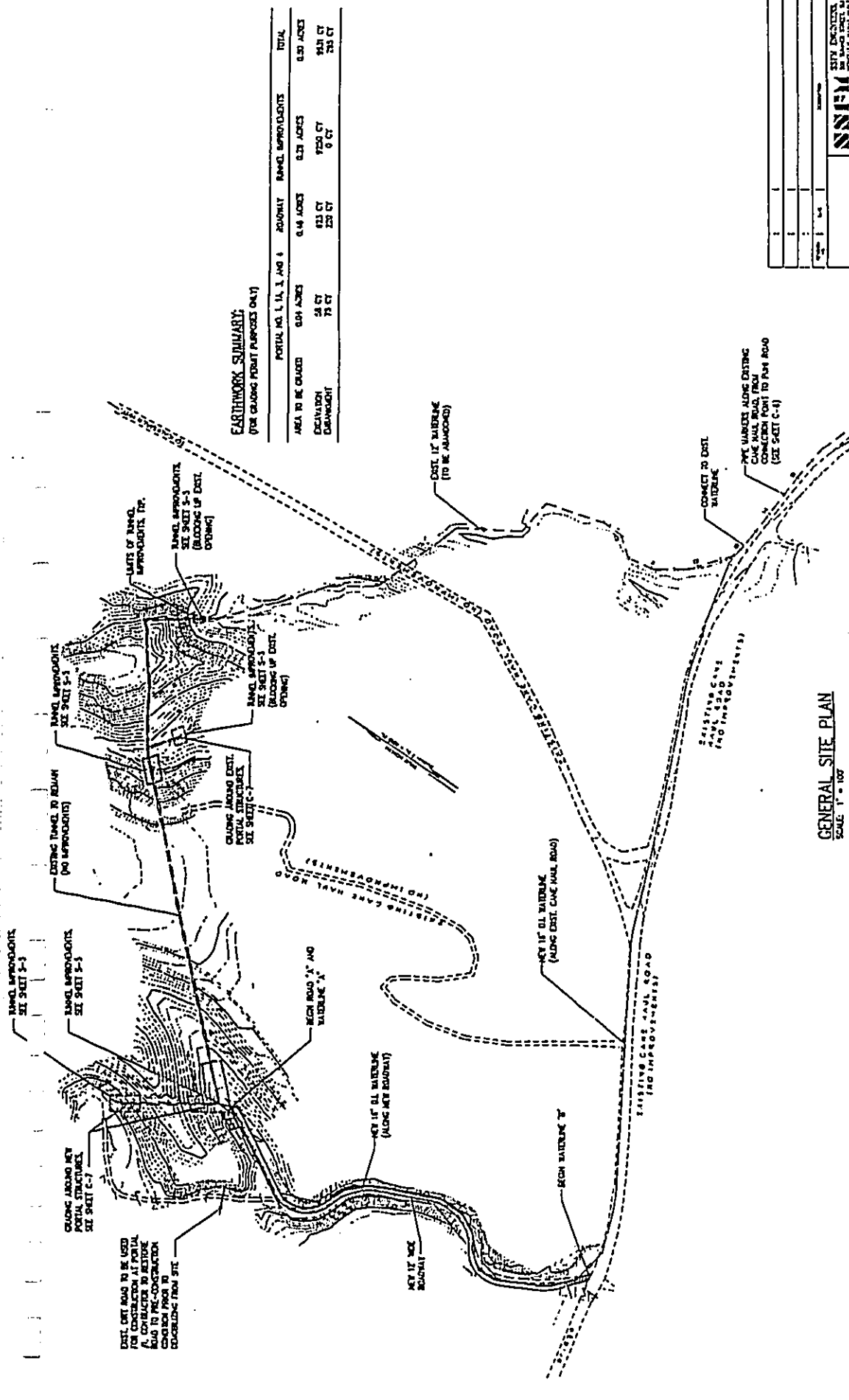


Figure 5 Kokolau Tunnel - Existing Layout Plan (Scale 1" = 40')

Figure 2.1 Existing Kokolau Tunnel Site Plan

		STATE ENGINEER DEPARTMENT OF PUBLIC WORKS HONOLULU, HAWAII
IMPROVEMENTS TO KOKOLAU TUNNEL & PIPELINE UNDER WATER SYSTEM		
PROJECT NO. 11100000	SHEET NO. 11100000-1	DATE 11/10/00
DRAWN BY J. M. HARRIS		
CHECKED BY J. M. HARRIS		
SCALE AS NOTED		
SHEET 33 OF 33		



EARTHWORK SUMMARY:
(FOR GRADING PERMIT PURPOSES ONLY)

	POSTAL RD. 1, 1A, 1, AND A	ROUNDAWAY	RANALO IMPROVEMENTS	TOTAL
AREA TO BE GRADED	0.09 ACRES	0.44 ACRES	0.23 ACRES	0.76 ACRES
EXCAVATION	24 CY	153 CY	920 CY	1117 CY
EMBANKMENT	72 CY	231 CY	0 CY	303 CY

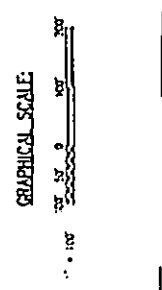


Figure 6 General Site Plan for Improvements to Kokohau Tunnel and Pipeline

SSP CITY ENGINEERS, INC.	
IMPROVEMENTS TO KOKOHAU TUNNEL & PIPELINE LIKOLE WATER SYSTEM	
PROJECT NO.	SSP1000
DATE	9/27/18
SCALE	AS NOTED
PROJECT LOCATION	

wide by 6 feet tall, concrete steps leading up to the door, and a lift-out flood panel with frame. Once the portal structure is completed, the tunnel entrance would be backfilled to original elevations and excavated areas would be landscaped. Portals 2 and 3 would be replaced to create a new single tunnel entrance situated in the general area of Portals No. 2 and 3. The new portal would serve as the new main entrance into the tunnel. Portal No. 2 would be excavated about 60 feet in the tunnel up to the hard basalt rock. A concrete box culvert would be constructed, and the existing portal entrance would be closed off.

Portal No. 3 would be similarly excavated about 120 feet into the tunnel up to the hard basalt rock before a concrete box culvert can then be constructed. The new portal entrance created would have a metal door, flood panel, steps, a sump pit and a concrete culvert. A new 16-inch waterline would also be constructed to transport water along the dirt access road. Once these portal entrances are completed, the tunnel entrances would be backfilled to original elevations, and excavated areas would be landscaped.

The portion of tunnel located near Portal No. 4 is collapsing and the tunnel entrance is being overgrown with vegetation. As a result, this tunnel entrance would be permanently sealed by excavating portions of the entrance and then backfilling it with material to close the entrance.

At Portal No. 5 the entrance would be improved by adding a new metal door.

A new 16-inch waterline would be constructed to transport water from the tunnel to the existing waterline located along the cane haul road. This new waterline would begin at a new portal created between, or at the site of, adjacent Portals No. 2 and No. 3 and be routed along the dirt access road. At this access road's intersection with the cane haul road, another segment of this waterline would be routed along the cane haul road before connecting to the existing waterline.

The access road would be improved to a width of 12 feet and would be paved with asphalt. Other minor improvements would include a vehicular turnaround area at the top near Portal No. 3, a concrete retaining wall, and a rip rap and concrete swale.

II. HA`IKŪ AHUPUA`A AND THE KOKOLAU TUNNEL: CULTURAL AND HISTORICAL DOCUMENTATION

This section begins with a review of the available documentary evidence for the general character of the present Ha`ikū project area as it had evolved in the years before western contact in the later 18th century. The development of Ha`ikū *Ahupua`a* during the 19th century and into the early 20th century was recorded in increasingly abundant documentation - including government records, private accounts (particularly those of Grove Farm Plantation), newspapers, maps and photographs. Finally, during subsequent decades of the 20th century, abundant documentation allows a more precise focus on the Kokolau Tunnels and environs.

A. Pre-Contact to 1800

The name "Ha`ikū" is translated as "speak abruptly" or "sharp break" (Pukui *et al.* 1984:34) but the meaning underlying this name is uncertain. Wichman (1998:51) offers additional translations of the name as "haughty" and "conceited" and asserts that "the story of its naming is lost and a new story has taken its place." This new story asserts that the name Ha`ikū means "pushed through" and the naming is related to ribald stories of the pig demi-god Kamapua`a having sexual relations with Kapo`ulakīna`u and her sister, the volcano goddess Pele. Pukui (Pukui *et al.* 1984:53) give this same account ("pushed through" from the Kamapua`a and Pele tradition) as the origin the place name "Hulā`ia" (an old name for Hulē`ia) Stream which runs through south western Ha`ikū. It is said in some accounts that Kamapua`a and Pele first met at Ha`ikū. Although this place name derivation may indeed be recent it seems plausible that the "pushed through" reference also relates to the unique gap feature on the west (Kōloa) side of Ha`ikū. As Joesting (1984:215) describes it:

There is one way through [the] thin mountain ridge [across central Kaua`i], a place where the barrier briefly parts. This lapse in the ridge is the way between east and west Kaua`i. It is called the Gap and travelers have used it since the beginning.

The route of the present Kaumuali`i Highway runs through the "Gap" likely following the alignment of the traditional trail system that joined east and west Kaua`i. The Gap itself was the subject of traditional Kaua`i legends and premonitory tales, "for the clump of *hau* trees formerly near the bend of the mountains at the Gap was said to have been the hiding place of robbers and *`akuas* lurked in its hidden depths" (Rice 1991:53).

Further evidence that the Gap marked a well-known and well-traveled area of Kaua`i in pre-contact times was presented in testimonies by native Hawaiians during Commission of Boundaries sessions in the 1870s. These testimonies of the *kama`āina* recorded in the proceedings of the commission throughout the Hawaiian islands provided otherwise anonymous Hawaiians an unprecedented opportunity to display not only a comprehensive understanding, passed down through generations, of the contours of the *ahupua`a*, but, at the same time, allowed them to reveal local traditions, place names, no-longer-existing sites including *heiau* and settlements, areas where traditional activities were practiced,

and historic events they had witnessed or participated in. Testifying on the boundaries of Kōloa *ahupua`a* in 1874, Hupai stated: "The boundary of Kona and Puna [districts] was at Hoaea [*i.e.* Kahoea on the Ha`ikū/ Kōloa border above the Gap] that was where the battle flags were hung that was when the battles were fought" (Boundary Commission, Kauai, vol. 1; Hawai`i State Archives).

The Hulē`ia River gulch runs along much of the south west portion of Ha`ikū, and is an area where traditional Hawaiian agricultural activities dating to pre-contact times have been noted:

The broad delta of the Hulē`ia River is 1.5 miles long and a half mile wide, and is in the *ahupua`a* named Ha`ikū, the next to last of the southeasterly valleys of Puna. This area was ideal for wet taro. Terraces continue upriver, and there were terraces up the streams that empty into the river. Old breadfruit and mango trees indicate that there were many Hawaiian *kuleana* up to 6 miles inland from the delta. (Handy and Handy 1972:427)

Traditional accounts give few clues to the exact routes of the trail system east of the Ha`ikū/ Kōloa Gap, but it seems probable that it roughly corresponded to the present highway alignment north of the Kokolau Tunnel project area.

There is some question as to whether the present boundaries of Ha`ikū were those of antiquity. Damon (1931: 391-392) writes that:

The irregular shapes of these ancient divisions of, Ha`ikū Niumalu, Nāwiliwili, Kalapakī, Hanamā`ulu and Wailua were by no means accidental. The Hawaiians, chiefs as well as people, knew their islands. From the land and adjacent waters they drew their entire sustenance.

But then she notes (1931:392-393) that:

The *ahupua`a* of Ha`ikū, it will be noticed from the map, does not reach the sea, and so seems to be a strange exception to the usual form of such land grants. This is due, it is said by old settlers, to an error in the first survey by a foreigner, for when this was done, the Hawaiians of the vicinity immediately remarked that in ancient times Ha`ikū had always had its strip of seacoast south of the Hulē`ia River.

The only pre-contact structure we were able to find reference to at Ha`ikū was to the Kua`ā Irrigation Ditch located in an *ili* land division of the same name (Wichman, 1998:51). This land division was located in the central portion of the Ha`ikū Land Court Awards along the Hulē`ia River three kilometers or more from the Kokolau Tunnel project.

B. 1800 to 1850

Western homesteading and commerce moved into the lands above Nāwiliwili Bay that would evolve into Līhu`e Town within a few years after the establishment of the missionary and business activities at Kōloa in the mid 1830s. Two years after he had arrived at the mission station at Kōloa, Dr. Thomas Lafon moved east to open a branch of the Kōloa church:

In 1839...Lafon made his home in what became known as the Līhu`e district. The church he was in charge of there had been built by order of Kaikio`ewa [governor of Kaua`i]. There must have been considerable activity in the Līhu`e area to cause Lafon to move there from Kōloa. James Jarves, who passed through the area in 1840, reported that in addition to the church there was a "straw palace," built for Keaweamahi, the wife of Kaikio`ewa. (Joesting 1984:153)

Kaikio`ewa, who died in 1839, had apparently intended to create a "city" at Līhu`e. Kaikio`ewa's activities at Līhu`e did, however, draw a small community of westerners, including Dr. Lafon and his family, to the area, which impelled the creation of a horse trail between Kōloa and the Līhu`e area. Accounts of 19th century travelers on the trail between Kōloa and Līhu`e present the first record of the lands surrounding Ha`ikū.

William DeWitt Alexander, son of the former Wai`oli missionary William P. Alexander, described a return visit to Kaua`i in 1849, six years after his family had left the island. Traveling on horseback from Kōloa to Wailua, Alexander noted in his diary:

We then rode through a gap in the hills, leading out from Kōloa. The scenery was very fine, and worthy of Kaua`i. Mauna Kāhili was close on the left, & on the right a beautiful range of hills extending towards the northeast, and terminating in an abrupt peak which goes by the name of "Hoary Head" [Hā`upu]. We rode on over a beautiful undulating table land, dotted with groves of *lauhala* and *kukui*. After riding about five miles, we crossed a stream fitly called Stoney Brook. We afterwards crossed many other streams on our way. Five miles further we passed Dr. Lafon's former residence. Here we began to descend towards the sea. (Alexander 1991:122).

Apparently, Alexander observed no conspicuous Hawaiian settlements between the Gap and Dr. Lafon's residence in the Līhu`e area.

C. *Māhele* and Land Commission Award Documentation

The Organic Acts of 1845 and 1846 initiated the process of the *Māhele* - the division of Hawaiian lands - which introduced private property into Hawaiian society. In 1848 the crown and the *ali`i* (royalty) received their land titles. Ha`ikū and Nāwiliwili *ahupua`a* were awarded - LCA 7713 - to Victoria Kamāmalu, sister of Kamehameha IV, Kamehameha V, and Moses Kekuaiwa. Victoria Kamāmalu's holdings at Ha`ikū were

estimated to contain 9585 acres. Documents associated with this award give no indication of specific land uses or activities other than for pasturage. The native register account (569 v 5) relates "Hulē'ia, a district of Kaua'i, however, the Government cattle shall graze there." It appears that Victoria Kamāmalu almost immediately leased the Ha'ikū lands to Judge Widemann, probably in 1850 for the span of 25 years. When Victoria Kamāmalu died in 1866, Princess Ruth Ke'elikōlani inherited her lands.

Kuleana awards for individual parcels within the *ahupua'a* were subsequently granted in 1850. These awards were presented to tenants - native Hawaiians, naturalized foreigners, non-Hawaiians born in the islands, or long-term resident foreigners - who could prove occupancy on the parcels before 1845 (Apple 1978:45). Current tax maps indicate that the nearest LCAs to the Kokolau Tunnels were 1.7 kilometers (1.1 miles) to the south east on the north bank of Hulē'ia Stream.

Thirty-eight claims are made in Ha'ikū *Ahupua'a*, of which thirty-five are awarded. There are 20 *'ili* mentioned with 264 *lo'i*, 26 houses, 31 *kula*, 3 *wauke kula*, a pig enclosure, and 2 mentions of bulrushes. The average number of *lo'i* per claimant (7) is higher than in most other *ahupua'a* on Kaua'i, even Hanapēpē where the average is 6.6 per claimant. One claim (No. 3634) mentions a dam, and three claims mention houses in other *ahupua'a*, either Kīpū or Kōloa. Thirty-one of these claims are located on the 1907 map of the lower portion of Hulē'ia River, (R.M. 2413) by J.M. Lydgate (Figure 7). One of the remaining four claims was in this area but is not shown, one is near Kāhili Pali way up *mauka*, one is in Kuia *'Ili* near the Kōloa border to the west of the project area and another is on the path to Kilohana. It is worth noting however, that of the 31 claims on the Lydgate map, only one has the correct number, but from information in the claims as to neighboring claims, it is presumed that the location of the claimants is correct.

As is often the case, the *konohiki* or overseer does not receive an award for his claim. The *konohiki*, Daniela Oleloa is the consort of Debra Kapule after her first husband, the ruling chief Kaumuali'i, is taken away by Ka'ahumanu. The other unawarded claims are by a person who has abandoned his land and another who makes two claims.

There are perhaps two mentions of the *'auwai* of Kua'ā: one is for a claim in Kua'ā and the other is for a claim in Makaokole with the *'auwai* called Okua'ā.

D. 1850s to 1900

Līhu'e Plantation started as a partnership of Henry Augustus Pierce, Judge William Little Lee and Charles R. Bishop in 1849 and really began in 1851. The company obtained up to 3,000 acres of land and by 1851 a water-driven sugar mill was constructed (on the site of the present Līhu'e sugar mill). Hawaiians made up the labor force. They built their homes on the land surrounding the mill...Planting was begun in 1850 and the first crop, amounting to a little over 100 tons of sugarcane, was ground in 1853. (Joesting 1984:173) Under the management of a former American Board of Commissioners for Foreign Missions (ABCFM) teacher, William Harrison Rice from 1854 to 1862, the plantation invested heavily in irrigation ditch infrastructure known initially as "Rice's Folly" (Krauss and Alexander 1984:67).

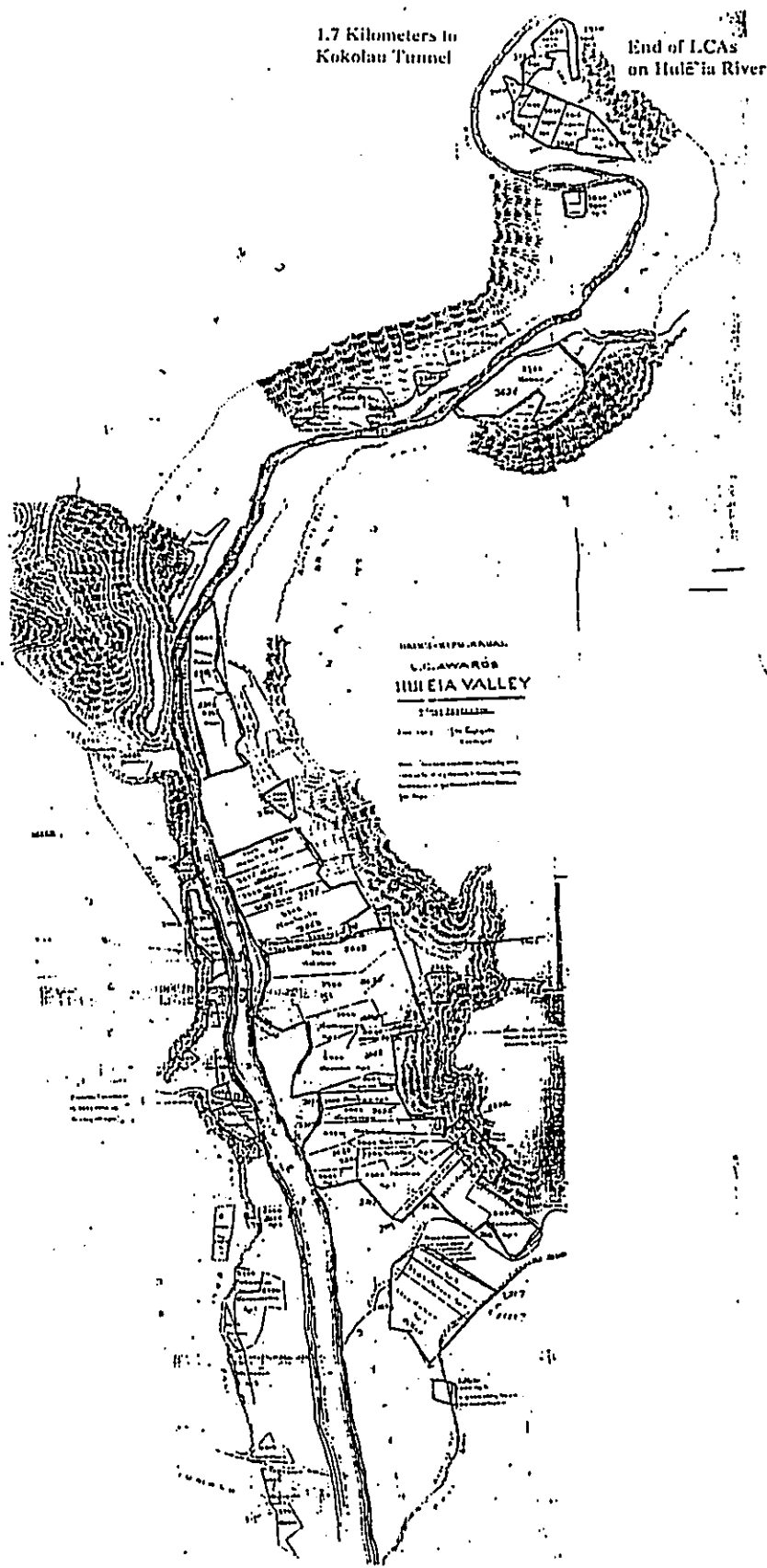


Figure 7 Map of (Lower) Hui'eia Valley by J. M. Lydgate 1907 (RM #2413) (reduced)

George Norton Wilcox, son of the ABCFM teacher Abner Wilcox, was raised on Kaua`i and observed Rice's successes with irrigation. He went to Yale and studied engineering and surveying earning a certificate in 1862. Upon returning to Kaua`i in 1863 he attempted sugar cane production at Hanalei Valley where he also worked on the plantation of Robert Crichton Wyllie. George Wilcox soon went to work for Judge H. A. Widemann, owner of the Grove farm Plantation as a surveyor.

Grove Farm (named after an old stand of *kukui* trees) was started by Warren Goodale in 1850, was sold the same year to James F. B. Marshall for \$3,000 and sold in 1856 to Mr. Widemann for \$8,000. At the end of 1863 Judge Widemann asked George Wilcox to undertake the supervision of the cutting of a water lead or irrigation ditch for the Grove Farm plantation using Hawaiian labor. The ditch ("1st Ditch") was completed in July of 1863 but failed to bring water to the fields. Wilcox leased Grove Farm Plantation from H. A. Wiedemann at the end of 1864 and rapidly developed the irrigation infrastructure further.

Western commerce between Kōloa and Līhu`e took off during the second half of the 19th century. A visitor to Kaua`i in 1865, William T. Brigham, described the route between Līhu`e and Kōloa:

From Līhu`e the road led over the plain with the mountains on the left. A ditch crossed and recrossed the road as it wound along the hills from the fountains to the canefields below. Owls (*pueo*) were very abundant. the Pass over the mountains was very good and not at all steep, and all the way which was some twelve miles, the road was very good, in fact a carriage road. Two hours riding brought me to Dr. Smith's [in Kōloa] at eight. (Lydgate 1991: 143).

The "ditch" Brigham, described probably included "1st Ditch" excavated in 1864 and "2nd Ditch" which was completed in 1865. "3rd Ditch", which traverses the Kokolau Tunnels area was developed in 1866-1867. The Kokolau Tunnel actually was excavated under portions of the 3rd Ditch.

The ditches were excavated by Hawaiian labor at 25 cents per man per day, but Chinese labor was used to excavate short tunnel sections. Almost all of the ditch construction was by shovel with one man capable of digging five linear feet in one day. Black powder blasting was used on occasional hard rock outcrops.

The 3rd Ditch is annotated on a map of Grove Farm (no date, Figure 8) as starting at the "Halenanaho" (properly "Halenānahu") Reservoir, *mauka* of the highway, then heading south, crossing the highway alignment and then running roughly parallel with the Hulē`ia River towards the core Grove Farm fields.

A 1912 USGS map (Figure 9) shows the route beginning at an unnamed gulch west of the Halenānahu drainage then heading southeast crossing the highway alignment in the same area as the Grove Farm depiction of the 3rd ditch, running roughly the same course in the vicinity of the Kokolau Tunnels project area, but then arcing north east for much of its length on the north (*mauka*) side of the highway alignment. In the vicinity of the Kokolau

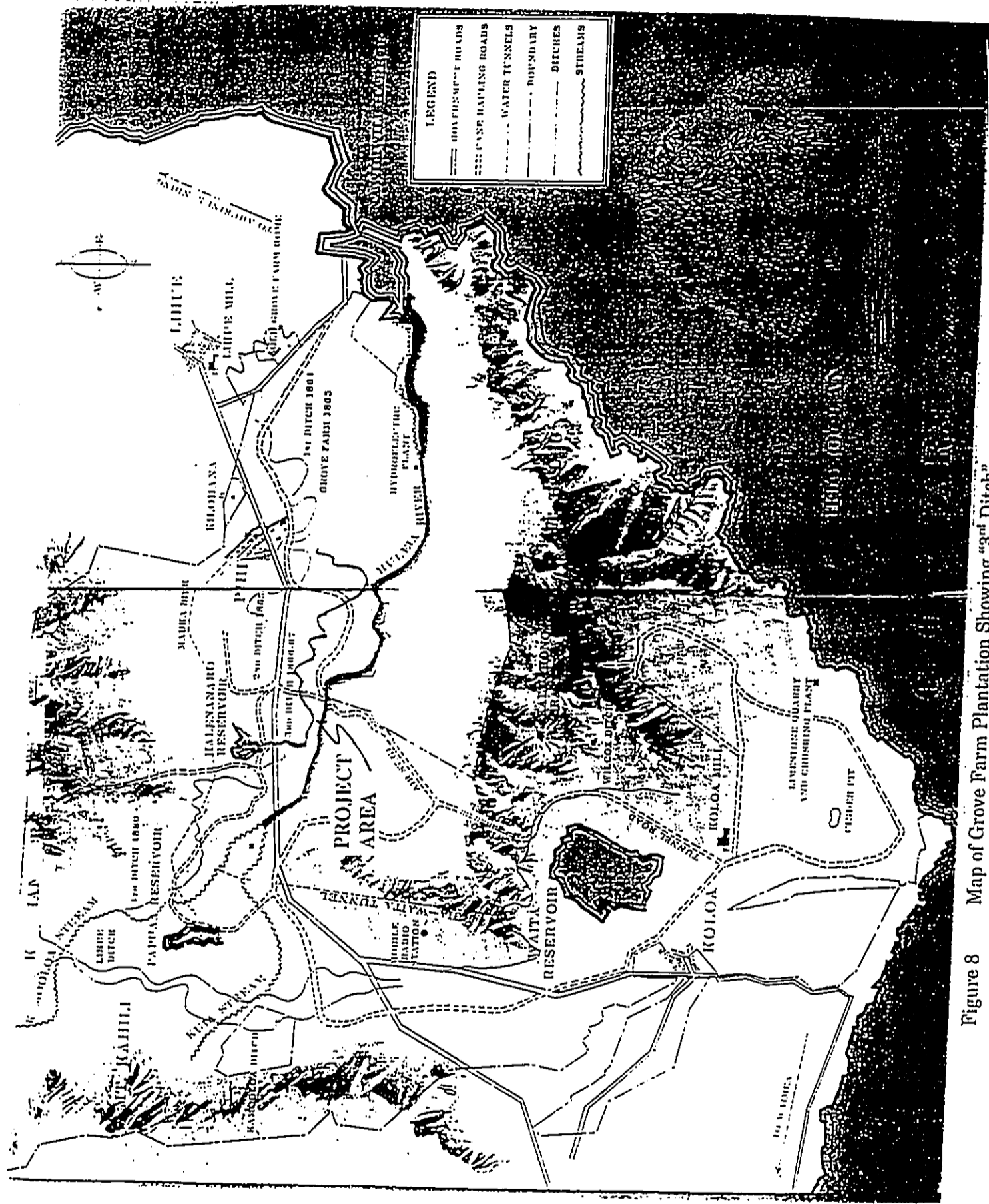


Figure 8 Map of Grove Farm Plantation Showing "3rd Ditch"

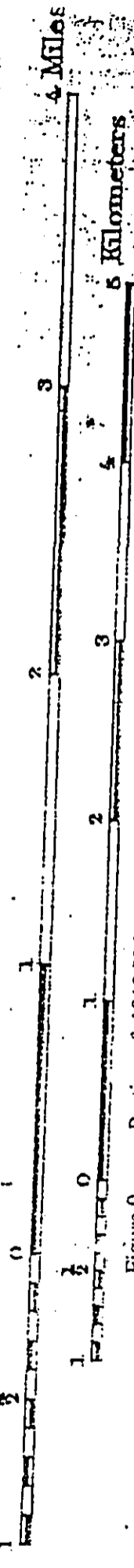
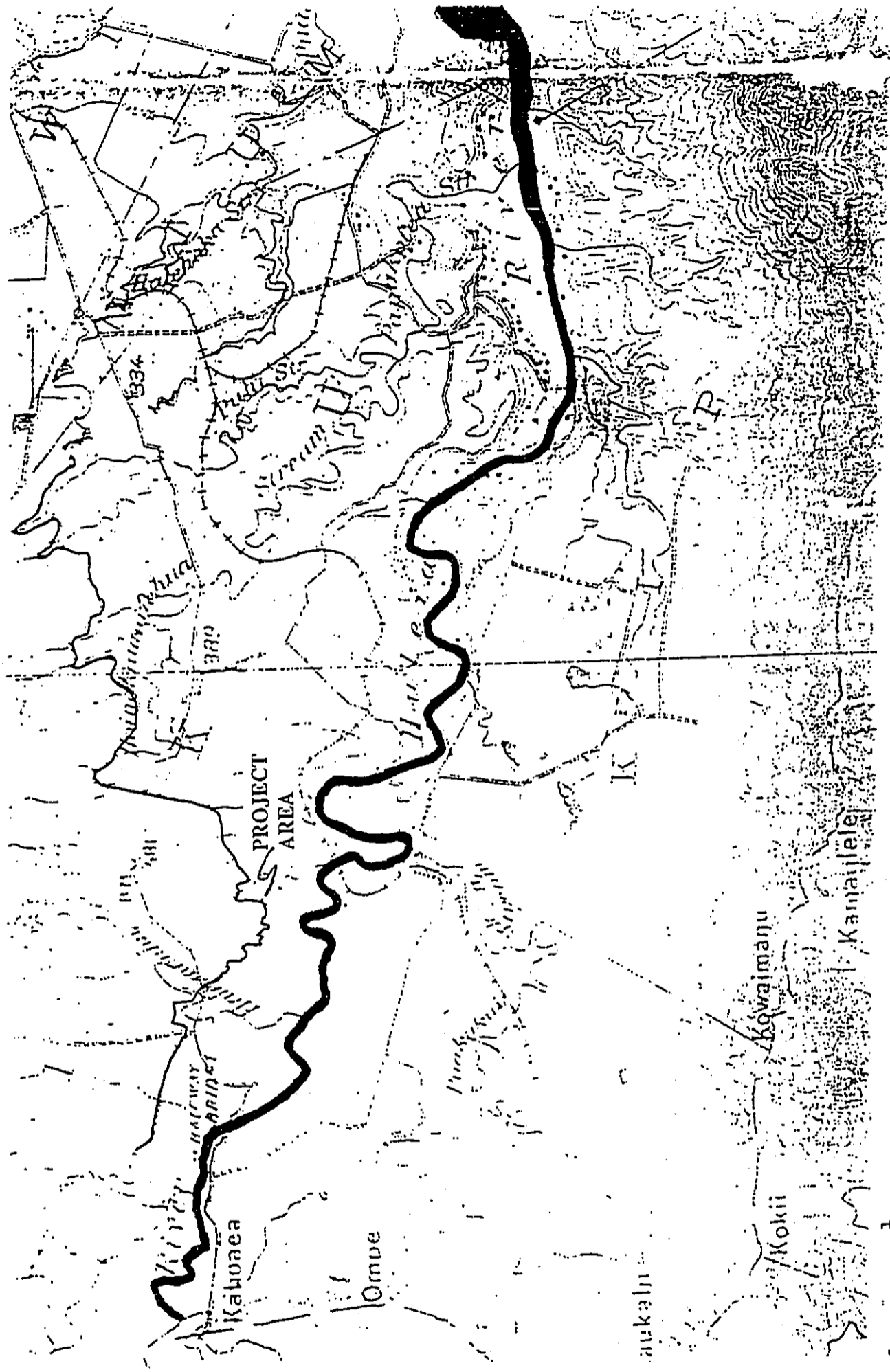
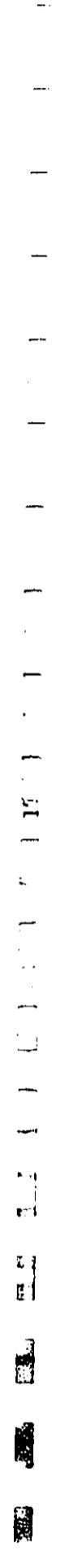


Figure 9 Portion of 1912 U.S. Geological Survey Topographic Map of the Island of Kauai Showing Route of 3rd Ditch



Tunnels project area these alignments are in accord and we feel confident that the *'auwai* observed over the tunnels are Grove Farm 3rd Ditch constructed in 1866-1867. The difference in the two alignments probably reflects later (1867-1912) re-adaption of earlier ditch alignments. It should be noted that the ditch observed on the ground was considerably more circuitous than those illustrated in Figures 5 and 6 sinuously winding along the toes of numerous short ridges. The maps are probably simplifications.

In 1870 Wilcox bought Grove Farm from Widemann for \$12,000, three-quarters of which was borrowed. Four years later he had 200 acres under cultivation. The cane was milled at the Lihu'e Mill and exported from Nāwiliwili. In 1874, Wilcox renewed a lease, for 25 years, for a 10,000-acre tract of Ha'ikū *Ahupua'a* from Princess Ruth Ke'elikōlani (Krauss and Alexander 1984:179). On April 1, 1881 George Wilcox bought 10,500 acres of Ha'ikū *Ahupua'a* from Princess Ruth increasing the acreage of Grove Farm nearly ten-fold (Krauss and Alexander 1984:206). The sale was part of a package deal in which Willie Rice also received Kīpū and Kīpū Kai for a total price of \$27,500 - money which Princess Ruth used to build her palace which rivaled Kalākaua's palace which was completed the following year.

E. 1900s to Present

In the 1920s, Grove Farm began a building program at Puhi, along the route of the present Kaumuali'i Highway:

About 1920 George [Wilcox] began construction of a completely modern camp at Puhi in the heart of the expanding plantation. Instead of building houses haphazardly as new families moved in, a complete village was laid out with streets, a playground, room for gardens, and lawns. The houses had proper kitchens equipped with running water and enough bedrooms for each family depending upon the number of children (Krauss 1965:310).

The provision of running water for the Puhi Camp may have inclined George Wilcox to cooperate with Kaua'i County in the creation of the Kokolau water tunnel complex (Figure 10) which was actually excavated between July 25, 1928 and February 29, 1929. George Wilcox's knowledge of surveying and tunneling in the vicinity would have facilitated the work. His well-known philanthropy and concern for civil engineering projects on Kaua'i (he had been a Kaua'i County road supervisor fifty years before) would have inclined him toward such a project to provide Lihu'e with a safe water supply.

This tunnel complex appears to have been known first by the names "Tunnel 9" and "Enoka Tunnel". Although the tunnel lies 800 meters or so from Enoka Spring this name suggests an early hope that the tunnel could tap the spring. MacDonald *et al.* (1960:134) offer the following account of Kokolau Tunnel:

Tunnel 9 was excavated in 1928 to intercept the water flowing from springs at an altitude of 300 feet in a tributary to Hulē'ia Stream. The aquifer is lava flows of the Kōloa volcanic series, and the water apparently is perched on a red soil. The tunnel is in three sections which have a total length of

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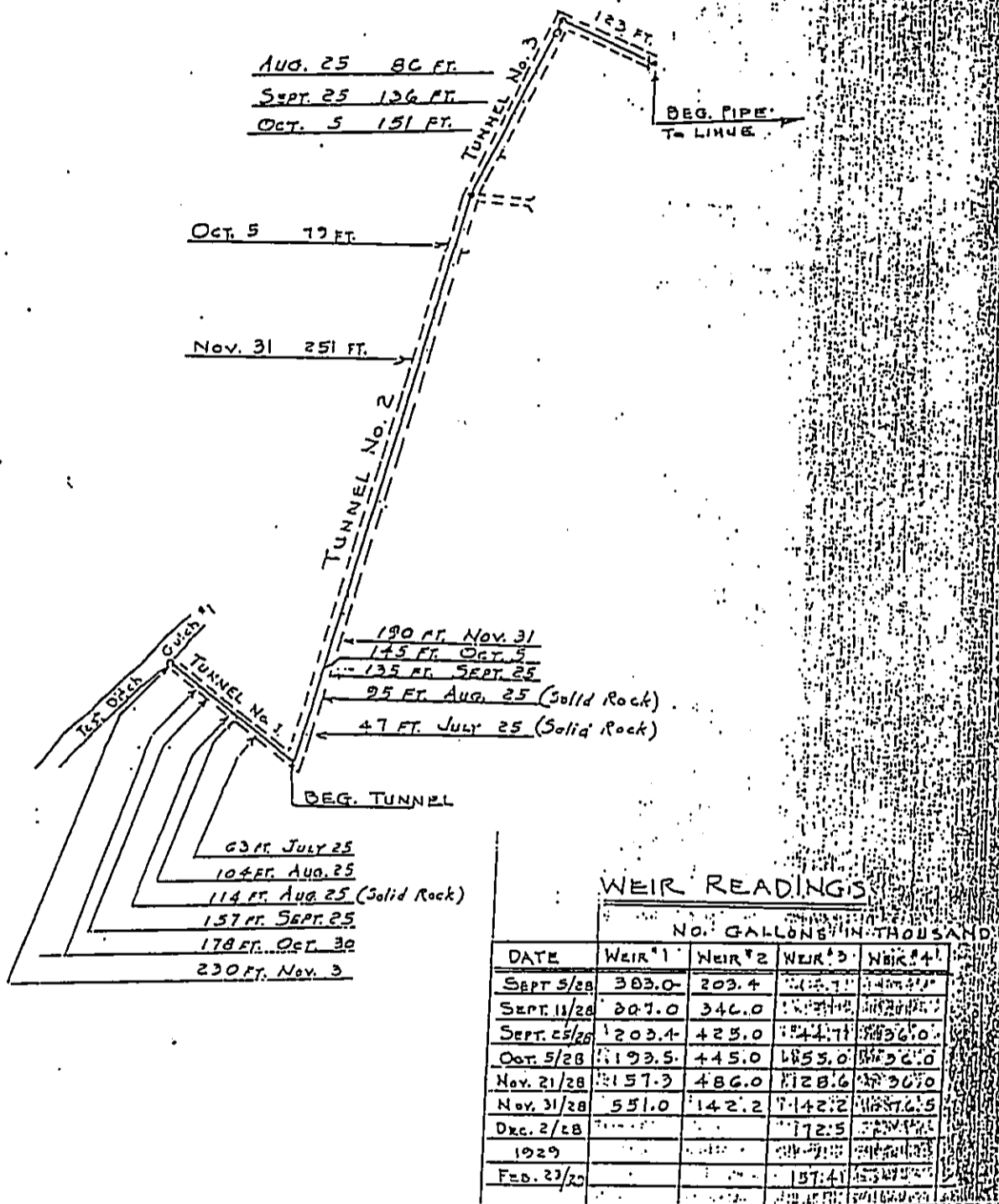


Figure 10 Map of the Kokolau Supply Tunnel Constructed in 1928-1929

nearly 1,600 feet. Most of the water discharged by the tunnel seems to come from the sections marked tunnel 1 and tunnel 2...The tunnel supplies about 0.6 mgd to the Kaua'i County water systems in Līhu'e and Nāwiliwili.

It was during the 1930s, when Federal funds became available to assist the Territory of Hawai'i's highway construction program, that development of the present Kaumuali'i Highway accelerated. Between 1933 and 1937 the "construction or reconstruction" of the Belt Road was completed incrementally. Ho'omana Overpass (Ho'omana Road Bridge), was constructed in 1928, Waihohonu Bridge was built in 1934, the Līhu'e Mill Bridge, was constructed in 1936, and the Weoweopilau Bridge was built in 1937.

At the same time that the Belt Road construction program was underway, during the mid-1930s, Grove Farm was further expanding into Puhi. It moved its headquarters there, constructing a new office building, shop and stables:

The new plantation headquarters was a snug, concrete building with grey-white walls and a Hawaiian style roof of grey cement shingles. Broadbent [the plantation manager] and Alexander [the assistant manager] shared a room almost as big as the entire old office. Time keepers had the main room, the bookkeeper a space for himself. The engineering department worked in another small room and supervisors had desks for filling out reports.

Nearby, across the compound, young Bill Moragne was busy erecting an all electric-powered plantation repair shop. By the end of 1935, Grove Farm would be the most modern, best equipped plantation in the Territory of Hawai'i. (Krauss and Alexander 1965:336).

In 1948 Grove Farm merged with Kōloa Plantation. This doubled the size of Grove Farm, gave Grove Farm its own sugar mill for the first time, and eliminated duplication in manpower, equipment and administrative costs. In 1948/49 a cane haul truck tunnel (the Wilcox Tunnel) was excavated under the Hoary Head Range connecting the sugar cane fields of Ha'ikū to the Kōloa Mill.

In 1954 an airstrip was developed at Ha'ikū for aerial spraying of fertilizer and herbicides. In the early 1960s the nearly one mile long Kuia-Waita Tunnel was completed bringing Ha'ikū water to the drier Kōloa side.

III. PREVIOUS ARCHAEOLOGICAL RESEARCH

The first attempt at comprehensive archaeological survey of Kaua'i was undertaken by Wendell Bennett (1931) of the Bishop Museum. Bennett's survey report identifies no archaeological sites within or in the vicinity of the present Kokolau Tunnel project area. The closest sites Bennett shows are nearly five kilometers away on the way to Kīpū Kai (Bennett sites 93 and 94) and the "Niamalu" or "Menehune" Fishpond (Bennett site 98). A review of reports presently on file in the library of the State Historic Preservation Division (SHPD) indicated that no archaeological surveys have been conducted in the immediate vicinity of the present project area. The major focus for archaeological studies in the neighborhood has been at the mouth of the Hulē'ia River.

In 1973, an archaeological reconnaissance of the Kaua'i Community College area *mauka* of Kaumuali'i Highway noted portions of an "old *'auwai*" (conforming to Grove Farm's "Mauka Ditch") an old military complex and possible *lo'i* but nothing was felt to warrant further investigation (Palama 1973).

Neller and Palama (1973) carried out an archaeological reconnaissance of the lower portion of the Hulē'ia River and vicinity recording a number of sites. The archaeological richness of that area from the "Menehune Fishpond" downstream and near the crest of the trail to Kīpū Kai is clear. They did however also record four sites upstream of the Menehune Fishpond, the nearest of which (site # 3010) lies on a prominent flat above the river about 1.7 kilometers south east of the present Kokolau Tunnel project area.

Ching *et al.* (1973) conducted detailed research on Alekoko (Menehune) Fishpond and vicinity.

In 1981, Patrick Kirch proposed a "Niumalu Archaeological and Historical District" for the rich archaeological area at the mouth of the Hulē'ia River extending west only as far as the west end of "Menehune Fishpond".

In 1986, Michael H. Kido performed further work at the Alekoko Fishpond and Hulē'ia Estuary.

Walker and Rosendahl (1988) conducted an archaeological surface and subsurface inventory survey at a 450-acre Grove Farm Lihu'e/Puhi project area extending from Puhi Town nearly to Nāwiliwili Bay but identified only a historic Japanese cemetery and a historic residence. The following year, Paul Rosendahl produced an addendum report covering an additional eight separate small adjacent areas and again found no sites.

O'Hare *et al.* (1993) carried out an archaeological inventory survey on a 100-acre Puakea Golf and Country Club project area located approximately one kilometer south east of Puhi Town but identified no sites or cultural remains.

In 1994, Francis Eble and Paul Cleghorn carried out archaeological monitoring of construction activities for a proposed U. S. Fish and Wildlife storage facility about two

kilometers up the Hulē'ia River from the Menehune Fishpond but identified no cultural remains.

In 1998, Hammatt and Chiogioji carried out an archaeological assessment of an approximately 11.5 kilometer-long portion of the Kaumuali'i Highway corridor through Nāwiliwili, Ha'ikū, and Kōloa *ahupua`a*. During the reconnaissance survey no surface traditional Hawaiian archaeological sites were observed but four historic sites (two bridges, a cemetery and an office building) were noted.

Thus as near as we can tell, no traditional Hawaiian sites have been previously reported within a distance of several kilometers of the present Kokolau Tunnels project area. This is probably primarily the result of historic land modification but the historic research suggests that there was never much Hawaiian activity in this area.

IV. RESULTS OF FIELD RECONNAISSANCE

Two archaeologists from Cultural Surveys Hawai'i carried out a visual inspection of the Kokolau Tunnel project area on September 8, 1999. Mr. William Eddy of the Design and Construction Division of the Kaua'i County Department of Water was kind enough to serve as guide. Without a guide we would not have been able to locate the tunnel entrances, surrounded as they are with exceedingly lush vegetation. The access trails are exceedingly overgrown. Ground visibility typically ranged from 0-5%. The configuration of the Kokolau Tunnel was found to conform to existing maps (see Figure 5).

We first visited Portal # 5, accessing it from a cane haul road to the southeast. Of the six portals (1, 1A, and 2 to 5), Portal #5 is by far the most visually impressive (Figures 11 and 12). The extra care given to facing this portal may have been because it is the closest to Lihu'e and public scrutiny. The entrance is 10.35' wide and 12.5' tall and features wing walls faced with cut basalt blocks on either side measuring 11.25' long, 3' wide and, in height, from 7.5' angling upwards to 12.5' high above the entrance. The entrance is a short tunnel section, 4.35' by 4.35' square, but soon constricts down to a crawl-through entrance formerly closed by an iron door. The door hinges have rusted through and the door is off to one side.

Our assessment was that this portal was significant for its age and architectural integrity. As explained to us on site and in earlier plans, the intention is to close this portal off for reasons of both public safety (to keep people out of a dangerous space) and public health (to keep animals out of a potable water supply). Plans call for closing this portal off at either the first 4.35' by 4.35' square constriction or 6.33' further in at the location of the former door. It was apparent that either of these obvious places for closure of the portal would involve little or no adverse impact to the integrity of the facade. As we understand it there are no plans for bulldozing or other impacts in the area.

Portal# 4 was accessed from an existing cane road to the west and a hike down a fairly steep and lush ravine. Half-way down the side of the ravine an *'auwai* was observed excavated into the earth running with the contour. The *'auwai* was .5- 1 m deep and 1.5 - 2 m wide and ran as far as we followed it through the lush growth in both directions. This is understood as part of the Grove Farm "3rd Ditch" constructed in 1866-1867 by George N. Wilcox.

The entrance to Portal #4 opens up into a small natural plunge pool. Its opening is a window-frame shaped structure built of 8" by 8" by 16" (standard) concrete masonry units (Figure 13). The opening of the concrete frame was 68 cm tall and 70 cm. wide. There is a U-shaped ditch leading out of the plunge pool area that seems unnaturally U-shaped. The near vertical walls had the appearance of stacked stone but are in fact of natural in situ mud-rock or decomposed basalt. The intended function of Portal # 4 is something of a mystery. The portal was sealed off in the 1980s because of concern that muddy water was entering the tunnel system through this opening and it remained sealed for approximately ten years. While it is presently open, plans are to reseal this entrance. Our assessment was that this portal was not significant owing to its mundane nature and lack of architectural merit.

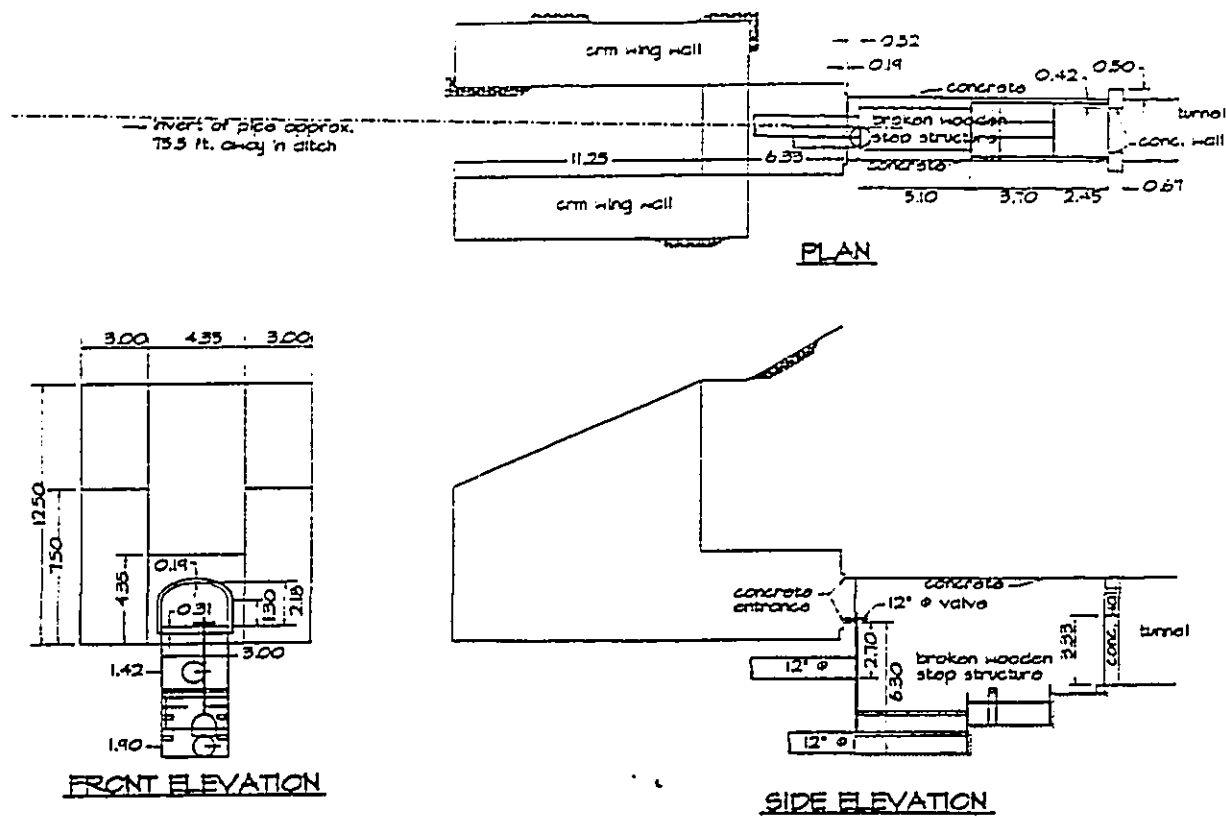


Figure 11 Engineering Plans of Portal # 5



Figure 12 View of Entrance to Portal # 5. View to North West



Figure 13 View of Entrance to Portal # 4, View to North West



Figure 14 View of Portal # 2 (to Left) and Portal # 3 (to Right), View to North

The vicinity above Portal # 4 was examined for sites but none were observed (other than the aforementioned *'auwai* higher on the slope). Given that Portal # 4 pops out in the floor of a relatively steep gully it seems highly unlikely that there was ever any traditional cultivation in this area which is probably prone to flash floods.

Portals #2 and #3 were accessed from the south via an existing but extremely overgrown jeep road. This jeep road alignment which is to be widened to 12' and paved with asphalt is cut into the ridge on the east side and drops away on the west side. One 20th century exploratory water tunnel (a small hole in the earth) was observed but is not suggested to be of any historic significance. Maps indicate there are many such test tunnels in the vicinity. No other sites were observed on the route to Portals #2 and #3.

Portals #2 and #3 lie next to each other at close to a right angle (see Figure 14 above). Portal # 2 (Figure 15) is a hole in the earth, 1.05 m wide and 1.15 m high. Portal # 3 (Figure 16) is also a hole in the earth, 1.05 m wide and 1.05 m high. Our assessment was that these portals were not significant owing to their mundane nature and lack of architectural merit. We crawled and walked through Portal # 2 to get to Portals #1 and # 1A. For most of the way this involved wading through thigh-high water.

Near the west end of the Kokolau Tunnel, near Portal #1 (Figure 17) there is a transverse tunnel exiting to the light through Portal # 1A (Figure 18). Portals # 1 and # 1A are also holes in the ground. Our assessment was that these portals were not significant owing to their mundane nature and lack of architectural merit.

Upon returning to Portal # 2, the area overlying and surrounding the Kokolau Tunnel in the vicinity was examined. An *'auwai*, similar to that observed on the way to Portal # 4 was observed (Figure 19). The *'auwai* is a cleft in the dirt dropping at perhaps 1 foot per thousand horizontal feet. The *'auwai* follows the contour of the ridge actually crossing over the (younger) tunnel twice. The *'auwai* was measured as lying 42' from Portal # 2 in the direction of the tunnel and 37' from Portal # 1 in the direction of the tunnel. Thus present plans call for the destruction of portions of this *'auwai* overlying these entrances to the Kokolau Tunnel. The *'auwai* was followed for a distance of a few hundred meters. The channel was lost in the small valley to the north east of Portals # 2 and # 3 and is assumed to have been obliterated by erosion. The *'auwai* extended to the west as far as it was followed through dense underbrush. This *'auwai* is understood as part of the Grove Farm "3rd Ditch" constructed in 1866-1867 by George N. Wilcox. While an impressive piece of engineering, falling as it does so gently it is difficult to discern the direction of flow, this ditch is thought to be similar to hundreds of miles of other *'auwai* on Kaua'i and no particular significance was accorded the ditch.

An earnest foray was made into the 3 m high grass and *hau* to the southwest of Portal # 1A but no sites or even a remnant of the former road there could be observed. The cane haul road along which the new water pipe is to be laid was examined but again no sites were found and site potential was judged to be very low. Aside from the *'auwai* and the Kokolau Tunnel complex itself no sites were observed or are believed to exist in the project area.



Figure 15 View of Portal # 2, View to North West



Figure 16 View of Portal # 3, View to North East



Figure 17 View of Portal # 1, View to South East



Figure 18 View of portal # 1A, View to South East

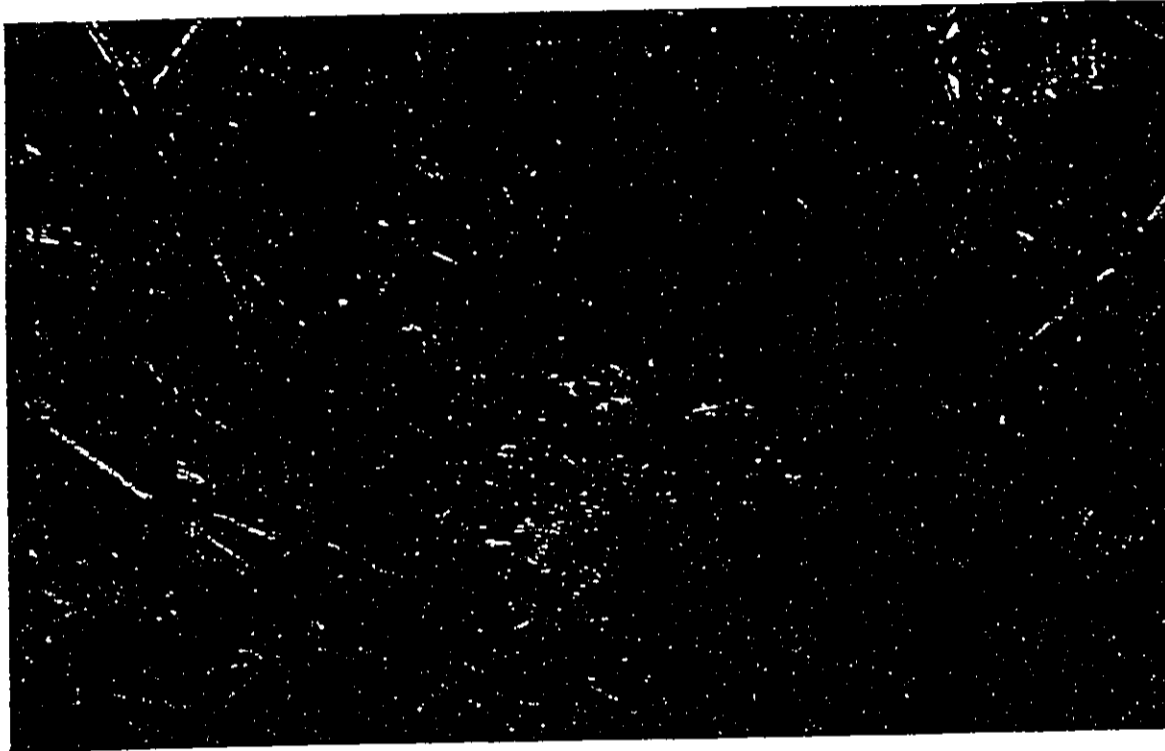


Figure 19 View of Relatively Clear portion of 'Auwai (Understood as Grove Farm "3rd Ditch". Dating to 1866-1867) Near Portal 1. View to South

V. SUMMARY AND RECOMMENDATIONS

A. Summary

Background research of *Māhele* records shows that the lower reaches of the Hulē'ia River, south east of the project area, were a major locus of Hawaiian habitation and agriculture. However, no Land Commission Awards or applications are known within 1.7 kilometers of the present study area. This is suggested to be indicative of traditional occupation patterns with permanent residence and agricultural activity being relatively dense where the flood plain of the Hulē'ia River was broad. We have no reference to land use of the Kokolau Tunnel project area other than for pasturage prior to the development of sugarcane infrastructure in the 1860s. During the reconnaissance survey, no surface prehistoric archaeological sites were observed in the Kokolau Tunnel area and none are believed likely to exist in the immediate vicinity.

In the mid-1860s a number of major irrigation ditch projects were undertaken within Ha'ikū *Ahupua'a* by George N. Wilcox for Grove Farm Plantation. George Wilcox was a major figure in the history of Hawai'i as a sugar planter, philanthropist and prime minister of the Kingdom of Hawai'i. The 3rd Ditch (shown on Figures 8 and 9), designated State Site # 50-30-11-1563, begun in 1866 and completed in 1867 overlies portions of the Kokolau Tunnels. Proposed plans for the tunnels will adversely impact two to three small sections (30 m stretches) of this ditch.

George Wilcox was an irrigation enthusiast and promoted a number of ditches ("1st Ditch" through "4th Ditch", "Lihu'e Ditch", "Mauka Ditch", etc.) as part of the Grove Farm plantation infrastructure. No particular import is accorded to 3rd Ditch. It is believed that there are a hundreds of miles of similar former ditch alignments on Kaua'i. It is believed that 3rd Ditch has been inactive for many decades, has been previously cut in many places by erosion and construction activities and has no chance of being revitalized in its former alignment. This site is suggested to be significant under Significance Criterion "D" for Historic Preservation as likely to yield information important in history only and it is further suggested that this present document adequately documents this ditch so that it may be declared no longer significant. We recommend that an assessment of "no longer significant" is indicated for Grove Farm 3rd Ditch.

The Kokolau Tunnel, designated State Site 50-30-11-1562, was excavated between July 25, 1928 and February 29, 1929 as part of a project to bring potable subsurface water to Lihu'e Town. Conceptually the Kokolau Tunnel is in fact three tunnels (Tunnel No. 1 through Tunnel No. 3) interconnected in the shape of a reverse letter "Z" with a total of 6 entrances (Portals 1, 1A, 2 to 5) (See Figure 7). The tunnel itself is unremarkable, and is simply bare rock for most of its length. Four of the portals (1, 1A, 2 and 3) are simply holes in ridges. One portal, number 4, has a concrete masonry "window-frame" improvement and an associated water course which appears to be in part man-made. Portal # 5 is faced with a fairly large entrance of cut "blue-rock" basalt. In coordination with the State Historic Preservation Division architectural staff it has been determined that the Kokolau Tunnel (Site-1562) is to be significant under criterion "C" as an excellent example of a water tunnel site type.

B. Recommendations

Two sites of note were observed in the archaeological/historical review and the field inspection of the Kokolau project area: State Site 50-30-11-1562, the Kokolau Tunnel system itself (built in 1928-1929) and State Site 50-30-11-1563, the remnants of Grove Farm "3rd Ditch" constructed by George N. Wilcox for Grove Farm Plantation in 1866-1867.

The present plans for the reworking of the Kokolau Tunnel system will adversely impact the ditch as well as change the appearance of portions of the tunnel system. It is recommended that, on the basis of this archaeological assessment, that the State Historic Preservation Division be approached for their concurrence that the Grove Farm "3rd Ditch" (Site -1563) be determined to be no longer significant. The rationale for this recommendation includes: 1) that the ditch is mundane, without distinctive architectural merit; 2) it is believed that there are a hundred miles of similar former ditch alignments on Kaua'i and 3) it is believed that 3rd Ditch has been inactive for many decades, has been previously cut in many places by erosion and construction activities, and has no chance of being revitalized in its former alignment and therefore has lost its historic integrity.

In coordination with the State Historic Preservation Division architectural staff it has been determined that the Kokolau Tunnel (Site-1562) is significant under criterion "C" as an excellent example of a water tunnel site type. In consultation with the SHPD concurrence has been reached that the proposed plans are appropriate because of concerns for public health and safety and because the proposed plans will have virtually no adverse impact on the most visually impressive portal construction. The SHPD has recommended (Hibbard letter of 10/6/1999, Log No: 24155, Doc No: 9909NM09) photo-documentation utilizing HABS/ HAER standards (4x5 negatives, 8x10 photographs on fiber based paper, archivally processed) of portals # 4 and 5 to further complete mitigation in advance of alteration of these structures. The SHPD has further requested consultation regarding the specific nature of the closure of Portal #5 in advance of the closure. The configuration of Portal # 5 is such that closure with minimal impact to the integrity of the entrance should be quite easily accomplished within present plans. We understand that this consultation may be handled directly between Kaua'i County Department of Water and the SHPD. We recommend that these two directives be followed through with in advance of the proposed alteration work.

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APPENDIX : HA'IKU AHUPUA'A LAND COMMISSION AWARD RECORDS

Land claim #s	Claimant	'Ili	Land Use	Landscape features	Awarded/Not awarded
3230	Opae	Kahakea / Kahaakea	1 ap.; 3 lo'i, kula, house	Hulā'ia River, Kahakea pali	2 ap.; 1 Ac. 1 rood
3247	Hua	Wainuiohui	1 ap.; 4 lo'i, kula, pig enclosure, house	Niumalu River	1 ap.; 3 roods 17 rods
3272	Leoiki	Makaopuna Lahoolo	2 ap. 8 lo'i, house 1 lo'i	Hanakaau-wai pali, Hanaleiia pali, Popouli Stream	2 ap.; 1.75 Acs 38 rods (2 'apana in Makaopuna)
3287	Wahawaha	Kahakea	1 ap.; 3 lo'i, kula, house	pali, Hulā'ia River	2 ap.; 1 Ac. 1 rood 23 rods
3317	Maikai	Makao-punaau Kapenu	2 ap.; House, kula 8 lo'i	Makaopuna & Kapenu 'auwai (s) Hulā'ia River, Kawaiiki stream, Hanalina pali,	Makaopuna 1 ap.; 2 Acs 3 roods 12 rods; Kaupenu 2 ap.; 1 Ac. 3 roods 14 rods
3318	Kipani, Maraki/ Malaki	Makaokole	2 ap.; 3 lo'i, 10 dry lo'i, house lot	Hulā'ia River, Makakole pali	1 ap.; 3 roods 22 rods
3319	Mahaulu	Makaokole	1 ap.; 5 lo'i, 'auwai, kula, house	'auwai, Hulā'ia River	
3324	Gaperiela Lalo (Kala)	Hoa Wailua Kalaniuli / Laniuli	3 ap.; 3 lo'i, kula 3 lo'i +, kula house lot	Omoe, Maunapali. & Wainuiohui pali(s), Hulā'ia River	1 ap.; Wailua 1.25 Acs (other awards elsewhere on Kaua'i)

Land claim #s	Claimant	'Ili	Land Use	Landscape features	Awarded/Not awarded
3360	Naniho	Wailua Pahani	2 ap.; 4 lo'i, house lot	Ha'ikū 'auwai, Hulā'ia river	Wailua 1 ap.; 2 roods 3 rods; Pahunui 1 ap.; 1 Ac. 3 rods 29 rods
3362	Nakao	Kapenu	2 ap.; 13 lo'i, wauke kula, house lot	Kawaiiki stream, Kamaluhale pali, Kapena 'auwai	2 ap.; 4.25 Acs 14 rods
3363	Naalualu	Wainuiohui	1 ap.; 5 lo'i, kula, house	pali, Niumalu River	1 ap.; 4.5 Acs 3 roods 24 rods
3364	Naihepapa	Peakoa/ Peekoa Makaopuna	2 ap.; 15 lo'i 2 lo'i	Hulā'ia River	2 ap.; 1 Ac. 30 roods
3391B	Paele	Puaku	1 ap.; 1 lo'i, kula, house (House in Kīpū)	Hulā'ia River, Kahua pali (Kīpū)	1 ap.; 1 rood 28 rods
3403B	Haupu	Pu'uloa	1 ap.; no land use given	path to Kilohana, road to Kōloa, Kipu'upu'u stream, Opaikoa pali	1 ap.; 7 Acs 30 roods
3405B	Limaloa	Puapuakii	6 lo'i (house in Kīpū)	Ahule pali, Hulā'ia River	Ha'ikū & Kīpū 3 ap.; 2 Acs. 2 roods 30 rods
3419	Poepoe	Alapaa & Makaopuna (1 ap.) Lahooli	2 ap.; 4 lo'i 1 lo'i 3 lo'i (house in another place)	Hanakaau-wai & Hanaleia pali(s), Popoulu stream	2 ap.; 2 Acs 9 roods (Alapa'a)
3420	Puupuniki	Kahakea	2 ap.; 11 lo'i, kula, house	pali, Hulā'ia River	3 ap.; 1.75 Acs 34 rods

Land claim #s	Claimant	'Ili	Land Use	Landscape features	Awarded/Not awarded
3422	Pakaua, K	Makaopuna	4 lo'i, kula (House in Kīpū; Kaluao-koke'e 'ili)	Makaopuna pali, Hulā'ia River	Makaakale 1 ap.; 1 Ac. 37 rods Makaopuna 2 ap.; 2 Acs 4 rods
3621	Kuhookahi	Pōhaku	2 ap.; 8 lo'i, kula, house	Hanaleua pali, Kaua'iiki stream & muliwai, 'auwai	2 ap.; Pahoni 2.75 Acs 6 rods
3623	Kamaka	Makaokole	2 ap.; 8 lo'i, kula, house on pali	Makaokole pali	1 ap.; 4 Acs 21 rods
3625	Ki, John	Pahunui	1 ap.; 13 lo'i, wauke kula, house lot	Niumalu River	1 ap.; 7.25 Acs
3626	Keoahu	Pahani	2 kula, large lo'i		abandons claim
3627	Kaelo	Wailua	8 lo'i, kula, house	side hill (hana hanai), Niumalu River	1 ap.; 1.5 Acs 19 rods
3630	Kauhi	Kua'a / Kuwaa	1 ap.; 6 lo'i, kula, house lot	Kua'a pali	2 ap.; 1.5 Ac. 14 rods
3632	Kalehua	Nakioi Kaumiumi	1 ap.; 9 lo'i, 1 wauke kula, 1 wauke kula		1 ap.; 4 Acs
3633	Kuanoa	Makaokole	1 ap.; 4 lo'i, kula, house	pali	1 ap.; 1 Ac. 1 rood 14 rods

Land claim #s	Claimant	'Ili	Land Use	Landscape features	Awarded/Not awarded
3634	Kahea	Kamoa	2 <i>ap.</i> ; 15 <i>lo'i</i> , house, <i>kula</i> , coconut	Kuamano (dam) of Pomahoa, Ha'ikū 'auwai, Kiowai, Ha'ikū Stream, Poma, Po'onahoa <i>pali</i>	1 <i>ap.</i> ; 8.5 Acs 9 rods
3635	Keakinou	Makaokole	1 <i>ap.</i> ; 4 <i>lo'i</i> , house, <i>kula</i>	'auwai of Okua'a, Makaokole <i>pali</i>	1 <i>ap.</i> ; 1 Ac. 30 rods
3636	Kukonou	Alapa'a	1 <i>ap.</i> ; 6 <i>lo'i</i> , <i>kula</i> , house	<i>pali</i> , Kawaiiki Stream	1 <i>ap.</i> ; 2 Acs 1 rood 15 rods
3648	Kala, Gapelela		3 <i>lo'i</i> , <i>kula</i>		Award
5311	Kawahinele, eiole, wahine	Makaopuna	1 <i>ap.</i> ; 4 <i>lo'i</i> , <i>kula</i> , house	Ahuli <i>pali</i> , Ha'ikū River	2 <i>ap.</i> ; 3 rods 24 rods
5351	Palea	Waipapa Wainuiohū Kīpūka	1 <i>ap.</i> ; 20 <i>lo'i</i> , 1 <i>lo'i</i> house lot	Waiolono Stream, Ha'ikū 'auwai, Hulē'ia River	Waipapa; 3 <i>ap.</i> ; 2 Acs 3 rods
5398	Haee	Waipapa	3 <i>ap.</i> ; 20 <i>lo'i</i> , house	Waiolono Stream, Waikunono <i>pali</i> , Kahiwaha <i>muliwai</i> , stone fence, Kahinapa river, 'auwai	1 <i>ap.</i> ; 2.75 Acs 18 rods
5481	Upai	Waiapuka	1 <i>ap.</i> ; 13 <i>lo'i</i> , <i>kula</i> , house	F.T. Ha'ikū Stream, N.T. Hulē'ia Stream	1 <i>ap.</i> ; 1 rood 16 rods
6611	Ku, Ioane	Kuia	2 <i>ap.</i> ; 13 <i>lo'i</i> , 2 <i>kula</i> (house in Koloa)	Kahili <i>pali</i> , road called Keleponakaheka	1 <i>ap.</i> ; 2 rods 25 rods

Land claim #s	Claimant	'Ili	Land Use	Landscape features	Awarded/Not awarded
6533	Kaoe	Kahakea	2 <i>ap.</i> ; 6 <i>lo'i</i> , <i>kula</i> , house lot	Waipuhi Stream, Kahakea <i>pali</i>	3 <i>ap.</i> ; 2 Acs 24 rods
7713	V. Kamamalu	Ha'ikū, Kīpū			Ha'ikū 9585 Acs; Kīpū 3029 acres
10564	Oleloa, Daniela konoohiki	10 <i>lo'i</i> , 3 fish ponds, 1 upland taro		Hulā'ia River	not awarded in Ha'ikū