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Punamano II

Final
Environmental Impact Statement

COUNTRY COURSES AT KAHUKU

Punamano

Kahuku, Koolauloa, Oahu

VOLUME II

THE ESTATE OF JAMES CAMPBELL

Tax Map Keys:
5-6-05: Portion of 1, Portion 2, 5, 6 and Portion 7
5-7-01: Portion 21

Prepared By:
William E. Wanket, Inc.

May 1990

FINAL

ENVIRONMENTAL IMPACT STATEMENT

VOLUME II

THE COUNTRY COURSES AT KAHUKU (PUNAMANO)

Kahuku, Oahu

May 1990

Submitted pursuant to Chapter 343, Hawaii Revised Statutes, Environmental Impact Statement Regulations.

Prepared For: **THE ESTATE OF JAMES CAMPBELL**

For Submittal To: **DEPARTMENT OF GENERAL PLANNING**

Prepared by: **WILLIAM E. WANKET, INC.**

William E. Wanket, President
Pacific Tower 660
1001 Bishop Street
Honolulu, Hawaii 96813

VOLUME II

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Smith, Young & Associates, Inc.

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Punamano

SOILS REPORT

FOR

THE COUNTRY COURSES AT KAHUKU

PUNAMANO SITE

PREPARED FOR

THE ESTATE OF JAMES CAMPBELL

PREPARED BY

DAMES & MOORE

1144 10TH AVENUE

HONOLULU, HAWAII 96816

DAMES & MOORE JOB NO. 07597-020-11

APRIL 1990

APPENDIX DM-1

PUNAMANO GOLF COURSES

INTRODUCTION

This Appendix presents our findings regarding soil conditions for the proposed development of three 18-hole golf courses in the vicinity of Kahuku on the North Shore of Oahu. The approximate location of the site is shown on the Map of Area, Plate P-1.

This report addressed the following:

a. Site Conditions
b. Geology
c. Soil Classifications
d. Anticipated impacts and mitigative measures.

SITE CONDITIONS

The site exhibits varying terrain, consisting of relatively flat-lying outwash allùvial plains and marginal coastal plains with elevations ranging from 10-25 feet above mean sea level (MSL) to low-lying foothills associated with the northern extension of the Koolau volcanic range with elevations ranging from 75-280 feet above MSL. Surface slopes range from flat (1 to 5 percent) over most of the makai portion of the site along Kamehameha Highway to moderately steep (5 to 20 percent) over much of the mauka area and along a portion of the eastern boundary. Steepest slopes occur around isolated peaks, escarpments, and along the margins of gulches where slopes can exceed 30 percent. The southwestern area is dominated by steep hillsides and isolated peaks that are marginal to Hoolapa Gulch. The northeastern boundary is marked by a very steep to near vertical escarpment that forms a prominant wedge-shaped flat-topped ridge or knoll with isolated depression features mauka of Kamehameha Highway. The southeastern region has a hummocky to slightly undulating topography with minor gulches and ridges that either intersect or make up the broad outwash basin of the Kalaeokahipa Gulch. Slopes are predominantly moderate in this region, except for the steep marginal slopes along Kalaeokahipa Gulch. Isolated semi-circular, small depressions, ranging from less than 100 feet to more than 600 feet in maximum linear dimension occur along the eastern margin of the site and within the Kalaeokahipa Gulch. These topographic features are confined to consolidated calcareous sand dune deposits and associated silty clayey soils. Their morphology is commonly funnel-shaped with a subterranean drainage system. They may be associated with a karst-like topography that develops primarily in calcareous deposits.

GEOLOGY

REGIONAL GEOLOGY

The Koolau volcano forms the eastern two-thirds of Oahu, and is the erosional remnant of a deeply dissected large-volume tholeiitic lava-shield in an oceanic intraplate tectonic environment.

Extinct and eroded shield volcanoes characteristically have dike complexes, these being regarded as the surface equivalent of the active rift zones. The regional rock types include gently-dipping, thin-bedded a'a and pahoehoe flows cut by numerous narrow, near-vertical dikes of similar basaltic material.

The site is located along the northernmost (windward) side the Koolau lava shield, adjacent to the bordering coastal plain (Plate P-1). Near Kahuku Point, the trend of the main dike complex changes to a more northly direction, reaching the sea at Kawela Bay. The rocks associated with the lava dome in this region are chiefly thin-bedded a'a-type tholeiitic (primative) basalts with minor amounts of interstratified pahoehoe and little or no pyroclastic ash deposits. This part of the dome is less deeply eroded than the southeastern portion near Kaneohe and Kailua (e.g. the Pali cliffline along windward Oahu), with the exception of long, meandering, narrow valleys (gulches) and cliffs near the shore.

Quarternary pyroclastic ash eruptions are not found in the northwestern region of the Koolau Volcano (Sterns, 1966). At Kahuku Point, beds of reef limestone are intercalated with other non-marine (terrigenous) sediments indicating the complexity of the geologic historic in this region. The occurrence of consolidated ancient wind blown eolian (dune) deposits at elevations greater than 200 feet above mean sea level (MSL) have added to the complexity of the geology in this area.

SITE GEOLOGY

The Punamano site is located less than one mile north-northeast (windward side) of the main northwest dike-complex (refer to Plate P-1). It is presumed that during the shield building stages that the dikes associated with the active rift zone feed basaltic lava flows that flowed seaward to the flanks in a direction generally at right angles to the dike-complex. This is substantiated by the general dip of the lava flows at 8°-10° to the northeast in the upland areas directly south of the site.

Based on previous findings (Stearns and Vaksvik, 1938; Stearns and Macdonald, 1940; Stearns, 1966), aerial photo interpretation, and our geologic investigation, we have identified four major categories of surfacial geologic features. They are: unconsolidated noncalcareous to slightly calcareous alluvial deposits; unconsolidated calcareous talus deposits; consolidated thin-bedded and cross-bedded to planar-bedded ancient, calcareous, eolian (dune) deposits; and the Koolau Volcanic Series, which includes vesicular to poorly vesicular porphyritic a'a-type basalt flows along with minor amounts of thinly bedded pahoehoe lava flows and narrow, near-vertical intrusive dike rock composed of similar basaltic material.

Basaltic lava of the Koolau Volcanic Series and associated alluvium and colluvium forms the bulk of the material along the south-southwest one-half to two-thirds of the site. Terrestrial sedimentary deposits (i.e., consolidated calcareous) and eolian (wind-blown) sandstone deposits dominate the northeastern boundary and occur along isolated portions of the Kalaeokahipa Gulch. A majority of the unconsolidated noncalcareous (Recent) alluvium locally may contain abundant gravel, cobbles, and boulders of consolidated calcareous dune sandstone material resulting in the slightly limestone nature of these terrestrial deposits particularly along the coastal plain (lowlands) portions of the site.

Good exposures of basaltic rock outcrops occur at upper elevations (roughly about +200 feet MSL), particularly along the southeastern boundary of the site. These rock outcrops become more discontinuous, fractured, and weathered at lower elevations. Where the basaltic rocks are most highly weathered, fractured, and jointed, a thin veneer (on the order of 2-3 feet to as much as 6-10 feet) of gravelly, silty clay is present above less weathered basalt. In-situ soils associated with extremely weathered basalt are saprolitic, highly plastic, and generally expandable in nature. Saprolite zones grade into spheroidally weathered basalt layers.

Along much of the eastern and northeastern portions of the site calcareous sandstone deposits containing solution pits are most abundant. In this area and portions of the Kalaeokahipa Gulch, the topography is quite variable, consisting of lowlying knolls, hummocks, and depression features that are commonly associated with land surfaces common to karst topography. Calcareous stalactites were noted within small caves along the sandstone cliffs near the northeastern corner of the site along Kamehameha Highway. The majority of these features are suggestive of a karst topography that may have formed in the calcareous sandstone rocks by dissolution of limestone by water. Furthermore, these erosional features indicate that an underground drainage system is also likely to be present below these deposits.

SOIL CLASSIFICATIONS - PUNAMANO GOLF COURSES SITE

Soil Conservation Service (SCS) Classification

According to the U.S. Department of Agriculture Soil Conservation Service (SCS), soils in the Punamano area consist of mainly clay, silty clay, coral and basalt rock outcrops. Based on the SCS soils survey, the Punamano site is divided into eight major categories, which are: Coral outcrop; Kaena Series; Kaloko Series; Kemoo Series; Lahaina Series; Paumalu Series; Rock Land; and Waialua Series. Based on the SCS soils map, many of these major categories are broken up into a number of subseries which will be discussed in the following sections and outlined in Table 1 and shown on Plate P-2.

The Kaena Series consist of poorly drained soils on alluvial fans and talus slopes. They develop in alluvium and colluvium derived from weathered basaltic material. They are dark grayish brown to reddish brown, stoney clay with a fine to medium subangular blocky structure. These clays tend to have very high plasticity and contain angular pebble-size basalt fragment which increase in both size and content with depth.

A brief description of the subseries soil types follows:

a. Kaena Clay, 2-6 percent slope (KaB). This soil contains few or no stones in surface layer. On this soil, runoff is slow and erosion hazard is slight. This soil covers approximately 37 acres or 6 percent of the site.

b. Keana Clay, 6-12 percent slope (KaC). On this soil, runoff is slight to moderate. This soil has few or no stones in the surface layer and covers approximately 37 acres or 6 percent of the site.

c. Kaena Stoney Clay, 10-35 percent slope (KaeC). This soil occurs on alluvial fans and is dark reddish brown. It is moderate to well drained, mottled, and exhibits slow permeability. On this soil, runoff is slow to medium, and erosion hazard is slight to moderate. This soil covers approximately 20 acres or 3 percent of the site.

d. Kaena, Very Stoney Clay, 10-35 percent slope (KanE). This soil occurs on steep talus slopes and alluvial fans. It contains many stones on the surface and in the profile. On this soil, runoff is medium to rapid, and erosion hazard is moderate to severe. This soil covers approximately 33 acres or 6 percent of the site.

The Kemoo Series consist of well-drained, dark reddish brown, silty clay soils which are derived from weathered basaltic material that develops on upland areas. These silty clays are well drained, have a subangular blocky structure, and moderate to moderately rapid permeability. Both runoff and erosion hazard are moderate. These soils have abundant calcareous fines that are strongly effervescent with hydrogen peroxide.

a. Kemoo Silty Clay, 2-6 percent slope (KpB). On this soil, runoff is slow to medium and the erosion hazard is slight. This soil covers approximately 18 acres or 3 percent of the site.

b. Kemoo Silty Clay, 6-12 percent slope (KpC). Soil runoff is medium and the erosion hazard is slight to moderate. This soil covers approximately 7 acres or 1 percent of the site.

c. Kemoo Silty Clay, 12-20 percent slope (KpD). On this soil, runoff is medium, and erosion hazard is moderate. This soil occurs on approximately 5 acres or 1 percent of the site.

d. Kemoo-Badland Complex, 10-70 percent slope (KPZ). These areas consist of barren areas that have remained after the Kemoo soil was removed by erosion. On this soil, runoff is rapid and the erosion hazard is very severe. The Badland areas cover approximately 6 acres or 1 percent of the site.

The Lahaina Series consist of well-drained, dark reddish brown silty clay. These silty clay soils contain cobbles (of cemented calcareous dune deposits and weathered basalts) on the surface in the upland areas, and near the coastal plains. They commonly contain coralline fragments (stones, gravel, or sand). These soils show strong effervescence with hydrogen peroxide, which is probably related to abundant fine-grained calcareous material.

a. <u>Lahaina Silty Clay, 3-7 percent slope (LaB)</u>. This soil occurs on smooth upland areas and locally contains considerable cobblestones of mainly recemented and/or recrystallized calcareous dune sands (eolian deposits). In some places, particularly along the coastal plains, just north of Kamehameha Highway, these silty clay soils are underlain (below 30 inches) by consolidated (beach sand) eolian dune deposits that show varying degrees of calcite recrystallization. Permeability is moderate, runoff is slow, and erosion hazard is slight. This subseries make up the largest single soil type found at the Punamano site. It covers approximately 97 acres or 16 percent of the site.

b. <u>Lahaina Silty Clay, 7-15 percent slope (LaC)</u>. This soil occurs on steep slopes where only a few cobblestones are on the surface. Runoff is medium and erosion hazard is moderate. Those soils cover approximately 70 acres or 12 percent of the site.

Paumalu Series consist of well-drained, dark reddish brown silty clay soil. These soils developed in old alluvium and colluvium derived from weathered volcanic basalt. They have a subangular to angular blocky structure. The substratum grades to a highly weathered clayey silty gravel which overlies less weathered basalt, which commonly exhibits spheroidal weathering.

a. <u>Paumalu Silty Clay, 3-8 percent slope (PeB)</u>. On this soil, runoff is slow and erosion hazard is slight. These soils cover approximately 26 acres or 4 percent of the site.

b. <u>Paumalu Silty Clay, 8-15 percent slope (PeC)</u>. On this soil, runoff is slow and erosion hazard is slight. Workability is easy. These soils cover approximately 60 acres or 10 percent of the site.

c. <u>Paumalu Silty Clay, 15-25 percent slope (PeD)</u>. On this soil, runoff is medium and erosion hazard is moderate. The associated subsoil (up to 5 feet thick) is a highly weathered (argillized) silty gravel composed of saproitic basalt. Permeability is moderately rapid. These soils cover approximately 15 acres or 2 percent of the site.

d. <u>Paumalu Silty Clay, 40-70 percent slope (PeF)</u>. On this soil, runoff is rapid and erosion is severe. It covers approximately 26 acres or 4 percent of the site.

Rock Land (rRK) consists of areas where exposed slightly to moderately weathered basalt rock outcrops cover approximately 25 to 90 percent of the surface. The rock land cover only approximately 2 acres (or less than 1 percent) of the study area.

Waialua Series consist of moderately well-drained dark reddish brown stony silty clay with a medium and coarse-grained subangular blocky structure. These soils are very sticky with high plasticity. These soils develop in alluvium or colluvium associated with weathered basaltic rocks.

a. Waialua Silty Clay, 0-3 percent slope (WkA). This soil consists of a dark reddish-brown silty clay that has subangular blocky structure. This soil occurs on smooth coastal plains where runoff is slow and the erosion hazard is slight. Permeability is moderate. This soil covers approximately 11 acres or 2 percent of the site.

b. Waialua Silty Clay, 3-8 percent slope (WkB). Like the WkA soil, runoff on this soil is slow and erosion hazard is slight. The WkB soil covers approximately 45 acres or 7 percent of the site (Refer to Table 1 and Plate P-2).

Agricultural Lands of Importance to the State of Hawaii (ALISH)

The ALISH classification system consists of identification of three broad classes mapped as agricultural land based, in part, on the criteria established by the Soil Conservation Service (SCS) soil survey. The State Department of Agriculture classifies approximately 346 acres or 57 percent of the Punamano Site as Prime Agricultural Land, 103 acres or 17 percent as Other Important Agricultural Land, and 156 acres or 26 percent as land that has not yet been classified. Based on the ALISH classification system, none of the Punamano Site is considered as Unique Agriculture Land or Existing Urban Development Lands (Refer to Table 2 and Plate P-3).

Detailed Land Survey Bureau Classification (LSB)

The Land Study Bureau (LSB) classifies soils by land type in which categories are provided for an overall crop productivity rating, with and without irrigation, and for selected crop productivity ratings for seven crops. LSB overall ratings range from A to E, with A being the best. Capability classifications within the Punamano site are shown on Table 3, and soil types are shown on Plate P-4.

Land Evaluation and Site Assessment System (LESA)

The LESA Commission's findings, conclusions, and recommendations concerning development of the State of Hawaii's "Important Agricultural Lands" (IAL) was presented in its final report dated February 10, 1986.

This report presents a classification system by which State of Hawaii lands were identified, and a process to review requests for a change in designation of specific parcels from IAL to "urban" or to "other uses" and vice versa.

Lands identified as "Important Agricultural Lands" can be reclassified by the State or rezoned by the Counties only after meeting the criteria established by the State Legislature and approved by a two-thirds vote of the body responsible for the reclassification or rezoning action.

Two categories of "agricultural lands" were established as a consequence of implementing the LESA standards, criteria, and procedures. They are: Important agricultural lands and other than important agricultural lands.

In checking with the Hawaii State Department of Agriculture, only generalized maps illustrating the application of the LESA system exist at this time. No detailed studies or maps using the LESA system have been made for the Kahuku area.

ANTICIPATED IMPACTS AND MITIGATIVE MEASURES

Environmental Issues Related to Soils that Could Impact or Enhance Golf Courses

- Expansive soils with high shrink-swell capability (particularly those soils associated with saprolitic basalt zone) may need to be excavated prior to construction of building structures and service roads.

- Approximately ten percent of the site contains soil that have abundant lithic material rich in coarse-grained cobbles and boulders. These stoney to very stoney soil may require excavation and removal and represent poor fill material for mass grading work.

- Approximately one percent of the site contains Badland areas where erosion hazard is very severe. These areas represent unstable areas and should be excavated, covered with vegetation to reduce soil erosion or terraced and benched to lower slope gradients so as to lower runoff and erosion hazard.

- Based on the LSB soil classificaton system, only 1 percent of the land area (if irrigated) is considered as the best agricultural land "A." While 58 percent is considered the next best choice for agricultural land, Class "B." Based on the ALISH classification, approximately the same total percent of the site is considered Prime Agricultural Land (57 percent).

- With construction of structures and roads, the percent imperviousness of the site's initial conditions will increase resulting in slightly increased runoff. Mitigative measures may include construction of water retention storage ponds in appropriate areas.

- During construction phases, increased soil erosion is expected, due to removal of plant cover and exposing large areas of barren soil.

Environmental Issues Related to Geology That Could Impact or Enhance the Golf Courses

- Naturally occuring depressions may be useful for possible temporary runoff impoundment and disposal of irrigation water and storm runoff.

- Narrow gulches in upland areas can channel storm runoff and cause severe erosion and flooding hazard to lowlying areas down-gradient over a very short time frame. Mitigative measures include construction of short term storage reservoirs to retain large volume influx of runoff water. During dry seasons, storage reservoirs should be inspected, cleared of debris, and maintained.

- Approximately 15 percent of the site consists of coralline sandstone and basaltic rock outcrop. Excavations into the less weathered portions of the dense, massive lava flows and recrystallized sandstones may be difficult.

- Surface drainage should be improved in the lowlying areas to reduce flooding hazards.

(6668A/439A)

TABLE 1: SOILS CONSERVATION SERVICE CLASSIFICATION (SCS)
THREE GOLF COURSES AT PUNAMANO SITE
FOR THE ESTATE OF JAMES CAMPBELL
JOB NUMBER 07597-020-011

SOIL TYPE	DESCRIPTION	APPROXIMATE ACREAGE	PERCENT TOTAL (%)	PERCENT SLOPE (%)	DRAINAGE RUNOFF	EROSION HAZARD	CAPABILITY NONIRRIGAIATED	CLASSIFICATION IRRIGATED
CR	Coral outcrop (coraline sand dunes)	87	14	0 to 15	slow	slight	VIIIs	-
KaB	Kaena Clay (reddish brown, v. plastic)	37	6	2 to 6	slow	slight	IVw	IIIw
KaC	Kaena Clay (few or no stones in surface)	37	6	6 to 12	moderate to well drained	slight to moderate	IVw	IIIw
KaeC	Kaena Stoney Clay (dark reddish brown)	20	3	6 to 12	moderate to well drained	slight to moderate	IVw	IIIw
KanE	Kaena Very Stoney Clay (occur on talus)	33	6	10 to 35	moderate to rapid	moderate to severe	VIs	:
Kfa	Kaloko Clay (dark reddish brown)	3	1	0 to 2	slow to very slow	slight	Vw	IIIw
KpB	Kemoo Silty Clay (weathered basalt)	18	3	2 to 6	slow to medium	slight	IIe	-
KpC	Kemoo Silty Clay (weathered basalt)	7	1	6 to 12	medium	slight to moderate	IIIe	-
KpD	Kemoo Silty Clay (weathered basalt)	5	1	12 to 20	moderate to rapid	moderate	IVe	-
KPZ	Kemoo Badland Complex (barren area)	6	1	10 to 70	moderate to rapid	moderate to severe	VIIe	-
LaB	Lahaina Silty Clay (coral sandstone frags.)	97	16	3 to 7	slow	slight	IIIc	IIe
LaC	Lahaina Silty Clay (coral sandstone frags.)	70	12	7 to 15	medium	moderate	IIIe	IIIe
PeB	Paumalu Silty Clay (weathered basalt)	26	4	3 to 8	slow	slight	IIe	IIe
PeC	Paumalu Silty Clay (weathered basalt)	60	10	8 to 15	slow to medium	slight to moderate	IIIe	IIIe
PeD	Paumalu Silty Clay (weathered basalt)	15	2	15 to 25	medium	moderate	IVe	IVe
PeF	Paumalu Silty Clay (weathered basalt)	26	4	40 to 70	rapid	severe	VIIe	-
rRK	Rock Land (Koolau volcanic series)	2	1	0 to 70	moderate to rapid	slight	VIIs	-
WkA	Waialua Silty Clay (weathered basalt)	11	2	0 to 2	slow	slight	IIIc.	I
WkB	Waialua Silty Clay (weathered basalt)	45	7	3 to 8	slow	slight	IIIc	IIe
	TOTALS =	605	100					

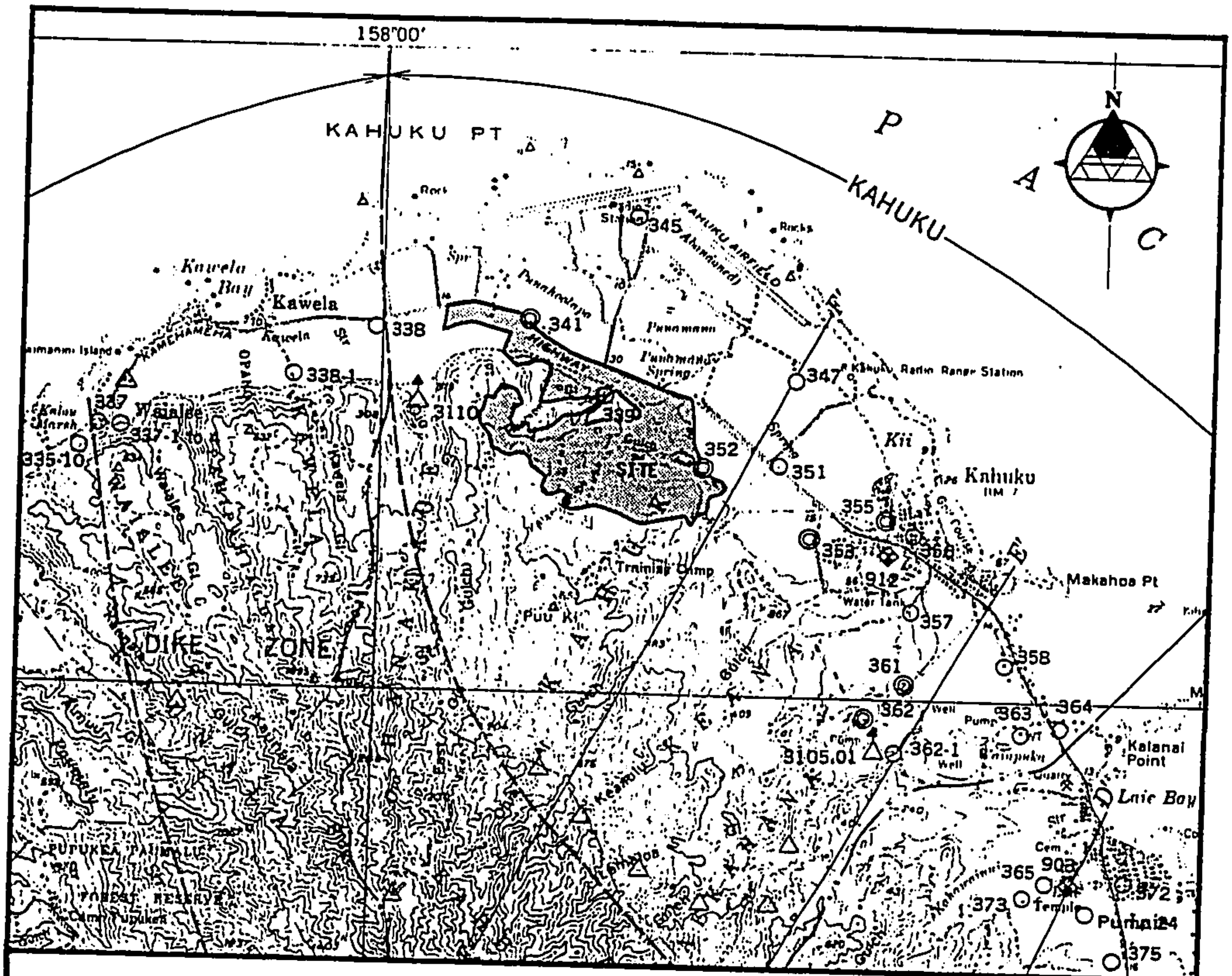
TABLE 2: AGRICULTURE LANDS OF IMPORTANCE TO THE STATE OF HAWAII (ALISH)
PUNAMANO SITE
ESTATE OF JAMES CAMPBELL
JOB NUMBER 07597-020-011

LAND USE CLASSIFICATION	APPROXIMATE ACREAGE	PERCENT OF TOTAL (%)	DESCRIPTION
Prime Agricultural Land	346	57	Land with the soil quality, growing season, and moisture supply needed to produce sustained high yields of crops economically when treated and managed according to modern farming methods.
Other Important Agricultural Land	103	17	Land with special combination of soil quality, location, growing season, moisture supply, and is used to produce sustained high quality and/or high yields of a specific crop when treated.
Unclassified Agricultural Land	156	26	Land not yet classified by Department of Agriculture, State of Hawaii.
TOTALS =	605	100	

TABLE 3: LSB LAND CAPABILITY CLASSIFICATION
PUNAMANO SITE
ESTATE OF JAMES CAMPBELL
JOB #07597-020-011

Soil Type	Approximate Acreage	Percent Total (%)	Capability Nonirrigated	Classification Irrigated
A124	45	7	D	A
B13	46	8	C	B
B16	36	6	E	B
B24	117	19	C	B
B25	68	11	D	B
B27	37	6	C	B
B96	11	2	C	B
C20	28	5	E	C
C28	11	2	D	C
C97	27	4	C	C
E29	18	3	E	D
E104	22	4	E	E(1)
E106	50	8	E	E(1)
E107	23	4	E	E(1)
E115	66	11	E	E(1)
Total =	605	100		

(1) Nonirrigated rating used when no rating is given for irrigation



5000 0 5000 10000

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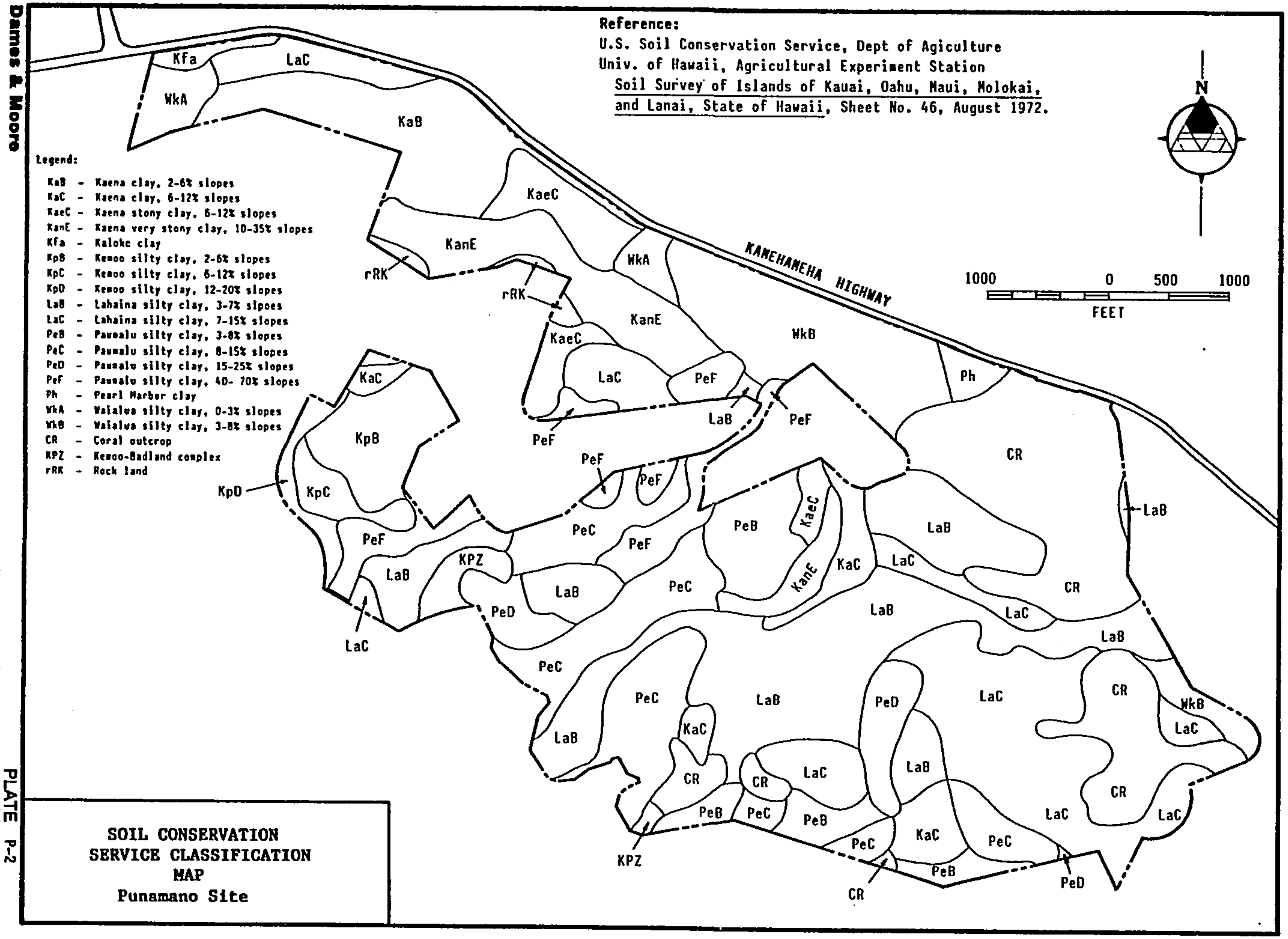
Reference:

Department of Land & Natural Resources, State of Hawaii
U.S. Geological Survey
"Hydrologic Map of the Kahuku Area, Oahu, Hawaii"
Water Supply Paper 1874, Plate 1, 1969.

PLOT PLAN
Punamano Site



Reference:
U.S. Soil Conservation Service, Dept of Agiculture
Univ. of Hawaii, Agricultural Experiment Station
Soil Survey of Islands of Kauai, Oahu, Maui, Molokai, and Lanai, State of Hawaii, Sheet No. 46, August 1972.

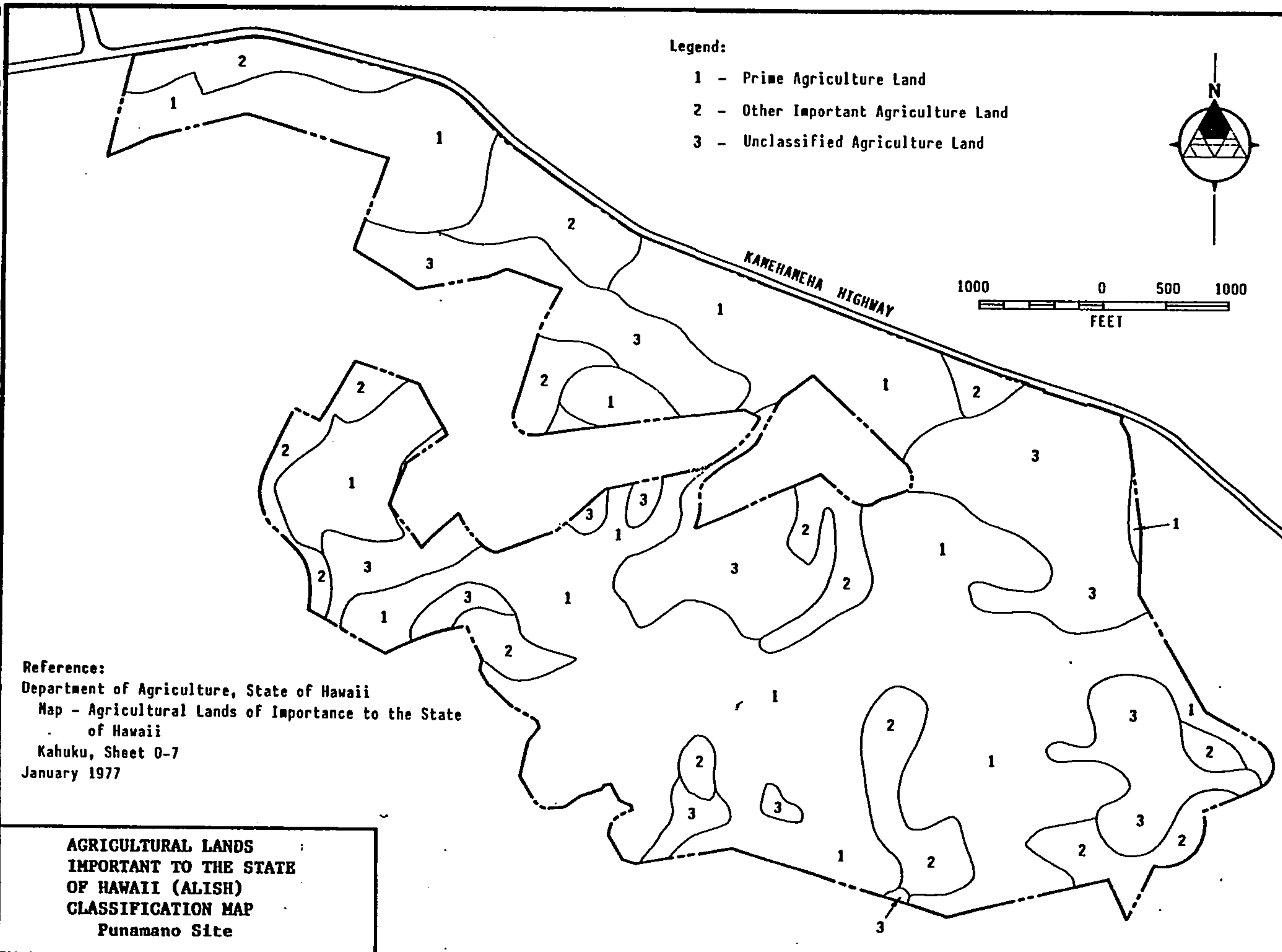
Legend:

- KaB - Kaena clay, 2-6% slopes
- KaC - Kaena clay, 6-12% slopes
- KaeC - Kaena stony clay, 6-12% slopes
- KanE - Kaena very stony clay, 10-35% slopes
- Kfa - Kaloke clay
- KpB - Kemoo silty clay, 2-6% slopes
- KpC - Kemoo silty clay, 6-12% slopes
- KpD - Kemoo silty clay, 12-20% slopes
- LaB - Lahaina silty clay, 3-7% slpoes
- LaC - Lahaina silty clay, 7-15% slopes
- PeB - Paumalu silty clay, 3-8% slopes
- PeC - Paumalu silty clay, 8-15% slopes
- PeD - Paumalu silty clay, 15-25% slopes
- PeF - Paumalu silty clay, 40- 70% slopes
- Ph - Pearl Harbor clay
- WkA - Waialua silty clay, 0-3% slopes
- WkB - Waialua silty clay, 3-8% slopes
- CR - Coral outcrop
- KPZ - Kemoo-Badland complex
- rRK - Rock land

SOIL CONSERVATION SERVICE CLASSIFICATION MAP
Punamano Site

Dames & Moore

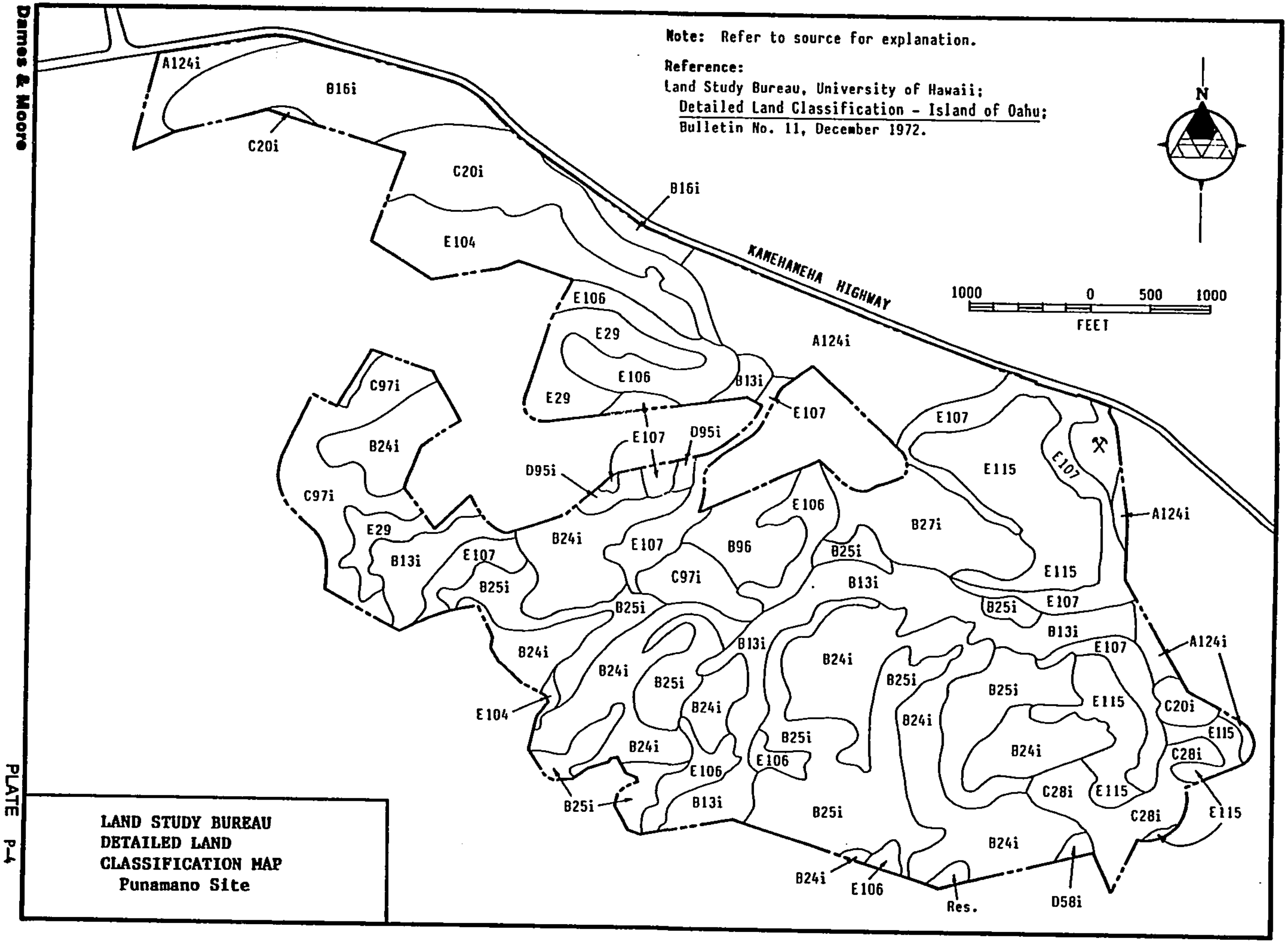
PLATE P-2



Reference:
Department of Agriculture, State of Hawaii
Map - Agricultural Lands of Importance to the State of Hawaii
Kahuku, Sheet O-7
January 1977

AGRICULTURAL LANDS IMPORTANT TO THE STATE OF HAWAII (ALISH) CLASSIFICATION MAP
Punamano Site

Dames & Moore



Note: Refer to source for explanation.

Reference:
Land Study Bureau, University of Hawaii;
Detailed Land Classification - Island of Oahu;
Bulletin No. 11, December 1972.

LAND STUDY BUREAU
DETAILED LAND
CLASSIFICATION MAP
Punamano Site

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(6668A/439A)

Sub-Appendix B

Punamano

Report

on

<u>The Topography</u>

For

The Country Course at Kahuku

Punamano Site

prepared for

The Estate of James Campbell

prepared by

Smith, Young & Associates, Inc.

3049 Ualena Street

Honolulu, Hawaii

April 1990

Introduction

The Estate of James Campbell is proposing to develop three 18 hole golf courses in the vicinity of Kahuku on the North Shore of Oahu. The area lies immediately southwest of Kamehameha Highway between Kahuku Village and Kuilima (Figure 1). The site contains approximately 605 acres and is situated mauka of Kamehameha Highway and some 2 miles northwest of the old Kahuku Mill (Figure 2).

The purpose of this report is to provide information on the topography of the site. This report addresses the following:

a. Existing site and site conditions;
b. Topography information on the site.

Site and Site Conditions

The proposed site for the three 18-hole golf courses at Punamano is located within the Koolauloa District of Oahu and lies in the Tax Map Key designations of TMK 5-6-05:Portion 1, Portion 2, 5, 6 and Portion 7, and a small bit of TMK 5-7-01:Portion 21. This project site at Punamano has been owned by The Estate of James Campbell since before the turn of the twentieth century.

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Land uses of property adjoining the Punamano site are military to the southwest, agricultural to the south and east, and aquaculture on the northeast. Across Kamehameha Highway, north of the site is the Tanaka Store, a well-known local landmark, which is a small grocery store and gas station. Farther west along Kamehameha Highway lies the Kuilima Resort and condominium complex. Other lands not specifically noted, which lie adjacent to the site, remain as vacant agricultural lands today.

CORRECTION

THE PRECEDING DOCUMENT(S) HAS
BEEN REPHOTOGRAPHED TO ASSURE
LEGIBILITY
SEE FRAME(S)
IMMEDIATELY FOLLOWING

Report

on

The Topography

For

The Country Course at Kahuku

Punamano Site

prepared for

The Estate of James Campbell

prepared by

Smith, Young & Associates, Inc.

3049 Ualena Street

Honolulu, Hawaii

April 1990

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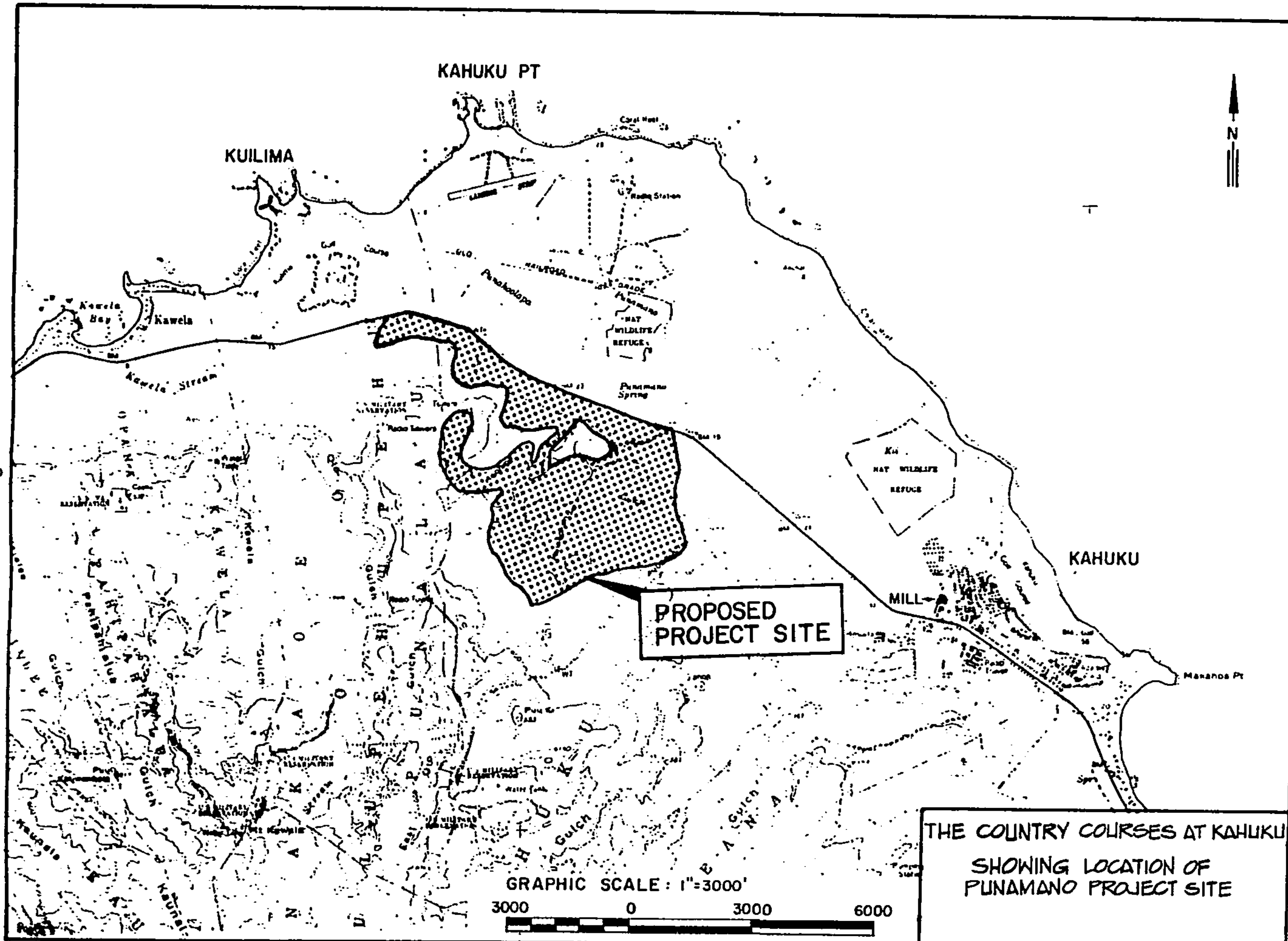

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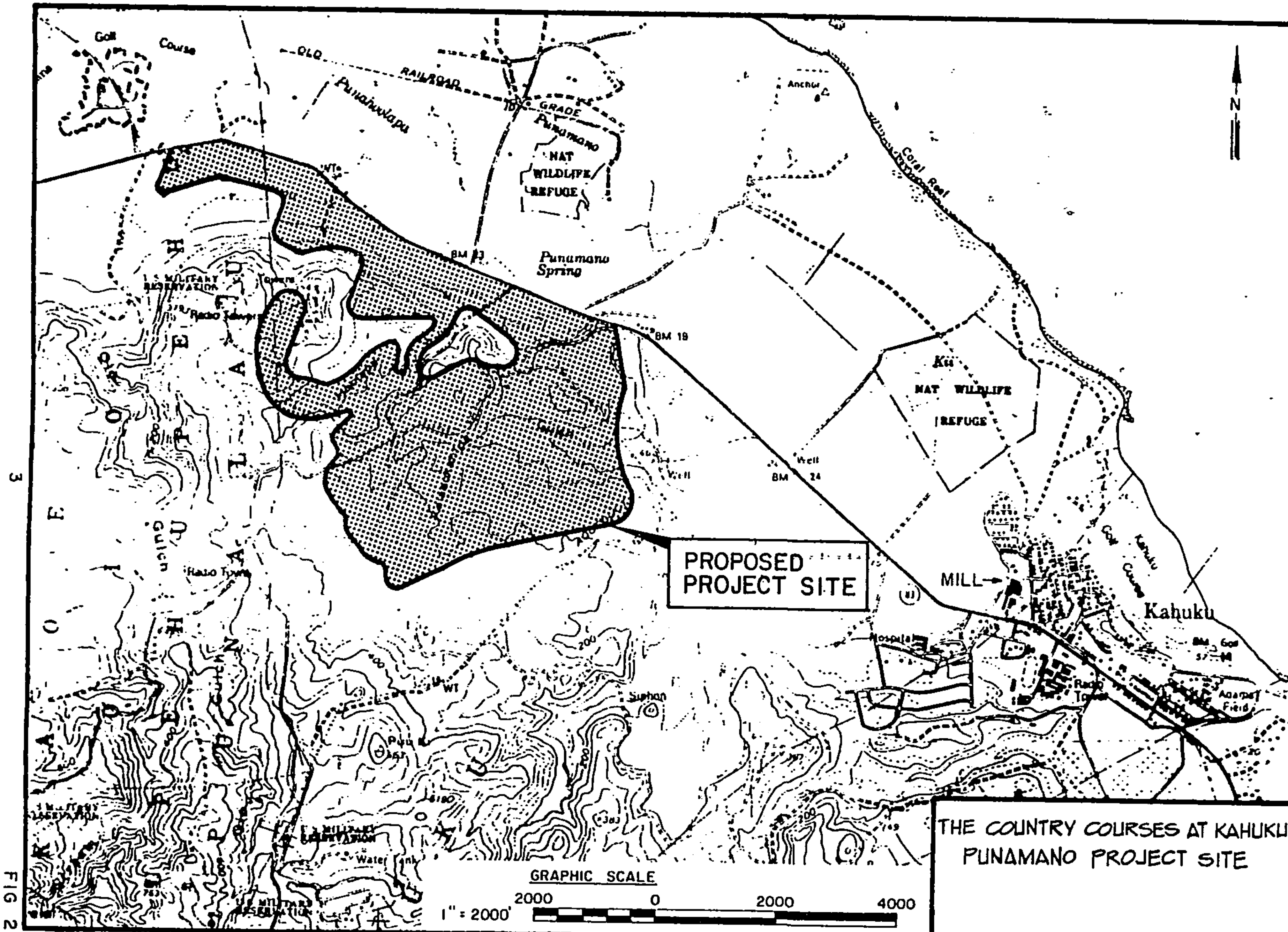
FIG. 1



THE COUNTRY COURSES AT KAHUKU
PUNAMANO PROJECT SITE

SMITH, YOUNG & ASSOCIATES, INC • CONSULTING ENGINEERS

FIG 2

The site is presently designated as an agricultural district by the State Land Use Commission. The Koolauloa Development Plan Land Use Map designates the site Agriculture, and the City and County of Honolulu Zoning District carries the site as Agriculture (AG-1/AG-2).

The site has a temperature readings range from the low 60 degrees F to the mid 80 degrees F, depending on the day and the season of the year. Daily temperatures vary as much as twenty degrees (F) between daylight hours and early morning hours. Cooler temperatures are noticeable in the higher levels of the site. Review of the median annual rainfall, as published by Department of Land and Natural Resources, State of Hawaii, shows that the site is located well within the 1000 millimeter and 1500 millimeter isohyets which indicate that the rainfall median is between 39 and 59 inches per year. The higher rainfall is found in the upper (southern) section of the site. The rainfall distribution is uneven and varies from month to month. Rain will be heavy some months and nearly non-existant at other times. Winter months, in general, are the months with the most rainfall.

Tradewinds are generally stronger at Kahuku than on other parts of the island. Velocities of twelve to fifteen miles per hour are average, with the direction of the prevailing winds coming from the northeasterly and east northeasterly directions. The winds at Kahuku are generally of greater velocity than the same winds in most other parts of Oahu. This is evidenced by the fact that the experimental wind turbines for electrical generation have been sited on adjacent areas immediately west of the proposed golf courses.

Topography

Figure 3 shows that the Punamano site lies within the Hoolapa and Kalaeokahipa Gulches. Figure 4 shows that the two intermittent stream gulches do traverse through the golf course site. Figure 4 has been produced from the photogrammetric survey map produced by R. M. Towill Corporation for the City and County of Honolulu Planning Department.

The northern boundary, along Kamehameha Highway, is the low lying portion of the site. This boundary varies from a low of 8 feet above sea level to approximately 20 feet above sea level. The highest elevation on site reaches 290 feet in the westerly section of the site in the Hoolapa drainage basin. The overall slope upwards from the highway to the southern boundary is about 6 percent. However; different ridges and ravines cause the slopes to vary from a near level plateau at 220 feet near the center of the site to 30 percent slopes in the upper reaches of Hoolapa Gulch. The northwesterly finger of the site, closest to Turtle Bay is nearly flat and is the lowest portion of the site.

During the active years of Kahuku Plantation most of this site was planted in sugar cane. Since the closing of the plantation some truck farming has been attempted in the low flat lands along Kamehameha Highway. Today the land is fallow.

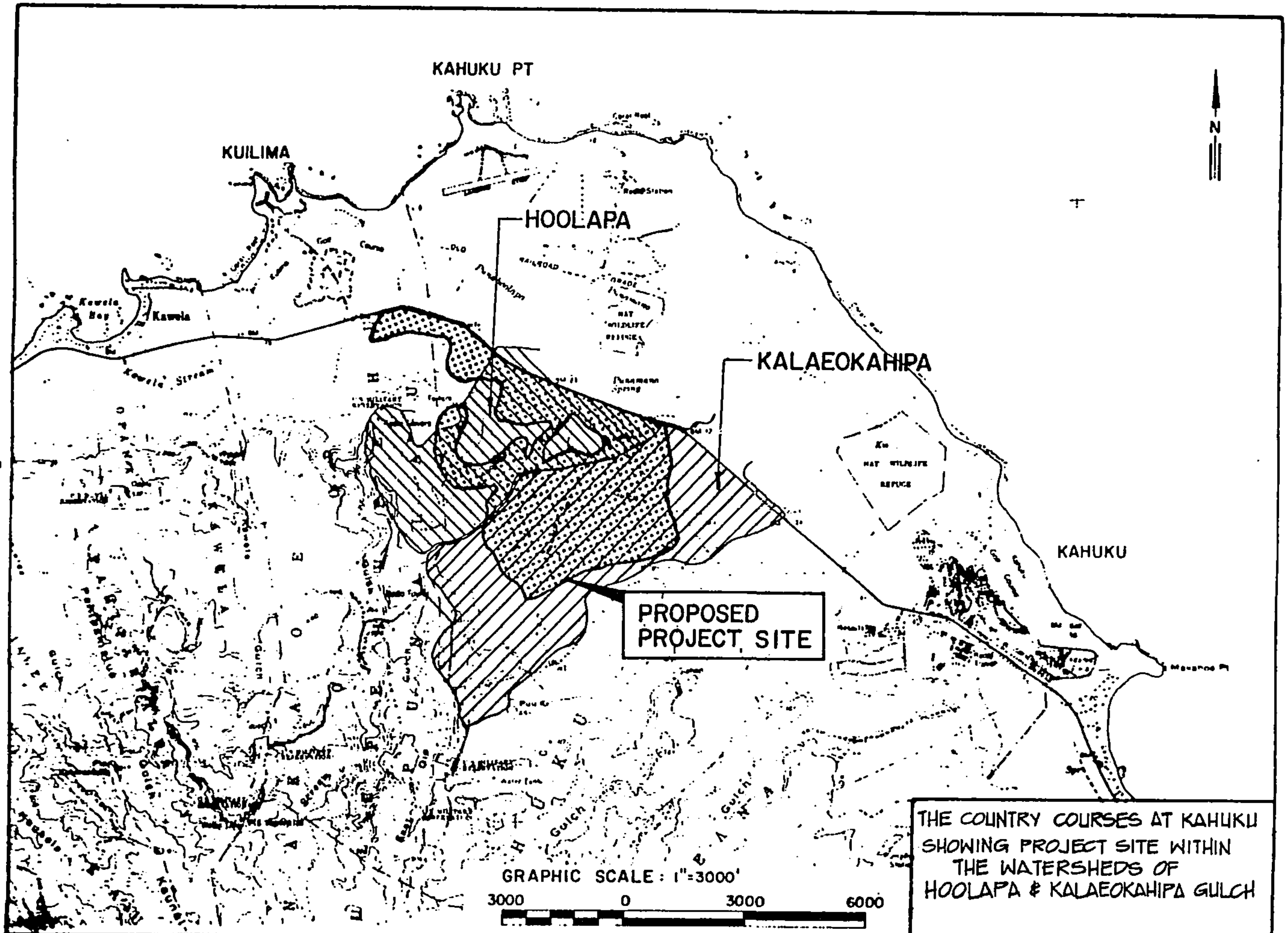


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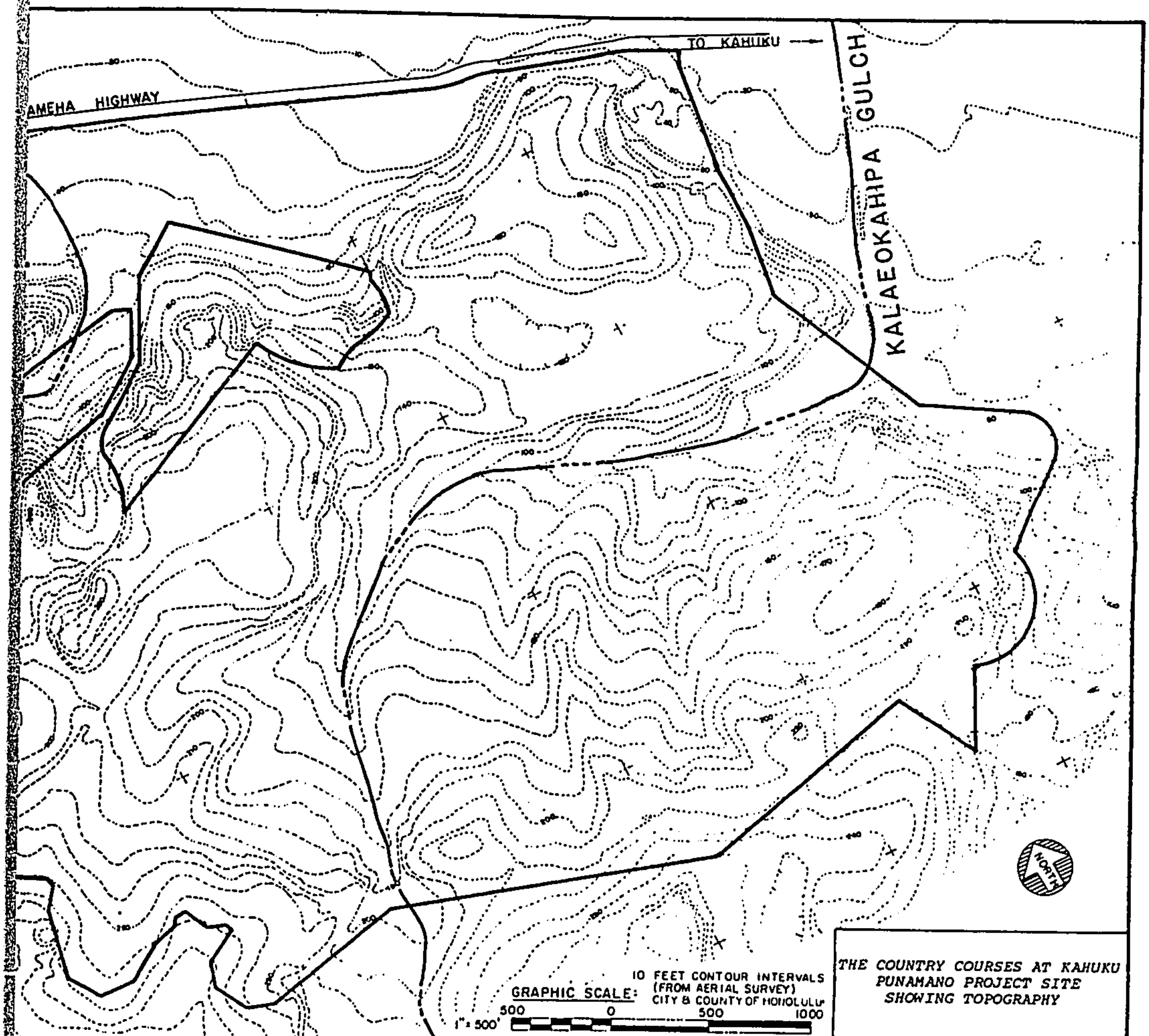
FIG. 3

SMITH, YOUNG & ASSOCIATES, INC - CONSULTING ENGINEERS



THE COUNTRY COURSES AT KAHUKU
PUNAMANO PROJECT SITE
SHOWING TOPOGRAPHY

FIG. 4

Sub-Appendix C

Punamano

Report

on

Climate

For

The County Courses at Kahuku

Punamano Site

prepared for

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The purpose of this report is to provide information on the prevailing climate at the site. This report addresses the following:

a. Existing site and site conditions
b. Rainfall and temperature data available for the area.

Site and Site Conditions

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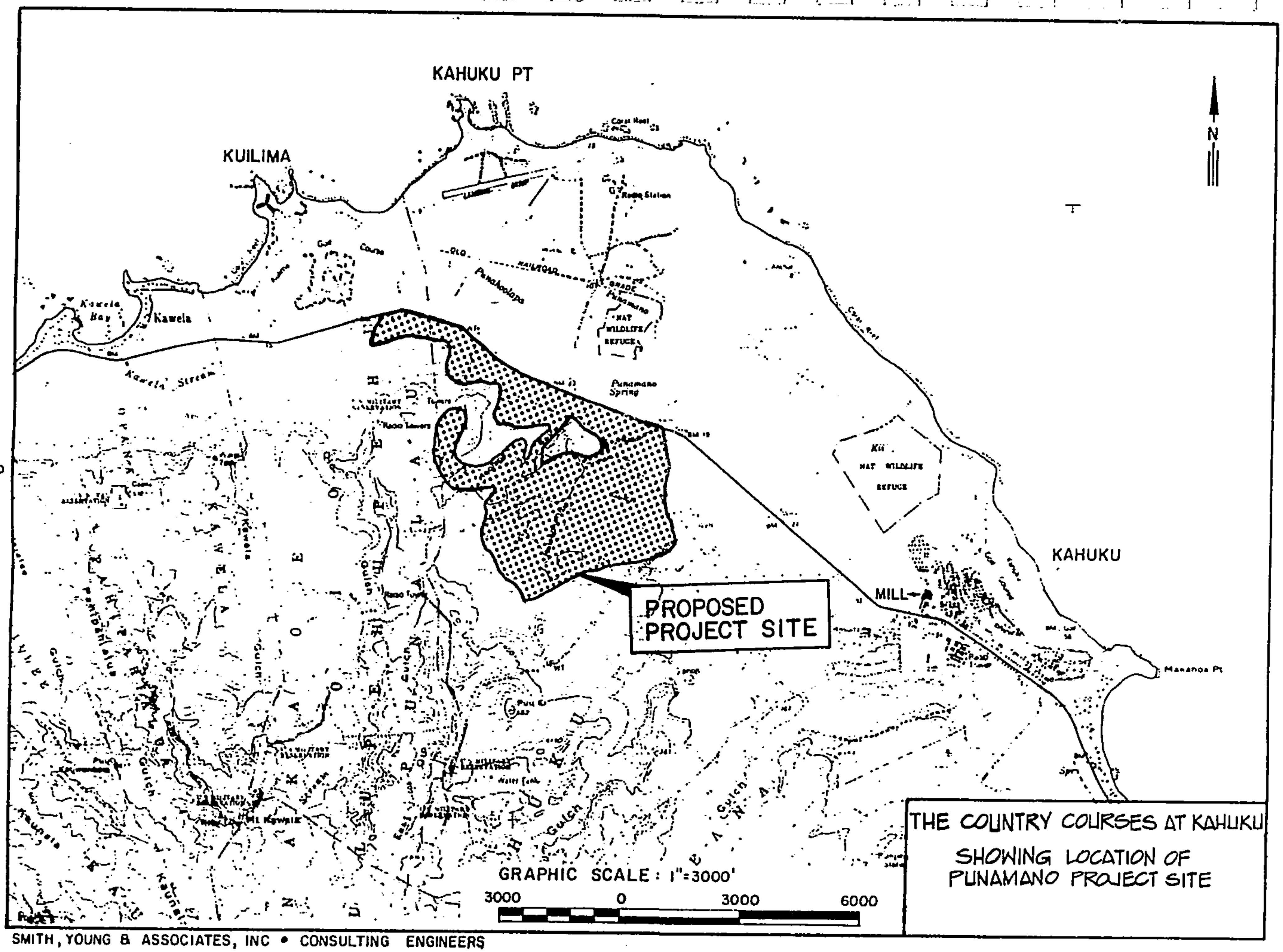
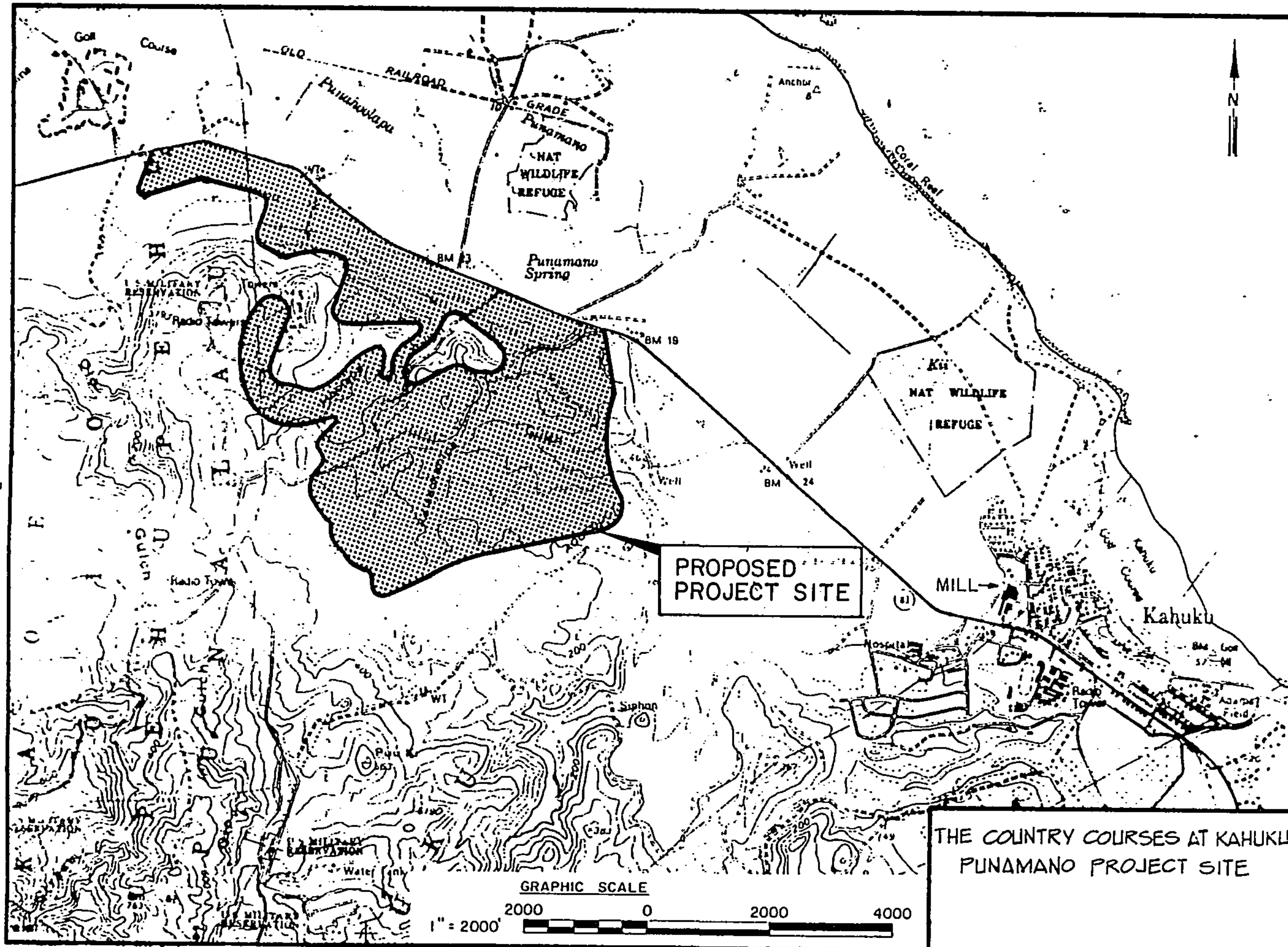

KAHUKU PT
KUILIMA
KAHUKU
MILL
Kawela Bay
Kawela
Kawela Stream
Punamano Spring
Radio Station
Kii NAT. WILDLIFE REFUGE
PROPOSED PROJECT SITE
N
Manana Pt
GRAPHIC SCALE : 1"=3000'
3000 0 3000 6000
THE COUNTRY COURSES AT KAHUKU
SHOWING LOCATION OF PUNAMANO PROJECT SITE
SMITH, YOUNG & ASSOCIATES, INC • CONSULTING ENGINEERS

FIG. 1



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Climate

As the tradewinds tend to slide around the lower levels of the Koolau Mountains near Kahuku Point, the uplift of the cloud formations diminish. As a result, the rainfall decreases as the northern shoreline is approached. Rainfall within the golf course site possibly varies some six or seven inches per year between the most northwesterly point of the site to the most southwesterly point. The tradewinds blow nearly 90 percent of the time in the Kahuku area. The area is subjected to "Kona winds" from the southerly direction some 10 percent of the time. Normally these winds are mild clear weather winds unless they are associated with a major "Kona storm". At that time the entire island of Oahu is subjected to heavy rains.

Although extremes in rainfall have been noted at the site some 30 percent of the time the skies are clear. Possibly one third of the time the sky is considered partly cloudy and another third of the time the sky is overcast. The climate is good for golfing activities.

The average monthly rainfall for the site has been taken from the isohyetal rainfall maps provided by the Rainfall Atlas of Hawaii, Report R76, published by the Department of Land and Natural Resources, State of Hawaii in 1986. These rainfall figures are tabulated in Table I below. The temperature averages for each month have come from The

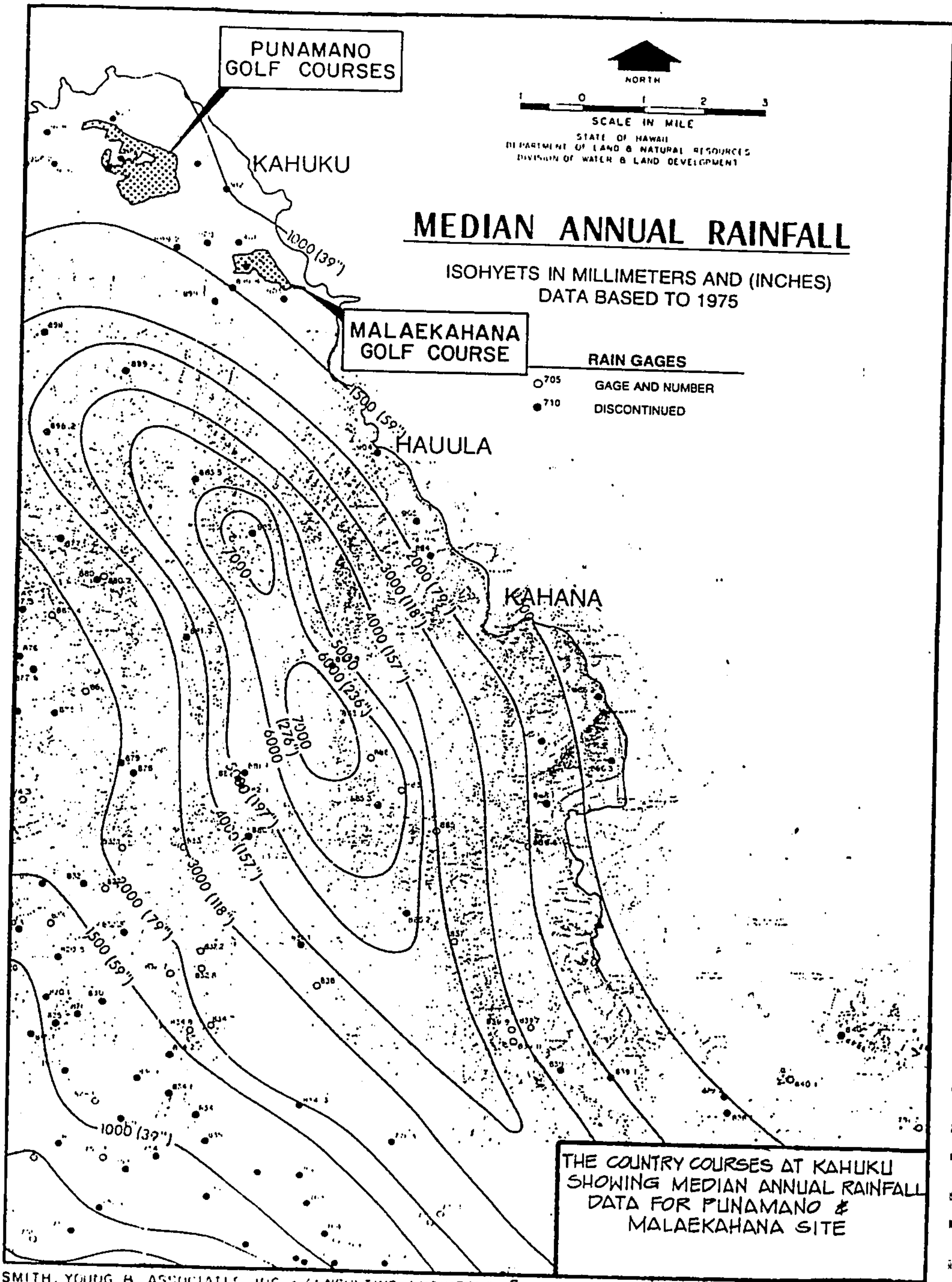

PUNAMANO GOLF COURSES
NORTH
SCALE IN MILE
STATE OF HAWAII
DEPARTMENT OF LAND & NATURAL RESOURCES
DIVISION OF WATER & LAND DEVELOPMENT
KAHUKU
MEDIAN ANNUAL RAINFALL
ISOHYETS IN MILLIMETERS AND (INCHES)
DATA BASED TO 1975
MALAEKAHANA GOLF COURSE
RAIN GAGES
GAGE AND NUMBER
DISCONTINUED
HAUULA
KAHANA
THE COUNTRY COURSES AT KAHUKU SHOWING MEDIAN ANNUAL RAINFALL DATA FOR PUNAMANO & MALAEKAHANA SITE

FIG. 3

Climatological Data-Annual Summary Hawaii & Pacific, published in 1978 by the National Oceanic and Atmospheric Administration. The temperature readings were taken at Waialee some 2.5 miles west of the site.

Table I

PUNAMANU SITE

Month	Average Monthly Rainfall Inches	Average Monthly Temperatures Degrees F
January	5.2	71.8
February	4.0	72.2
March	4.4	71.7
April	3.8	73.3
May	2.2	74.8
June	1.7	76.6
July	2.1	77.4
August	2.5	78.4
September	2.1	78.1
October	3.2	76.9
November	3.8	73.6
December	5.2	71.7
ANNUAL	40.2	74.7

From Table I it is very noticeable that the annual temperature differential varies only 3.7 degrees above and 3.0 degrees below the annual average. This minor variation provides for a pleasant climate throughout the twelve months of the year. Daily extremes varying from the low 60's in the early morning hours to the mid 80's in the early afternoons provide an ideal climate for golfing and other recreational activities.

Taking into account the fact that the tradewinds are stronger in the Kahuku area than in any other area of Oahu; that the rainfall tends to be less during the drier summer months when the temperature range is slightly higher, and combining this information with the evaporation data presented in Appendix J; the need for irrigation of the proposed golf courses is realized. Based on the fact that evaporation exceeds rainfall by some 6.5 inches during the month of July., the demand for irrigation water will reach about 2.6 mgd during that month and falling to about 1.4 mgd during January and December. The average being about 2.1 to 2.2 mgd. The rate of fluctuation being an inverse factor of the daily rainfall. The use of irrigation water and its supply are covered more fully in Sub-Appendix F.

Sub-Appendix D

Punamano

GROUNDWATER RESOURCES

FOR

THE COUNTRY COURSES AT KAHUKU

PUNAMANO SITE

PREPARED FOR

THE ESTATE OF JAMES CAMPBELL

PREPARED BY

DAMES & MOORE

1144 10TH AVENUE

HONOLULU, HAWAII 96816

DAMES & MOORE JOB NO. 07597-020-11

APRIL 1990

APPENDIX DM-2

PUNAMANO GOLF COURSE

GROUNDWATER RESOURCES

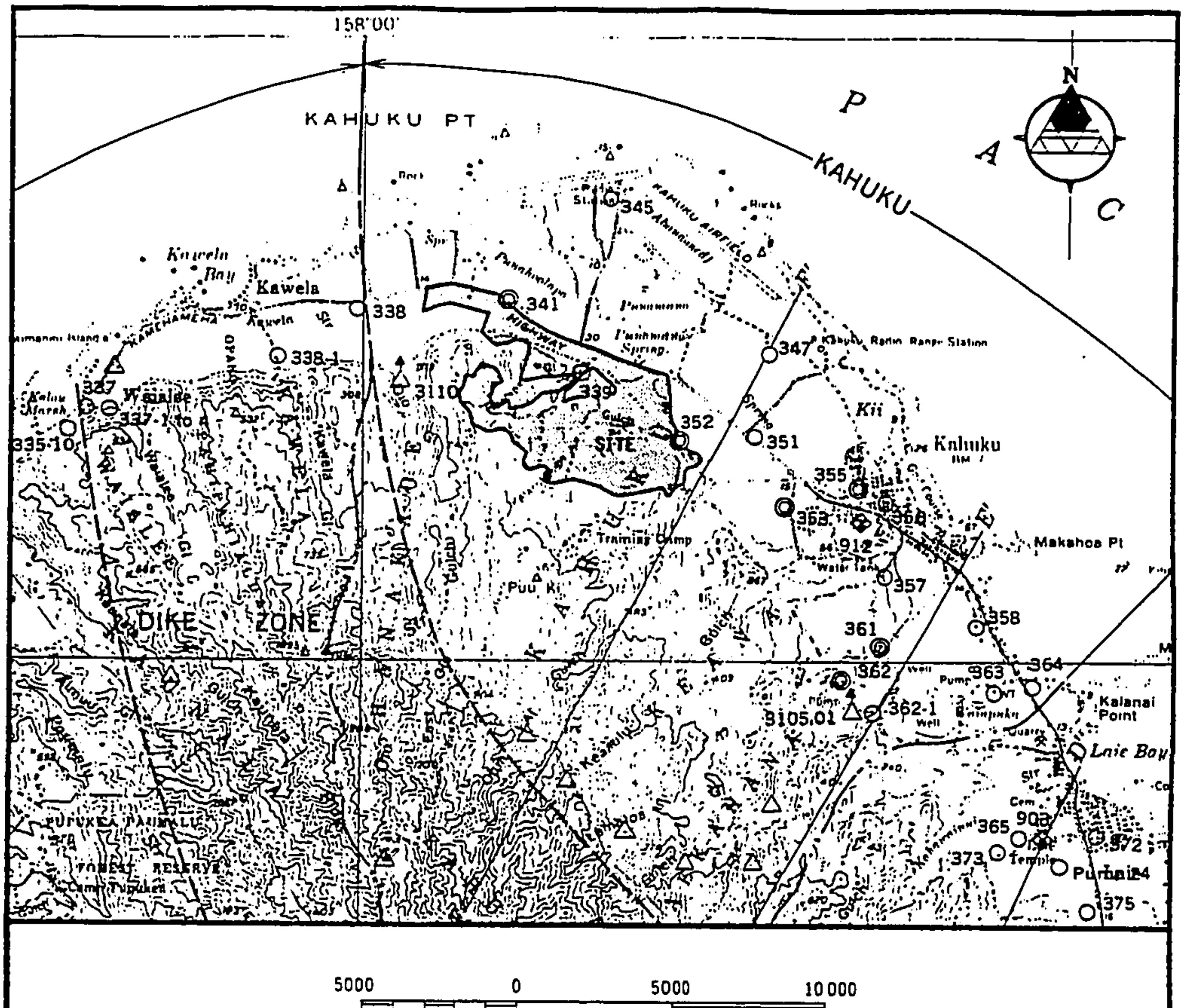
The Punamano site is located in the basal water zone in an area where streams are dry or intermittent. According to Takasaki and Valenciano (1969), basal water east of the Koolau dike zone is artesian wherever it underlies the coastal plain. Groundwater levels in the Kahuku Region range from about 7 feet to more than 20 feet above mean sea level (MSL). However, based on the August 1962 water-level contour map (Takasaki and Valenciano, 1969), we anticipate that water levels at the golf course site will be about 10 feet above MSL. This would mean that the fresh water lens would extend downward below sea-level to about 300 to 350 feet at Punamano.

The permeability of unweathered vesicular lava flows of the Koolau Volcanic Series is generally high. Structural features associated with lava flows determine permeability. For example, thin-bedded a'a flank flows (similar to those observed near the Punamano site) tend to have the highest proportion of highly permeable clinker zones, voids between flow surface, and shrinkage joints and fractures. These features combine to make these rock types the most permeable. Takasaki and Valenciano (1969) suggest that there is a general tendency for permeability to increase with distance from the dike zone and that permeability is highest parallel to the lava's flow direction, where interflow voids and clinker zones are most continuous. Permeability of flows can be reduced considerably depending on the degree of weathering, which decreases the size of voids and fractures. Weathering is mostly confined to near-surface rocks (generally less than several tens of feet thick) and is rare at a depth of more than 100 feet outside of the valleys and gulches. Deep weathering is generally confined to valley floors, broad gulches, and flood plains, where poorly permeable weathered rocks at depths of 200 feet are common (Takasaki and Valenciano, 1969).

Along the coastal plain, the water-bearing properties of the sedimentary material (clay to stoney clay soils) range from nearly impermeable with slow drainage runoff in compact alluvium, to highly permeable in unconsolidated talus with moderate to rapid drainage runoff. Most of the areas of recent alluvium exhibit slow to moderate drainage runoff (refer to the SCS classification Map, Plate P-2 and Table 1).

Soil conditions and sedimentary textures differ substantially within the site, ranging from nearly impermeable clay to highly permeable solution pitted, consolidated calcareous dune sand and associated talus; thus, water-bearing properties are variable, too. Extremely calcified dune deposits (recrystallized eolian deposits), and weathered lava (saprolite zones) constitute rock masses that are less permeable than the underlying fresh lava. Wherever these rock masses, locally referred to as caprock, overlie fresh lava, artesian conditions prevail in the fresh lava, as well as along permable zones within the caprock itself. Artesian conditions are presumed to be present just north (makai) of Kamehameha Highway, in the general area of the Punamano spring (refer to Plate P-1).

Referring to Plate P-1, the northern section of the Koolau dike zone can been seen lying west of the Punamano Site. This dike zone is approximately 2.5 miles wide and 10 miles long, extending southeastward as far as Kaneohe Bay. The high rainfall area of Kahana and Punaluu, where annual rainfall exceeds 250 inches, suply water to this dike system. As the dike alignment is northwesterly, the precipation that falls in this dike zone is permitted to flow in a northwesterly direction towards Waialee. As the dike decrease in heighth, water spills to the basal water lens which lies both east and west of the dike zone. It is this water which recharges the basal water lens underlying the Punamano site and seeps out to form Punamano Spring at about 8 feet above sea-level makai of Kamehameha Highway.



Reference:

Department of Land & Natural Resources, State of Hawaii

U.S. Geological Survey

"Hydrologic Map of the Kahuku Area, Oahu, Hawaii"

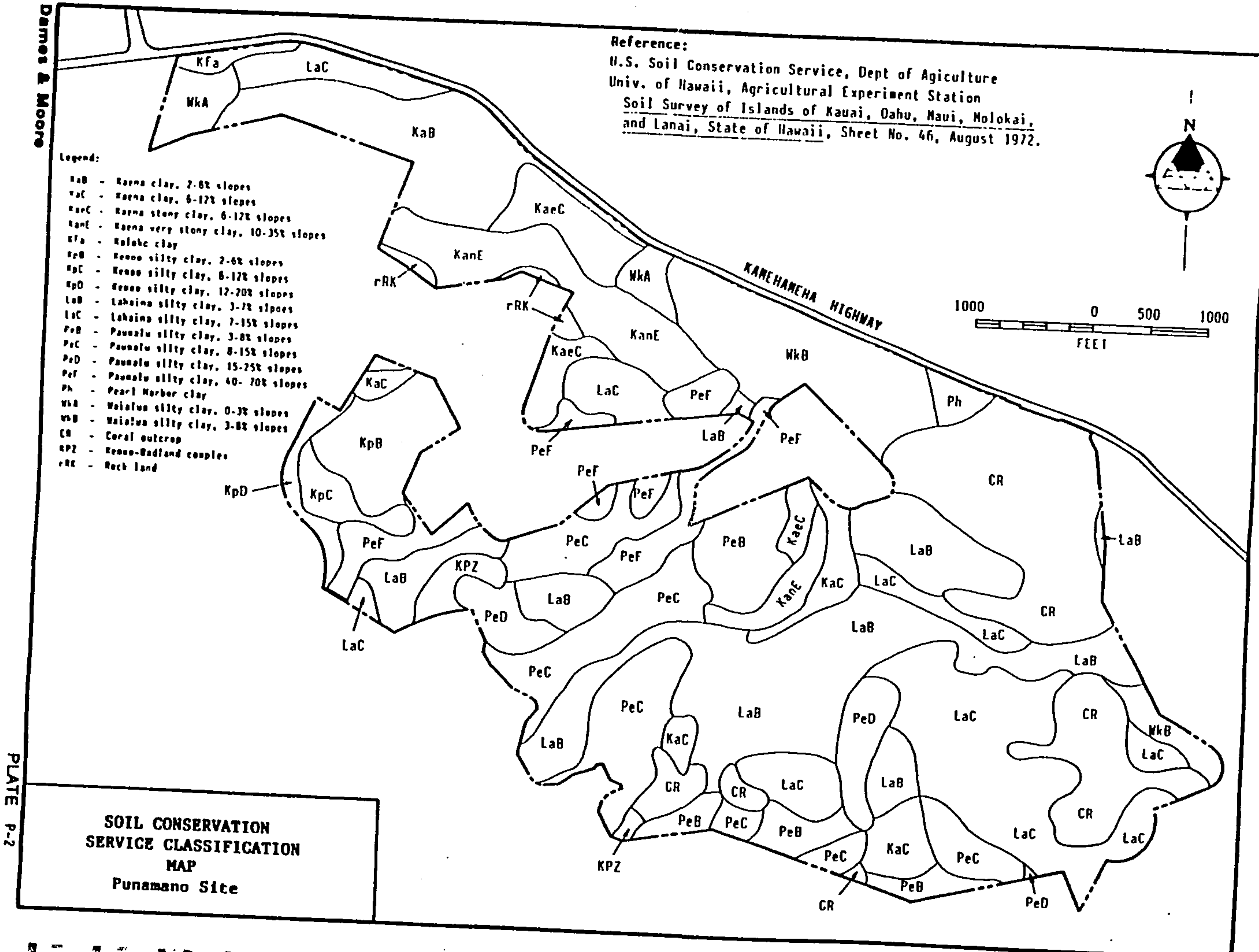
Water Supply Paper 1874, Plate 1, 1969.

PLOT PLAN

Punamano Site

TABLE 1: SOILS CONSERVATION SERVICE CLASSIFICATION (SCS)
THREE GOLF COURSES AT PUNAMANO SITE
FOR THE ESTATE OF JAMES CAMPBELL
JOB NUMBER 07597-020-011

SOIL TYPE	DESCRIPTION	APPROXIMATE ACREAGE	PERCENT TOTAL (%)	PERCENT SLOPE (%)	DRAINAGE RUNOFF	EROSION HAZARD	CAPABILITY NONIRRIGATATED	CLASSIFICATION IRRIGATED
CR	Coral outcrop (coraline sand dunes)	87	14	0 to 15	slow	slight	VIIIs	-
KaB	Kaena Clay (reddish brown, v. plastic)	37	6	2 to 6	slow	slight	IVw	IIIw
KaC	Kaena Clay (few or no stones in surface)	37	6	6 to 12	moderate to well drained	slight to moderate	IVw	IIIw
KaeC	Kaena Stoney Clay (dark reddish brown)	20	3	6 to 12	moderate to well drained	slight to moderate	IVw	IIIw
KanE	Kaena Very Stoney Clay (occur on talus)	33	6	10 to 35	moderate to rapid	moderate to severe	VIs	-
Kfa	Kaloko Clay (dark reddish brown)	3	1	0 to 2	slow to very slow	slight	Vw	IIIw
KpB	Kemoo Silty Clay (weathered basalt)	18	3	2 to 6	slow to medium	slight	IIe	-
KpC	Kemoo Silty Clay (weathered basalt)	7	1	6 to 12	medium	slight to moderate	IIIe	-
KpD	Kemoo Silty Clay (weathered basalt)	5	1	12 to 20	moderate to rapid	moderate	IVe	-
KPZ	Kemoo Badland Complex (barren area)	6	1	10 to 70	moderate to rapid	moderate to severe	VIIe	-
LaB	Lahaina Silty Clay (coral sandstone frags.)	97	16	3 to 7	slow	slight	IIIc	IIe
LaC	Lahaina Silty Clay (coral sandstone frags.)	70	12	7 to 15	medium	moderate	IIIe	IIIe
PeB	Paumalu Silty Clay (weathered basalt)	26	4	3 to 8	slow	slight	IIe	IIe
PeC	Paumalu Silty Clay (weathered basalt)	60	10	8 to 15	slow to medium	slight to moderate	IIIe	IIIe
PeD	Paumalu Silty Clay (weathered basalt)	15	2	15 to 25	medium	moderate	IVe	IVe
PeF	Paumalu Silty Clay (weathered basalt)	26	4	40 to 70	rapid	severe	VIIe	-
rRK	Rock Land (Koolau volcanic series)	2	1	0 to 70	moderate to rapid	slight	VIIs	-
WkA	Waialua Silty Clay (weathered basalt)	11	2	0 to 2	slow	slight	IIIc	I
WkB	Waialua Silty Clay (weathered basalt)	45	7	3 to 8	slow	slight	IIIc	IIe
	TOTALS =	605	100					



SOIL CONSERVATION SERVICE CLASSIFICATION MAP
Punamano Site

PLATE P-2

Sub-Appendix E

Punamano

Drainage

and

Stormwater Runoff

Report

For

The Country Courses at Kahuku

Punamano Site

Prepared For

The Estate of James Campbell

prepared by

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3049 Ualena Street

Honolulu, Hawaii

April 1990

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The objective of this report is to provide information on the site and to present the necessary planning and preliminary engineering for the drainage of the proposed golfing sites and to discuss storm runoff quantities. Specifically this report addresses the following:

a. Existing site and site conditions;
b. Background information on the proposed site development;
c. Proposed development and resulting drainage changes;
d. Impacts and mitigation measures to be undertaken at the site and overall watershed.

Site and Site Conditions

The proposed site for the three 18 hole golf courses at Punamano is located within the Koolauloa District of Oahu, and lies in the Tax Map Key designations of TMK 5-6-05:Portion 1, Portion 2, 5, 6 and Portion 7, and a small bit of TMK 5-7-01:Portion 21. This project site at Punamano has been owned by The Estate of James Campbell since before the turn of the twentieth century.

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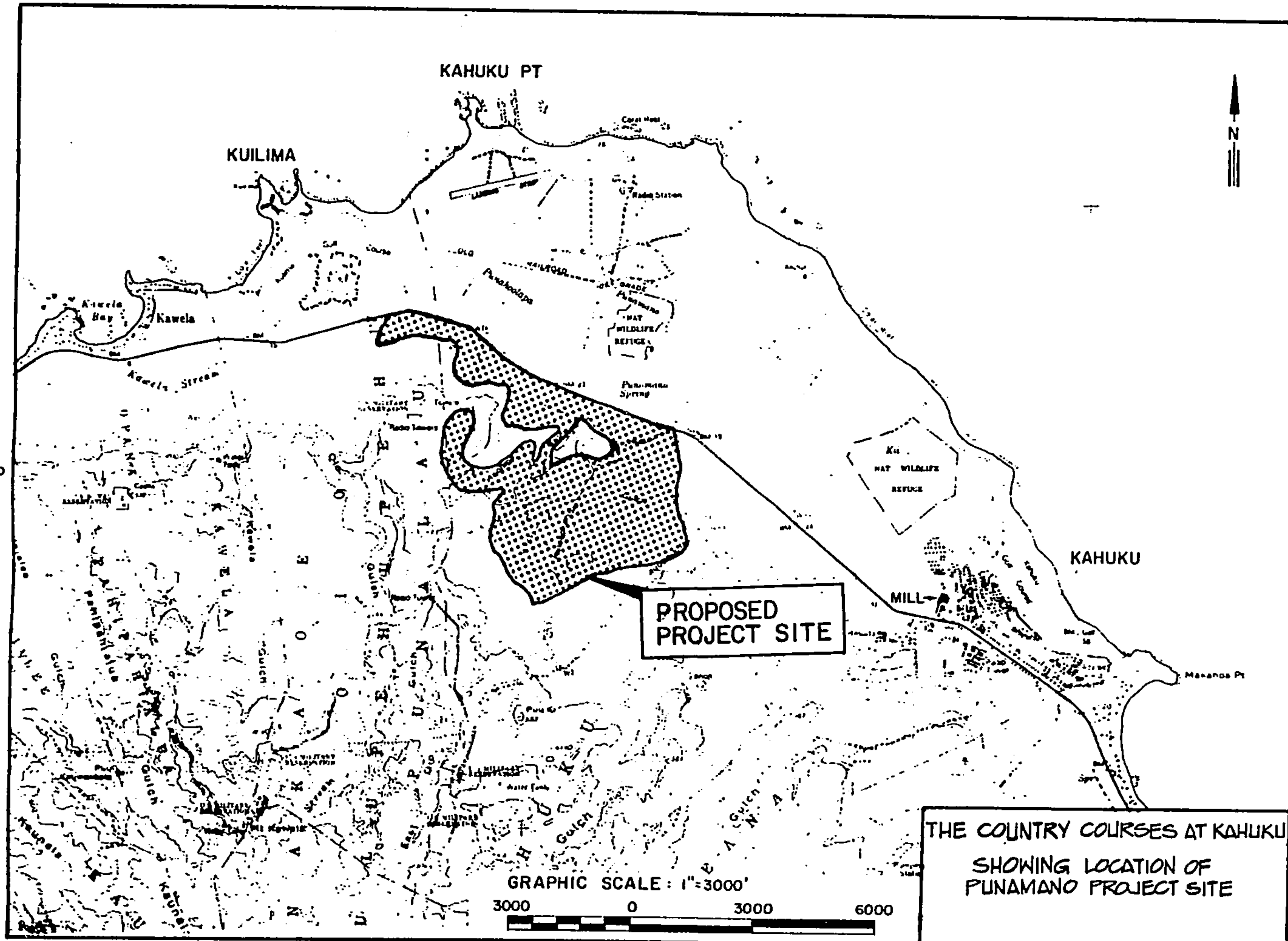

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FIG. 1

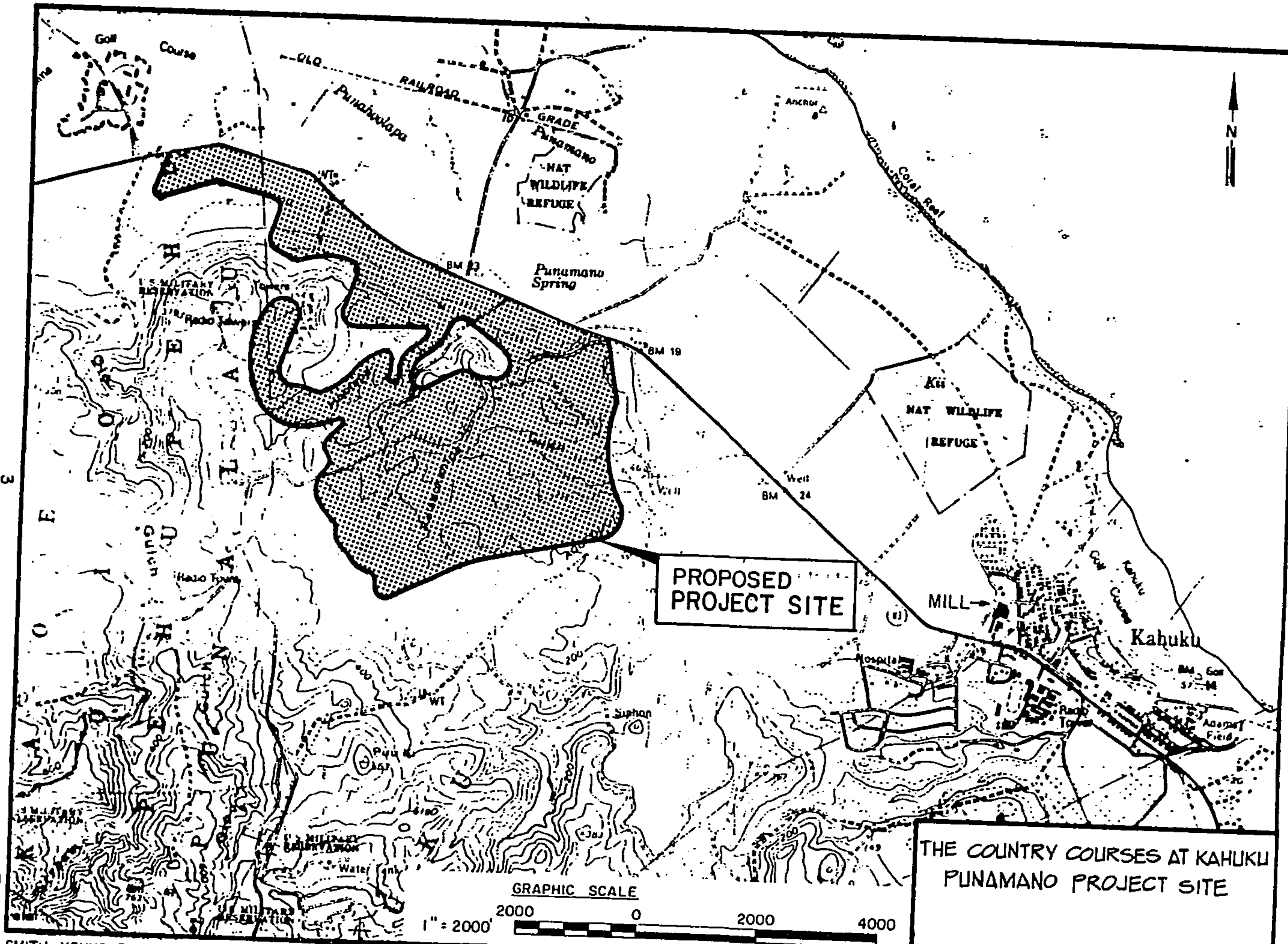

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FIG 2

The site is presently designated as an agricultural district by the State Land Use Commission. The Koolauloa Development Plan Land Use Map designates the site Agriculture, and the City and County of Honolulu Zoning District carries the site as Agriculture (AG-1/AG-2).

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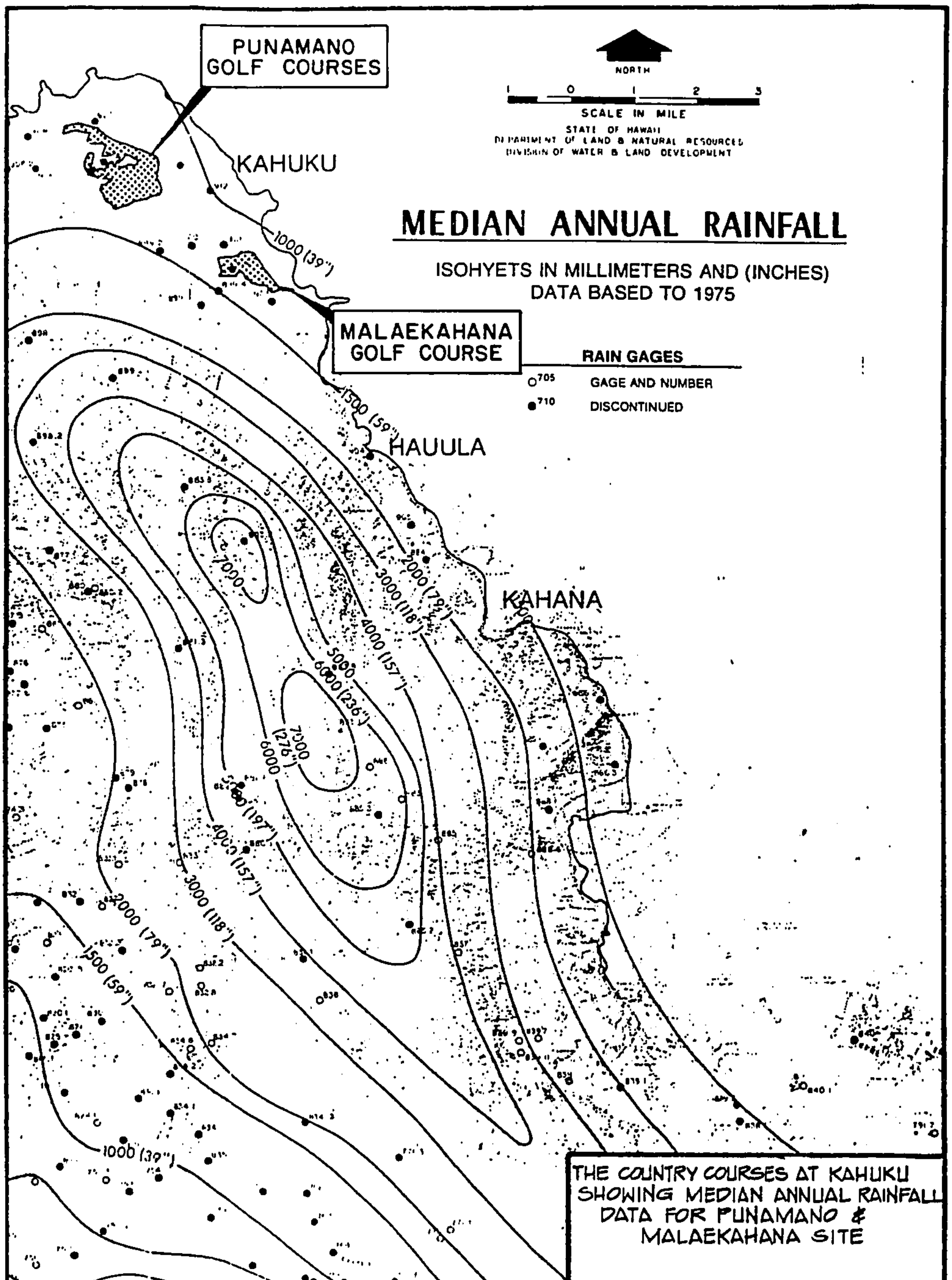
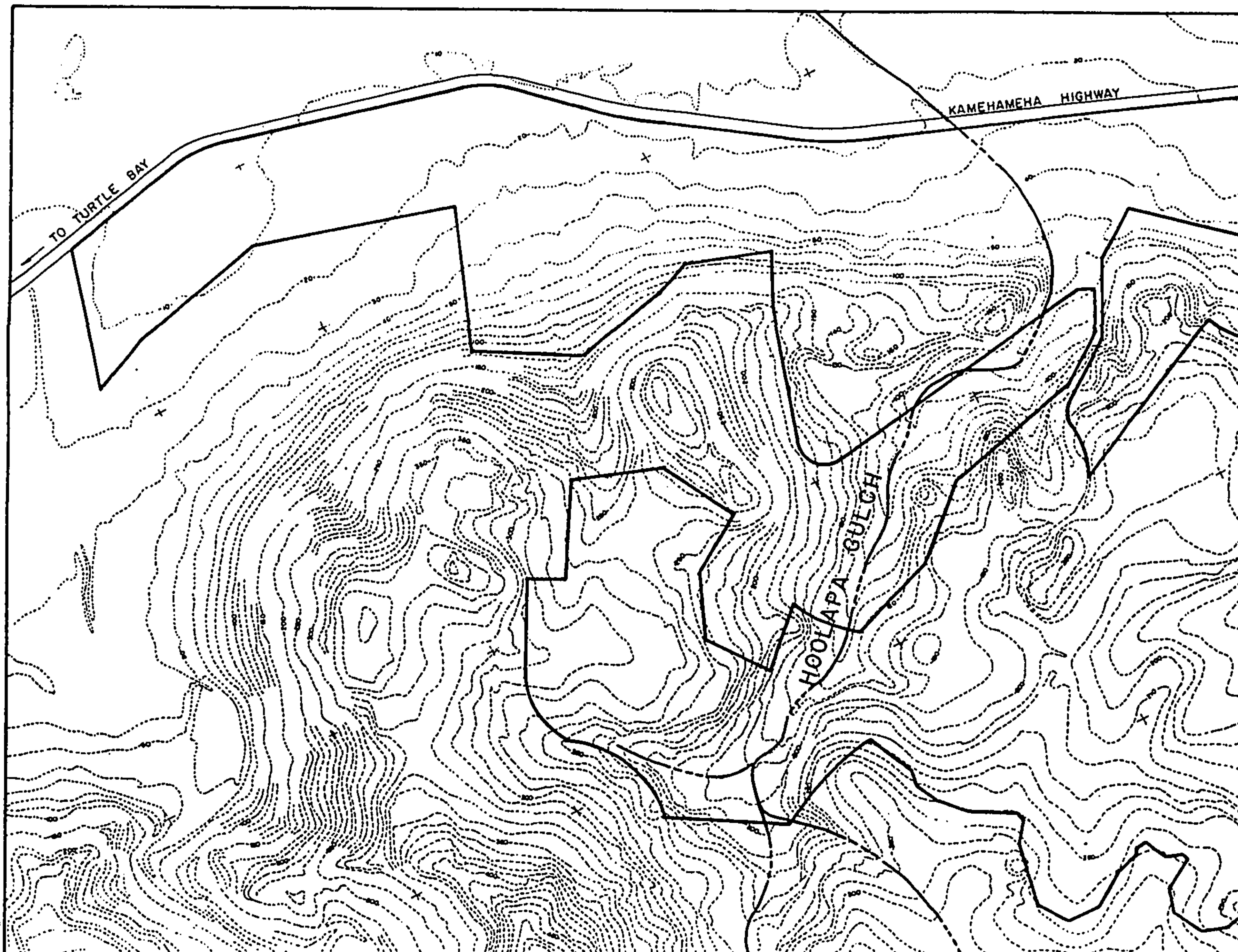
Tradewinds are generally stronger at Kahuku than on other parts of the island. Velocities of twelve to fifteen miles per hour are average, with the direction of the prevailing winds coming from the northeasterly and east northeasterly directions. The winds at Kahuku are generally of greater velocity than the same winds in most other parts of Oahu. This is evidenced by the fact that the experimental wind turbines for electrical generation have been sited on adjacent areas immediately west of the proposed golf courses.

As far as site topography is concerned, the elevations range from 10 feet above sea level near Kamehameha Highway to some 270 feet elevation along the mauka (western) boundary (Figure 4). The elevation within the site is 250 feet above sea level near the proposed parking lot for Clubhouse No. 2. Slopes of 5 to 10 percent are found throughout the site with slopes in the Hoolapa and Kalaeokahipa gulches. Here steeper slopes of 30 to 40 percent occur in isolated areas. One large depression lies within the site which can hold normal runoff at times of moderate to heavy rainfall/runoff. The normal drainage of the Hoolapa and Kalaeokahipa watersheds is eastward through the proposed golf course sites to and beyond Kamehameha Highway.

Calculations for runoff have been based on rainfall intensities of 2.5 inches per hour for 10 year storms, 3.0 inches per hour for 50 year storms and 3.5 inches per hour for 100 year storms. Table I shows the runoff quantities for the project site under existing conditions and also after development of the golf course. Both of these do not take into account the retention effect provided by depressions existing or to be made on the site as mitigating steps. Table II shows the total drainage basin runoff under existing and developed conditions.


PUNAMANO
GOLF COURSES
NORTH
SCALE IN MILE
STATE OF HAWAII
DEPARTMENT OF LAND & NATURAL RESOURCES
DIVISION OF WATER & LAND DEVELOPMENT
KAHUKU
MEDIAN ANNUAL RAINFALL
ISOHYETS IN MILLIMETERS AND (INCHES)
DATA BASED TO 1975
MALAEKAHANA
GOLF COURSE
RAIN GAGES
GAGE AND NUMBER
DISCONTINUED
HAUULA
KAHANA
1000 (39")
1500 (59")
2000 (79")
3000 (118")
4000 (157")
5000 (197")
6000 (236")
7000 (276")
THE COUNTRY COURSES AT KAHUKU
SHOWING MEDIAN ANNUAL RAINFALL
DATA FOR PUNAMANO &
MALAEKAHANA SITE



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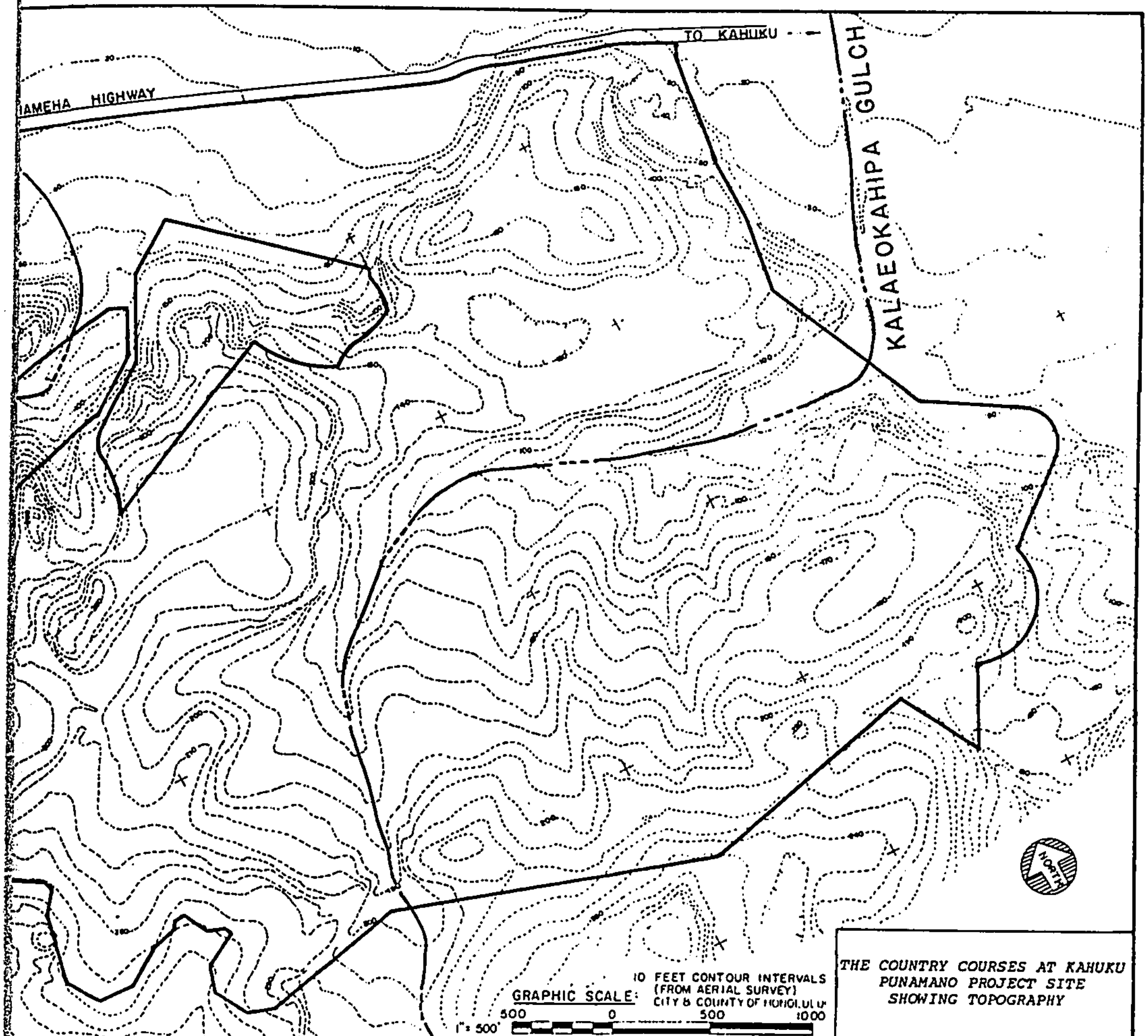

THE COUNTRY COURSES AT KAHUKU
PUNAMANO PROJECT SITE
SHOWING TOPOGRAPHY

FIG 4

Drainage Changes by Development

Development of the golf courses will change the drainage characteristics of the 605 acre project site. The more dense vegetation found on site today will be replaced by a closely-cropped grass turf normally associated with golf courses. Roadways, parking lots and buildings, combined with the closely-cut grass will account for a higher runoff and a shorter time of concentration. These features all will tend to increase runoff. Additional swales, depressions, sand traps and ponds will tend to reduce runoff. Without steps to reduce runoff, the net result is a potentially greater runoff from the project site after development of the golf course. The calculated unmitigated runoff for the 10 and 50 year storm intervals and the effect the development may have on the Hoolapa-Kalaeokahipa Drainage Basins are presented in Tables I and II. Figure 5 shows the relationship of the golf courses and the Hoolapa-Kalaeokahipa Drainage Basins.

The overall drainage patterns for the site will remain fairly much the same as before development. There will be additional ponding areas and swales will conduct minor surface flows to specific areas and to certain retention ponds or depressions. Areas not incorporated into the golf courses will remain as they presently are in both vegetation and slope configuration. It is recommended that mitigating steps be undertaken to reduce the development runoff.

Table I

STORM WATER RUNOFF - PUNAMANO GOLF COURSE SITES

Storm Interval	Acerage	Existing Conditions (cfs)	Developed Conditions (cfs)	Percent Increase
10 years	605	1286	1543	20.0
100 years	605	1800	2160	20.0

Table II

STORM WATER RUNOFF - HOOLAPA & KALAEOKAHIPA WATERSHEDS

Storm Interval	Acerage	Existing Conditions (cfs)	Developed Conditions (cfs)	Percent Increase
10 years	1057	1913	2170	13.4
100 years	1057	2678	3038	13.4

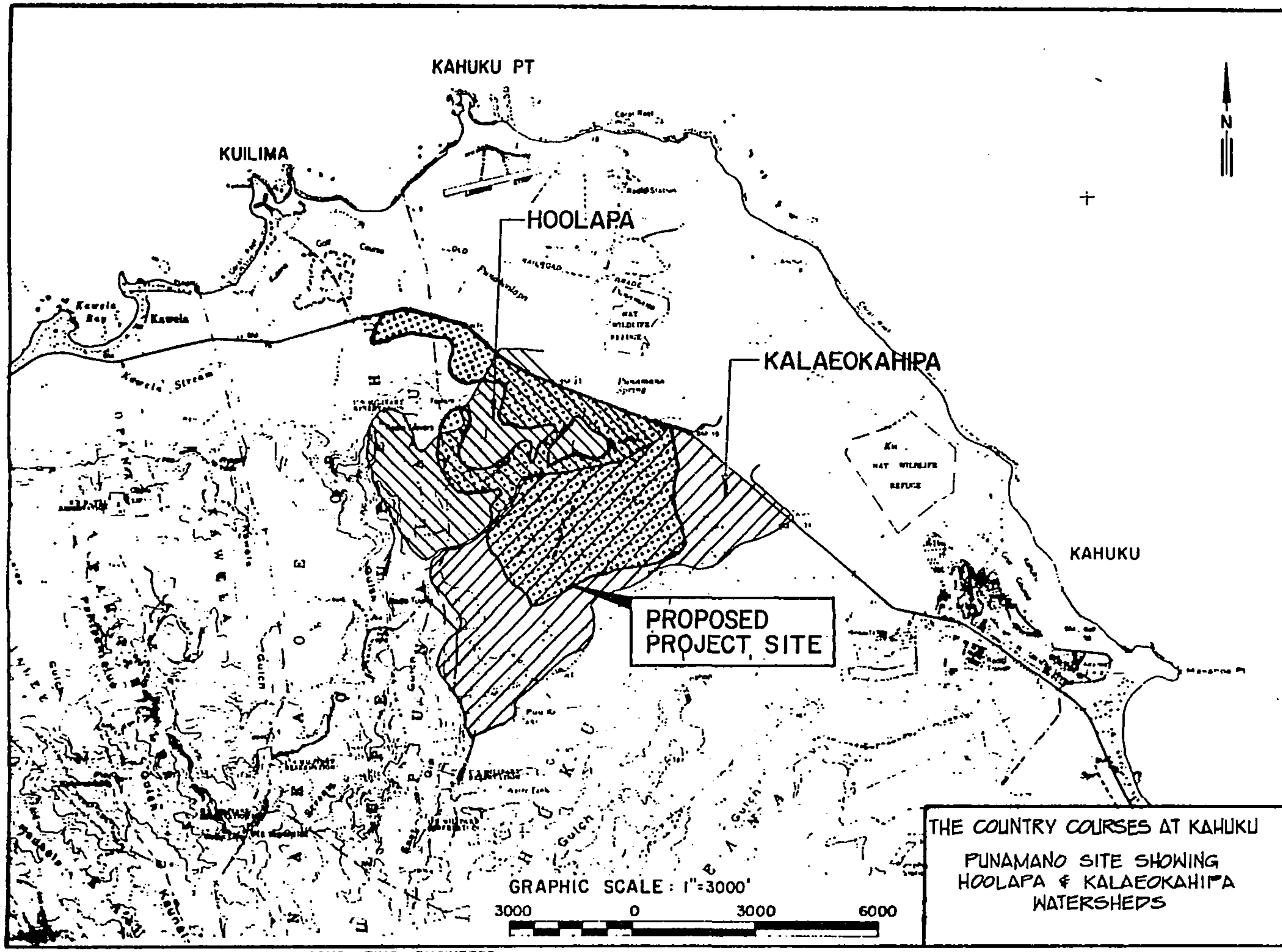

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FIG. 5

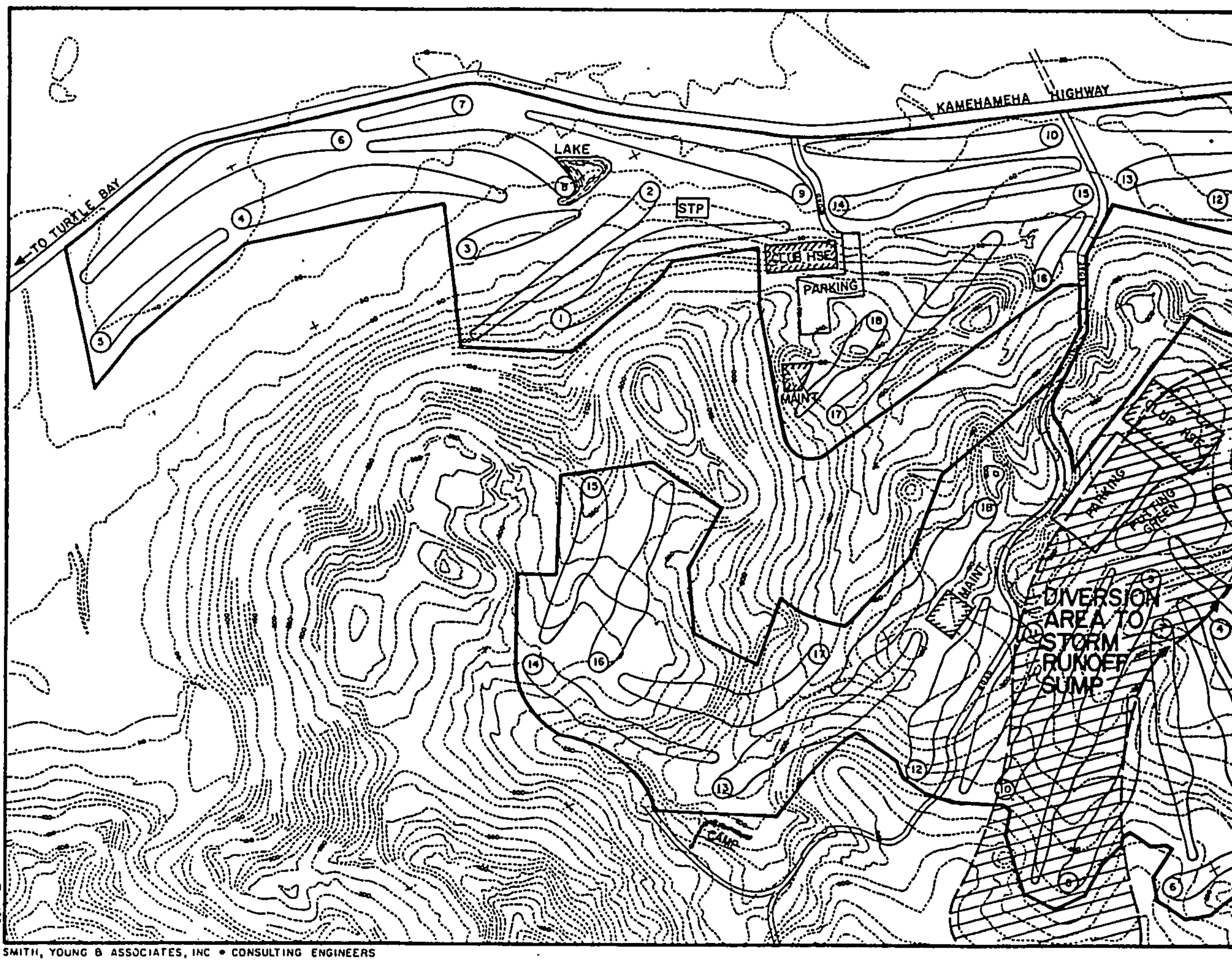
Impacts and Mitigation

It is important to note that mitigating measures are possible and recommended for the golf course area that will reduce the total runoff of the Hoolapa/Kalaeokahipa drainage basins under any specific storm. Giving no consideration to retention capabilities of the depression at the driving range or to other facilities which could mitigate runoff, it is seen that the runoff from the 605 acres of golf courses has increased 20 percent when the golf courses are developed fully. This increase is shown in Table I. Relating the 605 acres of developed golf courses to the 390 acres of Hoolapa Gulch and the 667 acres of Kalaeokahipa Gulch we find in Table II that the percentage increase is reduced to 13.4 for the 10 and 50 year storms for each gulch as a whole. This lower percentage increase is directly related to the 1057 acres of drainage area of the combined Hoolapa and Kalaeokahipa and the 605 acres of the golf course area.

The impact of the increased golf course flow can be mitigated by swaling the parking area, clubhouse site, putting green and some 70 acres of the Kalaeokahipa drainage basin near and mauka of the clubhouse to the large depression being used as the driving range (Figure 6). This single mitigating feature would reduce the golf course runoff to the main total flow by some eleven percent. This single reduction is equal to the increase shown on Table II. With additional mitigating steps such as swaling flows to sand traps, constructing additional retention basins or depressions and the like, it is possible to reduce the storm water runoff rate under the developed conditions to levels below those of the existing conditions. This action would then negate any impact on the wetlands lying makai of Kamehameha Highway as far as storm flow quantities are concerned from the golf courses development.

In addition to the diversion of the runoff from some 70 acres as discussed above, the Proposed Kahuku Drainage Master Plan, when implemented, will divert peak flows from Kalaeokahipa Gulch to the driving range depression. This depression can hold 64 acre feet of storm flow. This action reduces peak flows during heavy storms to a size that can be handled by the improved ditch system for the low lands makai of Kam Highway. Of particular note is the Lower Hoolapa Ditch which will direct flows away from the Punamano Spring area and the Punamano National Wildlife Refuge. Figure 7 also shows how storm flows from Hoolapa and Kalaeokahipa by-pass the Kii Wildlife Refuge to its north while the Ohia Ai Gulch runoff will by-pass it to the south and east. The ditch system will be sized to carry 100 year stormflows in compliance with City and County stormflow drainage criteria.

The major peak flow-area diversion in Kalaeokahipa watershed coupled with the new Hoolupa ditch and other Master Plan improvements will reduce peak storm flows of 50 and 100 year storms to flows that can be carried by the ditch system. The ditch system, in turn will redirect all flows so that there will be no storm flow into the Wildlife Refuge areas. Normal reinfall on the golf courses will be controlled and confined by swales, sand traps and detention basins so that minor sheet flow drainage will be confined to the golf course area itself.



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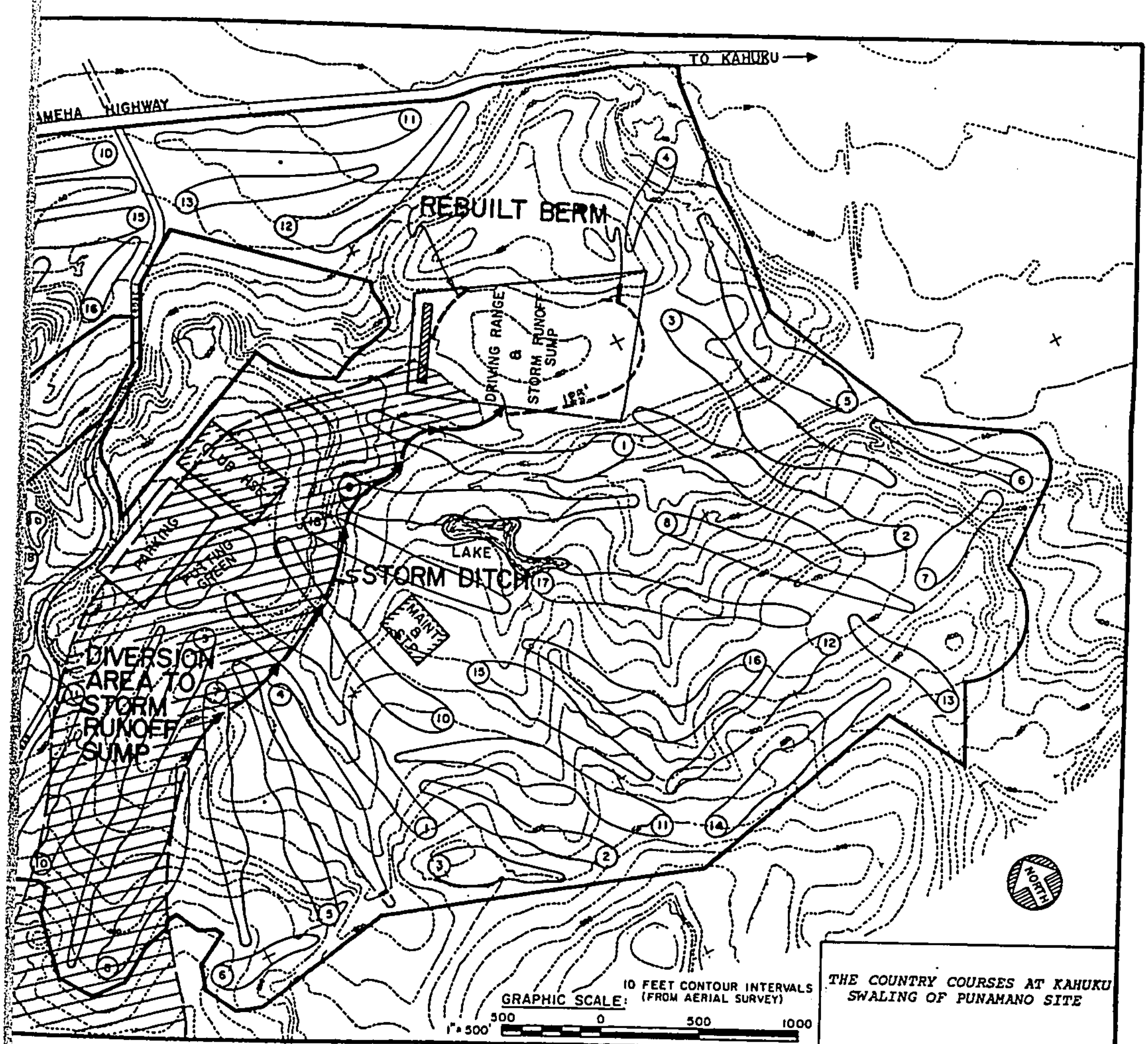
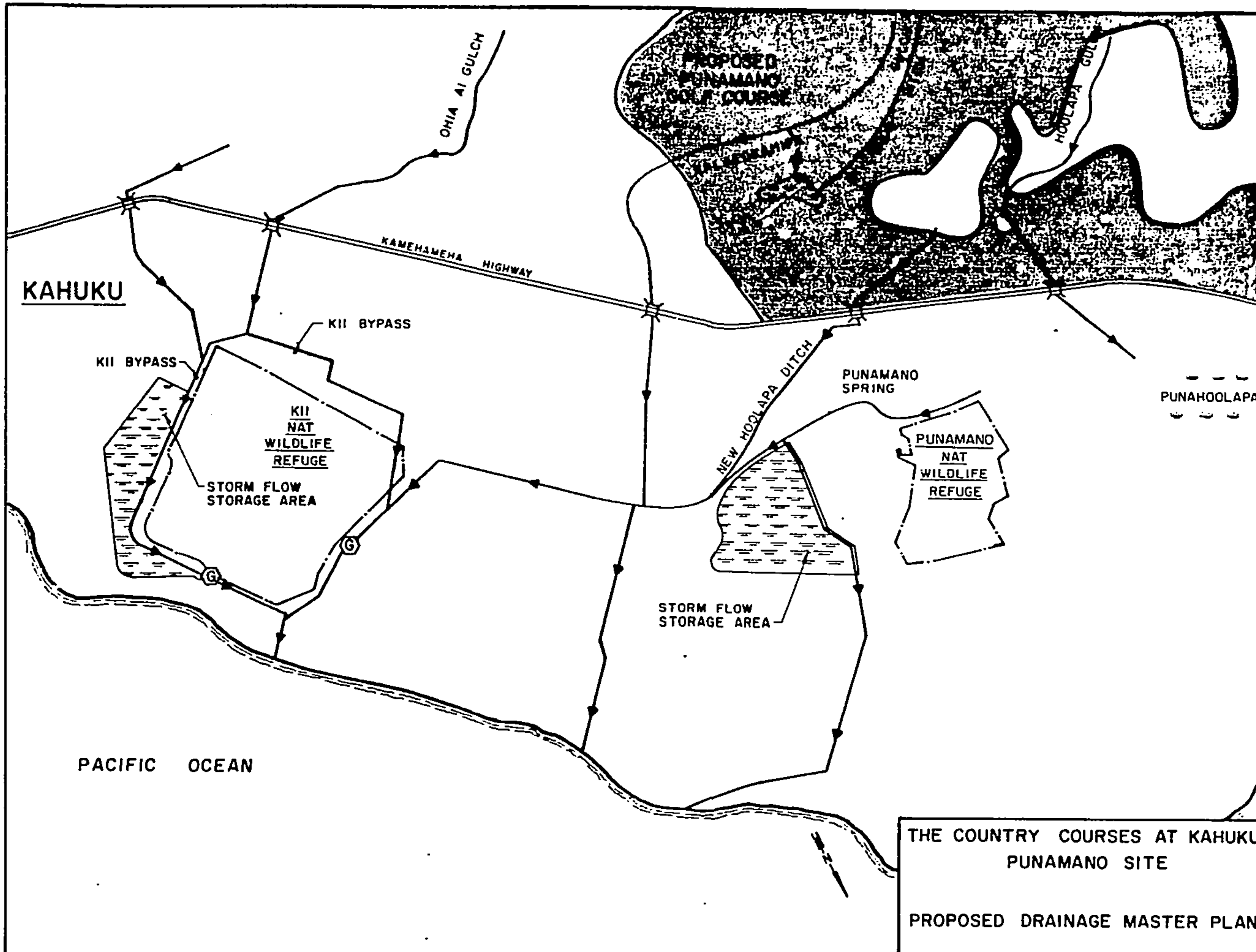


TO KAHUKU
AMEHA HIGHWAY
REBUILT BERM
DRIVING RANGE & STORM RUNOFF SUMP
LAKE
STORM DITCH
PARKING
PUTTING GREEN
MAINT & STP
DIVERSION AREA TO STORM RUNOFF SUMP
NORTH
10 FEET CONTOUR INTERVALS (FROM AERIAL SURVEY)
GRAPHIC SCALE:
1" = 500'
500 0 500 1000
THE COUNTRY COURSES AT KAHUKU
SWALING OF PUNAMANO SITE

FIG. 6



THE COUNTRY COURSES AT KAHUKU
PUNAMANO SITE

PROPOSED DRAINAGE MASTER PLAN

FIG 7

The propsed mitigating measures to be undertaken within the golf course development, combined with the Kahuku Drainage Master Plan presently being considered, will negate all possible impacts to the Wildlife Refuge areas and other wet-lands lying makai of Kamehameha Highway.

Sub-Appendix F

Punamano

GROUNDWATER QUALITY AND SUPPLY

FOR

THE COUNTRY COURSES AT KAHUKU

PUNAMANO SITE

PREPARED FOR

THE ESTATE OF JAMES CAMPBELL

PREPARED BY

DAMES & MOORE

1144 10TH AVENUE

HONOLULU, HAWAII 96816

DAMES & MOORE JOB NO. 07597-020-11

APRIL 1990

APPENDIX DM-3

PUNAMANO GOLF

GROUNDWATER QUALITY AND SUPPLY

GROUNDWATER QUALITY

The assessment of groundwater quality within the site is primarily based on earlier data summarized by Takasaki and Valenciano (1969). Two wells (339 and 352) occur within or very near the site. Well log data for Well 339 (located along the north alluvial fan and west of calcareous sandstone escarpment) indicates that the well ended at a final depth of nearly 180 feet and that the top of the weathered basalt was encountered at approximately -55 feet below MSL.

Takasaki and Valenciano (1969) indicate that the values for the quality of groundwater, as measured by its dissolved solids, range from about 100 milligrams/liter (mg/l) for dike water discharge into streams to about 2,500 mg/l for basal well water.

Induced sea-water intrusion due to large concentrated withdrawal of basal water from basaltic aquifers from 1930 to 1965 contributed most to the deterioration of the groundwater quality. In August 1964, a program was begun to monitor the nitrate content of water from selected wells to determine effects of infiltration of irrigation water in the Kahuku area. According to Mink (1962), *uncontaminated ground water contains less than 1 mg/l of nitrate. Mink (1962)* considers any nitrate content greater than 1 mg/l as the criterion of possible contamination from agricultural fertilizers. According to the Public Health Regulations Chapter 49, Potable Drinking Water, nitrate levels must reach 10 mg/l to be considered unsafe for consumption. For Well 339 water sample analysis measured in August 1964 indicated that nitrite levels reached 6.2 mg/l and that chloride levels reached 315 mg/l well below the Public Health regulation limits.

As indicated by Takasaki and Valenciano (1969) natural flow through most of the basal aquifer is generally large enough that infiltration of soluble fertilizer salts in irrigation water does not significantly contaminate the groundwater reservoir. Since the cessation of sugarcane cultivation, the groudwater quality should have improved.

WATER SUPPLY

Takasaki and Valenciano (1969) indicate that in the past the draft of the basal ground water in the Kahuku subarea ranged from about 3 mgd during periods of no irrigation to more than 50 mgd when fields were heavily irrigated. Wells 341 and 353, flowing continuously at a combined rate of 2-3 mgd, contributed most of the draft during the non-irrigation period. Domestic water was supplied by Wells 341, and 353, which pumped 100,000 to 200,000 gpd.

The presence of poorly permeable rocks underlying the extensions of valleys and gulches interferes with the flow of water across them. The natural underground groundwater flow to the ocean is estimated to range between 2 and 4 mgd per mile of shoreline. During the summer, the flow was much less than the draft, which was 10 mgd per mile (Takasaki, et al., 1969).

The basal water supply in most of the Kahuku subarea was fully developed. Small quantities of water of good quality can be developed in the mountains, but generally only at the expense of degrading the quality of water downgradient from such a new development (Takasaki et at., 1969).

According to John Mink, Hydrogeologist, in his 1988 report to Campbell Estate, stated;

(1) The average draft from the Koolauloa Aquifer during the Kahuku Plantation era was 28 mgd, but an average of 35 mgd was sustained during the 1950's. Monthly peaks rose as high as 43 mgd. Of the 28 mgd, about 24 mgd was pumped from Campbell Estate lands within the Kahuku area.

(2) The sustainable yield of the Koolauloa Aquifer is 35 mgd at a head of 13 feet at Kahuku and 19 feet in Hauula. Of the 35 mgd, the Kahuku Region has been assigned an allowable draft of 15 mgd. This assignment was agreed to by the State Department of Water and Land Development several years ago.

(3) Current draft in the Kahuku Region is 8.7 mgd. This leaves 6.3 mgd unused. The Board of Water Supply of Honolulu plans to take another 0.5 mgd eventually, thereby leaving 5.8 mgd unused. Campbell Estate lessees have expressed interest in taking an additional 1.8 mgd, leaving a surplus of 4.0 mgd unused. At this time Campbell Estate has a surplus of 6.3 mgd but if the BWS and lessees take their expected additional requirements, the surplus will be reduced to 4.0 mgd. As the Punamano Sites will need 2.1 to 2.2 mgd and the Malaekahana Site some .5 or .6 mgd, on the average, the supply is sufficient to meet the proposed golf courses needs.

(4) All 15 mgd of allowable yield in the Kahuku Region could be developed as potable water. To accomplish this, however, some existing wells would have to be refurbished and several new wells would have to be drilled.

(5) Turtle Bay Hotel complex receives its water from the Waialee Region which runs from Kawela Bay to Sunset Beach. This aquifer is completely separate fom the Koolauloa Aquifer. There is sufficient water available for Turtle Bay in the Waialee Aquifer.

Realizing that irrigation is fundamentally a practice of supplementing that part of the natural precipitation which is available for crop production; and taking into account that the tradewinds are stronger in the Kahuku area than in any other area of Oahu; that the rainfall tends to be less during the drier summer months when the temperature range is slightly higher, and combining this information with the evaporation data presented in Appendix J, Fertilizer and Pesticide Use On the Proposed Country Courses at Kahuku; the need for irrigation of the proposed golf courses is recognized. Based on the fact that evaporation exceeds rainfall by some 6.5 inches during the month of July, the demand for irrigation water will reach 2.6 mgd during that month. During January and February, when rainfall exceeds evaporation, the irrigation requirements will drop to about 1.4 mgd. The average will be 2.1 to 2.2 mgd for the year.

ENVIRONMENTAL ISSUES RELATED TO WATER QUALITY AND SUPPLY

- Due to the general reduction of well water pumping since the cessation of sugarcane cultivation, water quality in general should have been improved when compared to earlier water quality data.

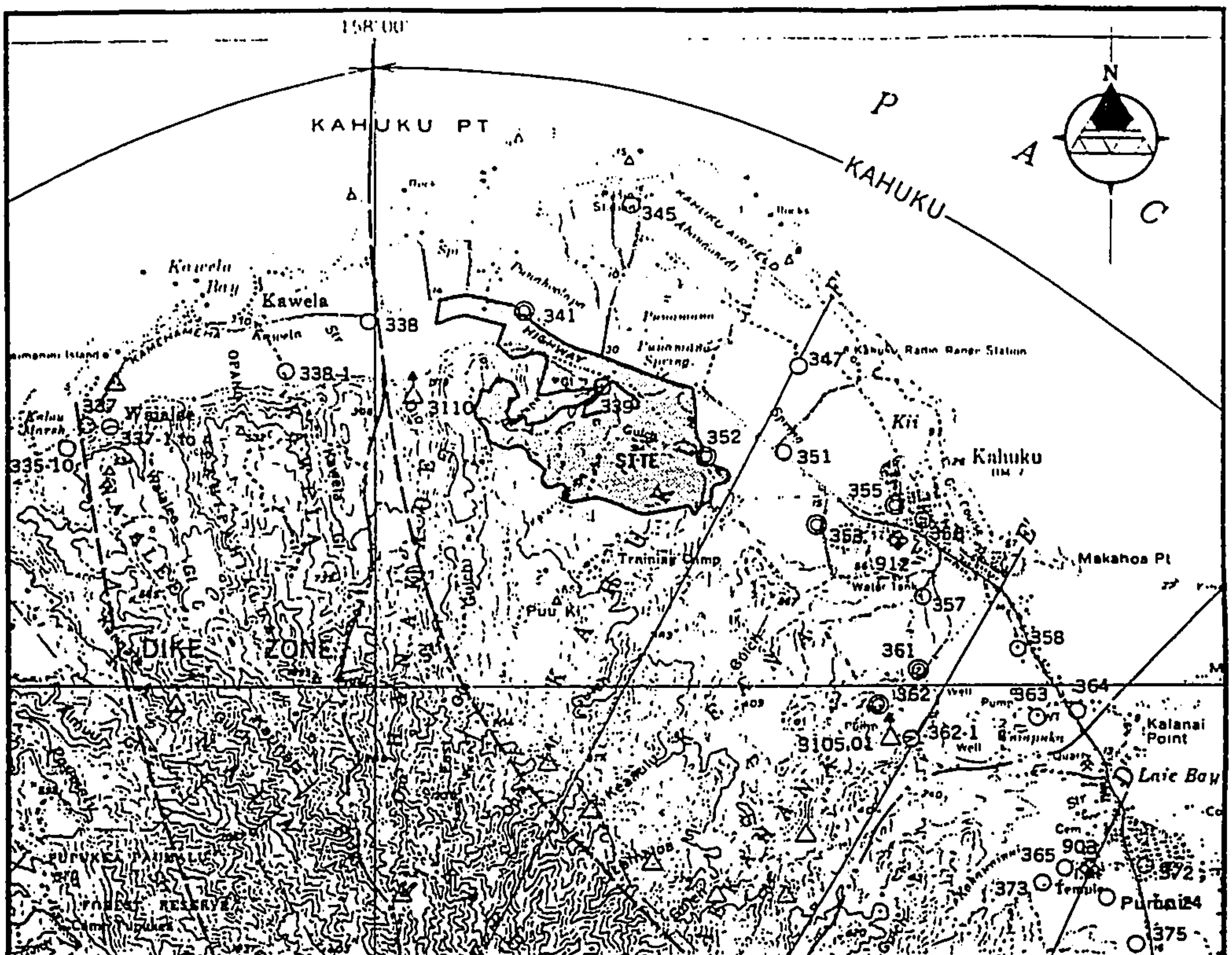
- The existing Board of Water Supply Sunset Beach-Kawela subsystem is an appropriate source for potable water supply for clubhouses and restaurants. A potable water demand on the order of 20,000 gallons per day from the existing system is availabe. Existing well 341 which also supplies domestic water may be refurbished and be availabe to supply 30,000 to 40,000 gpd to the proposed Punamano club houses. There are therefore two sources available.

- New water wells will be required to supply irrigation water for golf courses. In general, the new water wells should be placed close to Kamehameha Highway where the basal water lens has sufficient artesian head and the water quality may be below the drinking water standards but still suitable for golf course irrigation needs.

  To minimize the salt water intrusion into the brackish water zone, new wells should be designed for a low pumping rate on the order of 200 gpm each or to a rate that would produce less then a 2 foot drawdown within the well itself. The pumping rate and drawndown cannot be determined until the well is drilled and the pump test completed. A total of five or six wells may be required to supply the estimated mgd irrigation demand. The wells should be spaced far apart from each other and from the existing wells in the area. Surface storage ponds would be required to store the irrigation water to compensate for the low pumping rate. The selection of well and storage pond locations can best be made at the design phase of this project. Water quality and water level monitoring should be specified to safeguard the groundwater resources.

- Small surface impoundments should be created near buildings and structures to store sufficient quantities of non-potable water for fire-protection usage. Pressurized sprinkler lines with automatic pump starting capability could be installed.

- Increased irrigation of golf courses may tend to deteriorate the water quality of the site. To mitigate that impact, storm runoff at the site could be directed to temporary impoundments to be utilized for groundwater recharge.



Reference:
Department of Land & Natural Resources, State of Hawaii
U.S. Geological Survey
"Hydrologic Map of the Kahuku Area, Oahu, Hawaii"
Water Supply Paper 1874, Plate 1, 1969.

PLOT PLAN
Punamano Site

Sub-Appendix G

Punamano

Wastewater Management Plan

For

The Country Courses at Kahuku

Punamano Site

prepared for

The Estate of James Campbell

prepared by

Smith, Young & Associates, Inc.

3049 Ualena Street

Honolulu, Hawaii

April 1990

Introduction

The Estate of James Campbell is proposing to develop three 18 hole golf courses in the vicinity of Kahuku on the North Shore of Oahu. The area lies immediately southwest of Kamehameha Highway between Kahuku Village and Kuilima (Figure 1). The site contains approximately 605 acres and is situated mauka of Kamehameha Highway and some 2 miles northwest of the old Kahuku Mill (Figure 2).

The purpose of this report is to provide information on the site and to indicate the preliminary planning and engineering completed towards the collection, treatment and disposal of wastewater that might be generated on the site. This report addresses the following:

a. Existing site conditions
b. Information on the proposed development
c. Proposed process of waste treatment and disposal
d. Possible impacts of effluent disposal

Site and Site Conditions

The proposed site for the three 18-hole golf courses at Punamano is located within the Koolauloa District of Oahu and lies within the Tax Map Key designations of TMK 5-6-05:Portion 1, Portion 2, 5, 6 and Portion 7, and a small bit of TMK 5-7-01:Portion 21. This project site at Punamano has been owned by The Estate of James Campbell since before the turn of the twentieth century.

The site slopes up from the low grass lands lying along the mauka side of Kamehameha Highway and opposite from the Punamano Marsh which is a Natural Wildlife Refuge. The 605 acre, irregularly-shaped parcel consists mainly of vacant grass and shrub lands, rolling hillsides, intermittent stream gulches and several steep cliffs of upthrust coralline limestone. Portions of the site were, at one time, planted in sugar cane and some of the abandoned irrigation ditchwork still remains. From the north boundary of the site to its southern boundary the area is a gently rolling hillside with an overall slope of some 5 to 7 percent. An area of rough terrain exists some 100 feet mauka of Kamehameha Highway and extends in a westerly direction through the center of the property. This irregular formation is covered in the soils report for the site. It is this irregular formation that gives the project site the irregular boundary seen in Figure 2. Four abandoned windmill structures are located within the site near Kamehameha Highway. These will be removed. A road bisects the proposed golf course site. This road provides access to the U. S. Army Kahuku Training Area which is located immediately mauka of the site.

Land uses of property adjoining the Punamano site are military to the southwest, agricultural to the south and east, and aquaculture on the northeast. Across Kamehameha Highway, north of the site is the Tanaka Store, a well-known local landmark, which is a small grocery store and gas station. Farther west along Kamehameha Highway lies the Kuilima Resort and condominium complex. Other lands not specifically noted, which lie adjacent to the site, remain as vacant agricultural lands today.

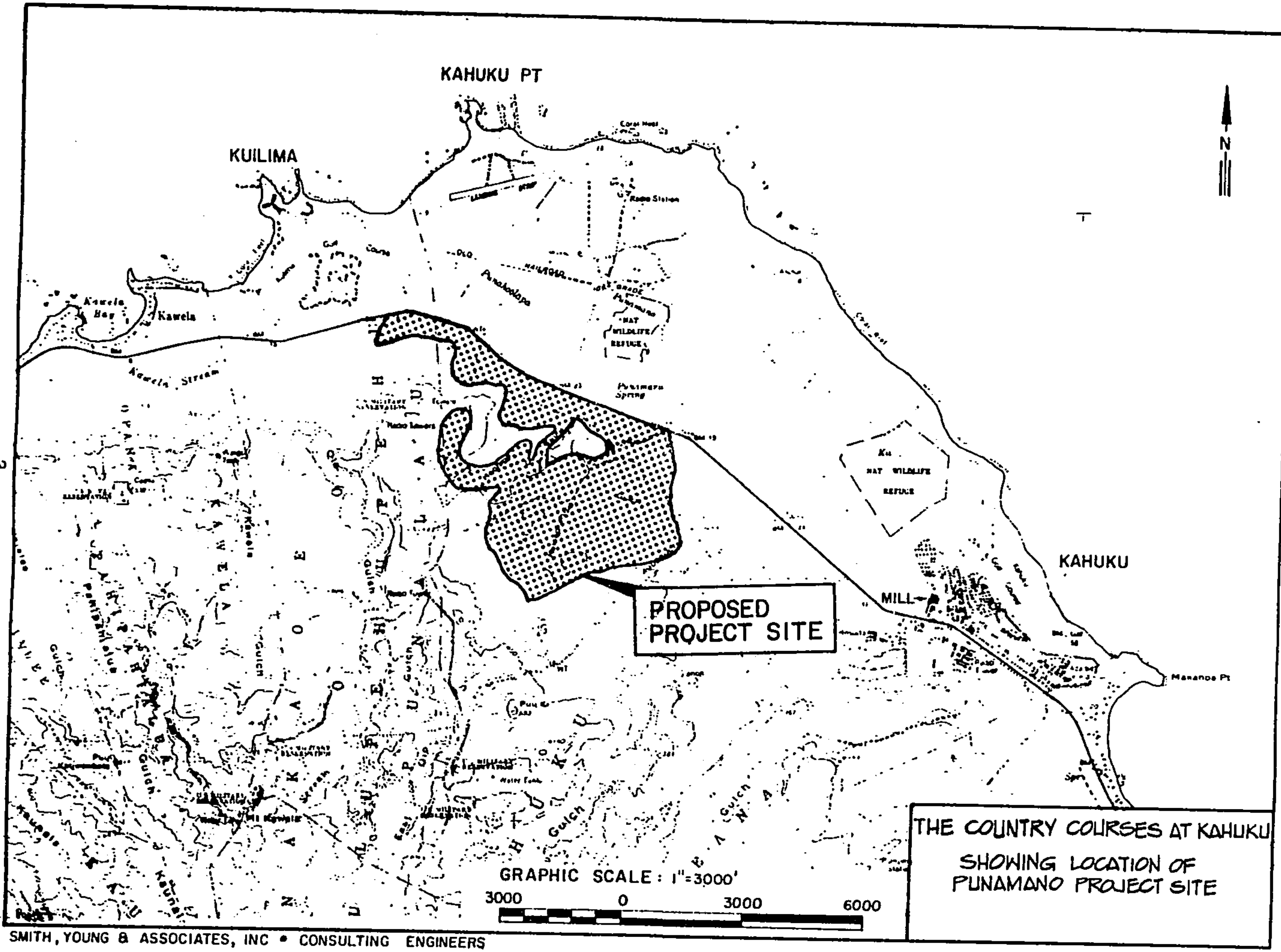

KAHUKU PT
KUILIMA
Kawela Bay
Kawela
Kawela Stream
Radio Station
Punamano Spring
KAHUKU
MILL
Manana Pt
PROPOSED PROJECT SITE
GRAPHIC SCALE: 1"=3000'
3000
0
3000
6000
N
THE COUNTRY COURSES AT KAHUKU
SHOWING LOCATION OF
PUNAMANO PROJECT SITE
SMITH, YOUNG & ASSOCIATES, INC • CONSULTING ENGINEERS

FIG. 1

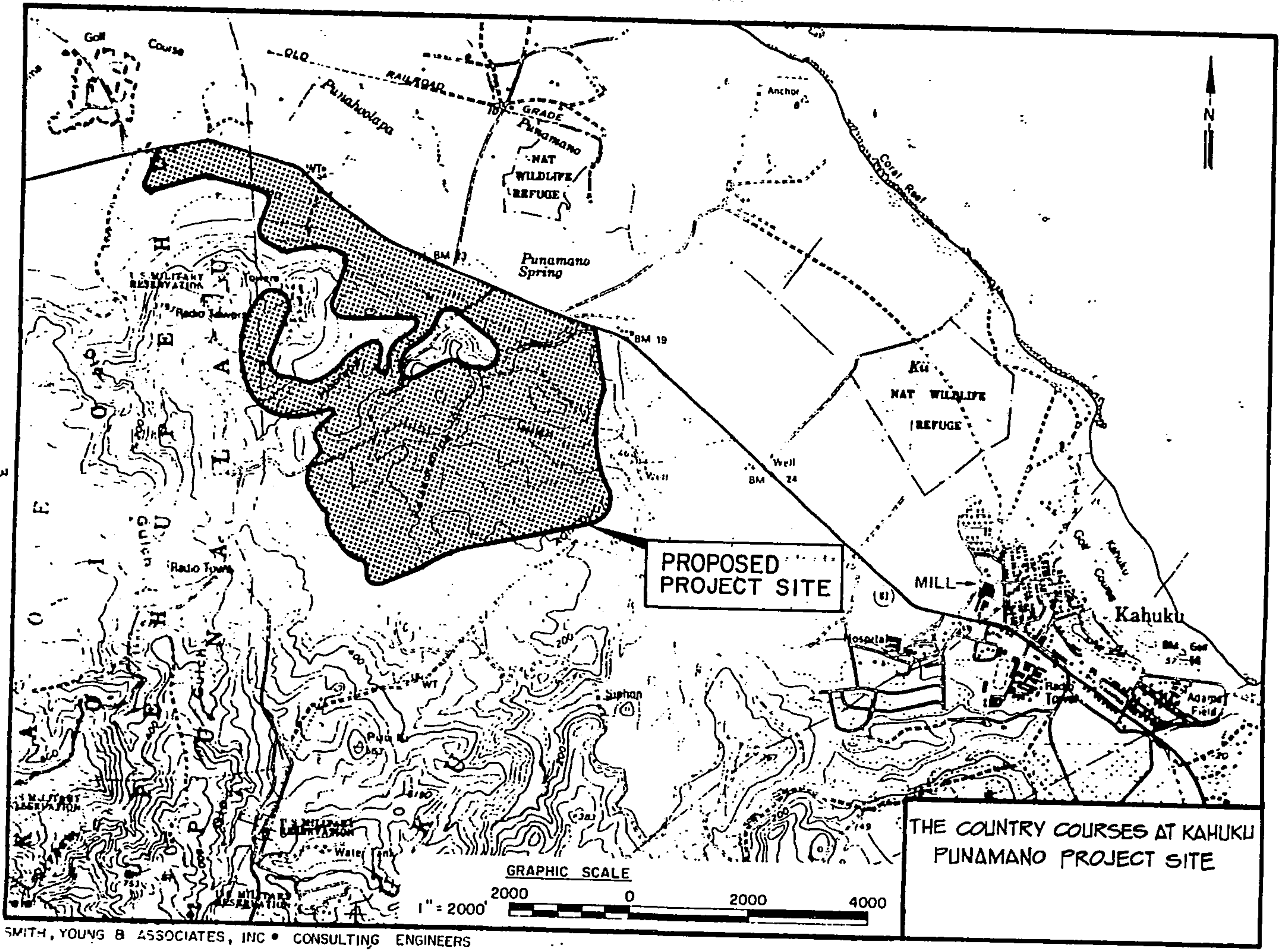

N
Golf Course
OLD RAILROAD GRADE
Punahoolapa
Punamano NAT WILDLIFE REFUGE
Punamano Spring
Anchor
Coral Reef
BM 19
Ku NAT WILDLIFE REFUGE
Well
BM 24
U.S. MILITARY RESERVATION
Radio Tower
Gulch
PROPOSED PROJECT SITE
MILL
Kahuku
Kahuku Golf Course
Hospital
Siphon
Radio Tower
Water Tank
THE COUNTRY COURSES AT KAHUKU
PUNAMANO PROJECT SITE
GRAPHIC SCALE
1" = 2000'
2000
0
2000
4000
SMITH, YOUNG & ASSOCIATES, INC • CONSULTING ENGINEERS

FIG 2

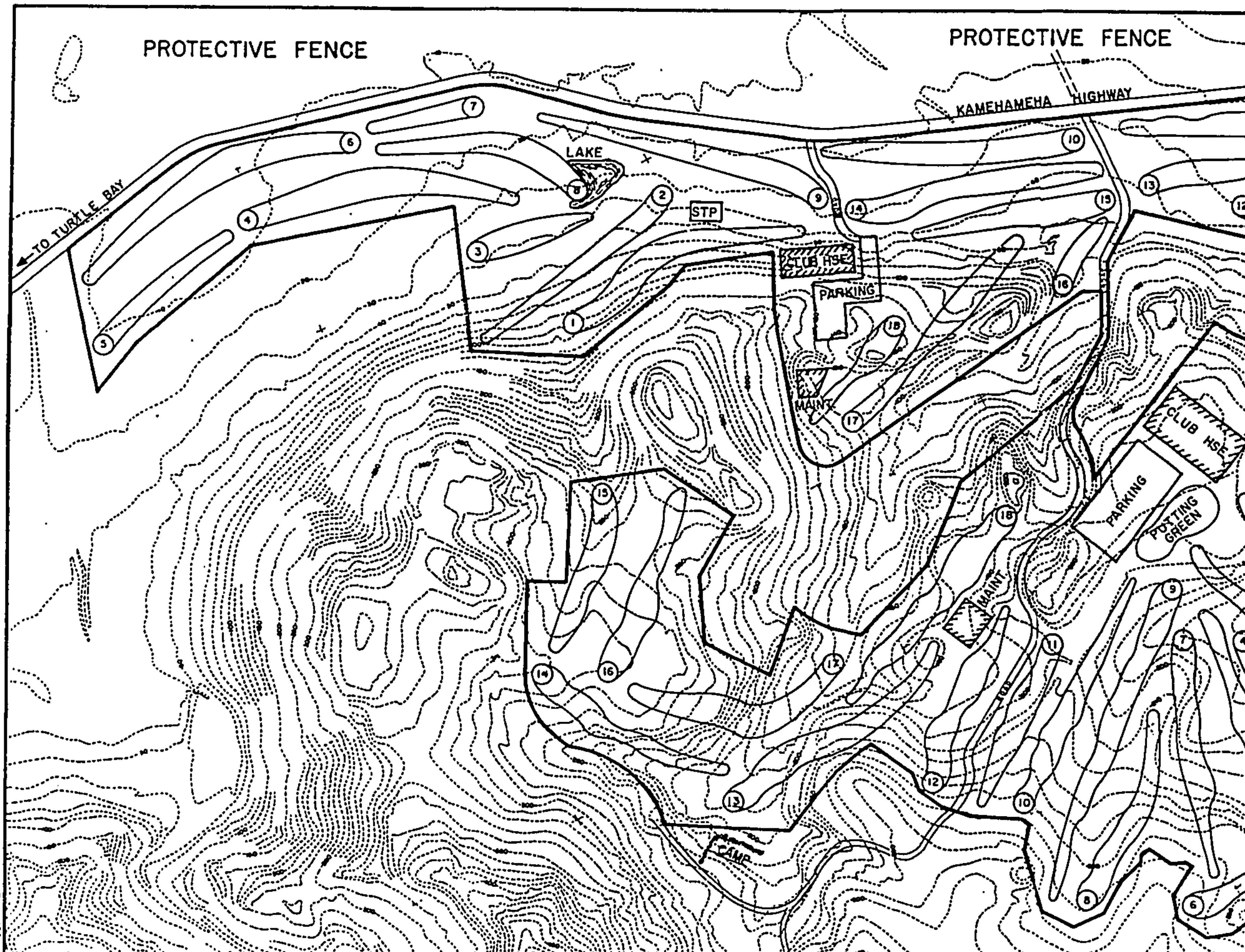
The site is presently designated as an agricultural district by the State Land Use Commission. The Koolauloa Development Plan Land Use Map designates the site Agriculture, and the City and County of Honolulu Zoning District carries the site as Agriculture (AG-1/AG-2).

The site has a temperature readings range from the low 60 degrees F to the mid 80 degrees F, depending on the day and the season of the year. Daily temperatures vary as much as twenty degrees (F) between daylight hours and early morning hours. Cooler temperatures are noticeable in the higher levels of the site. Review of the median annual rainfall, as published by Department of Land and Natural Resources, State of Hawaii, shows that the site is located well within the 1000 millimeter and 1500 millimeter isohyets which indicate that the rainfall median lies somewhere between 40 and 48 inches per year. The higher rainfall is found in the upper (southern) section of the site. The rainfall distribution is uneven and varies from month to month. Rain will be heavy some months and nearly non-existant at other times. Winter months, in general, are the months with the most rainfall.

Tradewinds are generally stronger at Kahuku than on other parts of the island. Velocities of twelve to fifteen miles per hour are average, with the direction of the prevailing winds coming from the northeasterly and east northeasterly directions. The winds at Kahuku are generally of greater velocity than the same winds in most other parts of Oahu. This is evidenced by the fact that the experimental wind turbines for electrical generation have been sited on adjacent areas immediately west of the proposed golf courses.

Proposed Development

Three 18 hole golf courses are planned for the Punamano Site covering approximately 605 acres. The proposed courses are shown in Figure 3. Each course will be designed for a different level of play capability. Course No. 1 which parallels Kamehameha Highway has its clubhouse set against the hill at elevation 60 feet. This 18 hole course will be nearly level and will be the easiest course to play. Clubhouse 2, reached by way of the U. S. Army access road to the training area, will be located at about 230 foot elevation with a southern exposure view overlooking Course No. 2 and No. 3. The 18 hole course lying in the southeast sector of the site will be the median course having several fairways with elevation changes and some hazards of note. Course No. 3 will be the longest course and will have steeper fairways, greater elevation changes and steeper roughs along the fairways. The concept is to have a course available for beginners on Course 1 and Courses No. 2 and No. 3 available for both exercise golfers as well as professionals. All available at this one site. Approximately 325 acres of the site will be developed into tees, greens, fairways, driving range and putting greens. The remaining 280 acres will serve as roughs, or be improved into clubhouses, parking areas or maintenance facilities.



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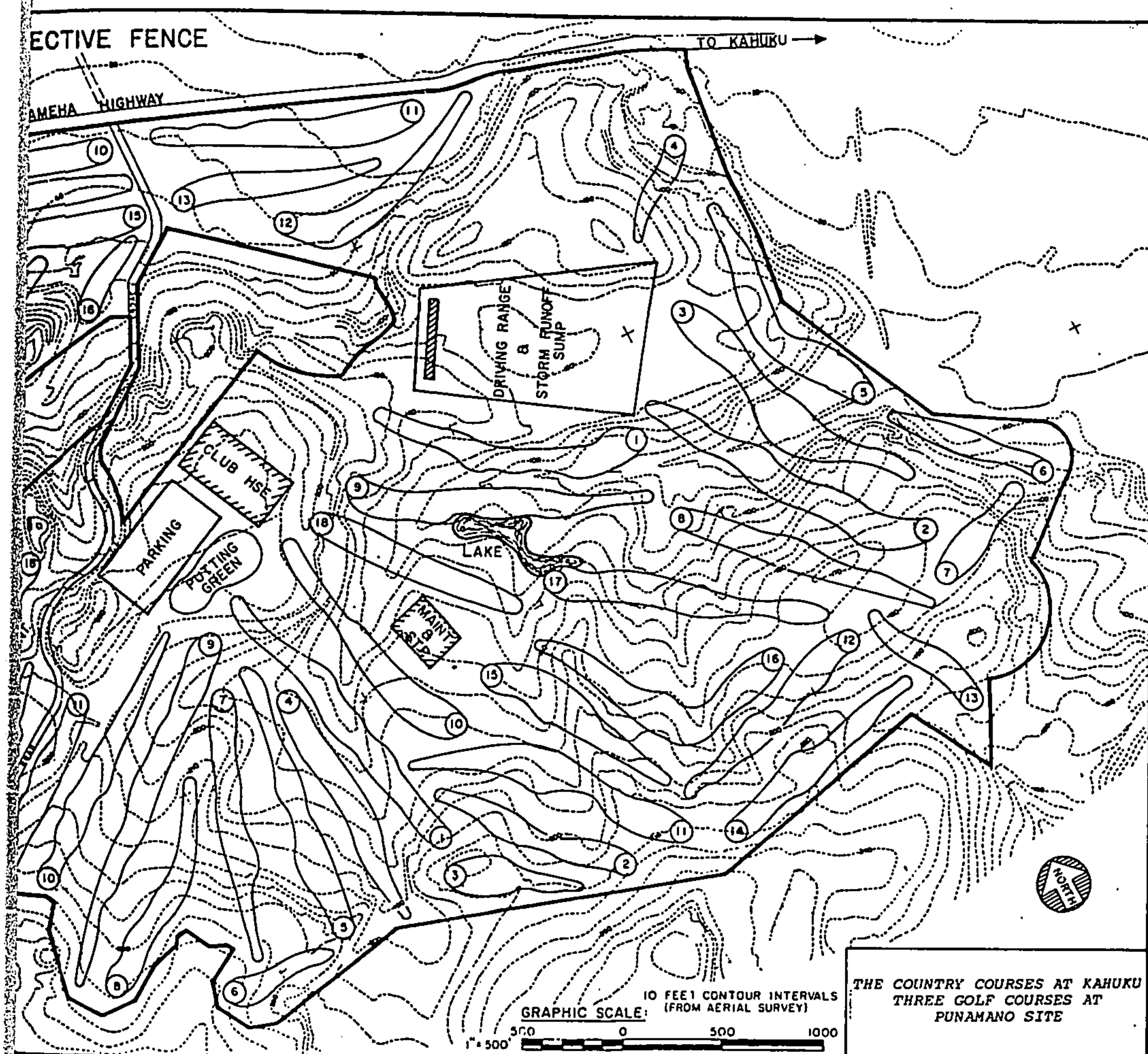


THE COUNTRY COURSES AT KAHUKU
THREE GOLF COURSES AT
PUNAMANO SITE

FIG. 3

The existing large swale which lies within the proposed driving range (Figure 3) will be improved and will remain as a major storm retention pond. Additional ponds or depressions will be constructed within the course development to act as retention ponds during storm periods when runoff would be heavy.

The clubhouse for Course No. 1 will be some 8,000 to 10,000 square feet and will contain a pro shop and starter station. A small lounge/snack bar with kitchen and men's and women's restrooms will be provided.

A parking area for some 75 to 100 cars will be constructed adjacent to the clubhouse. This course could serve as a beginners course for hotel and condominium guests who might be uncomfortable playing the major Kuilima Courses. It is expected that these players would come from the hotel, play the course and return to the hotel area to rest, shower and relax.

The clubhouse for Courses 2 and 3 will be some 16,000 to 18,000 sq. ft. in size. It will contain a pro-shop, two starter stations, a lounge/bar, kitchen and men's and women's locker rooms of limited size. Storage for golf carts will also be included. Players on these courses might be hotel guests unable to get convenient starting times on the hotel courses, local residents of Oahu desiring a different challenging course or local and foreign business partners relaxing from their business sessions being conducted in the hotel meeting rooms. With courses 2 and 3 being available for open play and both being at one clubhouse site, it will be possible for large local tournaments to be held on a simultaneous or "shotgun" basis; something that is not available at any other course on the island.

A large parking area suitable to handle some 225 to 250 cars will be provided. The large driving range would be sized to handle some 50 tee positions and the putting green would have some 40 or 50 cups. The concept is for a "convention center" for golfers yet courses that are sufficiently flexible to accomodate a single foresome.

Proposed Wastewater Treatment and Disposal

Clubhouse No. 1 will lie some 4000 feet southeast of the Kuilima Wastewater Treatment Plant being constructed by the Kuilima Resort Development Co. That plant will be operated by the City & County Wastewater Management Division when it has been completed and dedicated. The plant is designed to treat 1.3 million gallons of domestic wastewater per day. This plant could handle the flow from the clubhouse of No. 1 Course.

The clubhouse is expected to generate a maximum of some 4000 to 5000 gallons of wastewater per day. The contributing sources of the wastewater would be from the following:

250 golfers @ 10 gallons per day	= 2500 gpd
200 snack meals @ 4 gallons per meal	= 800 gpd
20 office & maintenance personnel @ 50 gpd	= 1000 gpd
	4300 gpd

Clubhouse No. 2 will lie some 7,500 feet southeast of the Kuilima Wastewater Treatment Plant and on the top of a ridge of coralline limestone. If this clubhouse wastewater were to be diverted to the City and County treatment facility, the Kuilima plant presently under construction could handle the flow.

Clubhouse No. 2 is expected to generate a maximum of some 8,000 to 10,000 gallons of wastewater per day. The contributing sources of the wastewater would be from the following:

500 golfers @ 10 gallons per day	= 5000 gpd
300 meals @ 5 gallons per meal	= 1500 gpd
40 office & maintenance personnel @ 50 gpd	= 2000 gpd
	8500 gpd

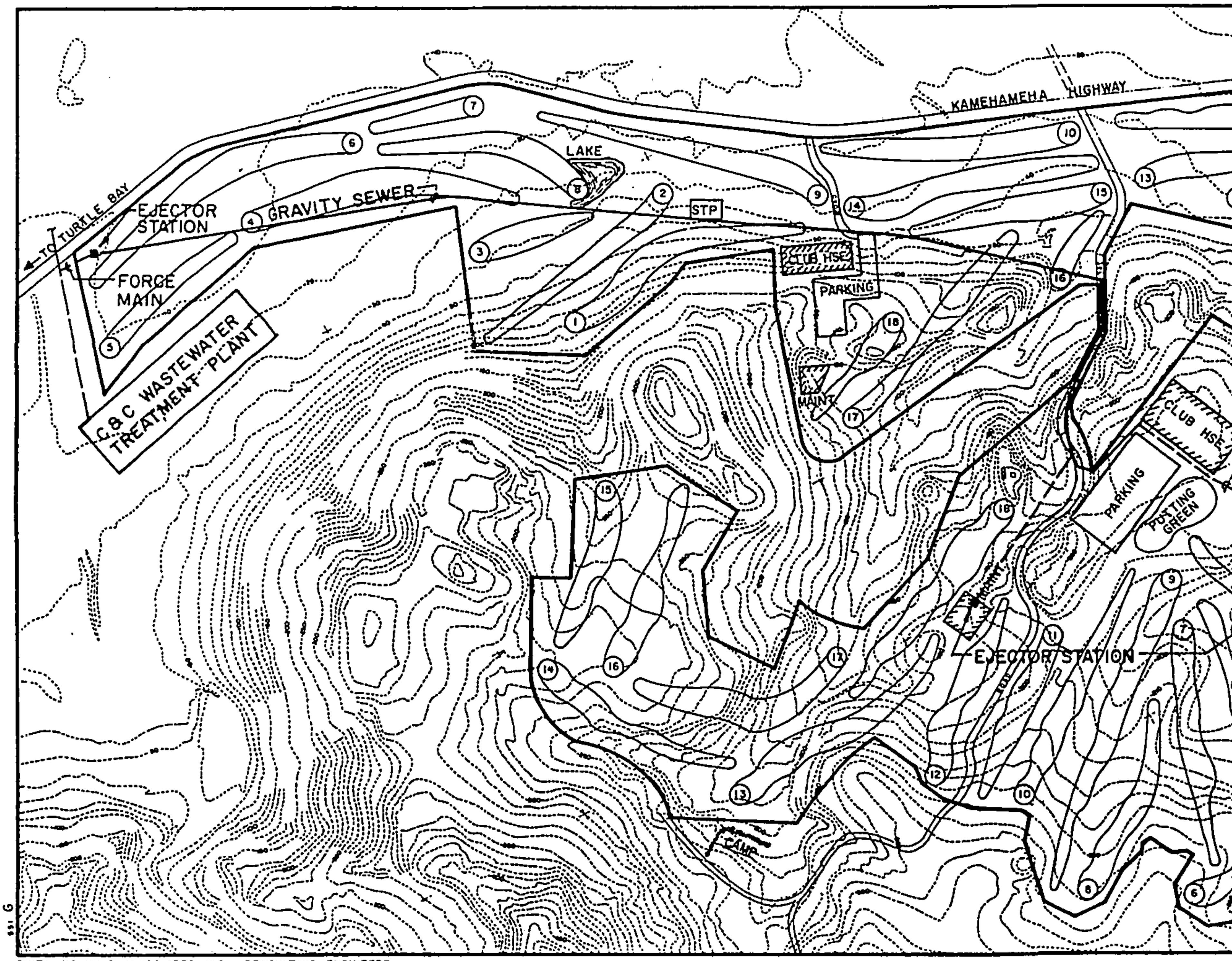
With the total wastewater quantity only reaching a possible 15,000 gallons per day, it becomes a questionable solution to dispose of the wastewater at the Kuilima Treatment Plant. Three ejector stations and some 9,500 feet of force mains and gravity sewers complete with manholes does not appear to be an economical method of disposal. It is offered herein as a solution should the recommended method described hereinafter not be permitted by governmental agencies. The system as discussed is shown in Figure 4. It is considered to be an alternative system.

The proposed, and recommended, treatment process to handle the small quantities of wastewater generated at both Clubhouse No. 1 and Clubhouse No. 2 would be a complete mix activated sludge "package" plant. This biological waste treatment process consists of the following major components:

1. Aeration tanks with diffused aeration equipment;
2. Settling tanks;
3. Return and waste sludge pumps and system;
4. Filters;
5. Chlorination contact tank.

A flow diagram of the treatment process is schematically shown in Figure 5. The treatment process would be constructed, maintained and operated in compliance with Chapter 62 of the State Department of Health Regulations. The description of the process is as follows:

1. <u>Aeration tank</u>. The aeration tank is a holding chamber where a suspension of microorganisms is maintained in the presence of oxygen. The organic material in wastewater is used by the microorganisms as a food source for growth and reproduction, thereby reducing the organics of the wastewater to inoffensive end products. Aeration is necessary to maintain oxygen levels required by the microorganisms. Mixing by air or mechanical mixers is required to maintan suspension of solids and to ensure direct contact between the activated sludge microorganisms and the incoming raw wastewater.



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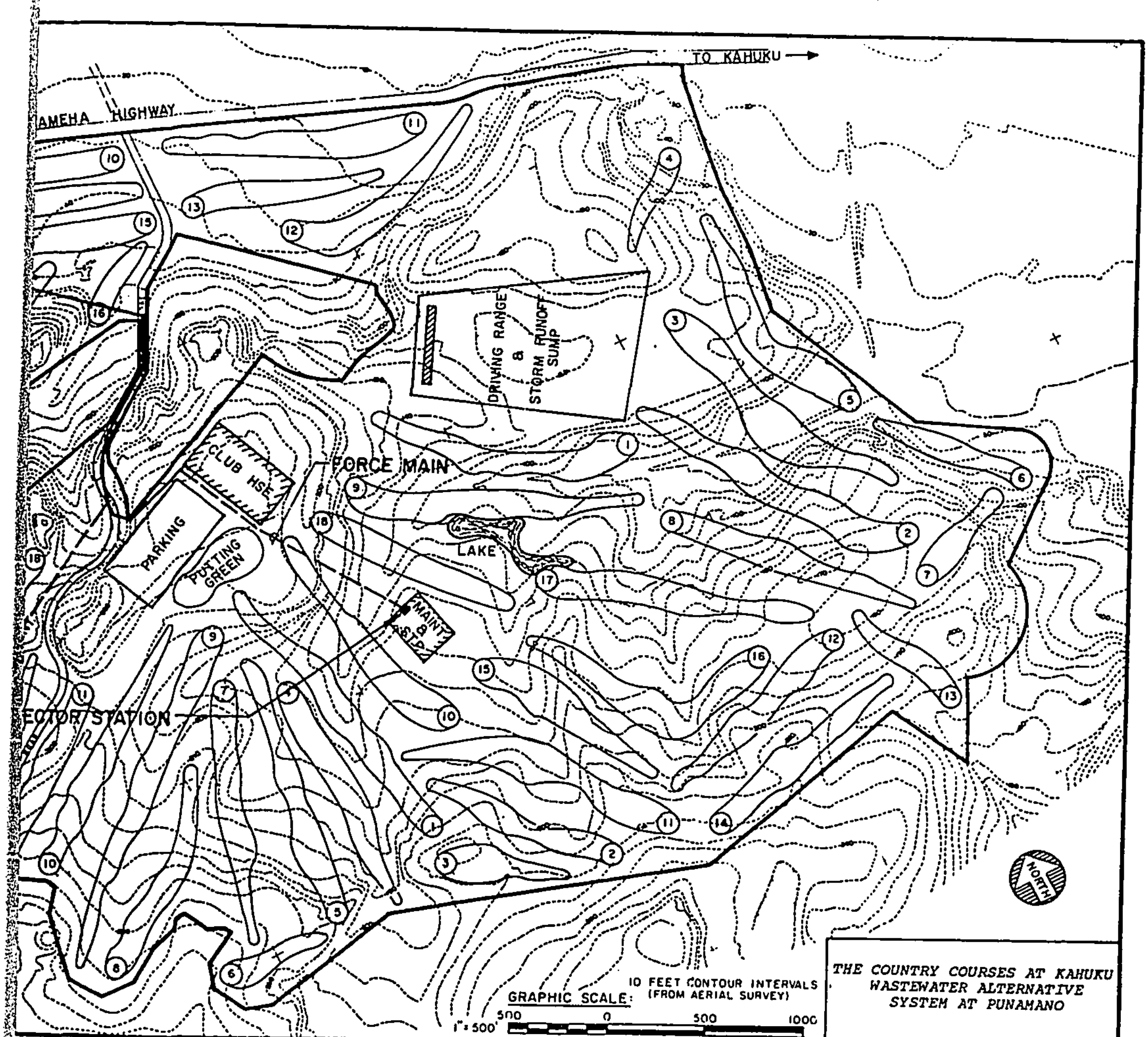
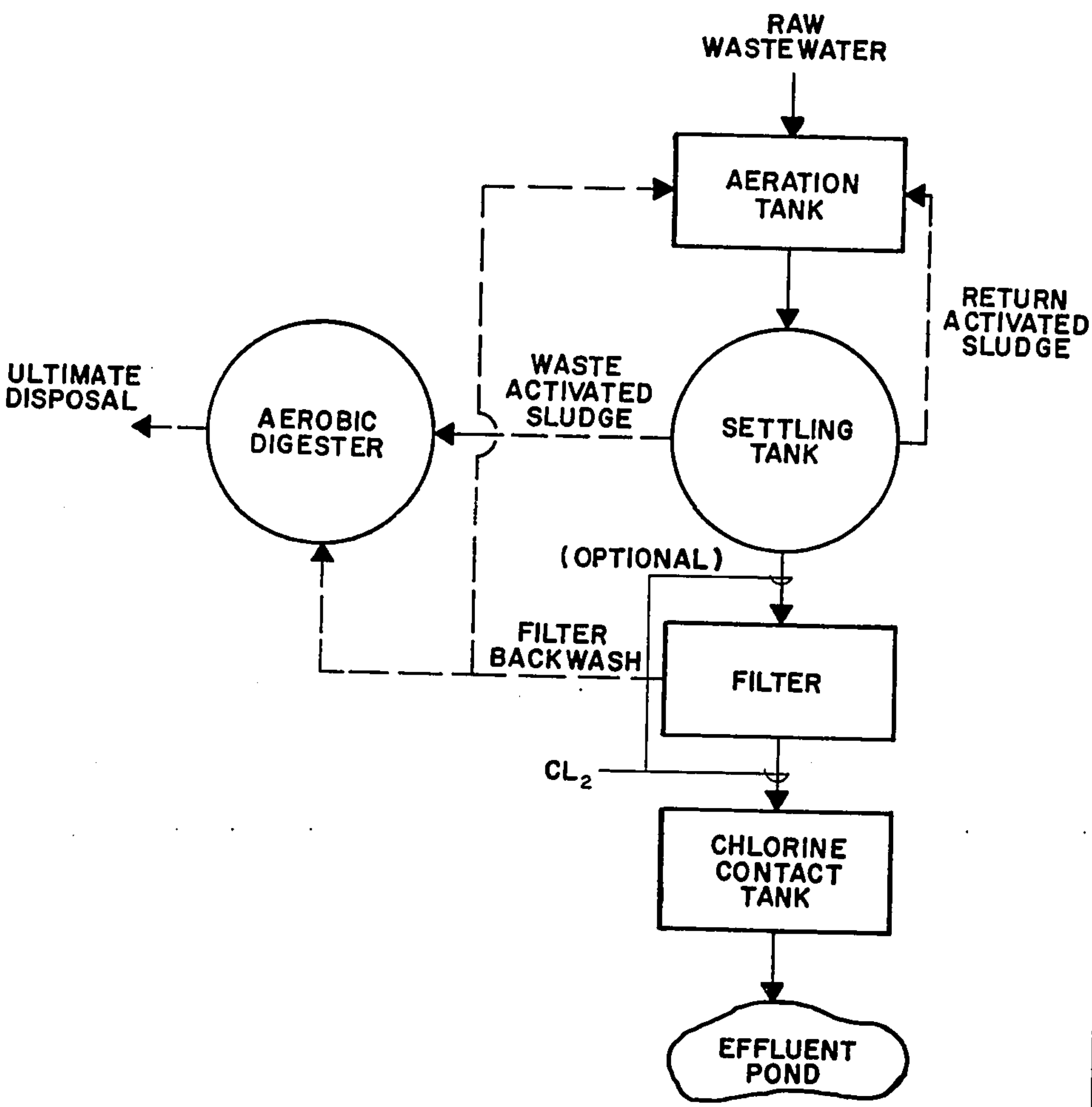

TO KAHUKU
AMEHA HIGHWAY
DRIVING RANGE & STORM RUNOFF SUMP
CLUB HSE.
FORCE MAIN
PARKING
PUTTING GREEN
LAKE
MAINT. & STP.
ECTOR STATION
NORTH
10 FEET CONTOUR INTERVALS (FROM AERIAL SURVEY)
GRAPHIC SCALE:
1" = 500'
500
0
500
1000
THE COUNTRY COURSES AT KAHUKU
WASTEWATER ALTERNATIVE
SYSTEM AT PUNAMANO

FIG. 4



THE COUNTRY COURSES AT KAHUKU
SCHEMATIC DIAGRAM
WASTEWATER TREATMENT PLANT

FIG. 5

2. <u>Settling tank</u>. Settling tanks rely on gravity to separate the mixture into a clear, treated effluent (overflow) and a heavier, concentrated activated sludge (underflow). An active culture of microorganisms in the settled sludge can then be continuously returned to the aeration tank to maintain the proper amount of bacteria for efficient treatment. When a surplus amount of settled sludge is present, a certain percentage is transferred into the aerobic digester for treatment and disposal.

3. <u>Filter</u>. Filtration of the settling tank overflow removes additional solids by deposition on the filter media. Thus, effluent quality can be improved by further reduction of BOD and SS concentrations as well as bacterial numbers. Periodic backwashing of the filter media is required to loosen and remove the accumulated solids from the media. Filter backwash can be returned to the liquid treatment process by recirculation to the aeration tank or directed to the aerobic digester for solids treatment.

4. <u>Chlorination</u>. Chlorination of effluent provides disinfection, prevents the spread of waterborne diseases, and controls algal growth and odors. Chlorination can be accomplished by in-line chemical injection to ensure good mixing of chlorine in the effluent. Mixing followed by adequate contact time in a chamber prior to disposal ensures effective disinfection. An optional point of chlorine application is before the filter. This controls algal growth on the filter media.

In the treatment process for solids treatment and disposal, waste activated sludge will be pumped to an aerobic digester-holding tank for sludge stabilization. Additional sludge treatment may be accomplished by transporting the aerobically digested sludge to a City and County treatment facility via tanker trucks. Disposal of sludge at the approved locations is free of charge but requires a permit from the City and County of Honolulu Division of Wastewater Management.

For treatment reliability, each unit process at the WWTP will be designed for redundancy to provide backup capability during times of equipment failure or repair. Two tanks of equal volume will be constructed for each of the following unit processes.

Aeration
Settling
Aerobic digestion

The filtration units will be sized so that the average design flow can be accommodated if one unit is off line.

<u>Effluent Characteristics</u>

The WWTP will be designed to remove 90% of biochemical oxygen demand (BOD) and suspended solids (SS). With the use of the filter the effluent characteristics should be:

BOD	10 to 15 mg/l
SS	10 to 15 mg/l
Nitrogen	20 mg/l
Phosphorus	6 mg/l
Total coliform bacteria	23/100 ml

The effluent quality will meet criteria stated in the proposed Hawaii Administrative Rules, Title 11, Department of Health, Chapter 62, Wastewater Systems (effective as of Dec. 10, 1988). The total coliform organisms in five grab samples of reclaimed water used for golf course irrigation taken during a 30-day period shall not exceed a median figure of 23 per 100 ml. This level is far better than that now found in the Kahawainui and Malaekahana streams shown in Table 1.

Proposed Method of Effluent Disposal

The proposed method of effluent disposal is irrigation of the golf course. Chlorinated effluent will flow to an irrigation storage pond. The pond capacity estimated at one to two million gallons, will contain a blend of wastewater effluent and nonpotable irrigation water from onsite wells. One to two feet of freeboard will be provided for additional storage during periods of prolonged inclement weather. The pond will be lined to prevent direct seepage of blended water to the water table below.

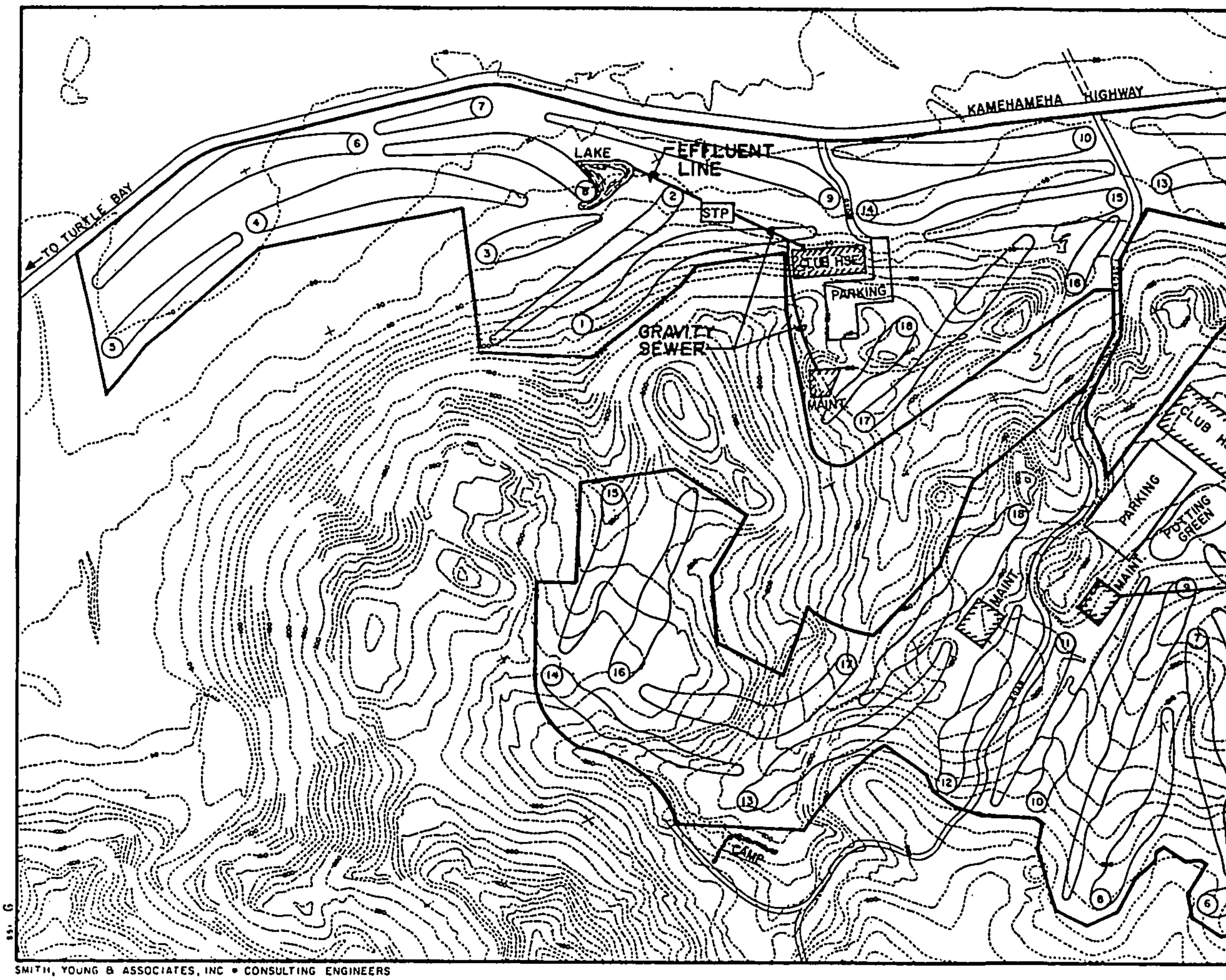
Reclaimed effluent will comprise less than 1 percent of the total daily irrigation water demand. As no portion of the wastewater collection system will lie within a brackish groundwater table there will be no infiltration of high chloride water. As the chloride content of municipal wastewater normally carries only 20 to 25 mg/l of chlorides above the domestic water used, the chloride content of the wastewater will probably never exceed 170 mg/l. This dilution rate will tend to improve the quality of the irrigation water.

This wastewater disposal system is shown schematically on Figure 6.

Impacts of Effluent Disposal

Under the new State Department of Health Regulations, the old Board of Water Supply's "pass-no pass" line has been suspended and the Department of Health's Underground Injection Control (UIC) line controls. The (UIC) line is situated along the old railroad right of way makai of Kamehameha Highway. Thus, the project site is located mauka of and within this injection control zone. Injection is not recommended or contemplated.

There is only the very remotest possibility that effluent will impact the groundwater and coastal waters if irrigation water should percolate and reach near mean sea level conditions. An evaluation of three elements (nitrogen, phosphorus, and biological organisms) will be discussed further to emphasize this reasoning.



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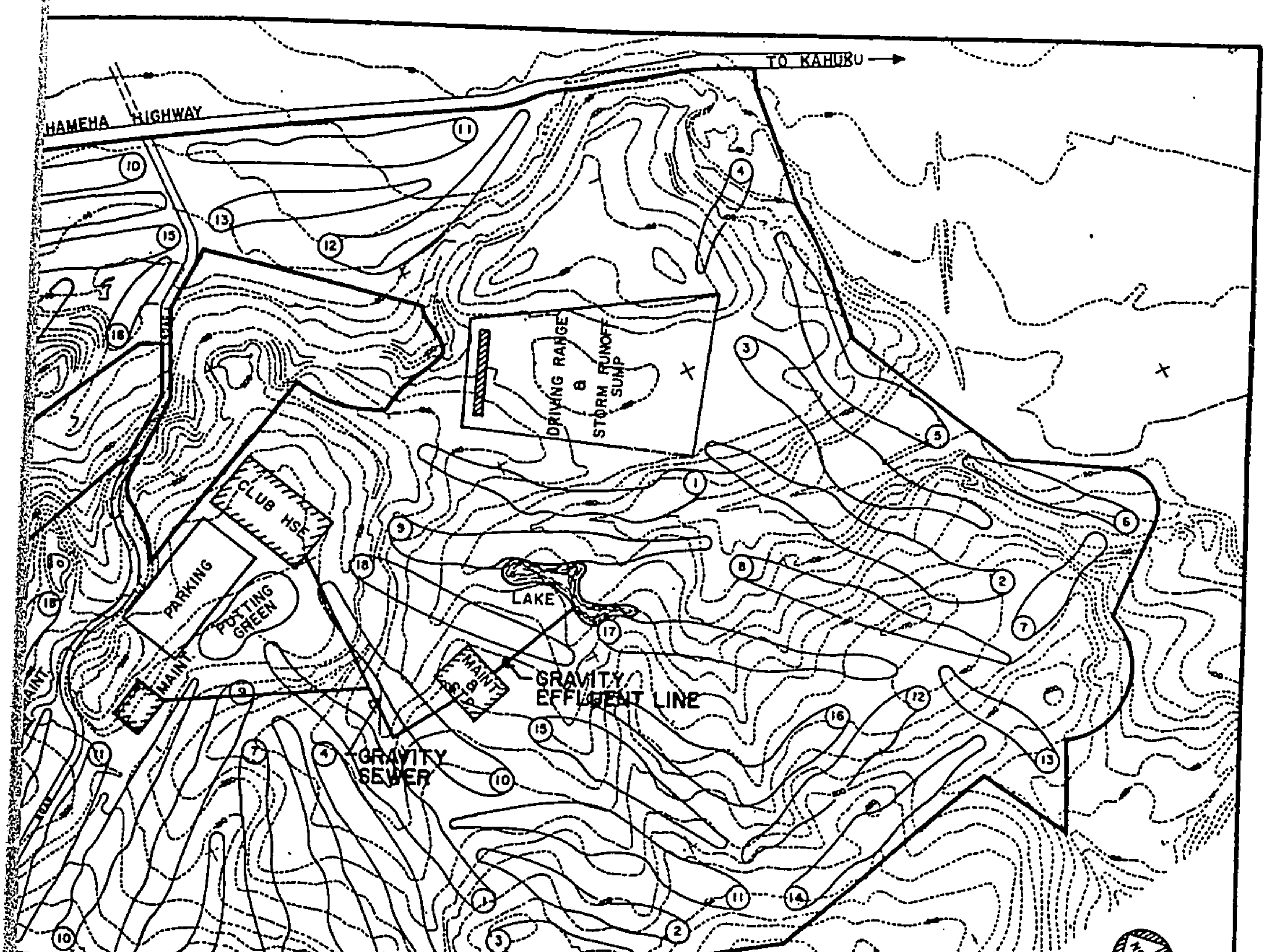

THE COUNTRY COURSES AT KAHUKU
PROPOSED EFFLUENT DISPOSAL
AT PUNAMANO

FIG 6

TABLE 1

BACTERIOLOGICAL SURVEY DATA ANALYSIS

Sub Area	Site No.	Site Location	Sample No.	5/13/82-5/19/82 (Wet Season) TC 100 ml	FC 100 ml	FS 100ml	8/24/82-9/14/82 (Dry Season) TC 100 ml	FC 100 ml	FS 100 ml
Kahuku	7	Reef Area By Golf Course	1	1	1	410	1	1	50
			2	1	1	10	1	1	90
	8	Malaekahana Stream	1	800	210	2,200	4,400	2,600	7,200
			2	1,500	200	1,500	4,000	3,400	2,100
	10	Shoreline Makahoa Bay	1	1	1	70	1	1	190
			2	1	1	10	1	1	43
Laie	11	Kahawainui Stream	1	16,000	7,200	2,700	2,700	500	3,700
			2	39,000	1,800	1,500	7,300	2,000	4,100
	12	Upstream of Site 11	1	800	300	800	6,000	400	500
				3,900	400	1,000	3,600	1,000	2,700
	14	Shoreline Laie Bay	1	30	20	200	50	40	240
			2	60	20	40	340	180	180
	15	Shoreline BYUH Outfall	1	8,000	5,000	3,200	13,000	2,900	2,600
			2	30,000	1,200	1,000	50,000	30,000	4,100
	17	Shoreline Poly.Cult.Cent.	1	1,400	600	1,350	6,300	800	900
			2	3,600	630	560	6,900	3,400	6,400

Notes: 1. TC = Total Coliform; FC = Fecal Coliform; FS = Fecal Streptococcus
2. For recreational use, FC $\leq$ 200/100 ml.

Nitrogen

Based on typical secondary effluent data, a nitrogen concentration of 20 mg/l may be expected. At a total flow rate of 15,000 gpd, approximately 2.5 pounds per day of nitrogen will be contributed by effluent. The irrigation requirement for three 18-hole golf courses is between 1.0 and 2.6 mgd depending on the weather conditions and rainfall. It is assumed that all of the 2.5 pounds per day of nitrogen will be applied to the golf course turf within that irrigation quantity. Three typical 18-hole golf courses could use, on the average, 180 to 200 pounds of nitrogen per day. Therefore the effluent will supply only 1.2 percent of the daily nitrogen requirements. Because the nitrogen from the effluent will be applied a bit at a time every day, all effluent nitrogen can be utilized by the turf roots. The impact of nitrogen from the treated effluent will not be detrimental to the groundwater or coastal water quality due to the following factors:

1. The quantity of effluent applied and its corresponding quantity of nitrogen is extremely small in comparison to the groundwater lens. The turf root structure can consume the available nitrogen from the daily effluent applications.
2. The immense "mixing" and "net transport" characteristics of the coastal waters fronting the project significantly dilute and disperse any percolate entering the coastal waters.
3. The amount of nitrogen introduced unto the ground by the effluent is small. After grass root uptake, the available nitrogen for percolation is nearly non-existent.

Phosphorus

A typical phosphorus concentration for secondary effluent averages 6 mg/l. At a flow rate of 15,000 gpd, approximately .75 pound per day of phosphorus will be applied to golf course turf. Unlike nitrogen, phosphorus remains fixed to soil particles with which it comes in contact; thus, groundwater infiltration of phosphorus is not to be expected.

Bacteria and Viruses

Disinfection of effluent by chlorination will reduce total coliform counts to no more than 23 per 100 ml, as specified by the State Department of Health. Thus, the maximum bacteria and virus levels in the effluent will be within allowable limits for landscape irrigation and better than those in Malaekahana and Kahawainui streams and Laie Bay. (Table 1). Studies conducted by the Water Resources Research Center of the University of Hawaii reported that bacteria and viruses were not present in percolate from secondary effluent irrigation. Researchers attributed the removal of these organisms to soil adsorption, dessication, elevated temperatures, and exposure to sunlight. Thus, infiltration of these organisms to deep aquifers is not probable after the effluent is sprayed on the golf course fairways.

Studies by the University of Hawaii were conducted to determine the possibility of secondary treated effluent being used for irrigation purposes in the Central Plain area of Oahu. The use of a very small quantity at Kahuku would have less impact on groundwater here than large quantities on the Central Plain. Both are feasible if properly applied and controlled.

Conclusion

Significant adverse impacts due to effluent disposal by irrigation of the golf course are not foreseen. Mitigation measures include:

1. Storage of excess effluent in an irrigation pond during periods of inclement weather; and
2. Incorporation of a filter in the process treatment scheme to provide reliable treatment efficiency at all times.

The process recommended can meet the eleven conditions applicable to new golf courses as promulgated by the State Department of Health on January 31, 1989.

Sub-Appendix H

Punamano

Report

on

Grading and Construction Activities

For

The Country Courses at Kahuku

Punamano Site

prepared for

The Estate of James Campbell

prepared by

Smith, Young & Associates, Inc.

3049 Ualena Street

Honolulu, Hawaii

April 1990

Introduction

The Estate of James Campbell is proposing to develop three 18 hole golf courses in the vicinity of Kahuku on the North Shore of Oahu. The area lies immediately southwest of Kamehameha Highway between Kahuku Village and Kuilima (Figure 1). The site contains approximately 605 acres and is situated mauka of Kamehameha Highway and some 2 miles northwest of the old Kahuku Mill (Figure 2).

The objective of this report is to present the necessary planning and preliminary engineering for the site grading and construction of the proposed golfing site. Specifically this report covers the following items:

a. Existing site and site conditions;
b. Background information on the proposed development site;
c. Proposed development and necessary grading and construction work;
d. Impacts and mitigative measures to be undertaken at the site.

Site and Site Conditions

The proposed site for the three 18-hole golf courses at Punamano is located within the Koolauloa District of Oahu and lies in the Tax Map Key designations of TMK 5-6-05:Portion 1, Portion 2, 5, 6 and Portion 7, and a small bit of TMK 5-7-01:Portion 21. This project site at Punamano has been owned by The Estate of James Campbell since before the turn of the twentieth century.

The site slopes up from the low grass lands lying along the mauka side of Kamehameha Highway and opposite from the Punamano Marsh which is a Natural Wildlife Refuge. The 605 acre, irregularly-shaped parcel consists mainly of vacant grass and shrub lands, rolling hillsides, intermittent stream gulches and several steep cliffs of coralline limestone. Portions of the site were, at one time, planted in sugar cane and some of the abandoned irrigation ditchwork still remains. From the north boundary of the site to its southern boundary the area is a gently rolling hillside with an overall slope of some 5 to 7 percent. An area of rough terrain exists some 100 feet mauka of Kamehameha Highway and extends in a westerly direction through the center of the property. This irregular formation is covered in the soils report for the site. It is this irregular formation that gives the project site the irregular boundary seen in Figure 2. Four abandoned windmill structures are located within the site near Kamehameha Highway. These will be removed. A road bisects the proposed golf course site. This road provides access to the U. S. Army Kahuku Training Area which is located immediately mauka of the site.

Land uses of property adjoining the Punamano site are military to the southwest, agricultural to the south and east, and aquaculture on the northeast. Across Kamehameha Highway, north of the site is the Tanaka Store, a well-known local landmark, which is a small grocery store and gas station. Farther west along Kamehameha Highway lies the Kuilima Resort and condominium complex. Other lands not specifically noted, which lie adjacent to the site, remain as vacant agricultural lands today.

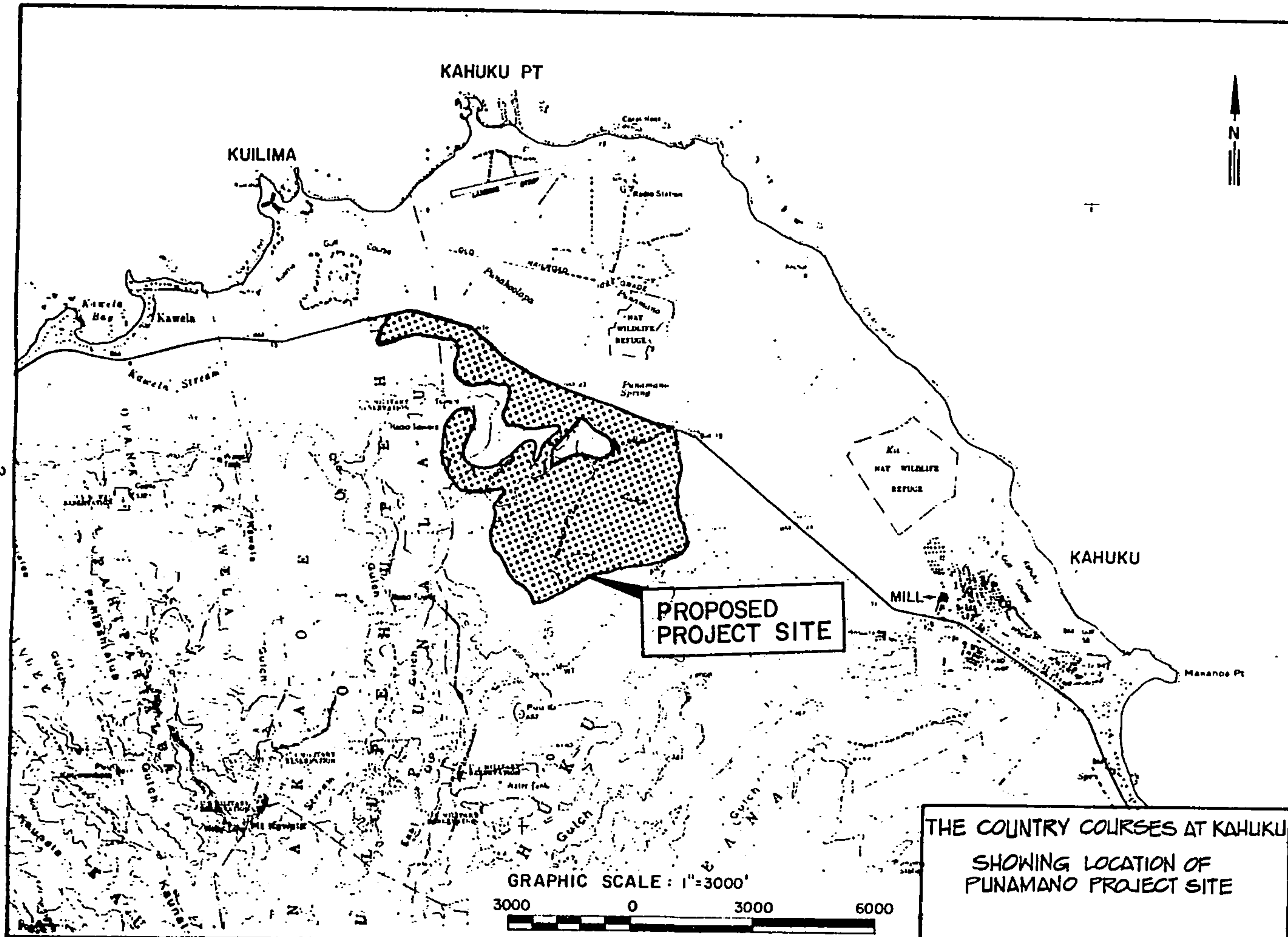

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FIG. 1

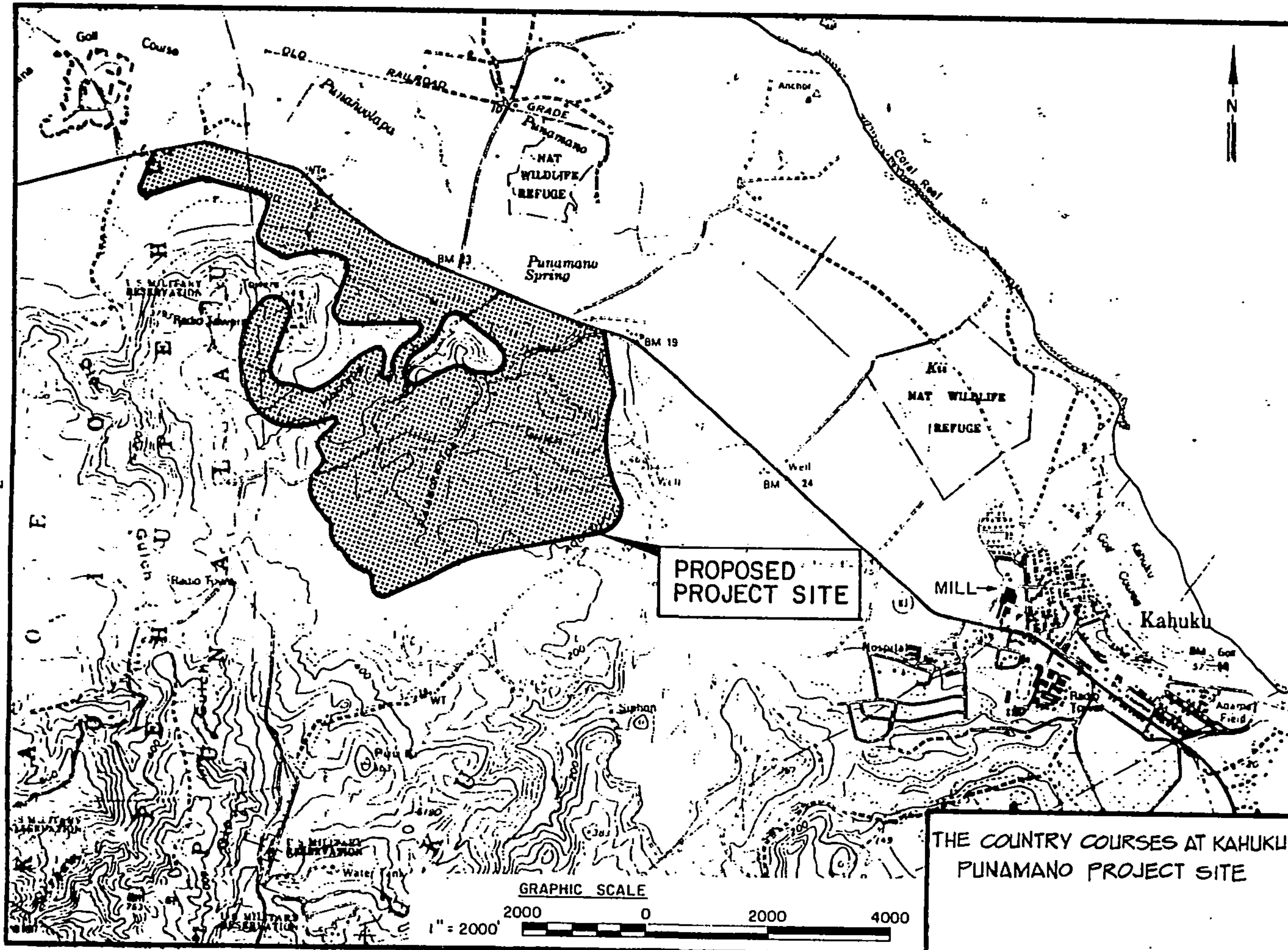

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FIG 2

The site is presently designated as an agricultural district by the State Land Use Commission. The Koolauloa Development Plan Land Use Map designates the site Agriculture, and the City and County of Honolulu Zoning District carries the site as Agriculture (AG-1/AG-2).

The site has a temperature readings range from the low 60 degrees F to mid 80 degrees F, depending on the day and the season of the year. Daily temperatures vary as much as twenty degrees (F) between daylight hours and early morning hours. Cooler temperatures are noticeable in the higher levels of the site. Review of the median annual rainfall, as published by Department of Land and Natural Resources, State of Hawaii, shows that the site is located well within the 1000 millimeter and 1500 millimeter isohyets which indicate that the rainfall median is probably between 42 and 48 inches per year (Figure 3). The higher rainfall is found in the upper (southern) section of the site. The rainfall distribution is uneven and varies from month to month. Rain will be heavy some months and nearly non-existant at other times. Winter months, in general, are the months with the most rainfall.

Tradewinds are generally stronger at Kahuku than on other parts of the island. Velocities of twelve to fifteen miles per hour are average, with the direction of the prevailing winds coming from the northeasterly and east northeasterly directions. The winds at Kahuku are generally of greater velocity than the same winds in most other parts of Oahu. This is evidenced by the fact that the experimental wind turbines for electrical generation have been sited on adjacent areas immediately west of the proposed golf courses.

Proposed Development

Three 18 hole golf courses are planned for the Punamano Site covering approximately 605 acres. The proposed courses are shown in Figure 4. Each course will be designed for a different level of play capability. Course No. 1 which parallels Kamehameha Highway has its clubhouse set against the hill at elevation 60 feet. This 18 hole course will be nearly level and will be the easiest course to play. Clubhouse 2, reached by way of the U. S. Army access road to the training area, will be located at about 230 foot elevation with a southern exposure view overlooking Course No. 2 and No. 3. The 18 hole course lying in the south east sector of the site will be the median course having several fairways with elevation changes and some hazards of note. Course No. 3 will be the longest course and will have steeper fairways, greater elevation changes and steeper roughs along the fairways. The concept is to have a course available for beginners on Course 1 and Courses No. 2 and No. 3 available for both exercise golfers as well as professionals. All available at this one site. Approximately 325 acres of the site will be developed into tees, greens, fairways, driving range and putting greens. The remaining 280 acres will serve as roughs, or be improved into clubhouses, parking areas or maintenance facilities.

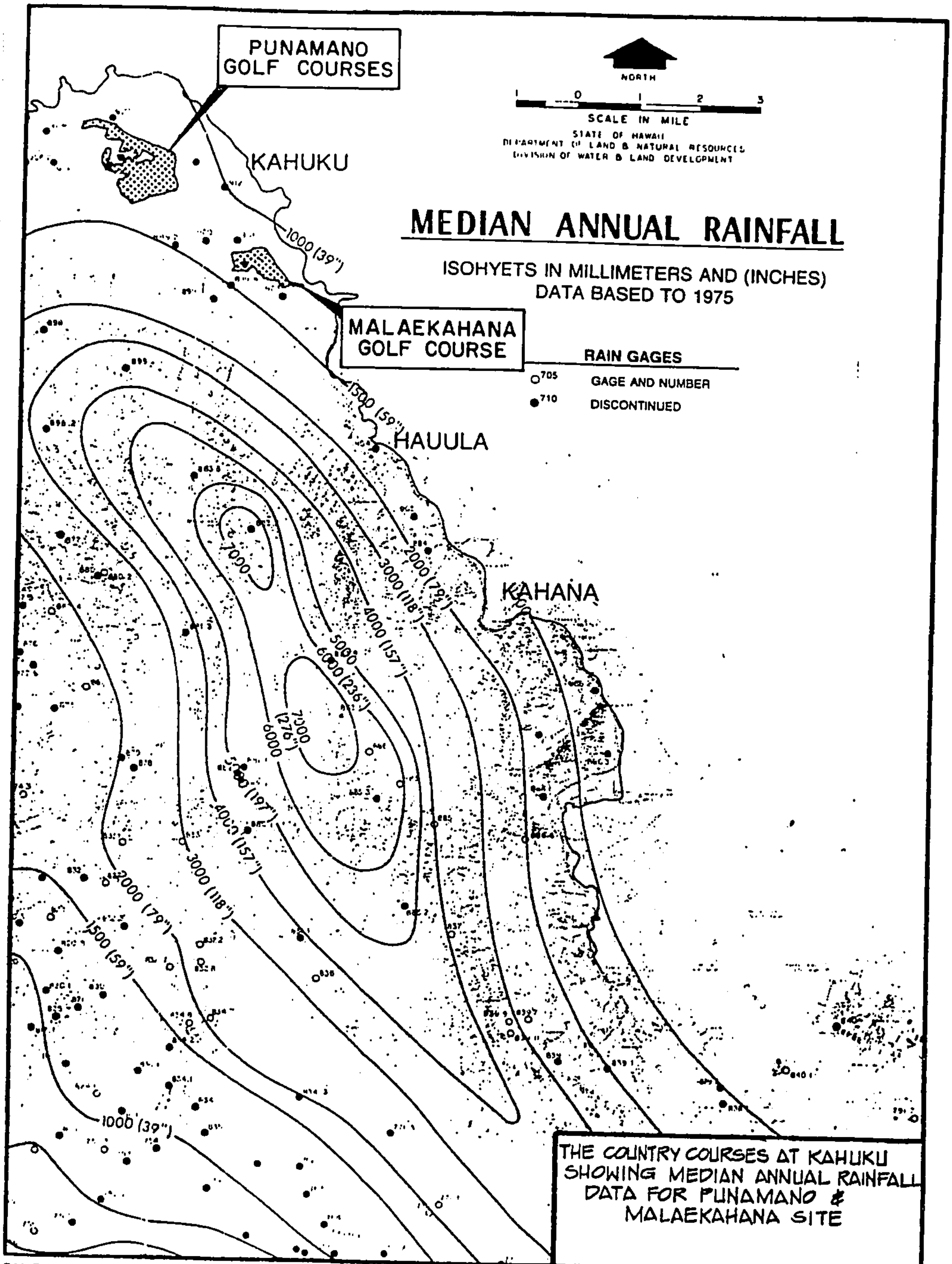

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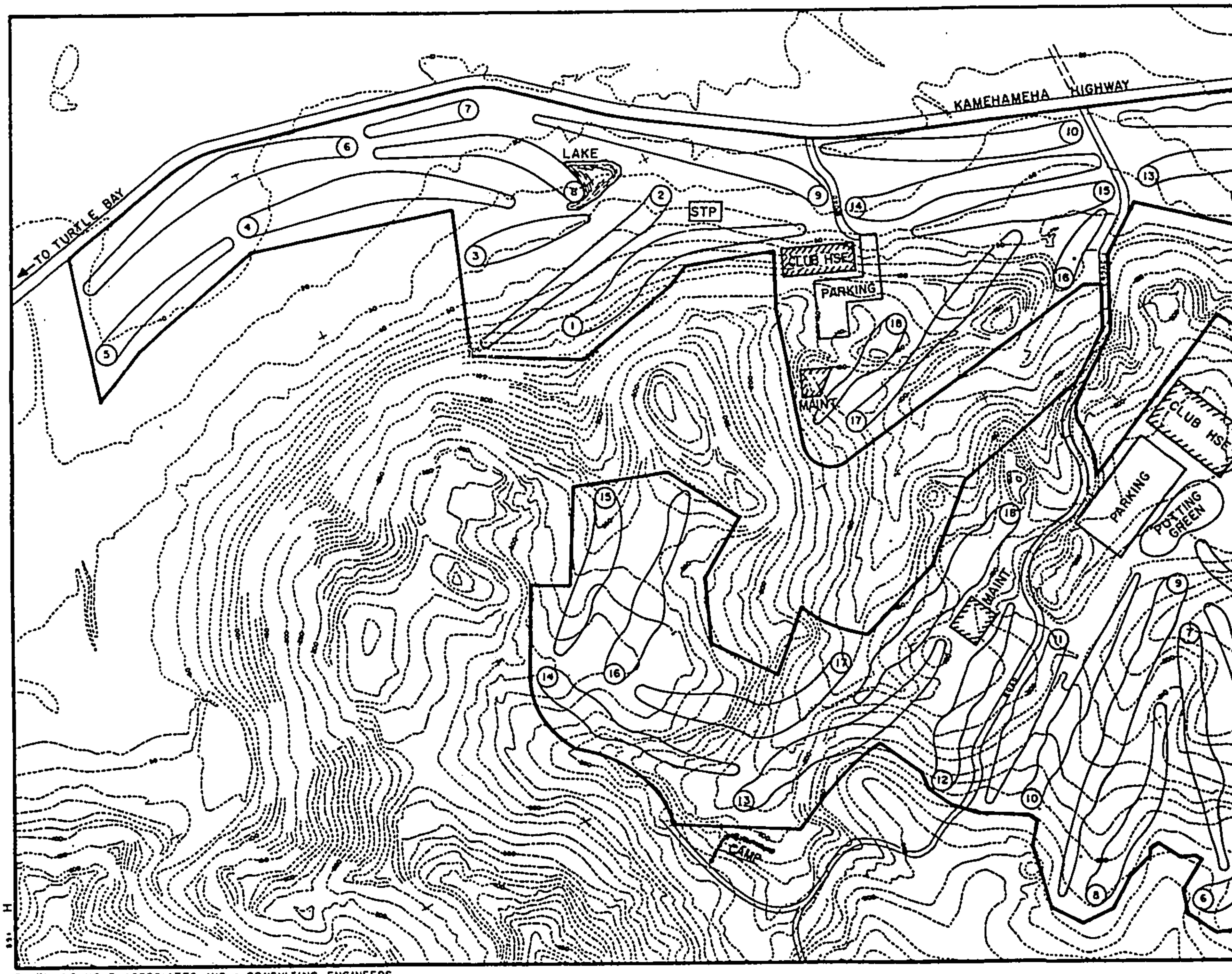
FIG. 3



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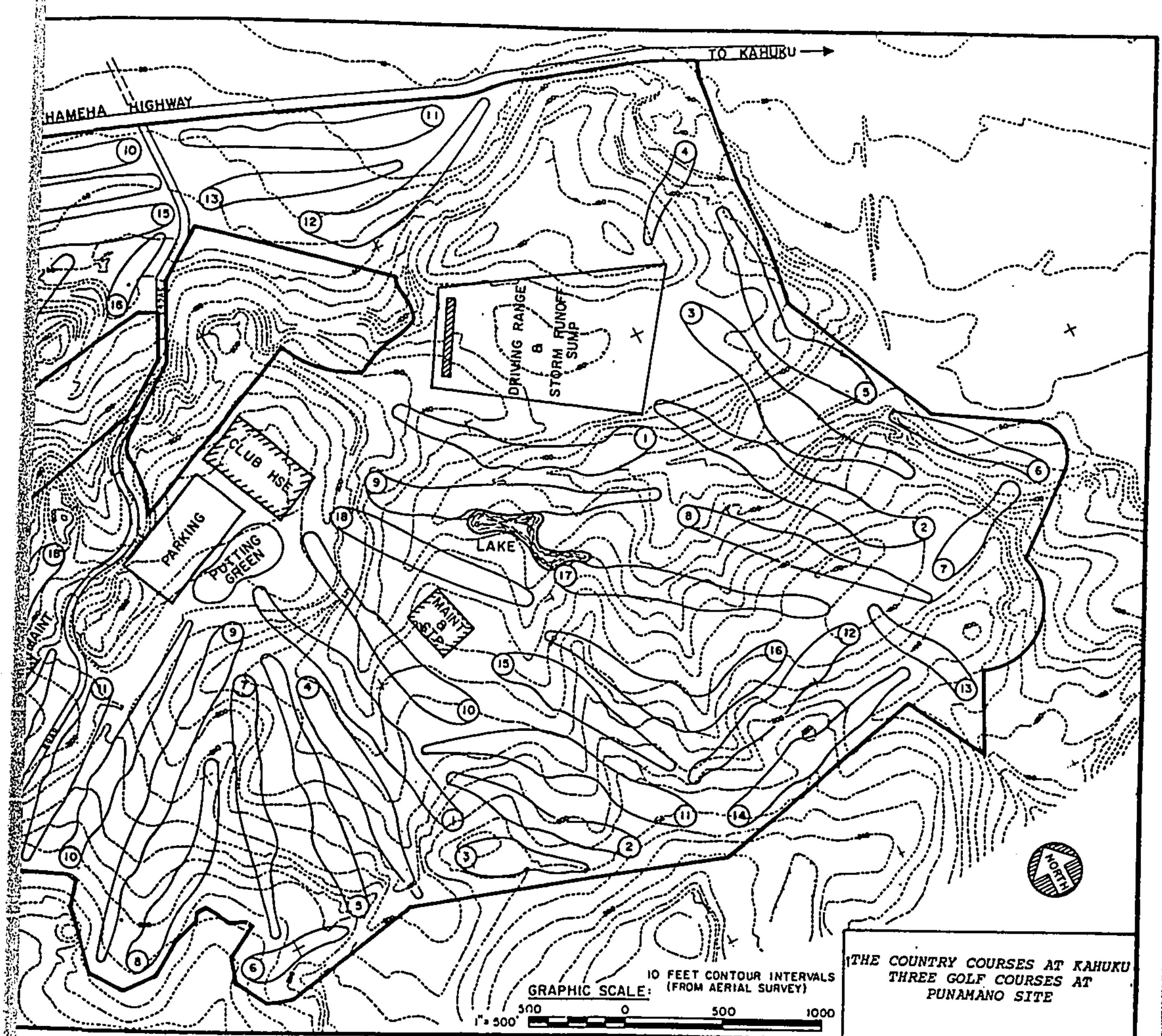

THE COUNTRY COURSES AT KAHUKU
THREE GOLF COURSES AT
PUNAMANO SITE

FIG 4

The existing large swale which lies within the proposed driving range (Figure 4) will remain as a major storm retention pond. Additional other ponds or depressions will be constructed within the course development to act as retention ponds during storm periods when runoff might be heavy.

The clubhouse for Course No. 1 will be some 8,000 to 10,000 square feet and will contain a pro shop and starter station. A small lounge/snack bar with kitchen and men's and women's restrooms will be provided.

A parking area for some 75 to 100 cars will be constructed adjacent to the clubhouse. This course could serve as a beginners course for hotel and condominium guests who might be uncomfortable playing the major Kuilima Courses. It is expected that these players would come from the hotel, play the course and return to the hotel area to rest and relax.

The clubhouse for Courses 2 and 3 will be 16,000 to 18,000 sq. ft. in size. It will contain a pro-shop, two starter stations, a lounge/bar, kitchen and men's and women's locker rooms of limited size. Players on these courses might be hotel guests unable to get convenient starting times on the hotel courses, local residents of Oahu desiring a different challenging course or local and foreign business partners relaxing from their business sessions being conducted at the hotel meeting rooms. With courses 2 and 3 both being open play courses available at one clubhouse site, it will be possible for large local tournaments to be held on a simultaneous basis ("shotgun"); something that is not available at any other course on the island.

A large parking area suitable to handle some 225 to 250 cars will be provided. The large driving range would be sized to handle some 50 tee positions and the putting green would have some 40 or 50 cups. The concept is for a "convention center" for golfers yet have a course sufficiently flexible to accomodate a single foresome.

Construction Work and Grading

In the construction of the facilities discussed in the previous paragraph, it will be necessary to bring about certain short-term negative impacts associated with construction. Within the 605 acre parcel that constitutes the project site, some 350 acres will be reshaped to some extent. This will require grading of the golf course sites themselves, reshaping tees and greens, developing sand traps and swaling areas to guide surface runoff to retention areas or ponds.

The total cubic yardage of excavation is not expected to be extensive. The volume and location of deposition of excavated soil will be indicated on the grading plan when the detailed grading requirements are known. It is expected the all excavated soil will be spread and leveled to shape the several fairways, tees and greens of the course. Shaping of drainage swales, retention basins, sand traps and the like will be a combination of excavated areas and embankments.

The grading permit review will require both the volume of grading and site location for deposition. When the permit is sought, an erosion control plan will be provided.

The location of swales, drainage ditches, irrigation water rention ponds and sedimentation basins will fall under the control of the golf course designer who lays out the course in its final form. Our general layout, and this EIS points out that swales, ditches, ponds, traps, retention basins will be required. The final design, after general concept approval has been received, will match these requirements with the design details of the course by the golf course professional selected. Control of these features will be by Public Works review at the time the grading permit requests and erosion control maps are presented.

As the golf courses develop, the access roads will be constructed, the parking lots graded and leveled and the clubhouses will be erected. Associated with these activities will be the necessary trenching for waterline, sewerline, electrical and telephone ducts and all utility work associated with such developments. At least two new wells will be drilled or refurbished for irrigation sources and one well for domestic water will be drilled or refurbished.

Trenching, foundation excavation, parking lot grading and stabilization as well as access road construction and protective fence erection along Kamehameha Highway will be accomplished in the normal manner as required by Public Works Construction.

Clearing, grubbing and grading of the golf courses proper will be accomplished in phases so that a limited acreage will be barren of ground cover at any given period of time. Every step possible to suppress dust will be undertaken by the golf course developer.

Prior to any work being undertaken at the site, an erosion control plan shall be completed and adhered to. Basically the following construction methods will be followed throughout the project:

1. All clearing and grubbing work shall be done in accordance with Chapter 23, Grading, Soil Erosion and Sediment Control, of the Revised Ordinances of Honolulu, 1978, as amended (Ordinance No. 81-13).
2. The contractor shall remove all silt and debris resulting from his work and it shall not be deposited in drainage facilities, roadways, and other areas.
3. The contractor shall keep the project area and surrounding area free from dust nuisance. The work shall be done in conformance with the air pollution control standards and regulations of the State Department of Health.
4. All slopes and exposed areas shall be sodded or planted as soon as final grades have been established. Planting shall not be delayed until all grubbing has been completed. Redistribution of surplus excavation shall be continuous, and any area within which work has been interrupted or delayed, shall be planted.

5. Fills on slopes steeper than 5 horizontal to 1 vertical shall be keyed.
6. Temporary erosion controls shall not be removed before permanent erosion controls are in-place and established.
7. All grubbing operations shall be performed in conformance with the applicable provisions of Chapter 54, Water Quality Standards, and Chapter 55, Water Pollution Control, of Title II, Administrative Rules of the State Department of Health.
8. Maximum cut and fill slopes shall be horizontal 2 to 1 vertical.
9. The limits of the area to be grubbed shall be flagged before the commencement of the grubbing work.
10. Grubbed material shall not be placed next to drainage ways, streams, waterways, etc.
11. The contractor shall maintain a water truck and shall dampen the grubbed graded area with water.
12. The contractor shall conduct his operations so that the exposed area shall be kept damp with water during his clearing and grubbing operation. At the end of each day, the site shall be sufficiently dampened so that the site remains moist during the night.

As the project site lies within agricultural lands mauka of Kamehameha Highway the site is an easy workable site as far as nuisance value is concerned. The land lies downwind from the main highway and traffic so that dust, should it be generated, will not bother the motorists during the time of tradewind conditions. Because the site lies on the leeward slope under "kona wind" conditions, the winds will be light and variable during that wind condition. Disturbance by dusty conditions would therefore be at a minimum.

No homes exist near the site. The nearest habitation is found at the aquaculture ponds makai of Kamehameha Highway. These buildings are for commercial operations. The closest residential areas are at Kuilima which is some 7000 feet cross wind from the major development area. The northwesterly finger of the proposed site is approximately 2000 feet from the Kuilima condominiums.

As the major portion of the site lies downwind from these residences and commercial buildings, any noise generated by the equipment will be suppressed by the wind direction during normal tradewind conditions. Equipment expected to be used by a contractor for the development of the site would be normal heavy equipment. Bulldozers, grades, turn-a-pulls, backhoes, drilling equipment, trenchers and trucks will accomplish the work. There appears to be no need for blasting or jack-hammer work on the site.

Mitigating Measures

Dust suppression by watering is the major mitigating step to be taken during the development of the course. Planting the graded areas as soon as possible after the grading and shaping is completed is probably a close second.

All equipment used on site shall be provided with mufflers and shall be operated during normal working hours between 7 a.m. and 5 p.m. There does not appear to be a need for night work. Building construction will be during normal working hours. Traffic, that might be generated at the access roads and Kamehameha Highway, shall be limited to normal automobile traffic between 6:00 a.m. and 8:00 a.m. and 4:00 p.m. and 6:00 p.m. Hauling of materials or use of heavy equipment along Kamehameha Highway shall be restricted to the hours after 8:00 a.m. and prior to 4:00 p.m. Because the site proper will only have some 60 percent of the land developed, or re-shaped, it is believed that hauling of material to and from the site will be minimal and that traffic nuisance will also be at a minimal level.

Sub-Appendix I

Punamano

Tsunami/Flood Hazards

For

The Country Courses at Kahuku

Punamano Site

prepared for

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prepared by

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3049 Ualena Street

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April 1990

Introduction

The Estate of James Campbell is proposing to develop three 18 hole golf courses in the vicinity of Kahuku on the North Shore of Oahu. The area lies immediately southwest of Kamehameha Highway between Kahuku Village and Kuilima (Figure 1). The site contains approximately 605 acres and is situated mauka of Kamehameha Highway and some 2 miles northwest of the old Kahuku Mill (Figure 2).

The purpose of this report is to provide information on the site and to indicate the preliminary planning concerning the Tsunami and Flood Hazards that might effect the site. This report addresses those hazards.

Site

The proposed site for the three 18 hole golf courses at Punamano is located within the Koolauloa District of Oahu and lies in the Tax Map Key designations of TMK 5-6-05:Portion 1, Portions 2, 5, 6 and Portion 7, and a small bit of TMK 5-7-01:Portion 21. This project site at Punamano has been owned by The Estate of James Campbell since before the turn of the twentieth century.

The site slopes up from the low grass lands lying along the mauka side of Kamehameha Highway and opposite fom the Punamano Marsh which is a Natural Wildlife Refuge. The 605 acre, irregularly shaped parcel consists mainly of vacant grass and shrub lands, rolling hillsides, intermittent stream gulches and several steep cliffs. From the north boundary of the site to its southern boundary the area is a gently rolling hillside with an overall slope of some 5 to 7 percent.

Basin Description

The Kahuku basin, on the north shore coastal plain of Oahu, drains a portion of the northern slopes of the Koolau Mountains. Elevation in the drainage basin range from sea level in the coastal plain to about 1800 feet in the upper limits. There are three distinct intermittent gulches -- Ohia Ai, Kalaeokahipa, and Hoolapa, draining an area of about 7.6 square miles. The latter two gulches, Kalaeokahipa and Hoolapa flow through the proposed project site.

The storm runoff from these gulches flows in a northerly direction, ponding in a low-lying swampy area, with eventual discharge into the ocean. The 3.2 square miles of low-lying flood plain between Kamehameha Highway and the coastline is used primarily for aquaculture today as well as serving as a bird refuge. Approximately 20 percent of the area can be classified as wet lands. The old Kahuku Airfield, now abandoned, is located on the northern sector of the area.

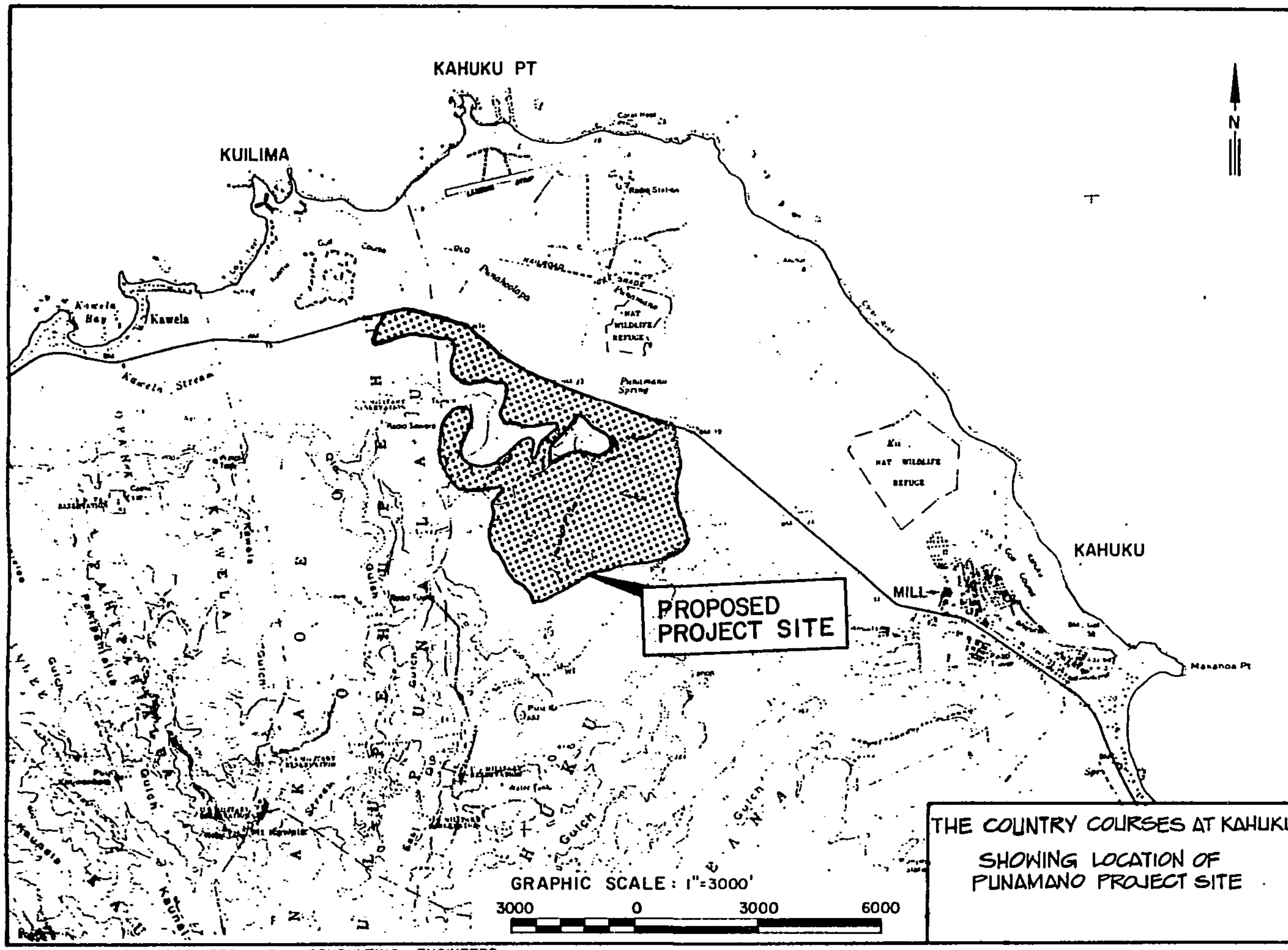

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FIG. 1

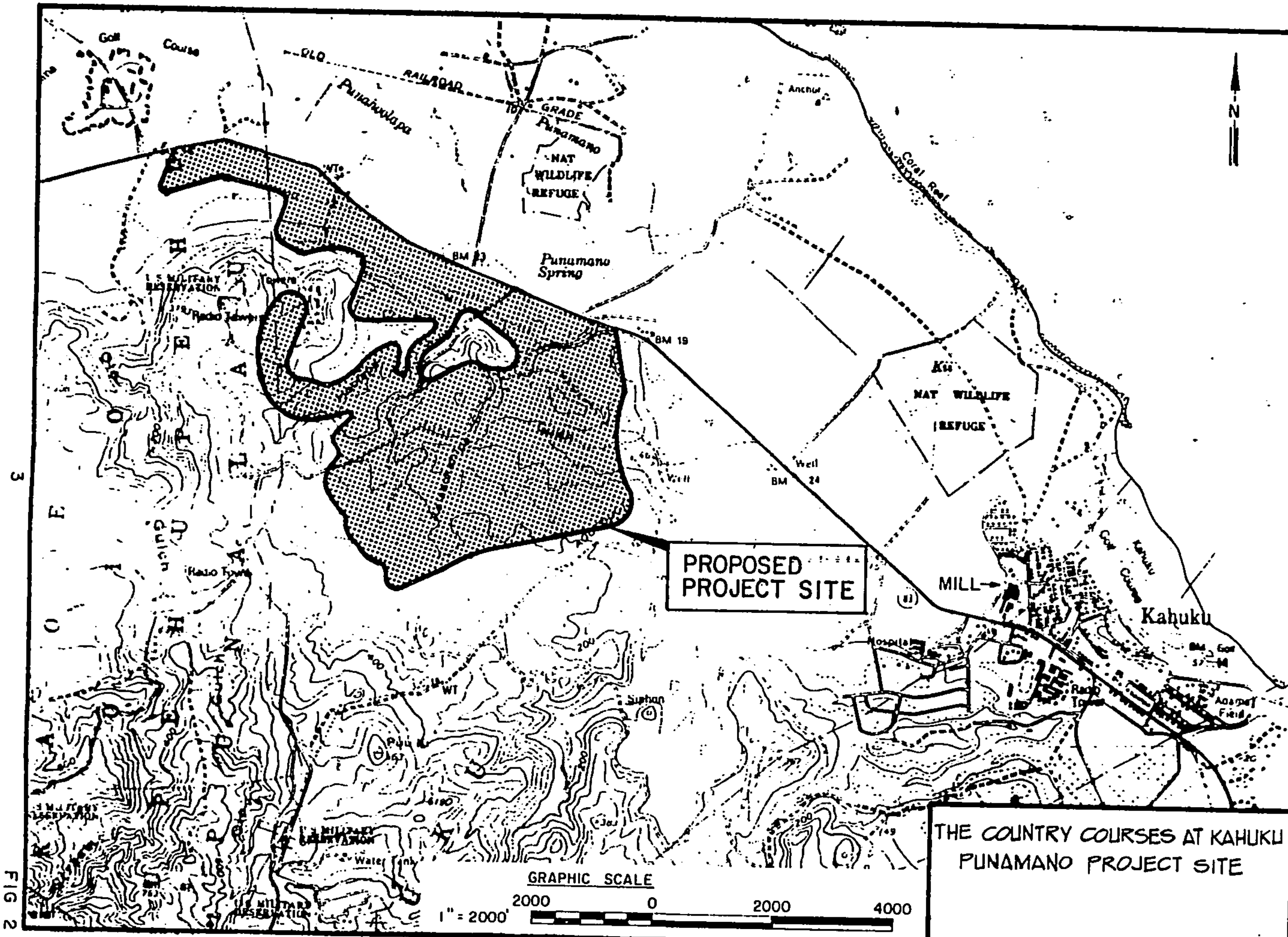

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FIG 2

Flood History

The Kahuku gulches, which are intermittent, have no streamflow records. An analysis of the available records from three nearby stream gaging stations indicates that floods for the Kahuku area are characterized by flows with sharp peaks of relatively short duration. The largest flood recorded during the 11-year period from 1958-69 for the Kahuku area occurred on April 15, 1963. During that occurrence, waterborne debris blocked the highway bridge openings and caused the flood waters to flow through the then canefields and into the depressed areas. No estimate of damage from the 1963 flooding is available.

Flood Problem

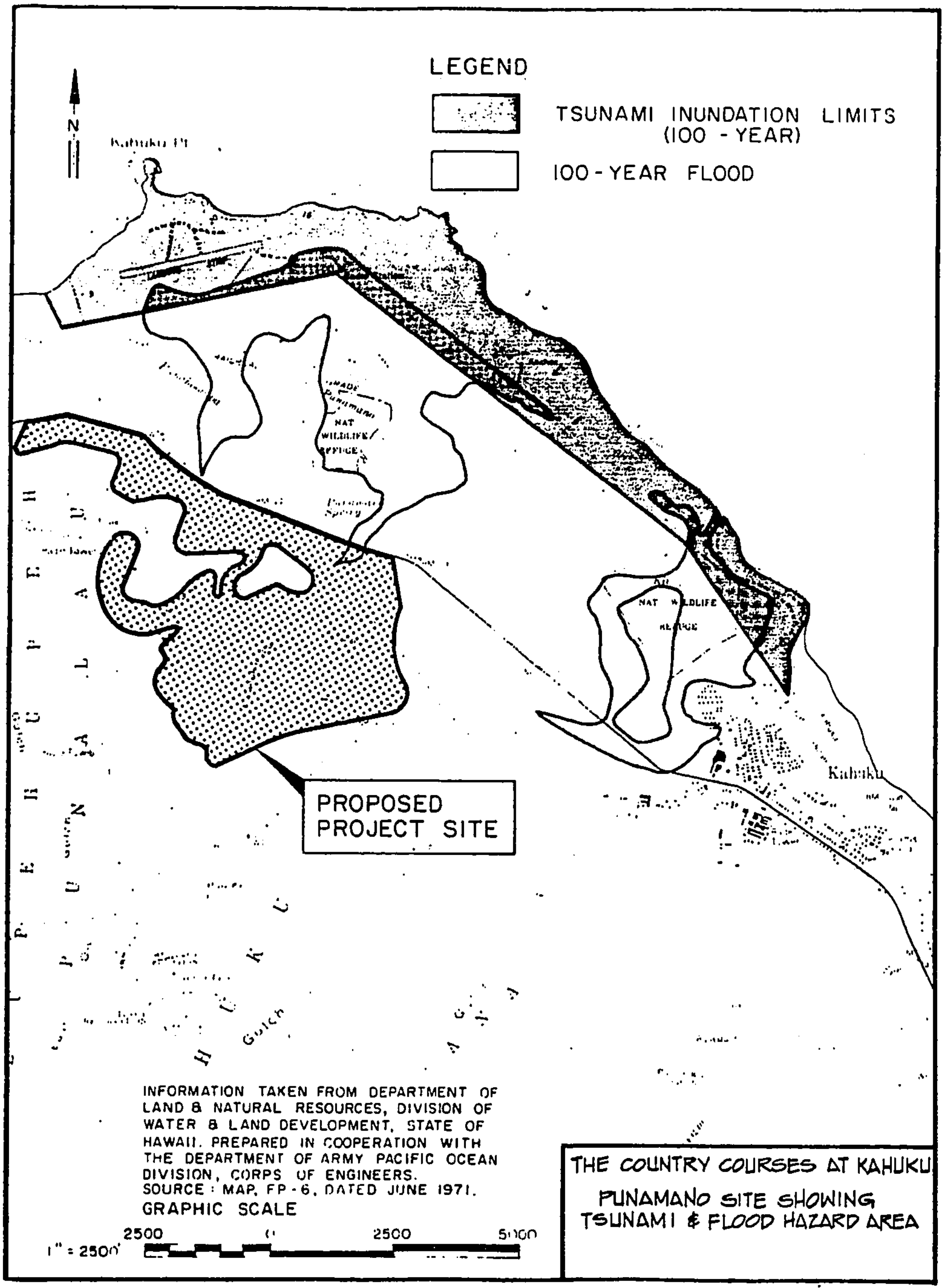
The area gulches are confined to narrow valleys until they reach the flood plain at about elevation 20. The basin topography and existing drainageway capacities are such that flooding in the Kahuku area is restricted almost entirely to the low-lying area below Kamehameha Highway. During floods with moderate to high peak discharges, flood waters overflow the drainageway banks. An investigation of the existing topography of the Kii, Punahoolapa and Punamano Swamps indicated adequate storage to contain floods of greater than a 100-year magnitude. However, in analyzing the potential flood hazards and considering the slow rate of discharge into the ocean, the low-lying areas can be inundated when runoff occurs at frequent intervals. Minor to moderate damages can be expected from ponding of these flood waters. The area flood problem is compounded by the sand dune formations at the beach which prevent floodwater from discharging overload into the ocean.

Flood Outlines

Flood storage volumes for the 100 year storm were computed. The 100 year volume was computed as 3400 acre-feet. As previously mentioned, flood waters overflow the drainageway banks, ponding in areas of lower elevations. The extreme limits of ponding area for the 100 year storm is represented by the highest waterline that would be reached by extraordinary flood runoff. Figure 3 shows that a small tip of the 100 year flood enters the project site at the point where Kalaeokahipa stream crosses Kamehameha Highway. This map is somewhat different from the Federal Insurance Rate Map (FIRM) shown in Figure 4. The FIRM evidently refers to the actual flow way of the flooding stream, while the State maps of Figure 3 refers to the impoundment limits of a 100 year storm.

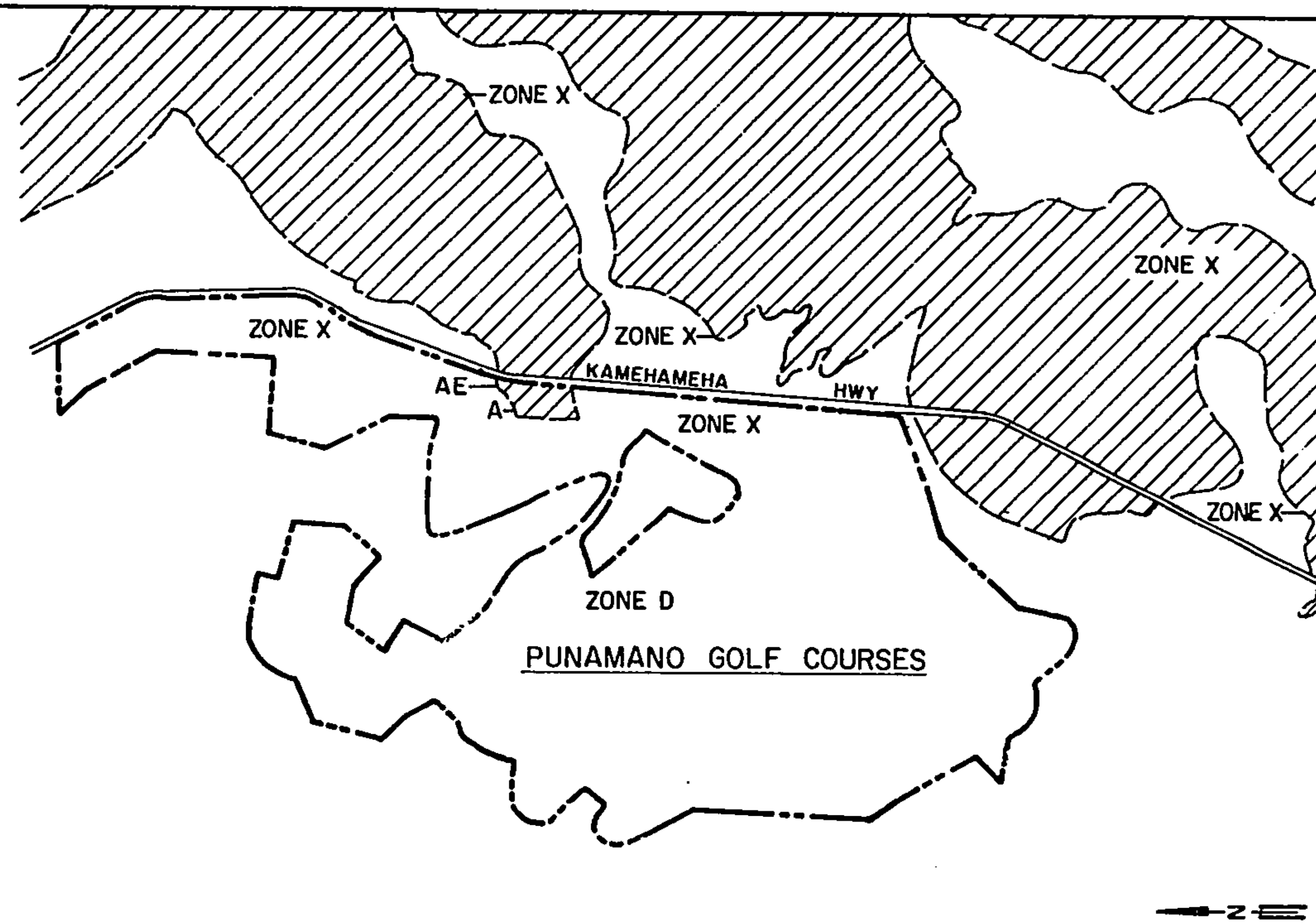
Mitigating Measures

Reference is made to Figure 6 and Figure 7 of the Stormwater Runoff Report (Sub-Appendix E) which shows the mitigating measures proposed to reduce the stormwater runoff from Kalaeokahipa Gulch. This diversion will reduce the floodway considerably under storm flow conditions. Also, the Drainage Masterplan presently being studied and



LEGEND
TSUNAMI INUNDATION LIMITS (100 - YEAR)
100-YEAR FLOOD
N
PROPOSED PROJECT SITE
NAT WILDLIFE REFUGE
Kahuku
INFORMATION TAKEN FROM DEPARTMENT OF LAND & NATURAL RESOURCES, DIVISION OF WATER & LAND DEVELOPMENT, STATE OF HAWAII. PREPARED IN COOPERATION WITH THE DEPARTMENT OF ARMY PACIFIC OCEAN DIVISION, CORPS OF ENGINEERS.
SOURCE: MAP, FP-6, DATED JUNE 1971.
GRAPHIC SCALE
2500
0
2500
5000
1" = 2500'
THE COUNTRY COURSES AT KAHUKU
PUNAMANO SITE SHOWING
TSUNAMI & FLOOD HAZARD AREA

FIG. 3



Source of Information–Federal Insurance Rate Map (FIRM)

THE COUNTRY COURSES AT KAHUKU
PUNAMANO SITE FLOOD
HAZARD DATA

NO SCALE

FIG. 4

drawn for the Campbell Estate will revise the limits of the flood hazard situations. When the project is completed the floodways for a given storm will be reduced in size and the 100 year flood (impoundment) limits will be makai of Kamehameha Highway and outside the boundaries of the golf course site.

Flooding By Tsunami

Tsunamis, commonly known as tidal waves, have also caused extensive flooding and damage along the Hawaiian coastal regions. Tsunamis are also referred to as "seismic sea waves" because of their association with earthquakes. The tsunami events of April 1, 1946 and March 7, 1957 had the severest effects in the Kahuku coastal areas. The waves of these two occurrences, generated by strong earthquakes near the Aleutian Islands, had runups to about the 9 foot elevation, flooding inland a distance of about 500 feet. The limits of this wave action is also shown on Figure 3. No mitigating measures are necessary.

Sub-Appendix J

Punamano

Report

on

Solid Waste Disposal

and

Landfill Requirements

For

The Country Courses at Kahuku

Punamano Site

prepared for

The Estate of James Campbell

prepared by

Smith, Young & Associates, Inc.

3049 Ualena Street

Honolulu, Hawaii

April 1990

Introduction

The Estate of James Campbell is proposing to develop three 18 hole golf courses in the vicinity of Kahuku on the North Shore of Oahu. The area lies immediately southwest of Kamehameha Highway between Kahuku Village and Kuilima (Figure 1). The site contains approximately 605 acres and is situated mauka of Kamehameha Highway and some 2 miles northwest of the old Kahuku Mill (Figure 2).

The purpose of this report is to provide information on solid waste disposal and the resulting requirements on a sanitary landfill during construction and operation of the proposed golf courses. This report addresses the following:

a. Existing site and site conditions;
b. Proposed development;
c. Possible generation of solid wastes at the site.

Site and Site Conditions

The proposed site for the three 18-hole golf courses at Punamano is located within the Koolauloa District of Oahu and lies in the Tax Map Key designations of TMK 5-6-05:Portion 1, Portion 2, 5, 6 and Portion 7, and a small bit of TMK 5-7-01:Portion 21. This project site at Punamano has been owned by The Estate of James Campbell since before the turn of the twentieth century.

The site slopes up from the low grass lands lying along the mauka side of Kamehameha Highway and opposite from the Punamano Marsh which is a Natural Wildlife Refuge. The 605 acre, irregularly-shaped parcel consists mainly of vacant grass and shrub lands, rolling hillsides, intermittent stream gulches and several steep cliffs of upthrust corraline limestone. Portions of the site were, at one time, planted in sugar cane and some of the abandoned irrigation ditchwork still remains. From the north boundary of the site to its southern boundary the area is a gently rolling hillside with an overall slope of some 5 to 7 percent. An area of rough terrain exists some 100 feet mauka of Kamehameha Highway and extends in a westerly direction through the center of the property. This irregular formation is covered in the soils report for the site. It is this irregular formation that gives the project site the irregular boundary seen in Figure 2. Four abandoned windmill structures are located within the site near Kamehameha Highway. These will be removed. A road bisects the proposed golf course site. This road provides access to the U. S. Army Kahuku Training Area which is located immediately mauka of the site.

Land uses of property adjoining the Punamano site are military to the southwest, agricultural to the south and east, and aquaculture on the northeast. Across Kamehameha Highway, north of the site is the Tanaka Store, a well-known local landmark, which is a small grocery store and gas station. Farther west along Kamehameha Highway lies the Kuilima Resort and condominium complex. Other lands not specifically noted, which lie adjacent to the site, remain as vacant agricultural lands today.

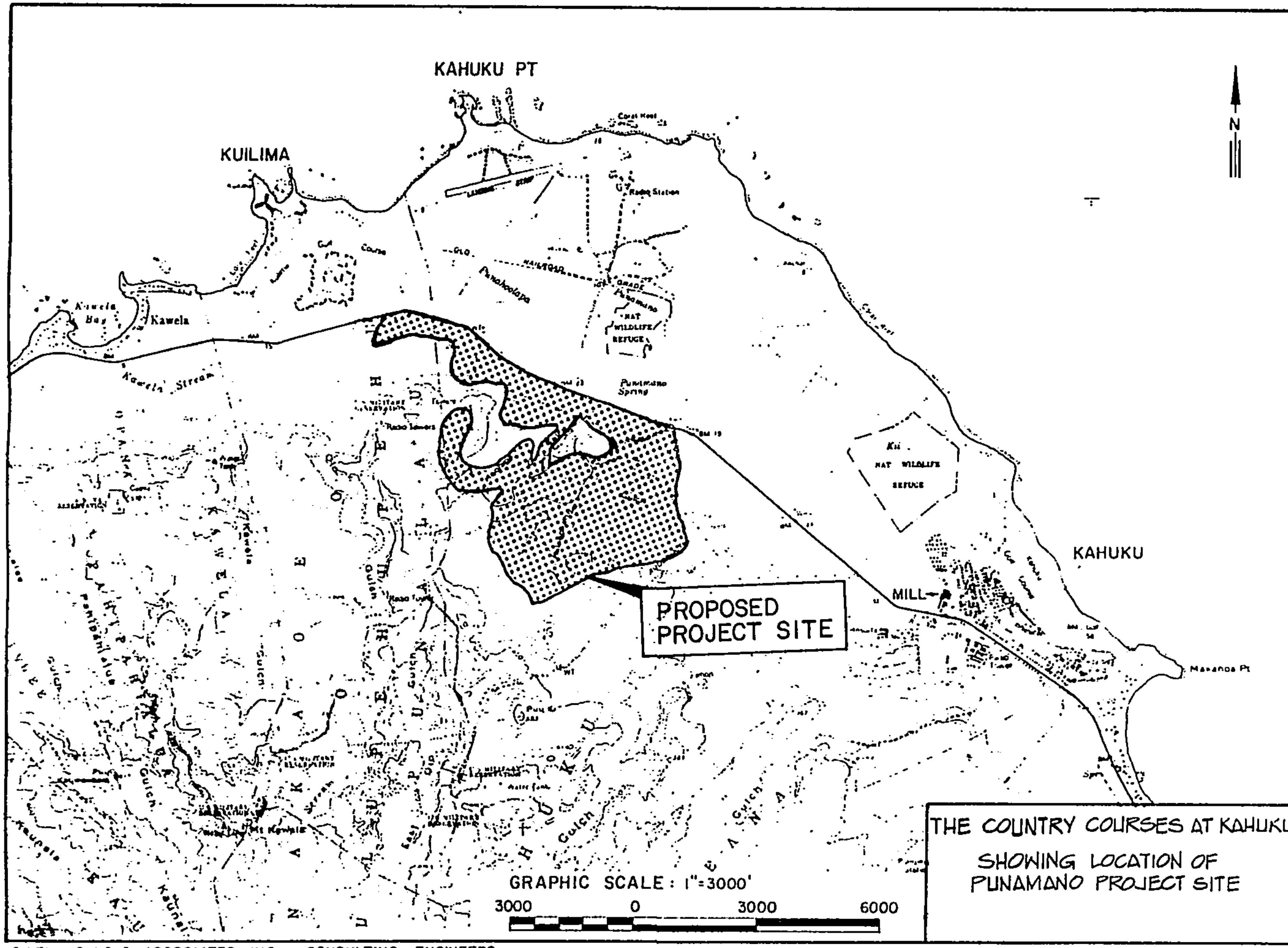


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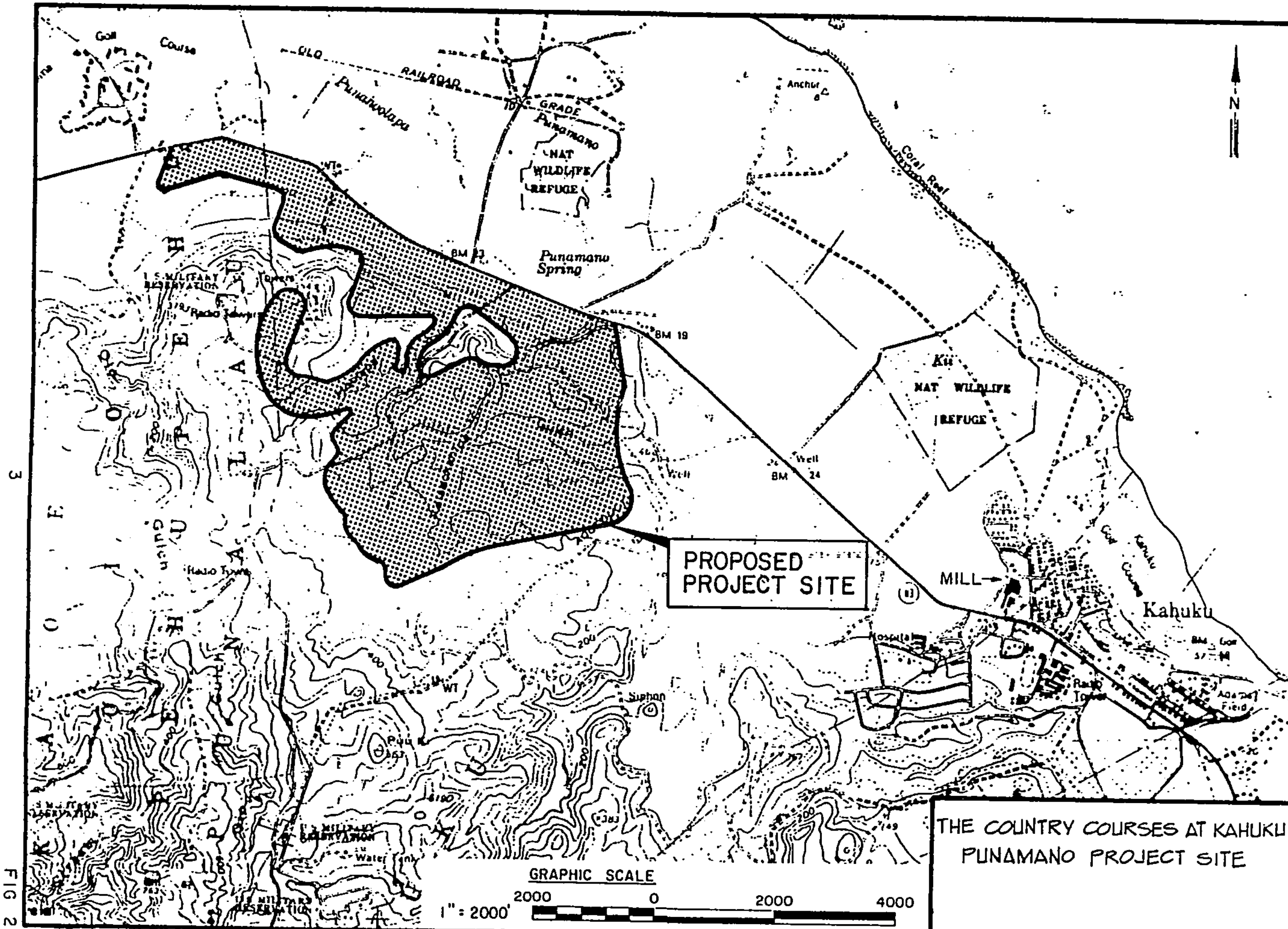
FIG. 1



THE COUNTRY COURSES AT KAHUKU
PUNAMANO PROJECT SITE

SMITH, YOUNG & ASSOCIATES, INC • CONSULTING ENGINEERS

FIG 2

The site is presently designated as an agricultural district by the State Land Use Commission. The Koolauloa Development Plan Land Use Map designates the site Agriculture, and the City and County of Honolulu Zoning District carries the site as Agriculture (AG-1/AG-2).

Proposed Development

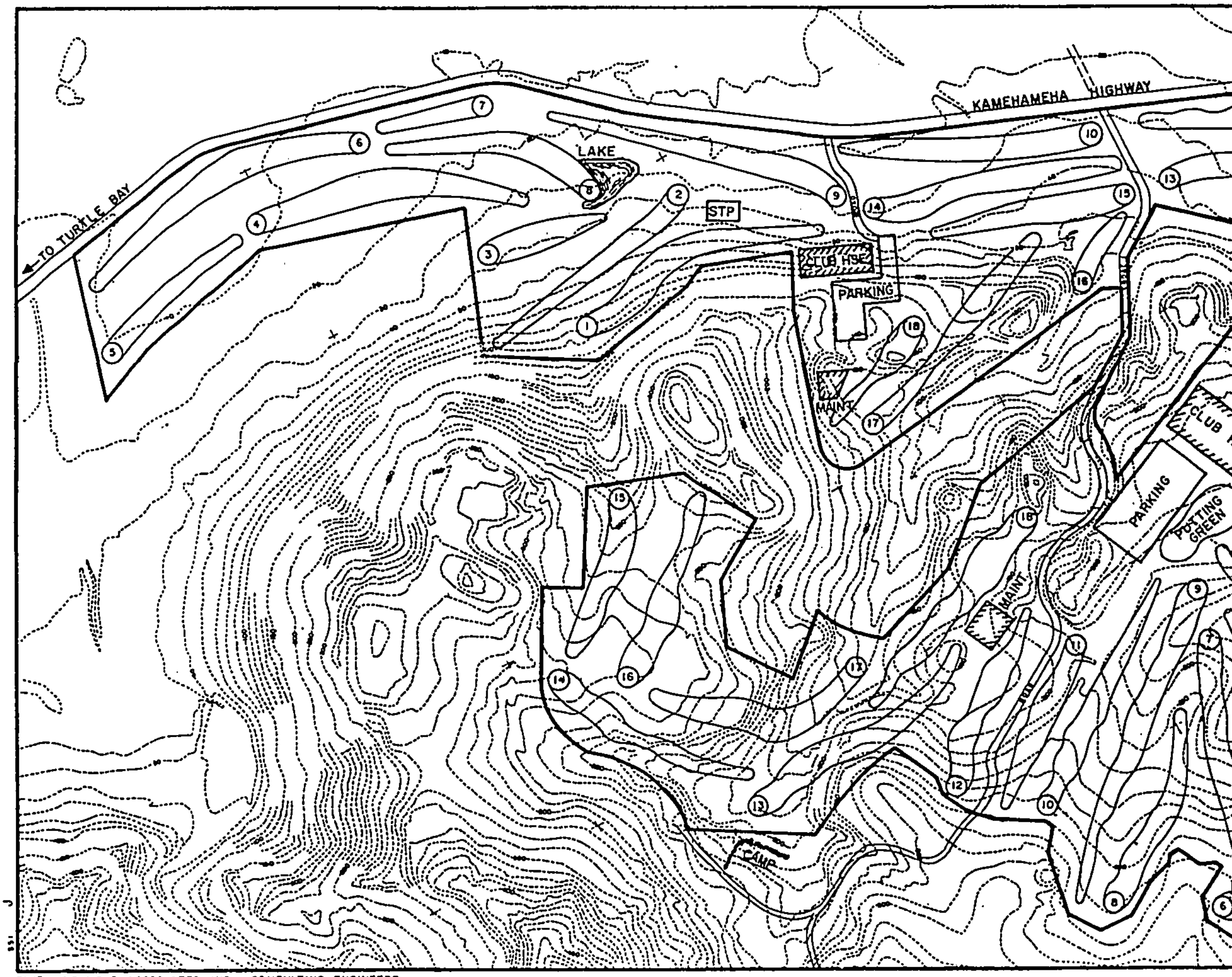
Three 18 hole golf courses are planned for the Punamano Site covering approximately 605 acres. The proposed courses are shown in Figure 3. Each course will be designed for a different level of play capability. Course No. 1 which parallels Kamehameha Highway has its clubhouse set against the hill at elevation 60 feet. This 18 hole course will be nearly level and will be the easiest course to play. Clubhouse 2, reached by way of the U. S. Army access road to the training area, will be located at about 210 foot elevation with a southern exposure view overlooking Course No. 2 and No. 3. The 18 hole course lying in the south east quadrant of the site will be the median course having several fairways with elevation changes and some hazards of note. Course No. 3 will be the longest course and will have steeper fairways, greater elevation changes and steeper roughs along the fairways. The concept is to have a course available for beginners on Course 1 and Courses No. 2 and No. 3 available for both exercise golfers as well as professionals. All available at this one site. Approximately 325 acres of the site will be developed into tees, greens, fairways, driving range and putting greens. The remaining 280 acres will serve as roughs, or be improved into clubhouses, parking areas or maintenance facilities.

The existing large swale which lies within the proposed driving range (Figure 3) will remain as a major storm retention pond. Additional other ponds or depressions will be constructed within the course development to act as retention ponds during storm periods when runoff is heavy.

The clubhouse for Course No. 1 will be some 8,000 to 10,000 square feet and will contain a pro shop and starter station. A small lounge/snack bar with kitchen and men's and women's restrooms will be provided.

A parking area for some 75 to 100 cars will be constructed adjacent to the clubhouse. This course could serve as a beginners course for hotel and condominium guests who might be uncomfortable playing the major Kuilima Courses. It is expected that these players would come from the hotel, play the course and return to the hotel area to rest and relax.

The clubhouse for Courses 2 and 3 will be 16,000 to 18,000 sq. ft. in size. It will contain a pro-shop, two starter stations, a lounge/bar, kitchen and men's and women's locker rooms of limited size. Players on these courses might be hotel guests unable to get convenient starting times on the hotel courses, local residents of Oahu desiring a different challenging course or local and foreign business



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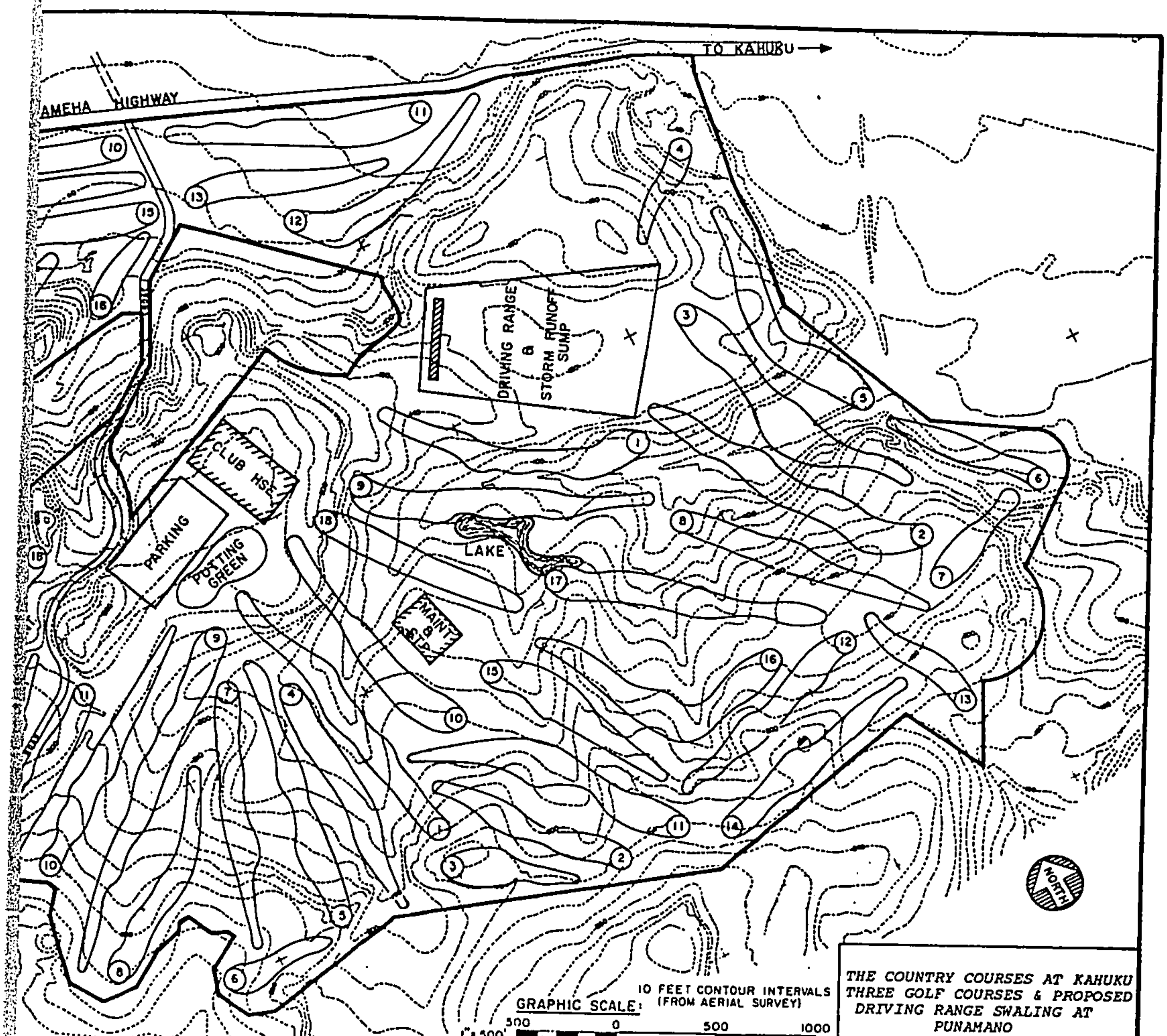

THE COUNTRY COURSES AT KAHUKU THREE GOLF COURSES & PROPOSED DRIVING RANGE SWALING AT PUNAMANO

FIG. 3

partners relaxing from their business sessions being conducted at the hotel meeting rooms. With open play courses 2 and 3 both being available at one clubhouse site, it will be possible for large local tournaments to be held on a simultaneous basis; something that is not available at any other course on the island.

A large parking area suitable to handle some 225 to 250 cars will be provided. The large driving range would be sized to handle some 50 tee positions and the putting green would have some 40 or 50 cups. The concept is for a "convention center" for golfers yet being a course sufficiently flexible to accomodate a single foresome.

Solid Waste Generation

Solid waste generation during construction will be trucked off site for disposal in a City and County sanitary landfill. This material would consist of the old abandoned concrete ditches, grubbed vegetation from the site, old fence materials and the excess construction materials developed in the process of building the clubhouses, parking lots, and maintenance facilities. This material would be collected by the contractor, or a private collection and disposal company, to be hauled to the nearest sanitary landfill operated by the City and County of Honolulu. It is impossible to estimate the volume of construction materials and other solid waste that will be generated during the construction phase.

After completion of the construction, when the three golf courses at Punamano are in full operation, it is estimated that a total of some 2000 pounds per day of solid waste will be generated on the golf course sites.

Clubhouse No. 1, which is small and provided with only a small snack bar and kitchen, will generate very little solid waste. Some 200 pounds of bottles (or cans) and paper plates will be the norm from the small clubhouse. Possibly another 300 pounds will be generated by the pro-shop and maintenance facility.

Clubhouse No. 2, which is larger, supplied with lounge, bar, kitchen and some locker room space will generate a possible 1000 pounds of solid waste while the two pro shops and maintenance facilities would add another 500 pounds per day. This 2000 pound solid waste product, generated by the two club facilities, will be hauled by a private refuse collector and disposed of in an appropriate active sanitary landfill, or carried to "H-Power" at Campbell Industrial Park.

Sub-Appendix K

Punamano

Preliminary Design of Courses

For

The Country Courses at Kahuku

Punamano Site

prepared for

The Estate of James Campbell

prepared by

Smith, Young & Associates, Inc.

3049 Ualena Street

Honolulu, Hawaii

April 1990

Introduction

The Estate of James Campbell is proposing to develop three 18 hole golf courses in the vicinity of Kahuku on the North Shore of Oahu. The area lies immediately southwest of Kamehameha Highway between Kahuku Village and Kuilima (Figure 1). The site contains approximately 605 acres and is situated mauka of Kamehameha Highway and some 2 miles northwest of the old Kahuku Mill (Figure 2).

The purpose of this report is to present the proposed improvements of the site. Specifically this report addresses the following:

a. Existing site and site conditions;
b. Information on the proposed development including preliminary design of the courses including necessary support facilities;
c. Impacts and mitigative measures to be undertaken at the site.

Site and Site Conditions

The proposed site for the three 18-hole golf courses at Punamano is located within the Koolauloa District of Oahu and lies in the Tax Map Key designations of TMK 5-6-05:Portion 1, Portion 2, 5, 6 and Portion 7, and a small bit of TMK 5-7-01:Portion 21. This project site at Punamano has been owned by The Estate of James Campbell since before the turn of the twentieth century.

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Land uses of property adjoining the Punamano site are military to the southwest, agricultural to the south and east, and aquaculture on the northeast. Across Kamehameha Highway, north of the site is the Tanaka Store, a well-known local landmark, which is a small grocery store and gas station. Farther west along Kamehameha Highway lies the Kuilima Resort and condominium complex. Other lands not specifically noted, which lie adjacent to the site, remain as vacant agricultural lands today.

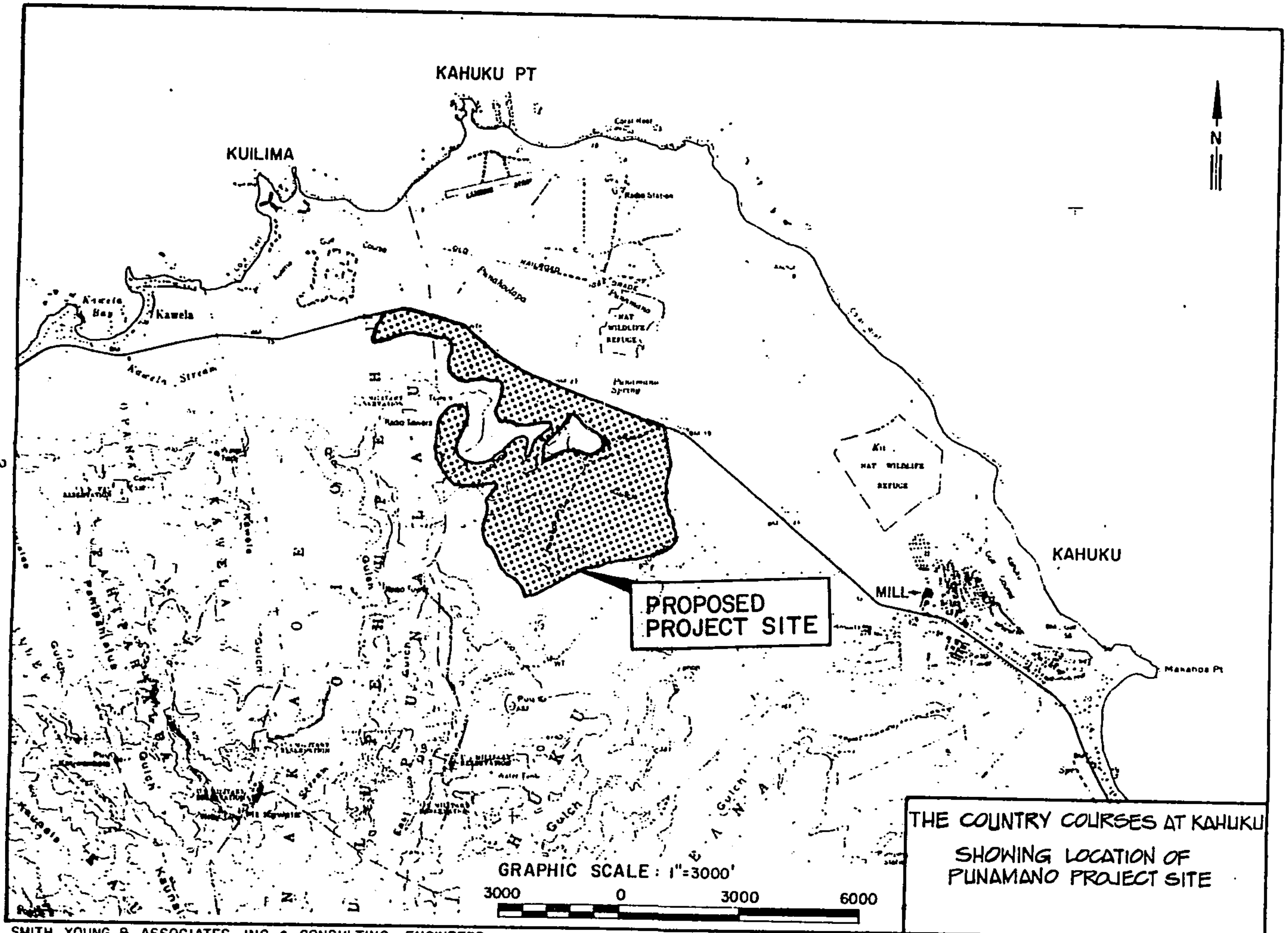

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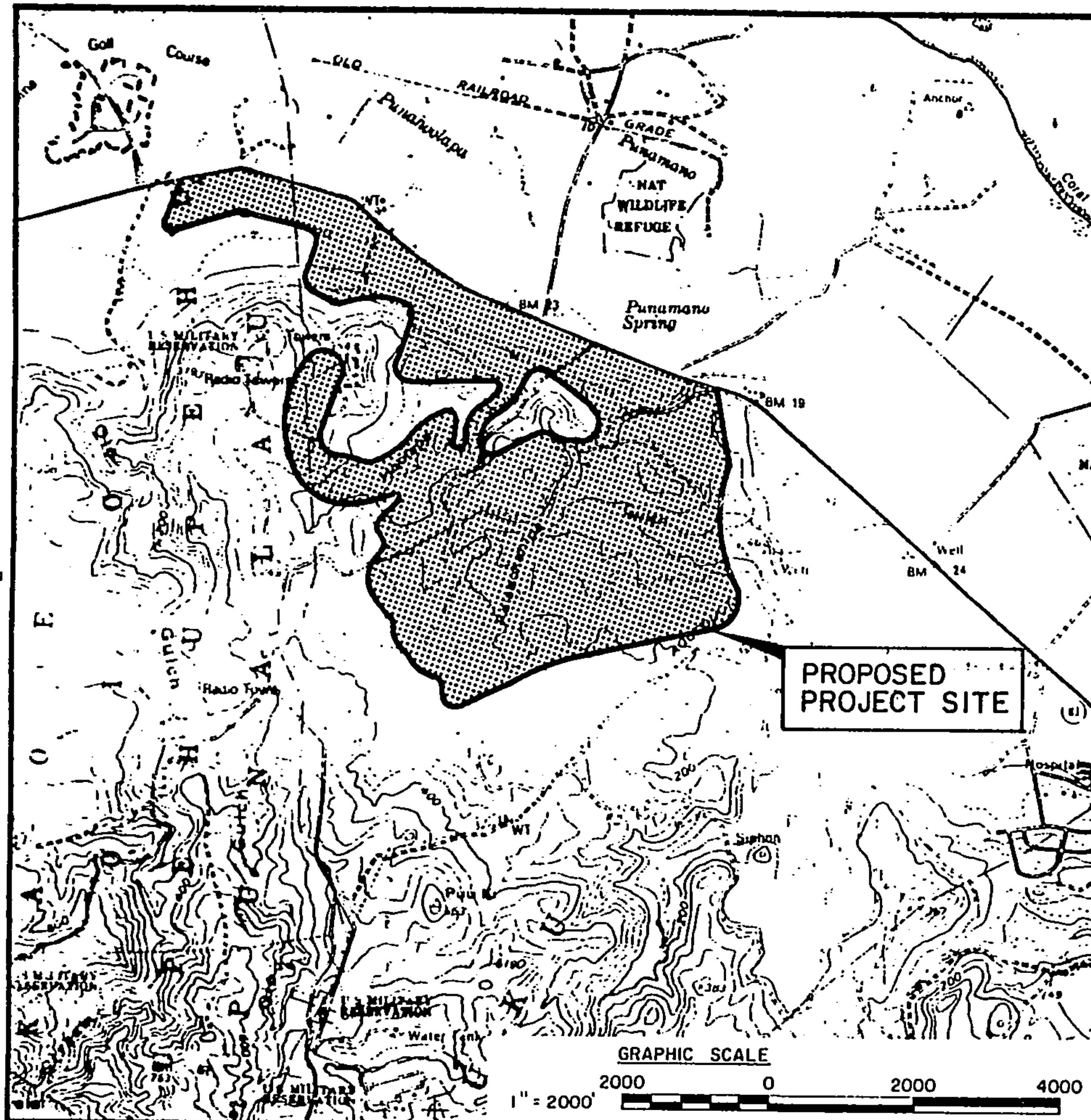
FIG. 1



THE COUNTRY COURSES AT KAHUKU
PUNAMANO PROJECT SITE

SMITH, YOUNG & ASSOCIATES, INC • CONSULTING ENGINEERS

FIG 2

The site is presently designated as an agricultural district by the State Land Use Commission. The Koolauloa Development Plan Land Use Map designates the site Agriculture, and the City and County of Honolulu Zoning District carries the site as Agriculture (AG-1/AG-2).

The site has a temperature readings range from the low 60 degrees F to the mid 80 degrees F, depending on the day and the season of the year. Daily temperatures vary as much as twenty degrees (F) between daylight hours and early morning hours. Cooler temperatures are noticeable in the higher levels of the site. Review of the median annual rainfall, as published by Department of Land and Natural Resources, State of Hawaii, shows that the site is located well within the 1000 millimeter and 1500 millimeter isohyets which indicate that the rainfall median is between 39 and 59 inches per year (Figure 3). The higher rainfall is found in the upper (southern) section of the site. The rainfall distribution is uneven and varies from month to month. Rain will be heavy some months and nearly non-existant at other times. Winter months, in general, are the months with the most rainfall.

Tradewinds are generally stronger at Kahuku than on other parts of the island. Velocities of twelve to fifteen miles per hour are average, with the direction of the prevailing winds coming from the northeasterly and east northeasterly directions. The winds at Kahuku are generally of greater velocity than the same winds in most other parts of Oahu. This is evidenced by the fact that the experimental wind turbines for electrical generation have been sited on adjacent areas immediately west of the proposed golf courses.

Preliminary Design of the Courses and the Support Facilities

Course No. 1 lies on the northwestern most finger of the Punamano Site immediately south of Kamehameha Highway. A short access road leads to the clubhouse which will be sited on the sloping ground near elevation 60 feet. The clubhouse will be a relatively small clubhouse of some 8,000 to 10,000 square feet that will contain a pro-shop, starter's station, a small lounge/snack bar with kitchen and men's and women's restrooms. Domestic water for the clubhouse will be from the refurbished Well 341, or a newly drilled well on site. A parking lot for some 75 to 100 cars will be constructed adjacent to the clubhouse. Mauka of the parking will be a course maintenance facility as indicated in Figure 4. Water for fire protection will be supplied from the irrigation storage ponds.

The preliminary design of the No. 1 Course is some 6,950 yards par 72 course. The course is fairly level except for holes 1, 2, 16, 17, and 18. All in all the course should be an easy one to play. An irrigation lake is shown as a water hazard at green No. 8. If the wastewater alternative is followed in which a treatment plant would be constructed near the No. 2 green, the lake would serve as a blending facility. Should the decision be for the wastewater to be transported to the City and County treatment facility, the lake would simply act as

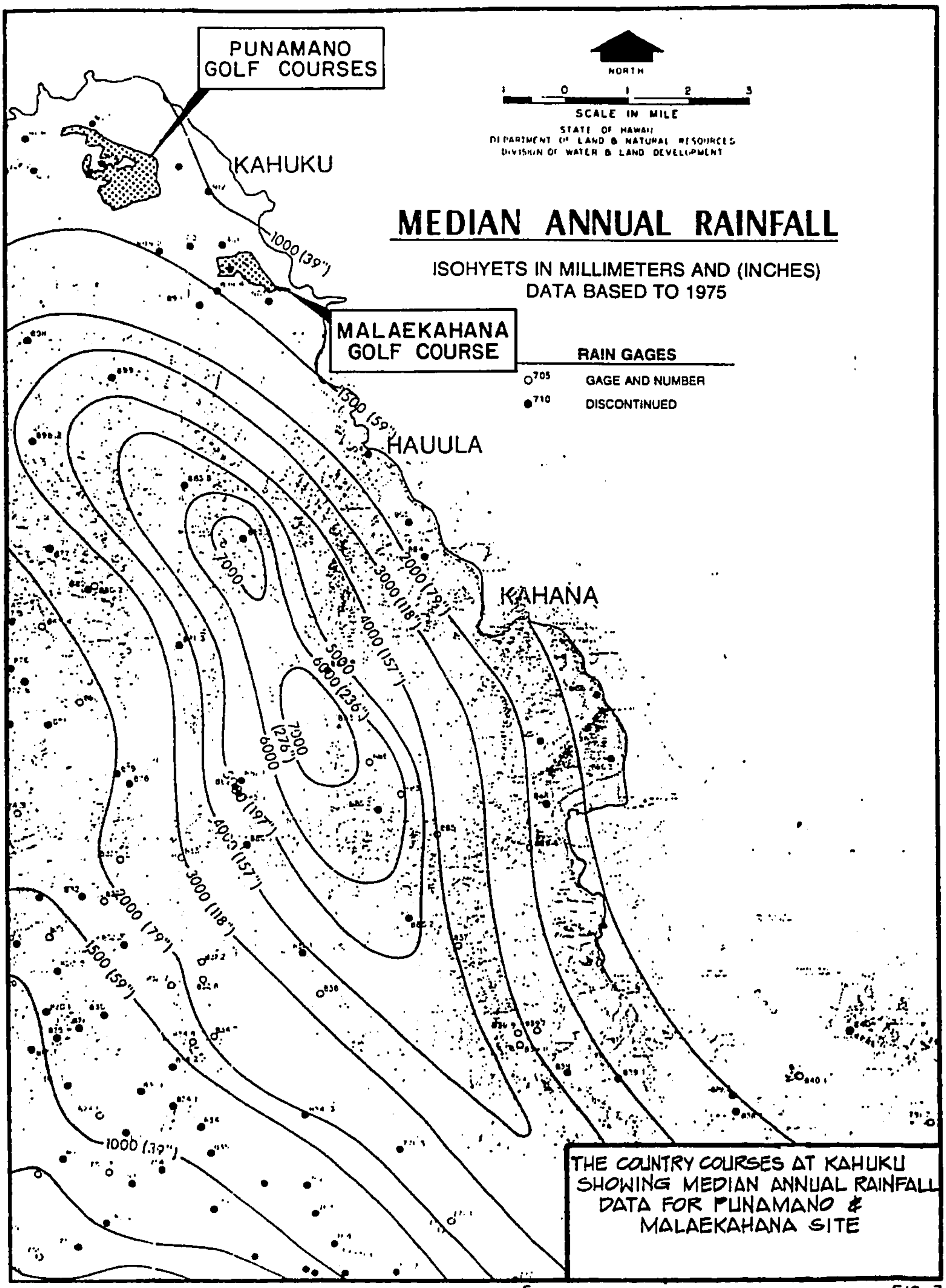


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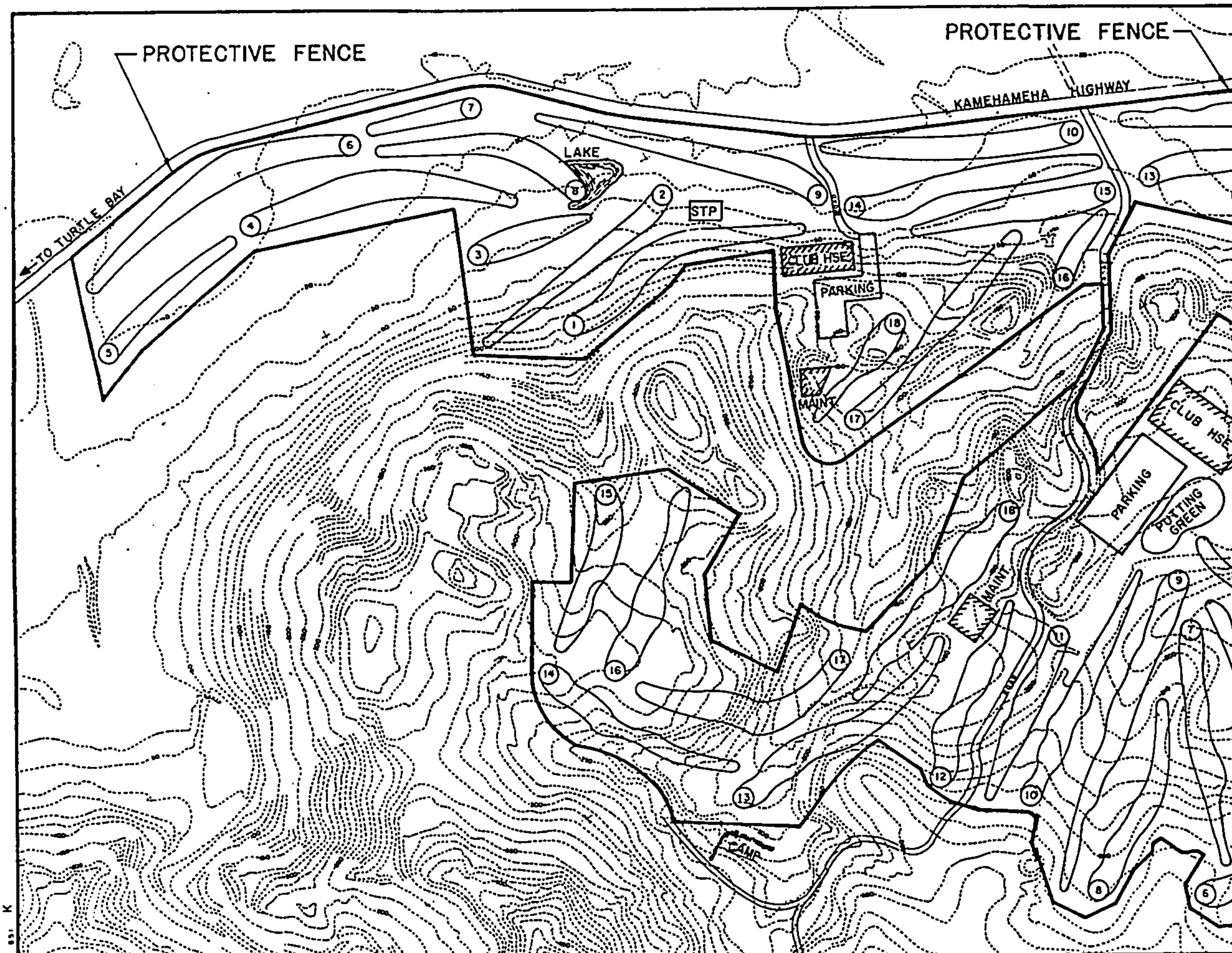
FIG. 3



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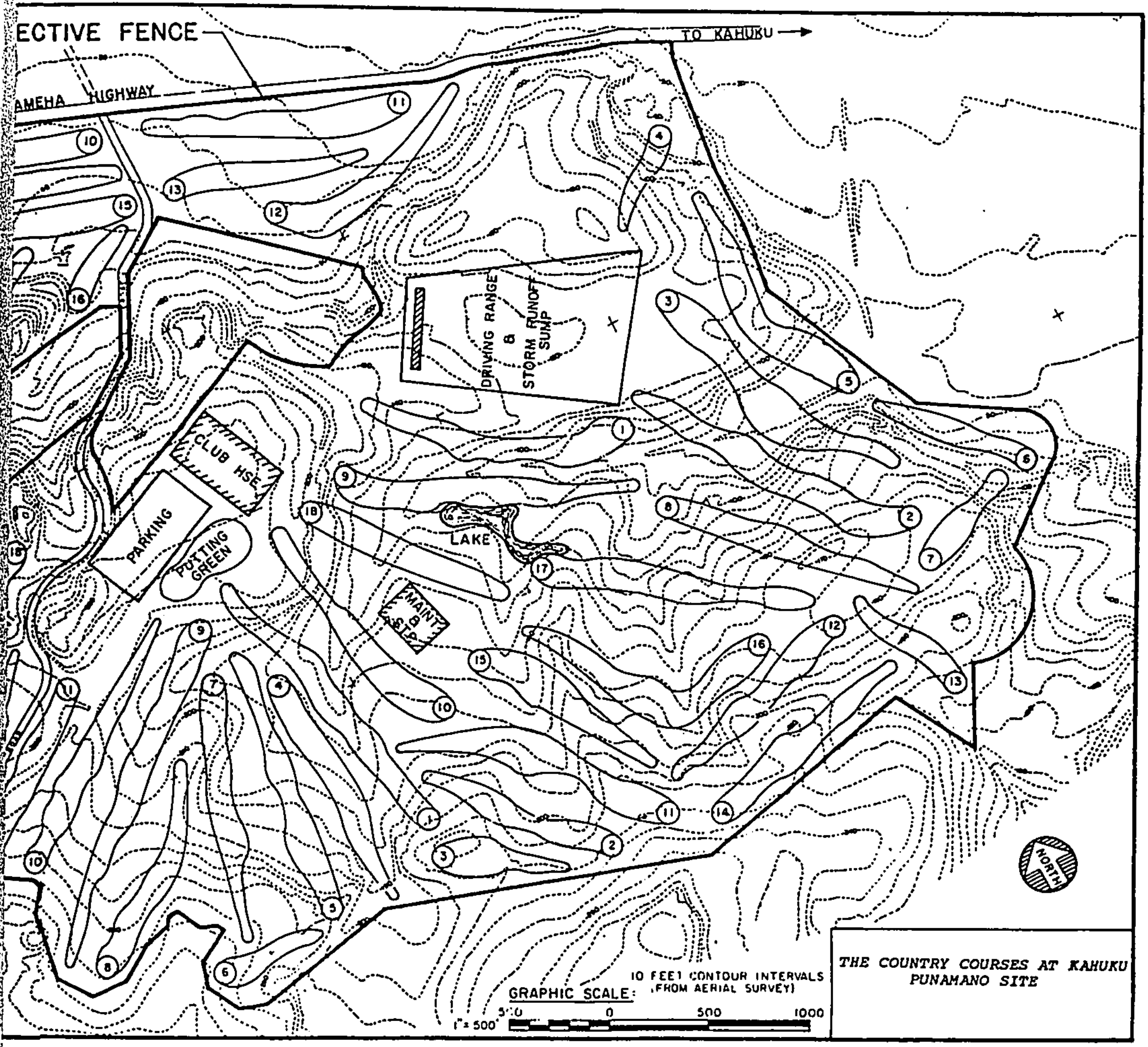

THE COUNTRY COURSES AT KAHUKU
PUNAMANO SITE

FIG 4

one of the storage lakes for the irrigation well water. The well water would be pumped slowly, over a 20 to 22 hour period each day and stored for use over an, 8 to 10 hour period each night. Additional swales, depressions and sand traps that would serve as retention basins for the reduction of storm water runoff are not shown in this preliminary layout.

Because the course parallels Kamehameha Highway with fairways 6, 7, 9, 10 and 11 a protective fence (or fence and vegetation combination) will need to be provided for motorists protection. Coordination with the State Department of Transportation will be necessary to determine the heighth and length of this facility.

The clubhouse for Courses No. 2 and No. 3 is to be located at elevation 230 feet as shown on Figure 3. This clubhouse will be some 16,000 to 18,000 square feet in size. It will contain a pro-shop, two starter stations, a lounge/bar, restaurant, kitchen and men's and women's locker rooms of limited size. Domestic water will be supplied through a separate potable system with the probably source from the refurbished Well 341. Mauka of the clubhouse will be a large parking lot suitable for handling some 225 to 250 cars. A large putting green with approximately 45 cups and a driving range with some 50 tee positions will also be provided. Fire protection will be from the irrigation storage ponds.

The preliminary layout of Course No. 2, lying in the south-easterly sector of the Punamano Site is a 7,040 yard course with fairly wide fairways and wide roughs. The course would be a challenging one for the average player. Hole No. 4 is a 240 yard par 3 with an 80 foot drop from the tee to the green.

Course No. 3, lying to the southwest of the site is the longest course with a total of 7070 yards. The course will be challenging even for professionals. Hole number 9 is a 613 yard par 5 with an 80 foot drop over the first 500 yards and a 20 foot rise in the last 100 yard approach shot to the green. The last six holes of the back nine will have fairly steep side slopes to the roughs paralleling the fairways. Each course will provide a different challenge.

Two maintenance facilities will be provided for courses 2 and 3. Course 2 maintenance will lie between fairways 18 and 10 while the other course maintenance will be near the 12th tee and the 18th fairway.

The main drainage retention basin for the golf courses will be the storm runoff sump that makes up the large driving range. This sump can sustain the inflow of 770 cubic feet per second for a one hour peak discharge from a major storm. This retention basin will hold 64 acre feet of pondage. This major diversion site, in addition to other retention ponds, swales and sand traps will retain sufficient stormwater runoff so that the peak storm runoff from the golf course site will be less under complete development than the runoff that occurs under the existing conditions.

Depending on the alternative to be followed in the wastewater disposal process, a treatment plant will be incorporated into the maintenance facility at Course No. 2. The lake shown as a water hazard for the 17th hole and the 9th fairway would serve as an irrigation/effluent blending pond. Should the selected alternative be to have all wastewater flow to the City and County treatment plant at Kuilima, the lake would simply act as an irrigation storage facility.

Irrigation water developed in new wells will be slowly pumped to several holding or irrigation storage facilities within the golf course. The accumulated irrigation water would then be used during the nighttime hours for irrigation of the course when needed. These storage facilities along with swales, depressions, sand traps and other methods of containing storm water runoff are not indicated in this phase of the design. It is proposed that the irrigation water supply and the irrigation distribution be conducted in the same manner as is presently done at the Waialae Country Club in Honolulu. The system works well; the course is irrigated adequately over a short period of time while the longer supply pumping does not overtax the groundwater lens from which the water is taken.

Development Impacts and Mitigating Measures

There appear to be no long term adverse impacts in the development of the golf courses. The short term impacts of construction have been addressed in the report on Construction Activities.

Sub-Appendix L

Punamano

Report

on

Infrastructure Improvements

For

The Country Courses at Kahuku

Punamano Site

prepared for

The Estate of James Campbell

prepared by

Smith, Young & Associates, Inc.

3049 Ualena Street

Honolulu, Hawaii

April 1990

Introduction

The Estate of James Campbell is proposing to develop three 18-hole golf courses at Punamano, along the mauka side of Kamehameha Highway between Kahuku and Kuilima (see Figure 1). The site contains some 605 acres of open agricultural land. Reports have been made on a number of features covering the proposed development. Our reports are on:

A. Soils
B. Topography
C. Climate
D. Ground Water Resources
E. Drainage and Storm Runoff
F. Water Quality and Supply
G. Wastewater Treatment and Disposal
H. Grading and Construction Activities
I. Tsunami/Flood Hazards
J. Solid Waste Disposal and Landfill Requirements
K. Electrical Power/Telephone
L. Preliminary Design of Courses Including Support Facilities
M. Electrical Power and Telephone

The summation of certain of these reports and the developments associated with them comprise the proposed infrastructure of the golf course.

Site and Site Conditions

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The site slopes up from the low grass lands lying along the mauka side of Kamehameha Highway and opposite from the Punamano Marsh which is a Natural Wildlife Refuge. The 605 acre, irregularly-shaped parcel consists mainly of vacant grass and shrub lands, rolling hillsides, intermittent stream gulches and several steep cliffs of upthrust coralline limestone. Portions of the site were, at one time, planted in sugar cane and some of the abandoned irrigation ditchwork still remains. From the north boundary of the site to its southern boundary the area is a gently rolling hillside with an overall slope of some 5 to 7 percent. An area of rough terrain exists some 100 feet mauka of Kamehameha Highway and extends in a westerly direction through the center of the property. This irregular formation is covered in the soils report for the site. It is this irregular formation that gives the project site the irregular bounday seen in Figure 2. Four abandoned windmill structures are located within the site near Kamehameha Highway. A road bisects the proposed golf course site. This road provides access to the U. S. Army Kahuku Training Area which is located immediately mauka of the site.

Land uses of property adjoining the Punamano site are military to the southwest, agricultural to the south and east, and aquaculture

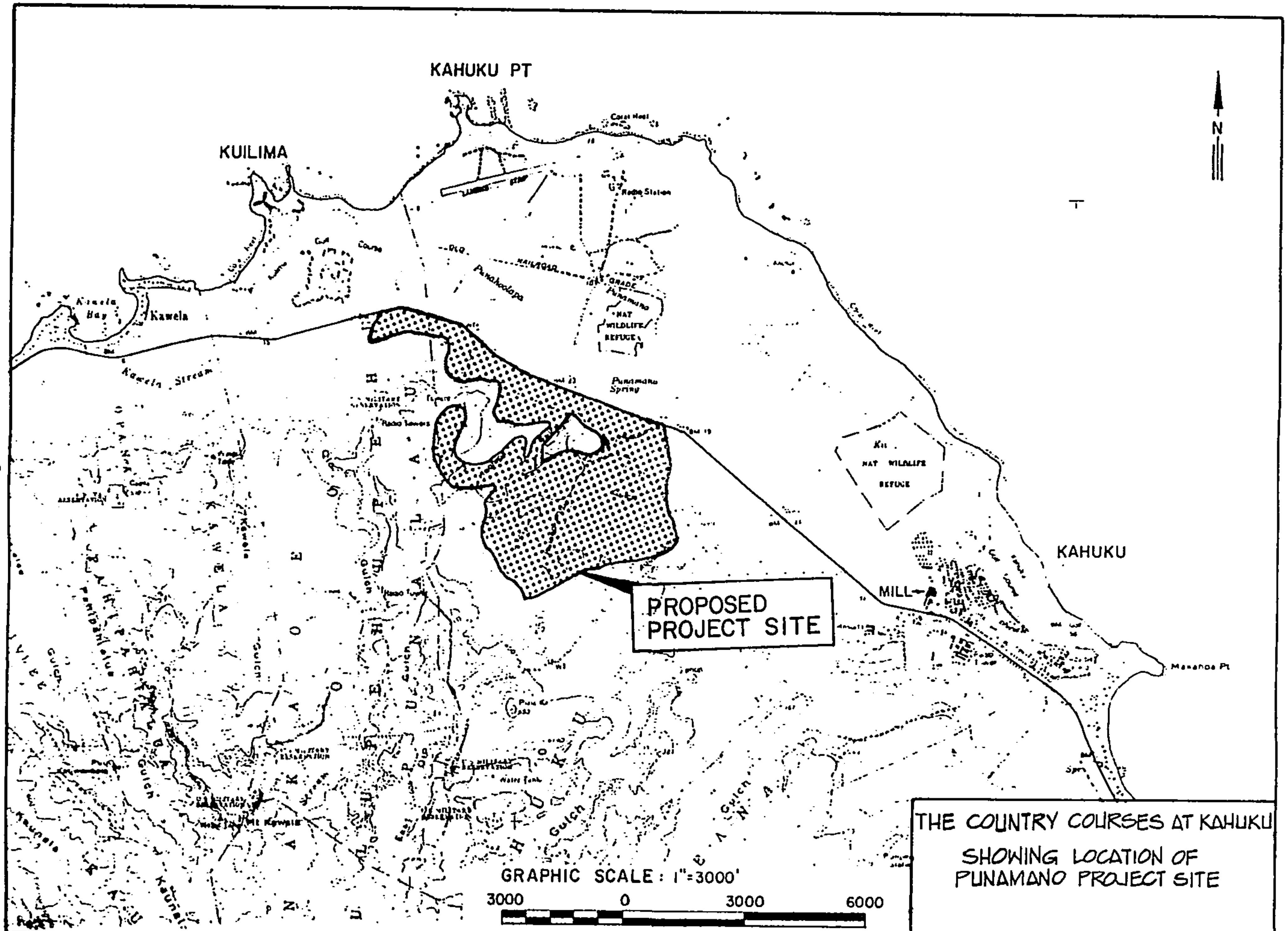

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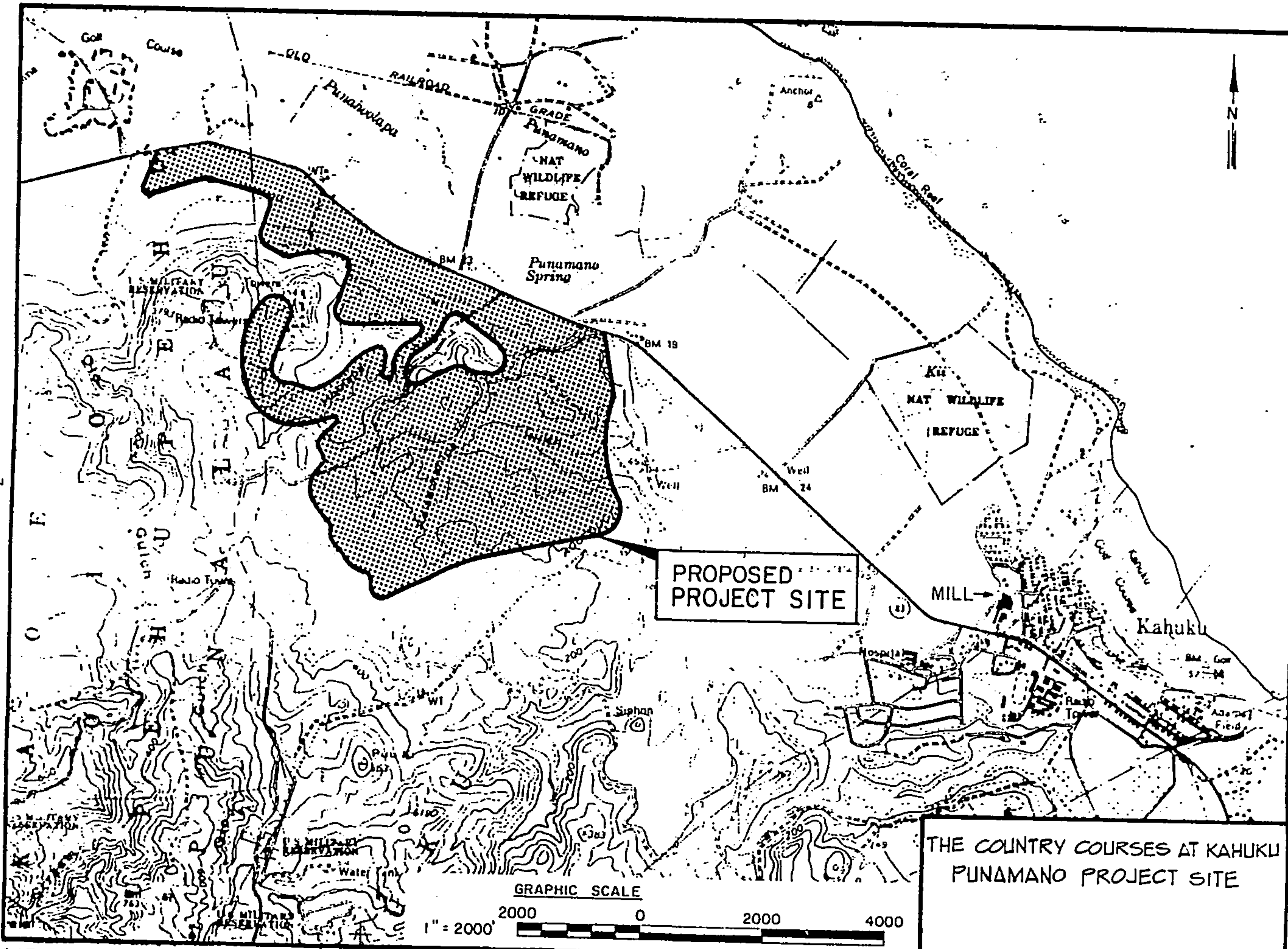
FIG. 1



THE COUNTRY COURSES AT KAHUKU
PUNAMANO PROJECT SITE

FIG 2

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on the northeast. Across Kamehameha Highway, north of the site is the Tanaka Store, a well-known local landmark, which is a small grocery store and gas station. Farther west along Kamehameha Highway lies the Kuilima Resort and condominium complex. Other lands not specifically noted, which lie adjacent to the site, remain as vacant agricultural lands today.

The site is presently designated an agricultural district by the State Land Use Commission. The Koolauloa Development Plan Land Use Map shows the site Agriculture, while the City and County of Honolulu's Zoning District classifies the site as Agriculture (AG-1/AG-2).

The site has a temperature readings range from the low 60 degrees F to the mid 80 degrees F, depending on the day and the season of hte year. Daily temperatures vary as much as twenty degrees (F) between daylight hours and early morning hours. Cooler temperatures are noticable in the higher levels of the site. Review of the median annual rainfall, as published by Department of Land and Natural Resourses, State of Hawaii, shows that the site is located well within the 1000 milimeter and 1500 milimeter isohyets which indicate that the rainfall median is between 40 and 48 inches per year. The higher rainfall is found in the upper (southern) section of the site. The rainfall distribution is uneven and varies from month to month. Rain will be heavy some months and nearly non-existant at other times. Winter months, in general, are the months with the most rainfall.

Tradewinds are generally stronger at Kahuku than on other parts of the island. Velocities of twelve to fifteen miles per hour are average, with the direction of he prevailing winds coming from the northeasterly and east northeasterly directions. The winds at Kahuku are generally of greater velocity than the same winds in most other parts of Oahu. This is evidenced by the fact that the experimental wind turbines for electrical generation have been sited on adjacent areas immediately west of the proposed golf courses.

The site has a temperature reading range from the low 60 degrees F to the mid 80 degrees F depending on the day and the season of the year. Daily temperatures vary as much as fifteen to twenty degrees between daylight hours and early morning hours. The median rainfall in the low areas of the site are around 40 inches per year and near the mauka site boundary some 57 inches. The rainfall varies from month to month with some months having zero rainfall. U. S. Department of Interior streamflow measurements of Malaekahana Stream, which flows some two miles south of the site, has a recorded average discharge of 2.11 cfs per day. Extremes show that in July 1971 the total flow for the month was only .50 cfs whereas on April 24, of the same year the daily flow was 66 cfs. Based on the stream flow data, it is safe to say that the area and the site itself are subject to occasional intense showers.

The Kahuku Area is subject to trade winds, which blow from the northeast. As moisture laden clouds are shoved against the northern most extremities of the Koolaus, the updraft of winds cool the clouds sufficiently so that rainfall is intensified at the higher elevations. Rainfall two miles southwest of the site exceeds 118 inches per year.

Although extremes in rainfall are noted at the site, some 30 percent of the days are clear, another 30-35 percent are partly cloudy and another 30-35 percent are cloudy. The climate is good for golfing activities.

1. Ground Water Resources

The Punamano site overlies the most northerly portion of the basal water lens that is found along the northeastern coastal plain of Oahu. It is expected that the top of this water lens is some 7 to 9 feet above sea level with the associated fresh water extending downward some 300± feet near Kamehameha Highway. The water resource appears more than sufficient for the proposed development. Farther inland the water lens rises to approximately 13 feet with the corresponding depth reaching some 450-500 feet below sea-level. This inland source will not be touched by the golf course development.

2. Drainage and Stormwater Runoff

The intermittent stream gulches of Hoolapa and Kalaeokahipa extend through the site. A large depression computed to hold some 64 acre feet of water will be used as a storm water diversion sump. It is proposed that a portion of the Course 2 and 3 sites will be diverted to this sump to mitigate the increased storm runoff when the courses are developed. Combined with this major diversion and the several depressions, sand traps and swales proposed in the golf course design, the actual peak storm water runoff is figured to be less after the courses are developed than under the current underdeveloped condition. The Proposed Kahuku Drainage Master Plan will direct storm flow away from the Punamano and Kii Wildlife Refuges. The controlled runoff will mitigate storm flow problems in the Natural Wildlife Refuge areas and recognized wetlands makai of Kamehameha Highway.

Although the surface runoff from closely cropped fairways will be greater than that presently anticipated from the present site conditions the increased retention areas will off-set the increase so that lower peak flows may be expected during any given storm situation. During normal rainfall the lesser sheet flows will be caught in the various swales and retention basins and thereby eleminated from off-site flow.

3. Water Quality and Supply

The water resource study indicates that there is a sufficient resource to provide both domestic and irrigation water to the development. It is not anticipated that more than 2.6 MGD will be needed, even on the drier days of the year. History has indicated that over pumpage degraded the quality of the supply during the "sugar cane" years of Kahuku Plantation. It is now believed the lens has re-established itself as a good water source. An existing well near Kamehameha Highway (Well 341) provides domestic water today. Site development will determine whether this well should be refurbished or a new well drilled to provide domestic water service. Irrigation water will probably require an additional two or three new wells on the site some distance from the domestic well site.

Several years ago the State Department of Water and Land Development (DOWALD) agreed that the sustainable yield at Kahuku is 15 mgd. As current and planned usage is some eleven million gallons per day for the area, the result is a 4.0 mgd surplus available for the golf courses development. This amount is more than adequate for the proposed 2.1 to 2.2 mgd average demand.

An important mitigating feature must be incorporated into the proposed water supply and distribution systems. A slow steady withdrawal of water from the wells that penetrate the basal lens is essential. This slow withdrawal is necessary to reduce well drawdown and thereby reduce possible salt water intrusion from the bottom of the lens. Well withdrawal should be over a 20 to 22 hour period per day, at a reasonable drawdown rate. If the drawdown is unreasonable (over 2 feet) a fourth, or even fifth well will be required. The water withdrawn from the wells shall then be stored in irrigation ponds (water hazards) for use over a 6 to 10 hour irrigation period during the night hours.

Depending on the distribution pipe system, the number of holding ponds and pump stations may vary. At least one large storage reservoir and one pump station will provide a continuous pressurized system around each clubhouse. The system will be pressurized by a small jockey pump for hand watering of putting greens etc. At a demand great enough to cause a sizeable pressure drop, large pumps will become activated for irrigation of the course or provide fire flows to the several fire hydrants to be located at the clubhouse or maintenance facility.

The system for irrigation would be identical in its operation to that at the Waialae Country Club in Honolulu as far as supply and distribution operations are concerned.

4. <u>Wastewater Treatment and Disposal</u>

Two alternativea are avaliable for the Punamano Courses. An activated sludge "package plant" could service each of the two proposed clubhouses and the maintenance facilities under gravity flow conditions. The use of treated effluent on the golf course can be accomplished without degradation of the water resources through effluent usage. However, the area does lie within the "no-pass" zone of the Board of Water Supply; therefore a second, but less economical solution is offered. A combination force main, ejector station, gravity system could carry the estimated 15,000 gpd quantity to the City and County Kuilima Treatment Plant Facility some 8000 feet away. Either alternatives is workable, both meet Department of Health Chapter 62 requirements, possible one is government agency acceptable.

5. <u>Grading and Construction Activities</u>

Site grading will be phased controlled and watered so as to reduce dust. Trenching, grading and all construction work will be conducted in compliance with Department of Public Works construction specifications. Noise and nuisance that might be generated will be controlled by the State Department of Health Requirements both as to times of operation and decibals of sound.

6. Solid Waste Disposal and Landfill Requirements

The amount of waste and need for landfill during construction is impossible to estimate. There will be construction material and existing concrete ditch material that will be required to be hauled to landfill sites by the contractor. After development, the daily quantity of solid waste that private collectors will haul to a landfill or to "H-Power" is estimated to be 2000 pounds per day.

7. Electrical Power/Telephone

Underground service to the two clubhouses, maintenance facilities and treatment plants will be provided by an underground duct and handhole system. Hawaiian Electric power and Hawaiian Telephone service are available from overhead lines which follow the Kamehameha Highway right-of-way alignment. On site trenching and backfilling for these underground utilities are covered in the construction activities report.

8. Preliminary Design of Course Including Support Facilities

The clubhouse, parking, and maintenance facilities have been covered in Appendix G. Each clubhouse will have a paved acces road, which ends in a sizeable parking lot at the clubhouse. The No. 1 clubhouse will contain a pro-shop, starter station, small snack bar, kitchen, and men's and women's restrooms. The clubhouse will provide limited amenities. The No. 2 Clubhouse servicing both No. 2 and No. 3 Courses will be considerably larger providing a pro-shop, two starter stations, lounge/bar restaurant, kitchen and both men's and women's locker rooms. A large putting green and driving range will be included at Clubhouse No. 2.

The No. 1 course paralleling Kamehameha Highway will be a 6950 yard par 72 course which will be fairly level and easy to play. It might be considered a beginner's course. Because it has five fairways that parallel the highway, a protective fence will be required. This fence will be coordinated with the State Department of Transportation.

Course Mo. 2 lies in the southeastern sector of the Punamano Site. This course will be some 7000 yards in length and be of median complexity. The No. 3 course lying in the mauka reaches of the site will be the longest course at 7070 yards and have sloping roughs making it the most difficult course to play. If properly managed, the No. 2/No. 3 courses could be open for "shotgun" tournament play making them available as a golf conventioned center flexible enough to handle single foursomes.

It must be recognized that the design and layout of the three courses in this report is a preliminary layout intended to show that the three proposed courses are feasible. Further studies may very well modify the layout's shown herein.

Sub-Appendix M

Punamano

Report

on

Electrical Power and Telephone

For

The Country Courses at Kahuku

Punamano Site

prepared for

The Estate of James Campbell

prepared by

Smith, Young & Associates, Inc.

3049 Ualena Street

Honolulu, Hawaii

April 1990

Introduction

The Estate of James Campbell is proposing to develop three 18 hole golf courses in the vicinity of Kahuku on the North Shore of Oahu. The area lies immediately southwest of Kamehameha Highway between Kahuku Village and Kuilima (Figure 1). The site contains approximately 605 acres and is situated mauka of Kamehameha Highway and some 2 miles northwest of the old Kahuku Mill (Figure 2).

The purpose of this report is to provide information on the site and to indicate the availability of electrical and telephone services at the site. This report addresses the following:

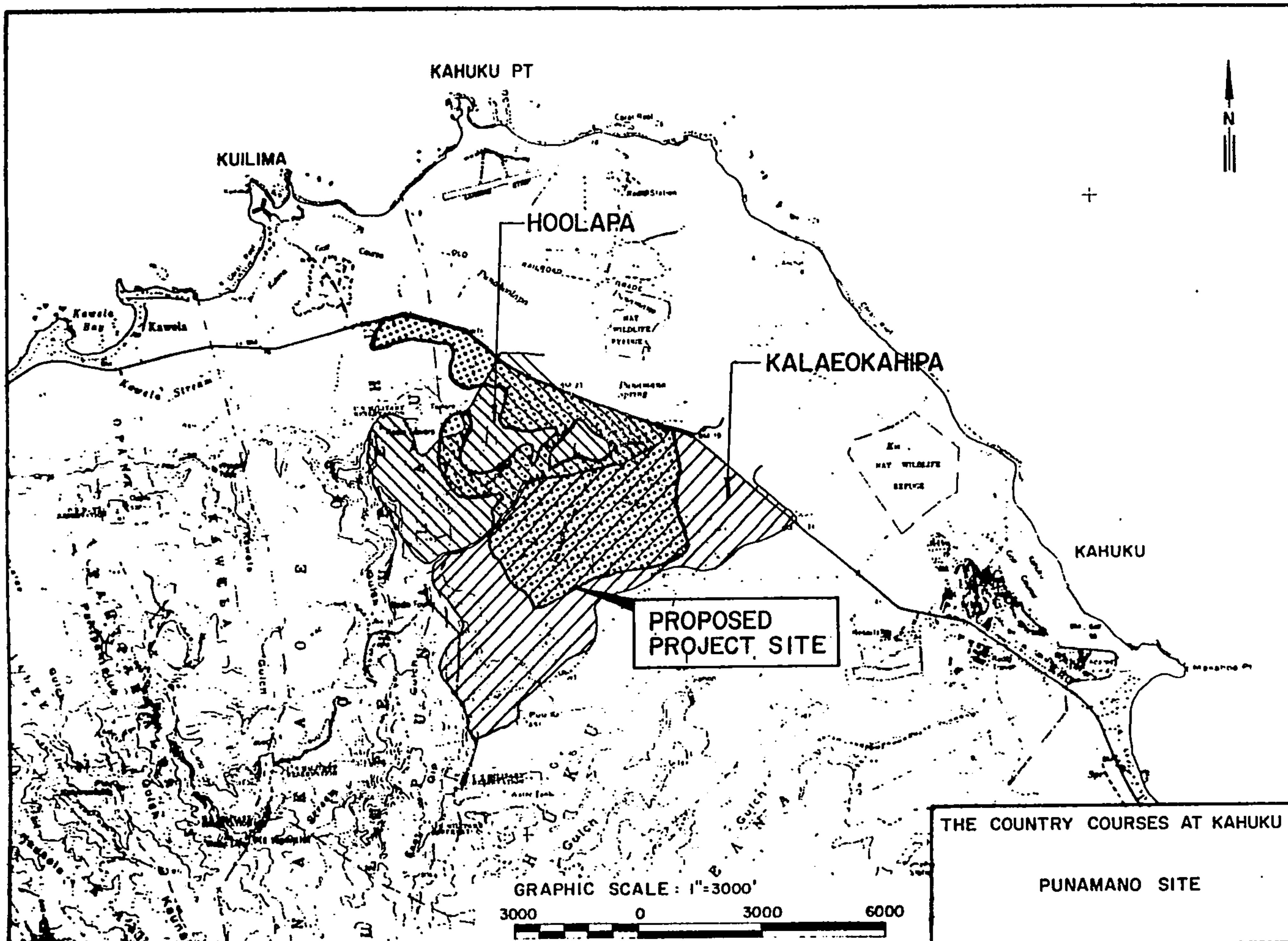
a. Existing site and site conditions
b. Availability of electrical power and telephone service

Site and Site Conditions

The proposed site for the three 18-hole golf courses at Punamano is located within the Koolauloa District of Oahu and lies in the Tax Map Key designations of TMK 5-6-05:Portion 1, Portion 2, 5, 6 and Portion 7, and a small bit of TMK 5-7-01:Portion 21. This project site at Punamano has been owned by The Estate of James Campbell since before the turn of the twentieth century.

The site slopes up from the low grass lands lying along the mauka side of Kamehameha Highway and opposite from the Punamano Marsh which is a Natural Wildlife Refuge. The 605 acre, irregularly-shaped parcel consists mainly of vacant grass and shrub lands, rolling hillsides, intermittent stream gulches and several steep cliffs of upthrust coralline limestone. Portions of the site were, at one time, planted in sugar cane and some of the abandoned irrigation ditchwork still remains. From the north boundary of the site to its southern boundary the area is a gently rolling hillside with an overall slope of some 5 to 7%. An area of rough terrain exists some 100 feet mauka of Kamehameha Highway and extends in a westerly direction through the center of the property. This irregular formation is covered in the soils report for the site. It is this irregular formation that gives the project site the irregular boundary seen in Figure 2. Four abandoned windmill structures are located within the site near Kamehameha Highway. A road bisects the proposed golf course site. This road provides access to the U. S. Army Kahuku Training Area which is located immediately mauka of the site.

Land uses of property adjoining the Punamano site are military to the southwest, agricultural to the south and east, and aquaculture on the northeast. Across Kamehameha Highway, north of the site is the Tanaka Store, a well-known local landmark, which is a small grocery store and gas station. Farther west along Kamehameha Highway lies the Kuilima Resort and condominium complex. Other lands not specifically noted, which lie adjacent to the site, remain as vacant agricultural lands today.



THE COUNTRY COURSES AT KAHUKU

PUNAMANO SITE

SMITH, YOUNG & ASSOCIATES, INC • CONSULTING ENGINEERS

FIG. 1

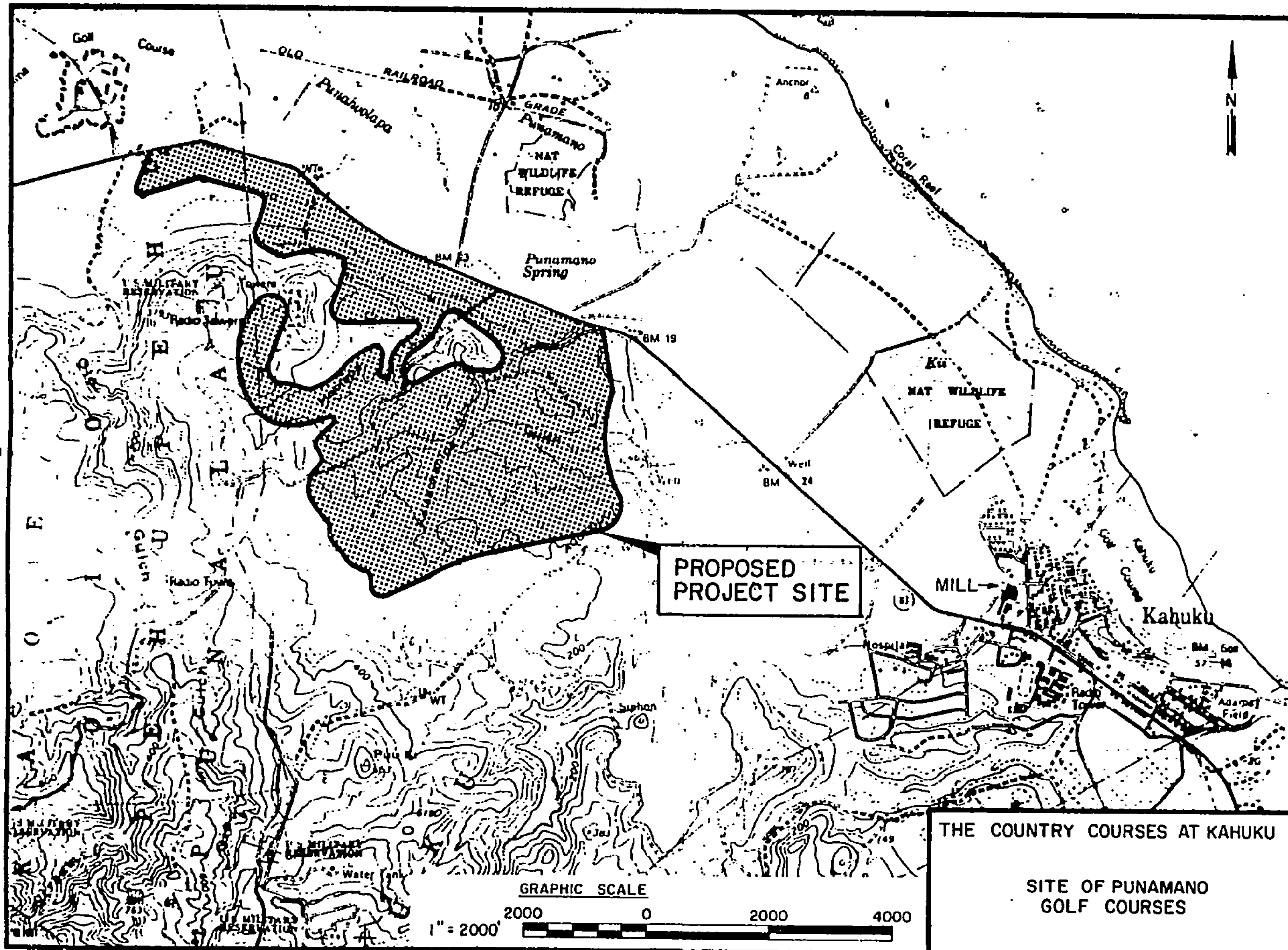


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FIG 2

<u>Electrical Power and Telephone</u>

At the present time commercial electrical power service is available from an overhead electric line that runs along Kamehameha Highway. Hawaiian Electric's distribution voltage in this service is 12.47 kv. The service has sufficient capability to service the proposed three course development and its infrastructure.

Hawaiian Telephone service also runs along Kamehameha Highway in an overhead service. It also has the capacity to serve the proposed golf course development at the Punamano Site.

The electrical and telephone service will be provided by an underground ducting and handhole system from the Kamehameha Highway overhead service to the clubhouses, maintenance facility and any other infrastructure facility that may be constructed.

<u>Impact and Mitigative Measures</u>

The installation of the underground electrical and telephone lines and handholes will require excavation and trenching. The anticipated short term impact of this construction activity is covered in the report on Grading and Construction Activities. The mitigating measures to reduce the short term impacts of construction are also covered therein. There are no long term impacts for electrical and telephone services.

TECHNICAL RESUME OF

RUSSELL L. SMITH, JR., President
Smith, Young & Associates, Inc.
(Consulting Engineers)
3049 Ualena Street Suite 1104
Honolulu, Hawaii 96819
Phone: (808) 836-0015

EDUCATION (FORMAL)

University of Hawaii - 1946-1949 - B. A. in Math and Physics in 1948
Stanford University - 1938-1941 - Undergraduate Prelegal Major

EDUCATION (SUPPLEMENTAL)

US Navy Sponsored - Redicheck Program - Honolulu 1987
ACEC/AIA Sponsored - Value Engineering Workshop - San Francisco - 1975
University of California - Extension Seminar Program VII - 1970
National War College - Summer - Washington D.C. - 1962
Yale University - Short Air Force Engineering Course - 1943

ENGINEERING REGISTRATION

Professional Civil and Sanitary Engineer, Territory of Guam, Certificate No. 23-E (1962)
Professional Civil and Sanitary Engineer, State of Hawaii, Certificate No. 711-E (1953)

PROFESSIONAL HISTORY

March 15, 1987 to Present
President - Smith, Young & Associates, Inc.

January 2, 1985 to December 31, 1986
Director and Chief Engineer, Department of Public Works, City and County of Honolulu

June 1, 1975 to December 31, 1984
President - The Russ Smith Corporation

June 12, 1959 to May 31, 1975
Vice President and Treasurer - Austin, Smith & Associates, Inc.

1966 - 1974
Consultant on Water Supplies to Public Utility Agency Guam, Territory of Guam

1960 - June 1967
Director of Materiel and Command Pilot with the rank of Lt. Colonel in the Hawaii Air National Guard - Served as Logistics Director of three radar sites and one fighter squadron area - Retired June 1967.

February 1, 1956 to March 31, 1964
Vice President and Secretary - H. A. R. Austin & Associates, Ltd.

May 1, 1957 to June 12, 1959
Secretary - Austin & Towill, Ltd.

1955 - 1960
Staff Installations Officer, Hawaii Air National Guard - Provided direct supervision of Construction of all Air National Guard facilities in the Territory of Hawaii - Command Pilot.

1953 - 1956
Associate Engineer - H. A. R. Austin

1949 - 1952
Junior Engineer - Austin & Towill

1947 - 1949
Pilot, Photogrammetric Engineer and Surveyor - Part-time for R. M. Towill.

1946
One of the founders of the Hawaii Air National Guard.

OTHER ENGINEERING ACHIEVEMENTS OF NOTE SINCE 1959

Hawaii Engineer of the Year for 1976 (Selected by the Hawaii Society of Professional Engineers).

Designed the first High Rate Trickling Filter Wastewater Treatment Plant in Hawaii (On island of Oahu).

Designed the first Wastewater Treatment Plant on the islands of Kauai, Maui and Hawaii.

Masterplanned the Sewerage and Water Systems of the Six Districts of the Trust Territory of the Pacific Islands.

Designed the Sewerage and Water Systems for the islands of Saipan, Koror and Ponape in the Trust Territory of the Pacific Islands.

Formulated the Storm Drainage Standards for the Island of Guam.

Masterplanned the Water System for the Island of Guam.

Designed first Advance Wastewater Treatment Plant (Tertiary) in the State of Hawaii - 1969.

Masterplanned the Water System for American Samoa and designed Phase I of the system in 1963 and Phase II in 1972.

Designed the Northern District Sewerage System, Territory of Guam.

Fresh Water System Analysis for Naval Station, Midway Island - 1978.

TECHNICAL SOCIETIES MEMBERSHIPS

American Society of Civil Engineers, Fellow (ASEC)
- Hawaii Section President - 1961
- Hawaii Section Vice President - 1960
- Hawaii Section Secretary-Treasurer - 1959
- Chairman of Qualifications Committee - 1969 - 1973; Member 1963-1968
- Conference Chairman - 1963

American Water Works Association (AWWA)

American Consulting Engineers Council (ACEC)
- National President - 1982-1983
- National President-Elect - 1981-1982
- National Vice President - 1976-1978
- Representative to International Federation of Consulting Engineers - Liaison with Asian Development Bank - 1971
- Member, International Committee (601) - 1971-1976

Consulting Engineers Council of Hawaii (Local Organization) (CEC/H)
- President - 1970-1971
- Vice President - 1969-1970
- National Director - 1972
- Alternate National Director - 1967, 1970
- Chairman Professional Practices Committee - 1969-1970
- By-Laws Committee - 1974-1977
- Past National Directors Committee - 1973-1977, Chairman - 1973
- Conference Chairman - 1968

Engineering Association of Hawaii (EAH)
  Director - 1956-1957
Hawaii Society of Professional Engineers (HSPE)
Hawaii Water Pollution Control Association (HWPCA) & (WPCF)
  President - 1967
  Vice President - 1966
  Secretary-Treasurer - 1965
  Acting National Director - 1965
  Conference Chairman - 1963
Interprofessional Council Environmental Design (ICED)
  National Chairman - 1981-1982
Society of American Military Engineers, Oahu Post (SAME)
  Director - 1963

BIOGRAPHICAL LISTINGS

Men and Women of Hawaii

Who's Who in the West

Who's Who in America

Who's Who in Engineering

Who's Who in the United States

Men of Achievement

International Biography

Library of Human Resources

Notable Americans of the Bicentennial Era

Community Leaders and Noteworthy Americans

APPENDIX B

TRAFFIC IMPACT ASSESSMENT, REPORT FOR THE COUNTRY COURSES AT KAHUKU - PUNAMANO SITE

Pacific Planning and Engineering, Inc.

APPENDIX B

TRAFFIC IMPACT ASSESSMENT REPORT

for

THE COUNTRY COURSES AT KAHUKU
PUNAMANO SITE

Kahuku, Hawaii

December 1989

Prepared for:

Estate of James Campbell

Prepared by:

Pacific Planning & Engineering, Inc.
1144 Tenth Avenue, Suite 202
Honolulu, Hawaii 96816

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EXECUTIVE SUMMARY

Introduction

Pacific Planning & Engineering, Inc. (PPE) was engaged to undertake a study to identify and assess future traffic impacts resulting from the Estate of James Campbell's proposed The Country Courses at Kahuku project. The project includes the development of three golf courses at Punamano near the Turtle Bay Resort, and one golf course at Malaekahana. This report represents the findings and recommendations of the traffic study for the three Punamano golf courses. The traffic impact assessment for the Malaekahana site will be reported in a separate document.

The focus of the study is to determine the impact of the project generated traffic at the intersection of Kamehameha Highway and the proposed golf course access roads and Marconi Road when the course is completed and in operation in 1998. The study intersections were analyzed for the present case, 1998 *without* the project, and 1998 *with* the project.

Project Description

The Estate of James Campbell is proposing to develop three eighteen-hole golf courses in Kahuku, Oahu, Hawaii. The courses will be located at the 605 acre Punamano site which is approximately 1.5 miles west of Kahuku Town. The two courses on the southeastern side of the site will include a driving range, putting green, parking lot, administrative office, and a clubhouse for a starting facility, proshop, lockers, restaurant/lounge, restrooms, cart maintenance and storage facility. The third course on the northwestern side of the site will include facilities similar to those at the other two courses except for the driving range and administrative office. Each course will operate on a daily fee basis and completion of all courses is scheduled for 1998.

The existing Kahuku Army Training Area access road will be used for access to the two golf courses on the southeastern side of the site. The intersection of the Military Access Road with Kamehameha Highway will be modified to form a four-way intersection with the Military Access Road and Marconi Road. A new access road (Road "A") from Kamehameha Highway will be constructed west of the Military Road to provide access to the third golf course.

Conclusions and Recommendations

The proposed Punamano Golf Course Site of The Country Courses at Kahuku will not significantly impact the traffic flow on Kamehameha Highway in 1998 when the project is expected to be completed.

Results of the intersection analyses show that the project will cause little delay (LOS B) to traffic along Kamehameha Highway during the weekend afternoon peak hour. The left turn traffic into Military Road and Road "A" from Kamehameha Highway will operate at LOS B in 1998 with the project. The left turn traffic into Marconi Road from Kamehameha Highway will remain at LOS A with or without the project.

By 1998, even without the project, the LOS for vehicles attempting to exit Marconi Road and Military Road onto Kamehameha Highway will operate with long delays during the weekend afternoon peak hour. Vehicles exiting Marconi Road and Military Road will operate at LOS D. This increased delay is due in part to an increase in traffic along Kamehameha Highway as well as traffic generated from nearby developments.

With the project in 1998, the LOS for the vehicles attempting to exit Marconi Road and Military Road will worsen. The LOS for vehicles exiting Marconi Road will drop from LOS D to LOS E while the LOS for vehicles exiting Military Road will drop from LOS D to LOS F. Vehicles exiting the newly constructed Road "A" will experience LOS F. The delays for vehicles exiting these intersections are expected only during the peak hours.

To minimize the very long delays for traffic exiting Military Road and Road "A", it is recommended that exclusive right and left turn lanes be provided along the realigned Military Road and Road "A" for traffic entering onto Kamehameha Highway. This will permit vehicles attempting right turns to bypass the left/through traffic and decrease delays for vehicles attempting right turns.

PROJECT DESCRIPTION

The Estate of James Campbell is proposing to develop "The Country Courses at Kahuku" in Kahuku, Oahu, Hawaii. The Country Courses at Kahuku consist of the three golf courses on 605 acres at the Punamano site and one golf course on 200 acres at Malaekahana. The Malaekahana Site is expected to be completed in 1994 and the Punamano Site in 1998. This report focuses on the developments at the Punamano site only. The traffic study for the Malaekahana golf course will be described in a separate report. Figure 1 shows the location of the proposed Punamano site and the adjoining roadway network.

The Punamano site is located approximately 1.5 miles west of Kahuku Town and mauka of the Turtle Bay Resort. The 605 acre site is located on marginal agricultural land previously used for sugar cane production and is presently covered with natural vegetation. The three eighteen-hole golf courses will include two clubhouses and parking lots. One clubhouse will serve the two courses in the southeastern portion of the site and will include a starting facility, proshop, lockers, restaurant/lounge, restrooms, cart maintenance and storage facilities, and an administrative office. This clubhouse facility will also feature a driving range and putting green.

The second clubhouse will serve the golf course on the northwest side of the site and will include a starting facility, proshop, lockers, restaurant/lounge, restrooms, and cart storage and maintenance facilities. The clubhouse will also include a putting green. The three courses will operate on a daily fee basis and is scheduled for completion in 1998. Figure 2 shows the layout of the three Punamano golf courses.

There will be two access roads for the project. Road "A" will be built to serve the golf course on the northwestern side of the site, and the existing Kahuku Army Training Area access road (hereinafter referred to as Military Road) will be used to serve the remaining two courses. The Military Road at its intersection with Kamehameha Highway will be realigned directly across Marconi Road to form a four-way intersection with Kamehameha Highway.

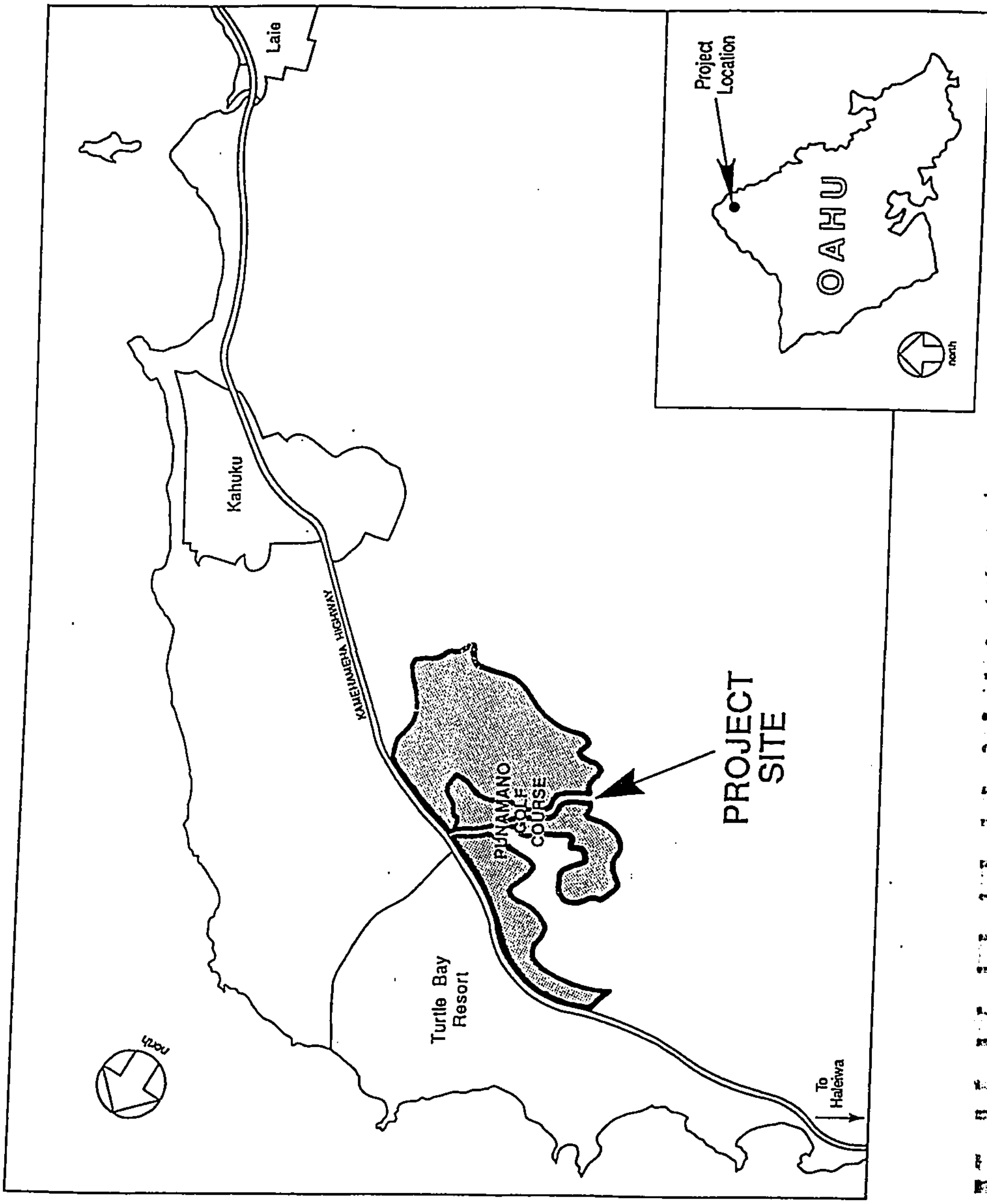

Figure 1. Project Location Map

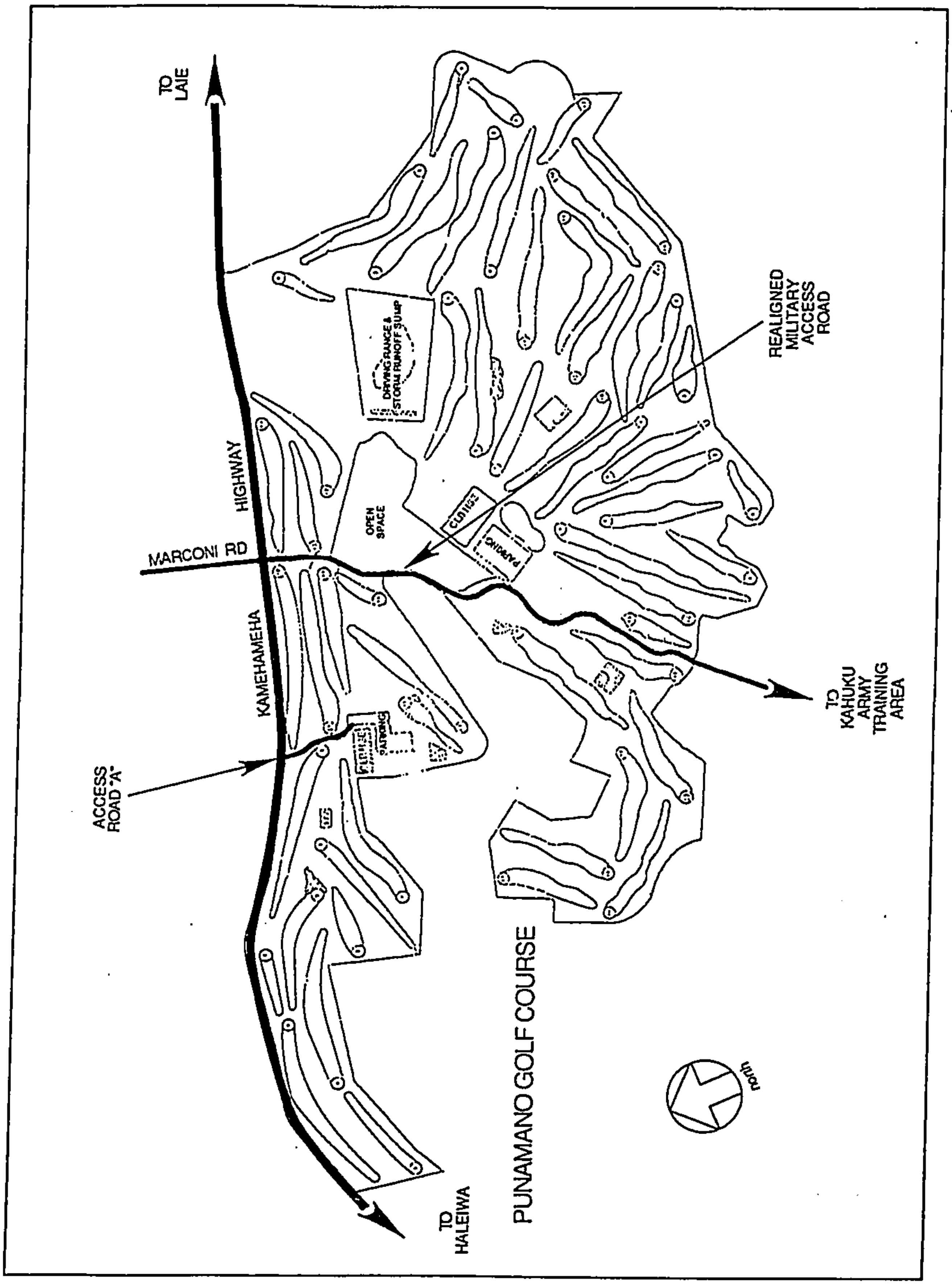

Figure 2. Project Site Plan

AREA CONDITIONS

A survey of existing conditions was conducted to better understand the traffic impact of the proposed project. The survey included the land use of the area, roadway facilities in the area and existing traffic conditions.

Existing Land Uses

Land uses adjacent to the project site include the U.S. Army Kahuku Training Area, agriculture uses including banana, papaya farms and the State Agricultural Park, and the Turtle Bay Resort on the makai side of the Kamehameha Highway. The Kahuku Aquaculture Farm is also makai of the highway, and east of Marconi Road.

The Turtle Bay Resort, Kahuku Town and Laie Town are three significant nearby residential and commercial communities. The Turtle Bay development presently consists of a 400 unit hotel, an 18 hole golf course, tennis courts, small commercial shops, and about 400 residential condominium units. Kahuku and Laie Towns are primarily low density, rural communities with residential homes, small commercial shopping centers, churches, and schools.

Roadway Facilities

Vehicular access to the proposed golf course will be from Kamehameha Highway which is the only highway in the area providing for through traffic along the North Shore of Oahu.

Kamehameha Highway is a rural arterial highway connecting major population centers along the North Shore such as Haleiwa, Kahuku, and Laie. It is a State maintained highway with a 20 foot wide pavement in the vicinity of the project. There is a 10 foot wide lane in each direction. The shoulders are grassed or dirt and vehicles park along both sides of the road. The posted speed of Kamehameha Highway in the project vicinity is 45 miles per hour.

The Military Road is a narrow paved road to the Kahuku Army Training Area that intersects Kamehameha Highway approximately 800 ft east of Marconi Road. Marconi Road is located on the makai side of Kamehameha Highway opposite the Punamano site. Marconi Road provides access to a few sport fishermen and beach goers and to the Aquaculture operations.

<u>Traffic Conditions</u>

Traffic growth along Kamehameha Highway was forecasted based on trend analysis of nearby State DOT traffic count station 25-A located on Kamehameha Highway at Pupukea Road. This station was selected because it was the closest station to the project site and would be representative of the traffic along Kamehameha Highway in the vicinity of the project.

Figure 3 is a graphic representation of the trend analysis for traffic count station 25-A. The trend line was estimated using linear regression analysis. The trend analysis indicates a 2.5% annual growth in daily traffic on Kamehameha Highway. This growth only reflects the change in traffic due to developments outside of the immediate area of concern.

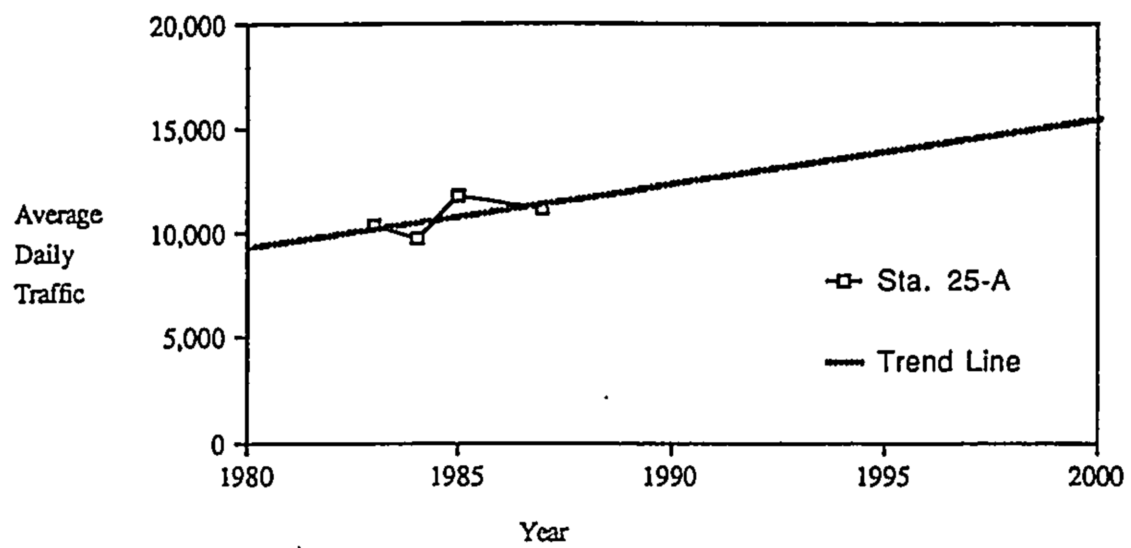

Figure 3. Recorded and Projected Traffic on Kamehameha Highway

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A review of State DOT traffic count data for station C–29-B along Kamehameha Highway near the old Kualoa Sugar Mill indicated that the peak hour traffic generally occurs between 3:30 and 4:30 pm on weekdays and between 2:00 and 3:00 pm on weekends. However, the heavier vehicular traffic is consistently found on the weekends. The DOT counts are shown in Appendix C.

Manual traffic counts were conducted on January 21, 1989, during the Saturday afternoon peak hour at the intersection of Kamehameha Highway with Marconi Road and the Military Road. Manual counts were taken of passenger cars, trucks, buses, and motorcycles by turning movements and approaches to the study intersection during these periods. During the manual counts, the weather was clear and the pavement was dry. The survey was conducted to establish a baseline condition to compare against future traffic. A summary of the traffic counts for the observed afternoon peak hour is shown in Figures 4. Manual traffic count data is shown in Appendix B.

At the project site, the traffic in both directions on Kamehameha Highway for the 2:00 to 3:00 pm period totaled about 820 vehicles. Approximately 48% headed in the Kahuku direction and 52% in the Haleiwa direction. Only a very small portion of the total traffic used Marconi or the Military Road as shown on the figure.

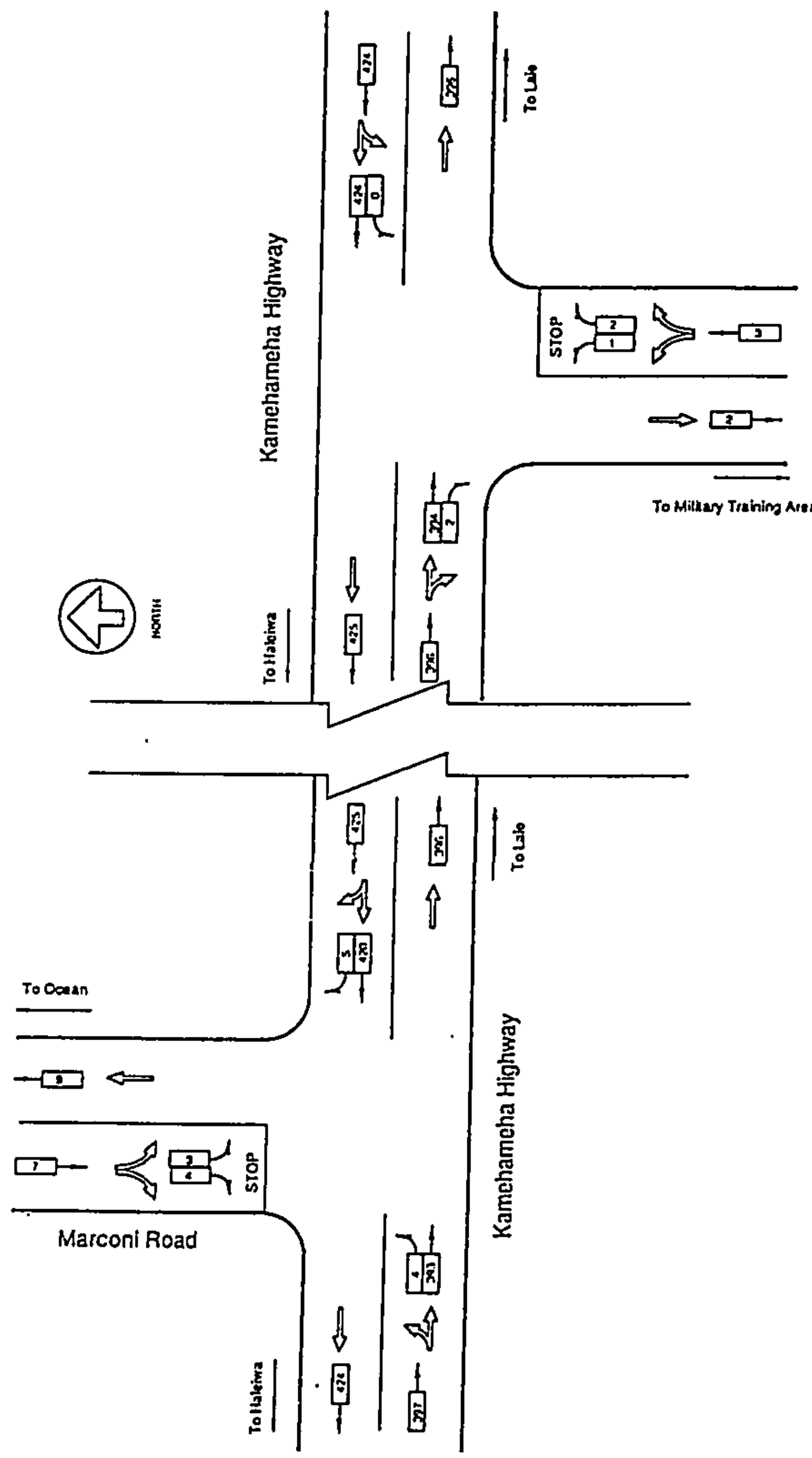

Figure 4. 1989 Saturday Afternoon Peak Hour Traffic
Kamehameha Highway @ Marconi and Military Road

FUTURE CONDITIONS

Future Land Uses

Three nearby developments which would likely contribute to traffic at the project site are the Kahuku Village Makai Subdivision, Campbell Estate's Malaekahana golf course, and the Turtle Bay Resort expansion. The Kahuku Village Makai project is an affordable housing subdivision to be constructed in Kahuku Town near the municipal golf course. Completion of this project is estimated to be 1992.

The Campbell Estate's Malaekahana golf course is an eighteen hole golf course scheduled for completion in 1994.

Turtle Bay Resort has a long range plan for expanding the resort. By 1998, the resort plans to construct additional hotels and condominium units, develop another golf course, and add commercial space for a shopping center.

Future Roadway Facilities

Presently, there are no major roadway improvements planned by the Department of Transportation for Kamehameha Highway in the vicinity of the project.

The proposed project will realign the Military Road directly across Marconi Road to form a 4-way intersection with Kamehameha Highway.

PROJECTED TRAFFIC CONDITIONS

Future traffic forecasts without and with the project were estimated for the year 1998. Traffic generated by major future developments were used to forecast traffic without the project. The additional traffic volumes from ambient growth and the proposed project were added to the present traffic counts to arrive at the 1998 forecast volumes with project.

Future Ambient Traffic

Ambient traffic is the traffic which would occur if the proposed project were not built. In this study, the 1998 ambient traffic was based on the traffic growth trend on Kamehameha Highway and traffic generated by major future developments.

Traffic counts by the State DOT shows that the average daily traffic on Kamehameha Highway has been increasing by about 2.5% annually, as discussed in the "Area Conditions" section of this report. The traffic growth rate on Kamehameha Highway generally reflects traffic increases from developments outside the study area. The existing peak hour through volumes, as shown in Figure 4, were increased by 22.5% (2.5% for 9 years) to obtain the growth trend forecast for 1998.

A three-step procedure of trip generation, distribution, and assignment was used to forecast future traffic due to three nearby developments: the Kahuku Village Makai Subdivision, Campbell Estate's Malaekahana golf course, and the Turtle Bay Resort expansion.

The trip generation step calculates the number of trips that would be generated during the peak hour by a particular development. The number of trips generated by the Kahuku Village Makai Subdivision and Campbell Estate's Malaekahana golf course were estimated using data from the ITE Trip Generation Report (Fourth Edition, 1987). The traffic generated by the Turtle Bay Resort expansion was estimated using the traffic report completed in 1985 by Austin Tsutsumi & Associates, Inc. (ATA) entitled, Traffic Impact Report For The Proposed Turtle Bay Resort. This study uses the generation rates and the traffic distribution analysis found in the ATA Traffic Impact Report.

Table 1 below shows the trip rates derived from the ITE and ATA reports and the number of trips generated by the proposed land uses for the weekend afternoon peak hour.

Table 1. Trip Generation for Ambient and Project Traffic

Saturday Afternoon Peak Hour

Land Use	Units	Size	Trip Rates Enter	Trip Rates Exit	Number of Trips Enter	Number of Trips Exit
Kahuku Village Makai	Trip/Dwelling	177 Dwellings	0.52	0.46	92	82
Malaekahana Golf Course	Trip/Acre	228 Acres	0.16	0.30	37	69
Turtle Bay Resort:						
Hotel	Trip/Room	2183 Rooms	0.14	0.13	306	285
Golf course	Trip/Acre	200 Acres	0.18	0.33	35	66
Shopping Center	Trip/1000 sf	40,000 sf	1.28	3.90	51	156
Condominium	Trips/Unit	1000 Units	0.14	0.13	140	130
Project: Golf Courses	Trips/Acre	605*	0.18	0.33	110	204

* Calculation made using estimated 200 acres per course.

Trip distribution and traffic assignment allocate the generated trips to the different directions of travel and specific turning movements on the roadway. The trip distribution and traffic assignment for Turtle Bay was based on the ATA report.

Traffic generated from the Kahuku Villages Makai Subdivision was distributed based on existing travel patterns derived from additional counts by PPE. About 45% of the traffic was distributed to the Haleiwa direction and 55% in the Laie direction.

Traffic generated by the Campbell Malaekahana Golf Course was distributed 70% in the Haleiwa direction and 30% in the Laie direction. It is expected that Turtle Bay Resort will be a major market for this golf course, with about 30% of its users from the resort.

When determining the traffic contribution on Kamehameha Highway due to the Kahuku Village Makai Subdivision and the Turtle Bay Resort expansion, it was assumed that 10% of traffic generated by these developments would remain in the Kahuku area. Traffic was assigned to Kamehameha Highway since it is the only through road in the area.

The volumes derived from increasing through traffic by the historical growth rate were added to the traffic generated by future developments in the area. The resultant ambient traffic volumes are shown in Figure 5.

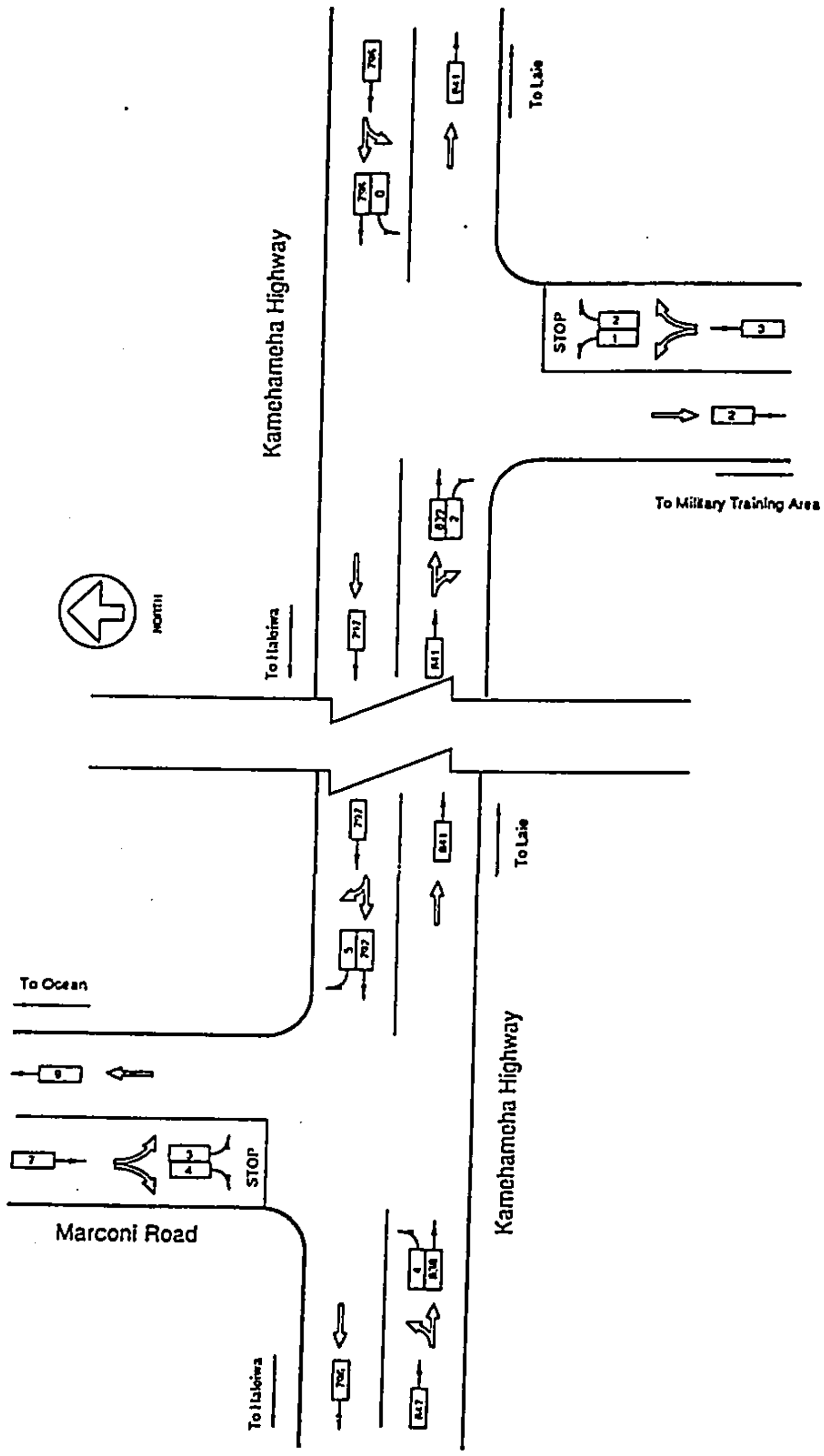

Figure 5. Forecasted Afternoon Peak Hour Traffic:
Kamehameha Highway & Marconi/Military Road
1998 Without Project

Project Generated Traffic

Traffic generated by Campbell Estate's proposed 605 acre site for the three golf courses was estimated using the three-step procedure of trip generation, distribution, and assignment. The number of trips and trip distribution were determined using data from the ITE Trip Generation Report (Fourth Edition, 1987) with the number of acres of the proposed golf course as the independent variable. When determining the trip generation for the Punamano project, separate calculations were made for each course with an estimated size of 200 acres. The trip generation rates and number of trips generated by the project are also shown in Table 1.

Trip distribution and traffic assignment allocate the generated trips to different directions of travel and specific turning movements on the roadway. The market for the Punamano Golf Courses are expected be tourists, especially from the Turtle Bay Resort, and local residents.

The project trips were distributed based on the distribution of population of Oahu and the shortest travel times to the project, with approximately 30% from the Kaneohe direction and 70% from the Haleiwa direction. It was estimated that 30% of the users would be from the Turtle Bay Resort. The project generated traffic entering and exiting the project site were assigned to Kamehameha Highway.

Total Traffic

Tables 2 and 3 summarize the existing and forecasted weekend afternoon peak hour traffic turning movements with and without the project at the study intersections. Figure 6 shows the resulting turning movement volumes with the proposed project.

Table 2. Intersection Turning Movements

Kamehameha Highway and Access Road "A"

	Kamehameha Highway				Access Road "A"	
	Laie Bound		Haleiwa Bound		Makai Bound	
Conditions	TH*	RT	LT	TH	LT	RT
Present	397	na	na	425	na	na
1998 w/out Project	842			797		
1998 with Project	892	26	11	887	50	21

na = not applicable

* TH=Through Lane, RT=Right Turn, LT-=Left Turn

**Austin Tsusumi & Associates' Turtle Bay Resort Traffic Impact Report, 1985

Table 3. Intersection Turning Movements

Kamehameha Highway and Marconi/Military Roads

	Kamehameha Highway						Military Road			Marconi Road		
	Laie Bound			Haleiwa Bound			Makai Bound			Mauka Bound		
Conditions	LT*	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Present	4	391	2	0	420	5	1	na	2	3	na	4
1998 w/out Project	4	836	2	0	792	5	1	na	2	3	na	4
1998 with Project	4	857	52	22	803	5	91	3	42	18	1	4

na = not applicable

* TH=Through Lane, RT=Right Turn, LT-=Left Turn

**Austin Tsusumi & Associates' Turtle Bay Resort Traffic Impact Report, 1985

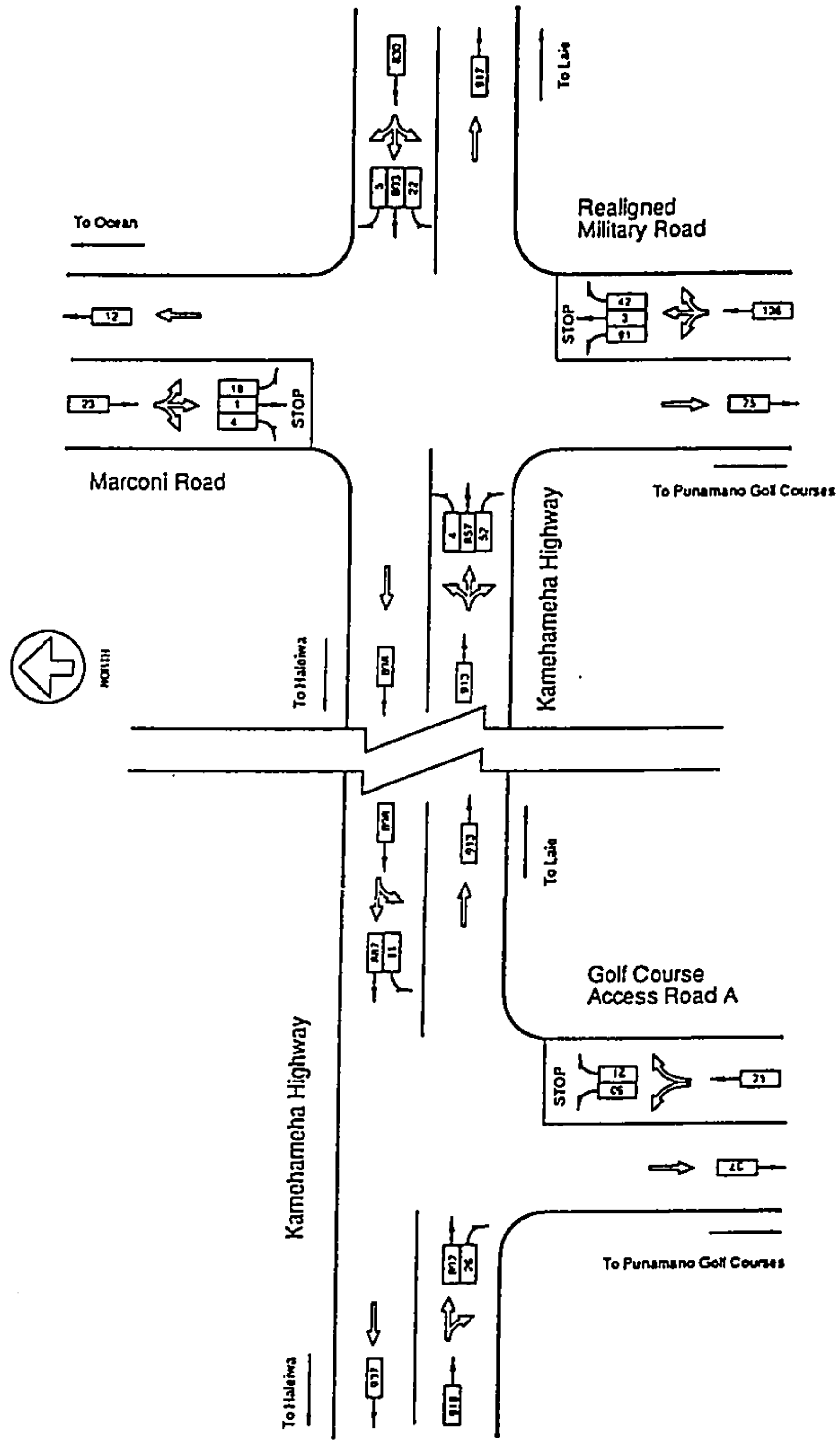

Figure 6. Forecasted Afternoon Peak Hour Traffic:
Kamehameha Highway & Access Roads
1998 With Project

TRAFFIC IMPACT ANALYSIS

Level-of-Service

Impacts on traffic resulting from the project were measured by the change in Level-of-Service (LOS) for the study intersections for traffic conditions with and without the project. The existing traffic, ambient traffic, and total traffic with project were analyzed using the methodologies for unsignalized intersections contained in the TRB Highway Capacity Manual Special Report 209 (1986).

The intersections of Kamehameha Highway with Marconi Road, Military Road, and Road "A" were analyzed using the methodology for analyzing unsignalized intersections. This method is based on the estimated number of turning movements that could occur through a conflicting traffic stream for stop or yield controlled turning movements. The LOS is determined by the amount of reserve capacity for a turning movement.

The methodology for unsignalized intersection analysis yields LOS ranging from A to F. The LOS for the traffic movements at an unsignalized intersection, summarized in Appendix A, is classified into six categories ranging from little or no delay (LOS A) to extreme delay (LOS F). The results are summarized in Tables 4 and 5.

The analysis indicates that presently, the study intersections are operating with little or no delays for all turning movements during the Saturday afternoon peak hours. The left turn movements from Kamehameha Highway into Marconi Road and Military Road operate with little or no delays (LOS A).

Table 4. Level-of-Service @ Kamehameha Highway and Access Road "A"

	Kamehameha Hwy	Access Road "A"	
	Haleiwa Bound	Makai Bound	
	LT	LT	RT
1989 - Present	na	na	na
1998 - w/out Project	na	na	na
1998 - With Project	B	F	F

na = not applicable TH=Through Lane, LT=Left Turn, RT=Right Turn

Table 5. Level-of-Service @ Kamehameha Highway with Marconi and Military Road

	Kamehameha Hwy		Military Road			Marconi Road		
	Kahuku Bd	Haleiwa Bd	Makai Bd			Mauka Bd		
	LT	LT	LT	TH	RT	LT	TH	RT
1989 - Present (Separate)[1]								
Kamehameha & Military Road	na	A	B	na	na	na	na	na
Kamehameha & Marconi Road	A	na	na	na	na	B	na	na
1998 - w/out Project (Separate)[1]								
Kamehameha & Military Road	na	A	D	na	na	na	na	na
Kamehameha & Marconi Road	A	na	na	na	na	D	na	na
1998 - With Project (4-Way Int)[2]	A	B	F	F	F	E	E	E

[1]Marconi and Military Roads form T-Intersection with Kamehameha Highway, 800' apart.

[2]Military Road realigned to form 4-way intersection with Marconi Road.

By 1998, without the project, the left turn movements from Kamehameha Highway into Marconi Road and Military Road will continue to operate at LOS A. Kamehameha Highway through traffic will experience little or no delays. However, the LOS for vehicles attempting to exit Marconi Road and Military Road onto Kamehameha Highway will worsen. Marconi road and Military Road will operate at LOS D with long delays during the weekend afternoon peak hour. This increased delay is due in part to an increase in traffic along Kamehameha Highway as well a traffic generated from the nearby developments.

With the project completed in 1998, the left turn movements from Kamehameha Highway into Marconi Road will remain at LOS A while left turn movements into Military Road and Road "A" will operate at LOS B. Traffic on Kamehameha Highway at these intersections will experience a little delay during the Saturday afternoon peak hour.

The LOS for vehicles attempting to exit the minor roads onto Kamehameha Highway will worsen. The LOS for vehicles exiting Marconi Road will drop from LOS D to LOS E. The LOS for vehicles exiting Military Road will drop from LOS D to LOS F. The LOS for vehicles exiting Road "A" will be LOS F.

If an exclusive right turn lane were provided for the Military Road and Road "A", the delays for vehicles turning right would decrease. Vehicles exiting the access road turning right would experience average delays (LOS C). The LOS for left or through traffic would remain at LOS F

CONCLUSIONS AND RECOMMENDATIONS

The proposed Punamano Golf Course Site of The Country Courses at Kahuku will not significantly impact the traffic flow on Kamehameha Highway in 1998 when the project is expected to be completed.

Results of the intersection analyses show that the project will cause little delay (LOS B) to traffic along Kamehameha Highway during the weekend afternoon peak hour. The left turn traffic into Military Road and Road "A" from Kamehameha Highway will operate at LOS B in 1998 with the project. The left turn traffic into Marconi Road from Kamehameha Highway will remain at LOS A with or without the project.

By 1998, even without the project, the LOS for vehicles attempting to exit Marconi Road and Military Road onto Kamehameha Highway will operate with long delays during the weekend afternoon peak hour. Vehicles exiting Marconi Road and Military road will operate at LOS D. This increased delay is due in part to an increase in traffic along Kamehameha Highway as well as traffic generated from nearby developments.

With the project completed in 1998, the LOS for the vehicles attempting to exit Marconi Road and Military Road will worsen. The LOS for vehicles exiting Marconi Road will drop from LOS D to LOS E while the LOS for vehicles exiting Military Road will drop from LOS D to LOS F. Vehicles exiting the newly constructed Road "A" will experience LOS F. The delays for vehicles exiting these intersections are expected only during the peak hours.

To minimize the very long delays for traffic exiting Military Road and Road "A", it is recommended that exclusive right and left turn lanes be provided along the realigned Military Road and Road "A" for traffic entering onto Kamehameha Highway. This will permit vehicles attempting right turns to bypass the left/through traffic and decrease delays for vehicles attempting right turns.

APPENDIX A

Definition of Level-of-Service For

Unsignalized Intersections

APPENDIX A
DEFINITION OF LEVEL-OF-SERVICE

For unsignalized intersections, the traffic most impacted will be the minor or cross-street with the stop or yield control. The major roadway will have the right-of-way. The level-of-service is the amount of delay expected for the average vehicle desiring to cross or enter the major road. The following gives a general description of the measure.

The concept of levels of service is defined as a qualitative measure describing operational conditions within a traffic stream, and their perception by motorists and/or passengers. A level of service definition generally describes these conditions in terms of such factors as speed and travel time, freedom to maneuver, traffic interruptions, comfort and convenience, and safety.

Six levels of service are defined for each type of facility for which analysis procedures are available. They are given letter designations, from A to F, with level-of-service A representing the best operating conditions and level-of-service F the worst.

<u>Level-of-Service definitions</u>--In general, the various levels of service are defined as follows for uninterrupted flow facilities:

<u>Level-of-service A</u> represents free flow. Individual users are virtually unaffected by the presence of others in the traffic stream. Freedom to select desired speeds and to maneuver within the traffic stream is extremely high. The general level of comfort and convenience provided to the motorist, passenger, or pedestrian is excellent.

<u>Level-of-service B</u> is in the range of stable flow, but the presence of other users in the traffic stream begins to be noticeable. Freedom to select desired speeds is relatively unaffected, but there is slight decline in the freedom to maneuver within the traffic stream from LOS A. The level of comfort and convenience provided is somewhat less than at LOS A, because the presence of others in the traffic stream begins to affect individual behavior.

<u>Level-of-service C</u> is in the range of stable flow, but marks the beginning of the range of flow in which the operation of individual users becomes significantly affected by

interactions with others in the traffic stream. The selection of speed is now affected by the presence of others, and maneuvering within the traffic stream requires substantial vigilance on the part of the user. The general level of comfort and convenience declines noticeably at this level.

Level-of-service D represents high-density, but stable, flow. Speed and freedom to maneuver are severely restricted, and the driver or pedestrian experiences a generally poor level of comfort and convenience. Small increases in traffic flow will generally cause operational problems at this level.

Level-of-service E represents operating conditions at or near the capacity level. All speeds are reduced to a low, but relatively uniform value. Freedom to maneuver within the traffic stream is extremely difficult, and it is generally accomplished by forcing a vehicle or pedestrian to "give way" to accommodate such maneuver. Comfort and convenience levels are extremely poor, and driver or pedestrian frustration is generally high. Operations at this level are usually unstable, because small increases in flow or minor perturbations within the traffic stream will cause breakdowns.

Level-of-service F is used to define forced or breakdown flow. This condition exists wherever the amount of traffic approaching a point exceeds the amount which can traverse the point. Queues form behind such locations. Operations within the queue are characterized by stop-and-go wave, and they are extremely unstable. Vehicles may progress at reasonable speeds for several hundred feet or more, then be required to stop in a cyclic fashion. Level-of-service F is used to describe the operating conditions within the queue, as well as the point of the breakdown. It should be noted, however, that in many cases operating conditions of the vehicles or pedestrians discharged from the queue may be quite good. Nevertheless, it is the point at which arrival flow exceeds discharge flow which causes the queue to form, and level-of-service F is an appropriate designation for such points.

These definitions are general and conceptual in nature, and they apply primarily to uninterrupted flow. Levels of service for interrupted flow facilities vary widely in terms of both the user's perception of service quality and the operational variables used to describe them.

APPENDIX B

Manual Traffic Count Data

KAMEHAMEHA HIGHWAY AND ACCESS ROAD "A"

JANUARY 21, 1989, PM

	KAMEHAMEHA HIGHWAY						ACCESS ROAD	
	Laie Bound			Haleiwa Bound			Makai Bound	
TIME	TH*	RT	LT	TH	RT	LT	LT	RT
1:45-2:00	103	NA	NA	105	NA	NA	NA	NA
2:00-2:15	91			120				
2:15-2:30	99			98				
2:30-2:45	101			99				
2:45-3:00	106			108				
PEAK HOUR	397			425				

KAMEHAMEHA HIGHWAY AND MARCONI/MILITARY ROAD

JANUARY 21, 1989, PM

	KAMEHAMEHA HIGHWAY						MILITARY ROAD			MARCONI ROAD		
	Laie Bound			Haleiwa Bound			Makai Bound			Mauka Bound		
TIME	LT*	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
1:45-2:00	0	100	3	1	102	1	2		0	2		1
2:00-2:15	0	91	0	0	117	0	1		1	0		2
2:15-2:30	0	97	2	0	98	2	0		1	1		0
2:30-2:45	2	99	0	0	98	0	0		0	1		1
2:45-3:00	2	104	0	0	107	3	0		0	1		1
PEAK HOUR	4	391	2	0	420	5	1	0	2	3	0	4

*LT=LEFT TURN, RT=RIGHT TURN, TH=THROUGH

NA=NOT APPLICABLE

APPENDIX C

State Department of Transportation
One Week Peak Hour Traffic Counts

Kamehameha Highway DOT Station C-29-B

Date (1989)	24-Hour Volume	Morning Peak Hour Time (am)	Vol.	Afternoon Peak Hour Time (pm)	Vol.
Sun, Jan. 31	7864	11:00-12:00	649	12:00-1:00	767
Mon, Feb. 1	9778	10:45-11:45	644	3:15-4:15	851
Tue, Feb. 2	9379	11:00-12:00	622	3:45-4:45	792
Wed, Feb. 3	9646	11:00-12:00	581	3:30-4:30	880
Thur, Feb. 4	9696	10:00-11:00	570	3:30-4:30	799
Fri, Feb. 5	10801	10:00-11:00	606	3:45-4:45	878
Sat, Feb. 6	11828	10:30-11:30	789	2:00-3:00	1092

PACIFIC PLANNING & ENGINEERING, INC.

COMPANY QUALIFICATIONS

JULY 1989

We provide planning and consultancy services to:

- Public Works Agencies
- Housing Agencies
- Transportation Departments
- Private Development Groups
- Major Facility Owners (Golf Courses, Major Resorts)
- Airports
- Airline Interests

We work closely with our clients to gain an understanding and appreciation of their needs beyond the bound report or design sheet. Our sensitivity to client needs arises from our experience in managing large public works departments. Our awareness of the pressures and nuances of management decision-making enables us to provide perspectives beyond the norm. Our understanding and working knowledge of agencies in planning and governance enable us to serve beyond the technical area.

Management Services

- Management Information Assistance
    - Rapid, Highly Focused Evaluations
    - Financial Analysis
    - Feasibility Studies
    - Organizational Assessments
- Planning and Design Team Management
- Construction Management
- Lease Negotiations
- Property Management Evaluations

Planning and Engineering Consultancy

- Assistance with Government Requirements
- Alternatives Analysis
- Traffic Impact Studies
- Traffic Engineering and Roadway Design
- Ground Transportation System Evaluations
- Facilities Planning

Personnel

The Principals of PPE, Inc. are Dr. Jonathan Shimada and Mr. Howard Abe. They have decades of experience and training in management and technical fields.

In managing the Hawaii Airports System for seven years, Dr. Jonathan Shimada has experience in:

-airport system management
-transportation planning consultancy
-traffic engineering and safety
-airport finance and budgeting
-lease and property management
-airline and retail concession operations
-ground transportation
-program planning and evaluation
-engineering administration
-media and public relations
-management and technical Workshops
-contract negotiations

He has a wide range of experience by having managed a large public works agency with a $120 million annual operating budget and over 800 employees. He has dealt with print and television reporters, small and large airport operators, State Legislature and County Governments, major retail businesses, protocol personnel, airlines, small businesses, ground transportation operators, special interest groups, and attorneys. This provides a strong and effective base for assisting those needing people and solutions who can deal effectively with technical problems, government agencies, and private enterprise. Dr. Shimada is well-known and respected in the world-wide system of airports, and particularly in the Pacific Basin.

Mr. Howard Abe's professional experience has been notable in its ever increasing management responsibilities. His management experiences, technical knowledge and field experience over three decades provide a strong and practical base. He is widely respected by the agencies he has served, and most significantly by government, media, private and community groups with whom he has worked. His awards and recognition are even more noteworthy when one considers they were given in the public service field of highways. He has received awards and recognition from such respected and diverse groups as:

-Maui Chamber of Commerce
-State Government
-Maui County
-Newspaper editors
-State legislators, mayors, and private citizens

His past achievements in his work represent abilities and knowledge which he will bring to bear in the most demanding and difficult planning/engineering situations.

PPE, Inc.--CLIENTS

Department of Housing and Community Development, City and County of Honolulu
Castle & Cooke
Queens' Development Corporation
Airport Operators Council International
The Estate of James Campbell
Hawaii Finance and Development Corporation, State of Hawaii
Princeville Development Corporation
Aloha Airlines
Japan Travel Bureau International
Department of Business and Economic Development, State of Hawaii
Department of Accounting and General Services, State of Hawaii
Signal Puako Corporation
R. M. Towill, Inc.
DHM, Inc.
Engineering Concepts, Inc.
Transcontinental Development Company
Department of Transportation
Aloha Tower Development Corporation

SAMPLING OF PROJECTS BY PPE, INC.

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Kapolei Town Center
Signal Puako
Maui Palisades
Honoapiilani Apartments
UH Hilo Expansion
Queens' Medical Center
Waikiki Landmark
Lanai Airport Planning
Lanai Highway Planning
Princeville Airport
Waikiki Convention Center
Honolulu Waterfront Development Project
Lanai City Traffic Circulation
Waikoloa Expansion Project
State Filming Facility
Lihue/Puhi District Project
Ewa Regional Long-Range Transportation Plan
Aloha Stadium Master Plan Update
Honolulu International Airport Intra-Airport Transportation System

APPENDIX C

ARCHAEOLOGICAL INVENTORY SURVEY FOR THE PROPOSED PUNAMANO GOLF COURSE, A PORTION OF THE COUNTRY COURSES AT KAHUKU

Archaeological Consultants of Hawaii

APPENDIX C

ARCHAEOLOGICAL CONSULTANTS
of
HAWAII

59-624 Pupukea Rd.
Haleiwa, Hawaii 96712
(808) 638-7442

JOSEPH KENNEDY
Archaeologist

Mr. William Wanket
William E. Wanket, Inc.
1001 Bishop St. Suite 660
Honolulu, Hawaii 96713

December 12, 1989

RE: **Archaeological Assessment and Reevaluation Report Concerning the Recently Surveyed, Proposed Punamano Golf Course; a Portion of the Country Courses at Kahuku.**

Dear Mr. Wanket:

EXECUTIVE SUMMARY

The following report represents a reevaluation of archaeological sites originally identified by PHRI* at the site of the proposed Punamano Golf Course, located at Kahuku, island of Oahu. The author of this report generally concurs with most of the PHRI identifications, evaluations and recommendations; however, we have added 2 new sites to the PHRI listings and a total of 14 additional features.

Our significance evaluations and mitigation plans agree with PHRI's, save for one site (4076) which we have modified to include preservation. We also feel that site 4070 should be considered as a possible burial until further testing proves otherwise. In addition, we have suggested a more substantial testing program in the newly identified features and sites order to help clarify the current situation.

INTRODUCTION

At the request of your office, Archaeological Consultants of Hawaii, Inc.** presents an assessment and reevaluation report of identical lands recently surveyed by Peter M. Jensen for PHRI, Inc. - a consulting archaeological firm - concerning the proposed Punamano Golf Course, located at Kahuku, island of Oahu.

* Paul H. Rosendahl, Ph.D., Inc. (PHRI)
* Archaeological Consultants of Hawaii, Inc. also referred to as ACH

This report will differ substantially from a standard archaeological inventory survey for several reasons;

1) First, and as mentioned, the identical property has been the object of a very recent, and in our opinion, very comprehensive and thorough inventory survey conducted by Jensen in April of this year. We deem it highly unlikely that any meaningful changes have been made to either the topography or the archaeological/historical sites contained on this property since the Jensen survey and the compilation of this report.

2) Secondly, we can see no reason for the representation of much of the archaeological survey data for a given area when:

a.) A previous survey of identical lands has taken place a few month's beforehand, and before any substantial changes have taken place;

b.) there has been adequate time to reexamine and evaluate the written report;

c.) there has been adequate time for field checking point data in the written report;.

d.) after subpoints a), b), and c), have been completed, the author of the reevaluation report is satisfied that the original report, in almost all cases, meets and exceeds current survey standards;

e.) conversations with Dr. Joyce Bath at the Department of Land and Natural Resources, Historic Sites Section indicate the a full duplication of effort is unwarranted.

METHODOLOGY

A resurvey of the proposed Punamano Golf Course was carried out over a four week period with field crew consisting of four members. This property was the object of a recent archaeological survey by Peter Jensen for PHRI.

At the request of the land owner, James A. Campbell Estate and William Wanket, Planner, Archaeological Consultants of Hawaii was called on to resurvey the area in question and submit an independent report for use in the owners development plans. Our tasks were to:

A. Relocate and retag all sites and features previously identified by Jensen.

B. Conduct a search for additional sites and tag them.

C. Resurvey a percentage of the property where no previous sites were identified by the Jensen report.

D. Reevaluate all identified sites and features in terms of function, significance and recommendations for future work.

Jensen's maps were used in the relocation of the sites and field checks of areas where no sites were recorded were conducted in a random fashion covering, roughly, 30% of these areas.

The results of these activities will be presented in six charts with the following titles:

1. List of original sites by PHRI at Punamano with no ACH changes.

2. Original sites identified by PHRI at Punamano with ACH alternative recommendations.

3. New sites and features identified at Punamano and ACH recommendations.

4. Description of new sites and site features found on subject property.

5. List of sites including newly identified features now located outside the project boundaries per E.I.S.

6. Comprehensive list of Punamano sites that are located on subject property.

LIST OF ORIGINAL SITES BY PHRI
AT PUNAMANO
WITH NO ACH CHANGES

(Please refer to Report 483-040489 PHRI Report April, 1989)
for Site Function/Recommendation & Significance

STATE SITE NUMBER		DESCRIPTION	CORRESPONDING ACH SITE NUMBER
4084	(T-25)	Terrace/Mound	S-1
4083	(T-24)	Rock Alignment	S-2
4078	(T-17)	Overhang/shelter complex	S-16
4078	(A)	Overhang	
4086	(T-27)	Ag clearing (recent)	S-18
4082	(T-22 A-K)	Burial Cliff	S-19
	(A)	Overhang/shelter	
	(B)	Overhang	
	(C)	Overhang	
	(D)	Overhang	
	(E)	Overhang/shelter	
	(F)	Midden Pocket	
	(G)	Overhang	
	(H)	Overhang/shelter	
	(I)	Overhang	
	(J)	Overhang	
	(K)	Overhang	
4098	(T-28)	Overhang/shelter	S-20
	(B)	Overhang/shelter	S-20(C)
	(A)	Overhang/shelter	
4073	(T-7)	Overhang/shelter	S-26
4074	(T-9)	Overhang/shelter	S-27

ORIGINAL SITES IDENTIFIED BY PHRI AT PUNAMANO WITH ACH ALTERNATIVE RECOMMENDATIONS

ACH Site Number:	S-5 (A)
State Site No.:	4076 (A) [T-15]
Feature Type:	Overhang
Function:	Habitation
PHRI Recommendation:	4-6 test cross-trenches
ACH Recommendation:	Same as PHRI
PHRI Significance :	D
ACH Significance :	C/D/E

ACH Site Number:	S-17 (A)
State Site #:	4077 (A) [T-16]
Feature Type:	Terrace Facing
Function:	Irrigation
PHRI Recommendation:	None
ACH Recommendation:	1 test trench
PHRI Significance :	None
ACH Significance :	D

ACH Site Number:	S-21 (B)
State Site #:	4071 (A) [T-4]
Feature Type:	Low stacked wall
Function:	Habitation (?) Ranching
PHRI Recommendation:	none
ACH Recommendation:	1 test trench
PHRI Significance :	NLS
ACH Significance :	D

ACH Site Number:	S-22 (B)
State Site #:	4070 (B) [T-3 A,B]
Feature Type:	Overhang/shelter
Function:	Possible burial
PHRI Recommendation:	Surface Check
ACH Recommendation:	1 Test trench & surface check
PHRI Significance :	D
ACH Significance :	D/E

Note* PHRI description of this feature corresponds more to feature A of site 4068 - which is no longer in project area.

ACH Site Number:	S-25 (A)
State Site #:	4072 (A) [T-5]
Feature Type:	Overhang/shelter
Function:	Habitation
PHRI Recommendation:	Surface Collection
ACH Recommendation:	1-2 test trenches & surface coll.
PHRI Significance :	D
ACH Significance :	Same as PHRI

CODE -NS -Not significant, NLS -No longer significant, A -Reflects major trends in history, B -Associated with significant person, C -Excellent site type, D -Important for scientific value, E -Cultural significance.

NEW SITES IDENTIFIED AT PUNAMANO AND ACH RECOMMENDATIONS

ACH Site Number: S-6
Feature Type: Enclosure complex
Function: Ranching (?)
ACH Recommendation: 1-2 Test trenches
ACH Significance: D

ACH Site Number: S-15
Feature Type: 1937 Irrigation ditch (maybe older below)
Function: Agricultural
ACH Recommendation: 1 Test trench
ACH Significance: D

NEW FEATURES IDENTIFIED AT PREVIOUSLY LOCATED SITES

Features found in ACH Site # S-5; State Site # 4076;
PHRI Site# T-15
Feature Type: Overhang/shelter complex

ACH Site Number: S-5 (B)
Feature Type: Low stacked wall
Function: Habitation or ranching
ACH Recommendation: 1 Test trench - interior
ACH Significance: C/D/E

ACH Site Number: S-5 (C)
Feature Type: Overhang/shelter
Function: Habitation
ACH Recommendation: 2-3 test trenches
ACH Significance: C/D/E

ACH Site Number: S-5 (D)
Feature Type: Low stacked wall, possible enclosure
Function: Habitation or ranching
ACH Recommendation: 1 test trench - interior
ACH Significance: C/D/E

ACH Site Number: S-5 (E)
Feature Type: Low stacked wall, possible enclosure
Function: Habitation or ranching
ACH Recommendation: 1 test trench
ACH Significance: C/D/E

ACH Site Number: S-5 (F)
Feature Type: Low stacked wall, possible enclosure
Function: Habitation or ranching
ACH Recommendation: 1 test trench
ACH Significance: C/D/E

NEW FEATURES IDENTIFIED AT PREVIOUSLY LOCATED SITES (CONT'D)

ACH Site Number: S-5 (G)
Feature Type: Overhang/shelter
Function: Habitation
ACH Recommendation: 1-2 test trenches
ACH Significance: C/D/E

ACH Site Number: S-5 (H)
Feature Type: Overhang/shelter
Function: Habitation
ACH Recommendation: 1-2 test trenches
ACH Significance: C/D/E

Features found in ACH Site # S-16; State Site # 4078;
PHRI Site # T-17
Feature Type: Overhang/shelter complex

ACH Site Number: S-16 (B)
Feature Type: Low stacked wall (possible enclosure)
Function: ranching (?)
ACH Recommendation: 1 test trench
ACH Significance: D

ACH Site Number: S-16 (C)
Feature Type: Low stacked wall (possible enclosure)
Function: ranching or trail mark
ACH Recommendation: 1 test trench
ACH Significance: D

Features found in ACH Site # S-17; State Site # 4077
PHRI # T-16
Feature type: Terrace/ditch complex

ACH Site Number: S-17 (B)
Feature Type: Wall/terrace
Function: irrigation or run-off protection
ACH Recommendation: none
ACH Significance: NLS

ACH Site Number: S-17 (C)
Feature Type: Auwai/modified crevasse
Function: irrigation
ACH Recommendation: Map course and grade of ditch
ACH Significance: D

Features found in ACH Site # S-21; State Site # 4071
PHRI Site # T-4
Feature type: Overhang shelter complex

NEW FEATURES IDENTIFIED AT PREVIOUSLY LOCATED SITES (CONT'D)

ACH Site Number: S-21 (A)
Feature Type: Overhang/shelter
Function: Habitation
ACH Recommendation: 1-2 test trenches
ACH Significance: D

Features found in ACH Site # S-25; State Site # 4072
PHRI Site # T-5
Feature Type: Overhang/shelter

ACH Site Number: S-25 (B)
Feature Type: Filled crevasse
Function: Burial (?)
ACH Recommendation: Recover burial or leave as is
ACH Significance: D/E

ACH Site Number: S-25 (C) *was ACH Site S-28*
Feature Type: Crevasse/shelter
Function: Habitation or trail
ACH Recommendation: 1-2 test trenches, surface collection
ACH Significance: D

DESCRIPTION OF NEW SITES AND SITE FEATURES FOUND ON SUBJECT PROPERTY

Site #: ACH (S-5); PHRI (T-15) STATE (4076)

New Features Found:

(B) Low stacked wall. Extends intermittently along length of ridge at top of coral escarpment for approximately 170 meters. Average width is 501cm., maximum height is 75cm. Constructed of medium sized rough limestone slabs 30-60cm. being the longest dimension. May have formed an enclosure in some places with parallel bedrock face on north.

(C) Overhang/shelter. Two overhang/shelters along south side of E-W ridge approximately 20meters below (south from) S-5E. Sheltered area is 3-4meters in length x 2meters deep, with a maximum interior height of 1.5meters. Some kukui shells and other midden observed, along with a small quantity of "black glass" ca. 1880's. Good excavation potential and a candidate for interpretive preservation along with the other features at Site S-5.

(D) Low stacked wall. 2.5meters length x 75cm. width x 50cm. average height. Wall structure partially closes off space between two reef blocks and may form an enclosure. Two small caves 1-2meters wide x 1meter deep are located on the interior (north) cliff face. No midden observed, however, some soil has accumulated within the enclosure and should be tested.

(E) Low stacked wall. 3.0meters length x 50cm. width, average height is 1.0meters. Forms semi-rectangular enclosure along top of ridge line.

(F) Low stacked wall. 5meters length N-S x 75cm. width x 1.30meters average height. Well constructed of flat limestone slabs 30-60cm. in diameter. Closes off a space between two coral outcrops.

(G) Overhang/shelter. Two overhangs running approximately 8meters E-W along cliff face, 1-2meters deep and average 1.5meters interior height. Numerous glass fragments ca. 1900-1920. No obvious surface midden but some soil accumulation.

(H) Overhang/shelter. Two overhangs 10meters total length x 1.75meters deep and average 1.5meters interior height. No surface midden but some charcoal stains mixed with accumulated soil.

DESCRIPTION OF NEW SITES AND SITE FEATURES
Continued

S-6 (New ACH site) Enclosure Complex. Two low stacked walls running parallel for approximately 30meters (NW-SE). Constructed of medium to large limestone blocks. Two small circular enclosures are located at either end consisting of a single course of medium limestone. A modified crevasse/ditch runs along the outer face of the northern wall. No surface artifact or midden observed.

S-15 (New ACH site) 1937 irrigation ditch. Concrete and cobble lined irrigation ditch with date 1937 inscribed. Runs into modern ditch which follows Kalaeokahipa gulch through the property.

S-16 ACH / (T-17 PHRI) / (4078 State) Overhang/shelter Complex

New Features found:
(B) Low stacked wall. 30meters NW of feature A, low stacked wall of medium size flat limestone blocks 5meters length x 50cm. width x 1meter height. Closes off area between two cliffs.

(C) Low stacked wall. Approximately 50meters SE of feature A is a second wall closing off a passage between two cliff faces and forming a trail boundary ascending the slope. Structure is 4meters length x 75cm. width x 1meter height.

S-17 ACH / (T-16 PHRI) / (4077 State) Terrace/ditch complex

New Features found:
(B) Wall/terrace. Approximately 1meter long, of similar size and construction as feature A to the north. It served a similar function, leveling a path or narrow terrace running 8meters SE-NW, 1.5meters average width.

(C) Auwai/modified crevasse. Modified crevasse running roughly E-W for 18meters along top of ridge 5-10meters upslope from terrace walls A and B. Channel width averages 50cm. with rocks from inside stacked on some edges along the course. Terminates on west with bulldozer push and on the east it approaches the terrace from above.

DESCRIPTION OF NEW SITES AND SITE FEATURES
Continued

S-21 ACH / (T-4 PHRI) / (4071 State) Overhang shelter complex

New Feature found:
(A) Overhang/shelter. Two adjacent overhangs under large boulder next to PHRI site T-4B(4071). Ash colored soil but no obvious signs of pre-historic use. Overhangs measure 3meters and 5meters in length respectively, 1-2meters deep and 1-2meters interior height.

S-25 ACH / (T-5 PHRI) / (4072 State) Overhang/shelter

New Features found:
(B) Filled crevasse. Crack in cliff face extending from feature A some 30meters SSW behind and parallel to cliff. Possible human burial under fill. Many bones were observed but close examination was not possible without further clearing.

(C) Crevasse/shelter. Large crevasse between two sections of coral bedrock behind overhang sites S-25A and S-26. A long grotto 30-40meters with modern trash and army comm. wire but interesting because it forms a trail up the steep slope and a "secret passage" behind the cliff. Possible habitation site, however, no surface midden was observed. Note: ACH had previously assigned this site temporary site number S-28, however, further examination shows that this site should have been a feature of S-25.

LIST OF SITES
INCLUDING NEWLY IDENTIFIED FEATURES
NOW LOCATED OUTSIDE THE PROJECT BOUNDARIES PER E.I.S.

Site Number	Description
S-7	Overhang/shelter
S-8*	Habitation/Burial Complex
S-8 (A)	Overhang/shelter
S-8 (B)	Rock-filled crevasse
S-8 (C)	C-Shape
S-8 (D)	2 Low stacked walls
S-8 (E)	Overhang/shelter
S-9	2 Low stacked walls
S-10	Historic Dump Site
S-12	Overhang/shelter
S-13	Terrace/alignment
S-14 (A)	Enclosure
S-14 (B)	Low stacked wall
S-23 (A)	Overhang/shelter
S-23 (B)	Overhang/shelter
S-23 (C)	Overhang/shelter
S-24	Wall/overhang

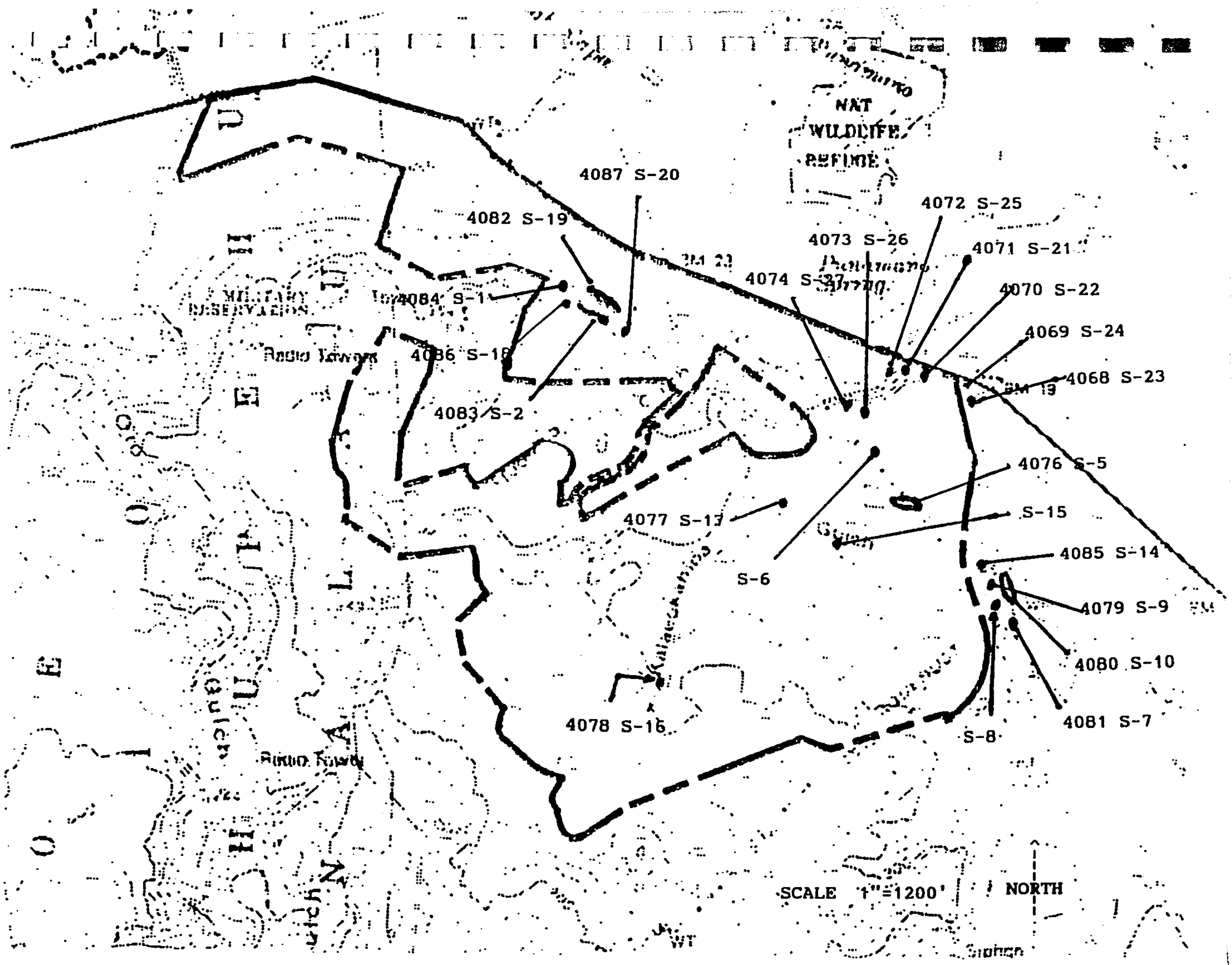
* Though now located just outside the project boundary on and below the cliff face, care must be taken not to push construction debris over the side to avoid damaging these sites. These features were not listed in the PHRI report.

COMPREHENSIVE LIST OF PUNAMANO SITES THAT ARE LOCATED ON SUBJECT PROPERTY

Site Number (ACH #/PHRI #/State #)		Description
1)	S-1/T-25/4084	Terrace/Mound
2)	S-2/T-24/4083	Rock alignment
3)	S-5/T-15/4076	Overhang/shelter Complex
	Feature A	Overhang
	Feature B	Low Stacked Wall
	Feature C	Overhang/shelter
	Feature D	Low Stacked Wall
	Feature E	Low Stacked Wall
	Feature F	Low Stacked Wall
	Feature G	Overhang/shelter
	Feature H	Overhang/shelter
4)	S-6 No corresponding site numbers-PHRI/State	Enclosure complex
5)	S-15 Same as above	1937 irrigation ditch
6)	S-16/T-17/4078	Overhang/shelter complex
	Feature A	Overhang
	Feature B	Low Stacked Wall
	Feature C	Low Stacked Wall
7)	S-17/T-16/4077	Terrace/ditch complex
	Feature A	Terrace facing
	Feature B	Wall/terrace
	Feature C	Auwai/modified crevasse
8)	S-18/T-26/4086	Wall
9)	S-19/T-22 A-K/4082	Burial Cliff
	Feature A	Overhang/shelter
	Feature B	Overhang
	Feature C	Overhang
	Feature D	Overhang
	Feature E	Overhang/shelter
	Feature F	Midden pocket
	Feature G	Overhang
	Feature H	Overhang/shelter
	Feature I	Overhang
	Feature J	Overhang
	Feature K	Overhang

COMPREHENSIVE LIST OF SITES
Continued

Site #		Description
10)	S-20/T-28/4087	Overhang/shelter
11)	S-21/T-4/4071	Overhang shelter complex
	Feature A	Overhang/shelter
	Feature B	Low Stacked Wall
	Feature C	Overhang/shelter
12)	S-22/T-3 A&B/4070	Overhang/shelter complex
	Feature A	Overhang/shelter
	Feature B	Overhang/shelter
13)	S-25/T-5/4072	Overhang/shelter
	Feature A	Overhang/shelter
	Feature B	Filled Crevasse
	Feature C	Crevasse/shelter
14)	S-26/T-7/4073	Overhang/shelter
15)	S-27/T-9/4074	Overhang/shelter


NAT WILDLIFE REFUGE
MILITARY RESERVATION
Radio Towers
4087 S-20
4082 S-19
4084 S-1
4086 S-18
4083 S-2
4073 S-26
4074 S-27
4072 S-25
4071 S-21
4070 S-22
4069 S-24
4068 S-23
BM 19
4076 S-5
S-15
4085 S-14
4079 S-9
4080 S-10
4081 S-7
S-8
4077 S-17
S-6
4078 S-16
SCALE 1"=1200'
NORTH

CONCLUSIONS
MITIGATION NOTES

Most of the cliff faces will not be graded according to the draft EIS. This includes S-22 (4070), S-21 (4071), S-16 (4078), S-25 (4072), S-26 (4073), S-19 (4082), and S-20 (4087). Section 4.10-c-3 of the EIS says measures will be implemented to protect these sites. It is our opinion that somewhat extensive data recovery will be necessary for some of these sites. If they are to be preserved, a more limited data recovery plan for these sites may be appropriate, followed by fencing with landscaping in order to protect unexcavated strata from disturbance.

Since important sites identified in the former project area - S-7 (4081), S-8, S-9 (4079), S-10 (4080), S-12, S-13, S-14 (4085), S-23 (4068) and S-24 (4069) - are now just outside the boundary below the top of the cliffs, care must be taken that no construction debris is pushed over the edge as damage to these sites would be likely to occur as a result.

Of the four sites located in areas subject to direct effects of the grading and construction, we differ from the PHRI report and EIS on two accounts; we believe that site S-17, a terrace/ditch listed as no longer significant should have one or two test probes and there also should be a more detailed examination of the surrounding irrigation system.

Site S-5, listed as significant for data recovery only, by PHRI. We suggest active, or passive preservation status for this site with limited data recovery. This recommendation is based in part on the integrity of the site, the evidence that a variety of activities took place there and the scarcity of intact precontact sites in the general area.

In addition, this site also represents an interesting, and somewhat unique adaptation by aboriginal Hawaiians to a local environment and therefore is symbolic of a specific cultural niche. We concur that the two other sites S-1 (4084) and S-18, (4086) are modern agricultural features and should be considered no longer significant (NLS).

A number of other sites were recorded which were not recorded in the PHRI report. For the most part, we described these as additional features associated with or attached to the PHRI sites already listed. The PHRI report states that some features were not recorded because no evidence was found to indicate human use. Others may have been overlooked because of the heavy vegetation and terrain. Without the benefit of subsurface testing and evaluation, and until such tests can be implemented, ACH has included these features as component parts of sites believed to be primary habitation areas.

Our newly added features will be subject to the same mitigation plans established for the original sites since they are essentially in the same location or in areas where no construction or grading will occur. Other sites, newly identified, must be assessed or reevaluated with regard to their location in the project area and the development of the grading plan for that specific location. New sites for which no mitigation plan has been established in the current draft EIS include: S-5 (4076 - features B through H), S-6, S-15, S-17, and S-25 (4072).

If there are any questions regarding this report, please feel free to contact me.

Aloha,

Joseph Kennedy
Consulting Archaeologist

BIBLIOGRAPHY

Jensen, Peter M. 1989 Archaeological Inventory Survey Punamano and Malaekahana Golf Course. PHRI Report 483-040489. Hilo.

ADDENDUM
TO
APPENDIX C

MEA 'IKE HANA LIMA O KE AU I HALA
1980

ARCHAEOLOGICAL CONSULTANTS
of
HAWAII

59-624 Pupukea Rd.
Haleiwa, Hawaii 96712
(808) 638-7442

JOSEPH KENNEDY
Archaeologist

Mr. William Wanket
William E. Wanket, Inc.
1001 Bishop, Suite 660
Honolulu, Hawaii 96713

April 20, 1990

RE: **Proposed Golf Course at Punamano, A Portion of the Country Courses at Kahuku**

Dear Mr. Wanket:

At the request of the Department of Historic Sites and your office, a brief follow-up to the first phase of testing was conducted over a one week period in April, 1990, by a team of three archaeologists. The specific goals of this work were:

1. Re-examine and test features in the vicinity of cave/shelter 4076A with regard to significance evaluations and recommendations for preservation. Map all of the features to accurately show their spatial relationship along the cliff face.

2. Evaluate sites previously identified outside of the property boundaries which are now included in the project area. These sites are 4068, 4069, 4079, 4080, 4081, 4085, and primary burial site 4230(S-8 A-F). All sites within the project area must be included in the mitigation proposals, with significance assessments and recommendations for further work and/or preservation, if needed.

3. Modify tables in the original survey report to facilitate reference by listing sites numerically by state site number, followed by ACH and PHRI temporary numbers. Create a comprehensive list of all sites on the property along with significance evaluations and recommendations for each feature.

Additional Sites Requiring Mitigation

A total of seven sites initially identified in the survey were located outside the project boundaries, but are now included in the development area. Six sites, including 4068, 4069, 4079, 4080, 4081, and 4085, were previously described and illustrated by Jensen for PHRI. A new site, 4230 (ACH temp.# S-8), was discovered adjacent to the old aqueduct line some 40 meters south of 4079 on the cliffs. These sites are now included in the comprehensive list of sites requiring mitigation contained in this report.

Description of Site 4230

Site 4230 consists of six features clustered around a small, relatively level clearing on the coral limestone cliffs in the eastern-most part of the project area (see map). Feature A is a modified overhang/shelter with an enclosed area of 2x2 meters. The enclosing wall of rough stones is open on the north and has a small "window" on the east. A small amount of midden and Kukui was observed on the surface.

Feature B is a concealed burial in a crevasse on the cliff face. Though close examination was not possible at this stage, the skeleton appeared to be in an extended position. A post was laid in the crevasse to support a covering of rough stones 20-40cm each.

Feature C is a C-shaped alignment 2.5 meters in length adjoining an overhang containing at least one burial (feature E). The structure, averaging 1 meter in height and .75 meter in width, may have been intended to channel rain water away from the cave entrance.

Feature D is two low stacked walls 2-3 meters in length, 1 meter in height, forming a trail or terrace between two limestone cliffs.

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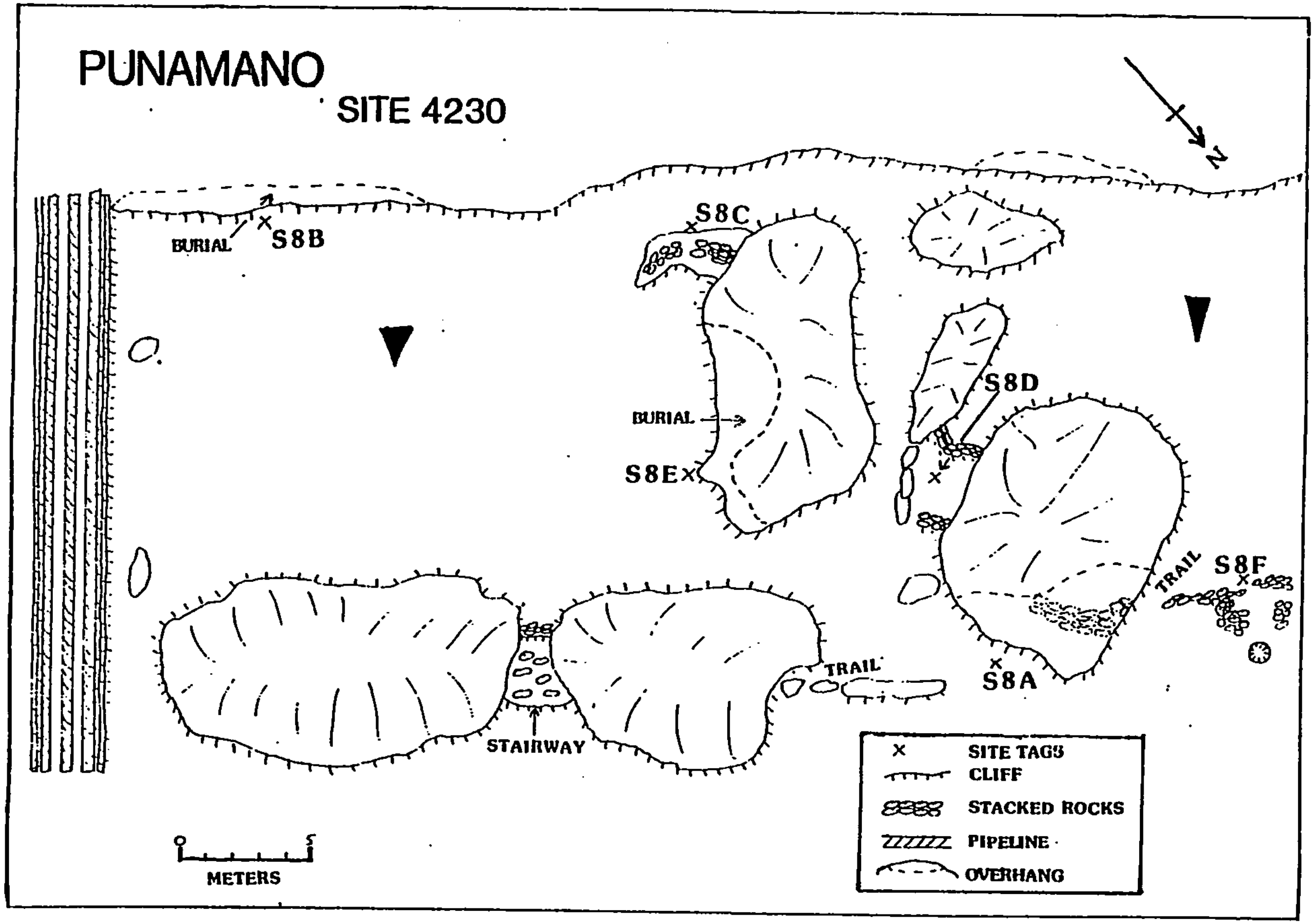


Feature E is a low overhang 2-3 meters deep with several interior sections parallel to the cliff face running south to north for 6 meters. The modified shelter, feature A, is on the opposite side of this large outcrop of limestone. Skeletal remains were observed behind a large rock in the back of the southern-most chamber. This may be a primary burial but it is quite disturbed. Near the entrance to this overhang are a few animal bones, perhaps dog or pig, along with some discarded camping equipment.

Feature F consists of several rock alignments or low mounds which may be evidence of a former trail or clearing activity fronting the features in site 4230. Data recovery will include more detailed mapping of this feature along with one or two test sections to check for underlying strata.

Test Excavations-Methodology

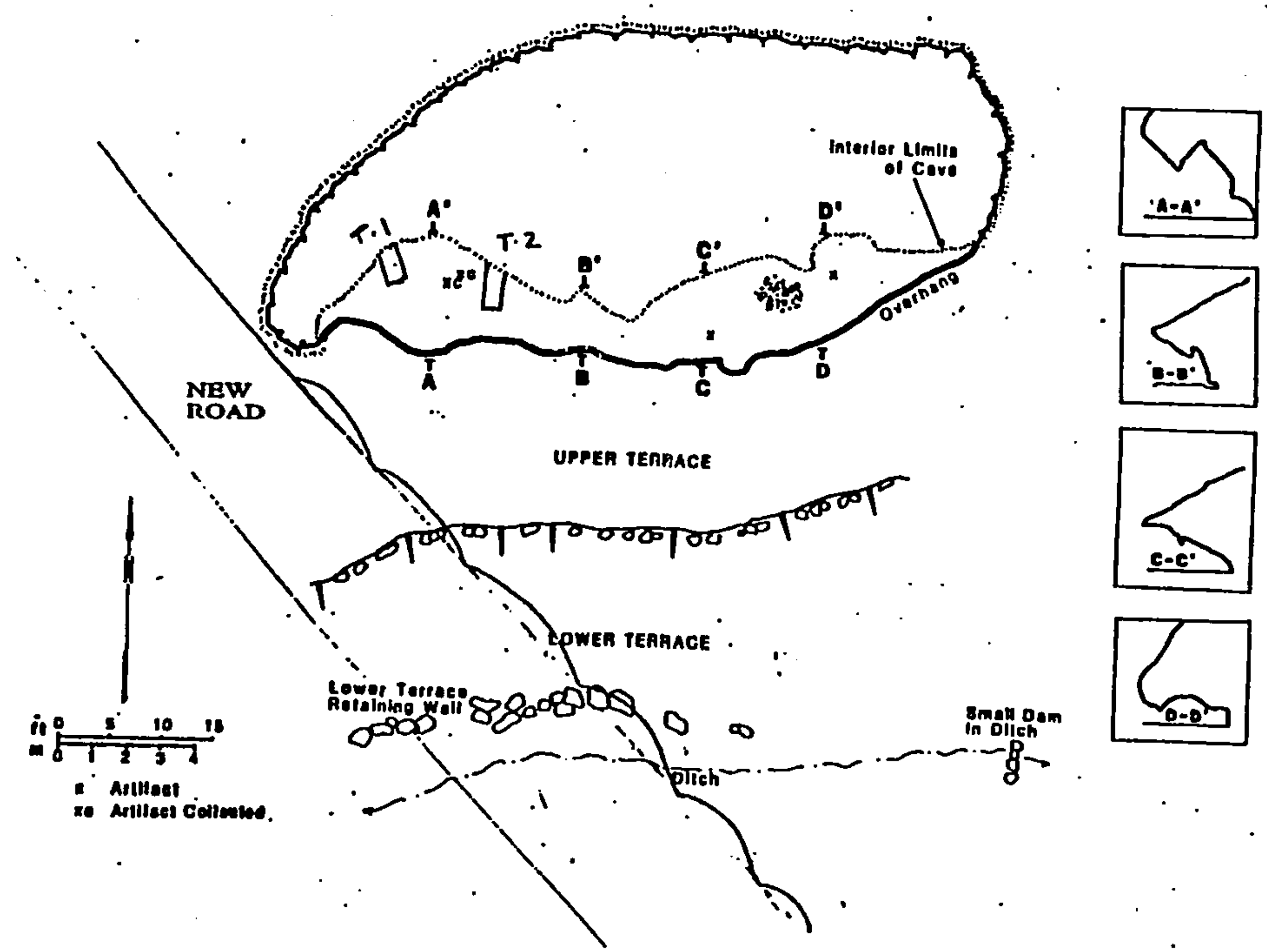
A total of four test excavation trenches were placed in three features at Site 4076, features A, E, and f. Standard size of each trench was 1.0 x 0.5 meters, carried to bedrock or sterile soil as indicated in the profile drawings. All soil was screened through 1/8" steel mesh to recover midden and artifacts, and samples of naturally occurring faunal remains were also collected. Layers were assigned to naturally occurring strata, generally averaging less than 10 cm. in depth.

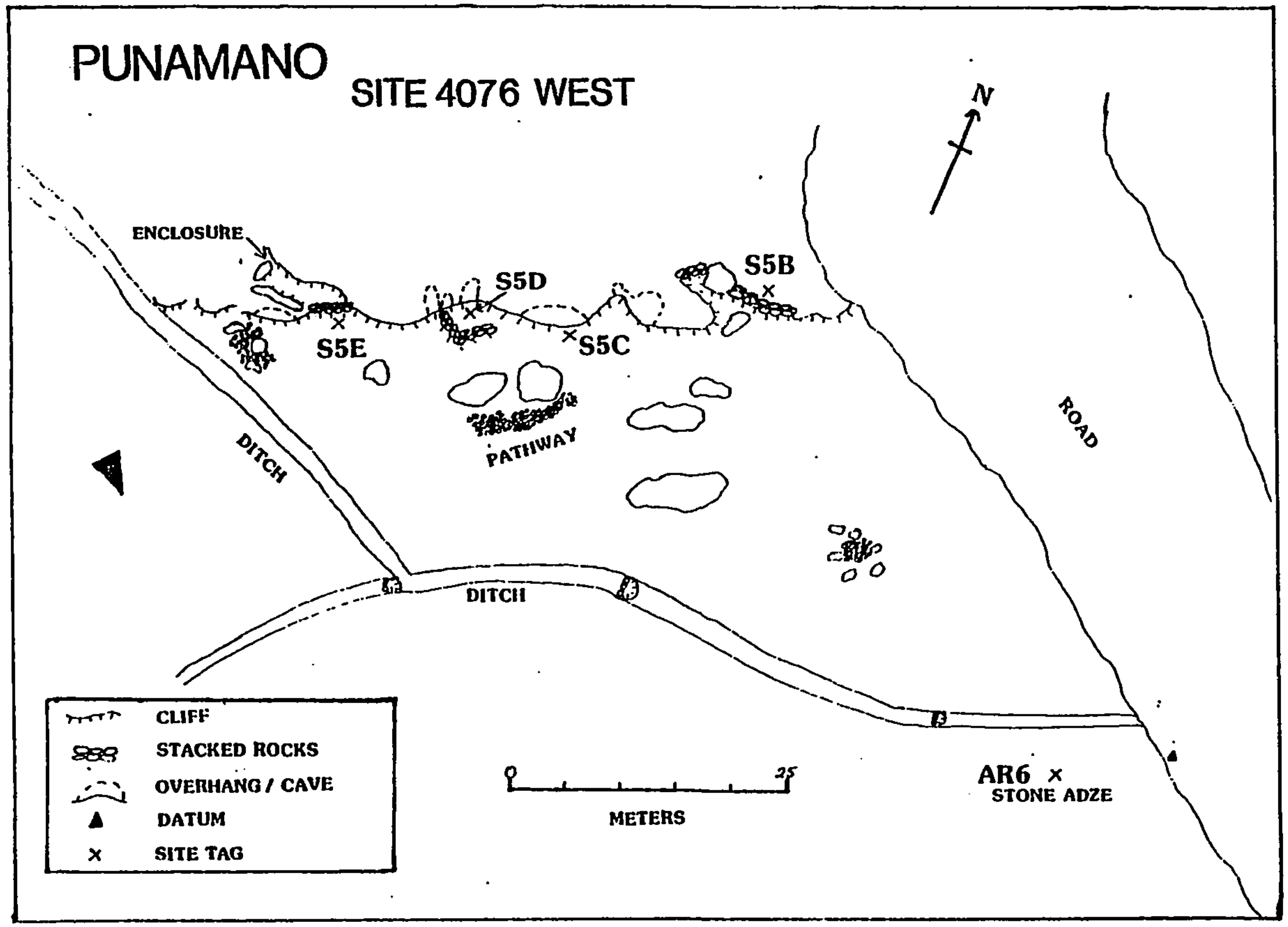
Testing of 4076A Overhang/Shelter

Two test trenches were positioned in the central feature of site 4076 in an effort to obtain bulk carbon samples for dating and other basic information about the occupants. Feature A is a rockshelter some 30 meters in length with a protected floor area 1-2 meters in depth. Ceiling height varies from 0.5-2.0 meters in four small chambers open to the south, or leeward direction (see map 4076). There is ample evidence of habitation on the surface including Kukui shells, broken cowry and other edible shellfish, and some fish bones. Several flakes of utilized basalt were recovered from the site previously, along with a fractured bowling stone (ulu maika) and part of a small adze.

Archaeological Consultants of Hawaii, Inc.
59-624 Pupukea Rd.
Haleiwa, Hawaii 96712

PUNAMANO   Site# 4076




PUNAMANO
SITE 4076 WEST
N
ENCLOSURE
S5D
S5B
S5E
S5C
PATHWAY
DITCH
ROAD
DITCH
CLIFF
STACKED ROCKS
OVERHANG / CAVE
DATUM
SITE TAG
0
25
METERS
AR6
STONE ADZE

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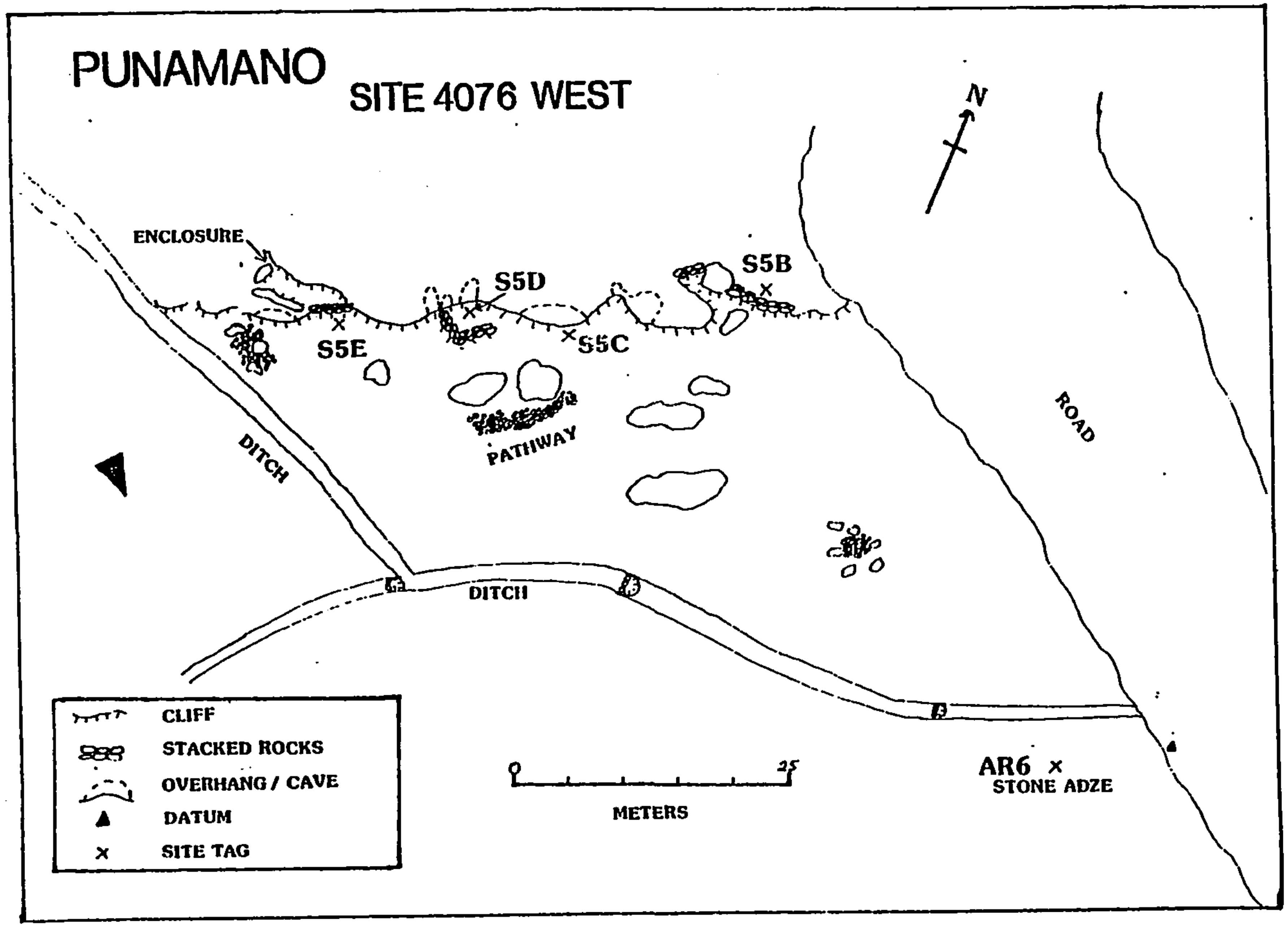

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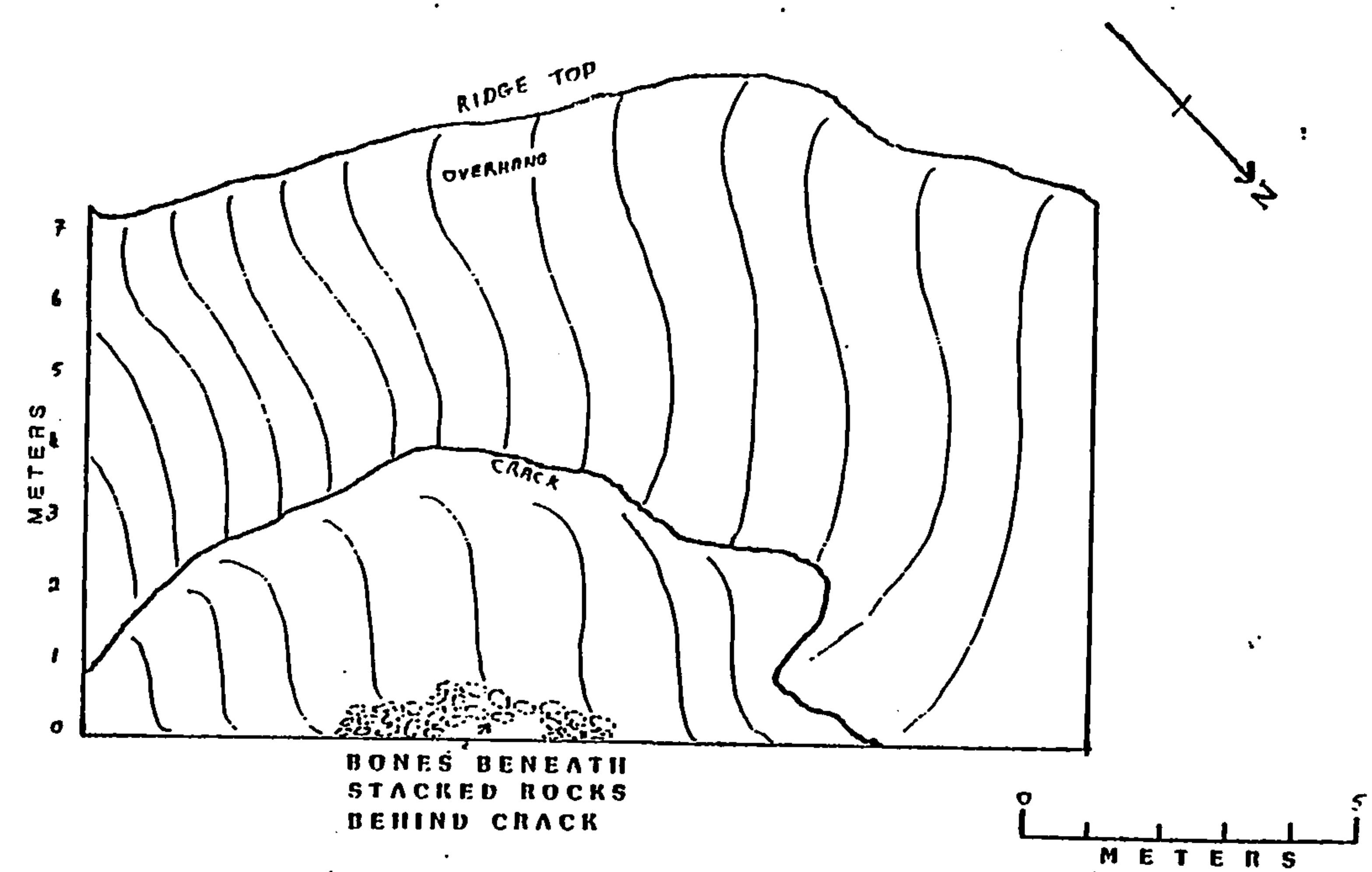
SITE S8B

PROFILE

Punamano



Trench T-1 was located in the northwest chamber over a small mound near the back of the shelter. Unfortunately, the mound resulted from a build-up of natural soil and not of midden as hoped. Layer 1 consisted of a loose reddish brown soil with occasional Kukui nut, bone and shell midden, to a depth of 5-8cm. Layer 2, 5-10 cm. thick, was similar to the upper layer but more compact, with lenses of charcoal and rubble from the coral bedrock towards the rear of the overhang. Layer 3 appeared to be a sterile, natural deposit of light red to cream colored, chalky clay.

The charcoal in layer 2 evidently came from a small fire pit which was cut into the sterile layer near the center of the trench. Material in this pit included burnt rock fragments, some kukui, charcoal, broken cowry and nerita. Similar finds were made in the rest of layer 2, but in much lower concentrations. Of interest is a single specimen of what may be an extinct form of Hawaiian Tree Snail recovered from this layer.

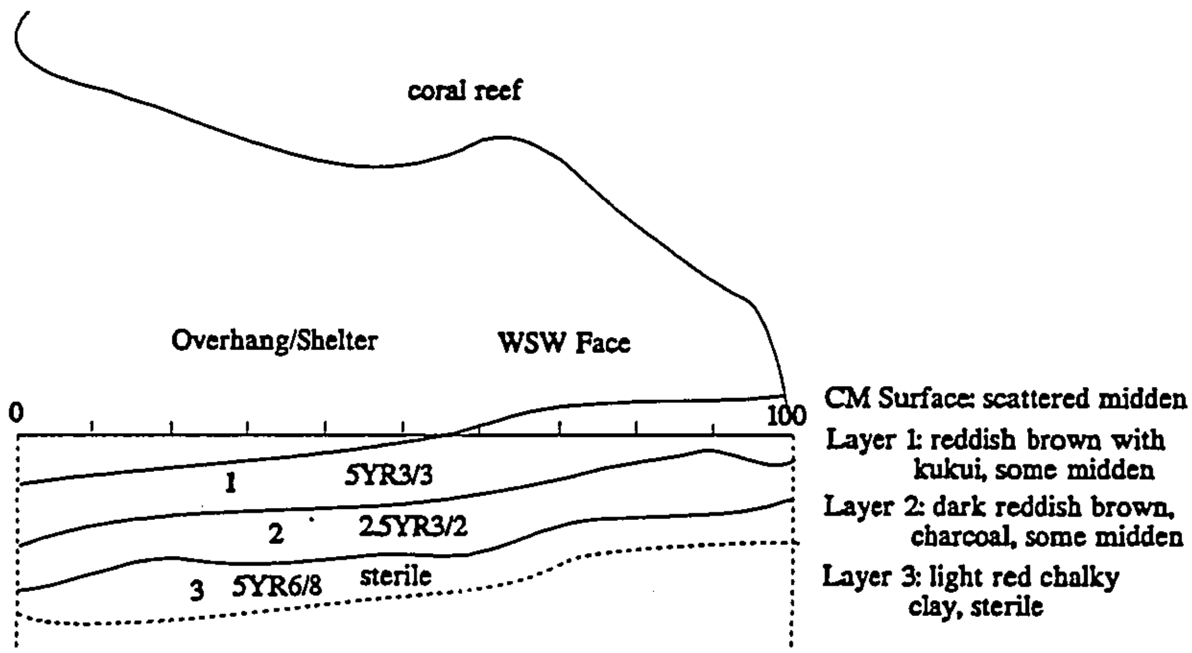
Trench T-2, located two meters east of trench T-1, provided evidence for deeper deposits. The second trench was perpendicular to the back wall of the overhang and parallel to a small interior terrace one meter further east. The terrace is an alignment of three or four rough stones, 20-30 cm. in height, back-filled and almost covered from the east.

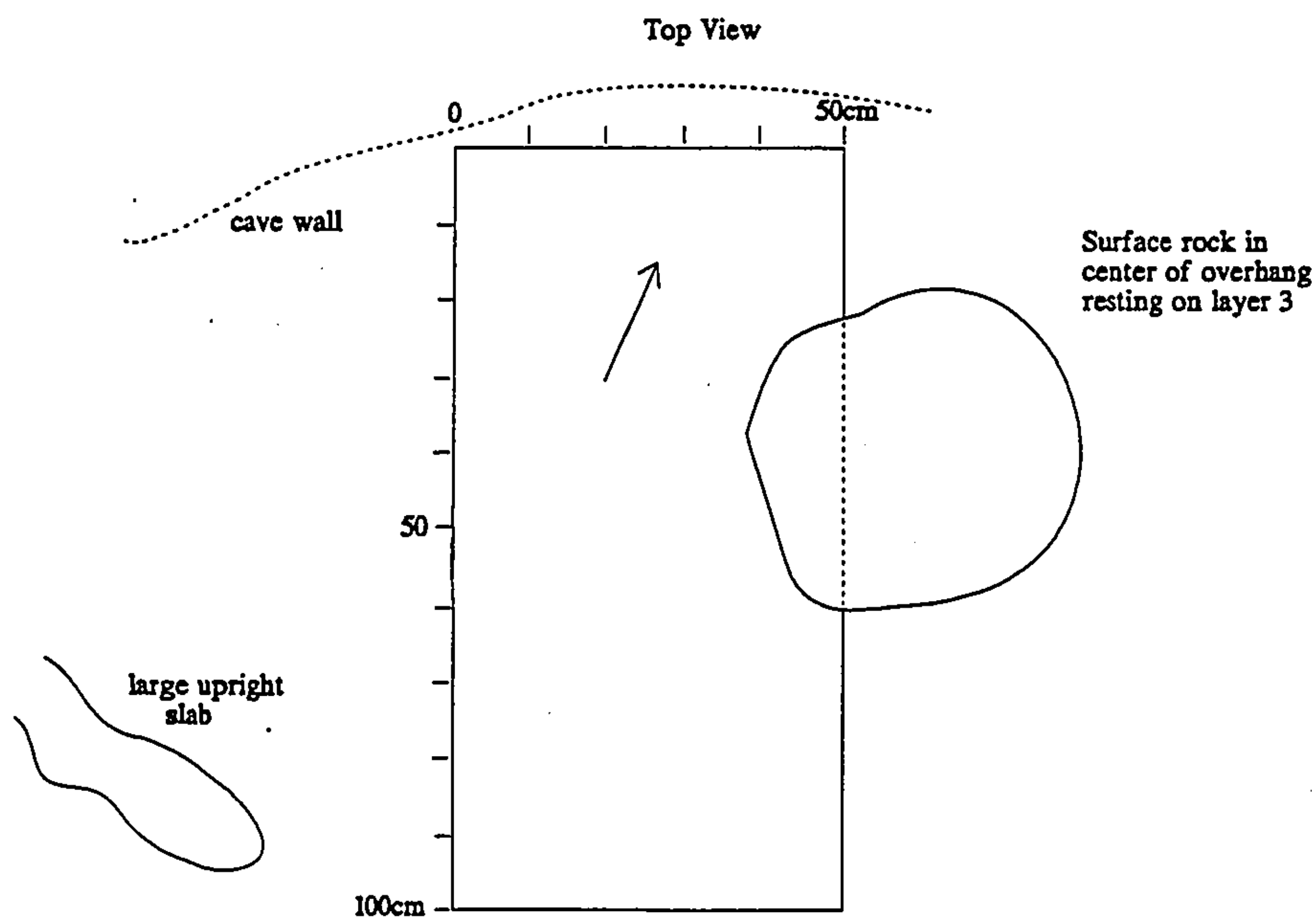
Within the drip line three layers were observed to contain material cultural remains, including the top layer and the present floor of the shelter. Lower layers 2 and 3 were associated with a probable hearth structure consisting of two rows of parallel upright stones and a surface of smaller flat stones between them. There were numerous pockets of charcoal containing small amounts of midden around the rocks above the structure in layer 2.

Below the structure we found a well developed layer 3 of ash, charcoal, and some midden. A lens of red soil within the charcoal may indicate intermittent temporary use of the hearth. Charcoal samples from specific locations within layer 2 and layer 3 were recovered to help establish a range of occupation dates. The deposits slope with increasing depth towards the interior terrace and warrant further investigation in the data collection phase of this project.

Archaeological Consultants of Hawaii,Inc.
59-624 Pupukea Rd.
Haleiwa, Hawaii 96712

PUNAMANO 4076A T-1 Scale = 1cm:10cm





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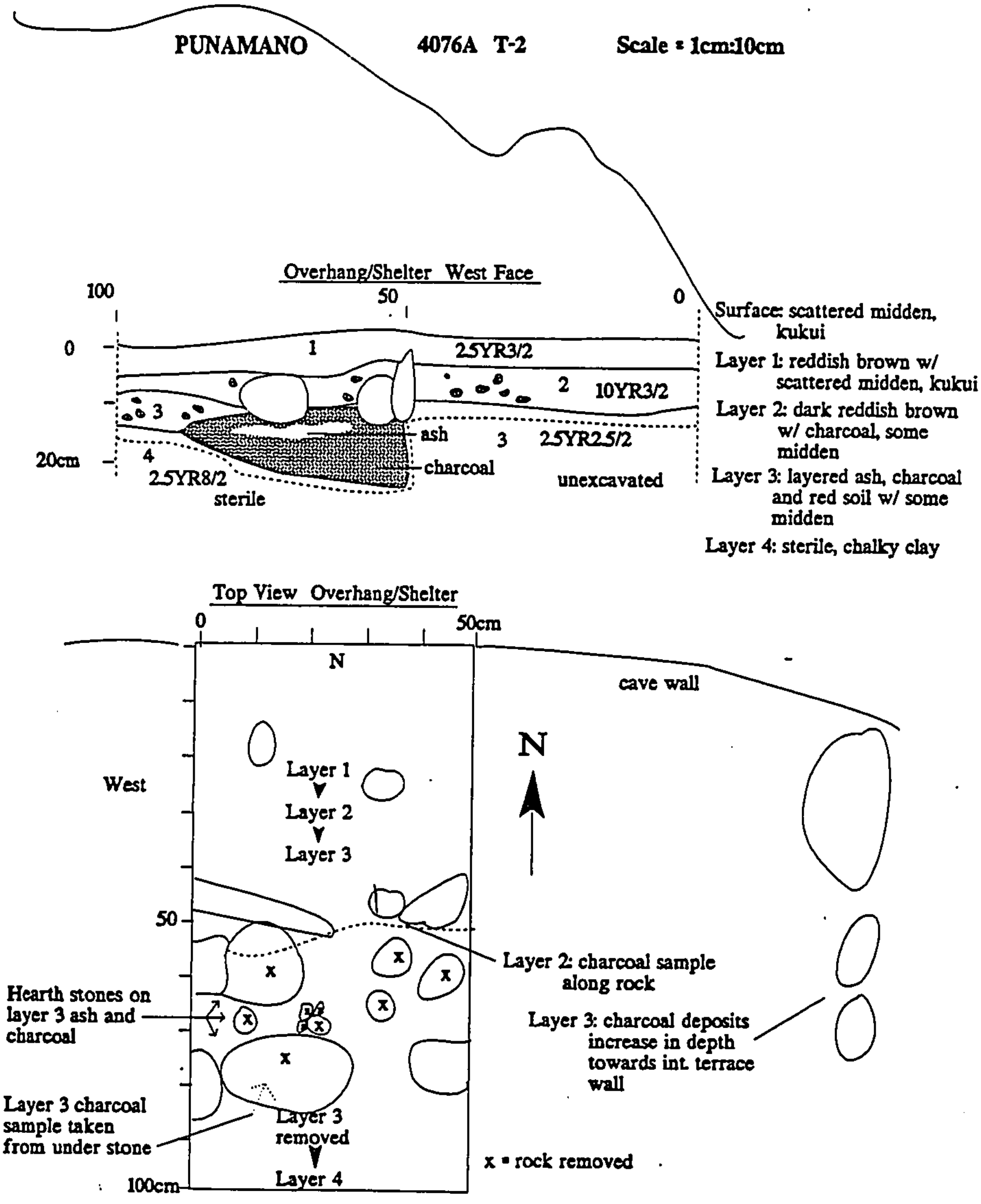
Haleiwa, Hawaii 96712



Test Excavation of 4076F Wall

Feature F of site 4076 is a neatly stacked wall closing off the level space between two coral limestone outcrops, and fitted to the contours of the cliff on either side. Total length of the structure is 6.0 meters at the top, 4.0 meters at the base, with a height of 1.10m and a width of .75m. A trench against the east face of the wall failed to produce any occupation debris, though this side seemed to afford the most protection from the elements and a clear level surface. The wall was founded on an apparently sterile layer of reddish brown soil with a very thin layer of topsoil, 2-4 cm thick, up against the stones.

Test Excavation of 4076E Wall

Feature E of site 4076 is a low stacked wall of small to medium size field stones, extending in a rough C-shape between coral outcrops 2-3 meters apart. We originally thought this might be a small habitation enclosure but closer examination shows this is probably not the case. As with wall feature 4076F, a test trench revealed only slight accumulations of topsoil around the base of the structure, which was also founded on fine reddish brown soil and coral bedrock. It now appears that the wall was constructed to block one end of a modified crevasse in the coral outcrop that may have carried water for historic period irrigation.

Summary and Conclusions

As a result of this investigation, several modifications have been made to our earlier recommendations and significance evaluations for site 4076 A-I. Test results in the habitation feature 4076A were very promising, with evidence of pre-historic structural modifications to the overhang area, significant midden deposits, and recovered cultural artifacts. We continue to recommend preservation of 4076 based on the information content of the four overhang/shelters, the excellence of the site types relative to surviving examples in this area, and the cultural adaptation to a local environment that these features represent. Because of the integrity of this site and its relative ease of access, it remains an excellent candidate for interpretive restoration and would be an asset to the developer and the community.

Most of the wall type structures in 4076 were probably not contemporary with the habitation of the overhang/shelters there. This tentative conclusion is based on the lack of occupation debris around features F and E, as well as the lack of accumulated soil around the bases of the structures. Unlike the sheltered overhangs, these exposed features were located in level areas or open depressions where such a build-up would be expected over time.

Feature E, a C-shaped wall, blocks off a sort of crevasse or channel running roughly in the direction of site 4231 (S-6). This site consists of a series of channels and low walls that may be related to early ranching efforts. Since there are no permanent springs now found on the property, an aqueduct system could have been used for watering stock and other purposes. Feature F, a well constructed wall with a level top, may then have given support to other water lines traversing the cliff.

Accordingly, the four wall structures associated with habitation site 4076 are no longer considered significant under criteria C and E of the historic sites evaluations. These structures may still be considered significant for information content, however, as they contain no mortar and do not apear to be part of a strictly modern irrigation system. Though not contemporary with habitation in the overhang/shelters, they represent a later phase of use of essentially the same site and should be recorded.

With regard to site 4230, at least two features, both burials, must be considered significant under criteria "C", "D" and possibly "E". Along with all other burials located on the property, these will be treated in accordance with Section 6E of the Hawaii Revised Statutes. The four remaining features in 4230 are significant under criteria "D", informational content only, but may also be considered for preservation based on their proximity to the burials.

Most of the significant sites on the property are located on cliffs where grading activity is not immediately planned. However, the developer may wish to notify an archaeologist whenever work is scheduled adjacent to known historic sites, to avoid unnecessary damage. In the event any new sites of historic value are encountered the developer should cease work in the area and notify the Department of Historic Sites as soon as possible.

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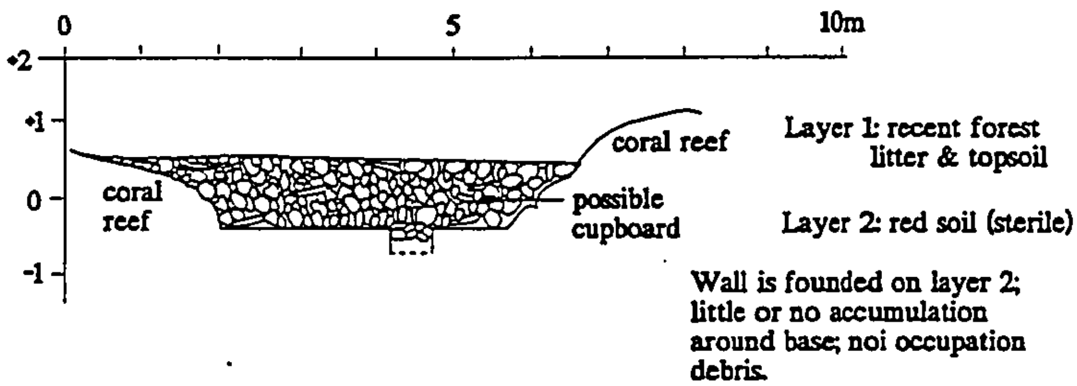
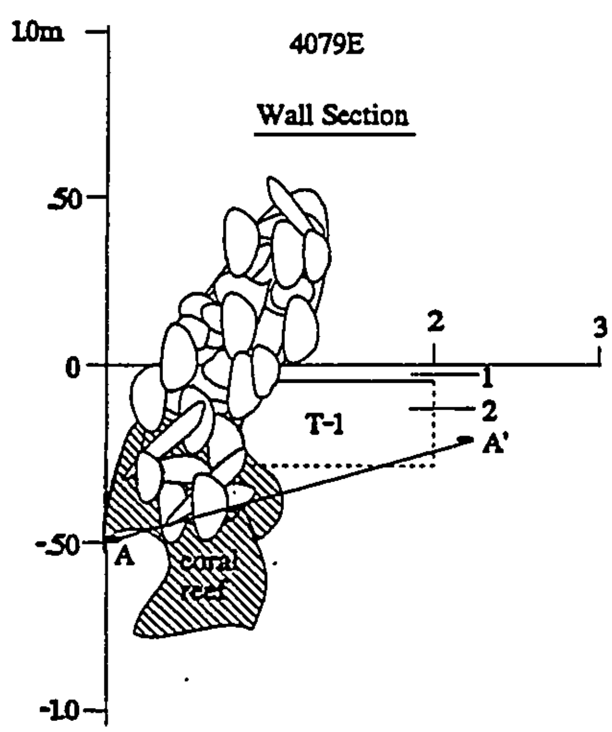
PUNAMANO 4079E & 4079F Scale = 1cm:100cm

4079F West Profile



4079E

Wall Section



Top Plan

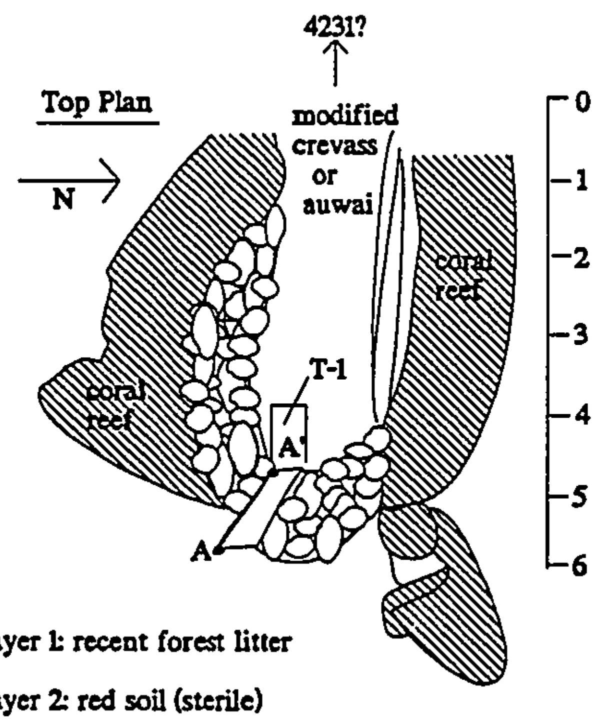


TABLE 1
SIGNIFICANCE CHART

REC #	State Site #	ACH #	PHRI #	Significance	Description
1	4068-A	S-23	T-1	D	Overhang/Shelter
2	4068-B	S-23	T-1	D	Overhang/Shelter
3	4068-C	S-23	T-1	D	Overhang/Shelter
4	4069	S-24	T-2	D	Overhang/Wall
5	4070-A	S-22	T-3	D,E	Overhang/Poss. Burial
6	4070-B	S-22	T-3	D	Overhang/Shelter
7	4071-A	S-21	T-4	D	Overhang/Shelter
8	4071-B	S-21	T-4	D	Low Stacked Wall
9	4071-C	S-21	T-4	D	Overhang/Shelter
10	4072-A	S-25	T-5	D	Overhang/Shelter
11	4072-B	S-25	T-5	D,E	Filled Crevasse/Poss. Burial
12	4072-C	S-25	T-5	D	Crevasse/Shelter
13	4073	S-26	T-7	D	Overhang/Shelter
14	4074	S-27	T-9	NLS	Overhang/Shelter
15	4075		T-11	NLS	Gun Emplacement
16	4076-A	S-5	T-15	C,D,E	Overhang/Shelter
17	4076-B	S-5	T-15	D	Low Stacked Wall
18	4076-C	S-5	T-15	C,D,E	Overhang/Shelter
19	4076-D	S-5	T-15	D	C-Shape
20	4076-E	S-5	T-15	D	Low Stacked Wall
21	4076-F	S-5	T-15	D	Low Stacked Wall
22	4076-G	S-5	T-15	C,D,E	Overhang/Shelter
23	4076-H	S-5	T-15	C,D,E	Overhang/Shelter
24	4076-I	S-5	T-15	D	Rectangular Enclosure
25	4077-A	S-17	T-16	D	Terrace Facing
26	4077-B	S-17	T-16	D	Wall/Terrace
27	4077-C	S-17	T-16	D	Auwai/Modified Crevasse
28	4078-A	S-16	T-17	D	Overhang
29	4078-B	S-16	T-17	D	Low Stacked Wall
30	4078-C	S-16	T-17	D	Low Stacked Wall
31	4079	S-9	T-19	D	2 Low Stacked Walls
32	4080	S-10	T-20	NLS	Historic Dump
33	4081	S-7	T-21	D	Overhang/Shelter
34	4082-A	S-19	T-22	D	Overhang/Shelter
35	4082-B	S-19	T-22	D,E	Overhang/Burial
36	4082-C	S-19	T-22	D,E	Overhang/Burial

REC #	State Site #	ACH #	PHRI #	Significance	Description
37	4082-D	S-19	T-22	D,E	Overhang/Burial
38	4082-E	S-19	T-22	D	Overhang/Shelter
39	4082-F	S-19	T-22	D	Midden Pocket
40	4082-G	S-19	T-22	D,E	Overhang/Burial
41	4082-H	S-19	T-22	D	Overhang/Shelter
42	4082-I	S-19	T-22	NLS	Overhang/Shelter
43	4082-J	S-13	T-22	NLS	Overhang/Shelter
44	4082-K	S-19	T-22	NLS	Overhang/Shelter
45	4083	S-2	T-24	NLS	Rock Alignment /Modified Ag.
46	4084	S-1	T-25	NLS	Terrace/Modified Ag. Mound
47	4085-A	S-14	T-26	NLS	Circular Enclosure
48	4085-B	S-14	T-26	NLS	Low Stacked Wall
49	4086	S-18	T-27	NLS	Wall/Modified Ag. Pile
50	4087	S-20	T-28	D	Overhang/Shelter
51	4230-A	S-8		D	Overhang/Shelter
52	4230-B	S-8		C,D,E	Crevasse/Burial
53	4230-C	S-8		D	C-Shape
54	4230-D	S-8		D	Low Stacked Wall
55	4230-E	S-8		D,E	Burial
56	4230-F	S-8		D	Low Stacked Mounds
57	4231	S-6		D	Low Stacked Walls/Enclosure
58	4232	S-15		D	Irrigation Ditch <= 1937

Total Sites: 23

Total Features: 35

TABLE 1A
RECOMMENDATION CHART

REC #	State Site #	ACH #	PHRI #	Description	RECOMMEND
1	4068-A	S-23	T-1	Overhang/Shelter	1-2 Trenches
2	4068-B	S-23	T-1	Overhang/Shelter	1 Trench
3	4068-C	S-23	T-1	Overhang/Shelter	1 Trench
4	4069	S-24	T-2	Overhang/Wall	1 Trench
5	4070-A	S-22	T-3	Overhang/Poss. Burial	Possible Burial Test
6	4070-B	S-22	T-3	Overhang/Shelter	1 Trench
7	4071-A	S-21	T-4	Overhang/Shelter	1-2 Trenches
8	4071-B	S-21	T-4	Low Stacked Wall	1 Trench
9	4071-C	S-21	T-4	Overhang/Shelter	1 Trench
10	4072-A	S-25	T-5	Overhang/Shelter	1 Trench
11	4072-B	S-25	T-5	Filled Crevasse/Poss. Burial	HRS Section 6E
12	4072-C	S-25	T-5	Crevasse/Shelter	1-2 Trenches
13	4073	S-26	T-7	Overhang/Shelter	2-3 Trenches
14	4074	S-27	T-9	Overhang/Shelter	None
15	4075		T-11	Gun Emplacement	None
16	4076-A	S-5	T-15	Overhang/Shelter	4-6 Trenches
17	4076-B	S-5	T-15	Low Stacked Wall	Map, 1 Trenches
18	4076-C	S-5	T-15	Overhang/Shelter	2-3 Trenches
19	4076-D	S-5	T-15	C-Shape	1 Trenches
20	4076-E	S-5	T-15	Low Stacked Wall	Map
21	4076-F	S-5	T-15	Low Stacked Wall	Map
22	4076-G	S-5	T-15	Overhang/Shelter	2-3 Trenches
23	4076-H	S-5	T-15	Overhang/Shelter	2-3 Trenches
24	4076-I	S-5	T-15	Rectangular Enclosure	1-2 Trenches
25	4077-A	S-17	T-16	Terrace Facing	1 Small Trench
26	4077-B	S-17	T-16	Wall/Terrace	1 Small Trench
27	4077-C	S-17	T-16	Auwai/Modified Crevasse	Map and Grade
28	4078-A	S-16	T-17	Overhang	1-2 Trenches
29	4078-B	S-16	T-17	Low Stacked Wall	1 Trench Small Sample
30	4078-C	S-16	T-17	Low Stacked Wall	1 Trench Small Sample
31	4079	S-9	T-19	2 Low Stacked Walls	1-2 Trenches
32	4080	S-10	T-20	Historic Dump	None
33	4081	S-7	T-21	Overhang/Shelter	2-3 Trenches
34	4082-A	S-19	T-22	Overhang/Shelter	2-3 Trenches
35	4082-B	S-19	T-22	Overhang/Burial	HRS Section 6E

REC #	State Site #	ACH #	PHRI #	Description	RECOMMEND
36	4082-C	S-19	T-22	Overhang/Burial	HRS Section 6E
37	4082-D	S-19	T-22	Overhang/Burial	HRS Section 6E
38	4082-E	S-19	T-22	Overhang/Shelter	3-4 Trenches
39	4082-F	S-19	T-22	Midden Pocket	1 Trench
40	4082-G	S-19	T-22	Overhang/Burial	HRS Section 6E
41	4082-H	S-19	T-22	Overhang/Shelter	1-2 Trenches
42	4082-I	S-19	T-22	Overhang/Shelter	None
43	4082-J	S-13	T-22	Overhang/Shelter	None
44	4082-K	S-19	T-22	Overhang/Shelter	None
45	4083	S-2	T-24	Rock Alignment /Modified Ag.	None
46	4084	S-1	T-25	Terrace/Modified Ag. Mound	None
47	4085-A	S-14	T-26	Circular Enclosure	None
48	4085-B	S-14	T-26	Low Stacked Wall	None
49	4086	S-18	T-27	Wall/Modified Ag. Pile	None
50	4087	S-20	T-28	Overhang/Shelter	3-4 Trenches
51	4230-A	S-8		Overhang/Shelter	1-2 Trenches
52	4230-B	S-8		Crevasse/Burial	HRS Section 6E
53	4230-C	S-8		C-Shape	1 Trench
54	4230-D	S-8		Low Stacked Wall	1 Trench
55	4230-E	S-8		Burial	HRS Section 6E
56	4230-F	S-8		Low Stacked Mounds	1-2 Trenches, Map
57	4231	S-6		Low Stacked Walls/Enclosure	2-3 Trenches
58	4232	S-15		Irrigation Ditch <= 1937	1-2 Trenches

Total Sites: 23
Total Features: 35

TABLE 1B
TABLE OF POSSIBLE BURIALS

State Site #	ACH #	PHRI #	Description	RECOMMEND
4070-A	S-22	T-3	Overhang/Poss. Burial	Possible Burial Test
4072-B	S-25	T-5	Filled Crevasse/Poss. Burial	HRS Section 6E
4082-B	S-19	T-22	Overhang/Burial	HRS Section 6E
4082-C	S-19	T-22	Overhang/Burial	HRS Section 6E
4082-D	S-19	T-22	Overhang/Burial	HRS Section 6E
4082-G	S-19	T-22	Overhang/Burial	HRS Section 6E
4230-B	S-8		Crevasse/Burial	HRS Section 6E
4230-E	S-8		Burial	HRS Section 6E

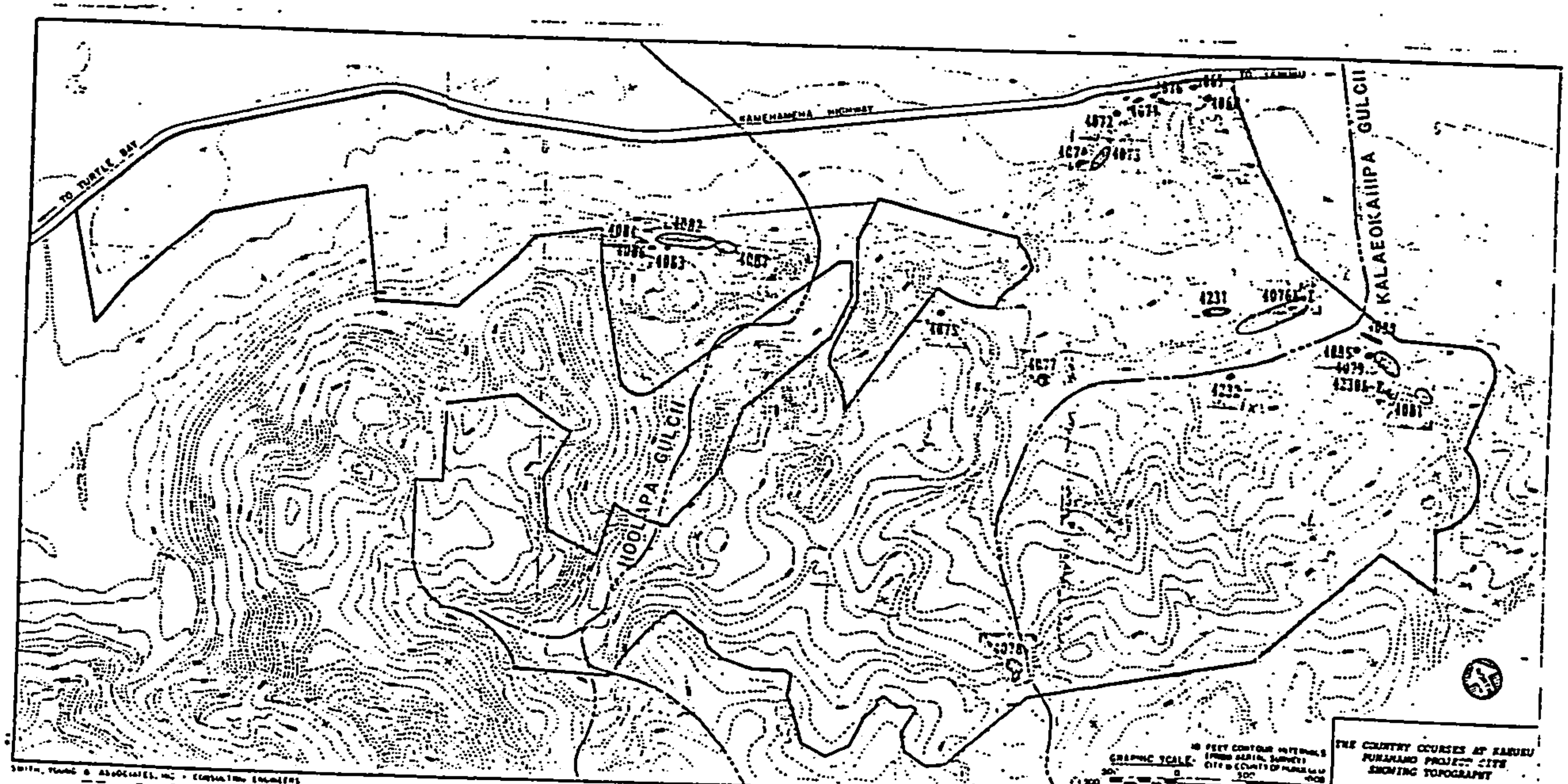
TABLE 1C
TABLE OF "NLS" SITES
WITH RECOMMENDATION "NONE"

State Site #	ACH #	PHRI #	Description	RECOMMEND
4074	S-27	T-9	Overhang/Shelter	None
4075		T-11	Gun Emplacement	None
4080	S-10	T-20	Historic Dump	None
4082-I	S-19	T-22	Overhang/Shelter	None
4082-J	S-13	T-22	Overhang/Shelter	None
4082-K	S-19	T-22	Overhang/Shelter	None
4083	S-2	T-24	Rock Alignment /Modified Ag.	None
4084	S-1	T-25	Terrace/Modified Ag. Mound	None
4085-A	S-14	T-26	Circular Enclosure	None
4085-B	S-14	T-26	Low Stacked Wall	None
4086	S-18	T-27	Wall/Modified Ag. Pile	None

Should you have any questions regarding this addendum report, please feel free to contact me.

Aloha,

Joseph Kennedy
Consulting Archaeologist



THE COUNTRY COURSES AT KAHUKU
PUNAMANO PROJECT SITE
SHOWING TOPOGRAPHY

FIG. 4

VITAE

Name: Joseph Kennedy

Address: 59-624 Pupukea Road, Haleiwa, Hawaii 96712

Telephone: 808-638-7442

Birthdate/place: September 9, 1948 Chicago, Illinois

Citizenship: USA

Appointments:

President, Senior Archaeologist, Archaeological Consultants of Hawaii, Inc.

President, Society for Hawaiian Archaeology (85-86)

Editor, Hawaiian Archaeology Vol. II

Editor, Native Planters

EDUCATION

Southern Methodist University, Fort Burgwin Research Center, Archaeological Field School. Ranchos de Taos, New Mexico. 1967

BA John Pershing College, Beatrice, Nebraska. History/Anthropology, 1970.

MA University of Hawaii, Honolulu, Hawaii Anthropology/Hawaiian Archaeology, 1974.

ARCHAEOLOGICAL FIELD EXPERIENCE

1966- Upper Republican River Valley Site; John Pershing College. Position: Student

1967a- Fort Burgwin Historic Renovation Project; Southern Methodist University. Position: Student

1967b- Pueblo Excavation at Pot Creek; Southern Methodist University; Position: Student

1968- Pawnee Burial Site, John Pershing College; Position: Supervisor

1969- Lapakahi Excavations; University of Hawaii; Position: Student

1970a- Panama Excavation; Luther College, Decorah, Iowa Position: Supervisor

1970b- Black Mesa Excavation; Prescott College. Position: Supervisor.

1970c- Kailua-Kawaihae Archaeological Survey. State of Hawaii, Department of Transportation. Position: Supervisor.

1971- Lapakahi III; University of Hawaii. Position: Supervisor.

1972- Honopue Valley Archaeological Survey; University of Hawaii. Position: Supervisor.

1973- Waimanalo Archaeological Survey; University of Hawaii. Position: Supervisor

1978- Barbers Point Archaeological Survey. Archaeological Research Center of Hawaii. Position: Supervisor.

1979- Kuliouou Archaeological Excavations. Chiniago Inc. Position: Supervisor.

1980- Paniau Archaeological Survey. Archaeological Consultants of Hawaii; Position: Principal Investigator

1981- Heeia Archaeological Survey. Archaeological Consultants of Hawaii; Position: Principal Investigator.

1982a- Waihee Archaeological Survey. Archaeological Consultants of Hawaii; Position: Principal Investigator.

1982b- Heeia Kea Archaeological Survey. Archaeological Consultants of Hawaii; Position: Principal Investigator.

1982c- Management Plan for Ahuimanu Taro Complex. Archaeological Consultants of Hawaii; Position: Principal Investigator.

ARCHAEOLOGICAL FIELD EXPERIENCE (cont.)

1982d- Kaunakakai Archaeological Survey. Archaeological Consultants of Hawaii; Position: Principal Investigator.

1982e- Pukoo Archaeological Survey. Archaeological Consultants of Hawaii. Position: Principal Investigator.

1982f- Makaha Archaeological Monitoring Project. Archaeological Consultants of Hawaii. Position: Principal Investigator.

1982g- Excavations at the Pyramid of Ra-Nefer-F. Abu Seer, Egypt. Czechoslovakian Archaeological Institute, Cairo. Position: Visiting Scholar.

1983a- Wailuku Archaeological Survey. Archaeological Consultants of Hawaii. Position: Principal Investigator.

1983b- Kahului Archaeological Survey. Archaeological Consultants of Hawaii. Position: Principal Investigator.

1983c- Kaloko Archaeological Survey. Archaeological Consultants of Hawaii. Position: Principal Investigator.

1983d- Kaloko Intensive Survey. Archaeological Consultants of Hawaii. Position: Principal Investigator.

1984a- Palolo Archaeological Survey. Archaeological Consultants of Hawaii. Position Principal Investigator.

1984b- Archaeological Interpretive Trail at Ahuimanu. Archaeological Consultants of Hawaii. Position: Principal Investigator.

1984c- Archaeological Survey at Maile. Archaeological Consultants of Hawaii. Position: Principal Investigator.

1984d- Keaau Archaeological Survey. Archaeological Consultants of Hawaii. Position: Principal Investigator.

1984e- Waianapanapa Archaeological Survey. Archaeological Consultants of Hawaii. Position: Principal Investigator.

1984f-Archaeological excavations at Hotel and Bethel St. Archaeological Consultants of Hawaii. Position: Principal Investigator.

1985a- Defense Environmental Restoration Program in American Samoa. Archaeological Consultants of Hawaii. Position: Principal Investigator.

1985b- Kahuku Archaeological Excavation. Archaeological Consultants of Hawaii. Position: Principal Investigator.

1985c- Waikakalaua Archaeological Survey. Archaeological Consultants of Hawaii. Position: Principal Investigator.

1985d- Hilton Hawaiian Village Monitering Project. PHRI, Inc. Position: Field Supervisor

1985e- Preliminary Archaeological Investigations on the Island of Tutuila, American Samoa. Archaeological Consultants of Hawaii. Position: Principal Investigator.

1986a- Kehei Archaeological Survey. Archaeological Consultants of Hawaii. Position: Principal Investigator.

1986b- Haleakala Ranch Archaeological Survey. Archaeological Consultants of Hawaiii. Position: Principal Investigator.

1986c- Lahilahi Archaeological Investigations. Archaeological Consultants of Hawaii. Position: Principal Investigator.

1986d- Lahina Archaeological Survey. Archaeological Consultants of Hawaii. Position: Principal Investigator.

1986e- Maalaea Archaeological Survey. Archaeological Consultants of Hawaii. Position: Principal Investigator.

1986f- Excavations at Waikiki Aquarium. Archaeological Consultants of Hawaii. Position: Principal Investigator.

1986g- Mokuleia Survey. Archaeological Consultants of Hawaii. Position: Principal Investigator.

1986h- Waiehu Archaeological Survey. Archaeological Consultants of Hawaii. Position: Principal Investigator.

1986i- Mokuleia Ranch Survey. Archaeological Consultants of Hawaii. Position: Principal Investigator.

1986j- Keanae Archaeological Survey. Archaeological Consultants of Hawaii. Position: Principal Investigator.

1986k- Lumahai Archaeological Survey. Archaeological Consultants of Hawaii. Position: Principal Investigator.

1986l- Puna Archaeological Survey. Archaeological Consultants of Hawaii. Position: Principal Investigator.

1986m- Kahana Archival Study. Archaeological Consultants of Hawaii. Position: Principal Investigator.

1986n- Limahuli Excavations. Archaeological Consultants of Hawaii. Position: Principal Investigator.

1986o- Kakaako Archaeology Project. Social Science Research Center, University of Hawaii. Position: Co-author.

1986p- Kihei Archaeological Survey. Archaeological Consultants of Hawaii. Position: Principal Investigator.

1987a- Kihei II. ACH. Position: Principal Investigator.

1987b- Kihei III. ACH. Position: Principal Investigator.

1987c- Old Kona Airport Survey for SeaGrant. Position: Principal Investigator.

1987d- Old Kona Archaeological Survey for County of Hawaii. Position: Principal Investigator.

1987e- Naalehu Archaeological Survey. Position: Principal Investigator.

1987f- Waikoloa Archaeological Survey. Position: Principal Investigator.

1987g- Subsurface Testing at Heeia. Position: Principal Investigator.

1987h- Subsurface Archaeological Testing at Kihei. Position: Principal Investigator.

1987i- Archaeological Monitoring At Hawaii Kai. Position: Principal Investigator.

1987j- Subsurface Archaeological Testing at Kahana. Position: Principal Investigator.

1987k- Subsurface Testing at Limahuli. Position: Principal Investigator

1987l- Archaeological Survey at Ewa. Position: Principal Investigator

1987m- Archaeological Archival Study of Transmission Line Corridor, South Oahu. Position: Principal Investigator.

1987n- Palolo Survey and Osteological Recovery. Position: Principal Investigator.

1987o- Archaeological Survey at Proposed Ewa Gentry, Oahu. Position: Principal Investigator.

1988a- Archaeological Survey at Holualoa. Position: Principal Investigator.

1988b- Subsurface Testing at Tula and Onenoa, American Samoa. Position: Principal Investigator.

1988c- Archaeological Survey at Kihei. Position: Principal Investigator.

1988d- Archaeological Survey at Mokuleia. Position: Principal Investigator.

1988e- Archaeological Survey at Kula. Position:Principal Investigator

1988f- Subsurface Testing at Hanalei. Position: Principal Investigator.

1988g- Archaeological Survey at Waioli. Position: Principal Investigator.

1988h- Archaeological Survey at Ewa. Position : Principal Investigator.

1988i- Data Recovery at Holualoa. Position: Principal Investigator.

1988j- Archaeological Survey at Kona Village. Position: Principal Investigator.

1988k- Archaeological Monitoring at Washington Place. Position: Principal Investigator.

1988l- Archaeological Survey at Kahului. Position: Principal Investigator.

1988m- Archaeological Monitoring at Kihei. Position: Principal Investigator.

1988n- Archaeological Survey at Kihei. Position: Principal Investigator.

1989a- Data Recovery at Kamani Tree Subdivision, Kona. Position: Principal Investigator.

1989b- Due Diligence, Wailea, Maui. Position: Principal Investigator.

1989c- Due Diligence, Kona Village Resort. Position: Principal Investigator.

1989d- Due Diligence, Watson Property, Kona. Position: Principal Investigator.

1989e- Archaeological Survey at Keonekai Subdivision, Maui. Position: Principal Investigator.

1989f- Archaeological Survey, Haena, Kauai: Position: Principal Investigator.

1989g- Archaeological Survey, Moloaa, Kauai. Position: Principal Investigator.

1989h- Subsurface testing at Hanalei, Kauai. Position: Principal Investigator.

1989i- Data Recovery Program, Ahalanui, Hawaii. Position: Principal Investigator.

1989j- Reconstructive Preservation Project, Kamani Tree Subdivision, Kona. Position: Coordinator.

1989k- Subsurface Testing, Kiawe Terrace Subdivision, Maui. Position: Principal Investigator.

1989l- Archaeological Monitoring, Lahaina, Maui. Position: Principal Investigator.

1989m- Data Recovery Program Design. Puna, Hawaii. Position: Principal Investigator.

1989n- Expert Witness, Hookena Mauka, Hawaii.

1989o- Expert Witness, Hanalei, Kauai.

1989p- Archaeological Interpretive Field Check, Waikapu, Maui.

1989q- Archaeological Survey, Meyer's Ranch, Molokai. Position: Principal Investigator.

PARTIAL CLIENT LIST FOR ARCHAEOLOGICAL CONSULTANTS OF HAWAII INC.

A&O International, Inc.
Ahuimanu Joint Ventures, Inc.
Architects Hawaii
Ashford & Wriston
Associated Engineering Consultants (Auburn CA)
Kep Aluli, Inc.
Belt, Collins & Associates
City and County of Honolulu
Central Pacific Development Corporation
Chee, Will, Planner
CH2MHILL (Denver, Colorado)
C Brewer Properties
Cowell and Associates
Dujardin Development Company
Environment Impact Study Corporation
Ecotropics
Franklin Grey & Associates

Government of American Samoa
Goodfellow Construction
Grey, Hong, Bills and Associates
Hanalai Properties
Hawaii Electric Renewable Systems
Heidi Helm & Associates
Hawaiian Electric Co.
Mike McCormack Inc.
Mokuleia Development Corp.
Okamoto, Wilson and Associates
Palapala Inc.
Palolo Estates
Pacific-Asian Inc.
Pete Marwick, Co.
Phillips, Brandt, Reddick & Associates
Quinn Anderson (et al)
Sea Grant, University of Hawaii
Schuler and Associates
Steven Pitt, Inc.
State of Hawaii, Department of Land and Natural Resources
Stone Mettenbrink & Associates (Phoenix, Arizona)
Takemasa International (Tokyo, Japan)
True Geothermal.
U.S. Army Corps of Engineers
U.S. Government, National Park Service, Dept. of Interior
Uwe Schulz & Associates
Waikiki Aquarium
Warren Unemori & Associates
Wankett, William, Planner
Wavecrest, Molokai, Inc.
Whalers Realty
Wilcox, Gaylord

LECTURES

" Sir Richard Burton - Founder of the Royal Anthropological Institute." Presented to the Hawaii Anthropological Association. Honolulu

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" Traditional Farming Methods in Ancient Hawaii. " Presented to the Institute of Echnotechnics, Kathmandu Conference. Kingdom of Nepal.

" Prehistoric Sweet Potato Farming in the Hawaiian Dry Forest." Presented to Natural History of Hawaii classes, Department of General Sciences, UH, Manoa.

" The Enthnohistory of <u>Erythloxyn</u> <u>Coca</u>." Presented to General Science 440, UH, Manoa (five times).

" The Ahuimanu Taro Terrace - An Interpretive Model of Historic Preservation in Hawaii." Presented to the participants of the Pacific Island Cultural Resource Management Workshop." Honolulu

" Historic Preservation in Hawaii." Presented to Anthropology 450. West Oahu College. Honolulu.

" Hawaii's Past as Seen through Archaeological Structures." Presented to several classes at Puanhou School. Honolulu.

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" E. Coca and Early Andean Society." Presented to the Lindsay Club. London. UK

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1973 - <u>Lapakahi Burials: Typology and Change</u>. In: Asian and Pacific Archaeology Series #5. Tuggle and Griffin eds. Social Science Research Institute. Honolulu.

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AWARDS

National Science Foundation stipend recipient at the University of Hawaii, 1969.

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CONFERENCES

Institute of Ecotechnics Sub Continent Conference, Kathmandu, Nepal, April, May. 1982

Excavations at the Pyramid of Ra-Nefer-F. Abu Seer, Egypt. Czechoslovakian Archaeological Institute, Cairo.

Society for Historic Archaeology (Jan. 86) Sacramento, Ca.

MEMBERSHIPS

Fellow of the Royal Anthropological Institute of Great Britain and Ireland.

Society for Field Archaeology.

Member of the Ethnopharmacological Society.

Professional Member of the Society for Hawaiian Archaeology.

Member, Historic Hawaii Foundation

Member, Society for Historic Archaeology

APPENDIX D

COUNTRY COURSES AT KAHUKU, SOCIAL IMPACT ASSESSMENT

Earthplan

APPENDIX D

COUNTRY COURSES AT KAHUKU

SOCIAL IMPACT ASSESSMENT

PREPARED FOR
WILLIAM E. WANKET, INC.
BY
EARTHPLAN
October 1989

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COUNTRY COURSES AT KAHUKU

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SECTION 1: INTRODUCTION AND BACKGROUND

1 INTRODUCTION AND BACKGROUND

1.1 DESCRIPTION OF THIS REPORT

1.1.1 Purpose Of This Report

The Estate of James Campbell proposes to develop *The Country Courses at Kahuku* in Koolauloa, Oahu. The project involves the development of four new 18-hole golf courses on two non-contiguous parcels of land. Both sites are located in the State Land Use Agricultural District and are designated Agriculture on the Koolauloa Development Plan Land Use Map. Zoning on these lands are Ag-1, Restrictive Agricultural District and Ag-2, General Agricultural District. Required land use approvals include Urban designation on the State Land Use Map, Parks and Recreation designation on the Koolauloa Development Plan Land Use Map.

An Environmental Impact Statement is required in seeking these land use approvals. This social impact assessment was prepared in conjunction with the Environmental Impact Statement.

1.1.2 Preparers Of This Report

This report was prepared by Earthplan whose office is located at 81 South Hotel Street, Suite 211. *Berna Cabacungan*, principal of Earthplan, was the project manager, and principal researcher and writer. Independent contractor *Michael P. Mays* assisted in research and analysis related to demographics and community issues.

1.1.3 Report Organization

This report contains five major sections. The remaining portions of Section 1 present the following discussions:

* Section 1.2 describes existing and surrounding uses and the proposed project.
* To help the reader understand the social impact assessment purpose and function, Section 1.3 describes social impact assessment in general and its application to Country Courses at Kahuku.

Section 2 provides a profile of the existing community to establish the social context in which project impacts may occur. Information includes employment, population, housing and other social characteristics.

Section 3 explores the study area's future without the proposed project. This information extends the baseline data by identifying the possible future scenarios for the community independent of the proposed project. Public policies and major public and private developments are included in this analysis.

Section 4 identifies potential community issues and concerns on this project, based on historical trends to date.

Section 5 identifies potential social impacts of the Country Courses at Kahuku. This section discusses how the project will increase the de facto population and the effects of this increase, the addition of recreational resources, the effects on the character of the surrounding community, displacement and the impacts on public services and facilities.

1.2 PROJECT DESCRIPTION

1.2.1 Description of the Subject Property

Encompassing a total of 805 acres, the project site comprises two separate and non-contiguous sites. The locations of these sites are depicted in Figure A.

1. The **Punamano** site contains 605 acres and includes Tax Map Key 5-6-05: Por. 1 and 2, 5, 6 and Por. 7 and Tax Map Key 5-7-01: Por. 21. This site is located mauka of Kamehameha Highway, across from Kuilima Resort, and is approximately 1.5 miles west of Kahuku Village.

   Punamano is currently vacant, with broad open areas and gentle slopes, hills and gulches. Three intermittent stream gulches cross the site.

   Previously, the site was used primarily for sugar cane production. After the Kahuku Sugar Mill closed in 1971, the site was used for other agricultural operations, but these were marginally successful.

   Mauka of the site are the U.S. Army Kahuku Training Area and several windmills. To the east lies vacant agricultural land and west of the project site is a U.S. Air Force telecommunications facility, as well as a small agricultural operation producing a variety of fruits and vegetables.

   The site is bounded by Kamehameha Highway on its north, or makai, side. Across Kamehameha Highway are, from west to east, are the Kuilima Resort, the Tanaka Store (a well-known local grocery story and gas station), and a major aquaculture operation.

2. The **Malaekahana** site encompasses approximately 200 acres and is designated as TMK 5-6-06: 2 and Por. 6. This site is also located mauka of Kamehameha Highway, approximately 1.4 miles east of Kahuku Village.

   Like Punamano, this site is bounded by Kamehameha Highway on its north, or makai, side. Across this major thoroughfare is the Malaekahana State Park, a large oceanfront park with picnic and camping facilities.

   A portion of the site is currently leased for grazing purposes.

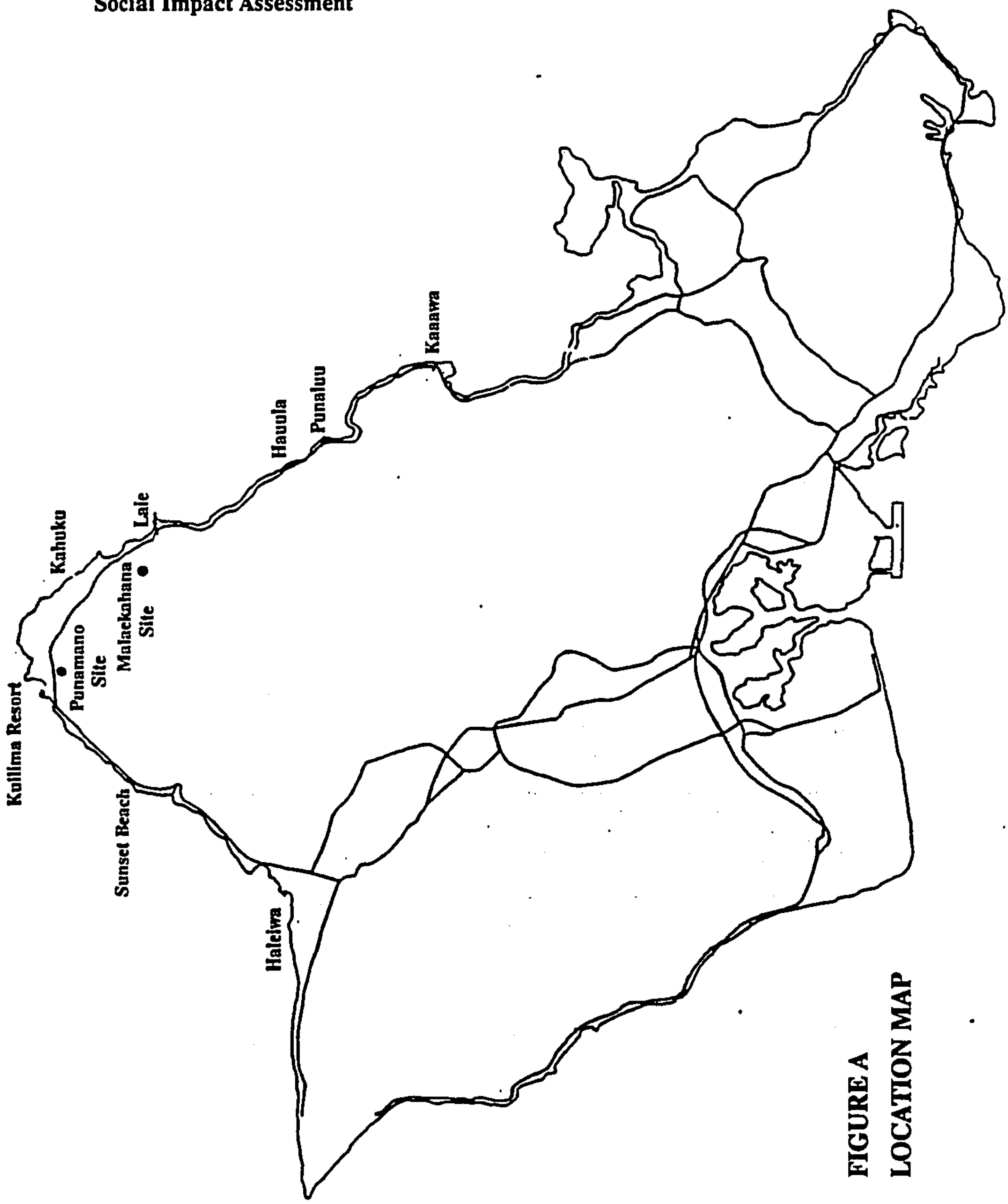


FIGURE A
LOCATION MAP

1.2.2 Project Components

Figures B and C illustrate the site plans for the Punamano and Malaekana sites.

Punamano.

Design -- The Estate of James Campbell proposes to develop three 18-hole golf courses on this 605-acre site. Each golf course will be designed at three different levels of playing difficulty, ranging from the relatively easy golf course similar to Oahu's municipal golf courses to a challenging championship course. The relatively easy course will be located in the lower or makai portions of the site.

Support facilities -- Two clubhouses are planned for Punamano. The two upper or mauka golf course will have driving ranges and parking areas will serve both the clubhouses and the driving ranges.

Access -- A separate entrance will serve the makai course and will be located approximately 2,100 feet east of the entrance to Kuilima Resort. Another entrance will be located along the existing roadway used as the U.S. Army access to the Kahuku Training area. This latter entrance will serve the two mauka courses.

Operation -- All three courses will be daily-fee courses open to the public. No private membership will be offered. The driving ranges will also be open to the public for a fee, and will operate only during daylight hours.

Time frame -- Operation of all three courses is anticipated for 1997. Play on the first course could begin in 1992, depending on the securing of necessary land use and building approvals and permits. Construction of each course is expected to require between 1.5 to two years.

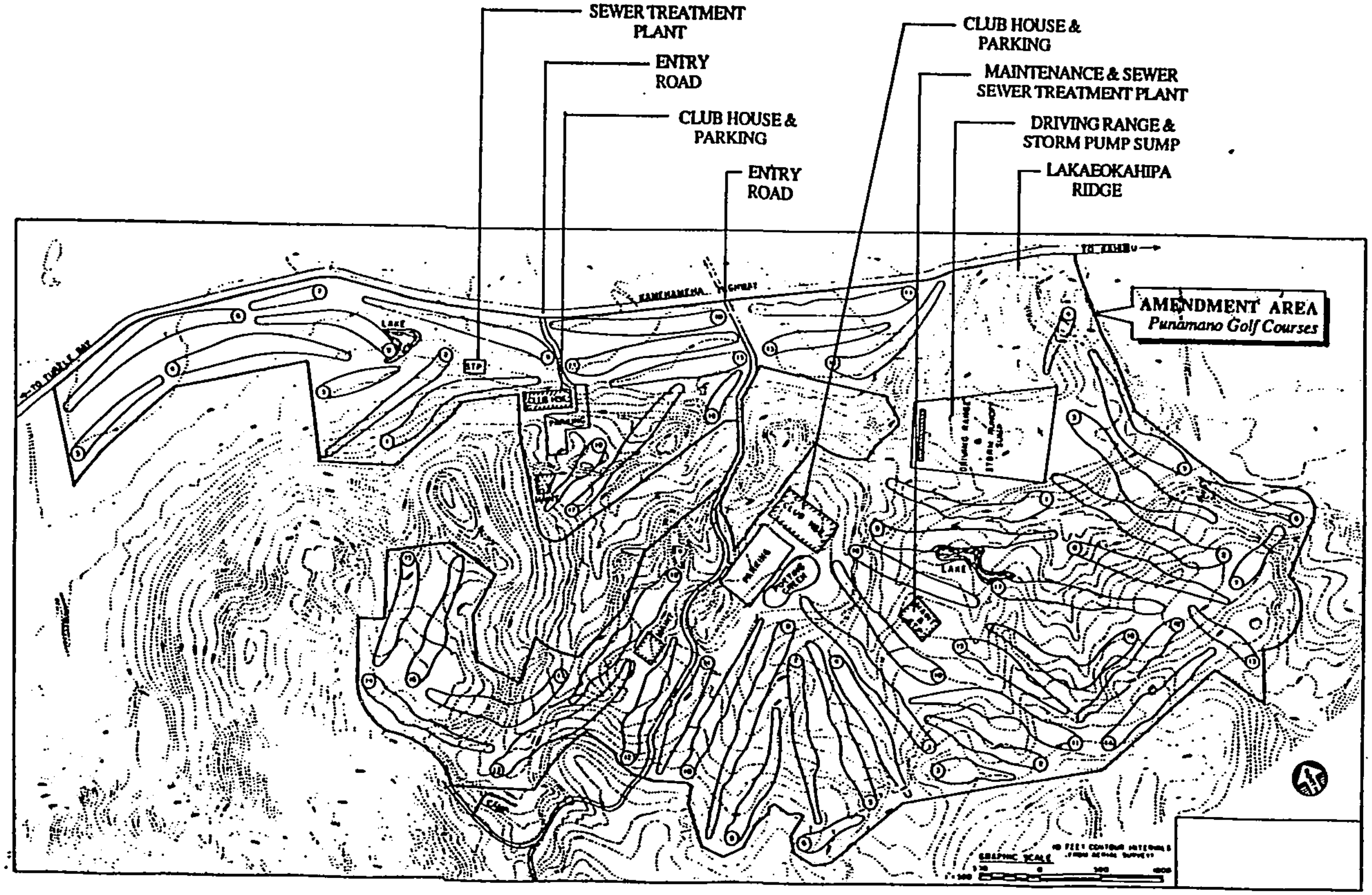
Malaekahana.

Design --One 18-hole golf course is planned for this 200-acre site. This will be a tournament-level golf course that will involve complex topography. Of the four proposed courses, this is the most difficult and would offer the most in terms of views.

Support facilities -- Support facilities will be similar to those provided at Punamano.

Access -- Access to the project site will be shared by the proposed golf course and that proposed by the Kuilima Resort Company.

Operation -- This course will also be a daily-fee course open to the public. No private membership will be offered. The driving range will also be open to the public for a fee, and will operate only during daylight hours.

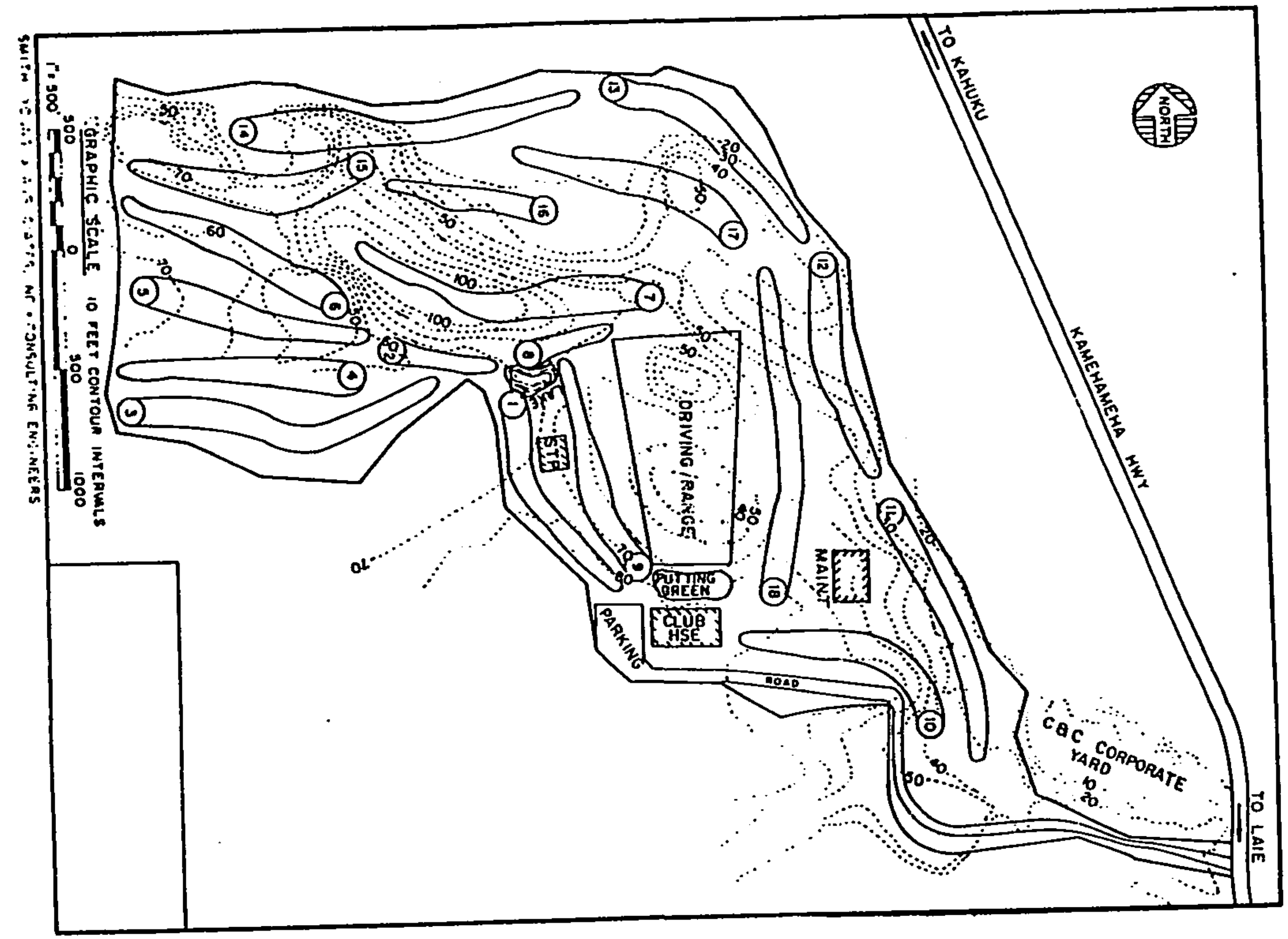


The Country Courses at Kahuku

PRELIMINARY SITE PLAN FOR PUNAMANO

prepared for: The Estate of James Campbell
prepared by: Michael S. Chu, Land Architect

FIGURE B



The Country Courses at Kahuku

prepared for: The Estate of James Campbell
prepared by: Michael S. Chu, Land Architect

PRELIMINARY SITE PLAN FOR MALAEKAHANA

FIGURE C

NORTH

Time frame -- This golf course is expected to begin operation in 1992, depending on the securing of necessary land use and building approvals and permits. Construction of each course is expected to require between 1.5 to two years.

1.3 SOCIAL IMPACT ASSESSMENTS AND ITS APPLICATION IN THIS PROJECT

Social impact assessment is a field of applied social science which has to do with the development and disclosure of social information relevant to (1) informing the decision-making process, and/or (2) developing management actions to deal with problematic social outcomes of a proposed project. It draws sometimes from social science, but other times from organizational development, political analysis, or simple journalism.

Commonly identified uses of social impact assessments include (1) understanding the ability of a community or group to adapt to changing conditions; (2) defining the problems or clarifying the issues involved in a proposed change; (3) illuminating the meaning and importance of anticipated change, and (4) identifying mitigation opportunities or requirements.

The emphasis of this process varies, based on the particular land use characteristics of a project, the extent of development in nearby areas and the requirements of the different permit processes.

This report serves as the mechanism to identify potential social impacts which should be considered in the request for amendments to the Koolauloa Development Plan.

In the overall social impact assessment *process*, however, this report can be useful in further and ongoing community dialogue between The Estate of James Campbell and the affected parties. The ongoing nature of this process can lead to an informed community and project team, possible project modifications, and, ideally, consensus on proposed actions.

COUNTRY COURSES AT KAHUKU

SOCIAL IMPACT ASSESSMENT

SECTION 2: PROFILE OF THE EXISTING COMMUNITY

2 PROFILE OF THE EXISTING COMMUNITY

This section provides information on the "existing community" to establish a baseline of information, upon which potential social impacts can be identified and examined.

Section 2.1 defines the study area used in this report. In Section 2.2, this study area is described in terms of in-area employment, population and housing trends and certain socio-economic characteristics. Kahuku and Laie, the communities nearest to the proposed project, are described further in Section 2.3.

2.1 STUDY AREA DESCRIPTION

The study area for this project includes the Koolauloa Development Plan area, in which both Punamano and Malaekahana are located, and the nearby North Shore Development Plan area.

Koolauloa Development Plan Area.

The economic base of Koolauloa has evolved from being dominated by sugar to one which includes tourism, aquaculture and specialized agriculture. Major employers are visitor-oriented and these include the Kuilima Resort and the Polynesian Cultural Center.

This region comprises a series of residential communities extending from Kahuku in the northernmost portion to Kaaawa in the southernmost area. The following describes major uses and these communities:

> **Kuilima Resort.** This resort complex is located north and makai of the proposed Punamano golf courses. The main feature at Kuilima is the Turtle Bay Hilton and Country Club, which contains 487 hotel and cabana units. The facilities at Kuilima also include two low-rise condominium complexes, a golf course and clubhouse, a riding stable and tennis courts. Expansion plans call for an additional 3,500 hotel and visitor condominium units, another golf course, a commercial area, beach parks and a wildlife preserve.
>
> **Kahuku.** Kahuku is just south of the Punamano site. This town's history is rooted in sugar, with the sugar mill and the Kahuku Sugar Plantation headquarters located in this town. Even though sugar production ended in 1971, this historic centrality has continued through today and Kahuku contains many area services, such as the high school and hospital. With a relatively small population, Kahuku is in transition because of the resident and government efforts to provide new and rehabilitated housing for original plantation camp residents.
>
> **Malaekahana.** The Malaekahana site is across from this area which contains the Malaekahana State Park, as well as vacation homes and cottages fronting Malaekahana Bay.

Laie. This is Koolauloa's largest residential community. Laie is the Hawaii's religious and educational center of the Church of Jesus Christ of the Latter Day Saints, with both the Temple and the Brigham Young University - Hawaii. A major tourist attraction, Laie's Polynesian Cultural Center provides income for the school and jobs for students.

Hauula. South of Laie is Hauula, a Hawaiian Homesteads community and Koolauloa's second largest residential community. This community has a small shopping center and a satellite City Hall.

Punaluu and Kaaawa. These communities are situated south and far from the project site. Punaluu is lightly-populated and some agricultural activities occur in the valley. Beachfront homes tend to be second residences for Honolulu residents and there is an oceanfront multi-story condominium complex (Pat's at Punaluu). Kaaawa also has large beachfront homes and contains a few multi-family units and some employment opportunities.

North Shore Development Plan Area.

The North Shore Development Plan Area extends from the Sunset Beach area, which is over two miles west of the *Punamano site, to Kaena Point.* Whereas Koolauloa tends to have pockets of residential communities, North Shore's population is more dispersed and homes in the North Shore region are found all along Kamehameha Highway. Except for the retail centers in Haleiwa and Waialua, commercial establishments are few and scattered.

The North Shore region has both major and diversified agricultural activities, the former of which is found in and near Haleiwa and Waialua. This region is also known for its high surf which attracts local and international surfing competitors.

Sunset Beach and Pupukea. Sunset Beach is located about a mile southwest of the Punamano site. Encompassing the Sunset Beach homes along the beach, Waimea and Pupukea, this area is primarily residential. Waimea Falls Park and small agricultural operations are the major non-residential uses. The types of homes range from the large cliffside homes in the Sunset Hills to the smaller homes in Pupukea along the highway.

Haleiwa. This town is the regional commercial and retail center. Pockets of residential communities are interspersed around the shopping complexes and stores along the highway. The Haleiwa Scenic District Design Ordinance protects this area's low-rise and colorful character and requires new buildings to be consistent with existing architecture.

Waialua. The Waialua area includes both the plantation town of Waialua and Mokuleia. The diversity in residential makeup ranges from the smaller homes near the mill to the beach frontage homes and agricultural lots in Mokuleia.

For the purposes of describing the study area, the two sources of information include (1) 1980 census information and (2) estimates provided by Traffic Assessment Zones as available at the City Department of General Planning, Planning Information Branch. The following indicates the delineation of communities and areas, based on these sources:

Koolauloa Development Plan and Area. Traffic Assessment Zone (TAZ) 166 includes Kahuku and the Kuilima Resort. The Punamano project site is located in this zone. This TAZ is *part of* Census Tract 101.

TAZ 168 is conterminous with Census Tract 102.02 and includes Laie and Malaekahana. The Malaekahana project site is located in this zone.

Hauula, Punaluu and Kaaawa are located in TAZ 167 and Census Tract 102.01.

North Shore Development Plan Area. TAZ 165 includes the Sunset Beach area and is *part of* Census Tract 101.

The area between Waimea Bay and Haleiwa Town is in TAZ 164 and Census Tract 100.

Haleiwa Town is in TAZ 163 and Census Tract 99.02.

TAZ 162, which is conterminous with Census tract 99.01, includes Waialua, from the edge of Haleiwa Town to Kaena Point.

Note that statistics generated by the U.S. Bureau of the Census includes Sunset Beach in the Koolauloa Census District. Otherwise, Sunset Beach is considered part of the North Shore Development Plan and Neighborhood Board areas.

2.2 DESCRIPTION OF THE EXISTING COMMUNITY

2.2.1 Population and Housing

In the first half of the 1980s, the City and County of Honolulu's resident population grew by five percent, from 762,564 in 1980 to 801,096 persons in 1985. Housing characteristics are summarized as follows:

* Housing units increased by 7.12 percent, from 254,785 to 272,936 units, during this five-year period.
* This disproportionate growth between housing and population correlates to the decrease in household size. The islandwide household size decreased from 3.20 persons in 1980 to 3.14 persons in 1985.
* Approximately 55 percent of the islandwide housing stock, or 128,643 units, were single-family residences in 1980. With the increase in multi-family units, the share of single family

residences decreased slightly to 53 percent in 1985, indicating an increase in multi-family residential units. In 1985, Oahu had 135,101 single family units and 118,559 multi-family units *(Single family + multi-family = total housing units).*

* Oahu's 9,324 "adjusted visitor units" (modification of Hawaii Visitor Bureau's report of housing units used for visitor accommodations) accounted for only 3.6 percent of the total housing stock in 1980 *(Adjusted visitor + dwelling units = total housing units).* This share decreased to 2.2 percent, as the total adjusted visitor units decreased to 5,965 units (City and County of Honolulu Department of General Planning, Traffic Assessment Zones, October 1987).

Population and housing trends for the study area are presented in Table 1, and the following summarizes this information:

1. Between 1980 and 1985, the study area population grew by 4.91 percent, which is a proportion slightly lower than the islandwide growth of five percent. In 1985, an estimate of 25,203 people lived in the combined Koolauloa and North Shore regions; 12,061 people, or 48 percent, of the total study area, were Koolauloa residents. Slightly over 13,000 people lived in the North Shore region.

2. Koolauloa grew at a faster pace than North Shore. Koolauloa experienced a population increase of 6.29 percent between 1980 and 1985, whereas the North Shore population grew by 3.68 percent.

3. The study area had an estimated 9,003 housing units in 1985, which represent a 6.49 percent (or 549 units) increase from 1980.

4. Corresponding to the larger proportion of population increase, the housing stock in Koolauloa also increased at a faster pace than that of the North Shore region. Koolauloa's 3,963 housing units in 1985 represent an 8.66 percent increase over the 1980 housing count. Contributing to this increase were over 300 new single family units and almost a hundred new visitor units.

5. Reflecting the rural character of the area, a significant 84 percent of study area housing units, or 7,555 units, were single-family homes, as compared to the 55 percent of the islandwide housing stock. Almost three-fourths of all the new 423 single-family units were built in the Koolauloa region.

6. Though lesser in numbers, multi-family housing units are increasing at a faster pace than single family units. The 124-unit increase between 1980 and 1985, which resulted in a total of 1,416 multi-family units in 1985, occurred in the North Shore region.

Table 1

Population and Housing Trends, 1980 and 1985:
Total Study Area, Koolauloa and North Shore

	TOTAL STUDY AREA			PRIMARY STUDY AREA KOOLAULOA			SECONDARY STUDY AREA NORTH SHORE		
	1980	1985	% change	1980	1985	% change	1980	1985	% change
Population	24,023	25,203	4.91%	11,347	12,061	6.29%	12,676	13,142	3.68%
% of total study area	N/A	N/A	N/A	47%	48%	N/A	53%	52%	N/A
Total Housing Units	8,454	9,003	6.49%	3,647	3,963	8.66%	4,807	5,040	4.85%
Single Family Units	7,132	7,555	5.93%	2,816	3,138	11.43%	4,316	4,417	2.34%
Multi-family Units	1,292	1,416	9.60%	833	825	-.96%	459	591	28.76%
Military Units	32	32	.00%	0	0	.00%	32	32	.00%
Visitor Units	97	221	127.84%	97	191	96.91%	0	30	100.00%
Household Size	2.87	2.87	-.15%	3.20	3.20	.06%	2.64	2.62	-.52%

Koolauloa includes Traffic Assessment Zones 166 through 168. North Shore includes Traffic Assessment Zones 162 through 165.

Source: City and County of Honolulu Department of General Planning, Planning Information Branch. Traffic Assessment Zones. October 1987. Calculations performed by Earthplan.

7. The reported housing units used as short-term visitor accommodations totaled 221 units in 1985 for the entire Study area. This represented over twice the number of such units in 1980. Almost all of these units were reported in Koolauloa, and the North Shore region accounted for only 30 visitor units.

8. Household sizes were smaller in the North Shore region, when compared to islandwide averages, while Koolauloa household sizes were similar to that of Oahu. Overall study area household sizes remained stable between 1980 and 1985, with 2.87 persons per household. In 1985, household sizes ranged from 3.25 persons in Koolauloa to 2.62 persons in North Shore.

2.2.2 Employment and Labor Force

Tables 2 and 3 presents estimated 1985 employment figures based on information generated by the City Department of General Planning. The following summarizes this information:

1. The study area contained approximately 9,202 jobs in 1985. Over half, or 5,154 jobs, were found in the Koolauloa region.

2. The Koolauloa region contained all of the area's hotel jobs, and most of these were in the Kuilima Resort located in Kahuku. Koolauloa also had almost three-fourths of the study area's service jobs and over 60 percent of the jobs in transportation, communications, and utilities. This region also had almost half of the study area's jobs in government and 54 percent of retail jobs.

3. On the other hand, the North Shore region contained all of the study area's military jobs, and 88 percent of the industrial jobs. Seventy three percent of the study area's agricultural jobs were in this region, as were 61 percent of the construction jobs.

4. The largest category of jobs for both regions is service, although the relative proportions differ greatly. In the Koolauloa region, service jobs accounted for 53 percent of the total area jobs. Only about a quarter of North Shore's total jobs were service-related, even though this was the largest category.

5. In Koolauloa, the distant second category of jobs was retail, at 17 percent. All other job categories added up to only 28 percent of the total Koolauloa jobs.

6. The second category of jobs in the North Shore region was also retail, at 19 percent, followed by agriculture and industry at 13 and 12 percent, respectively.

Table 2

STUDY AREA EMPLOYMENT
NUMBER AND BREAKDOWN BY STUDY AREA

1985

	TOTAL STUDY AREA	PRIMARY STUDY AREA KOOLAULOA Total	Kahuku	Laie	SECONDARY STUDY AREA NORTH SHORE
Military	336	0	0	0	336
% of total	100%	0%	0%	0%	100%
Government	662	326	127	97	336
% of total	100%	49%	19%	15%	51%
Hotel	328	328	299	29	0
% of total	100%	100%	91%	9%	0%
Transportation Communications Utilities	374	227	146	26	147
% of total	100%	61%	39%	7%	39%
Industry	558	66	27	12	492
% of total	100%	12%	5%	2%	88%
Finance, Insurance Real Estate	371	209	54	74	162
% of total	100%	56%	15%	20%	44%
Service	3,784	2,750	260	2,166	1,034
% of total	100%	73%	7%	57%	27%
Retail	1,673	899	330	219	774
% of total	100%	54%	20%	13%	46%
Construction	415	162	37	97	253
% of total	100%	39%	9%	23%	61%
Agriculture	701	187	90	81	514
% of total	100%	27%	13%	12%	73%
TOTAL	9,202	5,154	1,370	2,801	4,048
	100%	56%	15%	30%	44%

Koolauloa includes Traffic Assessment Zones 166 through 168. North Shore includes Traffic Assessment Zones 162 through 165.

Source: City and County of Honolulu Department of General Planning, Planning Information Branch. Traffic Assessment Zones. October 1987. Calculations performed by Earthplan.

Table 3

STUDY AREA EMPLOYMENT
BREAKDOWN BY TYPE OF JOB

1985

	TOTAL STUDY AREA	PRIMARY STUDY AREA KOOLAULOA Total	Kahuku	Laie	SECONDARY STUDY AREA NORTH SHORE
Military	4%	0%	0%	0%	8%
Government	7%	6%	9%	3%	8%
Hotel	4%	6%	22%	1%	0%
Transportation Communications Utilities	4%	4%	11%	1%	4%
Industry	6%	1%	2%	0%	12%
Finance, Insurance Real Estate	4%	4%	4%	3%	4%
Service	41%	53%	19%	77%	26%
Retail	18%	17%	24%	8%	19%
Construction	5%	3%	3%	3%	6%
Agriculture	8%	4%	7%	3%	13%
TOTAL	100%	100%	100%	100%	100%

Koolauloa includes Traffic Assessment Zones 166 through 168. North Shore includes Traffic Assessment Zones 162 through 165.

Source: City and County of Honolulu Department of General Planning, Planning Information Branch. Traffic Assessment Zones. October 1987. Calculations performed by Earthplan.

Based on the 1980 census, the study area had similar civilian unemployment rates as Oahu, as indicated in Table 4. The occupational characteristics differed as follows:

1. Corresponding to the relatively high proportion of area service jobs in 1985, and compared to the islandwide occupational profile, the Koolauloa population had a significantly higher proportion of residents working in service-related occupations. Koolauloa also had higher proportions of residents in agricultural-related occupations. Relatively fewer residents held the higher-paying occupations related to managerial/professional and technical/sales/administration.

2. Compared to the Oahu-wide occupational profile, a similar proportion of North Shore residents had service occupations. Like Koolauloa residents, proportionally less North Shore residents held the higher-paying occupations related to managerial/professional and technical/sales/administration.

3. Significantly higher proportions of both Koolauloa and North Shore employed residents had to travel 45 minutes or more to get to work.

2.2.3 Other Characteristics

Table 5 presents social and economic characteristics of Oahu, the entire Study Area and the Koolauloa and North Shore Development Plan areas. Based on 1980 census information, the following are highlights of this comparison:

Ethnicity. When compared to the islandwide profile, the study area had similar proportions of Caucasian residents. Koolauloa tended to have more Caucasian residents than the North Shore. As a whole, the Study area had less Japanese and Chinese residents and more residents who were of Filipino, Hawaiian or other ethnic extractions.

Age. The study area tended to be younger than the islandwide population. Koolauloa, in particular, had a relatively low median age of 23.8, when compared to the Oahu-wide median age of 28.1. Both Koolauloa and North Shore had higher proportions of children under five and lower proportions of residents between 18 and 64 years old. Further, the North Shore region had a relatively large elderly population, while Koolauloa had a smaller proportion of people 65 years and older.

Place of Birth. The study area population was generally similar to the islandwide population in terms of where residents were born. Of note is that both Koolauloa and North Shore had high proportions of people born in another country, with 17.7 and 17.8 percent respectively, when compared to the islandwide 14.8 percent.

Table 4

Labor Force Characteristics, 1980:
City and County of Honolulu and Study Area

	CITY AND COUNTY OF HONOLULU	TOTAL STUDY AREA	PRIMARY STUDY AREA: KOOLAULOA	SECONDARY STUDY AREA: NORTH SHORE
Total Potential Labor Force	574,903	17,207	9,833	7,374
Civilian labor force	59.1%	53.0%	62.2%	52.0%
Unemployed civilian labor force	4.6%	4.7%	4.9%	4.6%
Occupation of Employed Civilian Labor Force				
Service	17.6%	23.3%	28.6%	15.1%
Managerial and professional	24.7%	20.6%	22.2%	18.1%
Technical, sales and administration	33.7%	22.6%	23.5%	21.3%
Farming, fishing and forestry	1.8%	7.5%	5.8%	10.4%
Precision, craft and repair	11.3%	12.4%	10.7%	.151
Operators, fabricators and laborers	10.9%	13.4%	9.2%	27.2%
Commute to Work				
45 minutes or more	11.9%	23.1%	21.1%	27.2%
Mean travel time	22.9 minutes	25.5 minutes	25.1 minutes	25.9 minutes

Note: Statistics generated by the U.S. Bureau of the Census includes Sunset Beach in the Koolauloa Census District. Otherwise, Sunset Beach is considered part of the North Shore Development Plan and Neighborhood Board areas.

Sources: U.S. Bureau of the Census, 1981a and 1981b.

Table 5

Population Characteristics, 1980:
City and County of Honolulu and Study Area

	CITY AND COUNTY OF HONOLULU	TOTAL STUDY AREA	PRIMARY STUDY AREA: KOOLAULOA	SECONDARY STUDY AREA: NORTH SHORE
Ethnicity				
Caucasian	33.1%	35.3%	38.2%	31.2%
Japanese	24.9%	11.6%	7.4%	17.7%
Chinese	6.9%	2.3%	3.2%	1.0%
Filipino	12.8%	17.5%	7.1%	34.2%
Hawaiian	10.5%	18.3%	22.9%	11.6%
Other	11.8%	15.0%	21.2%	6.0%
Age				
Less than 5 years	7.9%	10.5%	11.6%	9.0%
5 to 17 years	20.2%	21.7%	22.8%	20.0%
18 to 64 years	64.6%	60.4%	59.3%	61.9%
65 years and older	7.3%	7.4%	6.3%	9.1%
Median Age	28.1	25.1	23.8	26.3
Place of Birth				
Hawaii	55.1%	52.7%	50.9%	55.2%
Other U.S.	30.1%	29.6%	31.4%	27.0%
Another country	14.8%	17.7%	17.7%	17.8%
Residence Five Years Previous				
Same house	48.2%	47.8%	46.0%	50.4%
Same county	25.5%	26.6%	28.3%	24.2%
Other county	1.3%	5.9%	.8%	2.8%
Other state	18.4%	16.5%	14.8%	18.9%
Other country	6.6%	8.8%	10.0%	3.7%
Education (25 years and older)				
Up to 11 years completed	24.4%	30.2%	24.7%	37.4%
Graduated from high school	35.5%	31.9%	31.9%	32.0%
Some post high school	18.3%	20.0%	23.3%	15.6%
College (4+ years)	21.7%	17.9%	20.1%	15.0%
Population in Families	85.6%	83.8%	82.3%	86.0%
Families Below Poverty Level	7.5%	11.5%	13.5%	9.0%
Median Family Income	$23,554	Not available	$19,556	$16,895

Note: Statistics generated by the U.S. Bureau of the Census includes Sunset Beach in the Koolauloa Census District. Otherwise, Sunset Beach is considered part of the North Shore Development Plan and Neighborhood Board areas.
Sources: U.S. Bureau of the Census, 1981a and 1981b.

Residence Five Years Previous. The study area tended to have more people who lived on other Hawaiian island (5.9 percent) or in another country (8.8 percent), when compared to the islandwide proportions of 1.3 and 6.6 percent, respectively.

Education. A significantly higher proportion of North Shore residents did not graduate from high school, with 37.4 percent having completed up to eleven years of schooling, when compared to the islandwide 24.4 percent. Correspondingly, only 15 percent attended a four-year college, as compared to 21.7 percent of the islandwide population.

Families. When compared to Oahu as a whole, the study area had similar proportions of its residents in families. A significantly high proportion of study area families were met poverty standards and the median family incomes for Koolauloa and the North Shore were respectively between $4,000 and $6,700 lower than the 1980 Oahu median family income of $23,554.

2.3 PROFILE OF NEARBY COMMUNITIES

The communities nearest to the Punamano and Malaekahana project sites are Kahuku and Laie, respectively. Because of the proximity and potential for interaction with the Country Courses at Kahuku, these communities are further described.

Population and Housing Trends. As Table 6 indicates, Kahuku's population grew by 34.7 percent between 1980 and 1985, resulting in a 1985 population of 2,240. Much of this growth is attributable to the addition of over 278 new single family housing units during this five-year period. The Kahuku community has had a series of housing-related organizations to provide new and/or rehabilitated housing for original plantation camp residents. The City's 1982 housing project provided new homes for longtime residents and newcomers, the latter of which contributed significantly to the area's growth.

During that time, Laie's population experienced only nominal growth and its 1985 count of 5,820 persons represented only a 1.54 percent increase over the 1980 population.

Unlike other communities in the study area, Kahuku has a large proportion of multi-family units, which accounted for 39 percent of the total housing stock; no new multi-family units were added in the first five years of this decade, however. Many of the multi-family units are townhouses at the Kuilima Resort. Household size was relatively small at 2.21 persons in 1985.

Table 6

Population and Housing Trends, 1980 and 1985:
Total Study Area, Kahuku and Laie

	TOTAL STUDY AREA			KAHUKU			LAIE		
	1980	1985	% change	1980	1985	% change	1980	1985	% change
Population	24,023	25,203	4.91%	1,663	2,240	34.70%	5,732	5,820	1.54%
% of total study area	N/A	N/A	N/A	7%	9%	N/A	24%	23%	N/A
Total Housing Units	8,454	9,003	6.49%	909	1,187	30.58%	1,084	1,111	2.49%
Single Family Units	7,132	7,555	5.93%	450	728	61.78%	1,076	1,105	2.70%
Multi-family Units	918	1,416	54.25%	459	459	.00%	8	6	-25.00%
Military Units	32	32	.00%	0	0	.00%	0	0	.00%
Visitor Units	97	221	127.84%	55	172	212.73%	0	1	100.00%
Occupied Dwelling Units	8,358	8,782	5.07%	854	1,015	18.85%	1,084	1,110	2.40%
Household Size	2.87	2.87	-.15%	1.95	2.21	13.33%	5.29	5.24	-.84%

Kahuku is in Traffic Assessment Zones 166. Laie is in Traffic Assessment Zones 168.

Source: City and County of Honolulu Department of General Planning, Planning Information Branch. Traffic Assessment Zones. October 1987. Calculations performed by Earthplan.

Laie's housing stock is virtually all single-family units and experienced only a nominal increase of 29 units between 1980 and 1985. Further, Laie's large and stable household size indicates a pressing need for increased housing supply in this area.

Note that both Kahuku and Laie have characteristics of a typical small town. They both evolved around a central focus. Kahuku grew around the sugar mill and Laie expanded around the church and its other facilities. In these towns, there are business or service centers and neighborhoods are easily discernible. Hence, residential densities are relatively high, when compared to other areas of the study area which are more rural in character, such as Kaaawa, Punaluu, Sunset and Pupukea.

Employment and Labor Force. Tables 2 and 3 present employment information on these nearby communities. Table 2 shows that Kahuku accounted for 15 percent of the study area's total jobs, and the bulk of the hotel jobs. Laie contained almost a third of the study area's jobs, and 57 percent of the area's service jobs.

Table 3 shows that the almost a fourth of Kahuku's 1,370 jobs in 1985 were in retail operations, and 22 percent were hotel-related. Of Laie's total 2,801 jobs, over three fourths were service-related.

Census information indicates that in 1980, the Kahuku Census Designated Place (CDP) had a very low unemployment rate of 1.3 percent, as compared to Oahu's 4.6 percent. As shown on Table 7, a significant portion of Kahuku CDP residents (25.9 percent) held agricultural-related jobs, when compared to Oahu's 1.8 percent, the Study Area's 7.5 percent and Laie CDP's 2.2 percent. At the same time, there were smaller proportions of residents in service, managerial, administrative and precision/craft/repair occupations.

Laie CDP residents also had a low unemployment rate at 3.7 percent. Except for a high proportion of residents in service (32.5 percent as compared to the island's 17.6 percent), Laie's labor profile was similar to that of the island and the Study area.

Other Population Characteristics. Table 8 compares 1980 population characteristics of nearby communities with the overall study area and Oahu.

Kahuku CDP had significantly more Filipinos (51.8 percent) than Oahu as a whole (12.8 percent), the study area (17.5) and Laie CDP (1.6 percent). Laie, on the other hand, had a significantly high proportion of people of other extractions (46.5 percent), and this is attributable to the large number of Pacific Islanders affiliated with the Church of Jesus Christ of the Latter Day Saints and the Polynesian Cultural Center.

In terms of age, Kahuku CDP tended to be older, while Laie CDP had a much younger population. Almost a fourth of Kahuku CDP's population was in the 65-years-and-older category, as compared to Oahu's 7.3

percent and Laie CDP's 2.8 percent. Correspondingly,, the median age in Kahuku CDP of 37.3 years was high, and Laie's median age of 20.6 was low, when compared to the islandwide median age of 28.1 years.

Both the Kahuku and Laie CDPs had large proportions of residents born in another country at 28.9 and 31.9 percent, respectively, when compared to the Oahu proportion of 14.8 percent.

With over 60 percent of its residents not graduating from high school, Kahuku CDP residents had generally less education than Oahu, the Study Area and Laie CDP.

Statistics indicate that, as a whole, Laie CDP residents were slightly less family-oriented, with 77.9 percent of the population living in families, as compared to Kahuku CDP's 87.7 percent. The former lower proportion is due to the presence of students at the Brigham Young University - Hawaii. Had these students not been counted in the overall count, however, Laie residents would undoubtedly exhibit strong family orientations, given the cultural and religious backgrounds which typifies Pacific Islanders and and those of the Morman religion. .

Both communities had higher proportions of families below poverty level, with Laie CDP's proportion being over twice that Oahu and Kahuku CDP.

Table 7

**Labor Force Characteristics, 1980:
City and County of Honolulu, Total Study Area
and Kahuku and Laie Census Designated Places**

	CITY AND COUNTY OF HONOLULU	TOTAL STUDY AREA	KAHUKU CENSUS DES. PLACE	LAIE CENSUS DES. PLACE
Total Potential Labor Force	574,903	3,171	659	2,512
Civilian labor force	59.1%	287.9%	56.4%	80.4%
Unemployed civilian labor force	4.6%	4.7%	1.3%	3.7%
Occupation of Employed Civilian Labor Force				
Service	17.6%	23.3%	14.4%	32.5%
Managerial and professional	24.7%	20.6%	17.7%	24.9%
Technical, sales and administration	33.7%	22.6%	21.8%	27.0%
Farming, fishing and forestry	1.8%	7.5%	25.9%	2.2%
Precision, craft and repair	11.3%	12.4%	2.7%	6.4%
Operators, fabricators and laborers	10.9%	13.4%	17.4%	6.9%
Commute to Work				
45 minutes or more	11.9%	23.1%	6.0%	9.0%
Mean travel time	22.9 minutes	25.5 minutes	15.0 minutes	12.6 minutes

The Total Study Area includes the Koolauloa and North Shore Development Plan areas.

Sources: U.S. Bureau of the Census, 1981a and 1981b.

Table 8

Population Characteristics, 1980:
City and County of Honolulu, Total Study Area
and Kahuku and Laie Census Designated Places

	CITY AND COUNTY OF HONOLULU	TOTAL STUDY AREA	KAHUKU CENSUS DES. PLACE	LAIE CENSUS DES. PLACE
Ethnicity				
Caucasian	33.1%	35.3%	16.4%	30.0%
Japanese	24.9%	11.6%	15.6%	4.1%
Chinese	6.9%	2.3%	.4%	6.3%
Filipino	12.8%	17.5%	51.8%	1.6%
Hawaiian	10.5%	18.3%	9.7%	11.5%
Other	11.8%	15.0%	6.1%	46.5%
Age				
Less than 5 years	7.9%	10.5%	6.7%	14.7%
5 to 17 years	20.2%	21.7%	23.1%	22.6%
18 to 64 years	64.6%	60.4%	46.5%	59.9%
65 years and older	7.3%	7.4%	23.6%	2.8%
Median Age	28.1	25.1	37.3	20.6
Place of Birth				
Hawaii	55.1%	52.7%	57.8%	35.1%
Other U.S.	30.1%	29.6%	13.3%	33.0%
Another country	14.8%	17.7%	28.9%	31.9%
Residence Five Years Previous				
Same house	48.2%	47.8%	41.2%	32.7%
Same county	25.5%	26.6%	44.2%	22.4%
Other county	1.3%	5.9%	.0%	.6%
Other state	18.4%	16.5%	2.4%	19.6%
Other country	6.6%	8.8%	12.2%	24.7%
Education (25 years and older)				
Up to 11 years completed	24.4%	30.2%	61.6%	15.0%
Graduated from high school	35.5%	31.9%	18.2%	26.2%
Some post high school	18.3%	20.0%	11.7%	33.7%
College (4+ years)	21.7%	17.9%	8.5%	25.1%
Population in Families	85.6%	83.8%	87.7%	77.9%
Families Below Poverty Level	7.5%	11.5%	9.9%	20.3%
Median Family Income	$23,554	Not available	$13,611	$15,183

The Total Study Area includes the Koolauloa and North Shore Development Plan areas.

Sources: U.S. Bureau of the Census, 1981a and 1981b.

COUNTRY COURSES AT KAHUKU

SOCIAL IMPACT ASSESSMENT
SECTION 3: POLICIES AND PROPOSALS WHICH WILL AFFECT THE COMMUNITY'S FUTURE

3 POLICIES AND PROPOSALS WHICH WILL AFFECT THE COMMUNITY'S FUTURE

This section examines public policies and proposed changes to understand what is anticipated to occur in the study area independent of the proposed project. Section 3.1 describes public policies for Koolauloa and North Shore, and identifies proposed amendments to the respective Development Plans. Section 3.2 provides an overview of proposed changes to the area. In Section 3.3, a description of a likely scenario *without* The Country Courses at Kahuku is provided.

3.1 DIRECTION OUTLINED IN GENERAL AND DEVELOPMENT PLAN POLICIES

The City and County of Honolulu General Plan recognizes the entire Study Area as rural. The residential population targeted for the study area is designed to be consistent with the character of development and environmental qualities desired for these areas.

Consistent with this policy is the General Plan's residential population distribution for the year 2010. As shown in Table 9, Koolauloa and the North Shore are targeted to collectively accommodate up to 3.2 percent of the island's population in 2010, as follows:

* The Koolauloa Development Plan area is currently targeted to accommodate between 1.3 and 1.4 percent of Oahu's 2010 population. The current distribution policy implies that, in 2010, between 12,994 and 13,993 people could be residing in this area. Given the 1985 residential population of 12,061 persons (see Table 1), the population could increase by between 1,000 and 2,000 people, or by eight to 16 percent.

* The North Shore Development Plan area is currently targeted to accommodate between 1.6 and 1.8 percent of Oahu's 2010 population. By that time, between 15,992 and 17,991 people could be living in the area, which implies a population increase of between 22 and 37 percent over the 1985 population of 13,142 persons.

In addition, the City Department of General Planning proposes to amend the Special Provisions for the both Development Plan areas to change the agricultural density to a maximum of one unit per acre, rather than the current one unit per two acres.

Table 9

Population Projections by
Development Plan Area, 2010

	General Plan Distribution of Residential Population [1]	2010 Population Range Based on Series M-K Projections [2]
Primary Urban Center	45.1% - 49.8%	450,775 - 497,751
Ewa	12.0% - 13.3%	119,940 - 132,934
Central Oahu	14.9% - 16.5%	148,926 - 164,918
East Honolulu	5.3% - 5.8%	52,974 - 57,971
Koolaupoko	11.0% - 12.2%	109,945 - 121,939
Koolauloa	1.3% - 1.4%	12,994 - 13,993
North Shore	1.6% - 1.8%	15,992 - 17,991
Waianae	3.8% - 4.2%	37,981 - 41,979
Total Oahu	95.0% - 105.0%	949,525 - 1,049,475

1. City Council, Resolution Relating to Amending the General Plan of the City and County of Honolulu, No. 88-404, CD-1, FD-1.

2. Table 18 of the The State of Hawaii Data Book: 1988 (State Department of Business and Economic Development, 1988) provides a population projection of 999,500 persons for the City and County of Honolulu in 2010.

Further, development priorities for each of these Development Plan areas are proposed as follows:

Koolauloa Development Plan Area:

1. Improvement of wastewater management services;
2. Expansion of public beach parks and beach access;
3. Encourage the improvement of the State highway system;
4. Improvement of water resources to support agriculture, aquaculture and needed urban uses; and
5. Encourage drainage facilities improvements.

North Shore Development Plan Area:

1. Improvement of water resources to support agriculture, aquaculture and needed urban uses;
2. Further expansion, acquisition and development of beach parks and preservation of beach access;
3. Encourage development of employment opportunities for North Shore residents;
4. Improvement of wastewater management services; and
5. Encourage the improvement of the State highway system, particularly the Haleiwa bypass road (City and County of Honolulu Department of General Planning, 1989a and 1989b).

3.2 MAJOR DEVELOPMENT PROPOSALS IN THE STUDY AREA

Neither the Koolauloa nor the North Shore Development Plan areas have specific land use amendments proposed in the current annual Development Plan review. Further, the only major approved proposal for these areas is the Kuilima Resort expansion which is located makai of the Punamano project site. This section provides a profile of changes which could occur in the study area independent of the proposed project.

Job-Generating Uses. The Kuilima Resort Expansion is expected to the major employment-generating force for the study area in the near future. The proposed expansion, which already has Development Plan and zoning approvals, includes (1) 4,000 visitor units, (2) an 18-hole championship golf course, (3) an 8.5 acre shopping village complex; (4) a tennis club, beach club and equestrian facilities; and (5) various recreational amenities for the general public. These efforts are anticipated to create 3,555 new direct, indirect and induced jobs in the region (Community Resources, Inc. and. A. Lono Lyman, Inc., November 1984).

Other job-generating potential uses would be generated by the development of land held by major landowners. The following summarizes potential uses which may generate employment in the Study Area. It is stressed, however, that these plans are very long-range in nature and implementation would require major approvals. Further, some of these plans are in very preliminary stages and have not been formally adopted by the respective landowners.

The Estate of James Campbell -- The Estate owns about 14,000 acres in Kahuku. The master plan of these lands is expressed in three "components." The first component is open space and agriculture, which would occupy most of their holdings and includes lands to be used in agriculture (including the State agricultural farm) and aquaculture, and lands leased to the U.S. Army. The second component is development in and around Kahuku Village. This includes residential development and a light industrial park. The third component is the Kuilima Resort expansion which was previously discussed (Helber, Hastert and Kimura, 1988 and personal communication with Charles Ehrhorn, Asset Manager, November 27, 1989). Not including the Kuilima Resort expansion, the job-generating efforts which would result from implementing this master plan are the industrial, agricultural and aquacultural operations.

Zions Security Corporation -- The Laie master plan is currently being revised, so specific components are still being identified. The revised master plan is expected to be presented to the public in February 1990.

In the short term, job-generating uses include an Imax screen theater, for which permits were recently received, and the 27,000-square foot expansion of the Laie Shopping Center. Both are anticipated for completion in 1990 (personal communication with Marvin Stone, Land Manager, Zion Securities Corporation, November 27, 1989).

Kamehameha Schools/Bishop Estate (KS/BE) -- KS/BE is currently preparing a master plan for its 800 acres in the North Shore region. The plan's preliminary concept includes enhancing the Haleiwa town core with a Main Street program, and adding a small golf course and residences. For the area just east of Haleiwa town, KS/BE is considering establishing outdoor recreational uses, such as a demonstration site for traditional Hawaiian aquaculture, a wildlife refuge and a championship golf course. Other plan elements include residential infill and resident and visitor attractions with small-scale lodgings (Kamehameha Schools, 1989a and 1989b and personal communication with Paul Cathcart, Land Development Manager, Bishop Estate, November 28, 1989).

Based on this preliminary information, the commercial and recreational/visitor activities proposed in this plan would generate many jobs for this area.

Castle and Cooke -- Castle and Cooke, Inc. and its subsidiaries Waialua Sugar Company and Oceanic Properties, Inc., owns lands in Haleiwa and Waialua. Long range plans call for urban/recreational development adjacent to the proposed Mokuleia resort development, residential infill in both Haleiwa and Waialua, a commercial center at the Haleiwa Gateway, an 18-hole golf course near Waialua and an agricultural theme park near Haleiwa. The major job-generating efforts in this plan are the resort and commercial efforts (Helber, Hastert, Van Horn and Kimura, Planners, 1986).

Residential Development. In Koolauloa, two-thirds of the 1980 housing stock were rentals. This is high, compared to the one-third in Oahu suburbs and one-half of the islandwide housing stock which are rented. When adding the high proportion of crowding in this region, affordable housing is a critical need in Koolauloa. At present, there is a 400-unit publicly-assisted housing project in Kahuku. Two hundred more units of rental housing are being considered in Hauula, and additional units may be built in Kahuku as employee housing for the expanded Kuilima Resort (City and County of Honolulu, 1989a).

No housing developments are planned in the immediate future for the North Shore Development Plan area (City and County of Honolulu, 1989b).

A potential for increasing the study area's residential supply is the development of lands held by major landowners. The following outlines the residential of long-range plans of the study area's major landowners:

The Estate of James Campbell -- The Estate's long-range plans call for the development of 400 to 600 residential units in and around Kahuku Village. These units would include the employment housing for the expanded Kuilima Resort, as well as an expansion of the Kahuku Elderly Housing Project (personal communication with Charles Ehrhorn, Asset Manager, November 27, 1989).

Zions Security Corporation -- In very preliminary stages, the Laie master plan may propose 350 new residential units near the Malaekahana project site (personal communication with Marvin Stone, Land Manager, Zion Security Corporation, November 27, 1989).

Kamehameha Schools/Bishop Estate (KS/BE) -- Three areas have been designated for residential development on the Kawailoa Master Plan; no specific unit count has yet been provided (Yamaguchi, 1989).

Castle and Cooke -- Castle and Cooke owns a number of remnant parcels in and around the communities of Haleiwa and Waialua, and these are targeted for residential infilling (Helber, Hastert, Van Horn and Kimura, 1986).

Infrastructure and public facilities. The study area is targeted for two major roadway improvements, both of which are located in the North Shore region. The most extensive proposed change is the Haleiwa Bypass Road, which will divert through-traffic away from the more congested areas of Haleiwa. As indicated in Section 3.1, this project is a proposed development priority in the North Shore Development Plan. With planning and engineering funds already budgeted, the Haleiwa Bypass Road is scheduled for construction this year. Completion of this roadway should be in the latter part of 1991. The State Department of Transportation is also planning to realign Kamehameha Highway at Waimea Bay.

The improvement of the wastewater management system in Koolauloa and North Shore regions is also a priority on the respective Development Plans. In Koolauloa, three small sewage treatment plants serve the Kuilima Resort, the vicinity of the Kahuku Hospital and the center of Laie. All three systems are operating near capacity and must be either expanded or replaced. Further, more sewage treatment plants will be needed to service other areas (City and County of Honolulu Department of General Planning, 1989a). In the North Shore region, a proposed Haleiwa-Waialua Wastewater Treatment Plant is expected to replace all cesspools in the Haleiwa-Waialua-Mokuleia area, the Paalaa Sewage Treatment Plant and 17 small, private sewage treatment plants. Construction is scheduled to begin within six years (City and County of Honolulu Department of General Planning, 1989b).

Another priority in these Development Plan areas is the improvement of the water system to support agricultural and necessary urban uses. In Koolauloa, the Board of Water Supply system stops short of Laie, which has its own private water system, and resumes near the Kuilima Resort. Kahuku town has its own special Board of Water Supply system (City and County of Honolulu Department of General Planning, 1989a). Proposed Board of Water Supply projects in the North Shore area include six wells to provide potable water, and reservoir facilities to increase overall storage capacity. Three of these wells are scheduled in the BWS six-year (1985-1991) Capital Improvement Program. (City and County of Honolulu Department of General Planning, 1989b).

Golf courses. The study area's two existing golf course are both in Koolauloa. These include a nine-hole municipal golf course in Kahuku, and an 18-hole Turtle Bay course at the Kuilima Resort. A second 18-hole golf course at the Kuilima Resort has been approved.

Recently, four golf courses have been proposed in the North Shore region. Landowner Sankyo Tsusho, through its Mokuleia Land Company, proposes to develop two golf courses on its Mokuleia property. Its application was not accepted by the City Department of Land Utilization, and no subsequent application was filed (Wiles, 1988). Two golf courses are proposed in Pupukea by Ohbayashi Hawaii Corporation. The Land Use Boundary Change petition has been withdrawn by the developer, although planning for this development continues.

Adjacent to the Malaekahana project site is an 18-hole championship golf course proposed by the Kuilima Resort Company.

The City is considering expanding the Kahuku Golf Course into an 18-hole course (Wagner, 1987). Currently, the implementation of this proposal is still being studied (personal communication with Steve Salis, Advanced Planning, City and County of Honolulu Department of Parks and Recreation, December 1, 1989).

Further, two additional courses are included in the master plans of Castle and Cooke and KS/BE (preliminary).

Thus, including the potential expansion of the Kahuku Golf Course, six golf courses have been discussed in the Study Area, *not including The Country Courses at Kahuku.*

Recreation. Recreational facilities and resources are major ingredients of most private development proposals, as well as of the government entities. The private developments have been presented previously in this section. Based on personal communication with Steve Salis (Advanced Planning, City and County of Honolulu Department of Parks and Recreation, December 1, 1989), the following are current actions being planned or considered by the City in the Koolauloa Development Plan area:

* The City is considering the acquisition of the four acres in Hauula and eleven acres in Laie, as well as smaller parcels along the shoreline, for beach parks and public shoreline access.

* The establishment of a nature reserve along four miles of Kahuku's shoreline (between Kuilima and Kahuku Point) is viewed as a long-range target.

* Inland recreation facilities include the improvement of the Kahuku Recreation Center, and the addition of a community park in Laie.

In the North Shore Development Plan area, the City is looking at acquiring various parcels of land for public access. The State is transferring the Wailee Beach to the City. In Kawailoa, the City is planning to meet the parking needs of nearby surfing beaches on two sites mauka of the highway. Further, the Haleiwa Beach Park and the Mokuleia Beach Park are in various stages of expansion.

3.3 STATUS OF GOLF COURSE DEVELOPMENT IN THE APPROVAL PROCESS

Recently, public officials have sought to revise rules pertaining to golf courses on both State and City levels.

In 1988, State legislators reacted to community concern about golf course on agricultural land (see Section 4.1) by proposing to repeal a 1985 state law which allows golf course on non-prime agricultural land (Yamaguchi, 1988a and 1988b). Proponents of the repeal bill argued that stricter requirements would improve the State's ability to monitor golf course impacts (Yamaguchi, 1988b).

Bill opponents felt that the 1985 law contained adequate provisions for control over golf courses (Yamaguchi, 1988c). The bill failed to pass (The Honolulu Advertiser, 1988b).

The Honolulu City Council also responded to the growing concern over golf course development. In March of this year, the Council adopted Resolution 89-91 which requested that the City Department of Land Utilization assess various issues related to further golf course development. Also, Resolution 89-36 was passed which established a one-year moratorium on golf course development, from which golf courses approved after January 1, 1989 were excluded.

The City administration found that the "magnitude of golf course development is clearly an excessive commitment of limited land and water resources, given other competing needs for these resources, particularly affordable housing." In the report to the City Council, the City administration suggested stricter controls over such development through (1) requiring Development Plan amendments for all new golf courses; (2) approvals of no more than three courses per year; and (3) the discouragement of "stand-alone" golf courses in rural and agricultural areas. The administration further recommended that new golf courses be part of an integrated plan for the area by having dual purposes, such as drainage and buffers (City and County of Honolulu, 1989).

The City Council is currently considering Bill 152 (1989) which, if passed would amend the Land Use Ordinance with regards to the approval process for golf course development. The bill proposes to ensure that golf courses are reviewed in a public hearing through the Plan Review Use process. Further, Bill 152 would instruct Council to take into consideration items such as the encouragement of the use of non-potable water for irrigation and provisions to enhance the opportunities for public play. The City Council is also re-evaluating the need to reinstate the moratorium imposed by Ordinance 89-36.

3.4 LIKELY SCENARIO WITHOUT THE COUNTRY COURSES AT KAHUKU

Changes in the Study Area are expected to be gradual, due to the public policies calling for the retention of the area's rural character.

1. **Change in economic base.** The hotel and commercial development of the Kuilima Resort expansion will essentially change the economic base for the area. The economic development in the Study Area has been limited, and unless an economic base such as tourism is developed, the area's future economic development should continue to lag behind that of the rest of the island. The projected 3,555 new direct, indirect and induced jobs resulting from the proposed actions will help the region in improving the overall economy.

2. **Continued need for affordable housing.** As discussed in previous sections of this report, the Study Area already has a major housing problem, as reflected in low vacancy rates and crowding. The only near-term solution is the affordable housing project in Kahuku. The potential residential development in Laie may help the situation, but planning is in preliminary stages, as is the potential new housing by the KS/BE.

   With the Kuilima Resort expansion, pressures for affordable units will increase as people move into the area to be near the Kuilima job site. Kuilima's housing impacts can be mitigated through job training of the area's current residents, thereby decreasing the need for out-of-area employees, and through the off-site affordable housing to be developed by Kuilima Resort Company.

   Although these residential and other projects may help relieve the housing pressure, a major increase in the area's housing stock is constrained by the City General Plan and Development Plan policies which allow only enough zoning for the Study Area to maintain roughly its present proportion of islandwide population over the next several years.

3. **Increased presence of visitors.** Study Area residents will experience increased interactions with visitors as the Kuilima Resort expansion brings more visitors into the area. Currently, resident-visitor interaction is enabled by the facilities at the Polynesian Cultural center in Laie, the Waimea Falls Park and accommodations and facilities at the Turtle Bay Hilton.

4. **Expansion and enhancement of the recreational resources.** As discussed in Section 3.2, the area's beaches are major recreational resources for Study Area and islandwide residents, as well as visitors. Efforts to expand and enhance these resources are expected to continue because of public efforts to acquire more land and private proposals to develop recreation-oriented facilities.

5. **Roadway changes and other infrastructure improvements.** The physical landscape is expected to gradually take on a more urban character as roadways are widened and added, the water system is expanded and sewers are upgraded and expanded.

6. **Increased community awareness of change.** Though preliminary and requiring major land use approvals, the master plans of major landowners can influence the type and pace of change in the Study Area. The master plans which were discussed in Section 3.2 were prepared with community input, and presumably incorporates the desires of at least some of the area's residents. Hence, change in the area's character is being discussed as a possibility, and, in some cases, as inevitable directions for the community's future.

7. **Development of more golf courses.** As discussed in Section 3.2, six golf courses, not including the proposed project, are being discussed for the Study Area. It is likely that some these will be developed, if they meet land use and planning criteria.

COUNTRY COURSES AT KAHUKU

SOCIAL IMPACT ASSESSMENT
SECTION 4: POSSIBLE COMMUNITY ISSUES ON COUNTRY COURSES AT KAHUKU

4 POSSIBLE COMMUNITY ISSUES ON THE COUNTRY COURSES AT KAHUKU

This section explores potential community issues and concerns on Country Courses at Kahuku. Section 3.1 discusses issues and concerns independent of the proposed project. Section 3.2 identifies possible community issues on Country Courses at Kahuku.

4.1 ISSUES AND CONCERNS INDEPENDENT OF THE PROJECT

4.1.1 Neighborhood Board Issues

The Neighborhood Board system is a formal mechanism for citizen input to public entities regarding islandwide City policies, specific community problems and other matters, and proposed changes. Often, the types of issues addressed by a Neighborhood Board and subsequent actions reflect values and concerns of the constituent population.

To understand the values, concerns and issues of Study Area residents, the meeting minutes of the Koolauloa Neighborhood Board No. 28 and the North Shore Neighborhood Board No. 27 from 1987 through October 1989 were reviewed.

In general, these Boards tended to support changes which would directly benefit the current population, but were apprehensive about changes which would cause or lead to major growth. For example, although roadway improvements were supported if they relieved localized congestion, Board members tended to oppose proposed improvements which would "open up" an area, such as the road around Kaena Point, or improve through-traffic, such as road widening north of Kaneohe.

The following are major topics discussed by these two Boards:

Proposed development. In reviewing development proposals, the Koolauloa Neighborhood Board generally favors efforts which increase economic opportunities for nearby communities, but tempers such support if there are negative impacts on agriculture or increased traffic congestion. Central to the North Shore's review of development proposals is the Haleiwa Historical, Cultural and Scenic Special Design District. This latter Board consistently expressed the desire to preserve the rural character of the town and region.

Beach parks. Both Boards have consistently supported City efforts to expand recreational resources, particularly those near the ocean. In February of this year, the Koolauloa Neighborhood Board reaffirmed its support of City efforts to acquire beach front property for beach parks, although protecting the rights of the private landowner is also a major concern. The North Shore Neighborhood Board also supports such efforts in this region and is anticipating the expansion of the Haleiwa Beach Park.

Housing. Although the Koolauloa Board acknowledges the need for affordable housing in this region, members are very concerned about the adequacy of existing infrastructure.

Traffic. Both Boards are increasingly concerned about peak hour and weekend traffic, roadway safety, and tour busses. In addition to the daily peak traffic, both regions experience heavy weekend traffic resulting from island residents and tourists visiting area beaches, shops and facilities. Certain areas reportedly have recurrent speeding problems. Further, there are numerous complaints about tour busses and sightseeing vehicles slowing down traffic.

The increase in housing units used for visitor accommodations has been an emerging issue with Windward Oahu residents, particularly those in Kailua. Concerned citizens complained to the City Council that such resort uses are inappropriate in a residential neighborhood. The Save Kailua Coalition opposed a bill which would allow bed and breakfast operations as a special accessory use in residential and country districts. The group was particularly concerned that those facilities in operation before October 22, 1986 may be allowed to continue if their operators can establish such use (Waite, 1989a, and Bill 151 (1989), CD-1, City Council).

On November 7, 1989, the North Shore Neighborhood Board held a special meeting with transient vacation rentals being an agenda item. The Board voted to support the Council bill.

4.1.2 Community Issues Related to Golf Courses

The islandwide community has had a wide range of reactions to proposed golf course developments throughout Oahu. Although many of golf course issues were raised in reaction to specific proposals, some common concerns have emerged. The following summary of golf course-related issues is based on a review of news articles regarding golf courses over a three-year period:

1. **Golf course versus agriculture.** Because of the land availability in rural areas, numerous golf courses have been proposed for the non-developed portions of Oahu. Over the past few years, golf course proposals have been met with vociferous opposition if the subject land is being farmed at the time of the proposal.

   Last year, the competition between golf course and agriculture was the key issue. Proposed golf courses in Lualualei (Yamaguchi, 1988), Maunawili (Honolulu Advertiser 1988a and 1988b, Young, 1988b) and Ohikilolo (Young, 1988a) have been opposed by community groups because of various degrees of farming activities.

   Nearby farmers are also concerned that the golf course will compete with agricultural operations for water. These issues are further exacerbated when displacement of existing farmers is necessary for project implementation.

2. **Ecological effects.** Golf course impacts on the water supply are frequent concerns, in terms of competition for use and chemical impacts from herbicides and pesticides normally applied to golf courses.

3. **Change in rural lifestyle.** Golf courses are commonly appreciated as open space, and this attribute complements the rural landscape. Rural communities often acknowledge that the development of a golf course will prevent large-scale residential development on that site.

   Nevertheless, there is concern that the improvement of a golf course site may increase nearby property values. The subsequent increase in property taxes may, in turn, pressure nearby landowners to urbanize their properties (Community Resources, Inc., 1988 and Oshiro, 1989).

4. **Foreign investment.** During 1988 and continuing into 1989, there growing concern over foreign investment particularly as related to real estate speculation in Hawaii. Hotel investment by Japanese reached 35 percent of the total hotel rooms in Waikiki, 27 percent statewide, by the end of 1988, and more purchases were anticipated (Harpham, 1988).

   In an Advertiser/Channel 2 News poll, over half of the respondents, or 54 percent, felt that foreign purchases of land for development of hotels was bad for Hawaii, and 51 percent to 28 percent felt foreign purchase of land for the development of hotels should not be allowed (Keir, 1988b).

   This attitude towards Japanese-based hotel development may spill over into Japanese-developed golf courses, particularly because foreign membership at these courses correlates to the visitor industry. All Oahu privately-owned golf courses which allow public play are partially or fully owned by Japan-based entities. In 1988, 21 golf courses in Hawaii, ten of which are located on Oahu, were owned by Japanese (Dooley, 1988).

4.2 POSSIBLE COMMUNITY ISSUES ON COUNTRY COURSES AT KAHUKU

This section discusses *preliminary* social issues on The Country Courses at Kahuku. Whereas social impacts are those changes which are likely to occur, social issues are community concerns which arise *in response* to a proposed action. Social issues often shift over time, as people's priorities, environment and lifestyles change.

As the project is presented to the community, the preliminary issues presented in this section need to be re-evaluated and re-assessed based on people's actual reactions to the project.

1. **Need for more golf courses.** As shown in the previous section, public awareness of golf course development is heightened by numerous proposals. Based on the recent report on golf course development prepared by the City Department of Land Utilization (1989), five golf courses, including the proposed project, have been proposed for the Study Area in recent years. In this study, Earthplan has found that, including those courses of preliminary long range master plans of major landowners, six golf courses have been discussed in the Study Area, *not including The Country Courses at Kahuku.*

   Further, seven golf courses on other parts of Oahu are scheduled to operate in the near future or are close to construction. Applications or inquiries have been made for more than 30 more golf courses (City and County of Honolulu Department of Land Utilization, 1989).

   As Section 3.2 discusses, this recent attention towards golf course development is often accompanied by apprehension about the long-term effects of this type of development. The need for more golf courses in the Study Area as well as throughout the island is likely to be questioned as more courses are proposed and constructed. Hence, the need for four more golf courses in the Study Area would probably be a major question among Study Area residents.

2. **The value of golf courses as a recreational resource.** A golf course is traditionally considered a recreational resource because it accommodates a relaxing physical leisure-time activity. As more private profit-oriented golf courses are proposed, however, the emphasis of golf course development shifts from its recreational value to economics.

   Instead of focusing on the potential to increase a recreational resource, the community is directing its attention to the Japanese developer, the high cost of development and the potential for economic exclusion of the local golfer.

   Although the operation and management of the Country Courses at Kahuku have not been determined at this time, preliminary project plans call for a daily-fee course, and not a membership club. The proposed courses may therefore be accessible and affordable to many resident golfers.

   Nevertheless, because of the numerous proposals for golf courses and because some degree of public play is being required of recent proposals, the community may perceive that there is a sufficient number of golf courses to serve the recreational needs of the resident population.

3. **Competition for land resources with "more desirable" uses.** Some people may view the proposed use of this land as "extravagant" considering the critical need for more jobs and housing. The

number of jobs generated by the proposed project may be low for some, considering the amount of land being used. Further, some community members may prefer that at least a portion of this land be used for affordable housing because of the current housing crisis in the area. These issues may be especially relevant for those who would question the overall need for more golf courses in the area.

4. **Change in rural character of the area.** Even though some people may prefer job-generating uses or residential units on these sites, most would probably choose uses dominated by open space to retain the rural quality of the Study Area. In fact, rural communities often acknowledge that the development of a golf course will prevent large-scale residential development on that site.

   Some people will likely be concerned, however, about the long-term effects of "urbanizing" this open space. They may fear that putting the project sites into more intense and exclusive use will eventually pressure the surrounding areas into becoming more urban.

5. **Impact on water supply.** The competition between golf courses and agricultural activities often focus on water supply. It is likely that nearby farmers will be concerned about the impact of the project on their irrigation water. Further, some will likely be apprehensive about the impacts on the water supply generated by the use of herbicides, pesticides and fertilizers on the golf course.

6. **Potential for foreign investor.** Given the number of Japanese-owned and -proposed golf courses, Study Area residents will likely be concerned about whether any of the Country Courses at Kahuku will be so owned and/or operated.

7. **Origin of employees at Country Courses at Kahuku.** Area residents are aware that the Kuilima Resort Expansion will generate several thousand jobs and that the area labor supply will not adequately fill these resort jobs. The project will add more jobs to the market, and thus increase the potential for out-of-area residents filling these jobs. Area residents will likely want some assurances that the golf course operators will hire nearby residents as much as possible.

7. **Community benefits.** The Study Area has numerous experiences of community involvement in private development efforts, including the proposals for the Kuilima Resort expansion and the Lihi-Lani community, as well as the master planning efforts of major landowners. A common thread in all of these efforts is the assurance that the proposed uses will somehow benefit the nearby communities, either through employment, recreational resources, off-site facilities or in-kind contributions.

8. **Traffic.** Because traffic is a major problem now (refer to Section 4.1.1), the community will likely express concern about the project's potential for increasing the number of cars and busses in the area.

CORRECTION

THE PRECEDING DOCUMENT(S) HAS
BEEN REPHOTOGRAPHED TO ASSURE
LEGIBILITY
SEE FRAME(S)
IMMEDIATELY FOLLOWING

8. **Traffic.** Because traffic is a major problem now (refer to Section 4.1.1), the community will likely express concern about the project's potential for increasing the number of cars and busses in the area.

COUNTRY COURSES AT KAHUKU

SOCIAL IMPACT ASSESSMENT

SECTION 5: POTENTIAL SOCIAL IMPACTS OF COUNTRY COURSES AT KAHUKU

5 POTENTIAL SOCIAL IMPACTS OF THE COUNTRY COURSES AT KAHUKU

This section identifies potential social impacts related to the Country Courses at Kahuku, as follows:

Section 5.1 describes the project's impact on population.

Section 5.2 looks at the effects of this de facto population on the Study Area.

In *Section 5.3*, the project's effect on recreational resources is evaluated, and includes a discussion on the resident use of this resource.

Section 5.4 discusses the potential effects of the proposed project on the character of the nearby neighborhood.

Section 5.5 identifies displacement impacts.

Project impacts on public services and facilities are discussed in *Section 5.6.*

5.1 De Facto Population Impacts

Having no residential component, the Country Courses at Kahuku will not increase residential population. The project will, however, increase the area's de facto population through its (1) on-site employment and (2) golf course and clubhouse users.

Each golf course is expected to generate between 30 and 50 jobs, which implies a total job count ranging from 120 to 200. Two-thirds of these jobs, or between 90 and 150 jobs, will be located at the Punamano site.

When fully operational, the Country Courses at Kahuku could accommodate approximately the following:

* *288* playing golfers, assuming one foursome per hole and 72 holes;
* *48* golfers waiting to play, based on an average of three foursomes could be waiting to play at each of these golf course at any given time;
* After play, golfers may choose to use other facilities such as the clubhouses. If two foursomes at each golf course use other on-site facilities after their play, then these post-play golfers could amount to *32* players.

Hence, a total of 368 golf course users could be on-site at the Country Courses at Kahuku at one time, and when the courses are fully operational.

All four courses would be operational in 1997. At that time, the Punamano and Malaekahana project sites could result in a total de facto population of 488 to 568 persons, including employees and facility users.

5.2 Effects of Increasing the de facto Population

The Country Courses at Kahuku is intended to serve primarily the visitor market, including the guests at the Kuilima Resort and participants in tour groups. The proposed project will therefore bring more people into the area and increase the potential for resident - visitor interaction.

Currently, Study Area residents have opportunities to interact with tourists who stay at the Kuilima Resort and/or use their facilities, as well as visitors to the Polynesian Cultural Center. Such interactions will greatly increase with the total development of Kuilima Resort expansion, which is expected to result in an estimated de facto resort population of 5,523 persons (Community Resources and A. Lono Lyman, 1984).

In addition, the Malaekahana Golf Course proposed by the Kuilima Resort Company (adjacent to the Country Courses at Kahuku Malaekahana site) would have a total de facto population of 130 to 150 people on a peak day (Community Resources, Inc., 1989).

In this context, the proposed project's contribution to the area's de facto population would result in a total de facto population of about 6,200 people. Hence, the Country Courses at Kahuku would account for eight percent of the area's increase in de facto population.

Although the project-related increase is relatively small, it is still necessary to consider the effects of increased resident-visitor interaction since the Country Courses at Kahuku would contribute to the overall changes. The following are presented as factors which influence increased resident-visitor interactions:

1. **Additional cultural diversification.**

   Non-project effects -- The diversity of visitors, mainland and foreign born, can be a culturally enriching experience for workers and nearby residents. Opportunities to meet these people at work or in recreation or commercial areas will prove stimulating if mutual respect for the other's differences is demonstrated. The downside to this is that, with the increasing emphasis on high-spending tourists and foreign tourists, the possibility of communication barriers increases.

   For example, though Japanese visitors are generally perceived to be respectful of local cultural differences, their tendency to move in large groups and to isolate themselves could be misinterpreted. Large bus loads of non-English speakers visiting a golf course, restaurant or beach park might test the patience of many local employees or residents present. These things will take time and understanding as is true elsewhere in Hawaii.

Project effects -- The project will add to this cultural diversity, since most of the golf course users are expected to be visitors. The project's contribution is negligible, however, within the context of the regional increase in visitors.

2. **Competition for recreational resources.**

Non-project effects -- It is likely that the effects of the influx of visitors will be felt by adolescents and young adults who will find their recreation areas, surfing spots and beaches infringed upon by those wanting these area for alternate activities. Adolescents are typically the most vocal and demonstrative toward tourists who infringe on what are considered local recreation areas. Though most young people welcome the excitement of new faces, tourists from Waikiki and Kuilima Resort will undoubtedly frequent these same areas and compete for recreation space. This could compel youth gangs or other locals to establish their territory either through incidents of confrontation or opportunistic crimes or misdemeanors.

The current government effort to expand and increase shoreline parks and accesses will help alleviate this competition for recreational resources. Further, the Kuilima Resort expansion includes various recreational areas for visitors and residents alike.

Project effects -- The effects of the proposed project on recreational resources are discussed in Section 5.3.

3. **Visitor tendency to remain at self-contained area.**

Non-project effects -- Tourists tend to remain on-site at the larger resorts, except for occasional side trips around the island or into Honolulu or Waikiki. Compared to Waikiki tourists who rent cars and visit off-site recreation areas, rural resort visitors leave their destination area at about 15 percent total per day (Community Resources and Lyman, 1984).

From experience gained from Kuilima (Community Resources and Lyman, 1984), visitors from the resort complex do not frequent public recreation areas near the resort site but prefer going some distance, such as Waikiki when they do travel off-site. The area may therefore experience additional traffic because of the rental cars/tour buses servicing these needs.

On one hand, the tendency for non-Waikiki visitors to remain on-site is positive in that this would lessen traffic and crowding a public beaches and facilities. On the other hand, this lack of interaction also implies minimal cultural exchanges and patronizing of local off-site businesses.

Project effects -- Ongoing experience of residents exposure to increased visitor population at the Kuilima Resort and the Polynesian Cultural Center would act to ameliorate any additional adaptation required by the Country Courses at Kahuku.

4. **Potential for feelings of economic disparity.**

Non-project effects -- The increasing presence of affluent tourists who patronize new hotels and other golf courses could create a us-them perception in the minds of some residents. This perception might become a focal aggravation to the extent that Hawaii-born residents are committed to employment within the visitor industry or are excluded from employment because of lack of skills or training. Research (Knox, 1979) has shown that, as the economic dependency on tourism increases, there is not necessarily a corresponding increase "Aloha Spirit" toward the industry.

Rather, one study (Noronha, 1979) concluded that, as people feel that they are losing political and economic control over their fate to absentee power-brokers in the industry, residents are more likely to direct their animosity toward the visible tourist. Though research in Hawaii is inconclusive as to which pattern may prevail, much will depend on the community's reaction to resort development in the area independent of the proposed project.

Another potential for an increasing sense of economic disparity is the prevalence of foreign-owned or proposed golf courses and correlating affluence. As discussed in Section 4.2, the media has given considerable attention to the popularity of expensive golf course memberships among affluent Japanese people. Many of these memberships extend outside Japan, and Hawaii is increasingly a golf destination for these people.

Project effects -- The Country Courses at Kahuku are expected to be daily fee courses. Specific rates have not been determined, however, and the potential for perceptions of economic disparity between golf course users (visitor and resident alike) may still occur if fees for the proposed courses are high.

Maintaining positive and productive resident-visitor interactions will be important for all visitor-oriented development in the Study Area. Positive interactions will help residents feel a sense of belonging and ownership with these facilities, and will be less likely to view visitor facilities as "necessary evils." The quality of resident-visitor interactions is also of direct import to the long-term economic viability of visitor-oriented facilities.

To work towards mutually beneficial resident-visitor relationships, the Estate of James Campbell should consider the following approaches as a collective strategy:

* *Community input in planning process* -- The Country Courses at Kahuku has already been presented to some community groups. These efforts should continue with the explicit purpose of soliciting community reactions and ideas on the proposed project.

* *Ongoing communication* -- Project planning is an ongoing process and the Estate should keep the nearby communities abreast of plan modifications and general project status. This is especially important if plan revisions are made in response to community input.

* *Participation in community events and programs* -- The Estate has already established a relationship with the community by participating in community efforts. The future operators of the proposed golf courses should be encouraged to continue these efforts by contributing resources, such as expertise, in-kind help and monetary participation, to events and programs important to the nearby community. It is also suggested that developer/operator participation be considered for educational programs involving the visitor industry. Developer/operator support for such programs can help familiarize young people with the proposed facilities, reduce alienation and help improve attitudes towards visitors.

5.3 Employment and Labor Supply

5.3.1 Estimated Project Long-Term Employment

It is estimated that the proposed golf courses will generate between 30 and 50 jobs per course, or a total of about 120 to 200 jobs. The actual number of jobs will depend on a number of factors, including terrain and difficulty in greens maintenance, the level of service provided in the clubhouses and pro shops, and the extent of resource-sharing at the Punamano courses.

Four general categories of jobs are anticipated for Country Courses at Kahuku:

1. *Grounds* -- These include the superintendent, assistant superintendents, maintenance superintendents, mechanics, equipment operators, groundskeepers and laborers.

2. *Golf and Pro Shops* -- These include the directing and teaching golf professionals, attendants, and golf pro shop sales assistants.

3. *Administration and Support* -- These include the clubhouse manager, assistant manager, accountant, secretary, receptionist, janitors, locker attendants parking attendants, and security.

4. *Clubhouse: Food and Beverage* -- These include the cooks, cashier, waithelp and bushelp, and bartender.

Table 10 provides a breakdown of these jobs.

Table 10

Breakdown of Estimated Jobs For Country Courses At Kahuku

	Malekahana (18-hole, 1 clubhouse, 1 pro shop)			Punamano (54 holes, 2 clubhouses, 2 pro shops)			Total Project		
	Low range		High range	Low range		High range	Low range		High range
Grounds	12	-	20	38	-	63	50	-	83
Golf and Pro Shops	7	-	11	20	-	33	26	-	44
Administration and Support	5	-	8	15	-	26	20	-	34
Clubhouse: Food and Beverage	7	-	11	17	-	29	24	-	40
Total	30	-	50	90	-	150	120	-	200

The various jobs generated by the project will offer both indoor and outdoor work, as well as jobs suitable for full-time breadwinners, part-time workers supplementing family incomes, and first-time workers.

Most of the jobs require little technical training or experience. Those jobs requiring *specialized or previous experience* are as follows:

Grounds: superintendent, assistant superintendents, maintenance superintendents, and mechanics.

Golf and Pro Shops: directing and teaching golf professionals.

Administration and Support: clubhouse manager, assistant manager, accountant, secretary.

Clubhouse: Food and Beverage: cooks, cashier, bartender.

5.3.2 Effect on Labor Supply

The employment generated by the proposed project could benefit residents of nearby communities, as follows:

* Country Courses at Kahuku will provide job options for the several thousand workers who currently spend more than 45 minutes traveling to their job site.

* The proposed project will further increase job diversity in the area, thus accommodating a wide range of job skills.

* The project will increase the number of "outdoor" jobs. This may appeal to those who are currently in agricultural jobs. Note that this percentage is high for Kahuku.

* Because many of the jobs require little or no experience, students, graduates and currently non-working spouses may qualify for part- and full-time employment.

* Finally, the project will provide job opportunities for the currently-unemployed. Even though there is a small percentage of unemployed persons in Kahuku, these people nevertheless need jobs.

It is noted, however, that in 1980, the overall Study Area had unemployment rates similar to that of Oahu, and both the Kahuku and Laie CDPs had very low unemployment rates. As discussed in Section 3, without the Country Courses at Kahuku, new jobs generated by other developments in the area, namely the Kuilima Resort expansion, will clearly outpace unemployment.

When considered in the context of the Kuilima Resort expansion, the proposed project will therefore add to the demand for labor supply and could increase the need for in-migrant workers.

The Estate and future golf course operators could minimize the hiring of out-of-area residents by providing job training to assist area residents in successfully competing with out-or-area residents for golf course jobs. A possible vehicle for job training is the "Turtle Bay Resort Employment Center," which is being established by the Kuilima Development Company (KDC) to help the area residents secure as many of the new jobs as possible.

As presented in the *Action Plan: Turtle Bay Resort Employment Center* (KDC, 1988), the KDC is creating a nonprofit entity to address only job training and related issues. This entity is the "Resort Training, Inc." or RTI.

In a support capacity, the Employment Resource Center would complement hotel training programs by providing additional support services that might be needed to maximize training benefits for the area residents. The Resource Center would (1) maintain a list of qualified potential applicants, (2) maintain contact with personnel directors to match applicants with jobs, (3) provide linkages with schools and employment services, and (4) other types of "facilitating" services.

Direct Resource Center services would focus on improving residents' awareness, skills and qualifications before they apply for specific resort jobs. A focal point of the Center is the direct provision of "basic skills" training to assist disadvantaged residents in meeting minimum job qualifications.

The Action Plan was approved by community representatives in 1988. This job training program is in early stages and Country Courses at Kahuku is not part of this resort-oriented program.

A possible participation for the Estate is financial contribution to the job training program. In compliance with the Unilateral Agreement for the Kuilima Resort Expansion, KDC has committed $500,000 for job training purposes. KDC may solicit other funding.

5.4 Addition of Recreational Resources

The proposed project will add four golf courses to the Study Area and therefore play a major role in enhancing the area's non-shoreline recreational resources. As noted in Section 4.1.1 and 4.2, however, the value of golf courses as recreational resources is increasingly being weighed against other values, such as the role of golf courses as visitor attractions, the competition with agricultural uses and foreign investment interests.

The following factors are apt to influence the value of Country Courses at Kahuku as recreational resources:

1. **The type of golf course.**

   The resident golfer on Oahu has three types of courses from which to choose: municipal, resort and private daily-fee courses. In addition, resident golfers may become members of exclusive private clubs or may qualify to play on military golf courses.

On Oahu, there are currently 28 golf courses, nine of which are military courses (Table 245, Hawaii State Department of Business and Economic Development, 1988). Four are private clubs for members only.

This leaves 15 golf courses which are available for public play. Of the 15, four are municipal courses, two are resort and nine are privately-owned golf courses open to the public (City and County of Honolulu, 1989).

Project effect -- The Country Courses at Kahuku are proposed as privately-owned courses open to the public. As daily-fee courses, the proposed golf courses will benefit the resident golfer by increasing the number of courses which would be open to any golfer.

2. **Affordability and desirability.**

In evaluating the proposed project, resident golfers will undoubtedly want to know if rates will be affordable to local players. Kamaaina rates and special rates for certain groups will likely elicit favorable responses.

The lowest rates do not necessarily imply the most desirable golf courses. As of the end of 1988, weekday green and cart fees for 18-hole golf courses on Oahu ranged from a low of $19 to a high of $95. Weekend fees ranged from $23 to $95 (Exhibit 10, City and County of Honolulu, 1989).

The lowest fees for both weekday and weekend play were offered by the municipal courses. If one were to base desirability solely on affordability, then municipal courses would apparently be the most desired. Further, it would be expected that municipal golf courses would be a priority among City recreational facilities because of financial accessibility.

A recent survey commissioned by the City did not verify this expectation, however. Municipal golf courses ranked the lowest among other recreational facilities, in terms of both importance and usage (Exhibits 11 and 12, City and County of Honolulu, 1989). This relative non-popularity of municipal golf courses on Oahu may be attributed to a number of factors, such as the proportion of golfers to the islandwide community, the quality of existing municipal courses, and the preference for privately-owned golf courses.

Project effect -- Project planners have likened the proposed courses to the Mililani Golf Course and Hawaii Kai Championship Golf Course. The average rates for these courses range from $24 to $42 for weekday play, and from $28 to $42 for weekends. Greens and carts fees for the Country Courses at Kahuku are therefore expected to be in the mid-range of current fees, and are expected to meet the affordable criteria of many of the local golfers, since they already pay similar fees for existing golf courses.

The proposed project will not add to the supply of the more affordable municipal golf courses. The Country Courses at Kahuku will, however, contain golf courses to match various levels of skill in attractive settings. Further, golf course operators should consider establishing incentives for local play, such as kamaaina rates.

3. **Resident vs. visitor use.**

Correlating to the affordability of golf courses is the intended market. The more a golf course is intended to attract the local resident golfer, the less likely the golf course will be used by visitors. Only two percent of the total rounds at municipal golf courses were played by visitors, as compared to 17 to 19 percent at private or semi-private courses. This proportion of visitor play increases greatly for resort courses (City and County of Honolulu, 1989).

A golf course is more likely to be valued as a recreational resource if the rates and amenities are primarily aimed at the local resident golfer. A resort golf course is considered more a visitor attraction, one which is intended to serve the recreational needs of the visitor.

Project effects -- The primary market for the Country Courses at Kahuku is the visitor, including guests at the Kuilima Resort and participants of arranged tours. To promote the project's recreational value for the local golfer, operators of the Country Courses at Kahuku should consider establishing incentives for local play, such as kamaaina rates. Also, management initiatives, such as community input in the planning of the project and ongoing communication, will help establish a community sense of belonging.

The proposed project is not anticipated to directly impact the numerous recreational resources in the area, nor is Country Courses at Kahuku likely to impact the planned expansion and addition of shoreline parks and accesses.

By attracting non-residents to the area, the proposed project could indirectly contribute to crowding at popular recreational sites if golf course users choose to return to or remain in the area to visit beaches. On the other hand, the new golf courses may encourage beach users to use the golf courses, thereby relieving some of the present crowding.

5.5 Project Effects on Character of Surrounding Community

5.5.1 Regional Character

To date, six golf courses have been proposed for the Study Area, not including the proposed project. These six courses are located in Waialua, Mokuleia, Kawailoa, Pupukea (two) and Malaekahana. The Country Courses at Kahuku raises this count to ten. If all of these courses are developed, the Study Area could become a major golf destination for Hawaii.

The most apparent effect of these golf courses would be the visual impression. The present rural landscape is characterized by a few small towns -- containing clusters of houses, neighborhood stores, and public facilities -- separated by strips of housing along the highway, undeveloped and agricultural land, and relatively large country lots. The golf courses would punctuate this pattern with frequently-maintained and well-manicured green open space, although some of the proposed golf course, including three of the Country Courses at Kahuku, are *not* expected to be visible from the highway.

The long-range effect of numerous golf courses on the regional character can be approached or viewed in two ways. On one hand, the large open space of a golf course will provide an attractive background for the Study Area, which would complement the vast ocean. The golf courses would also be permanent open space which would not be used for housing sprawl or other development. Town dwellers and those who wish to retain or "beautify" open space would likely appreciate the visual effects of golf courses.

On the other hand, the open space quality of a golf course differs from the existing openness. The placement of trees, waterways and support facilities would be deliberate and essentially urbanize what is now natural or agricultural. For those who prefer the "country" atmosphere, golf courses may be another introduction of urbanization.

5.5.2 Character of Nearby Communities

As discussed in Section 2.3, the nearby communities of Kahuku and Laie have characteristics of a typical small town. They both evolved around a central focus. Kahuku grew around the sugar mill and Laie expanded around the church and its other facilities. In these towns, there are business or service centers and neighborhoods are easily discernible. Hence, residential densities are high, compared to the country atmosphere of Kaaawa, Punaluu, Sunset and Pupukea.

The visual effects on these neighboring Kahuku and Laie would essentially be the same as those discussed relative to regional character (please refer to previous section).

Another potential impact the proposed project may have on these nearby communities is its effect on land value and urban encroachment. The Country Courses at Kahuku may contribute to urbanization of adjacent lands in following ways:

1. *Potential increase in land values* -- A current concern about golf course development is whether the values of adjacent lands will appreciate because of the higher value of golf course property. The apprehension about the potential property value increase of nearby lands is related to possible development pressures. If values of nearby properties increase, then property taxes will increase. The increased taxes may cause some landowners to (1) establish a use with higher revenue-generating potential to help pay taxes, or (2) sell the land at its higher value.

   Recently, property tax assessments for private golf courses increased greatly because of increases in assessed values. Increases ranged from 20 percent to over five times the current values (City and County of Honolulu, 1989).

   Whether these increased values will directly cause value appreciation of adjacent lands is undetermined at this time, however. In a study of the proposed Lihi-Lani Recreational Community potential effects on the surrounding property values, it was found that there was no significant effect on appreciation rates or historical price movements in the surrounding neighborhoods of a newly built golf course oriented subdivision. Rather, the more important factors impacting prices were the trends in sales activity and appreciation in the overall marketplace (Locations Inc. Research Department, 1989).

   Further, the socio-economic study for the proposed Waikane Golf Course suggests that, although nearby property owners may reap the benefits of increased values, this impact will likely not extend to the entire region. That study also speculated that a short period of land speculation near the project site could occur, due to the *expectation* of large-scale international investment (Community Resources, Inc., 1988).

2. *A "backyard" for expensive housing* -- Proposed planned communities on Oahu will often contain a golf course which would be fronted by higher-priced executive homes. The impetus for this is the market assumption that the golf course is a visual and recreational amenity which justifies higher prices. Although the project does not include a residential component, it may attract developers who want to build golf course frontage homes.

It is stressed that current public policy for the nearby communities, as well as the overall Study Area, *prohibits major urbanization*. Thus, if the proposed project or any of the other proposed courses stimulate more development, particularly residential development, then *major policy changes will be needed.*

If the Country Courses at Kahuku does encourage more urban uses in the nearby communities, then the character of the nearby Kahuku and Laie communities will change. Currently, the most intense activities are resort uses, and these are confined to the Polynesian Cultural Center and the Kuilima Resort. Further, Kahuku and Laie are socially and economically are relatively separate from each other, although both are internally homogeneous.

Potential urbanization of lands around the Malaekahana project site could form a physical connection between the two communities. Further, the two adjacent Malaekahana golf courses (one of which is proposed by Kuilima Development Company) would introduce a new force for change in the Laie. Currently, most of Laie's activities center around the church entity. Both of the proposed courses would add new entities which may influence the community.

As for Kahuku, the proposed project could be viewed as a "gateway" on both sides of Kahuku. If there is more development around the Punamano sites, then there will be less of an undeveloped, open space "buffer" between the Kuilima Resort and Kahuku town.

5.5.3 Kuilima Resort

The Country Courses at Kahuku will complement the Kuilima Resort by increasing visitor attractions for resort guests and promoting the area as a resort golf destination. This would especially be a major selling point for Japanese clientele, in light of the current popularity of the sport in Japan. Further, the project would bring more Waikiki visitors to the area, thus providing more business exposure for the Kuilima Resort.

Developing the Punamano site into three golf courses would result in an attractive backdrop for the Kuilima Resort. Note, however, that the Kuilima Resort currently enjoys a unique setting. The resort destination provides most of the comforts of urban living in the midst of rural, undeveloped landscape. Hence, the resort is a physically-cohesive development which is isolated from a city-like environment. The Country Courses at Kahuku would alter the landscape by being deliberately-landscaped open space. This landscape alteration would be further dramatized, if development occurs on the fringes of the proposed project.

The proposed Malaekahana golf course would not be in direct competition with the adjacent course proposed by the Kuilima Resort if the former targets non-Kuilima visitors as the primary market.

5.6 Displacement

The proposed project will cause the displacement of the operations of two tenants at the Malaekahana site.

A portion of the site is currently leased for grazing purposes. Max Smith, the owner of Gunstock Ranch, has month-to-month lease for approximately 250 acres, about half of which are part of the project site. He maintains 100 head of cattle, 40 horses and a small stable for boarding a dozen horses. The operation is marginally profitable to profitable, depending on beef prices and the amount of rainfall. Revenues are about $60,000 per year, which support one employee and cover feed, rent, water, and other operating costs.

If the proposed project is implemented, Gunstock Ranch will either close because of insufficient grazing land needed for a viable operation and the land for the headquarters would be lost, or relocate to other lands (letter from Bruce Plasch (President of Decisions Analysts Hawaii) to Charles Ehrhorn (Assets Manager, The Estate of James Campbell) dated December 18, 1989 *and* personal communication with Max Smith, December 1, 1989).

About ten acres of the Malaekahana project site is part of a combined long-term and monthly lease. Abigail Kawananakoa currently leases a total of 88.7 acres and 11 percent of these lands are affected by the proposed development (personal communication with Charles Ehrhorn, Asset Manager, December 6, 1989).

5.7 Public Facilities

5.7.1 Police Protection

The Country Courses at Kahuku is located in District 4 of Area 2 of the Honolulu Police Department. The region extends from Kailua to Kahuku. Police protection services is provided by officers at the Kahuku Police Substation, which patrols from Kaaawa to the Haleiwa Bridge. Six police officers are on duty during each shift and response time is five to ten minutes to locations near the project site.

The de facto population generated by the proposed project will cause occasional demand for police protection. Further, additional police officers will be required to control traffic and pedestrians related to major events at the project site.

To help minimize the need for police protection, golf course operators should take measures to provide on-site security during construction and operation.

5.7.2 Fire Protection

The Kahuku Fire Station is located between the Punamano and Malaekahana sites, at approximately 1.5 miles and two miles, respectively. Fire trucks are expected to be able to access the project sites in approximately five minutes.

Backup services would be provided by other fire stations with a response time of about ten minutes. The other fire station closest to the Punamano site is the Sunset Beach Fire Station, which is located six miles away. Next closest to the Malaekahana site is the Hauula Fire Station, which is approximately four miles south.

The structures supporting the Country Courses at Kahuku, which include the clubhouses and maintenance buildings, will require fire protection. On-site water lines and storage, as well as fire hydrants, will be designed to meet the required capacity. Further, the design of these buildings will follow City fire protection standards and safety precaution measures.

5.7.3 Schools

The Kahuku Elementary and High School and the Laie Elementary School are located near the project site. With no residential component, the Country Courses at Kahuku will not increase the residential population and is therefore not expected to impact these facilities.

5.7.4 Health Care and Hospitals

The Kahuku Hospital is a 26-bed facility which provides ambulance service and a helipad for medical evacuation by helicopter. Located in Kahuku Village, this hospital offers 24-hour comprehensive medical services. Other facilities at the hospital include a private dental office and a medical office/clinic with five physicians in private practice.

Because the project will not increase the resident population, the Country Courses at Kahuku is not expected to generate significant demand for services provided by these facilities.

The hospital staff and directors have indicated full support of the project, based on their review of the Preparation Notice for the Environmental Impact Statement. This support is based on (1) the project indirectly encouragement of more service industries in the Kahuku Sugar Mill Business Center and adjoining business communities, and (2) the employment-generating potentials (based on letter from Rikio Tanji, Chief Executive Officer, Kahuku Hospital, dated November 24, 1989).

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Berna Cabacungan

Principal

Ms. Cabacungan is a **community planner and communications specialist.** She provides services in community development and planning, particularly in the areas of

Plan input and preparation,

Management of the community planning process, and

Synthesis of physical and social plan components to achieve a feasible and workable plan.

Specific products of her efforts include:

Social impact assessments,

Documents comprising planning, social and environmental studies, and

A working relationship with various community segments.

She has contributed these skills to a diversity of projects, including:

Regional and community plans
Resort complexes
Residential projects
Recreational facilities
Medical and long term care facilities
Energy alternatives, and
Public facilities.

Ms. Cabacungan often incorporates both the community dialogue and analysis products in planning and development projects. She designs and implements dialogue programs for projects which could benefit from community participation.

These programs often result in a working relationship between developers and communities. Through these programs, community issues and concerns are identified, and, with input from all concerned parties, often mitigated.

The information gathered during community dialogue is used in preparing studies submitted to public agencies in the public approval and permit processes. Ms. Cabacungan has prepared studies which were then incorporated in Environmental Impact Statements, Development Plan Assessments and Land Use Commission petitions.

Education	Modern English, Bachelor of Arts, College of Arts and Sciences, University of Hawaii, 1976
Professional Affiliation	American Planning Association International Association for Impact Assessment

Social Impact Assessments *

(Reference to "assistance in. . ." indicates that
Earthplan was a *sub-consultant* to an intermediary firm)

Bypass for Honoapiilani Highway: *Social impact assessment for Potential Residential Displacement* of three alternative bypass routes proposed by the State Department of Transportation in Lahaina, Maui.

Chinatown Gateway Plaza: *Social impact assessment* for a proposal of the City and County of Honolulu for a residential, commercial and park complex in Oahu's Chinatown

Circle K: Assistance in *social impact assessment* for a proposed convenience store in Keauhou, Kona

Diamond Head Racquet Club: *Social impact assessment* for a proposed tennis complex on 17 acres situated on a portion of Diamond Head

Ewa Marina, Increment I, Central Oahu: *Social impact factors* for rezoning application for 174.7 acres

Ewa Marina, Increment II, Central Oahu: *Social impact factors* for rezoning application for 444.6 acres

Fort DeRussy, Honolulu, Hawaii: *Manager of informant interviews for social impact assessment* for Army's proposal to redevelop the site to include a 400-room hotel, two parking structures, roadway realignment, recreational and entertainment facilities and relocation of the U.S. Army Reserves.

Hawaiian Riviera, Kau, Hawaii: Assistance in *social impact assessment* for the Environmental Impact Statement for a proposed 3,000-unit resort destination on 3,200 acres near South Point on the Big Island

Heeia Kea Development, Windward Oahu: *Social impact assessment* for Supplemental EIS for the residential development of 102 acres

Honolulu Convention Center: *Social impact assessment* for a Planned Review Use application for a multi-tower privately-funded convention center between Waikiki and the Ala Moana Shopping Center

Kohala Ranch, North Kohala, Hawaii: Assistance in *social impact assessment* for Land Use Petition for a proposed 3,300-unit residential community on 1,300 acres

Kuilima Resort, Kahuku, Oahu: Assistance in *social impact assessment* for the Environmental Impact Statement for proposed resort expansion

Mixed Use Project in Wahiawa: *Social impact assessment* for a 40-unit single family project with 100 units for the elderly proposed by the State Housing Finance and Development Corporation

Mokuleia Development, North Shore, Oahu: Community interface for *social impact assessment* for the Development Plan Amendment Request and the Environmental Impact Statement; and preparation of certain sections of the Environmental Impact Statement. Proposed project consisted of resort development on 1,100 acres

Ocean Thermal Energy Conversion (OTEC), Kahe, Oahu: Assistance in *social impact assessment* for Environmental Impact Statement for proposed 40-Megawatt OTEC plant on the Waianae Coast

Pacific Basin Conference Resort, Makaha, Oahu: *Social impact assessment* for Environmental Impact Statement for proposed 300-room executive conference resort on 23.5 acres

Pupukea Golf Course: Assistance in *social impact assessment* for two golf courses and residential development proposed by Ohbayashi Hawaii Corporation

Royal Kunia Phase II, Central Oahu: *Social impact assessment* for Environmental Impact Statement and Development Plan Amendment for a 2,400-unit residential community on 660 acres

Village Park Expansion, Central Oahu: Assistance in *social impact analysis* for Environmental Assessment for residential development on 690 acres

Waiola Estates, Central Oahu: *Demographic impacts* for planned residential development proposed by the City and County of Honolulu

Waiola Estates, Central Oahu: *Update on community issues and concerns* for modified planned community proposed by the City and County of Honolulu

West Loch: Assistance in the *social impact assessment* for a proposed residential development by the City and County of Honolulu

Planning Projects, Community Dialogue and Other Areas

Alexander Manor, Oahu: Research and writing for the *Business Plan* of a proposed 150-bed elderly care home

Bayview Golf Course Expansion: Assistance in preparation of environmental assessment and impact statement for an 18-hole championship golf course and upscale residential units

Ewa Marina Golf Course: *Report on planning, environmental and engineering considerations* for Ewa Marina Golf Course for use in the Petition for a Land Use Boundary Amendment

Kauai Beach Villas, Kauai: Facilitation of *community dialogue* for proposed resort on 33 acres

Haggai Institute at Mauna Lahilahi, Makaha, Oahu: Identification of community issues and concerns and recommendations for *community dialogue* to resolve issues for religious training facility on 14 acres

Heeia Kea Development, Windward Oahu: Assistance in facilitation of *community dialogue*, including coordinating relocation agreements for existing residents, for the development of 102 acres

Honolulu Waterfront Project: *Planning input regarding social impacts* in State comprehensive planning effort for the waterfront project area extending from Ala Moana Beach Park to Keehi Lagoon, including Sand Island

Berna Cabacungan

Honolulu Youth Sports Facility: *Feasibility study* for a multi-use sports complex of the City and County of Honolulu; includes community dialogue, site selection, facility concepts and recommended sports program

Honpa Hongwanji Pali Expansion, Oahu: Design and implementation of *community dialogue* program for proposed expansion of religious and educational facilities

Kawaihae Master Plan, Kawaihae, Hawaii: Assistance in preparing the *Development Plan and Environmental Assessment* for long range planning recommendations concerning 10,000 acres of the State Department of Hawaiian Home Lands

Kuilima Resort, Kahuku, Oahu: Assistance in facilitation of *community dialogue* for the proposed resort expansion and job training program

Leeward Job Study: Assistance in *employment study* conducted in conjunction with the proposed Final Increment of Mililani Town, Central Oahu

Mahukona Resort, North Kohala, Hawaii: Facilitation of *community dialogue* for proposed resort on 1,100 acres

Makaiwa Sanitary Landfill, Ewa, Oahu: Facilitation of *community dialogue* for a proposed privately-operated landfill

Mauli-ola, Central Oahu: *Certificate of Need* for the proposed comprehensive medical complex, including hospital, long-term care facility and medical office building

Mokuleia Development, North Shore, Oahu: Design and implementation of *community dialogue* program for a proposed resort development

Ocean Thermal Energy Conversion (OTEC), Kahe, Oahu: *Community dialogue* for proposed 40 Megawatt plant in Waianae

Pokai Bay Development, Waianae, Oahu: Identification of *social impacts* and recommendations for a *community dialogue* program

Small Wahiawa Residential Cluster, Central Oahu: Preparation of social impact, housing and public policy sections for the *Development Plan Amendment* for proposed 14-unit cluster

Village Park Expansion, Central Oahu: Facilitation of *community dialogue* for proposed 690-acre expansion

Waialua Golf Course, North Shore, Oahu: Coordination and assistance in preparation of *Environmental Impact Statement* for a 218-acre 18-hole championship golf course proposed by Oceanic Properties

Wailuku Police Station Relocation: *Environmental Assessment*

Waiola Estates, Central Oahu: *Development Plan Amendment Request* for 270-acre residential development proposed by Castle and Cooke

List Of Clients

Alexander Manor, Inc.

City and County of Honolulu
Department of Housing and Community Development
Department of Parks and Recreation

Community Resources, Inc.

Environmental Communications, Inc.

Finance Realty/Mahukona Properties

First Development, Inc.

Larry Fukunaga, Inc.

GACI, Inc.

GMP and Associates, Inc./Oahu Land Engineering Partners

Greatwest Hospitals, Inc.

Haggai Institute

Hawaii Kau Aina/ Hawaiian Palace Development

Hawaiian Dredging and Construction

State of Hawaii
Department of Transportation
Office of State Planning

Home Properties, Inc./ Honolulu Federal Savings and Loan, Inc.

Helber, Hastert and Kimura, Planners

Honpa Hongwanji Hawaii Betsuin

Kohala Ranch

Kuilima Development Company/Prudential Life Insurance Company

Tyrone Kusao, Inc.

Malama-Gentry Joint Venture, comprising Hawaiian Electric Industries and The Gentry Companies

Mitsunaga and Associates, Inc.

Mokuleia Development Company/ Northwestern Mutual Insurance

MSM and Associates, Inc.

The Myers Corporation

Oceanic Properties/Castle and Cooke, Inc.

Ocean Thermal Corporation

Pacific Atlas, Inc. (Hawaii)

Pacific Standard Life Insurance Company

U.S. Army Engineer District Honolulu

Waitec Development, Inc.

William E. Wanket, Inc.

Wilson Okamoto and Associates, Inc.

APPENDIX E

NOISE IMPACT EVALUATION FOR THE COUNTRY COURSES AT KAHUKU, PUNAMANO, OAHU, HAWAII

Darby & Associates

APPENDIX E

DARBY
& ASSOCIATES
ACOUSTICAL CONSULTANTS

#J89-34P
December 14, 1989

WILLIAM E. WANKET, INC.
Pacific Tower, Suite 660
1001 Bishop Street
Honolulu, Hawaii 96813

Attention: Mr. William Wanket

Subject: Noise Impact Evaluation for The Country Courses at Kahuku, Punamano, Oahu, Hawaii

Dear Mr. Wanket:

A study has been performed to assess noise impact due to the proposed project. The following is provided as a result of this study:

I. EXECUTIVE SUMMARY

A. Noise sensitive locations which may be potentially be impacted by the project development are: existing homes in the immediate vicinity of the project site; multifamily dwelling units within Kuilima Resort; residences, schools, churches, a recreation area, and a hospital within the towns of Kahuku and Laie.

B. The existing acoustical environment at these noise sensitive areas varies depending on their locations relative to Kamehameha Highway and the coastline. Traffic and surf noise dominate at locations near the highway and the coastline, respectively. At

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locations away from the highways and the coastline, the typical neighborhood self-generated sound dominates the ambient sound levels.

C. Additional traffic on Kamehameha Highway generated by the project will not increase the future traffic noise level significantly.

D. Noise generated by clubhouse and ground maintenance activities may cause annoyance at the nearby noise sensitive locations. Implementation of proper noise mitigation measures, if needed, will ensure compliance with applicable noise regulations.

E. Noise from construction activities associated with the development will probably exceed the applicable noise limits at the nearby noise sensitive areas. Therefore, a permit will be required from the State Department of Health (DOH) to allow the exceedence and the permit conditions will strictly be observed. Any construction vehicles using trafficways will satisfy the noise level requirements specified in DOH vehicular noise regulation.

II. **PROJECT DESCRIPTION** -- The proposed project involves the development of three eighteen-hole golf courses on the mauka side of Kamehameha Highway between town of Kahuku and Kuilima Resort. The development will include two clubhouses, three maintenance buildings, a driving range, construction of an access road, and realignment of an existing military road. Refer to Figures 1 and 2 for the location and the layout of the subject project.

III. **EXISTING ACOUSTICAL ENVIRONMENT** -- Noise measurements have been performed in the vicinity of the proposed project area to assess the existing acoustical environment. The measurement results indicate that the locations near Kamehameha Highway are dominated by traffic noise with an average A-weighted sound level of about 63 to 64 dBA at a distance of 65 feet. Refer to Appendix I for an explanation of A-weighted sound level. Ambient sound levels at residential locations away from the highway are dominated by neighborhood self-generated sounds, e.g., occasional local vehicle movements, lawn mowers, weed wackers, TV's, radios, and sounds from children and animals. Wind blowing in the foliage is often the dominant source of sound along with intermittent muffled noise events from traffic on Kamehameha Highway. Occasional military helicopters from Kahuku Training Center cause audible noise throughout the project area and may be the dominant noise source at times. The sound of surf dominates the acoustical environment at locations near the coastline, especially during the periods when the traffic movement is minimal. A-weighted sound levels ranging from about 60 to 62 dBA generated by surf were measured at a distance of about 100 feet from the coastline during the nighttime hours. Appendix II provides a complete listing of the measurement data including those from previous projects in the vicinity of the project site.

IV. <u>ASSESSMENT OF POTENTIAL NOISE IMPACT</u> -- The nearest noise sensitive areas to the proposed golf courses are two homes located adjacent to the makai side of Kamehameha Highway across from the project. To the west of the proposed golf courses, there are few agricultural structures which may be residential. Kuilima Resort is located further west of the project site with two story condominium buildings facing Kamehameha Highway with the nearest building located at about 300 to 500 feet from the highway. The towns of Kahuku and Laie are located to the southeast of the project site. Noise sensitive locations within the towns are homes, hospital, schools, churches and beach parks along Kamehameha Highway.

Of primary concern regarding noise impact at these noise sensitive locations is the increase in noise levels due to additional traffic volume generated by the project. Also considered as a potential source of impact are various activities associated with the clubhouse operations and golf course maintenance. Construction activity involved with the development of the project are also discussed as a potential source of impact.

A. **Traffic Noise** -- Traffic noise level estimates have been made using the Federal Highway Administration (FHWA) Highway Traffic Noise Prediction Model (Reference 1). In order to calibrate the model, noise measurements have been obtained at locations on Kamehameha Highway together with traffic counts, including the mix of vehicles. Table 1 summarizes the comparison of the measured short term Equivalent Noise Levels, (e.g. Leq [10 minutes] and Leq [20 minutes]) with predicted hourly noise levels (Leq [60 minutes]). The fact that the two values agree within one dBA is considered acceptable. Also presented in Table 1 are maximum A-weighted sound levels (Lmax) generated by the traffic and ambient levels recorded during the measurement period.

Table 1. Summary of Measured and Predicted Leq, Measured Lmax and Measured Ambient Noise Level

Measurement Location	Meas. Leq	Predicted Leq(60 min)	Measured Lmax	Measured Ambient
Kamehameha Hwy. West of Punamano Site, mauka side, 350' from the highway	54.5 dBA	54.7 dBA	63.1 dBA	51.0 dBA
Kamehameha Hwy. West of Punamano Site, makai side, 500' from the highway	54.0	54.1	71.1	44.0
Kamehameha Hwy. Town of Kahuku 65' from the highway	63.9	63.4	85.3	52.6

Traffic noise calculations were performed using the above calibrated traffic noise prediction model along with traffic data provided in Reference 2. The results of the calculations for the existing and future (1998) years with and without the project at various segments of Kamehameha Highway are summarized in Table 2. As can be seen from the table, the increases in the future noise levels due to the project development are negligible. Therefore, the project development is not expected to cause any significant impact in terms of traffic noise. Note that the future noise levels with or without the project are about 3 dBA higher than the existing levels.

Table 2. Summary of Existing and Future Traffic Noise Prediction

Location	Peak Hour Leq(60 min)		
	existing (1989)	future(1997) w/out project	future w/ project
Kamehameha Hwy. west of Punamano, west of the access road A, 100' from the centerline of the hwy.	66.2 dBA	69.2 dBA	69.7 dBA
Kamehameha Hwy. between the access roads A and the realigned military road, 100' from the centerline of the hwy.	66.2	69.2	69.6
Kamehameha Hwy. east of Punamano, east of the realigned military road 100' from the centerline of the hwy.	66.2	69.2	69.4

B. <u>Clubhouse Activities</u> -- There are two existing homes located at about 650 to 800 feet from the proposed clubhouse for the most northern Punamano course.

Noise sources such as kitchen activities; refrigeration; air conditioning equipment; fans; golf cart chargers; pumps; and other stationary equipment should not cause the ambient noise levels at the homes to exceed the allowable noise levels specified in local noise regulations (References 3 and 4, when such long sound propagation distances are involved. If required, using standard noise mitigation measures, noise generated by such sources can readily be less than the allowable noise levels specified in local noise regulations (References 3 and 4). Public address sound system and entertainment activities should not cause "unreasonable" or "excessive" noise a defined in Reference 3 at the homes due to (a.) the attenuation of sound over the long propagation path; and (b.) the relatively high ambient noise levels at the homes due to traffic on Kamehameha Highway. Thus, sound levels which would be audible at the homes would have to be excessive to those in the club house.

Noise from equipment associated with ground maintenance activities, including lawn mowers and leaf blowers, could cause annoyance to the nearby residents particularly when the equipment is operating near Kamehameha Highway and there are lulls in the traffic. However, noisy equipment is also incompatible and disruptive with golf play. All equipment powered by internal combustion engines will have exhaust mufflers. Implementation of proper noise mitigation will ensure that noise from ground maintenance operations will not cause "unreasonable" or "excessive" noise as defined in Reference 3. It is noted that there are no known noise sensitive areas located near other clubhouses within the subject site.

C. **Noise Impact from Construction** - Development of the project site will involve grubbing, grading, and the construction of infrastructure and buildings. The various construction phases of a development project may generate significant amounts of noise; the actual amounts are dependent upon the methods employed during each stage of the process. Typical construction equipment noise ranges in dBA are shown on Figure 2. Earthmoving equipment such as bulldozers and diesel powered trucks will probably be the loudest equipment used during construction. If noise generated during construction exceeds the allowable limits in Reference 3, a permit will be obtained from DOH. DOH may grant permits to operate vehicles, construction equipment, power tools, etc. which emit noise levels in excess of the allowable limits. Required permit conditions 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 which emit noise in excess of ninety-five dBA...except between 9:00 a.m. and 5:30 p.m. of the same day."

"No permit shall allow construction activities which exceed the allowable noise levels on Sundays and on...[certain] holidays. Activities exceeding ninety-five dBA shall [also] be prohibited on Saturdays."

In addition, construction equipment and on-site vehicles or devices requiring an exhaust of gas or air must be equipped with mufflers. Also, construction vehicles using trafficways must satisfy the noise level requirements defined in Reference 5.

V. <u>Noise Mitigation Measures</u> - The design of the facilities will include noise mitigation measures in the planning of the location and orientation of the air conditioning equipment, exhause fans, etc. such that local noise regulations (References 3 and 4) will be satisfied.

Sincerely,

Prepared by

Mike S. Lee

Mike S. Lee
Senior Consultant

Approved by

Ronald A. Darby

Ronald A. Darby, P.E.
President

MSL;RAD:msl

REFERENCES

1. "FHWA Highway Traffic Noise Prediction Model", Federal Highway Administration, December 1978

2. Traffic data for the proposed golf course, provided by Pacific Planning & Engineering, Inc., received December 1989

3. "Chapter 43 - Community Noise Control for Oahu", Department of Health, State of Hawaii, Administrative Rules, Title 11, 1981

4. "Section 3.100, Noise Regulations", Land Use Ordinance, City and County of Honolulu, October 22, 1986

5. "Chapter 42 - Vehicular Noise Control for Oahu", Department of Health, State of Hawaii, Administrative Rules, Title 11, 1981

6. "Noise Impact Evaluation for the Proposed Kahuku Golf Courses (The Country Courses at Kahuku: Punamano and Malaekahana), Oahu, Hawaii", Darby & Associates, February 7, 1989

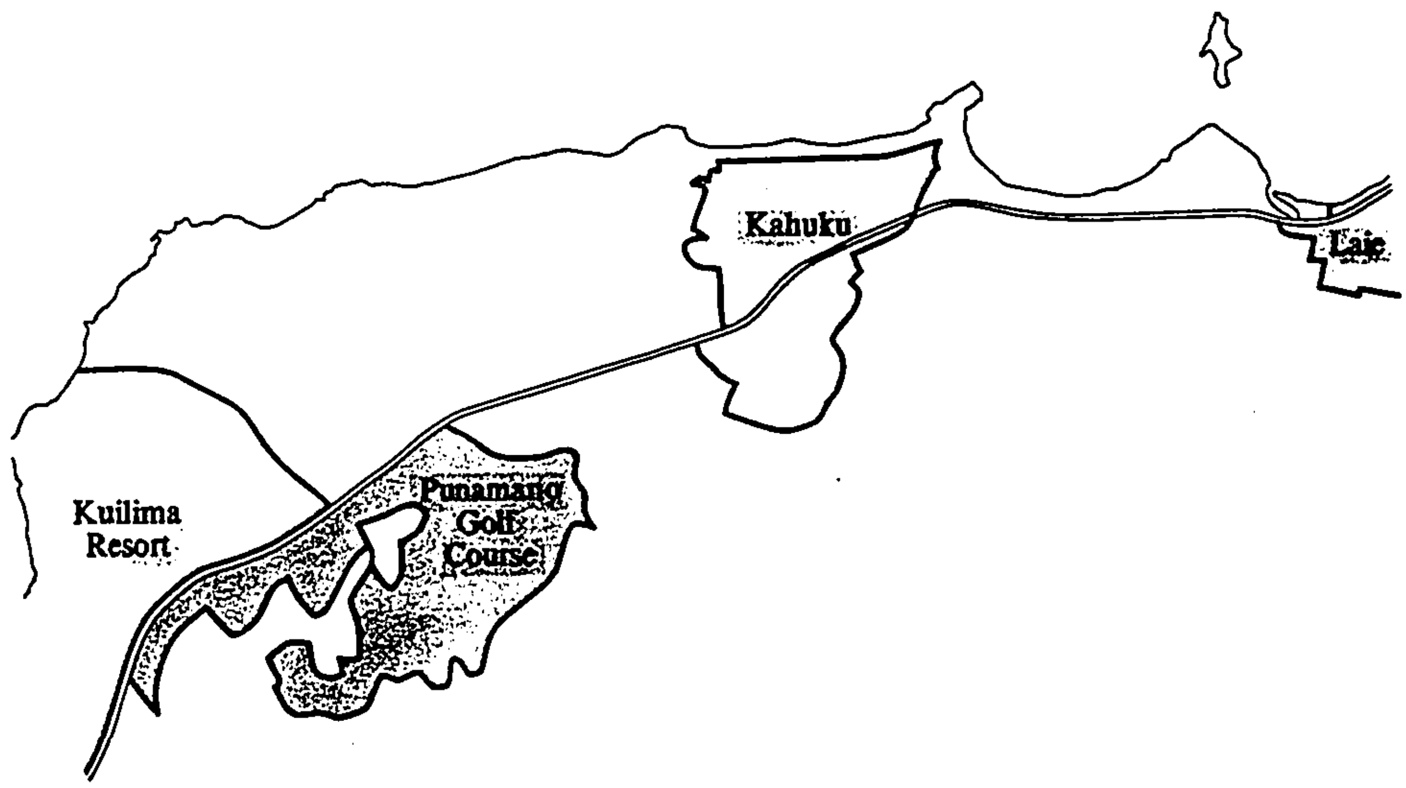

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Figure 1 Location of the Project Site

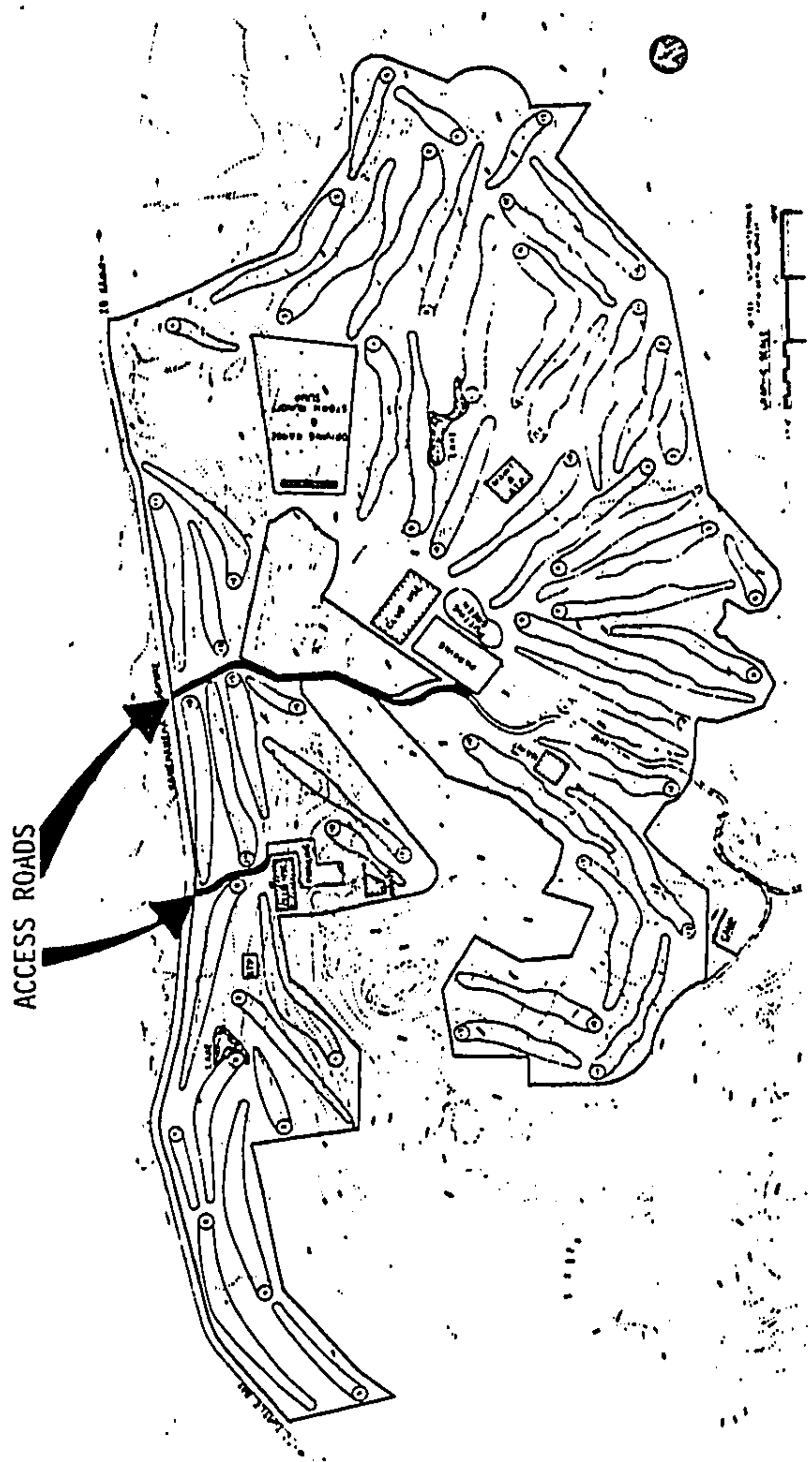

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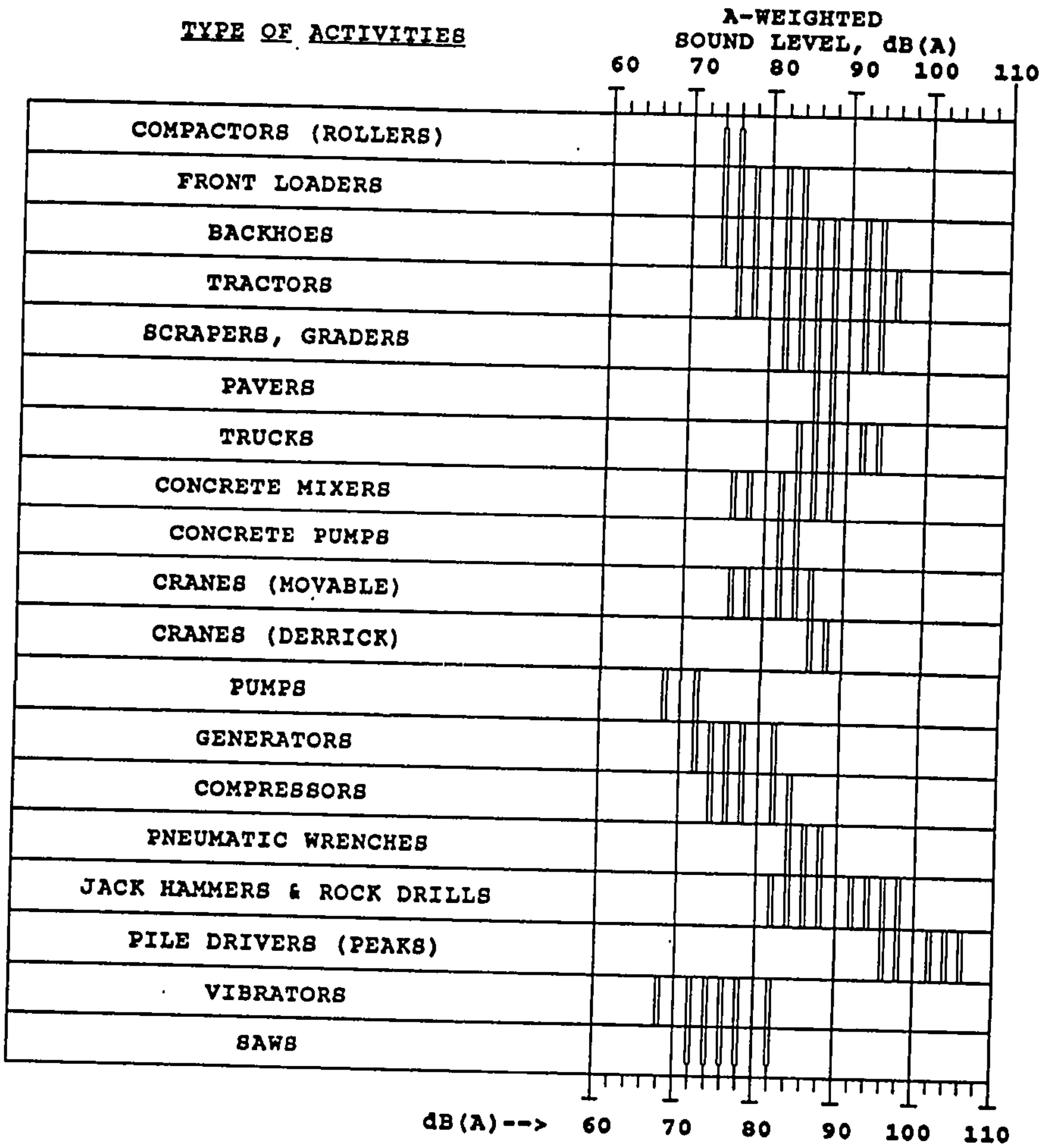
FIGURE 2. PROJECT LAYOUT



CONSTRUCTION EQUIPMENT NOISE RANGES

NOTE: BASED ON LIMITED AVAILABLE DATA SAMPLES

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Figure 3

APPENDIX I

A-WEIGHTED SOUND LEVEL

The human ear is more sensitive to sound with frequencies above 1000 cycles per second, or Hertz (Hz), than with frequencies below 125 Hz. Due to this type of frequency response, a weighting system, namely a A-weighting , was developed to approximate the sound response of the human ear. A-weighted sound level is a single number rating of a sound signal which de-emphasizes the low frequency portion of the spectrum of a signal, and is denoted either dB(A) or dBA. The A-weighted sound pressure levels of a few typical sources are listed in Figure I-1.

The A-weighted sound levels of long term noise producing activities such as traffic movement, aircraft operations, etc. can vary considerably with time. In order to obtain a single number rating of such a signal, several special noise indices have been developed and instrumentation are available to measure them. The following are two of commonly used noise indices:

* **Leq** -- <u>The Equivalent A-weighted sound level (the energy averaged level)</u>
  A single number rating which represents the fluctuating sound signal measured over a given time period as a constant level with the same amount of the total acoustic energy during that period (refer to Figure I-2). In this report, Leq assume a measurement period of one hour. This number is widely used to assess community noise annoyance and hearing damage potential.

* **Ln** -- <u>The A-weighted exceedence level</u>
  A single number rating which represents a A-weighted sound level that is exceeded for n% of total samples taken. For example, an L10 of 60 dB(A) for a traffic noise measurement for 20 minutes would mean that 10 percent of all the noise signals measured during the 20 minute period exceeded 60 dB(A). Note that 'n' can take any values (usually integers) between 1 and 99, where L1 and L99 represent the near maximum and the near minimum sound levels, respectively. This number is primarily used to assess community noise annoyance.

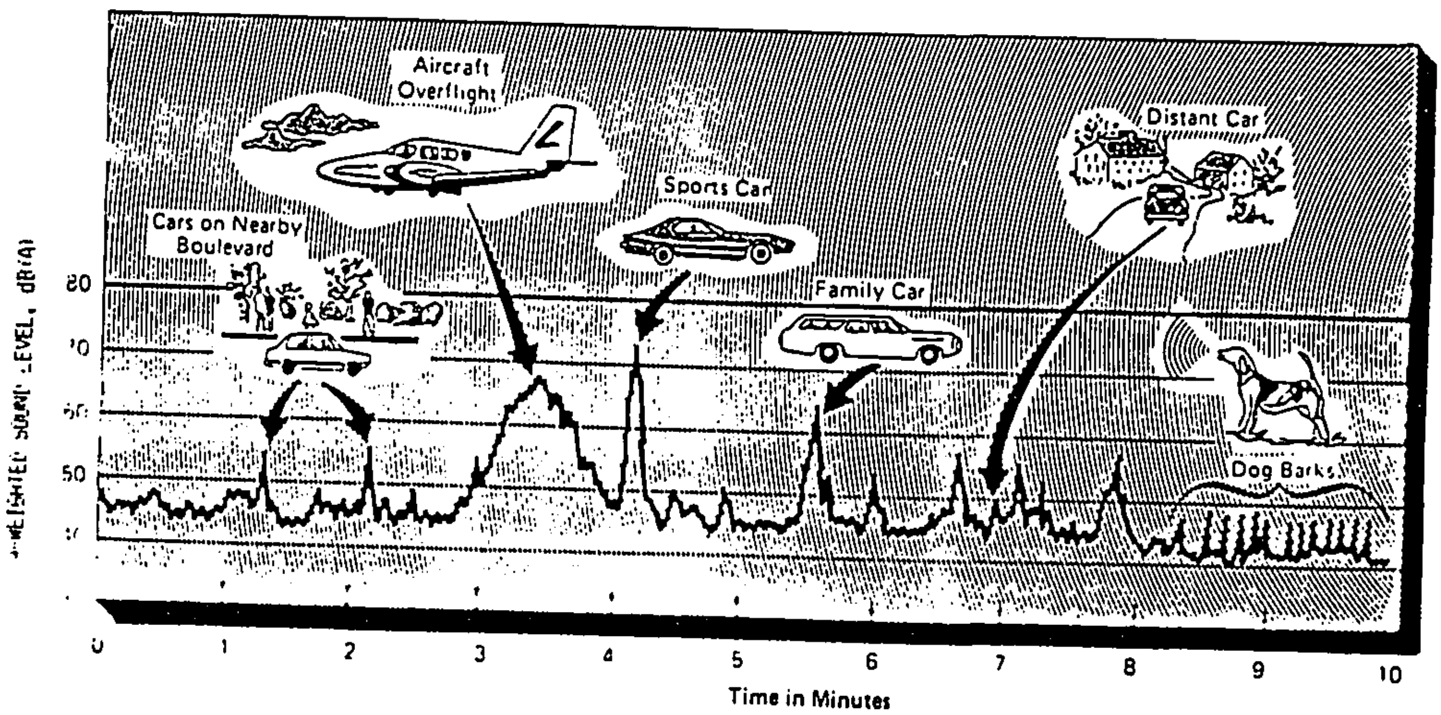

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FIGURE I-1. TYPICAL OUTDOOR A-WEIGHTED SOUND LEVELS MEASURED ON A QUIET SUBURBAN STREET

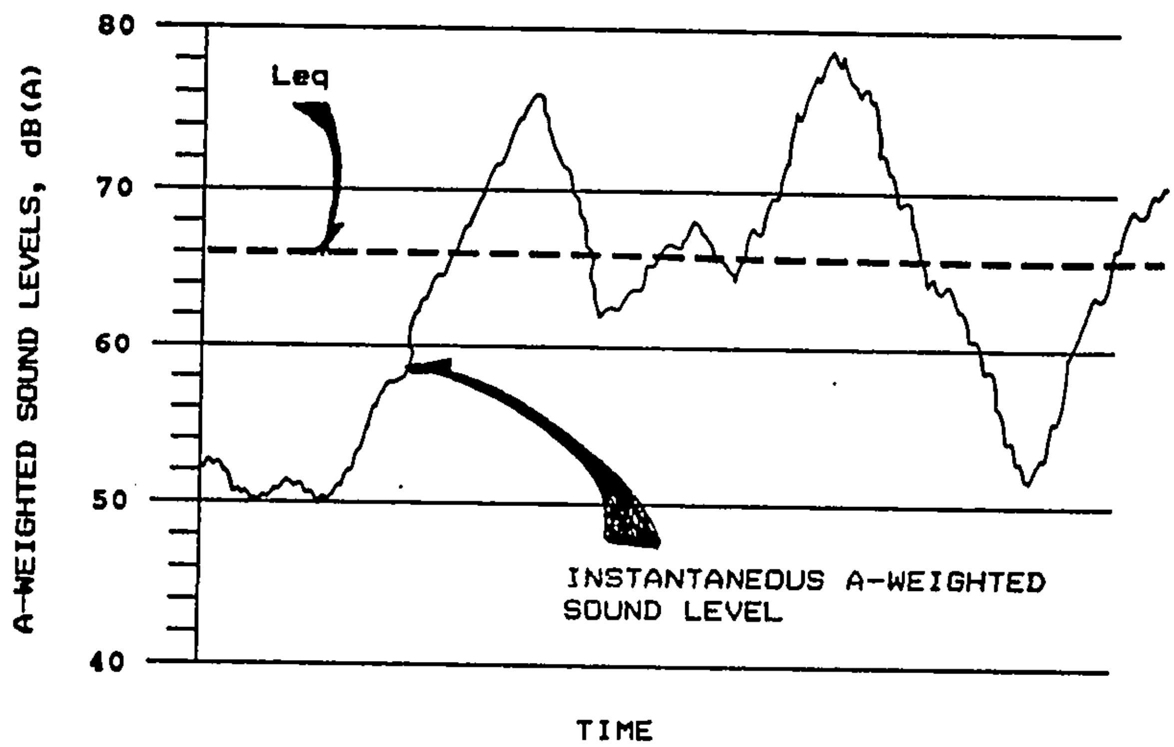

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FIGURE I-2. COMPARISON OF THE INSTANTANEOUS A-WEIGHTED SOUND LEVELS AND THE Leq

APPENDIX II

MEASUREMENT DATA LISTING

Table	Descriptions
1.	A-Weighted Ambient Noise Measurement Data, Position 1
2.	A-Weighted Ambient Noise Measurement Data, Position 2
3.	A-Weighted Ambient Noise Measurement Data, Position 3
4.	A-Weighted Ambient Noise Measurement Data, Position 3A
5.	A-Weighted Ambient Noise Measurement Data, Position 4
6.	A-Weighted Ambient Noise Measurement Data, Position 5
7.	A-Weighted Ambient Noise Measurement Data, Position 6
8.	A-Weighted Ambient Noise Measurement Data, Position 7
9.	A-Weighted Ambient Noise Measurement Data, Position 8
10.	Traffic Noise Measure Data, Position 9
11.	Traffic Noise Measure Data, Position 10

Sheet II-1 -- Notes and Legend for Tables 1 through 9

Figure II-1 -- Location of the Measurement Positions

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TABLE 1 - "A" WEIGHT AMBIENT NOISE LEVEL DATA - KAHUKU ENERGY PROJECT, LOCATION 1, HOSPITAL

Meas. Period	1981 Date	Start Time*	Noise Levels - dBA L_{99}	L_{90}	L_{50}	L_{33}	L_{10}	L_{max}	L_{eq}	Traffic** Car	Pick up	Van	Trk	Cycle	Plane	Meteorological Data Wind mph	Wind °	°F	RH %	Pressure in.of HG	Cloud Cover %	*** Surf	Dominant Source+ 1	2	3	NOTES
Thur "DAY"	11/12	1430	44	45	48	50	56	70	54.7	(4) 50	5	1	3	1	1	8	90	88	53	30.75		H	T	A	S	
Fri "DAY"	11/13	1500	42	44	47	49	54	63.1	51.1	(3) 58	(3) 10	(2) 5	3	1		6-8	90	82	62	30.57		H	T	S	P	
																						H				
Sat "DAY"	11/14	1150	43	45	49	50	52	60.1	50.4	(1) 50	4	3				5-6	45	77	74	30.62		M	T	S	N	1
		2140	46	46	48	48	49	51.1	48.3	9	1					<5	45	70	75	30.58		M	T	S	N	
Sat "NIGHT"	11/14	2210	45	46	48	48	49	55.1	48.5	17		1				<5		70	75	30.58		M	S	T	P	2
																						M				
Sun "NIGHT"	11/15	2230	41	41	42	42	44	53.1	43.3	(1) 6	1					6-9	90	70	74	30.56	90	M	T	P	S	
		2240	40	41	41	42	45	56.1	44.2	(1) 5						6-9	90	70	74	30.56	90	M	T	P	S	
Mon "DAY"	11/16	1300	45	46	48	50	57	67.1	53.4	(7) 45	(1) 4	(1) .4	(1) 5		1	7	90	78	75	30.54	95	M	A	T	S	
		1310	44	46	48	49	54	66.1	51.9	(5) 60	(5) 13	3	(1) 4			7	90	78	75	30.54	95	M	T	S	P	
Mon "NIGHT"	11/16	1040	42	42	43	45	47	60.1	46.5	(2) 10						8	90	68	84	30.60		M	T	S	P	1
Wed "NIGHT"	11/18	2210	41	42	43	44	46	59.1	45.5	10			1	1		6-9	90	73	80	30.66	50	M	T	S	P	
	11/19	0300	40	41	41	41	42	49.1	42.0	1						6	90	73	84	30.62		M	S	T	P	

TABLE 2 - "A" WEIGHT AMBIENT NOISE LEVEL DATA - KAHUKU ENERGY PROJECT, LOCATION 2, CONDO

Meas. Period	1981 Date	Start Time*	Noise Levels - dBA L_{99}	L_{90}	L_{50}	L_{33}	L_{10}	L_{max}	L_{eq}	Traffic** Car	Pick up	Van	Trk	Cycle	Plane	Meteorological Data Wind mph	Wind °	°F	RH %	Pressure in. of HG	Cloud Cover %	*** Surf	Dominant Source+ 1	2	3	NOTES
Thur "DAY"	11/12	1800	44	45	46	46	50	70.1	51.7	1						6	90	74	62	30.72		H	T	S	P	
Fri "DAY"	11/13	1100	45	46	49	50	53	67.1	51.9	1					1	8	90	80	64	30.62		H	T	N	P	
																						H				
Sat "DAY"	11/14	0800	41	43	46	48	52	71.1	52.3			(1)				<5		68	76	30.60		M	P	T	S	
		0810	43	44	46	47	51	59.1	49.6							<5		68	76	30.60		M	P	T	S	
Sat "NIGHT"	11/15	0240	50	51	52	53	54	55.1	53.2							<5		66	78	30.62		M	S	P		2
		0250	51	52	54	54	55	56.1	54.1							<5		66	78	30.62		M	S	P		2
Sun "NIGHT"	11/16	0220	41	42	43	44	44	54.1	44.0							6-7	90	69	81	30.54	80	M	N	P	S	
		0230	40	41	42	43	44	59.1	43.6							6-7	90	69	81	30.54	80	M	P	N	S	
Mon "DAY"	11/16	1640	45	46	48	49	51	63.1	49.5	(1)						8	90	73	80	30.54		M	T	S	N	
Mon "NIGHT"																						M				
																						M				
Wed "NIGHT"	11/18	2250	45	46	47	48	49	52.1	48.1							6	90	74	81	30.66	50	M	S	N		
	11/19	0230	43	44	45	45	46	48.1	45.5							6-8	90	74	85	30.64		M	S	N		

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TABLE 3 - "A" WEIGHT AMBIENT NOISE LEVEL DATA - KAHUKU ENERGY PROJECT, LOCATION 3. CABANAS

Meas. Period	1981 Date	Start Time*	Noise Levels - dBA							Traffic**						Meteorological Data							Dominant Source+			NOTES
			L_{99}	L_{90}	L_{50}	L_{33}	L_{10}	L_{max}	L_{eq}	Car	Pick up	Van	Trk	Cycle	Plane	Wind mph	Wind °	°F	RH %	Pressure in.of HG	Cloud Cover %	*** Surf	1	2	3	
Thur "DAY"	11/12																					H				
Fri "DAY"	11/13	1130	58	59	60	60	61	63.1	60.5							8	90	81	63	30.62		H	S			
																						H				
Sat "DAY"	11/14	0830	55	56	57	58	59	77.1	60.5							<5		70	78	30.60		M	S	P	N	
																						M				
Sat "NIGHT"	11/15	2110	54	55	56	57	59	60.1	57.3							<5		66	78	30.60		M	S			
																						M				
Sun "NIGHT"	11/16	0150	57	58	59	59	60	60.1	59.4							7-9	90	69	81	30.54		M	S			
		0200	57	57	58	59	59	61.1	59.0							7-9	90	69	81	30.54		M	S			
Mon "DAY"	11/16	1620	58	59	60	61	61	63.1	60.9	(1)						12	90	74	79	30.50	98	M	S	T		
																						M				
Mon "NIGHT"																						M				
Wed "NIGHT"	11/18	2230	59	60	60	61	62	63.1	61.1							12	90	74	80	30.66		M	S			
	11/19	0220	59	60	61	61	62	64.1	61.6							10-14	90	74	85	30.65		M	S			

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TABLE 4 - "A" WEIGHT AMBIENT NOISE LEVEL DATA - KAHUKU ENERGY PROJECT, LOCATION 3A, HI-RISE

Meas. Period	1981 Date	Start Time*	Noise Levels - dBA							Traffic**						Meteorological Data							Dominant Source+			NOTES
			L_{99}	L_{90}	L_{50}	L_{33}	L_{10}	L_{max}	L_{eq}	Car	Pick up.	Van	Trk	Cycle	Plane	Wind mph	Wind o	^oF	RH %	Pressure in.of HG	Cloud Cover %	*** Surf	1	2	3	
Thur "DAY"	11/12	2150	60	61	62	63	63	65.1	63.0							8-10	90	74	64	30.62		H	S			
Fri "DAY"	11/13	0800	59	61	62	62	63	65.1	62.8							<5		80	64	30.62		H	S			
Sat "DAY	11/14																					H				
																						M				
Sat "NIGHT"																						M				
																						M				
Sun "NIGHT"																						M				
																						M				
Mon "DAY"	11/16																					M				
																						M				
Mon "NIGHT"																						M				
Wed "NIGHT"																						M				
																						M				
																						M				

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TABLE 5 - "A" WEIGHT AMBIENT NOISE LEVEL DATA - KAHUKU ENERGY PROJECT, LOCATION 4, KAWELA BAY

Meas. Period	1981 Date	Start Time*	Noise Levels - dBA L_{99}	L_{90}	L_{50}	L_{33}	L_{10}	L_{max}	L_{eq}	Traffic** Car	Pick up	Van	Trk	Cycle	Plane	Meteorological Data: Wind mph	Wind °	°F	RH %	Pressure in.of HG	Cloud Cover %	*** Surf	Dominant Source+ 1	2	3	NOTES
Thur "DAY"	11/12	1520	50	51	52	53	55	65.1	53.8						2	<5		85	55	30.72		H	S	A		
Fri "DAY"	11/13	1430	49	50	51	52	53	56.1	52.1							<5		80	64	30.56		H	S	P		
																						H				
Sat "DAY	11/14	0910	49	50	52	53	55	63.1	53.6						(1)			73	78	30.62		M	S			
																						M				
Sat "NIGHT"	11/14	2240	49	50	51	51	52	53.1	51.5							<5		68	78	30.59		M	S			
		2250	49	50	51	51	52	54.1	51.3							<5		68	78	30.59		M	S			
Sun "NIGHT"	11/15	2310	47	48	49	49	50	58.1	49.8							<5		71	74	30.60		M	S			
		2320	47	48	49	49	50	52.1	49.6							<5		71	74	30.60		M	S			
Mon "DAY"	11/16	1540	49	50	51	52	54	59.1	52.3	(2)					1	<5		75	79	30.50		M	S	A		
																						M				
Mon "NIGHT"																						M				
Wed "NIGHT"	11/18	2310	48	49	50	51	52	55.1	51.3							<5		74	82	30.66		M	S			
	11/19	0200	48	49	51	51	52	55.1	51.5							<5		74	83	30.65		M	S			

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TABLE 6 - "A" WEIGHT AMBIENT NOISE LEVEL DATA - KAHUKU ENERGY PROJECT, LOCATION 5, BEACH PARK

Meas. Period	1981 Date	Start Time*	Noise Levels - dBA L_{99}	L_{90}	L_{50}	L_{33}	L_{10}	L_{max}	L_{eq}	Traffic** Car	Pick up	Van	Trk	Cycle	Plane	Meteorological Data Wind mph	Wind o	oF	RH %	Pressure in.of HG	Cloud Cover %	*** Surf	Dominant Source+ 1	2	3	NOTES
Thur "DAY"	11/12	1550	61	62	64	65	67	78.1	66.0	(9) 73	8	1	1	2	2	8	90	88	53	30.70		H	S	A	T	
Fri "DAY"	11/13	1323	59	60	62	63	66	73.1	64.3	(4) 56	4	7	4	4		8	90	83	56	30.61		H	S	T		
																						H				
Sat "DAY"	11/14	0950	61	62	63	65	69	84.1	68.6	51	5	1		3		5-7	90	74	75	30.64		M	S	T		
		1000	62	63	64	65	67	79.1	66.1	30	2	6	2	1		5-7	90	74	75	30.64		M	S	T		
Sat "NIGHT"	11/15	0050	59	59	60	61	62	70.1	61.5	5						<5		66	78	30.58		M	S			
																						M				
Sun "NIGHT"	11/16	0040	58	58	59	60	61	74.1	61.3	4						<5		70	78	30.55	90-100	M	S			
		0050	58	59	60	60	61	68.1	60.7	5						<5		70	78	30.55	90-100	M	S			
Mon "DAY"	11/16	1350	59	60	62	63	66	75.1	64.1	(9) 47	4	5	1			6	90	77	77	30.54	100	M	S	T		
Mon "NIGHT"																						M				
																						M				
Wed "NIGHT"	11/18	2320	58	59	60	61	63	72.1	62.0	12						<5		74	82	30.64		M	S	T		
	11/19	0050	58	59	60	60	61	67.1	60.7	1						<5		72	82	30.62		M	S			

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TABLE 7 - "A" WEIGHT AMBIENT NOISE LEVEL DATA - KAHUKU ENERGY PROJECT, LOCATION 6, WAIALEE, MAUKA

Meas. Period	1981 Date	Start Time*	Noise Levels - dBA							Traffic**						Meteorological Data							Dominant Source+			NOTES
			L_{99}	L_{90}	L_{50}	L_{33}	L_{10}	L_{max}	L_{eq}	Car	Pick up	Van	Trk	Cycle	Plane	Wind mph	Wind °	°F	RH %	Pressure in.of HG	Cloud Cover %	*** Surf	1	2	3	
Thur "DAY"	11/12	1620	51	51	53	54	56	63.1	54.5	(2) 43	(1) 11	2	3	1	1	6-9	45	82	53	30.64		H	T	A	S	
Fri "DAY"	11/13	1300	48	49	51	53	57	78.1	58.5	45	(2) 3	2	4	1	1	6-11	90	86	52	30.58		H	A	T	S	
																						H				
Sat "DAY	11/14	1020	54	54	55	56	57	73.1	57.3	(2) 41	5	1	2			5-8	90	74	76	30.62		M	T	S	P	
		1030	54	54	55	55	57	71.1	56.8	(1) 39	3	2			1	5-8	90	74	76	30.62		M	T	S	P	
Sat "NIGHT"	11/14	2340	48	48	49	50	53	63.1	51.7	17	4					<5		78	70	30.58		M	S	T		2
		2350	47	48	49	50	52	63.1	51.3	13						<5		78	70	30.58		M	S	T		2
Sun "NIGHT"	11/15	2340	46	47	48	48	50	59.1	49.1	5						5-7	90	71	75	30.56	100	M	S	T		
		2350	47	48	49	50	53	60.1	51.0	6						5-7	90	71	75	30.56	100	M	S	T		
Mon "DAY"	11/16	1410	48	49	53	54	60	70.1	57.7	(3) 54	(1) 6	6	3		2	7-11	90	76	78	30.51		M	A	T	S	
		1420	49	50	53	55	59	70.1	56.6	(1) 60	(2) 7	2	4		2	7-11	90	76	78	30.51		M	A	T	S	
Mon "NIGHT"																						M				
Wed "NIGHT"	11/18	2340	46	47	48	49	52	64.1	50.6	(1) 15						5-8	90	74	82	30.66		M	T	S	N	
	11/19	0120	46	47	48	48	49	66.1	49.3	2						<5		72	84	30.61		M	S	T	N	

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TABLE 8 - "A" WEIGHT AMBIENT NOISE LEVEL DATA - KAHUKU ENERGY PROJECT, LOCATION 7, WAIALEE, MAKAI

Meas. Period	1981 Date	Start Time*	Noise Levels - dBA L_{99}	L_{90}	L_{50}	L_{33}	L_{10}	L_{max}	L_{eq}	Traffic** Car	Pick up	Van	Trk	Cycle	Plane	Meteorological Data Wind mph	Wind °	°F	RH %	Pressure in.of HG	Cloud Cover %	*** Surf	Dominant Source+ 1	2	3	NOTES
Thur "DAY"	11/12	1650	47	48	50	51	55	70.1	55.1	(1) 48	9	2	1		3	6-9	45	78	57	30.65		H	A	T	S	
Fri "DAY"	11/13	1240	46	47	51	53	61	75.1	59.8	55	5	3	5	1	1	6-10	45	88	48	30.64	<10	H	A	T	S	
																						H				
Sat "DAY	11/14	1050	44	46	50	51	53	71.1	54	(1) 46	(1) 6	6	3			8	90	78	73	30.66		M	T	S		
																						M				
Sat "NIGHT"	11/15	0020	47	48	50	50	52	57.1	51.0	6	1					5		68	76	30.56		M	S	T		2
		0030	48	48	50	51	52	55.1	51.1	4	1					5		68	76	30.56		M	S	T		2
Sun "NIGHT"	11/16	0010	45	46	47	47	48	54.1	47.6	2						6	90	71	78	30.56	90	M	S			
		0020	46	46	47	48	48	56.1	48.0	2	1	1				6	90	71	78	30.56	90	M	S			
Mon "DAY"	11/16	1440	45	46	51	53	60	85.1	60.9	74	(1) 7	7	5		1	5		73	78	30.50	100	M	A	T	S	
		1450	46	47	51	53	57	74.1	56.8	45	(1) 9	1	7	1		5		73	78	30.50	100	M	T	S		
Mon "NIGHT"																						M				
Wed "NIGHT"	11/19	0000	42	43	44	45	48	56.1	46.5	7	1	1		1		7	90	74	84	30.62		M	T	S	N	
		0140	44	45	45	46	46	51.1	46.1							5-8	90	74	82	30.62		M	S			

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TABLE 9 - "A" WEIGHT AMBIENT NOISE LEVEL DATA - KAHUKU ENERGY PROJECT, LOCATION 8, CORNFIELD

Meas. Period	1981 Date	Start Time*	Noise Levels - dBA L_{99}	L_{90}	L_{50}	L_{33}	L_{10}	L_{max}	L_{eq}	Traffic** Car	Pick up	Van	Trk	Cycle	Plane	Meteorological Data Wind mph	Wind °	°F	RH %	Pressure in.of HG	Cloud Cover %	*** Surf	Dominant Source+ 1	2	3	NOTES
Thur "DAY"	11/12	1730	54	54	55	55	55	56.1	55.5	50		2	4	2		7-8	90	78	58	30.67		H	S	N	T	
Fri "DAY"	11/13	1410	43	44	46	47	76	77.1	64.3	48	6	7	3	1	1	8-10	90	82	59	30.56		H	A	P	S	3
		1630	54	54	54	55	56	60.1	55.8	49	10	3	1		1	8	90	82	58	30.60		H	S	T	N	
Sat "DAY	11/14	0930	48	49	50	55	55	56.1	53.4	45	3	3	3			6-7	90	74	77	30.64		M	S	T	N	
																						M				
Sat "NIGHT"	11/15	0140	50	51	53	53	55	57.1	53.8	9						6-7	90	66	78	30.56		M	S			2
																						M				
Sun "NIGHT"	11/16	0120	40	41	42	42	43	48.1	42.7	6						7	90	70	82	30.54		M	S			
		0130	41	42	42	43	43	48.1	43.1	1						7	90	70	82	30.54		M	S			
Mon "DAY"	11/16	1510	46	47	48	49	50	57.1	49.3	52	8	2	6	1	1	9-10	90	75	80	30.50	100	M	S	T	A	
		1520	45	46	48	49	59	77.1	58.6	42	2	4			1	9-10	90	75	80	30.50	100	M	A	S	T	4
Mon "NIGHT"																						M				
Wed "NIGHT"	11/19	0020	41	43	46	46	46	48.1	46.1	3						7	90	74	82	30.64		M	N	S		
		0030	39	40	45	46	46	54.1	45.5	2						7	90	74	82	30.64		M	N	S		

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SHEET II-1

NOTES

* Start time for the 10-minute sample period.

** Traffic counts are on the highway. () is count of vehicles moving off the highway on side roads or parking lot. "Trucks" include buses. Planes are either 1 or 2 prop fixed wing aircraft or helicopters.

*** Surf heights are: H = 11' to 15', M = 6' to 10',

\+ Dominant Noise Sources: S = Surf
T = Traffic
A = Aircraft
N = Natural Sources
P = Miscellaenous Sources

1. Highway pavement sufficiently wet to increase traffic noise.

2. Higher than normal surf noise levels believéd due to sound refraction caused by thermal inversion.

3. Threshing machine in field.

4. Helicopter noise dominated sample.

TABLE 10

TRAFFIC NOISE MEASUREMENT DATA SHEET

PROJECT NO.: 88-50

MEASUREMENT DATE: December 21, 1988

MEASUREMENT PERIOD: 20 minutes

NOISE SOURCE: Traffic on Kamehameha Highway

REMARKS:____

MEASUREMENT LOCATION: Position No. 9

MEASUREMENT RESULTS

Leq: 63.9 dB(A)	NO. OF PASSENGER AUTO COUNTED: 222 NO. OF PASSENGER AUTO / HOUR: 666
Lmax: 85.3	NO. OF MEDIUM TRUCKS COUNTED: 4 NO. OF MEDIUM TRUCKS / HOUR: 12
POSTED SPEED: 35 MPH	NO. OF HEAVY TRUCKS COUNTED: 4 NO. OF HEAVY TRUCKS / HOUR: 12
ESTIMATED AVERAGE SPEED: 35-40 MPH	TOTAL NO. OF VEHICLES COUNTED: 230 TOTAL NO. OF VEHICLES / HOUR: 690

MIC. DISTANCE TO THE SOURCE: 65 feet

MIC. HEIGHT RELATIVE TO THE SOURCE: 7 feet

TABLE 11

TRAFFIC NOISE MEASUREMENT DATA SHEET

PROJECT NO.: 87-41

MEASUREMENT DATE: February 18, 1988

MEASUREMENT PERIOD: 10 minutes

NOISE SOURCE: Traffic on Kamehameha Highway

REMARKS:

MEASUREMENT LOCATION: Position No. 10

MEASUREMENT RESULTS

Leq: 61.3 dB(A)	NO. OF PASSENGER AUTO COUNTED: 81 NO. OF PASSENGER AUTO / HOUR: 486
Lmax: 75.3	NO. OF MEDIUM TRUCKS COUNTED: 1 NO. OF MEDIUM TRUCKS / HOUR: 6
POSTED SPEED: 35 MPH	NO. OF HEAVY TRUCKS COUNTED: 1 NO. OF HEAVY TRUCKS / HOUR: 6
ESTIMATED AVERAGE SPEED: 35-40 MPH	TOTAL NO. OF VEHICLES COUNTED: 83 TOTAL NO. OF VEHICLES / HOUR: 498

MIC. DISTANCE TO THE SOURCE: 119 feet

MIC. HEIGHT RELATIVE TO THE SOURCE: not recorded

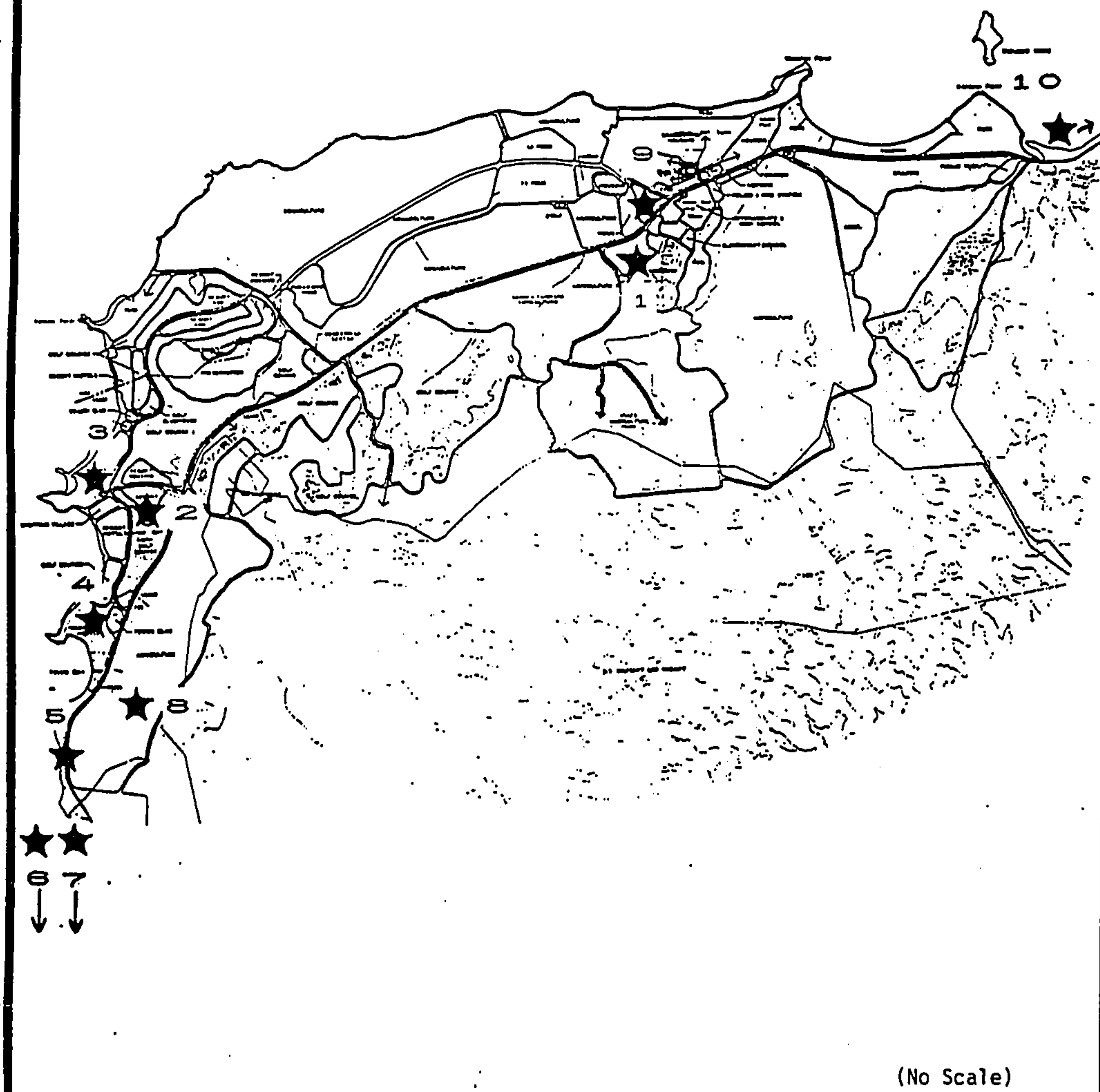

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FIGURE II-1. LOCATION OF MEASUREMENT POSITIONS

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RESUME OF RONALD A. DARBY, P.E.

EDUCATION:	B.S. in Mechanical Engineering, Pennsylvania State University, 1954. M.S. in Engineering, 1967, and all course work for Doctor of Engineering at Catholic University, Washington, D.C., Graduate courses at University of Maryland and the University of Hawaii.
PROFESSIONAL ENGINEER:	State of Hawaii, PE 3002-E State of Maryland, PE 6482-ME
PROFESSIONAL AFFILIATION:	Member of Acoustical Society of America, National Society of Professional Engineers, Tau Beta Pi, and Pi Tau Sigma.
1970 TO PRESENT:	President of Darby & Associates* which specializes in acoustics and noise control engineering. Airport, community and industrial noise exposure measurements, evaluations, and studies have been performed in the Hawaiian Islands, Guam and the mainland U.S.A. Architectural and mechanical equipment noise control efforts have been made for new and existing building projects in the Pacific Basic, mainland U.S.A. and Japan.
1967 TO 1970:	Research Scientist, LTV Research Center, Hawaiian Division. Involved in all phases of deep ocean underwater acoustic measurement exercises: planning, data collection, data processing (analog and digital), analysis, and reporting. Typical results were long range sound transmission loss values, ambient noise levels and source levels. Developed unique method to measure radiated noise levels of submarines using aircraft. Served as a member of Tactical Analysis Group for Commander, Antisubmarine Warfare Forces, Pacific at Pearl Harbor.
1960 TO 1967:	Research Mechanical Engineer at the Marine Engineering Laboratory Annapolis, Maryland (Now NSRDC). Was technical secretary for the "Submarine Noise Measurement Panel", Committee of Undersea Warfare, National Academy of Science for one and a half years. Developed practical technique for predicting radiated noise from ship's machinery. Developed laboratory techniques and special transducers for measuring structural noise transmission from machines. Created technological forecasts and cost effectiveness studies on machinery noise. Devised practical experiments to evaluate machinery noise quieting devices, i.e., isolation mounts, flexible hoses, sound enclosures, etc.
1959 TO 1960:	Engineer at Westinghouse Electric Corp., Defense Center, Baltimore, Maryland. Team member in developing high frequency sonar transducers for Navy Applications.

* Formerly Ronald A. Darby & Associates and Darby-Ebisu & Associates, Inc.

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1957 TO 1959: Research Engineer at Chesapeake Instrument Corp., in Shadyside, Maryland. Initiated program in study of dynamic mechanical properties of elastomers. Developed new products, i.e., hydrophones, accelerometers, special microphones, etc.

1956 TO 1957: Engineer in Vitro Corporation in Silver Springs, Maryland. Involved in acoustic homing torpedo development.

1955 TO 1956: Engineer at ERCO in Riverdale, Maryland. Did original development of novel techniques to simulate missile noise cone heating.

1954 TO 1955: University of Maryland, College Park, Maryland. Instructor. Taught full time in C.E. Department: Undergraduate Strength of Materials, Statics and Dynamics and Elementary Surveying.

PATENTS, AWARDS, ETC: Four patent grants; one patent pending; George Melville Award "for distinguished scientific and engineering achievement" at MEL in 1963; Severn Technical Society Award for Best Technical Paper at MEL in 1964.

MAJOR REPORTS AND PUBLICATIONS:

1. National Academy of Science Panel, "Measurement of Submarine Radiated Noise," NRC: CUW: 0331, Oct 1966 (Confidential).
2. R.A. Darby, "A Practical Method for Predicting Acoustic Radiation or Shock Excursions of Navy Machinery," Part 3, 34 Shock and Vibration Bulletin, The Shock and Vibration Information Center, USNRL, Dec. 1964.
3. H.A. Deferrari, R.A. Darby and F.A. Andrews, "Vibrational Displacement and Mode-Shapes Using a Laser Interferometer." J.A.S.A. Vol 42, No. 5, November 1967.
4. R.A. Darby, "Noise from Sugar Operations in Hawaii - A Study of the Extent and Effect on the Community," January 1971.
5. R.A. Darby, "A Study of Noise in the Kalihi-Palama Area and Practical Soundproofing of Housing," March 1971.
6. R.A. Darby, "Typical Noise Problems and Some Practical Solutions," Hawaiian Sugar Technicians Symposium, November 1972.
7. R.A. Darby, "Mechanical Impedance Measurements in Foundation Studies," Part 4, 33 Shock and Vibration Bulletin, The Shock and Vibration Information Center, USNRL, March 1964.
8. R.A. Darby, "The Quantitative Evaluation of Vibration Isolation Devices for Mounted Machinery Installations," MEL Report 82-287E. August 1963.
9. Film "Fundamental of Mechanical Impedance - Concepts Applicable to Ship Silencing," Navy Training Film MN9960.

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RESUME OF JOHN C. SHEARER

EDUCATION:	B.E. (Hons) in Mechanical Engineering, University of Adelaide, Australia, 1970. M.Sc. in Engineering Acoustics, University of Southampton, U.K.,1975.
PROFESSIONAL AFFILIATIONS:	Member of the National Association of Acoustical Consultants. Member of the Australian Acoustical Society. Member of the Institution of Engineers, Australia.
1989 to Present:	Senior Consultant, Darby and Associates.
1988 to 1989:	Senior Consultant, Richard Heggie Associates Pty: Ltd., Sydney, Australia. Involved in preparing guidelines for residential development in areas affected by aircraft noise; environmental noise impact assessments for proposed hotels, commercial and industrial developments; architectural acoustics and mechanical noise control for high rise office buildings, hotels and television studios; engineering noise control, including design of specialized acoustic enclosures.
1985 to 1988:	Senior Consultant, Wilson, Ihrig & Associates, Inc., Oakland, California. Involved in assessing the noise and vibration impact of new rapid transit systems throughout the U.S. Also involved in assessing the community noise impact of helicopter operations; analysis of existing and projected noise levels at proposed residential developments potentially impacted by aircraft noise; prediction of the environmental noise impact of proposed motor sport raceways; analysis of building sound isolation requirements; design of acoustic enclosures for pumps, compressors, etc.; sound and impact isolation measurements in condominium apartments, and preparation of recommendations on means of upgrading performance to code requirements.
1977 to 1984:	Director, Shearer-Gardner Pty. Ltd., Adelaide, Australia. Involved in the design and

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conformance testing of fan silencers and high performance natural gas blowdown atteuators; design, letting of sub-contracts for and conformance testing of specialized acoustic enclosures; studies of existing ambient noise levels in areas potentially impacted by noise from new transportation systems, assessment of the environmental noise impacts of alternative transportation systems and design of noise control measures to minimize passby noise levels; design of modifications to improve acoustics in existing radio and television studios; design of new television studio facilities, letting of sub-contracts, supervision of installation and final conformance measurements.

1975 to 1977: Branch Manager, Vipac and Partners Pty. Ltd. Adelaide, Australia. General consulting in environmental and industrial noise control and architectural acoustics.

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RESUME OF MIKE SANG LEE

WORK EXPERIENCE

- December 1988 - Present
  Senior Acoustical Consultant
  Darby & Associates, Kailua, Hawaii

  Conducted noise studies for projects in the Hawaiian Islands in the following areas of acoustics: field noise measurements, impact assessment analysis and research, noise and vibration mitigation measures. The studies involved noise sources such as aircraft, traffic, machinery, musical performance, and construction activity.

- October 1985 - November 1988
  Senior, Associate Acoustical Engineer
  J.J. Van Houten & Associates, Anaheim, CA

  Performed noise studies in the following areas of acoustics: field noise and vibration measurements; impact assessment analysis; mitigation measures for noise sources such as aircraft, arterial, trains, mechanical equipment and industrial plants; noise tests for compliance with standards; noise element studies.

EDUCATION

University of Wisconsin-Madison, Madison, WI
January '83 - May '85
Degree: Master of Arts - may '85
Major: Mathematics with emphasis on Numerical Analysis

University of Hawaii at Manoa, Honolulu, HI
January '77 - December '82
Degree: Bachelor of Science
Major: Mathematics and Physics

PROFESSIONAL AFFILIATION

Associate member of Acoustical Society of America (ASA); March '87 - present

Affiliate member of Institute of Noise Control Engineering (INCE); Jan. '88 - pres.

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REPRESENTATIVE STUDIES

1. Noise Impact Evaluation for Proposed West Maui Marina, Launiupoko, Maui
2. Noise Impact Evaluation for Environmental Assessment, Waikoloa Beach Resort, Hawaii
3. Noise Impact Evaluation for Proposed Kahuku Golf Courses, Kahuku, Oahu
4. Waikiki Shell Improvement, Honolulu, Oahu
5. Waikiki Shell Litigation, Honolulu, Oahu
6. Kona Alii Condominium Equipment Noise, Kailua-Kona, Hawaii
7. Kamehameha School Hearing Screening Research, Oahu
8. State of Hawaii Helicopter System Plan Review
9. Rooftop A/C Unit for a Learning Center, Honolulu, Hawaii
10. Fire Alarm System, Ritz Carlton Hotel, Kona, Hawaii
11. Helicopter Noise Contour Calculation, Princeville, Kauai
12. Chaminade PRU Noise Impact Evaluation, Honolulu, Oahu
13. HECO 138 kV Transmission Line Construction Noise Study, Honolulu, Oahu
14. Sound Transmission Class Testing, Four Seasons Hotel, Wailea, Maui
15. Kohala Helistop Noise Contour Calculation, Kohala, Hawaii
16. Aircraft Noise Measurement and Impact Evaluation, Kauai Lagoon Golf Course
17. Diesel Generator, Outrigger Hotel, Honolulu, Oahu

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APPENDIX F

VIEW ASSESSMENT, COUNTRY COURSES AT KAHUKU, PUNAMANO GOLF COURSE

Michael S. Chu, Land Architect

APPENDIX F

VIEW ASSESSMENT

Country Coursės at Kahuku, Punamano Golf Courses

Koolauloa, Oahu, Hawaii

prepared by: MICHAEL S. CHU, LAND ARCHITECT
prepared for: THE ESTATE OF JAMES CAMPBELL
DEC. 1989

VISUAL ASSESSMENT
for the
PUNAMANO GOLF COURSES

Note: Figures referred to in this assessment are located in Volume I, Country Couses at Kahuku, Punamano.

1. Purpose of Assessment

The purpose of this assessment is to evaluate the potential visual impacts of the proposed "Kahuku Country Courses, Punamano Golf Courses" Development Plan Amendment relative to open space, scenic and other visual resources within the project area, and to propose mitigations to reduce or eliminate possible adverse impacts.

This assessment is conducted within the context of (a) existing visual conditions and (b) current State and City/County development plans and policies relating to visual quality.

It should be noted that all of the project's site development and building design details have not yet been determined at this early stage of the land planning/permit process. Given the nature of this project, however (three golf courses and appurtenances), sufficient data exists for the preparation of a meaningful visual impact analysis and mitigative guidelines. Further detailed visual assessments will be considered by the applicant's professional team in locating and designing project features which may affect public views.

2. Project Location and General Setting

Three 18 hole golf courses are proposed within the 605 acre Kahuku Country Courses, Punamano amendment area . This irregular shape site is located at the north end of the windward side of Oahu, within the Koolauloa Development Plan area (see Figures 3 & 4). The property lies along the mauka side of Kamehameha Highway, approximately 2 miles west of the Kahuku community and is immediately east of the Turtle Bay Resort at Kuilima. It is one mile inland from the shoreline.

The amendment area contains approximately 1.75 miles of frontage along the mauka side of Kamehameha Highway. The lower (makai) portions of the site abutting the highway lie within the Kahuku Plain. This coastal plain is a broad, low lying area which extends from the shoreline across the highway to the descending foothills at the base of the Koolau Mountains. This coastal plain, on the mauka side of the highway, is currently planted with diversified agricultural crops as well as uncultivated fields which are presently overgrown with naturalized vegetation.

The upper portions of the site lie within the descending foothills and ridge top plateaus. These foothills provide a highly visible backdrop to the agricultural/open space in the foreground. A portion of the foothills (Kalaeokahipa Ridge) descends and abuts the highway at the southeastern point of the amendment area boundary and is a prominant and unique natural feature to the region. The surrounding mauka foothills are peppered with large wind turbine generator machines, utility lines and several military radio antennae however none of these facilities are located within the Punamano Golf Course amendment area.

The maintained landscape and lowrise structures across the highway at the Kuilima resort area contrast the character of the area and represents a distinct and unique urban node within the Koolauloa district. Except for this resort, the amendment area and all adjacent areas are designated as agriculture by the State Land Use maps (Figure 2) and the Koolauloa DP land use map:(Figure 3). Similarly, existing zoning for the site is designated as Ag 1 and Ag 2 (Figure 5). The site lies outside of the Special Management Area.

There are no existing or proposed public facilities within the amendment area boundary, however a sewer treatment plant (presently under construction) and a HECO facility are designated adjacent to the site. Improvements within the mauka side of the Kamehameha Highway right-of-way (water) are also proposed along a portion of the site (see Public Facilities map, Figure 4).

The extent of the Federal Insurance Rate Maps study (Figure 8) indicates most of the amendment area to be outside of the 500 year flood zone. The Oio Stream and the Hoolapa and Kalaeokahipa gulches however cut through the site and cross the highway, providing drainage relief from the foothill areas into the makai area across of Kamehameha Highway.

Figures 6 and 7 illustrate the soil classifications of the area relative to the ALISH and Land Survey Bureau data maps respectively.

Figure 9 represents a preliminary site plan and illustrates the general golf course layouts, major structures and entry roads into the site with annotated notes identifying the location of primary design features.

Except for the agricultural land uses and utilities, there are no structures, human habitation or other activities located on the site.

3. Description of Project

The proposed project consists of the construction and operation of 3 golf courses, 2 clubhouses, 1 driving range, 1 sewer treatment plant and several small maintenance structures and yards within the 605 acre amendment area. Upon approval, it is anticipated that the three golf courses and all appurtenances will be fully constructed and operational by 1998.

Two entry/access roads are proposed to be located (see Site Plan, Figure 9) approximately 1750 feet apart off of Kamehameha Highway These entry locations will provide direct access to each of the two club houses and will be distinctively landscaped for highway identification purposes. They will contain night lighting and identity signage.

One 18 hole golf course will be located within the low lying coastal plain (see Preliminary Site Plan, Figure 9). Its fairways will parallell the highway. A golf club house and parking area is proposed within this golf course will be located at an approximate elevation of 100 ft., about 500 ft. from the highway. A sewer treatment plant is planned nearby.

The second and third golf course and a second club house and parking area, will be located atop and behind the plateau area of the descending foothills (see Preliminary Site Plan, Figure 9). The club house and parking facility will occupy an upper plateau (approximately 250 ft. elevation) and the golf course fairways will radiate outward and down slope from this location. A driving range and storm run off sump will be located at a plateau elevation of approximately 120 ft. A maintenance and a second sewer treatment plant will be located nearby.

The specific design character /image of the golf courses and its appurtenances has not been established to date.

4. Applicable Policies & Land Use Controls

State and City/County policies regarding public views, open space, scenic resources and overall visual quality are as follows.

Hawaii State Plan (HRS Chapter 226)

The Hawaii State Plan, recognizing the need to "...provide for wise use of Hawaii's resources and to guide the future development of the State," identifies several Goals, Objectives, Policies and Priorities for the State. Those which are relevant to this report are as follows:

SEC.226-4 State Goals

(2) A desired physical environment, characterized by beauty, cleanliness, quiet, stable natural systems, and uniqueness, that enhances the mental and physical well-being of people.

SEC.226-12 Objective and policies for the physical environment - scenic, natural beauty, and historic resources

(a) Planning for the State's physical environment shall be directed towards achievement of the objective of enhancement of Hawaii's scenic assets, natural beauty, and multicultural/historic resources.

(b) To achieve the scenic, natural beauty, and historic resources objective, it shall be the policy of this State to:

(3) Promote the preservation of views and vistas to enhance the visual and aesthetic enjoyment of mountains, ocean, scenic landscapes, and other natural features.

(5) Encourage the design of developments and activities that complement the natural beauty of the islands.

SEC.226-23 Objective and policies for socio-cultural advancement - leisure

(a) Planning for the State's socio-cultural advancement with regard to leisure shall be directed towards the achievement of the objective of the adequate provision of resources to accommodate diverse cultural, artistic, and recreational needs for present and future generations.

(b) To achieve the leisure objective, it shall be the policy of this State to:

(4) Promote the recreational and educational potential of natural resources having scenic, open space, cultural, historic, geological, or biological values while ensuring that their inherent values are preserved.

SEC.226-104 Population growth and land resources priority guidelines

(b) Priority guidelines for regional growth distribution and land resources utilization:

> (10) Identify critical environmental areas in Hawaii to include but not be limited to the following: ...scenic and recreational shoreline resources; open space and natural areas; historic and cultural sites; areas particularly sensitive to reduction in water and air quality; and scenic resources.
>
> (13) Protect and enhance Hawaii's shoreline, open spaces, and scenic resources.

General Plan, City and County of Honolulu

The General Plan for the Island of Oahu contains several "...environmental and design objectives for the general welfare and prosperity of the people of Oahu" and "...broad policies which facilitate the attainment of the objectives of the Plan." The most relevant Objectives and Policies are:

(In the area of Natural Environment)

Objective A: To protect and preserve the natural environment.

> Policy 1: Protect Oahu's natural environment, especially the shoreline, valleys, and ridges, from incompatible development.
>
> Policy 9: Protect mature trees on public and private lands and encourage their integration into new developments.

Objective B: To preserve and enhance the natural monuments and scenic views of Oahu for the benefit of both residents and visitors.

> Policy 2: Protect Oahu's scenic views, especially those seen from highly developed and heavily travelled areas.

Development Plans, Common Provisions

The common provisions for all of Oahu's Development Plan Areas include the following relevant general urban design principles and controls (Section 32-1.4):

(1) Public Views

Public views include views along streets and highways, mauka-makai view corridors, panoramic and significant landmark views from public places, views of natural features, heritage resources and other landmarks, and view corridors between significant landmarks.

Such public views shall be protected by appropriate building heights, setbacks, design and siting controls established in the CZC. These controls shall be determined by the particular needs of each view and applied to public streets and to both public and private structures.

The design and siting of all structures shall reflect the need to maintain and enhance available views of significant landmarks. No development shall be permitted that will block important public views.

Whenever possible, overhead utility wires and poles that significantly obstruct public views shall be relocated or placed underground.

(2) Open Space

Open space areas consist of, but are not limited to, the ocean, beaches, parks, plazas, institutional properties with park-like grounds, streams, inland bodies of water, significant land forms, golf courses, cemeteries and agricultural and preservation lands. The functions of open space areas are to provide visual relief and contrast to the built environment, to serve as outdoor space for public use and enjoyment. The preservation and enhancement of areas that are well suited to perform these functions shall be given high priority.

Open spaces that act as physical boundaries distinguishing one community from another shall be preserved.

(3) Vehicular and Pedestrian Routes

Landscaping shall be provided along major vehicular arterials and collector streets as a means to increase the general attractiveness of the community and the enjoyment of vehicular travel for visitors and residents.

(8) Rural Areas

Rural areas are characterized by a preponderance of open and agricultural lands with limited development clustered in small, low density residential areas which have a strong sense of community and a country-like environment. Large-scale agricultural operations or small farms are major economic activities and constitute the predominant land use. Business centers are generally modest in size, low in intensity of use and primarily oriented to meeting the day-to-day shopping and service needs of the surrounding area's residents.

The location and character of new development in rural areas shall be consistent with the above-described characteristics of such areas and be guided by the following principles and controls:

(A) The visual attractiveness that distinguishes rural from urban and country from city shall be maintained.

(F) Commercial development shall be characterized by extensive landscaping and designs compatible with the rural character of the area.

(G) Design standards for streets and other infrastructure improvements shall reflect the reduced demands of lower density developments and be compatible with the desired country-like environment of rural communities.

Koolauloa Development Plan, Special Provisions

The Development Plan for the Koolauloa Area specifies that

"The land use pattern shown on the land use map provides for the preservation of the predominantly rural character of Koolauloa by allowing only limited single-familiy residential development and confining further tourist oriented development to the Kahuku Point-Kawela Bay area.

Further development within the Koolauloa area, particularly in the Kahuku Point-Kawela Bay area, is to be sensitive to the delicate coexistence between the natural scenic, recreational, and agricultural resources of the area. This is to be accomplished by minimizing adverse impacts on and preserving important agricultural lands and public views, maintaining public access to recreational areas, and providing building designs which reflect the rural character of the area.

The Urban Design Principles and Controls for Koolauloa (Section 32-7.2 of the DP) provide the following relevant Specific Urban Design Considerations:

(1) Open Space

The visibility, preservation, enhancement and accessibility of open space areas, as described in Section 32-1.4 of the development plan common provisions, shall be given high priority in the design of adjacent and nearby development in Koolauloa.

(2) Public Views

In order to protect and enhance the rural attractiveness of Koolauloa, views from public places of the lateral Koolau ridges and deep inland valleys of southern Koolauloa shall be protected wherever possible. Panoramic and continuous views from public places of the coast and the sea, as well as views of the expansive Kahuku plain, shall also be protected.

The subordinate role of the built environment with respect to the natural environment and agricultural activities shall be emphasized by the identification and protection of panoramic public views of the shore, streams, mountains and agricultural fields.

Kamehameha Highway provides the traveler with an exceptionally scenic experience, Development adjacent to the highway shall reflect the need to preserve the current panoramic roadway views of the sea, the coastline, the Koolau mountains and lateral ridges, inner valleys, and landmarks.

(3) Height Controls

The general height limits of buildings shall be as follows:

Preservation	25 feet
Agricultural	25 feet
Residential	25 feet
Low-density Apartment	30 feet
Medium-density Apartment	40 feet
Commercial	40 feet
Resort	70 feet
Industrial	40 feet

SMA Coastal View Study Considerations

As described in the Coastal View Study for the City and County of Honolulu (Chu and Jones, 1987), the site lies in Section A of the Kahuku Viewshed, wherein "the visual quality of this section is based primarily on the visual intactness of the agricultural land and open spaces surrounding the coastal highway." The study recommends maintaining existing view openings and preserving the rural character along the coastal highway.

5. Existing Visual Conditions

As noted by the Coastal View Study, the open space (cultivated and fallow agricultural fields) flanking both sides of Kamehameha Highway are the important visual attributes of the Kahuku Viewshed. Its vastness and overall intactness allows for extended view from the highway. This condition occurs along the entire 4.5 mile stretch from Kahuku to Kawela Bay and is reflective of the open space and public view preservation policies described by the Special Provisions of the Koolauloa Development Plan, and contributes to the rural/country character of the region.

Based on its topographic conditions, the 605 acre amendment area may be visually assessed according to the following categories:

a) Kahuku Plain- The low lying Kahuku Plain extends substantially into the amendment area. Its elevation at the highway is approximately 20 feet and gently rises in a mauka dirction to meet the descending foothills beyond, creating a wide and undulating foreground boarding the mauka side of the highway. This plain is planted with diversified agriculture and spotted with numerous small plots of land crops and aquaculture ponds however the amendment area itself is void of any noticeable agricultural activities. It lies instead in naturalized vegetation consisting of various tall grasses and koa haole, the latter ranging in coverage from individual shrubby trees (Photo C) to vast and dense stands. Such vegetation forms partial and complete visual screens at certain segments along Kamehameha Highway (Photos D and G). Visibility into the site at its highway frontage however is generally unobstructed except for these ocassional stands of roadside vegetation. Visibility into the site from eastern and western approach of the highway is generally not available due to a row of Ironwood trees (to the east) and agricultural crops (to the west).

Manmade intrusions into the existing views include four large, abandoned wind-turbine towers, located near but just off of the site's narrow northwest end (Photo E) and a sewage treatment plant (under construction, Photos B and C). Overhead utility poles and lines are located along the mauka side of the highway (Photos G, K and L).

b) Descending Foothills- The descending foothills are fairly gentle landforms extending downward to meet the Kahuku Plain. The transition occurs at approximately the 100 to 200 ft. elevation. Their angle of repose allows for good visibility of these landforms which are well vegetated and free of any visible manmade intrusions.

An exception to this observation is the Kalaeokahipa Ridge which rises steeply to form a vertical cliff condition. This ridge line is a prominant and important land form as it stands nearly perpendicular to the on-coming vehicular traffic circulation and extends in a mauka/makai direction and abuts Kamehameha Highway (see Photos K and L) at one location. The significant profile view of this land form is most appreciated from the northwest direction (from Sunset Beach)

A major portion of the site encompasses the southern flank of the Kalaeokahipa Ridge. This broad land area lies behind the ridge line in the vicinity of the Kalaeokahipa gulch and is not visible from the highway due to the topographic configuration of the terrain.

c) Upper Plateaus- The upper plateaus within the amendment generally occurs above the 200 ft. elevation and are not visible from Kamehameha Highway. Several wind mill and antennae structures are located on the plateau tops within the foothills. These tall structures penetrate the skyline and are highly visible however these structures are located at adjacent area and are not within the amendment area.

6. Potential Visual Impacts & Mitigative Measures

Overall Short-Term Visual Impacts

6.1 Construction of the project would have a significant short-term impact on the existing visual quality of the area due to necessary vegetation removal, contour grading, construction equipment, stockpiling of materials and occasional dust. Visual impact will be most apparent at the two entry roads proposed as primary access into the golf couses and along the faces of descending foothills. Such impacts will be visible from most portions of the highway directly fronting the amendment area.

> Mitigative Measures - Such impacts are unavoidable within the context of construction. There are however numerous mitigative measures which will be imposed to minimize them. The City/County Department of Public Works will specify various construction impact controls (temporary and permanent erosion control, limits on timing and phasing of construction, temporary and permanent revegetation, watering of graded areas for dust control, etcetera) which will keep such impacts within acceptable limits.
>
> Landscape planting will eventually re-vegetate all graded areas

Retention of the Ironwood trees along the highway and the continuation of agricultural activities at the east and west portions of Kamehameha highway will minimize certain view impacts from the highway.

Long-Term Visual Impacts

6.3 The overall permanent visual impacts of the proposed Country Couses at Kahuku, Punamano Golf Couses, will entails the conversion of the scenic quality of the site from a naturalized environment to a highly manmade setting. While it is likely that the golf course proposal will continue to provide the open space, public views and visual relief as described by the Koolauloa Special Provisions, the visual character will be substantially altered. The naturalized vegetation will be substantially replaced with manicured grasses, tree masses and other golf course ammenities.

This transformation will be most visible within the low lying Kahuku Plain area abutting the highway, along the faces of the descending foothills and atop the Kalaeohipa ridge line. Two new entry roads will be located at the highway and will substantially alter the visual character of the roadway.

Mitigative Measures- Although the character will be altered, the proposed golf course development will insure the long term preservation of open space and public views as seen from the highway, and will be consistent with the open space character currently found and/or under development along the opposite side of the highway (Kuilima). The underlying attributes of vastness of open space, extended views and relative absense of structures that comprise the essential visual quality of the Kahuku Viewshed can be preserved through the following additional measures:

Panoramic views into the site should continue to be retained as a component of the golf course concept.

Alteration of the rural or country character of the region can be minimized through design. A "pastoral" character employing a design palette of open space and landscape based on elements found in the Koolauloa district should be utilized by the planners and golf course architect(s).

Upon the completion of the golf courses, panoramic views overlooking the Kahuku Viewshed in a makai and lateral direction will become available from the upper plateaus and descending foothills. These views are currently unavailable to the general public and opportunity to enjoy such views should become accessible upon the completion and operation of the golf course facilities.

The visual integrity of the Kalaeokahipa ridge may be preserved by locating all structural elements along the eastern ridge line, thereby preserving the more prominant western view of the land form.

Ungraded areas of the site should remain in natural vegetation. Formalized planting along the edge of the highway which screen views into the site should be avoided.

The highway should retain a rural character. Public facility improvements along the highway should be scutinized. Grass shoulders should be used in place of concrete curbs and gutters. Undergrounding of overhead utilities should be considered.

The placement of all structures on the upper plateau should be setback from the ridgeline. Placement of all structures within the lower Kahuku Plain should be setback substantially from the highway and screened with landscape plantings.

Further design review of detailed site plans and architectural/landscape architectural schemes are appropriate at the regulatory permit stages.

6.4 The development of the proposed Punamano Golf Courses will contribute to a cummulative visual impact upon the region.

Mitigative Measures- The Punamano Golf Courses occupies a 1.75 mile frontage along the 4.5 mile stretch between Kahuku and Kuilima. The roadway viewing experience (as described in the Coastal View Study) is interupted only along those fareways adjacent to the highway. Anticipated visual impacts will therefore be confined to this locality and does not extend regionally, nor will the proposed golf course development be visible from areas beyond the immediate vicinity.

****

MICHAEL S. CHU
LAND ARCHITECT
PLANNING • LANDSCAPE ARCHITECTURE • URBAN DESIGN

MICHAEL S. CHU, LAND ARCHITECT

Michael S. Chu, Owner
81 South Hotel Street Suite 312
Honolulu, Hawaii 96813
phone (808) 5376-4674 FAX (808) 512-9054

PROFESSIONAL SERVICES

Land Use Planning
Landscape Architecture
Urban Design

EDUCATION

B.S. California State Polytechnic University, Pomona, 1977
Landscape Architecture
University of Hawaii, Urban and Regional Planning
Iolani School, 1967

PROFESSIONAL PRACTICE

Michael S. Chu, Land Architect, 1982 to present
Phillips Brandt Reddick, Hawaii 1978-82
EDAW Inc., 1977-78
Tongg Assoc. 1973-75

REGISTRATION

State of Hawaii, Board of Registration, Professional Landscape Architect
State of Hawaii, Board of Registration, Realtor Associate

PROFESSIONAL & COMMUNITY AFFILIATIONS

American Planning Association, Member
American Society of Landscape Architects, Member
American Institute of Architects, Professional Affiliate
Hawaii Architect Magazine
The American Land Resource Association, Charter Member
Honolulu Chamber of Commerce, Member
DLU Design Advisory Committee, Member
Honolulu Zoo Hui, Director

Background

Michael S. Chu, Land Architect is a professional consulting firm specializing in land use planning, landscape architecture and urban design. The firm was founded in 1982 and is located in downtown Honolulu.

The firm is often engaged by governmental agencies, private land owners, developers or other consultants to provide technical planning and/or design services. These services include land use analysis, site planning and landscape architectural design, environmental studies and permit processing.

As a sole propiertorship, the firm maintains a wide network of professional colleagues in related fields and often draws upon this network when undertaking multi-disciplinary projects. This flexibility has enabled the firm to successfully engage in larger and complex projects with a team of subconsultants specifically selected to meet the needs and work products of a particular project. In other instances, the firm participates as a subconsultant to others and is capable of contributing land use and site planning expertise, technical report writing, design graphics, and landscape architectural design services.

The services of the firm are particularly strengthened with its broad experience and familiarity with governmental objectives as they relate to land use planning and design. Most recently the firm was the prime consultant and author of the Coastal View Study for the City and County of Honolulu and the Statewide Planning for Private Marina Facilities for the State Department of Transportation, Harbors Division.

Since 1985 Michael S. Chu has served been a member of the DLU Design Advisory Committee and has served as a member of the DLU technical review committee for the BMX-4 zoning district of the Land Use Ordinance.

Prior to establishing the firm, Michael S. Chu was a planner and landscape architect with EDAW Inc., PBR Hawaii and Tongg Assoc. While at PBR he held the position of managing director of its Hawaii office and was project manager for several large multi-disciplinary projects to include the Oahu Urban Design and the Housing Location Study.

His professional experience includes planning and design work throughout Hawaii, as well as Guam, Tahiti and Japan.

List of Recent Projects

Waimea Main Street, Kauai
The firm performed planning and design services for the physical improvement and economic revitalization of Waimea Town. The project was the first to be sponsored under the Main Street Program and the Historic Hawaii Foundation. Performed for the West Kauai Professional and Businessmen Association and Spencer Mason Architects.

Old Koloa Town
The firm was responsible for planning and the development of a landscape architectural master plan for the renovation and revitalization of Koloa Town. Prepared for Koloa Town Associates and Spencer Mason Architects.

Russian Fort Elizabeth
The project consisted on preparing an overall master plan and phase I construction documents for the historic restoration of the Russian Fort Elizabeth at Waimea, Kauai. Performed for the State of Hawaii, Department of Land and Natural Resources.

Oahu Coastal View Study
This landmark study was completed in 1987 and consisted of a detailed inventory of coastal scenic resources on Oahu and the formulation of design guidelines applicable to the SMA and Coastal Zone Management program. Performed for the City and County of Honolulu, Department of Land Utilization.

Since the completion of the study, the firm was commissioned to conduct similar Coastal View Studies by the Hawaii County Planning Department (1988) and the Kauai County Planning Department (1989).

Kapolei Villages
Involvement in Kapolei Villages consisted of revising the 830 acre residential master plan and providing further design and design graphics to illustrate the overall development concept. Performed for the State of Hawaii, Housing and Finance Development Corp. and Towill Corp.

Architectural Compatibility Study, Oahu
This urban design project consisted of organizing and structuring a variety of independent projects into an overall and thematic development master plan for Hickam Air Force Base. Performed for the U.S. Air Force.

Servco Commercial Center
The services of the firm was utilized to prepare the owner's development requirements, preparation of a detailed development master plan and to process assorted governmental permits for Servco's newly acquired 14.5 acres of waterfront industrial land at Sand Island. Performed for Servco Pacific, Inc. and Aotani and Assoc.

Hotel Street Transit Mall
The firm participated in the planning and design of the Hotel Street Transit Mall by providing design guidance regarding historic features, street signage, bus shelters, light standards and sidewalks within the Chinatown historic district. Performed for the

Department of Transportation Services, City and County of Honolulu and Parsons Brinkerhoff, Quade and Douglas.

Kalakaua Center
The firm was retained to provide complete landscape architectural design and permit processing services for the renovation of the "Mitsukoshi building" located in the Waikiki Special District. Performed for Mutual of New York (MONY), Graham Murata and Russell, and the CJS Group Architects.

Hawaii State Library
The firm was the project landscape architect for the renovation of the Hawaii State Library locate within the Capital District on Honolulu. Performed for the Department of Accounting and General Services, State of Hawaii and Aotani and Assoc.

Chinatown Gateway
The firm participated as project landscape architect for the planning and design of the Chinatown Gateway Plaza, a mixed use project consisting of a highrise residential tower, lowrise commercial development and a major plaza and park flanking both sides of Hotel Street. Prepared for the City and County of Honolulu and Lacayo Architects.

EWA by Gentry, Soda Creek, Increment 2 & 3
The firm was retained to prepare the cluster development application for increments 2 and 3 of the EWA by Gentry development consisting of over 600 residential units and community support facilities. Services included the landscape design and the preparation of all material for the submittal and application of permits. Other services include participation in the rezoning application of the overall 700 acre development. Prepared for the Gentry Companies.

Pentagram Restaurant Projects
The firm provides exclusive landscape architectural services for all development and renovation of Burger King and El Pollo Loco restaurants in Hawaii and Guam . Work has included landscape development and/or renovation of over 12 restaurants since 1985. Performed for the Pentagram Corp.

Statewide Planning for Marina Facilities
The firm was retained as the prime consultant to provide a statewide study and recommendations for expediting the development of recreational marina facilities. Performed for the State of Hawaii, Department of Transportation, Harbors Division.

Honolulu Waterfront Master Plan
The firm served as the landscape architectural subconsultant (to R.M. Towill/ Helber Hastert Kimura, a joint venture) in preparing the overall redevelopment master plan for the 1500 acre Honolulu waterfront area. Performed for the State of Hawaii, Office of State Planning.

Kewalo Basin Park
The firm served as prime landscape architect for the park design at the triangle peninsula located at Kewalo Basin. The park development is the first increment of the "lei of green" concept envisioned by the Honolulu Waterfront Master Plan. Performed for the State of Hawaii, Hawaii Community Development Authority.

APPENDIX G

AIR QUALITY IMPACT REPORT, THE COUNTRY COURSES AT KAHUKU: PUNAMANO GOLF COURSE

J.W. Morrow, Environmental Consultant

APPENDIX G

AIR QUALITY IMPACT REPORT

**THE COUNTRY COURSES AT KAHUKU:
PUNAMANO GOLF COURSE**

December 19, 1989

PREPARED FOR

William E. Wanket, Inc.

AND

The Estate of James Campbell

PREPARED BY

J. W. Morrow
Environmental Management Consultant
563 Paulele Street
Kailua, Hawaii 96734

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1. INTRODUCTION

The Estate of James Campbell is proposing to develop three 18-hole golf courses between Kahuku and the Kuilima Resort, Oahu (Figure 1) in the Punamano Spring area. The site is located southwest of Kamehameha Highway (TMK: 5-6-05: por. 1, por. 2, 5, 6 and por. 7 and TMK: 5-7-01: por. 21). It is part of an integrated golf course complex consisting of four 18-hole courses located in the Kahuku area. This phase of the development is anticipated to be completed by 1998. Existing site conditions are depicted in Figure 2.

The purpose of this report is to assess the air quality impact of the proposed development. The project can be considered an "indirect source" of air pollution as defined in the federal Clean Air Act [1] since it will attract mobile sources of air pollution, i.e., motor vehicles. Thus, much of the focus of this analysis is on the project's ability to generate traffic and the resultant impact on air quality. Air quality impact was evaluated for existing (1989) and future (1998) conditions.

Also, during routine operation of the golf course, various pesticides are used which may result in air pollution contributions. This potential impact has been addressed.

Finally, during construction of the various buildings and facilities air pollutant emissions will be generated due to vehicular movement, grading and general dust-generating construction activities. These impacts have also been addressed.

2. AIR QUALITY STANDARDS

A summary of State of Hawaii and national ambient air quality standards is presented in Table 1 [2,3]. Note that Hawaii's standards are not divided into primary and secondary standards as are the Federal standards.

Primary standards are intended to protect public health with an adequate margin of safety while secondary standards are intended to protect public welfare through the prevention of damage to soils, water, vegetation, man-made materials, animals, wildlife, visibility, climate, and economic values [4].

Some of Hawaii's standards are clearly more stringent than their Federal counterparts but, like their Federal counterparts, may be exceeded once per year. It should also be noted that in April, 1986, the Governor signed amendments to Chapter 59 (Ambient Air Quality Standards) making the State's standards for particulate matter and sulfur dioxide the same as national standards. In the case of particulate matter, however, this uniformity did not last long. On July 1, 1987, the EPA revised the Federal particulate standard to apply only to particles 10 microns or less in diameter (PM-10) [5], leaving the State once again with standards different than the Federal ones.

In the case of the automotive pollutants [carbon monoxide (CO), oxides of nitrogen (NOx), and photochemical oxidants (Ox)], there are only primary standards. Until 1983, there was also a hydrocarbons standard which was based on the precursor role hydrocarbons play in the formation of photochemical oxidants rather than any unique toxicological effect they had at ambient levels. The hydrocarbons standard was formally eliminated in January, 1983 [6].

The U.S. Environmental Protection Agency (EPA) is mandated by Congress to periodically review and re-evaluate the Federal standards in light of new research findings [7]. The last review resulted in the relaxation of the oxidant standard from 160 to 235 micrograms/cubic meter (ug/m3) [8]. The carbon monoxide (CO), particulate matter, sulfur dioxide (SO2), and nitrogen dioxide (NO2) standards are cúrrently under review, but no new standards have been proposed [9].

Finally, the State of Hawaii also has fugitive dust regulations for particulate matter (PM) emanating from construction activities [10]. There simply can be no visible emissions from fugitive dust sources.

3. EXISTING AIR QUALITY

3.1 General. The State Department of Health maintains a network of air monitoring stations around the state to gather data on the following regulated pollutants:

- o total suspended particulates (TSP)
- o particulate matter <10 microns (PM-10)
- o sulfur dioxide (SO2)
- o carbon monoxide (CO)
- o ozone (O3)
- o lead (Pb)

In the case of TSP, PM-10, and SO2, measurements are made on a 24-hour basis to correspond with the averaging period specified in the standards. Samples are collected once every six days in accordance with U.S. Environmental Protection Agency (EPA) guidelines. Carbon monoxide and ozone, however, are measured on a continuous basis due to their short-term (1-hour) standards. Lead concentrations are determined from the TSP samples which are sent to an EPA laboratory for analysis. Note that the lead standard is a quarterly average.

There is no Department of Health (DOH) air monitoring station in the immediate vicinity of the project site. The nearest site on the windward side of Oahu is at Waimanalo, some 28 miles southeast of Kahuku. The DOH also monitors air quality at its downtown Honolulu building some 26 miles south-southeast of the golf course project. It seems safe to assume that present air quality is good most of the time since there are no large stationary sources in the vicinity, and the immediate area is not densely populated. The primary source of air pollution is the motor vehicle traffic along Kamehameha Highway.

3.2 Department of Health Monitoring Sites. Recent data from the Waimanalo and Honolulu stations are summarized in Tables 2 - 5. The data indicate that total suspended particulate (TSP) and sulfur dioxide (SO2) standards are being met. In fact, much of the time sulfur dioxide concentrations are below the detectable limit of the measurement method being employed. Carbon monoxide (CO) levels are also below State standards most of the time with only occasional exceedances.

Photochemical oxidants are secondary pollutants formed in the atmosphere largely as a result of anthropogenic emissions of hydrocarbons and oxides of nitrogen. Since there are no ambient standards for hydrocarbons, there is no monitoring. In the case of NO2, the State ceased routine monitoring in 1976. As indicated by federal and state standards, ozone is monitored at Sand Island as a surrogate for photochemical oxidants. Recent monitoring data from that station indicate that the state's 1-hour standard is being met over 99% of the time.

As noted above, the State also has been having particulate samples analyzed for lead content, and Table 5 summarizes ambient lead levels in recent years. Generally, airborne lead levels have declined as expected due to the federal program for gradual phaseout of leaded gasoline. Particulate lead accumulated over the years in roadside soils and plants, however, will remain indefinitely in the area and provide inhalation exposure whenever dust is re-entrained in the air as a result of scouring winds or mechanical disturbance due to vehicular motion.

3.3 Onsite Carbon Monoxide Sampling. In conjunction with this study, air sampling was conducted at a site along Kamehameha Highway in the project area during December, 1989.

The actual site was approximately 10 meters from the road edge on the southwest (mauka) side due to the winds prevailing at the time. A continuous carbon monoxide (CO) instrument was set up and operated during weekend traffic hours. An anemometer and vane were installed to record onsite surface winds. A simultaneous manual count of traffic along Kamehameha Highway was also made. The variability of each of the parameters measured during the peak hour is clearly seen in Figure 3.

Onsite surface winds were generally northwesterly and thus at an acute angle and at times parallel with Kamehameha Highway. Wind speeds were low during the sampling period, i.e., generally 1 - 2 meters per second (m/sec). Atmospheric stability was neutral to slightly unstable. The total 2-way traffic count of 913 vehicles was somewhat higher than the peak-hour volumes reported by the traffic consultant [12]. CO concentrations were also slightly higher than the computer-predicted concentrations discussed in Section 6 (which were based on the traffic report).

4. CLIMATE & METEOROLOGY

4.1 Temperature & Rainfall. The National Climatic Data Center in its 1982 annual summary for Honolulu notes that:

> "Hawaii's equable temperatures are associated with the small seasonal variation in the amount of energy received from the sun and the tempering effect of the surrounding ocean. The range of temperature averages only 7 degrees between the warmest months (August and September) and the coolest months (January and February) and about 12 degrees between day and night. Daily maximums run from the high 70's in winter to the mid-80's in summer, and daily minimums from the mid-60's to the low 70's. However, the Honolulu Airport area has recorded as high as 93 degrees and as low as 53" [13].

Based on historical records from the State Weather Station No. 907.00 at the Kuilima Resort north of the project site, median annual rainfall is 39.4 inches. In accordance with Thornwaite's scheme for climatic classification, the area is considered a subhumid grassland [14].

4.2 Surface Winds. Kaneohe Marine Corps Air Station (KMCAS) is the nearest long-term meteorological data collection station to the project. Records from KMCAS were therefore reviewed with particular attention to the p.m. peak traffic hours. This examination revealed seasonal and diurnal differences both in direction and velocity. Figures 4 and 5 depict directional wind roses for the 3:00 - 5:00 p.m. period during the months of January and August. The predominance of northeast tradewinds during the summer in contrast to the more variable nature of the winter months is quite clear.

The winter months also are characterized by generally lower wind velocities as evidenced again by the January-August comparison, this time presented in tabular form (Tables 6 and 7). Light, variable winds are much more prevalent during January than in August, and not surprisingly, it is during the winter months that most of the high carbon monoxide levels are recorded by the Department of Health in Honolulu.

5. HIGHWAYS AND TRAFFIC

As noted above, the principal access road to the project area is Kamehameha Highway. It is a typical 2-lane rural roadway as can be seen in Figure 6. Because of the generally recreational nature of the area, the peak traffic volumes tend to occur during weekend afternoons. Based on the traffic consultant's review of State DOT records, the peak period was between 1:30 and 3:30 p.m.; thus, both traffic and air quality impact analyses focused on this period.

Existing traffic volumes as well as projections for future volumes used in this impact analysis were obtained from the traffic consultant [12].

6. MOBILE SOURCE IMPACT

6.1 Emission Factors. Automotive emission factors for carbon monoxide (CO) were generated for calendar years 1989 and 1998 using the Mobile Source Emissions Model (MOBILE-3) [15]. To localize emission factors as much as possible, the August, 1988 age distribution for the City & County of Honolulu [16] was input in lieu of the national statistics normally used.

6.2 Microscale Analysis. Analyses such as this generally involve estimation of concentrations of non-reactive pollutants. This is due to the complexity of modeling pollutants which undergo chemical reactions in the atmosphere and are subject to the effects of numerous physical and chemical factors which affect reaction rates and products. For projects involving motor vehicles as the principal air air pollution source, carbon monoxide is normally selected for modeling because it has a relatively long half-life in the atmosphere (about 1 month) [17], and it comprises the largest fraction of automotive emissions.

In this instance, a microscale screening analysis was performed for the Marconi Road intersection with Kamehameha Highway because this is where the proposed golf course access road will also intersect Kamehameha Highway. The updated version of an EPA guideline model CALINE-4 [18,19] was employed with an array of receptors spaced at distances of 10 - 30 meters from the road edge. Because of the growing level of urbanization and traffic in the area, a background CO concentration of 1.0 milligram per cubic meter (mg/m3) was assumed.

Worst case meteorological conditions were selected for the weekend p.m. peak traffic hours. A wind speed of 1 meter per second, an acute wind/road angle, and neutral stability (Pasquill-Gifford Class "D") [20], were all selected to maximize concentration estimates in the vicinity of the intersections. Review of the traffic data and preliminary modeling indicated that southwesterly winds were most likely to produce the maximum CO concentrations near the intersections under study; thus, this wind direction was input for the modeling.

Maximum one- and eight-hour carbon monoxide (CO) concentrations were then computed for the peak traffic hours. The latter were obtained by multiplying the maximum 1-hour values by a "persistence" factor of 0.6 as recommended in an EPA publication on indirect source analysis [21]. The analyses were performed for existing conditions (1989) and future conditions (1998) both with and without the proposed project. The results are summarized in Figures 7 and 8.

7. PESTICIDE USE

The use of pesticides is routinely required at golf courses in order to maintain fairways and greens. Typical pesticide use at an 18-hole golf course is shown in Table 8 [22].

The herbicides MSMA, glyphosate, metribuzin, and pendimethalin all have relatively low mammalian toxicities with LD_{50} values on the order of hundreds or thousands of milligrams active agent per kilogram body weight (mg/kg) [23, 24]. They do, however, have WARNING and CAUTION labels because of their irritative effects on the eyes and skin. The OSHA 8-hour time-weighted average standard for metribuzin in the air is 5 mg/m3 [24].

The insecticide Sevin is a relatively low toxicity carbamate which can affect the normal functioning of mammalian nervous systems through its inhibition of the enzyme cholinesterase. It also has a relatively high LD_{50} value of about 500 - 850 mg/kg and therefore only has a CAUTION label on its containers. The OSHA standard for airborne concentrations of carbaryl (the active ingredient in Sevin) is 5 mg/m3 as an 8-hour average [24].

The fungicides Dithane M45, Kocide 101, and Subdue are also low toxicity chemical mixtures with LD_{50} values in the hundreds and thousands of mg/kg [23, 24]. Subdue has a WARNING label because of its potential for eye injury.

If properly used in accordance with label instructions, all of the aforementioned chemicals should present no hazard to the properties or owners of properties adjoining the proposed golf course. In fact, the greatest risk in using such chemicals is generally to the users themselves if they do not strictly follow label instructions. This is because the user may come in contact with the concentrated product while nearby properties and people may only be exposed to the greatly diluted and dispersed application solution.

The potential for significant airborne concentrations of these chemicals is relatively slight when one considers the dilution factor in application solutions plus the coarse spray that is normally used to assure adequate coverage in the desired area and avoidance of drift. Should a user improperly apply these chemicals under wind conditions which would contribute to drift, then there would be an increased possibility of downwind exposure of property and people. In order to assess the possible impact of such an event on people, a dispersion modeling analysis was performed for each of the chemicals. The results of this modeling are summarized in Table 9.

8. CONSTRUCTION IMPACT

The principal source of short-term air quality impact will be construction activity. Construction vehicle activity will increase automotive pollutant concentrations along the principal access roads as well as in the vicinity of the project site itself. During off-peak hours, the additional construction vehicle traffic should not exceed road capacities although the presence of large trucks can reduce a roadway's capacity as well as lower average travel speeds thereby contributing to additional air pollution emissions.

The site preparation and earth moving will create particulate emissions as will building and on-site road construction. Construction vehicles movement on unpaved on-site roads will also generate particulate emissions. EPA studies on fugitive dust emissions from construction sites indicate that about 1.2 tons/acre per month of activity may be expected under conditions of medium activity, moderate soil silt content (30%), and precipitation/evaporation (P/E) index of 50 [25].

Since the onsite soils are generally silty clays, in all probability having silt content greater than the 30% cited above [26], and the computed P/E Index for the area is 52, thus comparable to the aforementioned EPA case, it may be assumed that there is a potential for fugitive dust problems.

In addition to the onsite impacts attributable to construction activity, there will also be offsite impacts due to the operation of concrete batching plants needed for construction. Since it is also too early to identify specific facilities that will be providing the concrete, the discussion of air quality impacts is necessarily generic.

Design and operating features of a typical concrete batching plant were obtained for this analysis. This plant (Rex Transit Mix Batch Plant, Model LO GO 5) [27], is a portable unit capable of producing up to 100 cubic yards of concrete per hour.

Assuming 8 hours/day operation and published EPA emission factors [24] for both direct plant emissions and fugitive dust emissions, estimates of worst case ambient impact were derived using the PTPLU screening model [28]. Ninety percent control of particulate emissions from the plant itself and 60% control of fugitive dust emissions from the process were assumed. One-hour concentration estimates were adjusted to 8-hour averages using an EPA-recommended factor [29] and then to 24-hour averages based on a weighted averaging technique. The worst case concentration of total suspended particulates (TSP) was thus estimated to be 105 micrograms/cubic meter (ug/m3) due to the plant operation.

Since it is not known where exactly the plant(s) will be located and thus what the background concentration of TSP will be, it is somewhat difficult to predict cumulative concentrations for comparison with standards. However, if the batch plant's 105 ug/m3 were assumed to be all < 10 microns and were added to the second highest 24-hour PM-10 concentration (63 ug/m3) from the 1988 Waimanalo data, the sum would exceed the federal 24-hour standard of 150 ug/m3.

9. DISCUSSION AND MITIGATION

9.1 Microscale Analysis. While the project will impact local air quality, the 1-hour and 8-hour "worst case" carbon monoxide concentration estimates for existing as well as future "with project" and "without project" scenarios all indicated compliance with state and federal standards.

9.2 Pesticide Use. The results of the modeling indicated airborne pesticide concentrations several orders of magnitude below the effects and standards levels. More importantly, however, proper use of pesticides in accordance with the legally required label instructions should prevent any significant air quality impact. Use of other non-chemical means of pest control wherever possible would also help reduce or eliminate the potential for air quality impact.

9.3 Short-Term Impact. Since as noted in Section 8, there is a potential for fugitive dust generation during construction, it will be important for adequate dust control measures to be employed during the construction period. Dust control could be accomplished through frequent watering of unpaved roads and areas of exposed soil. The EPA estimates that twice daily watering can reduce fugitive dust emissions by as much as 50%. The soonest possible landscaping of completed areas will also help. Use of dust screens may be necessary when excavation and other construction activities occur in close proximity to existing dwellings.

With regard to construction vehicle effects, proper maintenance of vehicle engines will help reduce emissions, while scheduling truck traffic during offpeak hours will reduce the impact on Kamehameha Highway.

Offsite construction related activity such as asphalt and concrete batching will affect air quality in the vicinity of the batch plant site but such plants must demonstrate compliance with state and federal standards before they receive operating permits.

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TABLES

TABLE 1

SUMMARY OF STATE OF HAWAII AND FEDERAL
AMBIENT AIR QUALITY STANDARDS

POLLUTANT	SAMPLING PERIOD	FEDERAL STANDARDS PRIMARY	SECONDARY	STATE STANDARDS
1. Total Suspended Particulate Matter (TSP)	Annual Geometric Mean	--	--	60
(micrograms per cubic meter)	Maximum Average in Any 24 Hours	--	--	150
2. PM-10	Annual	50	50	--
(micrograms per cubic meter	Maximum Average in Any 24 Hours	150	150	--
3. Sulfur Dioxide (SO2)	Annual Arithmetic Mean	80	--	80
(micrograms per cubic meter)	Maximum Average in Any 24 Hours	365	--	365
	Maximum Average in Any 3 Hours		1,300	1,300
4. Nitrogen Dioxide (NO2) (micrograms per cubic meter)	Annual Arithmetic Mean	100		70
5. Carbon Monoxide (CO)	Maximum Average in Any 8 Hours	10		5
(milligrams per cubic meter)	Maximum Average in Any 1 Hour	40		10
6. Ozone (micrograms per cubic meter	Maximum Average in Any 1 Hour	235		100
7. Lead (Pb) (micrograms per cubic meter)	Maximum Average in Any Calendar Quarter	1.5		1.5

TABLE 2

AIR MONITORING DATA
WAIMANALO, OAHU
1988

Total Suspended Particulates (TSP)
24-Hour Concentration (ug/m3)

MONTH	SAMPLES	MIN.	MAX.	MEAN
Jan 88	5	20	63	34
Feb 88	5	27	82	43
Mar 88	5	16	60	36
Apr 88	5	22	41	27
May 88	5	16	30	24
Jun 88	5	19	27	22
Jul 88	5	24	36	29
Aug 88	6	16	37	25
Sep 88	4	20	31	24
Oct 88	5	16	20	18
Nov 88	5	20	34	25
Dec 88	5	21	54	34
ANNUAL	60	16	82	29

SOURCE: Department of Health

TABLE 3

SUMMARY OF AEROMETRIC DATA COLLECTED
AT THE DEPARTMENT OF HEALTH BUILDING

1978 - 1987

TOTAL SUSPENDED PARTICULATES	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
(24-hr values, ug/m3)										
Period of sampling (mos.):	12	12	12	8	12	12	12	12	12	12
Number of samples:	60	8	61	35	55	56	60	59	57	53
Range of values:	14-53	22-62	23-103	23-75	11-42	14-58	11-48	10-48	11-61	14-59
Mean of values:	29	32	37	40	29	26	25	24	25	25
Number of times State AQS exceeded:	0	0	1	0	0	0	0	0	0	0
SULFUR DIOXIDE										
(24-hr values, ug/m3)										
Period of sampling (mos.):	12	12	12	8	12	12	12	12	12	12
Number of samples:	61	57	58	38	50	56	58	53	57	54
Range of values:	<5-44	<5-42	<5-60	<5-44	<5-38	<5-16	<5-<5	<5-<5	<5-6	<5-11
Mean of values:	18	22	18	19	11	<5	<5	<5	<5	<5
Number of times State AQS exceeded:	0	0	0	0	0	0	0	0	0	0
PHOTOCHEMICAL OXIDANTS										
(Daily 1-hr maxima, ug/m3)										
Period of sampling (mos.):	10	12	11	12	12	12	12	12	12	12
Number of samples:	284	337	295	314	335	348	296	341	348	342
Range of values:	10-84	10-80	10-84	10-104	0-151	0-123	0-104	8-198	10-88	4-84
Mean of values:	33	39	38	37	32	46	44	43	39	38
Number of times State AQS exceeded:	0	0	0	1	2	2	1	3	0	0

TABLE 4

SUMMARY OF AEROMETRIC DATA COLLECTED
AT THE DEPARTMENT OF HEALTH BUILDING

1971 - 1987

NITROGEN DIOXIDE	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980-87
(24-hr values)										
Period of sampling (mos.):	10	12	12	12	12	3	n.d.	n.d.	n.d.	n.d.
Number of samples:	83	113	99	90	91	22				
Range of values:	<20-159	<20-236	<20-95	<20-95	16-70	12-63				
Mean of values:	56	56	46	37	33	35				
Number of times State AQS exceeded:	1	2	0	0	0	0				

CARBON MONOXIDE	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
(Daily 1-hr maxima)										
Period of sampling (mos.):	12	8	n.d.	n.d.	n.d.	6	12	12	12	12
Number of samples:	365	208				169	318	342	348	345
Range of values:	0-20.7	0-17.3		Station moved to		0-8.6	0.6-10.9	0.0-10.4	0.2-13.5	0.3-11.1
Arithmetic mean of daily maximum values:	3.1	3.0		Kaimuki		2.4	2.4	1.5	2.2	1.7
Number of days State AQS exceeded:	19	10	10			0	1	1	3	1

TABLE 5

LEAD MONITORING DATA
HONOLULU, OAHU
1970-87

AVERAGE CONCENTRATION
(micrograms/cubic meter)

YEAR	1st QUARTER	2nd QUARTER	3rd QUARTER	4th QUARTER
1970	0.78	0.81	0.65	0.92
1971	1.65	0.63	0.65	1.05
1972	--	0.75	0.65	0.48
1973	0.52	0.52	0.72	0.55
1974	0.84	0.61	0.70	0.92
1975	0.65	0.81	0.59	1.05
1976	0.91	0.65	0.99	1.00
1977	0.89	0.59	0.48	0.80
1978	--	--	--	0.72
1979	0.39	0.25	0.26	0.42
1980	0.41	0.23	0.21	0.20
1981	0.25	--	--	--
1982	0.21	0.16	0.09	0.21
1983	n/a	n/a	n/a	n/a
1984	0.3	0.2	0.2	0.3
1985	0.1	0.03	0.02	0.1
1986	0.1	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0

Source: Department of Health

TABLE 6

JOINT FREQUENCY DISTRIBUTION
OF WIND SPEED AND DIRECTION
KANEOHE MARINE CORPS AIR STATION
JANUARY (3:00 - 5:00 P.M.)

Frequency of Occurrence (%)

Direction	Wind Speed (knots) 1 - 3	4 - 6	7 - 10	11 - 16	17 - 21	>21	Total
N	0.5	1.9	3.4	1.5	0.3		7.5
NNE	0.3	2.6	3.5	2.2	0.7	0.1	9.4
NE	0.4	2.4	3.2	5.1	1.0	0.5	12.6
ENE	0.3	1.2	4.9	7.0	1.1	0.1	14.6
E	0.5	1.1	5.0	5.1	1.3		13.1
ESE	0.5	2.1	4.3	3.8	0.3		11.0
SE	0.1	0.7	1.5	0.5	0.1		3.0
SSE	0.1	0.4	0.8	0.7		0.2	2.2
S	0.3	1.1	2.3	0.9	0.1	0.2	4.9
SSW	0.1	0.7	2.1	3.0	0.8	0.6	7.3
SW	0.3	0.6	1.5	1.6	0.5	0.4	4.9
WSW	0.3	0.4	0.5	0.6	0.1	0.1	2.0
W		0.2	0.1	0.1			0.3
WNW	0.2	0.4	0.3	0.3			1.1
NW	0.1	0.3	0.3	0.2			0.9
NNW	0.1	0.8	1.2	0.7	0.5	0.1	3.4
Calm							2.0
Total:	4.1	16.8	34.7	33.3	6.8	2.3	100.0

TABLE 7

JOINT FREQUENCY DISTRIBUTION
OF WIND SPEED AND DIRECTION
KANEOHE MARINE CORPS AIR STATION
AUGUST (3:00 - 5:00 P.M.)

Frequency of Occurrence (%)

Direction	Wind Speed (knots) 1 - 3	4 - 6	7 - 10	11 - 16	17 - 21	>21	Total
N		0.3	0.5				0.8
NNE		1.1	4.5	1.9	0.1		7.5
NE		0.9	7.9	15.1	1.0		24.9
ENE		0.8	9.4	33.3	4.0	0.1	47.7
E		0.2	2.6	8.8	1.8	0.1	13.5
ESE		0.1	0.5	3.5	0.5	0.1	4.6
SE	0.1			0.1			0.1
SSE					0.1	0.1	0.1
S		0.1		0.2			0.3
SSW							0.0
SW			0.1				0.1
WSW							0.0
W		0.1	0.1				0.2
WNW		0.1					0.1
NW							0.0
NNW			0.1				0.1
Calm							0.1
Total:	0.1	3.5	25.6	62.9	7.5	0.4	100.0

TABLE 8

TYPICAL PESTICIDE USE AT AN 18-HOLE GOLF COURSE

PRODUCT	AREA (acres)	QUANTITY	FREQUENCY	ANNUAL REQUIREMENT
Herbicides (fairways & roughs)				
MSMA	100	33 gal	4/yr	132 gal
Glyphosate				25 gal
Metribuzin	100	25 lb	2/yr	50 lb
Pendimethalin	100	400 lb	2/yr	800 lb
Insecticides (greens & tees)				
Sevin	10	21 gal	12/yr	252 gal
Fungicides (greens & tees)				
Dithane M-45	10	109 lb	25/yr	2,725 lb
Kocide 101	10	217 lb	12/yr	2,604 lb
Subdue	10	6.7 gal	3/yr	20 gal

TABLE 9

ESTIMATES OF DOWNWIND PESTICIDE CONCENTRATIONS

Product	Active Agent Concentration (mg/m3)
Subdue	0.007
Kocide 101	0.057
Dithane M45	0.046
Sevin	0.044
Glyphosate	0.010
Metribuzin	0.001
Pendimethalin	0.013
MSMA	0.011

Conditions:		
	Windspeed:	4.5 m/sec
	Stability category:	D (neutral)
	Downwind distance:	100 m
	Exposure duration:	5 - 10 minutes
	Treated area:	1 acre
	Application height:	0.5 m
	Active agent drift:	0.4%

FIGURES

FIGURE 1

PROJECT LOCATION

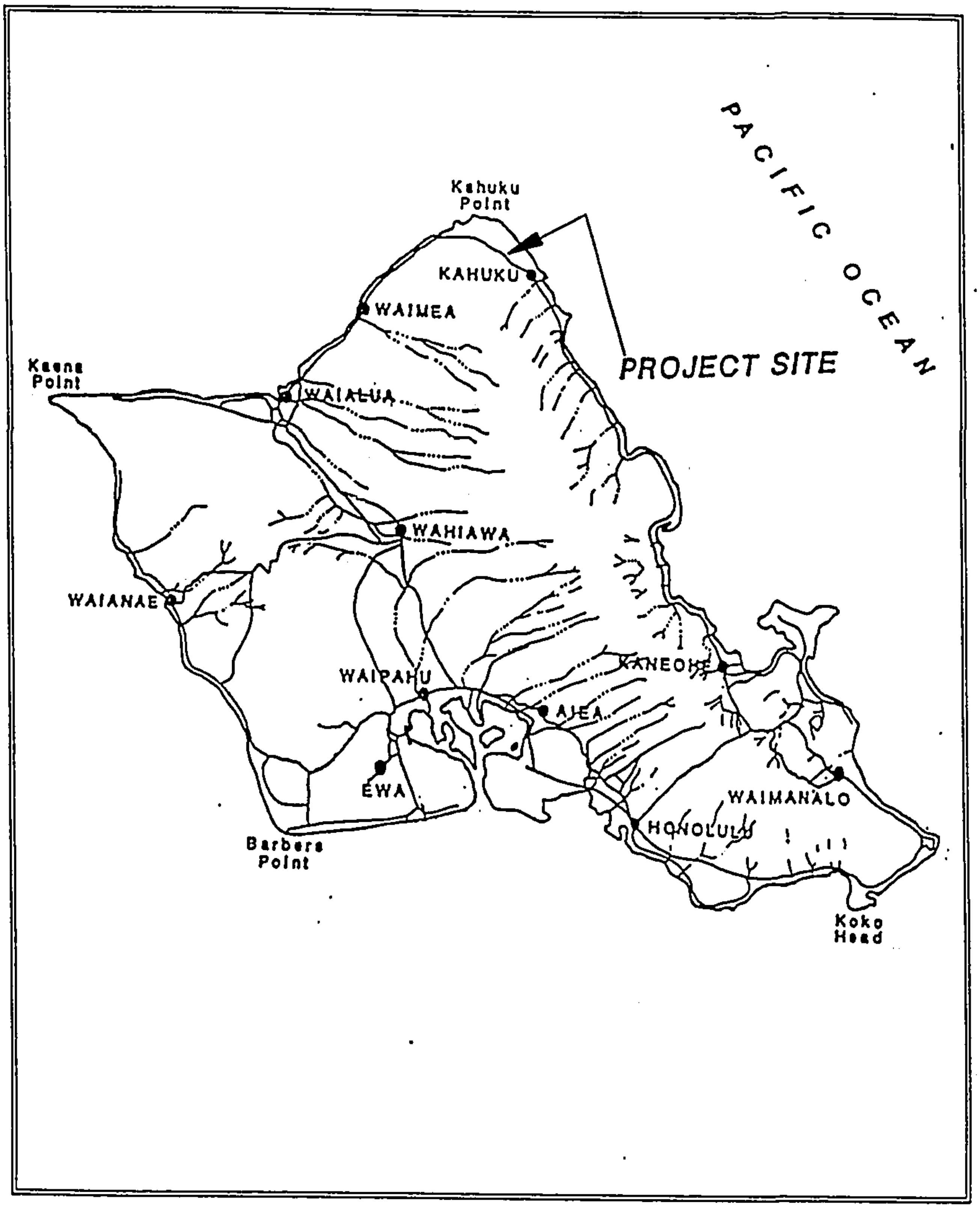
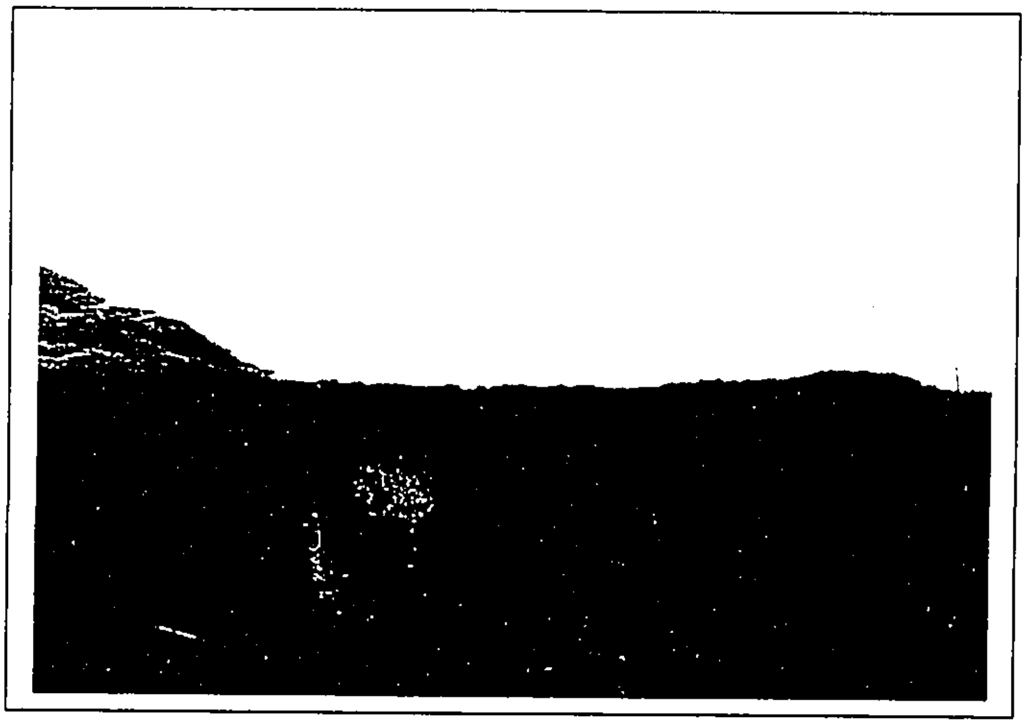
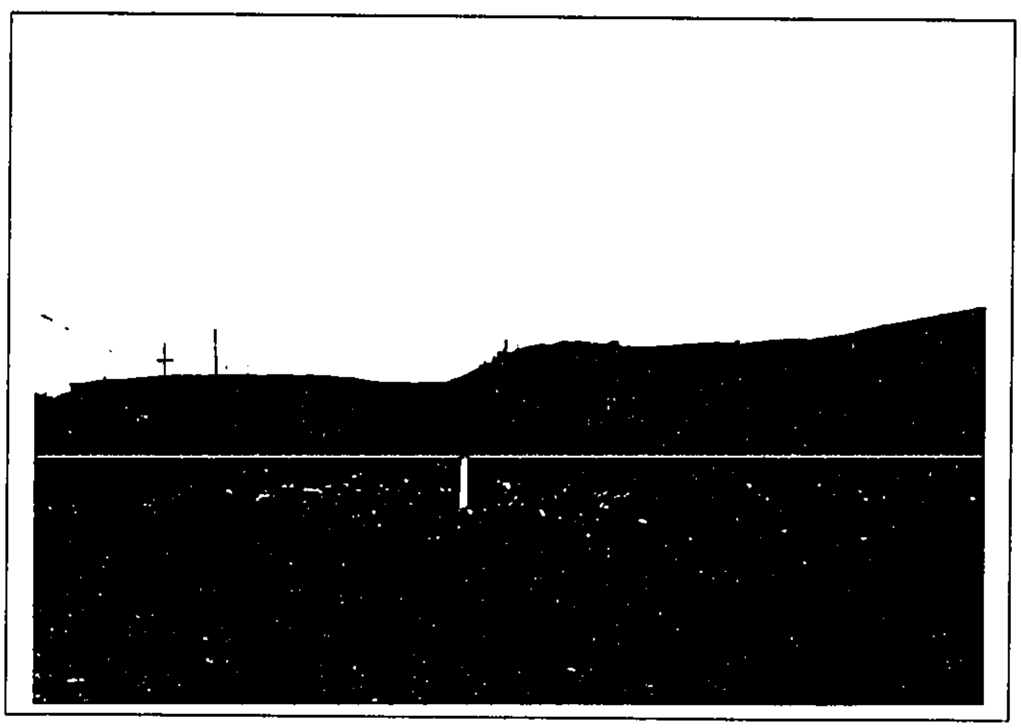


FIGURE 2

EXISTING SITE CONDITIONS

Facing Northwest at Northern End of Site





Facing Southwest at Northern End of Site

FIGURE 3

WEEKEND AFTERNOON CONDITIONS
KAMEHAMEHA HIGHWAY IN THE VICINITY OF THE PROPOSED
PUNAMANO GOLF COURSE
DECEMBER 3, 1989

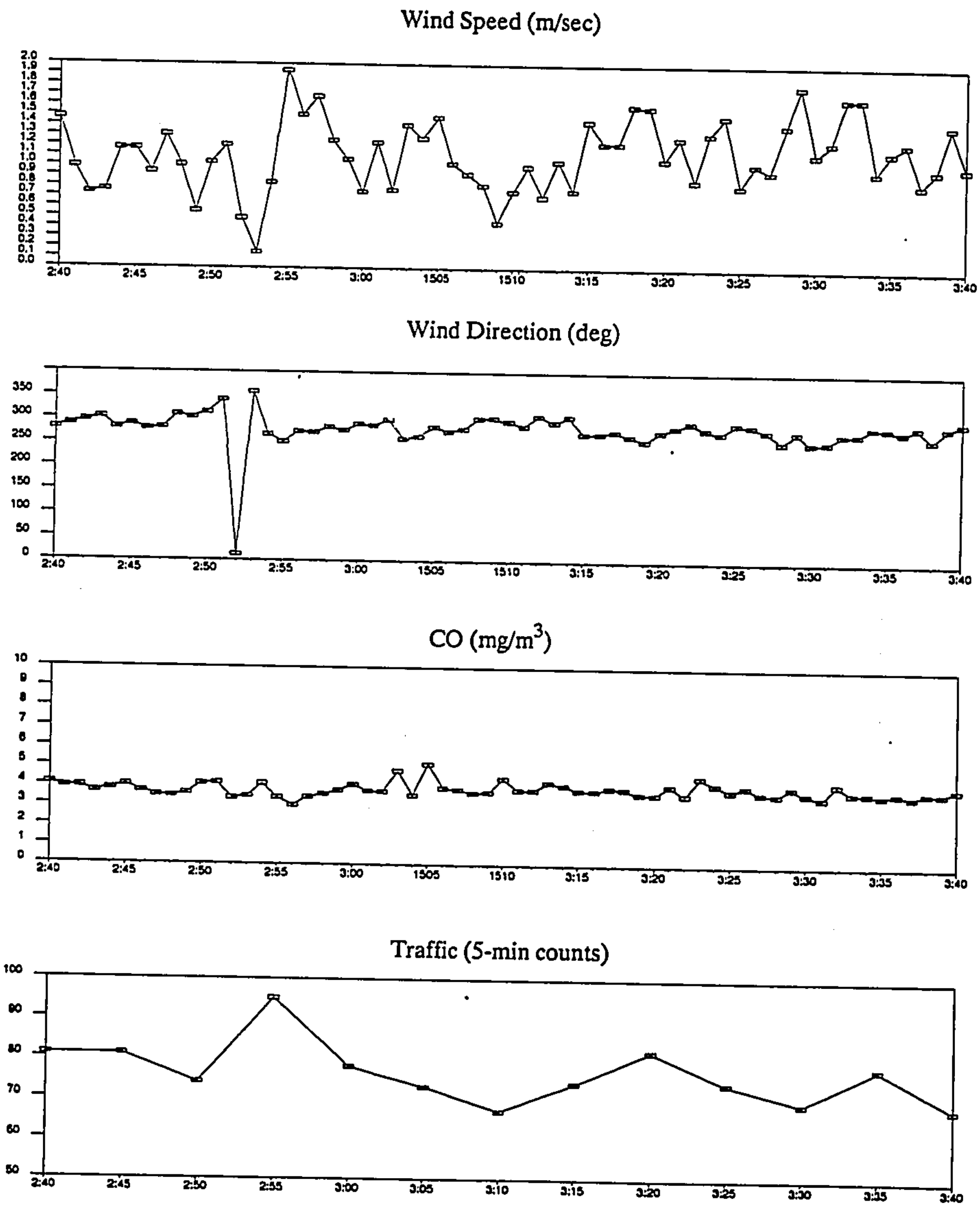
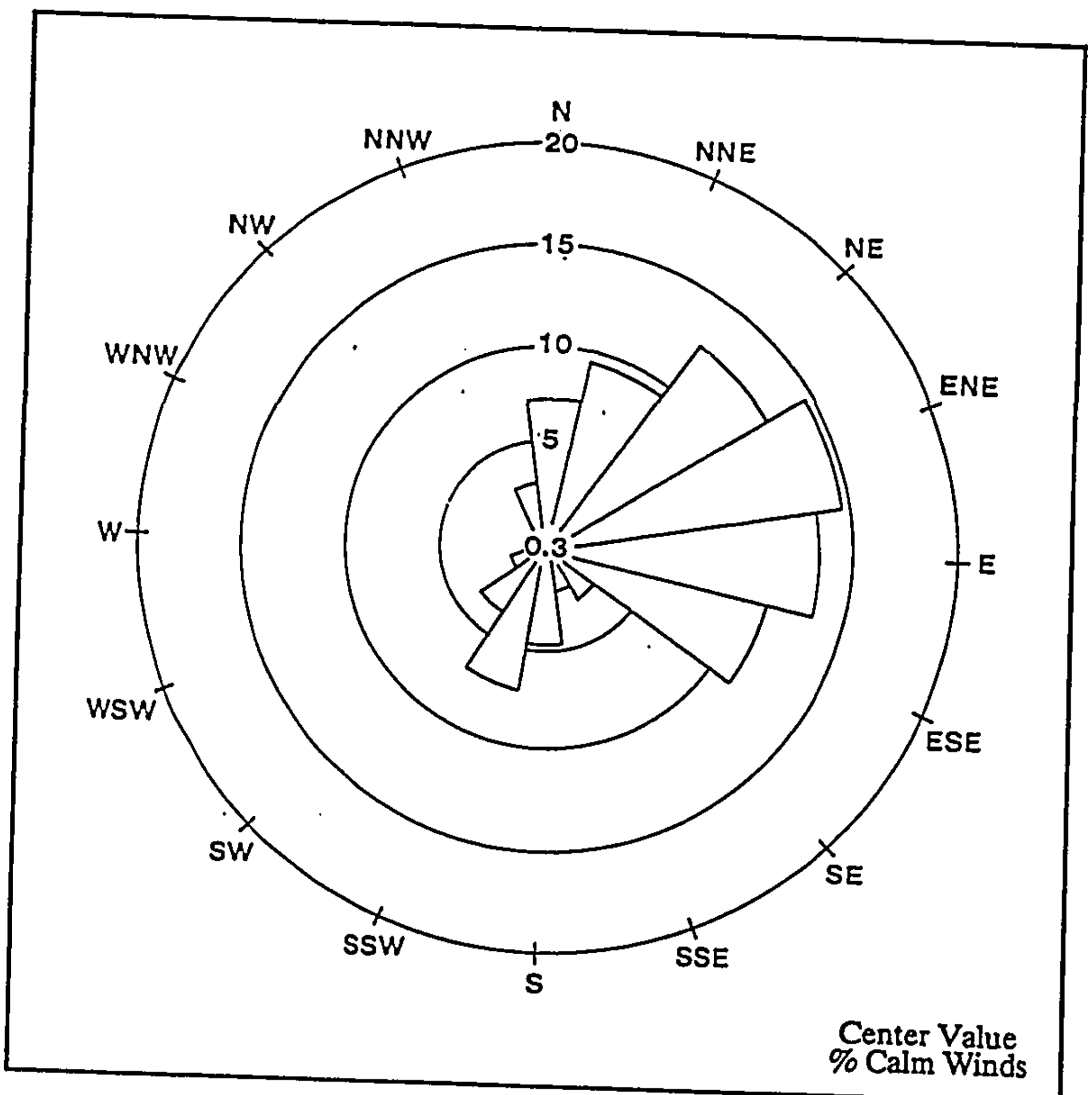


FIGURE 4

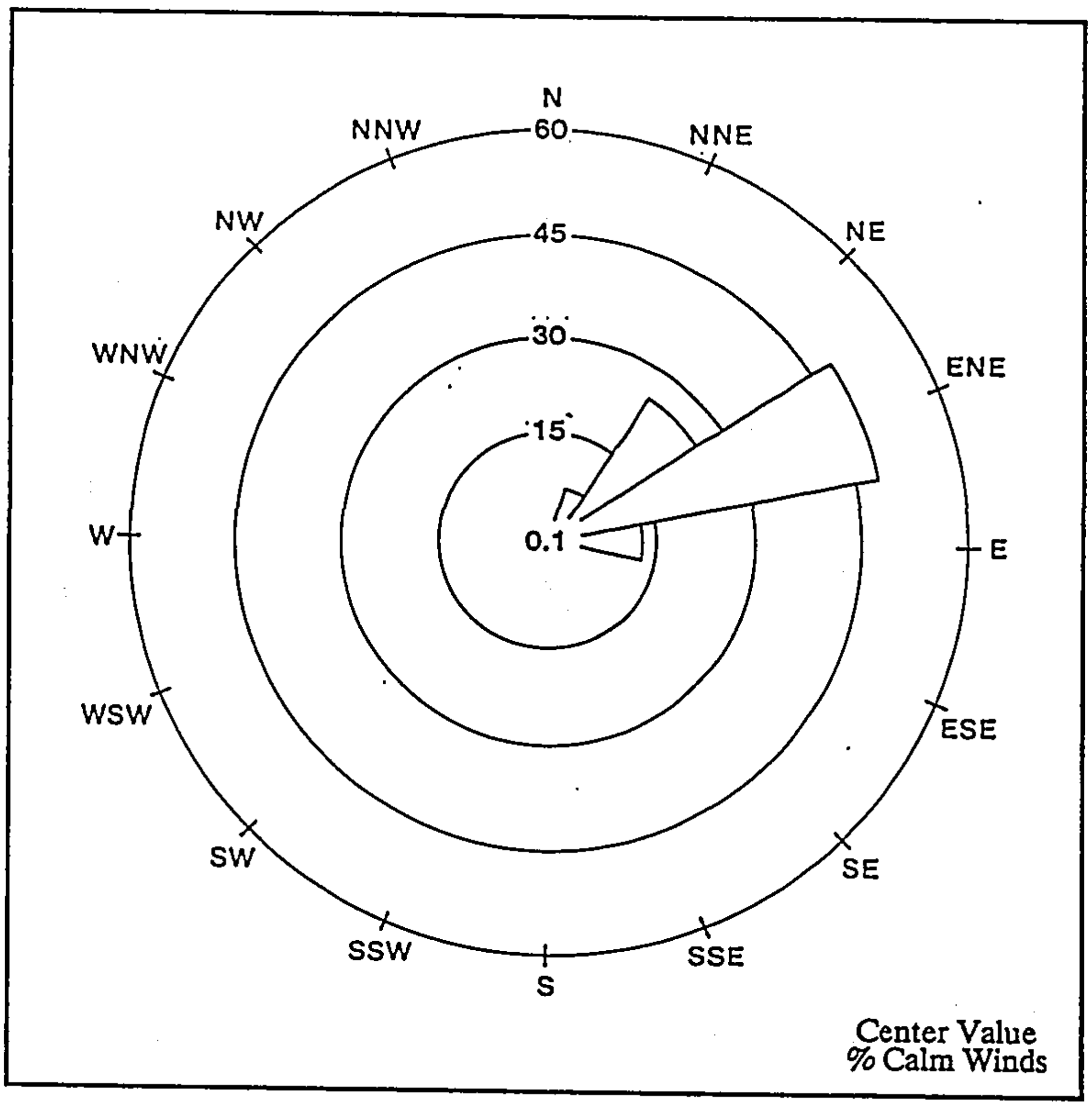
JANUARY WIND ROSE
KANEOHE MARINE CORPS AIR STATION
3:00 - 5:00 PM



SOURCE: National Weather Service

FIGURE 5

AUGUST WIND ROSE
KANEOHE MARINE CORPS AIR STATION
3:00 - 5:00 PM

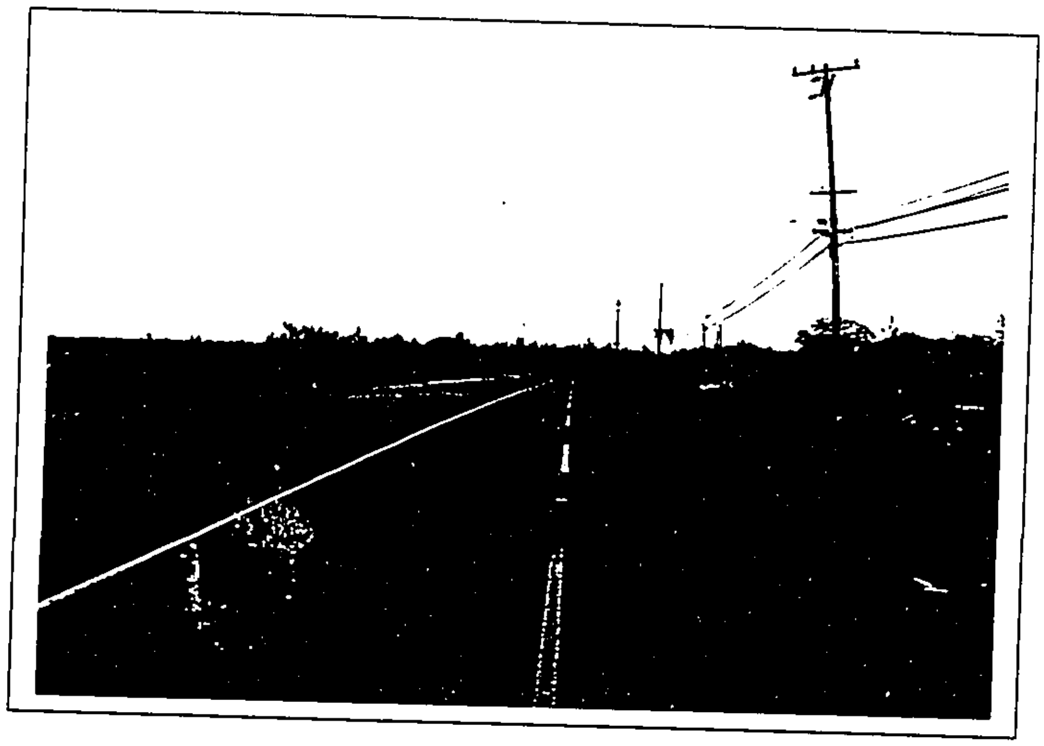


SOURCE: National Weather Service

FIGURE 6

KAMEHAMEHA HIGHWAY IN THE VICINITY OF THE PROPOSED PUNAMANO GOLF COURSE

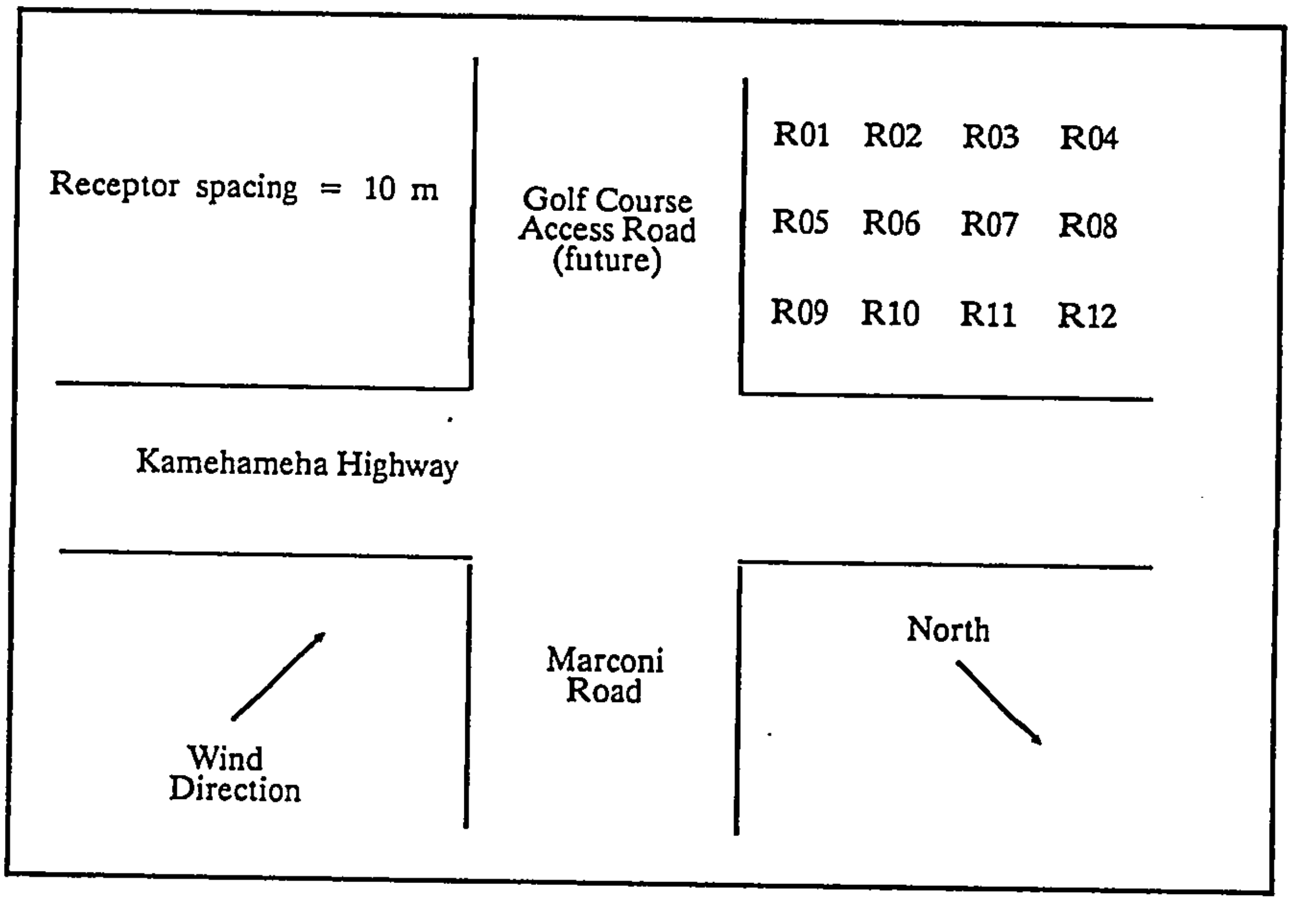
Facing Northwest



Facing Southeast

FIGURE 7

ESTIMATES OF MAXIMUM 1-HOUR
CARBON MONOXIDE CONCENTRATIONS
Kamehameha Highway at Marconi Road
P.M. Peak Hour
1989 - 1998

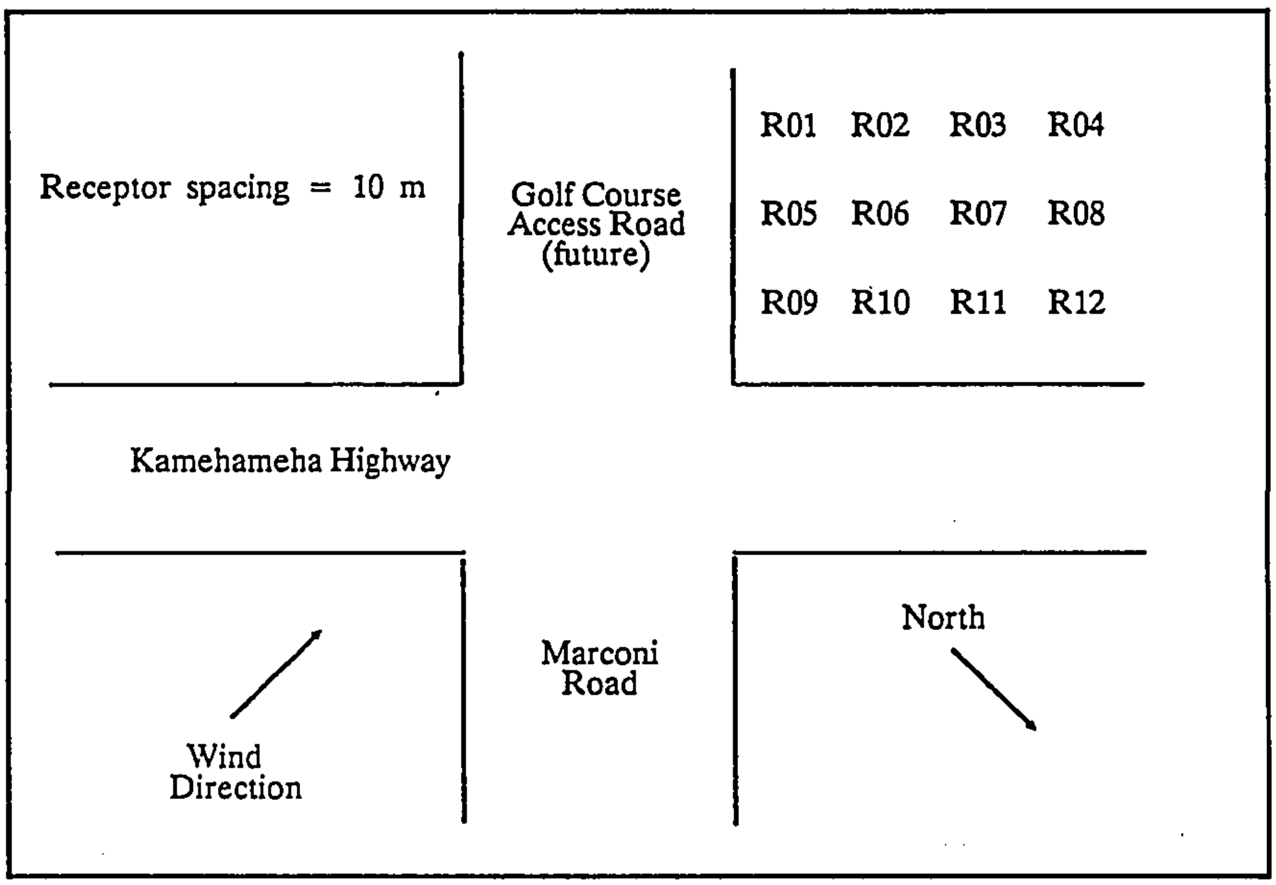


Receptor	Concentration (mg/m^3) 1989	1998 w/o proj	1998 w/proj
R01	1.6	1.6	1.8
R02	1.6	1.6	1.8
R03	1.6	1.6	1.8
R04	1.6	1.6	1.8
R05	1.7	1.8	1.9
R06	1.7	1.8	2.1
R07	1.7	1.8	2.1
R08	1.7	1.8	2.1
R09	1.9	2.1	2.4
R10	1.9	2.1	2.4
R11	1.9	2.1	2.4
R12	1.9	2.1	2.3

FIGURE 8

ESTIMATES OF MAXIMUM 8-HOUR
CARBON MONOXIDE CONCENTRATIONS

Kamehameha Highway at Marconi Road
1989 - 1998



Concentration (mg/m^3)

Receptor	1989	1998 w/o proj	1998 w/proj
R01	1.0	1.0	1.1
R02	1.0	1.0	1.1
R03	1.0	1.0	1.1
R04	1.0	1.0	1.
R05	1.0	1.1	1.2
R06	1.0	1.1	1.2
R07	1.0	1.1	1.2
R08	1.0	1.1	1.2
R09	1.2	1.2	1.4
R10	1.2	1.2	1.4
R11	1.2	1.2	1.4
R12	1.2	1.2	1.4

PROFESSIONAL QUALIFICATIONS

James W. Morrow, M.S.

Environmental Management Consultant

DATE OF BIRTH:	January 25, 1945	
EDUCATION:	B.S. (cum laude) Biochemistry June, 1966	University of New Hampshire Durham, New Hampshire
	M.S. Public Health August, 1973	University of Hawaii Honolulu, Hawaii

LANGUAGE TRAINING:

Vietnamese (3 years) - University of Hawaii
Cambodian (2 years) - University of Hawaii
Thai (2 years) - University of Hawaii
German (1 year) - University of New Hampshire

HONORS, SCHOLARSHIPS:

East-West Center Grantee, 1971-73
National Science Foundation Undergraduate Research Program, 1964-66
New York State Regents Scholarship, 1962

MILITARY TRAINING:

ROTC Distinguished Military Graduate, 1966
US Army Chemical School Basic Officer's Course, 1967
Chemical Officer's Advanced Course, 1980
Radiological Safety Course, 1985
Command & General Staff College, 1986 (with honors)

MILITARY ASSIGNMENTS:

Assistant Corps Chemical Officer (HQ IX Corps)
Radiological Protection Officer (HQ IX Corps)
Instructor, Nuclear-Biological-Chemical Defense
Current Rank: Lieutenant Colonel

PRESENT POSITION(S):

Environmental Management Consultant
1974 to present

Director, Environmental Health
American Lung Association of Hawaii
August, 1973 to present

Clinical Faculty (currently Associate Professor of Public Health)
School of Public Health,
University of Hawaii-Manoa
1978 to present

AIR QUALITY CONSULTING SERVICES

PROJECT	YEAR(S)
Bayview Golf Course	1989
Pu'uhonua Subdivision	1989
Pualani Subdivision	1989
Kwajalein Environmental Assessment	1989
Kihei Hotel Project	1989
Honolulu Waterfront Development	1989
Ford Isle Causeway	1988
Pokahea Quarry Relocation	1988
Paluaea Lands Development (Maui)	1988
Waikoloa Resort Expansion	1988
Hawaii Film Studio (Fort Ruger)	1988
Airport Trade Center	1988
West Maui Marina	1988
Kinau Street Offramp	1988
Wahiawa Mixed Use Project	1988
Maui Wailea 670	1988
Honolulu Civic Center and City Hall Annex	1988
Maili Kai Property Affordable Housing	1988
Honolulu Rapid Transit System	1987
Kahului Airport Master Plan	1987
Keahole Airport Master Plan	1987
Kapolei Village	1987
West Loch Estates	1987
Hawaii Film Studio	1987
Honolulu International Airport Master Plan Update	1987
Ewa Town Center	1987
Hawaiian Riviera Resort	1987
AMFAC Entertainment Center	1987
Kwajalein Power Plant Renovation	1987
Kalakaua Sidewalks Widening Project	1986
Kaupulehu Resort	1986
Nitto Kogyo Golf Course	1986
Kipapa Cannery	1985
Hawaii High Technology Park	1985
Kuakini Medical Center Incinerator	1985
Pali Highway Carbon Monoxide Study	1985
Mauna Lani Resort	1985
Ka'u Agribusiness Power Plant	1985
Honolulu Resource Recovery Facility	1985

AIR QUALITY CONSULTING SERVICES (continued)

Ford Island Causeway	1984
North Kohala Residential/Resort	1984
Hapuna Beach Resort	1984
Waikoloa Hyatt Regency Hotel	1984
Hilton Hawaiian Village Renovation	1984
Queens Medical Center Incinerator	1983
Waipahu Incinerator Stack Testing	1983
Tripler Army Medical Center Steam Plant	1982
Honouliuli Wastewater Treatment Facility Sludge Incinerator and Backup Boiler	1982
Kalua Koi Residential/Resort	1982
Ala Moana Center Parking Structure Carbon Monoxide Study	1982
Honolulu Program of Waste Energy Recovery (HPOWER)	1980
Honolulu International Airport Master Plan Study	1980
Ewa Marina Community	1979
Mahukona Residential Resort	1979
Lalamilo Water Supply System	1979
Kailua-Kona Shopping Center & Industrial Park	1979
Mauna Kea Beach Hotel Power Plant	1978
Halekulani Hotel Expansion	1978
Mililani Town - Increment Five	1978
Tapa Tower - Hilton Hawaiian Village	1977
Kunia General Aviation Airport	1977
Dillingham Airfield	1977
Tripler Army Medical Center Modernization	1977
Oahu General Aviation Master Plan Study	1976
Aliamanu Military Housing Project	1974

CONTINUING EDUCATION

Course Title & Sponsoring Institution	Year
"Design & Current Status of Dry Scrubbing Systems" Air Pollution Control Association New York, New York	1987
Lethal Chemical Agent Decontamination Training US Army Chemical School Ft. McClellan, Alabama	1987
M8A1 Automatic Chemical Agent Alarm Certification Course Schofield Barracks, Hawaii	1986
Radiological Safety Course US Army Chemical School Ft. McClellan, Alabama	1984
"Principles & Practice of Air Pollution Control" (EPA Course No. 452) Honolulu, Hawaii	1982
"EPA Disperson Models" Air Pollution Control Association New Orleans, Louisiana	1982
"Dispersion Modeling of Complex Sources" Air Pollution Control Association Philadelphia, Pennsylvania	1981
"Control Equipment for Particulate Emissions "Industrial Ventilation Systems" "Airborne Radioactive Emissions" "Thermal Processing of Hazardous Organic Wastes" Air Pollution Control Association Montreal, Canada	1980
"Coastal Zone Meteorology and Air Quality Problems" Air Pollution Control Association Cincinatti, Ohio	1979
"Pesticide Protection for Health Personnel" EPA and University of Miami Medical School Honolulu, Hawaii	1977
"Principles of Industrial Toxicology" Wayne State University Detroit, Michigan	1977

RESEARCH

American Lung Association of Hawaii, 1973-74. Study of the unique short term air pollution episode occurring annually in Honolulu due to extreme use of fireworks at New Years.

University of Hawaii, School of Public Health, 1972-73. Study of the character, problems and solutions of wastewater treatment at a ready mix concrete plant.

University of New Hampshire, Department of Biochemistry, 1965-66. Study of cell wall constituents of selected Lactobacilli and means of separating and identifying those constituents.

University of New Hampshire, Department of Chemistry, 1964. Development of gas chromatographic method for separating and identifying polyamines from biological samples.

MEMBERSHIP IN HONORARY/PROFESSIONAL SOCIETIES

Air Pollution Control Association
American Public Health Association
National Association of Environmental Professionals
American Industrial Hygiene Association (Hawaii Section)
Hawaii Public Health Association
Alpha Chi Sigma (professional chemistry)
Sigma Xi
Phi Sigma (honorary biological sciences)
Phi Kappa Phi (academic honors)
Alpha Epsilon Delta (honorary pre-medical)
Alpha Zeta (honorary agricultural science)

PUBLICATIONS

Morrow, J. W., D. Thomas and H. Burkard. "H2S Monitoring in the Vicinity of Hawaii's First Geothermal Well," Paper No. 95-105B, Air Pollution Control Association Annual Meeting (1988)

Flachsbart, P. G. and J. W. Morrow. "Development of Hawaii's H2S Standards and Geothermal Regulations," Paper No. 87-104.5, Air Pollution Control Association Annual Meeting (1987)

Bach, W., A. Daniels, L. Dickinson, F. Hertlein, J. Morrow, S. Margolis, and V. Dinh. "Fireworks Pollution and Health," Intern. J. Environmental Studies, 7: 183-192 (1975)

Burbank, N. C. and J. W. Morrow. "Wastewater and Wastewater Treatment at a Ready Mix Concrete Plant, "Proceedings, 28th Annual Purdue Industrial Waste Conference (1973)

Ikawa, M., J. Morrow and S. Harney. "Paper Chromatographic System for the Identification of Glycerol in Bacterial Cell Walls," J. Bact., 92: 812-814 (1966)

APPENDIX H

THE COUNTRY COURSES AT KAHUKU, IMPACT ON AGRICULTURE

Decision Analysts Hawaii, Inc.

APPENDIX H

THE COUNTRY COURSES AT KAHUKU:
IMPACT ON AGRICULTURE

PREPARED FOR:

The Estate of James Campbell

PREPARED BY:

Decision Analysts Hawaii, Inc.

December 1989

CONTENTS

TABLES

Table **Page**

EXECUTIVE SUMMARY

The Country Courses at Kahuku, a proposed complex of four golf courses, would result in the development of approximately 200 acres of agricultural land at *Malaekahana* and 605 acres at *Punamano*, for a total of 805 acres.

AGRONOMICAL CONDITIONS

Based on various soil surveys, a little over half of the *Malaekahana* site and about two-thirds of the *Punamano* site are comprised of goods soils. However, the good soils at *Punamano* are scattered throughout the properties, with gulches and steep slopes intersecting the more gently sloping terrain. It should also be noted that some of the soil ratings are quite old (1972) and, based on the agricultural experiences of the current lessee, may be inaccurate in that much of the topsoil may since have eroded.

Elevation ranges from 20 to 100 feet at *Malaekahana* and 10 to 300 feet at *Punamano*. Rainfall averages 40 to 50 inches a year, and groundwater is available in the area. Heavy winds limit the choice of crops and/or require windbreaks.

PAST AND CURRENT AGRICULTURAL USES OF THE PROPERTIES

Until 1971, most of the *Malaekahana* and *Punamano* properties were cultivated in sugarcane as part of Kahuku Plantation Company.

Currently, most of the *Malaekahana* property is being used by the Gunstock Ranch for grazing 100 head of cattle and 40 horses, and for boarding about a dozen horses. The operation supports one employee. Development of the Malaekahana golf course project would cause Gunstock Ranch to either (1) close because insufficient land would remain for a viable operation, or (2) relocate to other lands. Campbell Estate owns other nearby lands that are of similar quality and could be made available to Gunstock Ranch. Another possibility would be to relocate grazing operations around the fringes of the golf course.

Since 1973, the *Punamano* property has been leased to Amorient Aquaculture International ("Amorient"), a local firm. However, after over a decade of analyzing the economic feasibility of numerous crops, including field testing of the more promising ones, the company has not identified a profitable agricultural use for the property, and the lands now lie fallow. Amorient concluded that the Punamano lands are completely unsuited for crop production, and has expressed a desire to be released from its lease obligation to Campbell Estate. The principal difficulties cited were the cost of pumping water to irrigate mauka fields; soils that are poor and thin, and subject to erosion on the steeper slopes and very rocky at the lower elevations; difficult terrain, with the area chopped up by gullies and ravines; and excessive winds which damage plants.

AVAILABILITY OF ADDITIONAL AGRICULTURAL LAND IN KAHUKU

Additional agricultural lands will become available soon in the Kahuku area with the completion of the State's Kahuku Agricultural Park, which is now under development. This Park, which will be under a 30-year lease from Campbell Estate, will have 220 usable acres of land divided into 24 lots. Land will be available for nursery products, truck crops, and orchards. Other Campbell Estate lands in the Kahuku area could be made available for diversified agriculture operations if justified by the economics; this justification would include lease rents that are sufficient to cover the cost of any improvements that might be required.

DEMAND FOR AND SUPPLY OF LAND FOR DIVERSIFIED AGRICULTURE—STATEWIDE

The development of The Country Courses at Kahuku would eliminate the possibility of using the affected lands for diversified agriculture. However, it is extremely doubtful that the project would adversely affect the growth of diversified agriculture in Hawaii. There are four reasons for this assessment: (1) a vast amount of agricultural land and water in the State has been freed from sugar and pineapple production due to past plantation closings and reductions in operations—over 100,000 acres since 1968, including announced reduction plans—and most of this land has favorable soil ratings and remains available for diversified-agriculture activities; (2) it is very possible that additional sugarcane acreage and water will be freed, given the existence of unprofitable sugar operations; (3) some, if not most, of the sugar companies would make their lands available for profitable replacement crops to the extent that such crops exist; and, in contrast, (4) land requirements to accommodate the growth of diversified agriculture are surprisingly modest. In other words, the limiting factor is not the *land supply*, but rather the *market demand* for those crops that can be grown profitably in Hawaii. The proposed Country Courses at Kahuku involve too little land to affect this conclusion, and would therefore not affect adversely the Statewide growth of diversified agriculture.

However, small-scale farmers do have difficulty obtaining land because of *expensive subdivision requirements*. To help overcome this problem in the Kahuku area, the State is developing the Kahuku Agricultural Park.

RETRIEVABLE COMMITMENT OF RESOURCES

Even though the development of The Country Courses at Kahuku constitutes a commitment of prime agricultural land to recreational use, this would not constitute an irretrievable loss of these agricultural lands. If, at some time in the future, farming this land would contribute more economically than the Kahuku golf operations contribute, then the land could be planted in crops relatively easily. Although such a conversion is possible, it is extremely improbable in that Hawaii's economy would have to undergo a dramatic change through one or both of two highly improbable events: (1) the collapse of Hawaii's very healthy and robust visitor industry, followed by the collapse in the demand for golfing by visitors and residents; and/or (2) the discovery of some high-value land-intensive export crop that is unique to Hawaii, and for which the demand would be so large as to virtually absorb all of Hawaii's agronomically suitable land for that crop. Such a crop has been sought for over a century without success.

IMPACT ON AGRICULTURAL LAND VALUES AND LEASE RENTS

To the extent that The Country Courses at Kahuku are perceived to increase the long-term development potential of nearby agricultural lands, the proposed golf courses will also increase the current market value of the nearby lands. The resulting higher land values represent a market signal that, at some time in the future, greater benefits can be derived from the nearby lands than were previously anticipated. Until such development occurs—assuming that it in fact does occur—the land may be put to some temporary use, and this can include an agricultural activity which can last for decades. In the meanwhile, lease rents will be unaffected.

CONTRIBUTION OF THE COUNTRY COURSES TO THE GROWTH OF DIVERSIFIED AGRICULTURE

To an undetermined extent, The Country Courses at Kahuku would contribute to the growth of diversified agriculture in that nursery sales would increase, since a large number of plants and trees would be required to landscape four golf courses.

Also, The Country Courses at Kahuku would allow a significant number of people who possess agricultural skills to work in an activity that is closely related to farming, since about 80 of the jobs involve cultivating grasses and plants, applying fertilizers and chemicals, maintaining irrigation systems, etc. This represents a significant number of agricultural-type jobs inasmuch as Statewide agricultural field employment has exhibited a declining trend for the sugar and pineapple industries, and even for diversified agriculture. After increasing their agricultural skills even further, some of these people may eventually move on to start their own commercial farm operations, thereby contributing to the growth of diversified agriculture

CONSISTENCY WITH STATE AND COUNTY PLANS

The Country Courses at Kahuku (1) would not adversely affect plantation agriculture, since none exists on the properties; (2) would not adversely affect existing diversified-agriculture crop production, since none exists on the properties; (3) involves lands which, for the *Punamano* site, have been found to be poorly suited for crop production; (4) would not limit the Statewide growth of diversified agriculture since the supply of land available to diversified agriculture far exceeds projected demand, with additional agricultural lands to be made available in the area at the State's Kahuku Agricultural Park; (5) would not represent an irretrievable commitment of resources, although a dramatic economic change sufficient to justify converting the golf courses to crop production is regarded as extremely improbable; (6) would not increase agricultural lease rents in the area, although some land values may increase; and (7) would enhance the growth of diversified agriculture to an undetermined extent by increasing nursery sales, and by maintaining and increasing the pool of workers having skills applicable to farming. However, grazing operations on the *Malaekahana* property would have to be relocated; otherwise, one job would be lost.

In view of these findings, The Country Courses at Kahuku is consistent with the major thrust of the *Hawaii State Plan*, the *State Agriculture Functional Plan*, and the *General Plan of the City and County of Honolulu*. The thrust in all three plans calls for preserving the economic viability of plantation agriculture, and maintaining and promoting the growth of diversified agriculture. To accomplish this, an adequate supply of agriculturally suitable lands and water must be assured. Nevertheless, a portion of the development—a little over half of the *Malaekahana* site and about two-thirds of the *Punamano* site—is inconsistent with the lower-level State agricultural guidelines which call for Agricultural Lands of Importance to be protected from development. However, this guideline does not apply if an overriding public interest exists to provide such lands for other objectives of the Hawaii State Plan.

Finally, The Country Courses at Kahuku would conform with those State and County objectives and policies which favor increased recreation and employment. The four golf courses would accommodate over 600 resident and visitor golfers per day; would contribute to the economic health of the visitor industry; and would provide an estimated 200 jobs, of which about 80 would be outdoor jobs similar to certain jobs in the agriculture industry.

THE COUNTRY COURSES AT KAHUKU: IMPACT ON AGRICULTURE

The Country Courses at Kahuku, a proposed complex of four golf courses, would result in the development of approximately 605 acres for three golf courses at Punamano and 200 acres for one course at Malaekahana, for a total of 805 acres.[1] The impact of this development on existing agricultural operations and on the potential growth of diversified agriculture in Hawaii is summarized in this report.

AGRONOMICAL CONDITIONS

Soil Types and Agricultural Uses

The affected acreage consists of six soil types at Malaekahana, and 19 soil types at Punamano.[2] At *Malaekahana*, the soil types are:

CR	Coral outcrop;
JaC	Jaucas sand, 0 to 12 percent slope;
KmA	Keaau clay, 0 to 2 percent slope;
KlA	Kawaihapai clay loam, 0 to 2 percent slope;
LaB	Lahaina silty clay, 3 to 7 percent slope;
LaC	Lahaina silty clay, 7 to 15 percent slope;

At *Punamano*, the soil types are:

CR	Coral outcrop;
KaB	Kaena clay, 2 to 6 percent slope;
KaC	Kaena clay, 6 to 12 percent slope;
KaeC	Kaena stony clay, 6 to 12 percent slope;
KanE	Kaena very strong clay, 10 to 35 percent slope;
Kfa	Kaloko clay;
KpB	Kemoo silty clay, 2 to 6 percent slope;
KpC	Kemoo silty clay, 6 to 12 percent slope;
KpD	Kemoo silty clay, 12 to 20 percent slope;

KPZ	Kemoo-Badland complex;
LaB	Lahaina silty clay, 3 to 7 percent slope;
LaC	Lahaina silty clay, 7 to 15 percent slope;
PeB	Paumalu silty clay, 3 to 8 percent slope;
PeC	Paumalu silty clay, 8 to 15 percent slope;
PeD	Paumalu silty clay, 15 to 25 percent slope;
PeF	Paumalu silty clay, 40 to 70 percent slope;
rRK	Rock land; 0 to 70 percent slope;
WkA	Waialua silty clay, 0 to 3 percent slope;
WkB	Waialua silty clay, 3 to 8 percent slope.

For each soil type, Table 1 (for Malaekahana) and Table 2 (for Punamano) show the approximate land area in acres and by percentage of total land area, possible agricultural uses, and two soil ratings (explained below).

The predominate soil types at *Malaekahana*— CR, LaB, and LaC—comprise about 82 percent of the project area. Of the total area, 66 percent can be used for sugar, pineapple, truck, or orchard crops; the remaining land is unsuited for agriculture.

The predominate soil types at *Punamano*—Cr, LaB, LaC and PeC—comprise about 52 percent of the project area, while the remaining land contains 15 different soil types. Of the total area, 74 percent can be used for sugar, pineapple or truck crops; the remaining land can be used for pasture or is unsuited for agriculture.

Soil Ratings

The soils within the petition area have been rated in terms of four classification systems commonly used in Hawaii: (1) Land Capability Grouping, (2) Agricultural Lands of Importance to the State of Hawaii, (3) Overall Productivity Rating, and (4) Proposed Land Evaluation and Site Assessment. These classification systems are discussed below.

(1) *Land Capability Grouping by the United States Department of Agriculture Soil Conservation Service (SCS).*

This classification system rates soils into eight levels, ranging from the highest classification level, "I," to the lowest level, "VIII." The ratings for the two sites, which are made under the assumption that the land is irrigated, are shown in Tables 1 and 2.

At *Malaekahana,* approximately 4 percent of the area has a land capability rating of **I**, which indicates that the soils have few limitations that restrict their use. About 13 percent of the land has a rating of **IIe**, which indicates that the soils have moderate limitations that reduce the options on plants that can be grown successfully, or indicates that moderate conservation practices are required. The subclassification "e" indicates that the limitation is due to the risk of erosion, and therefore the soils require protection when cultivated. About 35 percent of the land is rated **IIIe**, and 9 percent is rated **IIIw**. Class III soils have severe limitations that reduce options on plants that can be grown successfully, require special conservation practices, or both. Subclassification "e" indicates risk of erosion as described above, while subclassification "w" indicates that the limitation results from excess water because the soils are poorly drained and subject to seepage. About 5 percent of the land is rated **IVs**, which indicates that the soils have very severe limitations that reduce the options on plants that can be grown successfully, require very careful management, or both. The subclassification "s" indicates that the soils limitation is because of stoniness, unfavorable texture, shallowness, or low water-holding capacity.

Table 1.— **PROPOSED GOLF COURSE AT MALAEKAHANA: SOIL TYPES, AGRICULTURAL USES, AND LESA AND SCS RATINGS**

Soil Type	Approximate Acreage	Percentage of Total	Agricultural Uses	SCS Rating[1]	LESA Rating
CR	68	34	None	VIIIs	—
JaC	10	5	Sugar, Pasture, Truck Crops	IVs	41
KmA	18	9	Sugar, Pasture	IIIw	45
KIA	8	4	Sugar, Truck Crops, Pasture, Orchards	I	94
LaB	27	13	Sugar, Pineapple, Truck Crops	IIe	90
LaC	70	35	Sugar, Pineapple, Pasture	IIIe	82

1. Assuming that the soils are irrigated.

Source: Dames & Moore, Honolulu, Hawaii; and U.S. Department of Agriculture, Soil Conservation Service in cooperation with The University of Hawaii Agricultural Experiment Station, *Soil Survey of Islands of Kauai, Oahu, Maui, Molokai, and Lanai*, State of Hawaii, Washington, D.C., August 1972.

Table 2.— PROPOSED GOLF COURSES AT PUNAMANO:
SOIL TYPES, AGRICULTURAL USES, AND LESA AND SCS RATINGS

Soil Type	Approximate Acreage	Percentage of Total	Agricultural Uses	SCS Rating[1]	LESA Rating
CR	87	14	None	VIIIs	—
KaB	37	6	Sugar, Truck Crops, Pasture	IIIw	79
KaC	37	6	Sugar, Pasture	IIIw	70
KaeC	20	3	Sugar, Pasture	IIIw	62
KanE	33	6	Pasture	VIs	41
Kfa	3	1	Sugar, Pasture	IIIw	81
KpB	18	3	Sugar, Pasture	IIe	87
KpC	7	1	Sugar, Pasture	IIIe	85
KpD	5	1	Pasture, Sugar	IVe	69
KPZ	6	1	Pasture	VIIe	23
LaB	97	16	Sugar, Pineapple, Truck Crops, Pasture	IIe	90
LaC	70	12	Sugar, Pineapple	IIIe	82
PeB	26	4	Sugar, Pasture	IIe	85
PeC	60	10	Sugar, Pasture	IIIe	76
PeD	15	2	Pasture, Sugar	IVe	57
PeF	26	4	Pasture	VIIe	20
rRK	2	1	Pasture	VIIs	—
WkA	11	2	Sugar, Truck Crops, Pasture	I	93
WkB	45	7	Sugar, Truck Crops, Pasture	IIe	91

1. Assuming that the soils are irrigated.

Source: Dames & Moore, Honolulu, Hawaii; and U.S. Department of Agriculture, Soil Conservation Service in cooperation with The University of Hawaii Agricultural Experiment Station, *Soil Survey of Islands of Kauai, Oahu, Maui, Molokai, and Lanai, State of Hawaii*, Washington, D.C., August 1972.

The remaining 34 percent of the land is coral outcrop rated **VIIIs**, which indicates that the soils and landforms have limitations that preclude their use for commercial plant production.

At *Punamano*, about 2 percent of the proposed project has a land capability rating of **I**, 30 percent is rated **IIe**, 39 percent is rated **IIIe** or **IIIw**, and 3 percent is rated **IVe or IVw**. These ratings are described above. The remaining lands—about 26 percent of the total area—have a land capability rating of **VI** or higher, which indicates that severe limitations make them generally unsuitable for cultivation—either because of erosion or stoniness.

(2) *Agricultural Lands of Importance in the State of Hawaii (ALISH), by the SCS, University of Hawaii (UH) College of Tropical Agriculture and Human Resources, and the State of Hawaii, Department of Agriculture.*[3,4]

This system classifies lands into three categories: (a) "Prime" agricultural land which is land that is best-suited for the production of crops because of its ability to sustain high yields with relatively little input and with the least damage to the environment; (b) "Unique" agricultural land which is non-prime agricultural land that is currently used for the production of specific high-value crops; and (c) "Other" agricultural land which is non-prime and non-unique agricultural land that is of importance to the production of crops.

At *Malaekahana*, about 23 percent of the lands proposed for the golf course are rated as "Prime" agricultural lands, 38 percent as "Other," and the remaining 39 percent is not rated.

At *Punamano*, 57 percent of the lands are rated as "Prime" agricultural lands, 17 percent as "Other," and the remaining 26 percent is not rated.

(3) *Overall Productivity Rating, by the UH Land Study Bureau (LSB).*[5]

This classification rates soils according to five levels, where "A" represents the class of highest productivity and "E" the lowest.

At *Malaekahana*, none of the lands are rated "A," while 55 percent are **B**; 5 percent are **C**; and 34 percent are **E**.

At *Punamano*, 7 percent of the lands are rated **A**; 52 percent are rated **B**; 11 percent are **C**; 3 percent are **D**; and 27 percent are **E**. A quarry and a reservoir take up less than 1 percent of the area, and are not rated.

(4) *Proposed Land Evaluation and Site Assessment (LESA) System, by the State of Hawaii Land Evaluation and Site Assessment Commission.*[6]

Based on soil quality, locational attributes, improvements, nearby activities, and land-use plans, this proposed classification system attempts to designate a sufficient amount of the better agricultural lands to meet projected agricultural goals. If the LESA classification approach were applied to the *Malaekahana* site, 52 percent of the lands would be termed "important agricultural lands" (IAL), which would include all lands having a rating of 66 or higher, out of a possible total of 100. At the *Punamano* site, about 69 percent of the lands would be termed IAL. Again, the ratings for each soil type are shown in Tables 1 and 2. However, the designations would be subject to change based on a change in nearby activities and a change in County land-use plans. Also, the designation could be changed if an overriding public benefit were demonstrated.

Based on the various soil surveys, a little over half of the *Malaekahana* site and about two-thirds of the *Punamano* site are comprised of goods soils. However, for the *Punamano* site, these good soils are scattered throughout the property, with gulches and steep slopes intersecting the more gently sloping terrain. It should also be noted that some of the soil ratings are quite old (1972) and, based on the agricultural experiences of the current lessee (see below), may be inaccurate in that much of the topsoil may since have eroded.

Other Agricultural Conditions[7,8]

At the *Malaekahana* site, most of the terrain is comprised of rolling hills with some broad areas of gently sloping grasslands; elevations range from 20 feet to 100 feet above sea level. For most of the land area, rainfall averages between 40 and 50 inches per year.

At *Punamano*, where the elevation ranges from 10 feet to 300 feet above sea level, the terrain is comprised of broad open areas and gentle slopes including some hills, and some steep slopes and cliffs. Three intermittent stream gulches cross the site. For most of the land area, rainfall averages between 40 and 45 inches per year.

Groundwater is available in the area; however, since these are mauka lands the water must be pumped up to the surface and the cost of the water is correspondingly high.

Heavy winds in the area limit the choice of crops and/or require windbreaks.

POSSIBLE CROPS

Studies for the nearby Kahuku Agricultural Park, which is located on similar terrain between the Malaekahana and Punamano sites, indicates that vegetables, fruits and melons, and flowers and nursery products can be grown in the Kahuku foothills.[8] Vegetables could include snap beans, green peppers, cucumbers, eggplant, ginger root, mustard cabbage, green onions, Italian squash, sweet potatoes, sweet corn, and tomatoes. Vegetables unsuited for the Kahuku area include carrots, broccoli, celery, lettuce, and dry onions. Fruits and melons which can be cultivated include avocados, bananas, guava, papaya, tangerines, passion fruit, and various kinds of melons. Flower and nursery products include ornamental potted plants and dendrobiums.

PAST AND CURRENT AGRICULTURAL USES OF THE PROPERTIES

Malaekahana[9]

Until 1971, most of the Malaekahana property was cultivated in sugarcane as part of Kahuku Plantation Company. This plantation closed primarily because of the poor agronomical conditions in the Kahuku area, and because of its small size and lack of economies of scale.

Most of the Malaekahana property is now being used by the Gunstock Ranch under a short-term lease from Campbell Estate. Including some adjoining property, the Gunstock Ranch covers about 250 acres of land that is used for grazing about 100 head of cattle and 40 horses, and for boarding about a dozen horses. The operation is marginally profitable to profitable, depending upon beef prices and the amount of rainfall—plentiful rainfall increases the amount of grass for grazing and reduces feed costs. Revenues of about $60,000 per year support one job, and cover feed, rent, water, taxes and other operating costs. By comparison, revenues from the proposed Malaekahana golf course alone are projected to be about $2.7 million per year, while employment is projected to be about 50 jobs, including about 20 jobs which would require agricultural skills to maintain healthy plants and greens.

Development of the Malaekahana golf course project would cause Gunstock Ranch to either (1) close because insufficient land would remain for a viable operation, or (2) relocate to other lands. Campbell Estate owns other nearby lands that are of similar quality and could be made available to Gunstock Ranch. Another possibility would be to relocate grazing operations around the fringes of the golf course.

Punamano[10]

Until 1971, most of the Punamano property was cultivated in sugarcane as part of Kahuku Plantation Company. Since 1973, the property has been leased to Amorient Aquaculture International ("Amorient"), a local firm. However, to date, the company has not identified a profitable agricultural use for the property, and the lands now lie fallow. Amorient has investigated the economic feasibility of numerous candidate crops on this land, including test cultivation of Christmas trees, pineapple, hale koa seed for export, and other crops. They also analyzed the economics of feed corn, sorghum, sudex, hay and other fodder crops.

After over a decade of effort, Amorient concluded that in today's economic environment the lands are unsuitable for commercial agricultural crop production, with the principal difficulties being the cost of pumping water to irrigate mauka fields, poor soils, difficult terrain, and excessive wind. Because Amorient has considerable experience with wind power, it had hoped that windmills might reduce pumping costs. The firm concluded, however, that the initial cost of wind turbines, coupled with the very poor reliability of commercially available units and the consequent high cost of maintenance, made this option economically unfeasible.

Amorient also concluded that the soils over most of the lands are poor and thin—a condition which was made worse by nearly 50 years of sugarcane production and the consequent severe loss of topsoil that resulted from the standard farming practices for sugar. In many areas, relatively steep slopes make it difficult to conserve soil and, furthermore, crop cultivation would cause an unacceptable increase in erosion rates. Also, lands at the lower elevations are rocky and therefore difficult to plow. Furthermore, the whole area is chopped up by gullies and ravines. In the opinion of Amorient, these conditions severely limit the available options for suitable crops. Their experience with the property strongly suggests that some of the soil surveys—most of which are based on conditions when the land was cultivated in sugarcane—overstate the quality of the soils.

The winds in the area, which are high and virtually constant, severely restrict options on crops that can be grown successfully. This is evidenced by the number of candidate species that are either stunted or experience extensive lodging under these wind conditions.

Amorient ultimately concluded that the *Punamano* lands are completely unsuitable for crop production, and have expressed a desire to be released from their lease obligation to Campbell Estate because of their inability to find a profitable crop to cultivate on the site.

AVAILABILITY OF ADDITIONAL AGRICULTURAL LAND IN KAHUKU

Additional agricultural lands will become available in the Kahuku area with the completion of the State's Kahuku Agricultural Park, which is now under development. This Park, which will be under a 30-year lease from Campbell Estate, will have 220 usable acres of land divided into 24 lots. Land will be available for nursery products, truck crops, and orchards[8] By the end of 1989, the number of applicants for lots at the Park exceeded the supply; however, these applicants have not yet been screened by the Department of Agriculture for their farming abilities.[11]

Other Campbell Estate lands in the Kahuku area could be made available for diversified agriculture operations if justified by the economics; this justification would include lease rents that are sufficient to cover the cost of any improvements that might be required.

DEMAND FOR AND SUPPLY OF LAND FOR DIVERSIFIED AGRICULTURE—STATEWIDE AND OAHU

The development of The Country Courses at Kahuku constitutes a commitment of prime agricultural land to recreational use. For the purposes of this discussion, prime agricultural land is loosely defined to mean any high-quality agricultural land that can produce high yields for a variety of crops. Based on soil quality, between 100 and 130 acres at *Malaekahana* and between 340 and 430 acres at *Punamano* could be considered prime agricultural land. This commitment raises the question of whether The Country Courses at Kahuku would affect adversely the development of diversified agriculture in Hawaii—either immediately or over the long term. To address this issue, the demand for and the supply of prime agricultural land for diversified agriculture are clarified below.

Demand for Prime Agricultural Land

The highest projections known to the consultant for the amount of land required to accommodate the growth of diversified agriculture in Hawaii are those prepared by the Land Evaluation and Site Assessment (LESA) Commission. These projections—which are shown in Tables 3 and 4 for the State and Oahu, respectively—were prepared in 1985. The projections represent an attempt to quantify the amount of agricultural land that will be required to (1) accommodate resident-plus-visitor population growth, (2) increase food and animal-feed self-sufficiency, and (3) increase crop exports.

As indicated, the LESA Commission projected in 1985 that an estimated 52,684 additional acres of land would be required Statewide to accommodate the increase in production from 1983 to 1995. The corresponding figure for Oahu is 7,979 acres. The crops and acreage requirements are categorized according to those which generally do not require prime agricultural land (although some crops may be grown profitably on prime agricultural land), those which generally do require prime agricultural land, plus a contingency of 10 percent of all acreage used for purposes other than beef and cattle production.

The relevant figures from Tables 3 and 4 are not the total figures, but rather the increase in the amount of *prime* agricultural land that is projected to be required to accommodate diversified agriculture: the increase is 8,858 acres for the State, and 2,314 acres for Oahu. These increased requirements for prime agricultural land are surprisingly small. Nevertheless, the projected land requirements, as small as they are, are high in that diversified agriculture is growing more slowly than the LESA Commission projections. A more realistic estimate of the amount of prime agricultural land required to accommodate Statewide growth of diversified agriculture over the next decade to the year 2000 is probably closer to 2,000 acres.[12] Furthermore, land is being freed from plantation agriculture faster than it can be absorbed by other crops (see discussion below).

Table 3.— LESA AGRICULTURAL ACREAGE REQUIREMENTS, STATE OF HAWAII: 1983 AND 1995

Crop or Activity	1983	1995	Increase
Crops and Activities which Generally Do Not Require Prime Agricultural Lands			
Beef/cattle [1,2]	765,450	365,090	--
Livestock:			
Dairy	1,000	1,182	182
Eggs/Poultry	281	515	234
Swine	600	1,050	450
Subtotal for Livestock	1,881	2,747	866
Unique Crops:			
Aquaculture	500	4,500	4,000
Coffee	2,000	5,700	3,700
Flowers/Nursery	1,786	3,040	1,254
Papaya	2,120	11,850	9,730
Taro/Watercress	400	527	127
Subtotal for Unique Crops	6,806	25,617	18,811
Macadamia Nuts	15,800	27,000	11,200
Crops and Activities which Generally Do Require Prime Agricultural Lands			
Plantation:			
Sugarcane [2,3]	194,300	177,700	-16,600
Pineapple	36,000	36,049	49
Subtotal for Plantation	230,300	213,749	-16,551
Other:			
Guava	965	1,400	435
Seed Corn	730	1,060	330
Bananas	1,100	2,200	1,100
Feed/Forage [2,4]	8,705	12,495	3,790
Fruits	635	1,156	521
Vegetables/Melons [5]	4,340	7,022	2,682
Subtotal for Other Crops	16,475	25,333	8,858
Contingency [6]	--	29,500	29,500
TOTAL	1,036,712	689,036	--
TOTAL, Excluding Beef/Cattle	271,262	323,946	52,684

Table 3.—LESA AGRICULTURAL ACREAGE REQUIREMENTS, STATE OF HAWAII: 1983 AND 1995
(continued)

Source: Derived from State of Hawaii Land Evaluation and Site Assessment Commission, *A Report on the State of Hawaii Land Evaluation and Site Assessment System*, Legislative Reference Bureau, Honolulu, Hawaii, February 1984.

1. Includes marginal grazing and pasture lands. The 1983 figure includes arid zones and other areas having low carrying capacity, while the 1995 figure does not.
2. Often includes land in a holding operation awaiting discovery of profitable uses.
3. The decline in acreage primarily reflects the loss of Puna Sugar Co.
4. Includes some pastureland and 8,000 acres of guinea grass on Molokai.
5. Overstated in that the acreage figures are for harvested acres, rather than for the amount of land required (i.e., the acreage requirements for a crop harvested twice a year should be halved).
6. Based on 10% of all acreage other than that for beef/cattle. This contingency amounts to double counting in that the LESA projections are already high. Also, the contingency figure allows for an additional 17,770 acres for expansion of sugarcane, even though the sugar industry is expected to decline, not expand.

Table 4.— LESA AGRICULTURAL ACREAGE REQUIREMENTS, CITY AND COUNTY OF HONOLULU: 1983 AND 1995

Crop or Activity	1983	1995	Increase
Crops and Activities which Generally Do Not Require Prime Agricultural Lands			
Beef/cattle [1,2]	18,200	10,090	--
Livestock:			
Dairy	340	40	62
Eggs/Poultry	250	390	140
Swine	144	200	56
Subtotal for Livestock	734	992	258
Unique Crops:			
Aquaculture	300	2,400	2,100
Flowers/Nursery	495	850	355
Papaya	70	170	100
Taro/Watercress	60	85	25
Subtotal for Unique Crops	925	3,505	2,580
Crops and Activities which Generally Do Require Prime Agricultural Lands			
Plantation:			
Sugarcane [2]	27,200	25,300	-1,900
Pineapple	11,829	11,800	-29
Subtotal for Plantation	39,029	37,100	-1,929
Other:			
Guava	--	242	242
Seed Corn	125	180	55
Bananas	540	836	296
Feed/Forage [2,3]	1,741	2,912	1,171
Fruits	90	200	110
Vegetables/Melons [4]	1,155	1,595	440
Subtotal for Other Crops	3,651	5,965	2,314
Contingency [5]	--	4,756	4,756
TOTAL	62,539	62,408	--
TOTAL, Excluding Beef/Cattle	44,339	52,318	7,979

Table 4.— LESA AGRICULTURAL ACREAGE REQUIREMENTS, CITY AND COUNTY OF HONOLULU: 1983 AND 1995 (continued)

Source: Derived from State of Hawaii Land Evaluation and Site Assessment Commission, *A Report on the State of Hawaii Land Evaluation and Site Assessment System,* Legislative Reference Bureau, Honolulu, Hawaii, February 1984.

1. Includes marginal grazing and pasture lands. The 1983 figure includes arid zones and other areas having low carrying capacity, while the 1995 figure does not.
2. Often includes land in a holding operation awaiting discovery of profitable uses.
3. Includes some pasture.
4. Overstated in that the acreage figures are for harvested acres, rather than for the amount of land required (i.e., the acreage requirements for a crop harvested twice a year should be halved).
5. Based on 10% of all acreage other than that for beef/cattle. This contingency amounts to double counting in that the LESA projections are already high. Also, the contingency figure allows for an additional 17,770 acres for expansion of sugarcane, even though the sugar industry is expected to decline, not expand.

If diversified agriculture is to require a large amount of prime agricultural land, then additional crops will have to be grown for the export market rather than for the small Hawaii market. However, the extreme difficulty of developing large export markets should be noted. For over a century, numerous and extensive crop searches and experiments have been conducted by many people and organizations, and have led to surprisingly few major long-term successes in Hawaii, thereby confirming the extreme difficulty in identifying new export crops and developing them into new and profitable industries. Furthermore, the difficulty in developing export markets is increasing because of increasing competition from other sugarcane-growing areas. Periodic low sugar prices have led nearly all sugarcane operators throughout the world to search for profitable replacement crops, particularly those crops which can increase the level of earnings from exports. Thus far, few successes have materialized.

Supply of Prime Agricultural Land

Regarding the supply of land in Hawaii, an enormous and growing supply of prime agricultural land is available for diversified agriculture. Since 1968, about 90,000 acres of Hawaii's prime agricultural land have been freed from sugar and pineapple production: about 62,700 acres of land freed from sugar production (about 15,200 acres on Oahu and 47,500 acres on the Neighbor Islands), and about 27,300 acres freed from pineapple production (about 6,600 acres on Oahu and 20,700 acres on the Neighbor Islands).[13-15]

Some of the land which has been freed from sugar and pineapple production has or will be converted to urban, diversified agriculture, and aquaculture uses. After making allowances for the various conversions, uncommitted acreage which remains available to diversified agriculture and aquaculture amounts to many tens of thousands of acres, with a significant amount of this land in the Kahuku area and other parts of Oahu. Much of this land is fallow, in pasture, or in some other low-value land-holding operation.

The Statewide supply of prime agricultural land probably will increase given the very real possibility of future sugar company closings. A number of Hawaii's sugar plantations are unprofitable but remain in operation today only because they are committed to lease and/or energy contracts which make closing prohibitively expensive. However, these contracts eventually will end.

Furthermore, a portion of the sugarcane land is in holding awaiting the discovery of profitable replacement activities; this land forms part of the supply of prime agricultural land available to profitable diversified agriculture crops.

Many of the lands freed, to be freed, or which can be freed from sugar and pineapple production have excellent agricultural qualities and climatic conditions, and are well-suited for a variety of crops. Also, water is available for most of these lands, particularly those lands which have been freed from sugar production.

Additional lands which have been or will be made available for diversified agriculture are in government-sponsored agricultural parks throughout the State, including the Kahuku Agricultural Park which is being developed. Lands for agricultural activities which do not require prime agricultural land include pasture land, land for livestock operations, and "unique" lands as classified by ALISH (see page 5). Unique lands are not prime agricultural lands, but are important lands for certain crops, the principal examples are the coffee lands in Kona, and certain lava lands in Puna that are particularly well-suited for growing papaya. The supply of unique lands is quite large and is distinct from the supply of prime agricultural lands.

Availability of Land to Small-Scale Farmers

Even though considerable agricultural land exists in the State, small agricultural parcels are seldom available to small-scale farmers under long-term leases because land-use regulations and the political environment make it unprofitable and too risky to the landowner to lease out small farm parcels. Agricultural use constitutes a low-value use of the land and, correspondingly, farmers pay relatively low lease rents. At the same time, in order to rent land to small-scale farmers, landowners are required to subdivide the property. Applicable County subdivision regulations (designed for rural estates) require expensive electrical power, paved rather than gravel roads, and buried rather than surface water lines. Thus the combination of low rents and expensive subdivision requirements makes it unprofitable for the landowner to subdivide land for small farms. For example, rather than developing the State agricultural park in Kahuku, it would have been—as surprising as it may seem—less expensive for the State to give each farmer in the park $100,000.[1]

In addition, there is the risk that when the leases expire, small-scale farmers will turn to the Legislature in an attempt to prevent landowners from raising lease rents, or to prevent landowners from evicting them in favor of a higher and more profitable use of the landowner's land—this often occurs in long-term leases for land on which small-scale farmers have built homes (e.g., Waihole-Waikane, Kona, Waianae, Kalama Valley). Such an economic environment favors leases to large-scale operators (including cooperatives consisting of many small-scale farmers), short-term and illegal leases of unsubdivided land, subdivision of the land into rural estates for sale to buyers who can afford the costs of the subdivision requirements, or leaving the land fallow.

1. This is based on 220 usable acres divided into 24 lots, a land cost to the State of $50 per acre per year; improvement costs for developing the farm plots (electric power, roads, etc.) of $3.4 million; rents received from farmers of $300 per acre per year; an 8-percent discount rate based on State bonds; and a 30-year term for the bond and the lease. Improvements are not to County standards.

In summary, the shortage of small parcels of land for farmers is a serious problem. Nevertheless, a vast supply of prime agricultural land does exist and is available for those profitable diversified agriculture operations that are large in scale, or for which the subdivision requirements are somehow circumvented.

Availability of Land for Diversified Agriculture

Based on the above assessment, ample prime agricultural land will be available to easily accommodate the Statewide requirements of diversified agriculture. This conclusion derives from the following: (1) a vast amount of prime agricultural land and water is available Statewide having been freed from sugar and pineapple production in recent years; (2) it is very possible that additional sugarcane acreage and water will be freed, given the existence of unprofitable sugar operations; (3) some, if not most, of the sugar operations would make their lands available for profitable replacement crops to the extent that such crops exist; and, in contrast, (4) land requirements to accommodate the growth of diversified agriculture are surprisingly modest. In other words, the limiting factor is not the *land supply*, but rather the *market demand* for those crops that can be grown profitably in Hawaii and, for small farms, *expensive subdivision requirements*. The proposed Country Courses at Kahuku involve too little land to affect this conclusion, and would therefore not affect adversely the Statewide growth of diversified agriculture.

Consistency with Overseas Long-Term Trends

The increased availability of prime agricultural land in Hawaii compared to that of prior decades results from some very long-term and accelerating trends that are occurring throughout the United States, Europe, and many developed and developing market economies.[16] For example, U.S. farmers are paid by the government not to farm their land. This has resulted in 30 million acres of agricultural land lying fallow in 1984.[17] In Europe, quotas are used to limit production. The principal agricultural problem has been overproduction, which has occurred as a result of the tremendous success of increasing yields, coupled with a slowing of the population growth rate. Because yields increase faster than population growth, resources must be freed from agriculture in order to restore balanced markets, and to increase income to the farmers who remain. Otherwise agricultural products glut the market; this is followed by low prices, a decline in farmers' income, and bankruptcies.

Furthermore, the export market has not been able to absorb the excess production, partly due to the agricultural successes achieved in many developing counties. For example, India once suffered from severe food problems. With the introduction of modern agriculture, however, its farm industry has been transformed, making India self-sufficient and even an exporter of many foods it once had to import. Similar gains have been achieved throughout Asia and Central and South America.

Of significance to Hawaii, sugar is clearly part of this trend which, over the long term, shows supply increasing more quickly than demand. In fact, some of the newer sweeteners have the theoretical potential of causing the release of all the land in the world that is now planted in sugarcane and sugarbeets.

The major agricultural problem facing the United States and many other economies, therefore, is how to make the reduction in production an orderly one so as to minimize social problems. This is a problem that arises from the tremendous successes in agriculture production, and contrasts sharply with, and invalidates, the 200-year old prediction of Thomas Malthus that population will increase faster than the food supply.

RETRIEVABLE COMMITMENT OF RESOURCES

Even though the development of The Country Courses at Kahuku constitutes a commitment of prime agricultural land to recreational use, this would not constitute an irretrievable loss of these agricultural lands. If, at some time in the future, farming this land would contribute more economically than the Kahuku golf operations contribute, then the land could be planted in crops relatively easily.

Although such a conversion is possible, it is extremely improbable in that Hawaii's economy would have to undergo a dramatic change through one or both of two highly improbable events: (1) the collapse of Hawaii's very healthy and robust visitor industry, followed by the collapse in the demand for golfing by visitors and residents; and/or (2) the discovery of some high-value land-intensive export crop that is unique to Hawaii, and for which the demand would be so large as to virtually absorb all of Hawaii's agronomically suitable land for that crop. Such a crop has been sought for over a century without success.

IMPACT ON AGRICULTURAL LAND VALUES AND LEASE RENTS

Regarding land values, if it is anticipated that homes or some other high-value development will be constructed on agricultural land in the next 25 years, then the current market value of this land will be significantly higher than the "agricultural" value of the land.

To the extent that The Country Courses at Kahuku are perceived to increase the long-term development potential of nearby agricultural lands, the proposed golf courses will also increase the current market value of the nearby lands. The resulting higher land values represent a market signal that, at some time in the future, greater benefits can be derived from the nearby land than were previously anticipated.

Until such development occurs—assuming that it in fact does occur—the land may be put to some temporary use, and this can include an agricultural activity which can last for decades.

In the meanwhile, lease rents will be unaffected. If the highest and best permitted use of the land (i.e., the most profitable use) is agriculture, then the lease rents will reflect the ability to pay for an agricultural use of the land. Lease rents will not be increased so as to drive agriculture off the land if this results in less income for the landowner. In fact, there are recent examples on Oahu where the land has become more expensive, but lease rents have been reduced because the most profitable agricultural activity has become less profitable, with a reduced ability to pay lease rents.[18]

In summary, The Country Courses at Kahuku may increase the values of some agricultural lands, but lease rents on the lands and the agricultural uses of the lands are unlikely to be affected until such time as the lands are in fact developed.

CONTRIBUTION OF THE COUNTRY COURSES TO THE GROWTH OF DIVERSIFIED AGRICULTURE

To an undetermined extent, The Country Courses at Kahuku would contribute to the growth of diversified agriculture in that nursery sales would increase, since a large number of plants and trees would be required to landscape four golf courses.

Also, the four golf courses may enhance the growth of diversified agriculture by helping to retain and increase the pool of people who have farming-type skills, while also increasing their knowledge of plant cultivation. About 80 of the estimated 200 jobs provided by The Country Courses at Kahuku would be outdoor jobs involved with cultivating grasses and plants, applying fertilizers and chemicals, maintaining irrigation systems, etc. Most of these outdoor jobs are similar to certain jobs in the agriculture industry, and require similar skills and training. This represents a significant number of agricultural-type jobs inasmuch as Statewide agricultural field employment declined by an average of 260 jobs per year between 1978 and 1988; the average annual loss has been 148 field jobs for the sugar industry, 85 field jobs for the pineapple industry, and 28 jobs in diversified agriculture. This *decline* in diversified agriculture employment has occurred despite *increasing sales* in the industry, which reflects a gradual conversion to higher-value crops. Furthermore, few of the 80 or so agriculture graduates each year from the University of Hawaii's College of Tropical Agriculture and Human Resources find employment in farming in Hawaii, and those who do generally receive low salaries.[19]

The Country Courses at Kahuku would allow a significant number of people who possess agricultural skills to continue working in an activity that is closely related to farming, thereby retaining and increasing their skills and knowledge of plant cultivation. Some of these people may eventually move on to start their own commercial farm operations, thereby contributing to the growth of diversified agriculture.

CONSISTENCY WITH STATE AND COUNTY PLANS

The Country Courses at Kahuku (1) would not adversely affect plantation agriculture, since none exists on the properties; (2) would not adversely affect existing diversified-agriculture crop production, since none exists on the properties; (3) involves lands which, for the *Punamano* site, have been found to be poorly suited for crop production; (4) would not limit the Statewide growth of diversified agriculture since the supply of land available to diversified agriculture far exceeds projected demand, with additional agricultural lands to be made available in the area at the State's Kahuku Agricultural Park; (5) would not represent an irretrievable commitment of resources, although a dramatic economic change sufficient to justify converting the golf courses to crop production is regarded as extremely improbable; (6) would not increase agricultural lease rents in the area, although some land values may increase; and (7) would enhance the growth of diversified agriculture to an undetermined extent by increasing nursery sales, and by maintaining and increasing the pool of workers having skills applicable to farming. However, grazing operations on the *Malaekahana* property would have to be relocated; otherwise, one job would be lost.

In view of these findings, The Country Courses at Kahuku is consistent with the major thrust of the *Hawaii State Plan*, the *State Agriculture Functional Plan*, and the *General Plan of the City and County of Honolulu*. The thrust in all three plans calls for preserving the economic viability of plantation agriculture, and maintaining and promoting the growth of diversified agriculture (see Table 5). To accomplish this, an adequate supply of agriculturally suitable lands and water must be assured. Nevertheless, a portion of the development—a little over half of the *Malaekahana* site and about two-thirds of the *Punamano* site—is inconsistent with the lower-level State agricultural guidelines which call for Agricultural Lands of Importance to be protected from development. However, this guideline does not apply if an overriding public interest exists to provide such lands for other objectives of the Hawaii State Plan.

Finally, The Country Courses at Kahuku would conform with those State and County objectives and policies which favor increased recreation and employment. The four golf courses would accommodate over 600 resident and visitor golfers per day; would contribute to the economic health of the visitor industry; and would provide an estimated 200 jobs, of which about 80 would be outdoor jobs similar to certain jobs in the agriculture industry.

Table 5.-- SELECTED STATE AND COUNTY OBJECTIVES, POLICIES, AND GUIDELINES RELATED TO AGRICULTURAL LANDS

HAWAII STATE PLAN (Chapter 226, Hawaii Revised Statutes, as amended):

Section 226-7 Objectives and policies for the economy--agriculture.

(a) Planning for the State's economy with regard to agriculture shall be directed towards achievement of the following objectives:

(1) Continued viability in Hawaii's sugar and pineapple industries.

(2) Continued growth and development of diversified agriculture throughout the State.

(b) To achieve the agricultural objectives, it shall be the policy of the State to:

(6) Assure the availability of agriculturally suitable lands with adequate water to accommodate present and future needs.

Section 226-103 Economic priority guidelines.

(c) Priority guidelines to promote the continued viability of the sugar and pineapple industries:

(1) Provide adequate agricultural lands to support the economic viability of the sugar and pineapple industries.

(d) Priority guidelines to promote the growth and development of diversified agriculture and aquaculture:

(1) Identify, conserve, and protect agricultural and aquacultural lands of importance and initiate affirmative and comprehensive programs to promote economically productive agricultural and aquacultural uses of such lands.

Section 226-104 Population growth and land resources priority guidelines.

(b) Priority guidelines for regional growth distribution and land resource utilization:

(2) Make available marginal or non-essential agricultural lands for appropriate urban uses while maintaining agricultural lands of importance in the agricultural district.

Table 5.-- SELECTED STATE AND COUNTY OBJECTIVES, POLICIES, AND GUIDELINES RELATED TO AGRICULTURAL LANDS
(continued)

STATE AGRICULTURAL FUNCTIONAL PLAN (June 1985)
(Functional plans are guidelines for implementing the State Plan, and are not adopted by the State Legislature.)

B. Objective: Achievement of Productive Agricultural Use of Lands Most Suitable and Needed for Agriculture.

(5) Policy: Provide greater protection to agricultural lands in accordance with the Hawaii State Constitution.

(c) Implementing Action: Identify important agricultural lands to promote diversified agriculture, increased agricultural self-sufficiency, and assure the availability of agriculturally suitable lands.

(d) Implementing Action: Until standards and criteria to conserve and protect important agricultural lands are enacted by the Legislature, important agricultural lands should be classified in the State Agricultural District and zoned for agricultural use, except where, by the preponderance of the evidence presented, injustice or inequity will result or overriding public interest exists to provide such lands for other objectives of the Hawaii State plan.

CITY AND COUNTY OF HONOLULU
GENERAL PLAN, Objectives and Policies (Resolution No. 82-188)

Economic Activity

Objective C. To maintain the viability of agriculture on Oahu.

Policy 4. Provide sufficient agricultural land in Ewa, Central Oahu, and the North Shore to encourage the continuation of sugar and pineapple as viable industries.

Policy 5. Maintain agricultural land along the Windward, North Shore, and Waianae coasts for truck farming, flower growing, aquaculture, livestock production, and other types of diversified agriculture.

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APPENDIX I

THE COUNTRY COURSES AT KAHUKU, IMPACT ON STATE AND COUNTY FINANCES

Decision Analysts Hawaii, Inc.

APPENDIX I

THE COUNTRY COURSES AT KAHUKU:
IMPACT ON STATE AND COUNTY FINANCES

PREPARED FOR:
The Estate of James Campbell

PREPARED BY:
Decision Analysts Hawaii, Inc.

December 1989

Contents

Executive Summary

The proposed Country Courses at Kahuku would be comprised of four 18-hole golf courses, two driving ranges, practice putting greens, three clubhouses, and associated improvements.

After the project is approved, the County would net approximately $370,000 in rollback taxes which are triggered when land which has been assessed and taxed at its agricultural value is developed. Upon full development of the project, the County would net about $460,000 per year. This compares with 1989 property taxes of less than $28,000 per year.

The State would net about $1.7 million from taxes on construction expenditures and, at full development, would net about $410,000 per year from taxes on operations.

THE COUNTRY COURSES AT KAHUKU: IMPACT ON STATE AND COUNTY FINANCES

INTRODUCTION[1]

The proposed Country Courses at Kahuku would be comprised of four 18-hole golf courses, two driving ranges, practice putting greens, three clubhouses, parking areas, maintenance areas, sewage treatment plants, access and circulation roadways, wastewater collection systems, storm-water runoff control, a potable water supply and fire protection system, a non-potable irrigation water system, and other utilities systems. A golf course, clubhouse, and maintenance area would be located on 200 acres at *Malaekahana* on a site between Laie and Kahuku and mauka of Kamehameha Highway; and the other three golf courses, two clubhouses, and maintenance areas would be located on 605 acres at *Punamano*, mauka of Kamehameha Highway between the Turtle Bay Resort and Kahuku. Each clubhouse would have a starting facility, pro shop, lockers, restaurant/lounge, kitchen, restrooms, administration area, cart storage area, and maintenance facilities for golf carts. The Malaekahana clubhouse and one of the Punamano clubhouses would have an area of 10,000 to 12,000 square feet; the other Punamano clubhouse would have an area of 17,000 to 20,000 square feet. Operations are expected to begin in 1994 for the Malaekahana course, and 1998 for the Punamano courses.

The impact of this project on State of Hawaii and City & County of Honolulu finances is summarized below, with all values expressed in 1989 dollars.

COUNTY REVENUES AND EXPENDITURES

Current Revenues[2]

Currently, the property tax on the *Malaekahana* site is $3,824 per year. The tax is low because the property is used for grazing, which qualifies it for a property tax assessment based on the agricultural value of the land, rather than its market value.

For the *Punamano* site, the property tax is $24,079 per year. In this case, a portion of the land is taxed at its agricultural value, while the remainder is taxed at its estimated market value.

Projected Revenues[2]

When land assessed and taxed at its agricultural value is developed, the action triggers "rollback" taxes which recover 10 years of back taxes based on the difference between taxes computed on the market assessment and the agricultural assessment, plus a penalty of 10 percent. Development of the golf courses would trigger the rollback tax. For 1989, taxes on the *Malaekahana* property would have been $17,517 if based on its market, rather than its agricultural, value. The 10-year rollback tax—including the 10-percent penalty—amounts to an estimated $170,000.[3]

For the *Punamano* property, 1989 property taxes would have been $36,245 if based on its market value, rather than its mix of market and agricultural values. When development occurs, the rollback tax is estimated to be $200,000.

Upon full development, the property assessment would be about $51 million. This is based on the property assessments for the golf course at $625,000 per hole (the current County guideline), and $1.5 million each for two of the clubhouse and associated improvements (maintenance area, parking, roads, water systems, sewers, drainage, etc.), and $2 million for the third clubhouse and associated improvements.

Property taxes on the four golf courses would be about $460,000 per year, based on a tax rate of $9 per $1,000.[4]

Additional revenues to the County would be derived from miscellaneous taxes and user fees. In addition, revenues would be derived from County taxes paid by employees of the golf courses. However, these taxes would be offset by corresponding government expenditures on facilities and services provided to these employees.

Projected Expenditures

No significant County expenditures are anticipated for infrastructure development, facilities, or services in support of the golf courses, since these items would be paid by the developer, operator, and/or users.

Projected Net Increase in Revenues

Based on the above, the County would net approximately $370,000 in rollback taxes after the project is approved. Upon full development, the County would net about $460,000 per year. This compares to less than $28,000 currently being paid in property taxes on the land.

STATE REVENUES AND EXPENDITURES

Current Revenues

Current economic activity at the property proposed for development is at a low level: the *Malaekahana* property is used for grazing, and no economic activity takes place on the *Punamano* property. Correspondingly, State revenues are negligible.

Projected Revenues[1,5]

Construction

The State would derive an estimated $1.7 million in general excise taxes on construction expenditures for the four golf courses and related facilities. This estimate is based on 4 percent of the construction value, which is estimated at 85 percent of the estimated $51 million value of the property.

Operations

At full development, revenues from golf operations, the pro-shops, and restaurants are estimated at $10.2 million per year. This is based on an estimated 140 rounds of golf per day for each of the four golf courses, and an average expenditure of $50 per golfer. The 4-percent general excise tax on this amount is $410,000 per year. Additional revenues to the State would derive from corporate income taxes, taxes paid by suppliers, and miscellaneous taxes and user fees.

Further State revenues would be derived from income taxes paid by employees of the golf courses and excise taxes on their expenditures. However, these taxes would be offset by corresponding government expenditures on facilities and services provided to support these employees.

Projected Expenditures

No significant State expenditures are anticipated for infrastructure development, facilities, or services to support the golf course operations since these items would be paid by the developer, operator, and/ or users.

Projected Net Increase in Revenues

Based on the above, the State would net about $1.7 million from taxes on construction expenditures and, at full development, would net about $410,000 per year from taxes on operations. Currently, the State derives negligible tax revenues from the activities on the property.

COMBINED NET REVENUES TO THE STATE AND COUNTY.

In summary, the County would net approximately $370,000 in rollback taxes after the project is approved, and the State would net about $1.7 million from taxes on construction expenditures. Upon full development, the State and County would net about $870,000 per year from taxes on operations.

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[2] Existing property taxes and rollback taxes provided by Campbell Estate.
[3] Inflation factor derived from Department of Planning and Economic Development, *The State of Hawaii Data Book 1988*, p. 389.
[4] Tax rate from Department of Planning and Economic Development, *The State of Hawaii Data Book 1988*, p. 289.
[5] Expenditures per day estimated by Decision Analysts Hawaii, Inc.

BRUCE STEVEN PLASCH
1655 Kamole Street
Honolulu, HI 96821
Office: (808) 373-9364
Fax: (808) 373-9590

August 1989

AREAS OF EXPERTISE

Economic Analysis: Economic development, input-output and other economic models, economic impacts, and evaluation of complex resource allocation problems.

Financial Analysis: Evaluation, feasibility, planning, comparative costs, funding sources, and financial impacts.

Market Analysis: Market potential, prices, marketing and price strategies.

Demographic Analysis: Population and housing forecasts and impacts.

Analytical Techniques: Systems analysis, mathematical modeling of complex relationships, decision analysis under uncertainty, analysis of multivariable/dynamic/probabilistic systems, statistical analysis, simulation, and linear programming and other optimization techniques.

Strategic/Policy Planning: Strategic plan development and implementation, project and research team management, and preparation of planning reports, position papers, and analyses.

Selected Fields of Specialty: Economic development (tourism, agriculture, energy, etc.), feasibility analysis, land and housing economics, valuations, and impact analysis (economic, financial, and demographics).

This strong multidisciplinary foundation enables successful analysis of complex problems and decisions.

EDUCATION

Ph.D. 1971: Stanford University, Engineering-Economic Systems
M.S. 1966: Stanford University, Engineering-Economic Systems
B.S. 1965: University of California, Santa Barbara, Electrical Engineering, unofficial liberal arts minor.

PROFESSIONAL EXPERIENCE

1980- President, Decision Analysts Hawaii, Inc.
1971 - 1980 Economic/Financial Consultant
1970 - 1973 Assistant Prof., University of Hawaii, Information Sciences
- 1970 Various part-time and summer jobs.

ACADEMIC HONORS

Various honors and honor societies; fellowships from the National Science Foundation, Ford Foundation, and Wheeler Foundation; various elected offices.

AFFILIATIONS

Adjunct Professor, University of Hawaii, Department of Regional and Urban Planning (1989 -).
Hawaii Economic Association (1978 –).
International Agricultural Development Service of Washington, D.C. (Rockefeller Foundation affiliate), registered consultant (1981 –).
Chamber of Commerce, Land & Water Use Planning Committee (1983 –).
American Bar Association, registered expert witness (1983 –).
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APPENDIX J

ENVIRONMENTAL ASSESSMENT OF FERTILIZER AND PESTICIDE USE ON THE PROPOSED COUNTRY COURSES AT KAHUKU (PUNAMANO AREA)

Charles L. Murdoch, Ph.D and
Richard E. Green, Ph.D

APPENDIX J

ENVIRONMENTAL ASSESSMENT

OF

FERTILIZER AND PESTICIDE USE

ON THE PROPOSED

COUNTRY COURSES AT KAHUKU

(PUNAMANO AREA)

A REPORT TO

WILLIAM E. WANKET, Inc.

December 9, 1989

PREPARED BY

Charles L. Murdoch, Ph. D

Richard E. Green, Ph. D.

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Overview and Conclusions

This assessment examines the potential environmental impact of fertilizer and pesticide use on three proposed golf courses west of Kahuku Village and south of Kahuku Point, Oahu. Site factors considered are topography, geology, soils, climate, sensitivity of off-site areas and the nature of the groundwater aquifer. Management factors include fertilizer use, pesticide use and irrigation. The principal focus of the report is the possible impact on the quality of ground and surface waters.

A basal, unconfined, flank aquifer underlies the site and is considered irreplaceable and highly vulnerable to contamination. Runoff water from the site is expected to be diluted by runoff from surrounding off-site areas, since the treated area is less than 20% of the entire watershed in which the golf courses are located. However, the quality of runoff is important, since runoff waters discharge into a low-lying marsh area in which the James Campbell National Wildlife Refuge is located.

The project area is about 605 acres, consisting of both lowland and upland areas. About 20% of the upland area has slopes exceeding 15%; runoff will be relatively high in these areas. Although the surface horizons of the dominant upland soils are relatively shallow at this site, probably as a result of past erosion, the profiles are generally deep. Soil organic carbon contents range from about 2% to 4% in the surface soil in areas that are not severely eroded. Abundant soil organic matter in surface soils is effective in retarding pesticide leaching. Eroded areas, if leveled and included in the treated area, will be more subject to pesticide leaching. Most of the year there is a water deficit in the area (evaporation exceeds rainfall by about 40 inches). Irrigation is necessary, therefore, and careful management of water can prevent excessive recharge of the groundwater.

Nitrogen is the only nutrient element in fertilizers applied to golf courses which is a potential contaminant of waters. A total of about 44 tons N would be applied each year to the three golf courses. Although this site is not prone to groundwater contamination by fertilizer nitrogen due to the low natural water recharge, the substantial quantity of nitrogen applied to the three contiguous golf courses suggests the need for careful management of both irrigation and fertilization. A slow-release fertilizer or small amounts of soluble nitrogen applied through the irrigation system (fertigation) is recommended. Water budgeting should be based on actual rainfall and pan evaporation or on a computer controlled irrigation system which programs water application from calculations of water use by means of weather sensing components. These careful management practices will result in reduced loss of nitrogen from the site by both leaching and runoff.

Pesticides applied to golf courses are approved by the EPA for such use and are unlikely to have an adverse impact on the environment. Groundwater contamination is of greatest concern at this site since the aquifer is a source of potable water. The pesticides used in largest quantity (MSMA, bensulide, glyphosate and chlorothalonil) are all highly sorbed on soil organic matter and are, therefore, not mobile. The more mobile pesticides are generally used in small quantities or are seldom used. Metribuzin, a herbicide, is the only mobile pesticide applied at a rate of over 100 pounds per year on the entire area. It is not considered a hazard to either surface or ground water as it is of low mammalian toxicity, has a high health advisory level for drinking water and is relatively non-persistent in the environment. Thus, with judicious use of pesticides and careful irrigation management, there is no apparent threat of pesticide contamination of either surface waters or groundwater.

A unique environmental consideration for this site is the possibility of off-site impact on the water quality and associated biota of the James Campbell National Wildlife Refuge. The Refuge is located down-gradient between the development area and the shoreline, and is subject to flooding during heavy rains. According to the U. S. Fish and Wildlife Service, the elevation of Ki'i Pond and some of the surrounding area has been increased in the past 100 years due principally to sediment deposited in the wastewater from the sugarcane mill at Kahuku. Fresh water is presently pumped into the pond and surrounding area to maintain the fresh-water ecosystem. Other marsh areas between Turtle Bay Resort and the aquaculture area are presumably brackish. Thus, except during flood periods, runoff from the project area is not likely to affect the National Wildlife Refuge due to elevation differences within the marsh. Also, the chemicals applied in golf course management pose little hazard for birds or wildlife. Fertilizers are relatively non-toxic unless ingested in large amounts. With the exception of chlorpyrifos, the pesticides are of low toxicity to birds. Chlorpyrifos has a low solubility in water, is highly sorbed, and degrades rapidly; thus its use does not threaten either water quality or birds. The low areas of the marsh provide a buffer between the project and the shoreline, so there is no anticipated adverse impact of the project on shoreline waters.

There will be no significant impact on air quality from application of herbicides or pesticides in golf course management provided that appropriate application techniques are used. The spray equipment used in golf course maintenance is ground-operated. Nozzle heights are typically less than 2 feet. Low spray pressures and coarse nozzle openings result in relatively large droplet sizes which are not highly subject to drift.

Recommendations

1. Irrigation management is critical to the conclusions reached above. For this reason we recommend that a U. S. Weather Bureau class A evaporation pan be used to measure evaporation and schedule irrigation application in the management of the proposed golf course. An excellent discussion of irrigation scheduling can be found in the book Golf Course and Grounds Irrigation and Drainage (Jarret, 1985).

2. Where grading is necessary, topsoil should be stockpiled and replaced over the areas to which chemicals will be applied; the high-organic matter content of surface soils will retard pesticide movement. Eroded soil areas that are leveled should be covered with surface soil containing at least 1.5% organic carbon.

3. Judicious use of fertilizers and pesticides, especially in the early establishment of turf, is essential, since pesticides and nitrogen will be more likely to move before an extensive root system and thatch layer are developed. Special care in pesticide application is also necessary during the winter months when runoff-producing storms are likely.

4. Slow-release nitrogen fertilizers should be used during the rainy season (November through February) to reduce the likelihood of nitrate-enriched runoff waters.

5. Although we do not anticipate significant movement of applied chemicals in either leachate or runoff, a modest monitoring program of marshland waters seems appropriate. Since fertilizer nitrogen is applied in the largest amounts and nitrate nitrogen derived from this source is the most mobile and persistent chemical used in golf course management, it would be the most logical chemical for which to test initially. Pre-development samples should be taken three times at one-to two-month intervals during the period November through March to provide an adequate reference nitrate level. After development, water samples should be taken quarterly in the lowest areas in the marsh for 3 to 4 years. Any enrichment of marsh waters would signal the need for more restrictive use of nitrogen fertilizer.

6. As our conclusions are based on the assumption that sound management practices will be followed with regard to fertilizer and pesticide application and irrigation, we recommend that a qualified Golf Course Superintendent be given the responsibility of managing the golf course.

I. INTRODUCTION

The development of the three proposed 18-hole golf courses west of Kahuku Village will require application of fertilizers to supply essential nutrients to turfgrasses and ornamental plants, and pesticides to control their associated weed, disease, and insect pests. The term pesticide, used in its generic sense in this report, includes herbicides, fungicides and insecticides. The assessment provided in the report focuses principally on the potential for applied chemicals to move in surface runoff and to groundwater. Additionally, the potential for pesticide transport in the air and potential for negative impact on birds in the area are addressed briefly in the appendices. The toxicity and environmental behavior of pesticides which are likely to be used are considered in the analysis, as are soil, topographic and climatic factors which may impact on fertilizer and pesticide movement.

II. APPROACH

Key elements of the analysis are (1) calculation of quantities of applied chemicals (pesticides and fertilizer nutrients) which are likely to be used throughout the year, (2) compilation of soil, geologic and climatic information which will aid in the assessment of chemical movement, (3) estimation of water balance from rainfall, irrigation and evapotranspiration, (4) compilation of pesticide properties which may be of environmental significance, and (5) computation of the Attenuation Factor for pesticides used on golf courses, using properties of the chemicals and soil properties, in order to estimate the likelihood of chemical movement to groundwater.

A site location map was provided by William E. Wanket, Inc. We visited the site on November 24, 1989. Soil maps and associated soil survey publications provided information required for an assessment of infiltration and runoff potentials, as well as soil organic carbon contents. Published rainfall and evaporation data in the area provided an estimate of groundwater recharge with turf cover. Anticipated use of chemicals in golf course management is based on our own recommendations, and pesticide properties were obtained from published reports.

III. ANALYSIS OF FACTORS IMPACTING ON CHEMICAL MOVEMENT

A. Site Factors

1. Topography, geology, soils

The project area consists of 605 acres located south of Kahuku Point, Oahu on the northern-most end of the Koolau Range. The northern side of the development is bounded by Kamehameha Highway at an elevation of 20 to 25 feet. This low-lying area extends southward several hundred yards where steep cliffs or steeply sloping lands are encountered, increasing in elevation to 100 to 300 feet in a few hundred yards. In the upland area the elevation is generally 100 to 200 feet, the landscape being somewhat segmented by two major drainage ways, Hoolapa and Kalaeokahipa gulches. Lowland areas consist of alluvial fans and talus slopes. Upland areas consist principally of alluvium and colluvium derived from basic igneous rock of the Koolau volcanic series; the northeast corner consists of an ancient coral outcrop with little soil development.

There are five principal soil series in the project area, as shown in Table 1 (see also Appendix Figure A-1). The approximate percentage of the total area occupied by each soil type and also the slope range of each are indicated.

Table 1. Soils of the development area west of Kahuku Village.

Soil Type	Soil mapping unit	Slope (%)	Approximate Percent of area
Lahaina silty clay loam	LaB	3-7	20
(Typic Torrox)*	LaC	7-15	5
Paumalu silty clay	PeB	3-8	8
(Humoxic Tropohumults)*	PeC	8-15	8
	PeD	15-25	5
	PeF	40-70	5
Kemoo silty clay (Oxic Rhodustalfs)*	KpB	2-6	5
Kaena clay	KaB	2-6	10
(Typic Pelluderts)*	KaC	6-12	3
Kaena stony clay	KaeC	6-12	3
Kaena very stony clay	KanE	10-35	3
Waialua silty clay (Typic Haplustolls)*	WkB	3-8	10
Coral outcrop	CR		15

* Soil Great Group according to U. S. Soil Taxonomy

The Lahaina soil is generally well drained and has a good water holding capacity. Although it is deep at many locations, the presence of much coral outcrop at this site suggests that the Lahaina soil may be relatively shallow in some of the areas (e.g. one to two feet rather than several feet).

The Paumalu silty clay is found principally on moderate to steep slopes. The surface horizon is generally relatively shallow, but subsoils are 30 to 60 inches thick. The substratum is highly weathered gravel. Permeability is moderately rapid; runoff is medium and the erosion hazard is moderate.

The Kemoo series consists of well-drained soils developed in material weathered from basic igneous rock. Permeability is moderate to moderately rapid. Runoff is slow to medium and the erosion hazard is slight.

The Kaena series consists of very deep, poorly drained soils on alluvial fans and talus slopes. Permeability is slow, but runoff is generally slow because of the level landscapes where these soils occur.

The Waialua soil at this site is east of the Kaena soil in the low-lying area near Kamehameha Highway. In contrast to the Kaena soil, the Waialua soil is moderately well-drained.

With approximately 28% of the land area having slopes exceeding 15%, erosion hazard must be considered during land shaping operations.

The organic carbon content of surface horizons of all of the soils in the project area is relatively high, ranging from a low of about 2% for the Waialua silty clay to about 4% for the Paumalu soil in areas that have not suffered much erosion (Loague, et al., 1989). The presence of abundant soil organic matter in surface soils is significant in retarding pesticide leaching.

2. Climate and hydrology

Mean monthly rainfall for the site varies from a low of 1.54 inches in June, to a high of 5.04 in January (Giambelluca et al., 1986). Mean annual total precipitation for the area is approximately 39 inches. Mean annual pan evaporation for the area is approximately 79 inches and ranges from a high of over 8 inches per month for the period May through August to a low of less than 5 inches/month for December and January (Ekern and Chang, 1985). Thus, without irrigation and neglecting runoff there is a water deficit of approximately 40 inches per year . The data indicate that unirrigated cropped or grassed areas providing a full canopy for ET would not contribute recharge to the groundwater aquifer. Because of the water deficit, vigorous turf could not be sustained without irrigation through the dry months. Mean monthly rainfall and pan evaporation are given in Figure 1. Mean monthly rainfall minus pan evaporation (evaporation deficit) is shown in Figure 2.

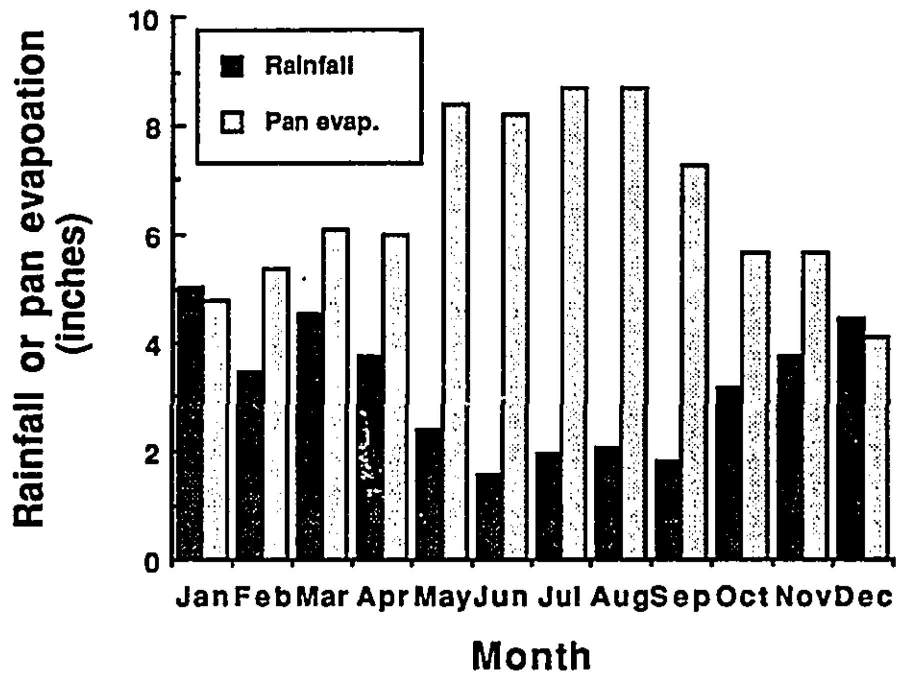

Figure 1. Mean monthly rainfall and pan evaporation for the Kahuku area.

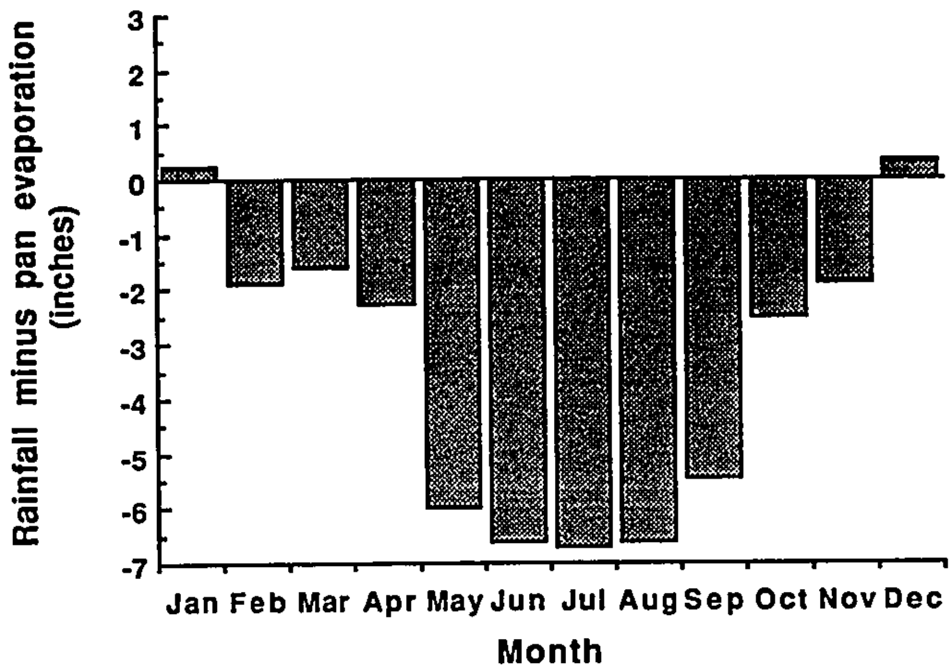

Figure 2. Mean monthly rainfall minus mean monthly pan evaporation for the Kahuku area.

The groundwater aquifer which could be impacted by the proposed development is identified and classified by Mink and Lau (1987). It is in the Koolauloa aquifer system of the Windward sector of Oahu. This basal, unconfined, flank aquifer is currently used for drinking water in the area and is considered irreplaceable and highly vulnerable to contamination.

B. Management Factors

1. Fertilizers

Fertilizers are applied to golf courses to supply those essential nutrients which are used in large amounts and which are deficient in most soils. In typical soils, the elements which are normally applied in a turfgrass fertilization program are nitrogen (N), phosphorus (P), and potassium (K). Fertilizers are normally applied to only the greens, tees, fairways, and part of the roughs of a golf course. Typical areas in each of these types of turf are estimated in the discussion below.

Turfgrasses use much more N than other elements. Based on turfgrass clipping composition, it has been shown that the turfgrasses grown in Hawaii use about twice as much N as K and about 4 times as much N as P.

The primary fertilizer elements of concern for contamination of ground and surface waters are nitrogen and phosphorus. Phosphorus is attached very tightly to soil clays and moves little if any from the site of application. Phosphorus,therefore will not cause any problem with contamination of drainage water. Ammonium nitrogen (NH_4) likewise moves little in soils. Nitrogen applied in the ammonium form, however, is rapidly converted to the nitrate form (NO_3) which is not bound to the soil and moves readily with water. Because of high nitrogen use rates by turfgrasses, however, nitrogen will be used rapidly after application. Only under conditions where rainfall occurs soon after application of a soluble nitrogen source would there be excessive loss by surface runoff or by leaching below the root zone. Thus nitrogen movement can be mitigated by applying a slow-release nitrogen fertilizer in which the nitrogen is in an insoluble form when applied (Brown, et al., 1977) or by applying small amounts of soluble N through the irrigation system and irrigating only to replace soil moisture used by evapotranspiration (Snyder, et al., 1984).

Fertilizer use rates for the different golf course areas are shown in Table 2. Complete fertilizers (ones containing N, P, and K) are usually applied. Because nitrogen is applied in larger quantities and also because it is the only fertilizer element likely to cause contamination of ground or surface waters, only nitrogen application rates are given.

Table 2. Approximate fertilizer use for different areas of three 18-hole golf courses in Hawaii.

Type of Turf	Area (acres)	Application rate (lbs. N/1000 sq. ft.)	Application Freq.	Total Annual Application (tons)
Greens	9	0.5	2 weeks	2.55
Tees	9	1.0	4 weeks	2.55
Fairways	150	1.5	8 weeks	31.85
Rough	80	1.0	3 months	6.97
Total	248			43.92

2. Pesticides

There are a number of weed, insect and disease pests of turfgrasses in Hawaii which sometimes require application of chemical pesticides. Pesticides are normally applied only in response to outbreaks of pests. There are few instances in which pesticides other than herbicides are applied in a regularly scheduled, preventative program. A typical pesticide program for golf courses in Hawaii is given in Table 3 below. There are several chemicals which may be substituted for certain ones in this suggested program. Properties of the chemicals listed in Table 3, as well as those of most chemicals used in turf in Hawaii, are given in Appendix Table B-1.

Table 3. A typical pesticide program for three 18-hole golf courses in Hawaii.

Turfgrass area	Area (acres)	Chemical	Frequency	Rate/application	Annual total
I. Herbicides					
A. Greens	9	MSMA	6 times/year	2 lb. ai/acre	108 lb. ai
		bensulide	2 times/year	12 lb ai/acre	216 lb. ai
B. Tees	9	MSMA	6 times/year	2 lb. ai./acre	108 lb. ai
		33 Plus	3 times/year	1 pint/acre	3.4 gallons
		bensulide	2 times/year	12 lb. ai./acre	216 lb. ai
C. Fairways	150	MSMA	6 times/year	2 lb. ai./acre	1,800 lb. ai
		33 Plus	3 times/year	1 pint/acre	56 gallons
		metribuzin	2 times/year	0.75 lb. ai/acre	225 lb. ai.
D. Perimeter areas	60	glyphosate	3 times/year	1.5 lb ai./acre	270 lb. ai.
II. Insecticides					
A. Greens	9	chlorpyrifos	As needed	1 lb. ai./acre	54 lb. ai.
B. Tees	9	chlorpyrifos	As needed	1 lb. ai. acre	54 lb. ai.
C. Fairways	Spot treatments	chlorpyrifos	As needed	1 lb. ai./acre	150 lb. ai.
III. Fungicides					
A. Greens	9	metalaxyl	As needed	1.3 lb. ai./acre	75 lb. ai.
B. Tees	9	metalaxyl	As needed	1.3 lb. ai./acre	75 lb. ai.
C. Fairways	Spot treatments	chlorothalonil	As needed	8 lb. ai./acre	750 lb. ai.

3. Irrigation

Because rainfall is not uniformly distributed throughout the year, all golf courses are irrigated to supplement rainfall. Golf courses usually have permanent sprinkler irrigation systems with sophisticated control systems. Many are computer controlled, so that each sprinkler head on the golf course can be adjusted to apply a selected amount of water on each cycle.

Because golf greens are constructed of sand (or primarily sand), the water holding capacity is less than for other areas containing soil. For this reason, golf greens must be watered more frequently than other areas.

Typical evapotranspiration rates for well-watered turf in Hawaii range from 0.1 to 0.3 inches per day, depending on temperature, the amount of sunlight, relative humidity, wind speed, the amount of available water in the soil, etc. Soils store approximately 0.5 to 2.5 inches of available water per foot of depth, depending on soil texture. Sands hold less, clays hold more. Irrigation should be applied when about one-half the available water has been used. The effective rooting depth for mown turf is approximately one foot. Therefore, turfgrasses will need to be watered every day to about once a week depending upon the type of soil and the water use rate. Amount of water applied at each irrigation varies greatly for different golf courses. Murabayashi (1989) reported that irrigation amounts for 11 golf courses in the State varied from 0.0023 million gallons per day per acre (mgd/acre) to 0.011 mgd/acre, a 478% difference. Average water use for the 11 golf courses was 0.006 mgd/acre. The Turtle Bay golf course which is very near the proposed Punamano site reported using 0.0038 mgd/acre. Using the reported amount from Turtle Bay and assuming 150 acres each for the three golf courses, approximately 1.7 mgd irrigation water would be required on days when irrigation is necessary.

Irrigation practices may have a large influence on the movement of soluble nitrogen fertilizers in soils. If excessive irrigation water is applied soon after application of soluble nitrogen sources, the likelihood of runoff or leaching of nitrogen below the root zone is increased. Because of the high cost of irrigation water, there is little incentive to over-water golf courses.

IV. Potential for Chemical Movement to Groundwater and Surface Waters

A. Issues of concern and the scope of this assessment

The principal issue addressed in this report is the potential for movement of fertilizers and pesticides to groundwater and surface waters.

The presence of agricultural chemicals in groundwaters at many locations in the State (Honolulu Star Bulletin, Aug. 13, 1989) is reason for caution in the use of chemicals in recreational areas such as parks and golf courses as well as in agriculture. It is important to recognize, however, that detection of a chemical in water bodies, even in potable water, does not necessarily constitute a health hazard as defined by the U. S. Environmental Protection Agency (EPA). In an effort to assist federal, state and local officials in responding to drinking water contamination, the EPA has set "Lifetime Health Advisory" levels (concentrations in drinking water) for many chemicals. EPA estimates these levels after reviewing available human data and experimental animal studies to evaluate potential human health effects. The Health Advisories are considered tentative and are updated as new information becomes available. Some agricultural chemicals which have reached groundwater in Hawaii, for example nitrate from fertilizers and the herbicide atrazine, have been detected at many locations in the State, but seldom are at a concentration considered a threat to human health. Also, Health Advisory Levels (HAL) vary widely for different chemicals: for nitrate the level is 10,000 micrograms per liter (10 milligrams/liter) of water while for atrazine it is 3 micrograms per liter. Thus for these two chemicals, the HAL's differ by a factor of 3,333. The relative oral toxicity of a number of pesticides registered for use in golf courses, given in Appendix Table B-1, reflect the wide range of toxicities obtained in animal feeding studies.

In the assessment which follows, we attempt to evaluate the potential for groundwater and surface water contamination by chemicals which might be applied to the proposed Punamano Golf Course. Our assessment does not include an estimate of the chemical concentration in waters or of human exposure or risk. Useful estimates of health risk are not possible when concentrations of chemicals in water are not known. However, when the evidence indicates the likelihood of no contamination or of concentrations well below the Health Advisory Level, further analysis of health risk is neither possible nor appropriate.

B. Potential impact on groundwater quality

Because the area treated with pesticides on a golf course is small, the total amount of pesticide applied is relatively small also. The pesticides used in golf course management are mostly of low toxicity (Appendix Table B-1). Most are either rapidly degraded in soil and/or are sorbed tightly to organic matter or soil colloids and move little from the site of application. The pesticides in Appendix Table 1 which are most likely to move below the root zone are metribuzin, mecoprop, dicamba, simazine, and trichlorfon. The relative mobility of these chemicals can be quantified by computation of the Attenuation Factor (AF) of each chemical for an appropriate set of conditions. Attenuation of chemical movement by the soil includes both retardation of movement due to sorption on soil organic matter and degradation in the soil by both biological and chemical pathways. The AF numerical index (Rao et al., 1985) is presently being evaluated (Khan and Liang, 1989; Loague et al., 1989) for use in an assessment methodology which the State of Hawaii will use in pesticide regulation. The AF index can have numerical values from AF = 0 (total attenuation) to AF = 1 (no attenuation). By definition, AF is the fraction of chemical remaining in the soil after a single application when the recharge is sufficient to carry the chemical to the bottom of a soil layer of a given depth (for example, 50 cm). For soil and water recharge conditions of practical interest in Hawaii, AF values for the five chemicals which are most likely to move beyond a depth of 50 cm are shown in Table 4. AF values range from 2.1×10^{-6} for simazine (lowest contamination potential) to 7.1×10^{-3} for trichlorfon (highest contamination potential). For comparison, DBCP, which was used for 25 years in pineapple and has contaminated groundwater at many locations, has AF = 4.6×10^{-1}, indicating a much higher likelihood for DBCP movement to groundwater than any of the chemicals listed in Table 4. Also, the total amounts of chemicals in Table 4 which are used on golf courses are relatively small. Trichlorfon is not used in Hawaii to our knowledge, although it is labeled. Mecoprop and dicamba are components of the herbicide Trimec®. Total annual mecoprop and dicamba application for the three golf courses will be approximately 28.8 and 7.2 pounds, respectively. The total amount of metribuzin applied will be approximately 225 lb. annually. Simazine is used on few golf courses in Hawaii. If used, simazine application would not exceed 300 lb. annually for the three golf courses.

Table 4. Attenuation factors (AF) for the most mobile pesticides labeled for use on golf courses.†

Pesticide	AF
Metribuzin	3.5×10^{-6}
Mecoprop	1.3×10^{-3}
Dicamba	7.1×10^{-5}
Simazine	2.1×10^{-6}
Trichlorfon	7.1×10^{-3}

†Based on the following conditions: soil organic carbon content = 1.5%; soil bulk density = 1.2 g/cm^3; soil water content = 35% by volume; water recharge = 0.1 cm/day; depth of penetration = 50 cm.

The importance of the Koolauloa groundwater aquifer as a drinking water source is a major consideration in this assessment. It is unlikely that any of the chemicals used on the golf course would reach the aquifer in sufficient concentration to adversely affect human health. Nitrate and metribuzin are the two chemicals which are applied in sufficient quantities and are sufficiently mobile and persistent to possibly be detected in groundwater. It is unlikely that the small amount of metribuzin used on golf courses would contribute a measurable amount to the groundwater and the contribution of nitrate from fertilizer may be small relative to background nitrate present in the aquifer. If fertilizer nitrate did reach the aquifer, it would not likely increase the level sufficiently to be of concern to human health; the nitrate Health Advisory Level (HAL) is 10 mg/L. The metribuzin HAL is 200 µg /L. Detection at even 1 µg in aquifer water is unlikely.

Recharge of groundwater from infiltration of rainfall in the development area will be minimal due to relatively low rainfall much of the year, high evapotranspiration most of the year, and high potential for runoff on steeply sloping areas which comprise about 20% of the land area at this site. The soils which dominate the area contain sufficient organic carbon (2% or more) in the surface horizon to retard movement of pesticides through the soil profile. Although the golf course will occupy almost all of the project area, the major portion of the developed area will be at elevations exceeding 100 feet above sea level. This great leaching distance will reduce the likelihood of pesticides reaching groundwater, as both degradation and dispersion reduce the concentration of any pesticide which may move below the root zone. The lowland area is dominated by the Kaena soil series; the distance to groundwater is no more than 10 to 20 feet, but the soils have low permeability which will restrict leaching losses.

C. Potential Impact on Surface Water Quality

The area which might be impacted most by chemical application on the proposed golf course is the marsh land north of Kamehameha Highway. Both Hoolapa and Kalaeokahipa Gulches pass through the area to be developed and drain into the marshes. The soil in the marsh area is principally Pearl Harbor Clay (Typic Tropaquepts), a very low permeability clay soil underlain by muck or peat. The relatively poor drainage of this area plus water inputs from both surface runoff and groundwater seepage contribute to the maintenance of the wet condition of the marsh. Hydraulic heads of the aquifer in the marsh area are thought to be about 10 feet above mean sea level (K. Muranaka, Engineering Concepts, Inc., personal communication); groundwater flux toward the ocean and the high water table should maintain the marsh water relatively free of salinity much of the year. Also, fresh water of high quality is pumped from deep wells by the U. S. Fish and Wildlife Service to maintain the fresh-water status of Ki'i Pond and the surrounding marsh. The elevation of the marsh was apparently increased by decades of sediment deposit, principally from the sugar mill wash water, so that historic fresh-water springs no longer maintain the fresh water status of the pond and marsh throughout the year (S. Fefer, U. S. Fish and Wildlife Service, personal communication, Nov., 1989).

Groundwater and shoreline waters are not likely to be affected adversely by chemicals applied to the proposed golf courses. However, portions of the marshes north of Kamehameha Highway, in and around James Campbell National Wildlife Refuge, might receive runoff from the golf courses, thus the water in these marshes appears more vulnerable to impact of transported chemicals than are coastal waters. Estimates of runoff rates from the developed on-site areas relative to existing off-site areas in the same watersheds (data from Engineering Concepts Inc., Jan. 1989) suggest that developed areas (616 acres) will contribute about 47% of the total runoff from the 1303 acre watershed in which the development is located. The approximate area to be treated with chemicals is about 250 acres (three 18-hole golf courses), which is less than 20% of the entire watershed in which the golf courses are located. While movement of applied chemicals in runoff from turfed areas is not considered a major problem under these conditions, caution should be exercised in applying the chemicals during the rainy season (November through February) when high rainfall intensity and duration might move recently applied chemicals, especially nitrogen fertilizer, to lowland areas in runoff. Diversion of runoff through improved drainage ways which would bypass the National Wildlife Refuge would circumvent the problem of the chemicals in runoff reaching the protected portions of the marsh. In our visit to the marsh area we were not able to determine how much of the storm runoff from the development area and associated watershed would reach the shoreline through existing drainage channels without recharging the marsh itself. Several of the small culverts on Kamehameha Highway along the boundary of the area to be developed appear to be clogged and non-functional. Only two drainage ways appeared to be operational, one a few hundred yards west of Marconi Road and one just west of the access road to the Wildlife Refuge.

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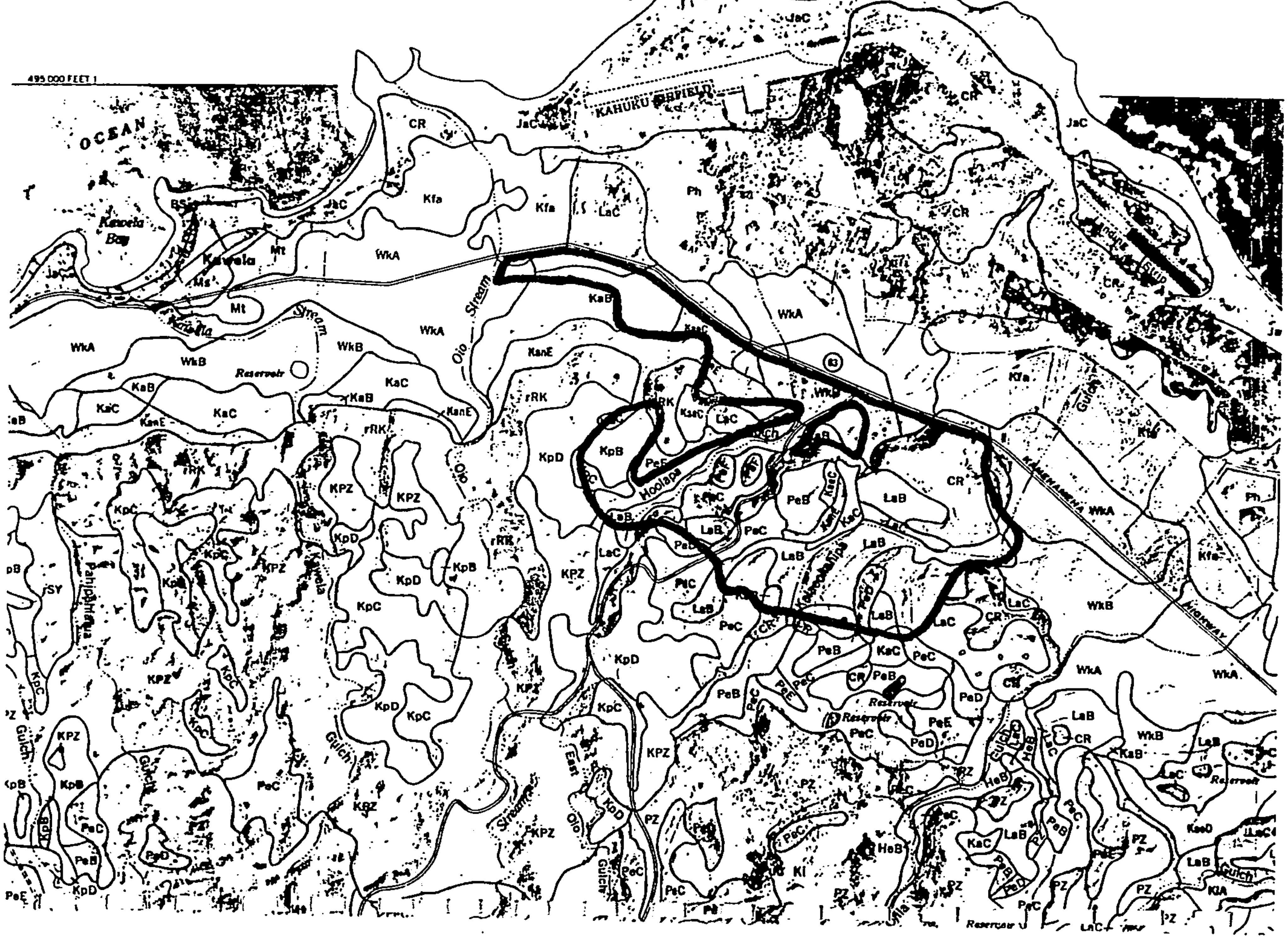
APPENDIX A

Soil map

Appendix Fig. A-1. Soil map for Country Courses at Kahuku (Punamano)



APPENDIX B

Pesticide Data

Appendix Table B-1. Properties of pesticides used on turf in Hawaii.

Pesticide common name	Trade name (s)	Oral LD-50 (mg/kg body wt)*	Toxicity to fish and wildlife*	Soil sorption Index (Koc)**	Water solubility (mg/l)**	Half-life in soil (days)**	Leaching potential**
I. Herbicides							
MSMA	WeedHoe etc.	1800	Low	10000	1000000	100	Small
glyphosate	Roundup, Kleenup	150	Mod. to birds, none to fish	10000	1000000	30	Small
metribuzin	Sencor	2200	Moderate	41	1220	30	Large
2,4-D	part of mixtures	370-700	High to fish	109	300000	10	Medium
mecoprop	ditto	700-1500	Low	3	660000	21	Large
dicamba	ditto	1000-2000	Non toxic to fish	2	800000	14	Large
oryzalin	Surflan	10000	Mod. to birds, toxic to fish	2700	2.5	60	Small
oxadiazon	Ronstar	8000	Toxic to fish		0.7		
propyzamide	Kerb	5620-8350	Low	990	15	30	Small
simazine	Princep	>5000	Low	138	3.5	75	Large
chlorthal-dimethyl	Dacthal	>3000	Low	5000	0.5	30	Small
bensulide	Betasan, Betamec	770	Mod. to fish	10000	25	60	Small
paraquat dichloride	Ortho Paraquat CL	150	Mod. to birds, none to fish	100000	1000000	3600	Small
benfluralin	Balan	10000	Low to birds, high to fish	11000	0.1	30	Small
II. Insecticides							
chloropyrifos	Dursban	135-163	High	6070	2	30	Small
bendiocarb	Ficam	40-156	High				
carbaryl	Sevin	400-850	Moderate	229	40	7	Small
trichlorfon	Dylox	450-630	Moderate	2	154000	27	Large
III. Fungicides							
anilazine	Dyrene	<5000	Low	3000	10	1	Small
benomyl	Benlate	9590	Low	2100	2	100	Small
chlorothalonil	Daconil 2787	>10000	Low to birds, mod. to fish	1380	0.6	20	Small
iprodione	Chipco 26019 RP	3500	Low	500	13	20	Small
mancozeb	Dithane M-45	>8000	Low	1000	0.5	35	Small
quintozene	PCNB, Terrachlor	12000	Non-toxic	1000	0.44	21	Small
thiram	Tersan	7500	Low	383	30	20	Medium
triadimefon	Bayleton	568	Low	273	260	21	Medium
metalaxyl	Subdue	669	Non-toxic	16	7100	7	Medium
thiophanate-methyl	Cleary 3336	7500	Low	1000	3.5	0	Small

*From: Hartley, Douglas and Hamish Kidd (Eds.) 1983. The Agrochemicals Handbook. Unwin Bros., Ltd. Old Working., Surrey, England.

**From: Wauchope, R. D. 1988. U. S. D. A.-ARS Interim Pesticide Properties Database, Version 1.0. Unpublished.

Appendix Table B-2. Toxicity classes of pesticides.

Class	Description	Warning Statement	Oral LD50
1	Highly Toxic Skull & Crossbones	Poison,	1-50
2	Moderately Toxic	Danger	51-500
3	Low Toxicity	Warning	500-5,000
4	Very Low Toxicity	Caution	>5,000

APPENDIX C

IMPACT ON MIGRATORY BIRDS AND ENDANGERED HAWAIIAN WATERBIRDS.

The fertilizers, herbicides, and fungicides used in golf course maintenance pose little or no hazard to birds frequenting the grassed areas or ponds associated with golf courses. Fertilizers are relatively non-toxic unless ingested in large amounts. All herbicides and fungicides used in golf course maintenance in Hawaii are of low to moderate toxicity (Appendix Table 1). The only chemicals used in golf course maintenance in Hawaii which are highly toxic to birds are the organic phosphate insecticides, especially chlorpyrifos.

Although chlorpyrifos is toxic to birds, it is strongly adsorbed on the thatch layer of turf and moves little from the site of application. One reason for its weakness in controlling soil infesting insects is the inability to get the insecticide through the thatch layer to the depth needed to contact these insects. Recent studies (Sears and Chapman, 1980; Tashiro, 1980) have shown that chlorpyrifos applied to turfgrasses does not penetrate more than 2 to 3 centimeters in the soil. In addition to resistance to movement in the soil, it has been shown that it is rapidly degraded in the soil, both by hydrolysis and microbial action (Miles et al. 1979).

Because of the adsorption of organic phosphate insecticides on organic layers in turf and their rapid break down, there is little chance of their movement from grassed areas into the ponds associated with the proposed golf course. Label instructions for application of these pesticides (which turfgrass managers are required by law to follow) specifically prohibit their direct application to streams and ponds.

The likelihood of bird injury by pesticides used in maintenance of the proposed golf course can be reduced by proper application of pesticides with reduced toxicity to birds. Appendix Table 1 shows that carbaryl and trichlorfon are less toxic to birds than chlorpyrifos. In most cases these insecticides may be substituted for chlorpyrifos with little loss of effectiveness.

Golf courses are frequently visited by birds. As far as we are aware, there have been no reported incidents of bird kill in Hawaii from chemicals applied in golf course management. Waterfowl and fish appear to thrive in ponds and water hazards on golf courses in Hawaii. Many golf courses cultivate white amur fish in the ponds to control algae. Mosquito fish are generally stocked to prevent mosquito problems. We are aware of no incidents of fish or waterfowl injury from chemicals applied to golf courses.

The labeling of herbicides and pesticides by EPA for particular uses, enforced by the Hawaii Department of Agriculture, is perhaps the best assurance of protection of humans and wildlife from their hazards. All pesticides must be applied in compliance with federal and state laws regulating their use. Hazards to both humans and wildlife are included in the decision to label a pesticide for specific uses, including use on golf courses, and in developing regulations on allowable application procedures of the pesticide for various uses.

APPENDIX D

IMPACT ON AIR QUALITY

Most herbicides and pesticides used on golf courses are of relatively low mammalian toxicity, with LD_{50} values ranging from hundreds to several thousand mg/kg body weight (Appendix Table 1). None of the chemicals listed in Table 2 above are highly volatile. A measure of volatility is the vapor pressure (VP). The compounds used in highest quantity, for which vapor pressure data is readily available, are chlorothalonil (VP=1.3 x 10^{-5} atm at 25° C) and chlorpyrifos (VP=2.4 x 10^{-8} atm at 25° C). In comparison, DBPC, which is known to be volatile, has a vapor pressure of 1.2 x 10^{-3} atm at 21° C, i.e. at least 100 times the vapor pressure of chlorothalonil and 100,000 times the vapor pressure of chlorpyrifos. In addition, pesticides are applied on golf courses in dilute sprays (50 to 100 gallons of spray solution per acre) to open areas. For these reasons there is little likelihood of volatility once the pesticides are applied.

If properly applied, there is also little potential for drift of spray particles from golf course spray equipment. The greatest danger of significant drift of pesticides is from aerial application. Golf course pesticides are applied with ground spray equipment. Boom height of spray equipment is less than one meter. Low spray pressures (20 to 40 psi) and coarse spray droplets further reduce the hazard of airborne fine droplets. Droplets larger than 100 micrometers diameter are not highly subject to drift.

Most of the spray volume from typical flat-fan nozzles used in agricultural spray equipment is from droplets larger than 100 micrometers. Table 3 below shows a typical distribution of droplet sizes for a flat-fan nozzle (the type used in most golf course spray equipment). At the low concentrations used in pesticide application, this would not result in significant quantities of pesticides being carried downwind. High wind speed would increase the likelihood of drift of fine spray droplets, however, because high wind speed distorts spray patterns and results in poor coverage; spraying in periods of high wind is not common practice. Table 4 below shows the percent of spray application volume deposited at 4 and 8 feet downwind and the distance downwind for the volume to drop to 1% or below for flat-fan nozzles under different conditions. Even under high wind conditions (almost 10 mph) and spraying at 40 psi, the distance downwind at which 1% or less of the total spray volume was deposited was only 17 feet.

Appendix Table D-1 Droplet size range for a typical flat-fan nozzle at 20 and 40 psi. (from Hofman et al., 1986)

Droplet size range (microns)	Percent of spray volume 20 psi	40 psi
0-21	0.1	0.4
21-63	3.0	10.4
63-105	10.7	20.1
105-147	16.2	25.4
147-210	36.7	35.3
210-294	27.5	7.7
>294	5.8	0.7

Appendix Table D-2. Percent of spray volume deposited at 4 and 8 feet downwind and the distance in feet for the volume of spray solution to drop to 1% of the total spray volume (from Hofman et al., 1986).

Nozzle ht. (in.)	Pressure (psi)	Wind speed (mph)	Percent deposited 4 ft.	8 ft.	Distance to drop to 1% of volume
14	40	3.5	3.1	0.6	7.0
27	40	3.5	5.9	1.5	13.0
18	30	5.3	9.3	2.2	14.0
18	25	9.9	10.3	3.1	15.5
18	40	9.9	9.1	3.6	17.0

To facilitate spray operations and to comply with label instructions of some pesticides, spray applications are only made in late afternoon or early morning hours when golfers are not on the golf course. This reduces the risk of exposure of people to airborne spray particles. Sufficient buffer space with tall vegetation between the golf course and housing sites and facilities (such as the clubhouse) which will be used by people will further reduce the chance of exposure to airborne pesticide particles.

The greatest danger of airborne pesticides is to the applicators of pesticides themselves. Mixing of wettable powder formulations and being in close proximity to airborne spray particles, particularly when operating spray equipment in a downwind position, places spray operators in particularly vulnerable positions. EPA and OSHA have strict standards which specify that spray operators wear appropriate protective clothing and breathing apparatuses.

C. V. of C. L. Murdoch

Charles L. Murdoch, Professor of Horticulture, Horticulture Department, University of Hawaii, 3190 Maile Way, Honolulu, HI 96822

Personal Data

Born: Atkins Arkansas, August 23, 1932

Wife: Margaret Ann (Turner); Children: Kathryn, age 19; Martha, age 17

Military Service: U. S. Navy, 1950-1955; Honorable Discharge

Education:

B. S. General Agriculture, University of Arkansas, 1959

M. S. Agronomy, University of Arkansas, 1960

Ph. D. University of Illinois, 1966

Employment:

1970-present:	Professor (1978-present); Associate Professor (1974-78); and Assistant Professor (1970-74) of Horticulture, University of Hawaii. Chairman, Horticulture Department Graduate Faculty (July,1986-present); Acting Department Chairman (December, 1983 to September, 1984). Research (60%), Extension (20%), and instruction (20%) in Turfgrass Management. State Extension Turfgrass Specialist.
1966-70:	Research Associate, Agronomy Department, University of Arkansas, Fayetteville, Arkansas.
1962-66:	Graduate Research Assistant (1964-66) and Graduate Teaching Assistant (1962-64), Agronomy Department, University of Illinois, Urbana Illinois.
1950-62:	Research Assistant, Southwest Branch Experiment Station, Hope, Arkansas.

Professional Society Membership:

American Society for Horticultural Science
American Society of Agronomy
Crop Science Society of America
Soil Science Society of America
Hawaii Turfgrass Association (President, 1975), member, Board of Directors, 1970-present.

C. V. of C. L. Murdoch

Honorary Societies:

Alpha Zeta, Sigma Xi, Gamma Sigma Delta · [Treasurer, 1981-83; Secretary, 1983-84; President, 1984-85 (local chapter)].

Publications (since 1976):

Murdoch, C. L. 1988. Watering turfgrasses. Hawaii Cooperative Extension Service. College of Tropical Agriculture and Human Resources. University of Hawaii. Turf Management Series No. 4 . 3pp.

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BIOGRAPHICAL RESUME

for

RICHARD E. GREEN, Professor of Soil Science
Department of Agronomy and Soil Science
University of Hawaii
1910 East-West Road
Honolulu, HI 96822
(808) 948-8419

PERSONAL INFORMATION:

Date of birth: March 23, 1931
Place of birth: Seward, Nebraska
Social Security No.: 523-42-7715
Married (Mary E. Mahoney), four children (ages 24-30)
Home address: 834 A 12th Avenue, Honolulu, 96816
Home phone: (808) 737-8749

EDUCATION:

B.S.	1953	Colorado State University	Agriculture
M.S.	1957	University of Nebraska	Soil Fertility
Ph.D.	1962	Iowa State University	Soil Physics

PROFESSIONAL EMPLOYMENT:

1957-58 Univ. Nebraska Instructor (Soils research)
1958-62 Iowa State Univ. Research Assoc. (Soil mgt. research)
1962-present University of Hawaii, Asst., Assoc. and Prof.

OTHER EXPERIENCE:

Sabbatical leaves:
- 1968-69 AEC Savannah River Lab., Aiken, SC
- 1975 University of Florida, Gainesville
- 1983 EPA Environ. Research Lab., Athens, GA

Occasional consultant for consulting engineers, mining company, land-use planners, developers, 1975-88
IAEA Expert in soil physics, Malaysia, Apr/May 1982
Associate Editor, SSSA Jour. (Soil Physics) 1980-86
Chairman, Div. S-1 (Soil Physics), Soil Sci. Soc. Amer., 1987

PROFESSIONAL INTERNATIONAL TRAVEL:

Australia, N.Z., Fiji (1968); Papua-New Guinea (1975); Israel, Sweden, Netherlands (1976); Philippines (1979,80); Taiwan (1980); USSR (1981); Malaysia (1982).

AWARDS:

Fellow, Soil Science Society of America (1987)

CURRENT RESEARCH PROJECTS (PI or Co-PI):

Matching Drip-Irrigation System Design and Operation to Soil Hydraulic Properties (CSRS-USDA support, 1985-89)

Pesticides and Other Organics in Soil and Their Potential for Groundwater Contamination (Western Regional Project W-82, CSRS-USDA support, 1983-88)

Evaluation of Fumigants and Non-Volatile Nematicides for Control of Reniform Nematodes (supported by special State legislative action to assist the pineapple industry, 1984-89)

Assessment of the Potential for Groundwater Contamination Due to Proposed Urban Development in the Vicinity of the Navy's Waiawa Shaft (Navy support through WRRC, 1987-89)

Implementation of a Computerized Procedure for Regulating the Sales and Use of Pesticides in Hawaii (State of Hawaii, Department of Agriculture, 1988-89)

Transformation and Sorption of Pesticides in the Vadose Zone and Impact on Mobility to Groundwater (Calif. Dept. of Food and Agric., 1987-1990)

INSTRUCTION:

Chairman of Graduate Field of Agronomy and Soil Sci., 1983-88
Graduate course, Soils 660 Hydrologic Processes in Soils
Direct thesis research of three graduate students currently
Member of several thesis committees within and outside dept.

CURRENT SERVICE:

Department:	Personnel Committee (1983 to present)
College:	Student Research Symposium Planning Committee (1988-89)
University:	University Research Council (1986-89)
	International Student Office Advisory Comm. (1986-)

APPENDIX K

BOTANICAL SURVEY, THE COUNTRY COURSES AT KAHUKU: PUNAMANO, KO'OLAULOA DISTRICT, OAHU

Char and Associates

APPENDIX K

BOTANICAL SURVEY

THE COUNTRY COURSES AT KAHUKU: PUNAMANO

KO'OLAULOA DISTRICT, O'AHU

by

Winona P. Char

CHAR & ASSOCIATES

Botanical/Environmental Consultants
Honolulu, Hawaii

Prepared for: WILLIAM E. WANKET, INC.

December 1989

BOTANICAL SURVEY
THE COUNTRY COURSES AT KAHUKU: PUNAMANO
KO'OLAULOA DISTRICT, O'AHU

INTRODUCTION

The Punamano parcel consists of approximately 605 acres of land, most of which were formerly in sugar cane cultivation. Elevation on the site ranges from 20 ft. along Kamehameha Highway to about 300 ft. on the upland portions. Old agricultural fields are now largely overgrown and covered by shrublands and grasslands composed almost exclusively of weedy introduced species. Moderate to steeply sloping areas which were not in cultivation are occupied by koa-haole shrublands or exposed, windswept scrub.

Field studies to inventory the botanical resources on the Punamano parcel were conducted in November 1989. The primary objectives of the field studies were to (1) provide a general description of the major vegetation types; (2) inventory the terrestrial, vascular flora; and (3) search for threatened and endangered plant species protected by federal and state laws.

SURVEY METHODS

Prior to undertaking the field studies, a search was made of the pertinent literature to familiarize the principal investigator with other botanical studies conducted in the general area. Topographic maps and aerial photographs were examined to determine vegetation patterns, terrain characteristics, access, boundaries, and reference points.

A walk-through survey method was employed. Uncultivated areas most likely to harbor native species, such as rocky outcrops and knolls, were more intensively surveyed. Notes were made on plant associations and distribution, substrate types, topography, exposure, etc. Species were identified in the field; plants which could not be positively determined were collected for later examination in the herbarium and for comparison with the taxonomic literature.

DESCRIPTION OF THE VEGETATION

Prior botanical studies have been made for portions of the Punamano parcel (Nagata and Char 1981; Nagata 1989). From these previous surveys, it seems that most of the uplands with the exception of the steepest slopes and ridge crests were planted in sugar cane at one time or another. Since these fields were abandoned, most have become overgrown with mixed thickets of koa-haole, Christmas berry, guava or grasslands. Steep ridge crests are characterized by low, windswept scrub. In such areas a few natives as 'ulei and 'akia may be found.

Five major vegetation types are recognized on the site and are discussed below. A list of all those species inventoried during the field studies is presented at the end of this report.

Mixed Shrubland

This vegetation type generally occurs on abandoned sugar cane fields and is the most common vegetation type encountered. Much of the uplands behind Kahuku Village were once cultivated and the fields taken out of cultivation during the successive years. Cane fields which were abandoned earlier have been invaded and largely replaced by a mixed thicket of koa-haole (Leucaena leucocephala), Christmas berry (Schinus terebinthifolius), guava (Psidium guajava), and bingabing (Macaranga tanarius), although small pockets of sugar cane (Saccharum officinarum) can occasionally be found.

In many places, the thicket is dense and very little light is able to reach the understory. Ground cover is sparse with litter and soil characterizing the understory. Only along the margins of these dense thickets, in openings, and on old cane haul roads is the ground cover abundant; among the plants found in these areas are white-flowered beggar's tick (Biden alba var. radiata), hue-hue-haole (Passiflora suberosa), Chinese violet (Asystasia gangetica), Guinea grass (Panicum maximum), sourgrass (Digitaria insularis), and wild bittermelon (Momordica charantia). In areas where the thicket is open and the shrubs spaced further apart, California grass or paragrass (Brachiaria mutica) may form dense mats with the course, grass stems spreading up into the shrubs.

Mixed thickets can also be found on some of the steeper slopes which have not been cultivated. Scattered individuals or stands of Chinese banyan (Ficus microcarpa), Port Jackson fig (Ficus rubiginosa), and ironwood (Casuarina equisetifolia) can be found in these areas.

Koa-haole Shrubland

This is the second most common vegetation type on the site. It is found on gentle to moderate slopes on the east side of the property and in drainages of gulches, usually on non-cultivated lands. Koa-haole shrubs, 10 to sometimes 20 ft. tall, form a dense, closed canopy thicket. The koa-haole shrubland is almost monodominant with few other woody species; Christmas berry is occasional and bingabing and hau (Hibiscus tiliaceus) occur as scattered clumps in drainages.

In most places, ground cover is sparse and may consist almost exclusively of koa-haole seedlings. A few plants of California grass and honohono (Commelina diffusa) can be found in the moist areas associated with drainages. Only where the koa-haole shrubs thin out is there a dense ground cover, often of California grass or Guinea grass. Margins of old trails and roadways support white-flowered beggar's tick, pluchea (Pluchea symphytifolia), huehue-haole, pohapoha (Passiflora foetida), virgate mimosa (Desmanthus virgatus), and sougrass.

Grasslands

Four type of grasslands were recognized and mapped by Nagata (1989) on portions of the project site. These have been reduced to two subtypes in this report.

a) Mixed lowland grasslands -- This first subtype occurs on the relatively level area bordering Kamehameha Highway. Sugar cane and later Sorghum and corn (Zea mays) were cultivated in this area. Since the fields have been fallow, a mixed grass association with scattered individuals or small thickets of koa-haole has become established. The dominant grasses in this association are Johnson grass (Sorghum halpense), California grass, and Guinea grass. These can occur intermixed as is most common or with only one of the species covering a small to somewhat extensive field. California grass is again associated with drainageways, where it forms dense mats, 3 to 5 ft. deep.

Scattered clumps of Christmas berry and castor bean (Ricinus communis) as well as guajava and bingabing are also found in this vegetation type. Smaller herbaceous species found here include virgate mimosa, sensitive plant (Mimosa pudica var. unijuga), asystasia, and white-flowered beggar's tick.

b) Upland grasslands -- Unlike the lowland grasslands which are composed of a varied and mixed association of grasses, the upland grasslands tend to be monodominant. Three types of upland grasslands can be recognized on the slope areas on fallow agricultural fields.

The largest of these is the Guinea grassland which is characterized by dense grass clumps, 4 to 8 ft. tall. A few shrubs of Christmas berry and koa-haole can be found in this grassland but other species are usually uncommon.

The second largest of the upland grasslands is composed of California grass. In this grassland, California grass forms dense spreading mats, 5 to 7 ft. tall, again with a few scattered shrubs of koa-haole and Christmas berry.

Both Guinea grass and Californis grass grow rapidly and tend to exclude other species. Only where the grasses have thinned out as on old cane haul roads, trails, and exposed areas, are other species more common; these include nettle-leaved vervain (Stachytarpheta urticifolia), partridge pea (Chamaecrista nictitans), white-flowered beggar's tick, pitted beardgrass (Bothriochloa pertusa), sensitive plant, and ricegrass (Paspalum scrobiculatum).

The third grassland type, Digitaria grassland, occupies only a small area along the access road leading to the windfarm site. Pangolagrass (Digitaria decumbens) and hairy crabgrass (Digitaria ciliaris) have been planted on this site for soil erosion control. Unfortunately, the plants have not completely established and spread onto this site. During the earlier survey by Nagata and Char in 1981, it was noted that the grasses did not form a complete cover and bare areas were common. Vegetation is sparse in this grassland and only a few other weedy species such as three-flowered beggarweed (Desmodium trflorum), sensitive plant, partridge pea, and koa-haole have become established.

Exposed Scrub

On the summits and windward facing, steep, upper slopes of ridges the vegetation consists of dwarfed, windblown shrubs and grasses. The native 'ulei shrub (Osteomeles anthyllidifolia) is often the dominant species in this vegetation type, where it forms dense, tangled, woody mats up to 3 ft. thick. Common associates of the exposed scrub are nettle-leaved vervain and partridge pea. Wind-pruned koa-haole and Christmas berry are scattered through the scrub. Grasses are a common feature of this vegetation type and

and include broomsedge (Andropogon virginicus), sourgrass, golden beardgrass (Chrysopogon aciculatus), and Natal redtop (Rhyncheltrum repens). Other natives found associated with the exposed scrub are huehue (Cocculus trilobus), 'akia (Wikstroemia oahuensis), 'ilima (Sida fallax), and 'uhaloa (Waltheria indica).

Abandoned Sugar Cane Fields/ Abandoned Agricultural Fields
Most of the uplands were in sugar cane at one time. Today, the majority of these cane fields have been overgrown by weedy shrublands or grasslands. However, a few small pockets of sugar cane still persists; these probably represent fields which were abandoned last. California grass is abundant along the margins of most of these fields, and, eventually these fields will be replaced by California grasslands. Few other species are associated with thses remnant fields.

Along portions of Kamehameha Highway and the military access road are a few fields which were until recently cultivated for crops other than sugar cane, these were probably vegetable crops. Most of the fields are now largely overgrown with Guinea grass and California grass as well as a mixed assortment of weedy species such as white-flowered beggar's tick, sensitive plant, and virgate mimosa. Again the ubiquitous koa-haole can be found scattered through these fields. In places, koa-haole and the wild variety of cane cane be found in long hedgerows where they were used as windbreaks for the vegetable crops. Scattered through these fields are afew clumps of bananas, usually associated with packing sheds or other structures.

DISCUSSION AND RECOMMENDATIONS

Vegetation on most of the project site is dominated by introduced or alien species. Lands formerly in sugar cane cultivation are now largely overgrown by mixed shrublands, koa-haole thickets or grasslands, although a few remnant pockets of cane still persist. A few, small fields used for growing vegetable crops are overgrown with weedy species associated with agricultural lands. Lands not previously cultivated support koa-haole thickets or mixed thickets with scattered stands of trees. Surveys conducted on nearby areas (Char 1989a, 1989b) and on portions of the project site (Nagata and Char 1981; Nagata 1989) have recorded similiar findings.

Only on exposed ridges and steep slopes are native species abundant to common. 'Ulei, a native member of the rose family, is the dominant species in such areas, forming tangled mats on ridge tops.

Two individuals of the native caper or maiapilo (Capparis sandwichiana) are known from the general area and have been discussed in two previous surveys (Nagata and Char 1981; Nagata 1989). One plant is located on limestone outcrops across from Tanaka Store along Kamehameha Highway. The other plant is found on another limestone outcrop at about 175 ft. elevation, northeast of and outside the project site. Maiapilo occurs throughout the main Hawaiian Islands in lowlands and coastal areas; it is also found on a few of the leeward Hawaiian Islands (Wagner et al. in press). Although, at present, it is a category 1 candidate endangered species, it is expected to be downgraded to a less critical category 2 status later (Nagata 1989).

The proposed golf course development is not expected to have a significant negative impact on the botanical resources on the site as it will affect areas already disturbed by past agricultural activities. These areas are vegetated largely by weedy introduced or alien species. The steeper slopes and ridge tops which support a few remnant native plants will not be developed. None of these native species is officially listed as threatened or endangered by the federal and state agencies (U. S. Fish and Wildlife Service 1985; Herbst 1987). The one candidate endangered species, the maiapilo, located across from Tanaka store, is on the boundary of the project site on a rough coralline outcrop. Golf course plans do not include this area for landscaping or development.

Of concern, are the effects of removal of upland vegetation and the resulting increase in soil erosion. Areas grubbed and cleared should be landscaped as soon as possible. Other standard precautions for erosion control, such as siltation ponds, should also be initiated as soon as possible.

Use of native material for landscaping should also be considered. These plants are adapted to the local conditions of the site, especially the constant windy nature of the site. Natives such as 'ulei, 'akia, and maiapilo are easy to cultivate and are attractive specimens.

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PLANT SPECIES LIST -- THE COUNTRY COURSES AT KAHUKU: PUNAMANO

Following is a checklist of all those terrestrial, vascular plant species inventoried during the field studies. Plant families are arranged within each of four groups: Ferns and Fern Allies, Conifers, Monocots and Dicots. Taxonomy of the Ferns and Fern Allies follow Lamoureux (1984); Conifers are in accordance with St. John (1973); and the flowering plants (Monocots and Dicots) follow Wagner _et al_. (in press). In most cases, the English names follow St. John (1973); Hawaiian names are in accordance with St. John (1973) or Porter (1972).

For each species, the following information is provided:

1. Scientific name with author citation.
2. Common English and/or Hawaiian name, when known.
3. Biogeographic status. The following symbols are used:
   - E = endemic = native only to the Hawaiian Islands
   - I = indigenous = native to the islands and also one or more other geographic area(s)
   - P = Polynesian = plants of Polynesian introduction prior to Western contact (1778); not native
   - X = introduced or alien = all those plants brought to the islands intentionally or accidentally after Western contact; not native.

SCIENTIFIC NAME	COMMON NAME	STATUS
FERNS AND FERN ALLIES		
HEMIONITIDACEAE (Gold Fern Family)		
Pityrogramma calomelanos (L.) Link	gold fern	X
LINDSAEACEAE (Lace Fern Family)		
Sphenomeris chinensis (L.) Maxon	pala'a, palapala'a	I
NEPHROLEPIDACEAE (Sword Fern Family)		
Nephrolepis multiflora (Roxb.) Jarrett ex Morton	hairy sword fern	X
POLYPODIACEAE (Common Fern Family)		
Phymatosorus scolopendria (Burm.) Pic.-Ser.	laua'e, lauwa'e	X
PSILOTACEAE (Psilotum Family)		
Psilotum nudum (L.) Beauv.	moa	I
PTERIDACEAE (Pteris Family)		
Pteris vittata L.	pteris	X
THELYPTERIDACEAE (Downy Woodfern Family)		
Christella dentata (Forsk.) Brownsey & Jermy	downy woodfern	X
CONIFERS		
ARAUCARIACEAE (Araucaria Family)		
Araucaria heterophylla (Salisb.) Franco	Norfolk Island pine	X

SCIENTIFIC NAME	COMMON NAME	STATUS
FLOWERING PLANTS -- MONOCOTS		
AGAVACEAE (Agave Family)		
Agave sisalana Perrine	sisal	X
Cordyline fruticosa (L.) A. Chev.	ti, ki	P
ARECACEAE (Palm Family)		
Cocos nucifera L.	coconut, niu	P
Phoenix dactylifera L.	date palm	X
COMMELINACEAE (Spiderwort Family)		
Commelina benghalensis L.	hairy honohono	X
Commelina diffusa N. L. Burm.	honohono	X
CYPERACEAE (Sedge Family)		
Cyperus rotundus L.	nutgrass, nut sedge	X
MUSACEAE (Banana Family)		
Musa X paradisiaca L.	banana, maia	P
ORCHIDACEAE (Orchid Family)		
Spathoglottis plicata Blume	Philippine ground orchid	X
PANDANACEAE (Screwpine Family)		
Pandanus tectorius S. Parkinson ex Z.	hala, puhala	I?
POACEAE (Grass Family)		
Andropogon virginicus L.	broomsedge	X
Bothriochloa pertusa (L.) A. Camus	pitted beardgrass	X
Brachiaria mutica (Forssk.) Stapf	California grass, paragrass	X
Cenchrus ciliaris L.	buffel grass	X
Cenchrus echinatus l.	common sandbur, 'ume'alu	X
Chloris barbata (L.) Sw.	swollen finger grass, mau'ulei	X

SCIENTIFIC NAME	COMMON NAME	STATUS
Chloris divaricata R. Br.	stargrass	X
Chloris radiata (L.) Sw.	radiate finger grass	X
Chrysopogon aciculatus (Retz.) Trin	golden beardgrass, manienie 'ula	I?
Coix lachryma-jobi L.	Job's tears	X
Cynodon dactylon (L.) Pers.	Bermuda grass, manienie	X
Digitaria ciliaris (Retz.) Koeler	crabgrass	X
Digitaria decumbens Stent	pangolagrass	X
Digitaria insularis (L.) Mez. ex Ekman	sourgrass	X
Digitaria radicosa (Presl) Miq.		X
Echinochloa colona (L.) Link	jungle rice	X
Echinochloa crus-galli (L.) P. Beauv.	barnyard rice	X
Eleusine indica (L.) Gaertn.	wiregrass, goosegrass	X
Heteropogon contortus (L.) P. Beauv. ex Roem. & Schult.	pili, piligrass	I
Hyparrhenia rufa (Nees) Stapf	thatching grass	X
Melinis minutiflora P. Beauv.	molasses grass	X
Oplismenus hirtellus (L.) Beauv.	basket grass	X
Panicum maximum Jacq.	Guinea grass	X
Panicum maximum var. trichoglume Eyles ex Robyns	green panicgrass	X
Paspalum conjugatum Bergius	Hilo grass, mau'u Hilo	X
Paspalum frimbriatum Kunth	fimbriate paspalum	X
Paspalum scrobiculatum L.	ricegrass	I?
Pennisetum purpureum Schumach	Elephant grass, Napier grass	X
Rhynchelytrum repens (Willd.) Hubb.	Natal redtop	X
Saccharum officinarum L.	sugar cane, ko	P
Setaria gracilis Kunth	yellow foxtail	X
Setaria verticillata (L.) P. Beauv.	bristly foxtail	X
Sorghum halpense (L.) Pers.	Johnson grass	X
Sporobolus indicus (L.) R. Br.	West Indian dropseed	X
ZINGIBERACEAE (Ginger Family)		
Zingiber zerumbet (L.) Sm.	'awapuhi-kuahiwi	P

SCIENTIFIC NAME	COMMON NAME	STATUS
FLOWERING PLANTS -- DICOTS		
ACANTHACEAE (Acanthus Family)		
Asystasia gangetica (L.) T. Anderson	Chinese violet	X
AMARANTHACEAE (Amaranth Family)		
Amaranthus spinosus L.	spiny amaranth, pakai kuku	X
Amaranthus viridus L.	slender amaranth, pakai	X
ANACARDIACEAE (Mango Family)		
Mangifera indica L.	mango	X
Schinus terebinthifolius Raddi	Christmas berry, wilelaiki	X
APIACEAE (Parsley Family)		
Centella asiatica (L.) Urb.	Asiatic pennywort, pohekula	X
Ciclospermum leptophyllum (Pers.) Sprague	fir-leaved celery	X
ARALIACEAE (Ginseng Family)		
Schefflera actinophylla (Endl.) Harms.	octopus tree, umbrella tree	X
ASTERACEAE (Sunflower Family)		
Acanthospermum australe (Loefl.) Ktze.	spiny-bur, star-bur	X
Ageratum conyzoides L.	maile hohono	X
Bidens alba var. radiata (Schultz-Bip.) Ballard ex Melchert	white-flowered beggar's tick	X
Bidens pilosa l.	Spanish needle, ko'oko'olau	X
Calyptocarpus vialis Less.	hierba del cabello	X
Conyza bonariensis (L.) Cronq.	hairy horseweed, ilioha	X
Crassocephalum crepidioides (Benth.) S. Moore	crassocephalum	X
Eclipta alba (L.) Hassk.	false daisy	X
Emilia fosbergii Nicolson	pualele	X
Pluchea indica (L.) Less.	Indian pluchea	X
Pluchea symphytifolia (Mill.) Gillis	pluchea, sourbush	X

SCIENTIFIC NAME	COMMON NAME	STATUS
Sonchus oleraceus L.	sow thistle, pualele	X
Synedrella nodiflora (L.) Gaertn.	synedrella	X
Tridax procumbens L.	coat buttons	X
Verbesina encelioides (Cav.) Benth. & Hook.	golden crownbeard	X
Vernonia cinerea var. parviflora (Reinw.) DC.	little ironweed	X
Wedelia trilobata (L.) Hitchc.	wedelia	X
Xanthium strumarium var. canadense (Mill.) Torr. & A. Gray	cocklebur	X
Youngia japonica (L.) DC.	oriental hawksbeard	X
BIGNONIACEAE (Bignonia Family)		
Spathodea campanulata P. Beauv.	African tulip	X
BRASSICACEAE (Mustard Family)		
Coronopus didymus (L.) Sm.	swinecress	X
BUDDLEJACEAE (Butterfly Bush Family)		
Buddleia asiatica Lour.	dog tail, huelo 'ilio	X
CAPPARACEAE (Caper Family)		
Capparis sandwichiana DC.	maiapilo, pilo	E
CARICACEAE (Papaya Family)		
Carica papaya L.	papaya, mikana	X
CASUARINACEAE (Ironwood Family)		
Casuarina equisetifolia L.	ironwood	X
Casuarina sp.	ironwood	X
CHENOPODIACEAE (Goosefoot Family)		
Atriplex semibaccata R. Br.	Australian saltbush	X
Chenopodium murale L.	'aheahea	X
CONVOLVULACEAE (Morning-glory Family)		
Ipomoea alba L.	moon flower, koali-pehu	X

SCIENTIFIC NAME	COMMON NAME	STATUS
Ipomoea indica (J. Burm.) Merr.	koali-'awania	I
Ipomoea obscura (L.) Ker-Gawl.	field bindweed	X
Ipomoea triloba L.	little bell, pink bindweed	X
Merremia tuberosa (L.) Rendle	wood rose	X
CUCURBITACEAE (Gourd Family)		
Coccinea grandis (L.) Voigt	scarlet-fruited gourd	X
Momordica charantia L.	wild bittermelon	X
EPACRIDACEAE (Heath Family)		
Styphelia tameiameiae (Cham.) F. Muell.	pukiawe	I
EUPHORBIACEAE (Spurge Family)		
Aleurites moluccana (L.) Willd.	kukui, tutui	P
Chamaesyce hirta (L.) Millsp.	hairy spurge, garden spurge	X
Chamaesyce hypericifolia (L.) Millsp.	graceful spurge	X
Chamaesyce hyssopifolia (L.) Sm.	spurge	X
Chamaesyce prostrata (Aiton) Sm.	prostrate spurge	X
Euphorbia heterophylla L.	Mexican fireweed	X
Macaranga tanarius (L.) Müll. Arg.	bingabing	X
Phyllanthus debilis Klein ex Willd.	phyllanthus weed	X
Ricinus communis L.	castor bean, koli	X
FABACEAE (Pea Family)		
Acacia confusa Merr.	Formosan koa	X
Caesalpinia major (Medik.) Dandy & Exell	gray nickers, kakalaioa	X?
Canavalia ensiformis (L.) DC.	Jack bean	X
Chamaecrista nictitans (L.) Moench	partridge pea, lauki	X
Crotalaria incana L.	fuzzy rattlebox, kukae hoki	X
Crotalaria pallida Aiton	rattlepod	X
Desmanthus virgatus (L.) Willd.	slender mimosa	X
Desmodium incanum DC.	Spanish clover, ka'imi	X
Desmodium triflorum (L.) DC.	three-flowered beggarweed	X
Indigofera suffruticosa Mill.	indigo, 'iniko	X
Leucaena leucocephala (Lam.) de Wit	koa-haole	X
Macroptilium lathyroides (L.) Urb.	wild bean, cow pea	X
Medicago lupulina L.	black medic	X

SCIENTIFIC NAME	COMMON NAME	STATUS
Mimosa pudica var. unijuga (Duchass. & Walp.) Griseb.	sensitive plant, sleeping grass, puahilihila	X
LAMIACEAE (Mint Family)		
Hyptis pectinata (L.) Poit.	comb hyptis	X
Leonotis nepetifolia (L.) R. Br.	lion's-ear	X
Stachys arvensis L.	staggerweed	X
MALVACEAE (Mallow Family)		
Abutilon grandifolium (Willd.) Sweet	hairy abutilon, mao	X
Hibiscus tiliaceus L.	hau	I?
Malva parviflora L.	cheese weed	X
Malvastrum coromandelianum (L.) Garcke	false mallow, hauuoi	X
Sida fallax Walp.	'ilima	I
Sida rhombifolia L.	Cuba jute	X
Sida spinosa L.	prickly sida	X
MENISPERMACEAE (Moonseed Family)		
Cocculus trilobus (Thunb.) DC.	huehue	I
MORACEAE (Mulberry Family)		
Ficus microcarpa L. f.	Chinese banyan	X
Ficus rubiginosa Desf.	Port Jackson fig	X
MYRTACEAE (Myrtle Family)		
Psidium cattleianum sabine	strawberry guava, waiawi 'ula'ula	X
Psidium guajava L.	guava, kuawa	X
Syzygium cumini (L.) Skeels	Java plum, palama	X
NYCTAGINACEAE (Four-o'clock Family)		
Boerhavia coccinea Mill.	red-flowered boerhavia	X
Boerhavia repens L.	alena, anena	I
Mirabilis jalapa L.	four-o'clock	X

SCIENTIFIC NAME	COMMON NAME	STATUS
ONAGRACEAE (Evening Primrose Family)		
Ludwigia octovalvis (Jacq.) Raven	primrose willow, kamole	P?
OXALIDACEAE (Wood Sorrel Family)		
Oxalis corniculata L.	yellow wood sorrel, 'ihi'ai	P?
Oxalis corymbosa DC.	pink wood sorrel, 'ihi pehu	X
PASSIFLORACEAE (Passion Flower Family)		
Passiflora edulis Sims	passion fruit, liliko'i	X
Passiflora foetida L.	red-fruited passion flower, pohapoha	X
Passiflora suberosa L.	huehue haole	X
PLANTAGINACEAE (Plantain Family)		
Plantago lanceolata L.	narrow-leaved plantain	X
Plantago major L.	common plantain, lau-kahi	X
PLUMBAGINACEAE (Leadwort Family)		
Plumbago zeylanica L.	'ilie'e	I
PORTULACACEAE (Purslane Family)		
Portulaca oleracea L.	pigweed	X
PRIMULACEAE (Primrose Family)		
Anagallis arvensis L.	scarlet pimpernel	X
PROTEACEAE (Protea Family)		
Grevillea robusta A. Cunn.	silk oak, 'oka-kaliko	X
ROSACEAE (Rose Family)		
Osteomeles anthyllidifolia (Sm.) Lindl.	'ulei	I
RUBIACEAE (Coffee Family)		
Morinda citrifolia L.	noni	P

SCIENTIFIC NAME	COMMON NAME	STATUS
Spermacoce assurgens Ruiz. & Pav.	buttonweed	X
RUTACEAE (Citrus Family)		
Murraya paniculata (L.) Jack	mock orange	X
SOLANACEAE (Nightshade Family)		
Lycopersicon pimpinellifolium (Jusl.) Mill.	wild tomato, currant tomato	X
Solanum americanum Mill.	popolo	I?
THYMELAEACEAE ('Akia Family)		
Wikstroemia oahuensis (A. Gray) Rock	'akia	E
VERBENACEAE (Verbena Family)		
Lantana camara L.	lantana, lakana	X
Stachytarpheta jamaicensis (L.) Vahl	Jamaica vervain, owi, oi	X
Stachytarpheta urticifolia (Salisb.) Sims	nettle-leaved vervain	X
Verbena litoralis Kunth	weed verbena, oi	X

Addendum:

STERCULIACEAE (Cocoa Family)		
Waltheria indica L.	'uhaloa, hi'aloa	I?

CHAR & ASSOCIATES
Botanical/Environmental Consultants
4471 Puu Panini Ave.
Honolulu, Hawaii 96816
(808) 734-7828

WINONA P. CHAR

EDUCATION

Master of Science (M.S.) degree in the Botanical Sciences, University of Hawaii, Manoa. December 1983. Area of specialization: Plant taxonomy with special emphasis on the native Hawaiian flora. M.S. thesis topic: "A revision of the Hawaiian species of Sesbania (Leguminosae)."

Bachelor of Arts (B.A.) in the Botanical Sciences, University of Hawaii, Manoa. May 1970.

Graduate of Kaimuki High School. June 1965.

EXPERIENCE

Botanical Consultant - 1976 to present; self-employed.
Field investigation, data analysis, and preparation of findings for the biological section in Environmental Impact Statements (EIS). The scope of work involves: (1) a discussion of rare, threatened or endangered plant species found on the study site; (2) a general description of the major vegetation types found on the study site; (3) an inventory of the flora on the study site; (4) the identification of areas of potential environmental problems or concerns; and (5) a summary of the extant botanical knowledge of the study site.

Natural Area Biologist, SR-21 - July 1985 to June 1986. One year funding. Natural Area Reserves System (NARS), State Department of Land and Natural Resources. Major duties: Plan, develop, and direct native and non-native plant and animal surveys within the reserves system. Evaluate existing and potential impact of non-native species within each reserve. Develop site-specific management programs as well as direct on-site management activity. Supervise a lower-level NARS biologist and, when available, part-time and volunteer workers.

Horticulturist, SR-18 - May 1978 to September 1979. Honolulu Botanic Gardens, City and County Department of Parks and Recreation. Major duties: Program director, Exceptional Trees Program. Working with the City Administration and the City Council in establishing a permanent staff organization and Arborist Advisory Committee necessary to fulfill the Exceptional Trees' Law; documentation and identification of the Exceptional Trees designated by the City and County Ordinance; identification of additional trees to the list. End of contract; left to complete M.S. degree program.

INTERESTS

Hiking, fishing native plants, bonsai, photography, trivia collector.

Member of the following organizations:

- Hawaiian Botanical Society. Life membership. Served as Chairman, Science Fair Committee, 1981, 1983. Secretary 1978, 1979. Director 1977. Native Coastal Plants Committee 1986.

- The Nature Conservancy. Sponsor 1986.

Community service:

- The Nature Conservancy. Resource person. Scientific Advisory Committee.

- State Department of Education (DOE). Resource person and lecturer, native plants and island ecosystems.

- Marine Advisory Program, Sea Grant, University of Hawaii. Resource person, strand vegetation.

PERSONAL BACKGROUND

One-quarter Hawaiian, that's why the active interest in native plants and island ecosystems. Single, 5 ft. 5 in. tall, roughly 128 lbs. Born 16 May 1947(a baby boomer).
References will be furnished on request.

PUBLICATIONS

Char, W. P. 1976. Field studies of the Sesbania complex on the island of Hawaii. Pacific Tropical Botanical Garden Bulletin 6(2): 41.

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APPENDIX L

AVIFAUNAL AND FERAL MAMMAL SURVEY OF PROPERTY PROPOSED FOR GOLF COURSES TO BE KNOWN AS THE COUNTRY COURSES AT KAHUKU, KAHUKU, OAHU

Phillip L. Bruner

APPENDIX L

AVIFAUNAL AND FERAL MAMMAL SURVEY OF PROPERTY PROPOSED FOR GOLF COURSES TO BE KNOWN AS THE COUNTRY COURSES AT KAHUKU, KAHUKU, OAHU

Prepared for

William E. Wanket Inc.

By

Phillip L. Bruner
Assistant Professor of Biology
Director, Museum of Natural History
BYU-H
Laie, Hawaii 96762

15 November 1989

AVIFAUNAL AND FERAL MAMMAL SURVEY OF PROPERTY PROPOSED FOR GOLF COURSES TO BE KNOWN AS THE COUNTRY COURSES AT KAHUKU, KAHUKU, OAHU

INTRODUCTION

The purpose of this report is to summarize the findings of a two day (9,11 November 1989) faunal field survey of two properties located near Punamano and Malaekahana, Kahuku, Oahu (see Fig.1,2). In addition references to pertinent literature are also provided in order to give a more comprehensive view of the potential wildlife that might occur in the area. The objectives of the faunal survey were to:

1- Determine what species of birds and mammals occur or potentially might occur on the property.

2- Determine, within the time constraints available, the relative abundance of each species.

3- Check for the presence of any endangered species and note their particular use of the site ie. feeding, nesting, loafing.

4- Identify any special habitats that may occur on the sites and suggest ways in which they might be protected.

SITE DESCRIPTION AND METHODS OF SURVEY

Both properties are located mauka of Kamehameha Highway near Kahuku (Fig.1,2). Vegetation consists of a variety of introduced species the most common of which are: Koa Haoli (Leucaena leucocephala), Christmas Berry (Schinus terebinthifolius), Indian Pluchea (Pluchea indica) and an assortment of grass and weed species. The overall appearance of each property is one of parkland with scattered trees and open grassy fields. The topography is generally flat with gentle rolling hills.

The survey was conducted by following the roads and trails through each site. A total of 22 census stations were established at the two sites and eight minute counts of all birds seen and heard at these stations were recorded (Fig.1,2). Tallys of birds observed between these census stations were also kept. From these data relative abundance estimates were calculated (see Table One). Mammals were surveyed by visual means and by noting the presence of scats and tracks. No trapping of mammals was attempted in order to determine their relative abundance.

Scientific names used in this report follow those given in the most recent American Ornithologist's Union Checklist (A.O.U. 1983), Hawaii's Birds (Hawaii Audubon Society 1989), A Field Guide to the Birds of Hawaii and the Tropical Pacific (Pratt et al. 1987), Mammal species of the world (Honacki et al. 1982), Tropical Trees of the Pacific (Hargreaves and Hargreaves 1970) and Hawaiian Coastal Plants (Merlin 1980).

RESULTS AND DISCUSSION

Endemic Species:

The Punamano Unit of the James Campbell National Wildlife Refuge is located makai of the Punamano property (Fig.1). This refuge provides habitat for four endangered species: Common Moorhen (Gallinula chloropus sandvicensis), American Coot (Fulica americana alai), Black-necked Stilt (Himantopus mexicanus knudseni) and Koloa or Hawaiian Duck (Anas wyvilliana). No wetlands exist on the Punamano property proposed for golf course development. One irrigation pond was located on the Malaekahana property. This pond contained a pair of Koloa. Koloa are very opportunistic and will utilize not only ponds but streams and ditches as well.

The Pueo or Short-eared Owl (Asio flammeus sandwichensis)is rare on Oahu but does occur in the Kahuku area. This species of owl forages during the day as well as at night. No Pueo were observed on this survey.

Indigenous Species:

The only resident indigenous species recorded was the Black-crowned Night Heron (Nycticorax nycticorax). Two herons were observed flying over the Malaekahana property. Migratory birds observed on the survey include: Pacific Golden Plover (Pluvialis fulva) and Ruddy Turnstone (Arenaria interpres). A total of two plover were found on the Punamano property and 30 at Malaekahana.

One turnstone was also seen on the Malaekahana site. Plover are known to be site-faithful and territorial which makes it possible to determine their abundance in a particular area with a reasonable degree of accuracy (Johnson et al. 1981, 1989). The only other shorebird that might be found in the area is the Bristle-thighed Curlew (Numenius tahitiensis). This species can be found in upland grasslands and coastal habitats during September as it migrates through Hawaii on its way to the South Pacific (Pratt et al. 1987, Hawaii Audubon Society 1989).

Introduced (Exotic) Species:

A total of 16 species of exotic birds were recorded on the survey. Table One shows the relative abundance of each species based on the data from this two day survey. Two exotic species not recorded but likely present at times on the property are Barn Owl (Tyto alba) and Chestnut Mannikin (Lonchura malacca). Bruner (1989a, 1989b) obtained a similar list of exotic species on lands elsewhere in the Kahuku area.

Feral Mammals:

Mongooses (Herpestes auropunctatus) and cats were seen on both properties. Rats and mice were not recorded but undoubtedly are resident at these sites. This survey found no unusual concentrations of mammals. The endemic and endangered Hawaiian Hoary Bat (Lasiurus cinerus semotus) is known from Oahu (Tomich 1986) but was not recorded on this survey.

CONCLUSIONS AND RECOMMENDATIONS

A two day survey can provide only a brief glimpse of the use of the habitat by wildlife. Species composition and abundance vary depending on the time of year and the availability of resources. Some species are common for a time and then decline or disappear althogether (William 1987). The conclusions that can be drawn from this field survey are:

1- The variety of habitats available at these two sites contain the typical array of introduced species of birds one would expect to find at this locality on Oahu. The diversity and abundance of exotic species should decline following the construction of golf courses and the subsequent loss of a more diversified habitat.

2- Native birds at these sites are limited due to inappropriate habitat ie. absence of good wetlands and native vegetation. The most abundant native bird in this area is the migratory Pacific Golden Plover. This species utilizes open grassy habitat such as pastures and lawns. Their numbers should actually increase following the development of the golf courses.

3- Feral mammal populations will decline following development due to loss of cover and the construction of a more monotypic environment.

CONCERNS AND RECOMMENDATIONS

1- The close proximity of the Punamano Unit of the James Campbell National Wildlife Refuge down slope from the proposed Punamano golf courses is a concern. Ground water from the golf course operations may contain pesticides and herbicides that could potentially contaminate the refuge water supply. A study of the likelyhood of this problem and measures that would be needed to protect the refuge should be conducted. Punamano is an important wetland for migratory water fowl as well a for native resident waterbirds. The integrity of this refuge must not be violated. Contamination of its water would quickly reduce the value of this essential wetland.

2- The Malaekahana property does not contain any natural wetlands but irrigation ponds do provide habitat for Koloa and Black-crowned Night Heron. If water features are to be arpart of the golf course design these "ponds" or water traps could be made attractive to waterbirds as well as to the appearance of the golf course if they were planted with emergent vegetation around the edges of the pond. This vegetation would provide cover for waterbirds and would present a more suitable habitat than the usual open sterile looking ponds seen on most golf courses.

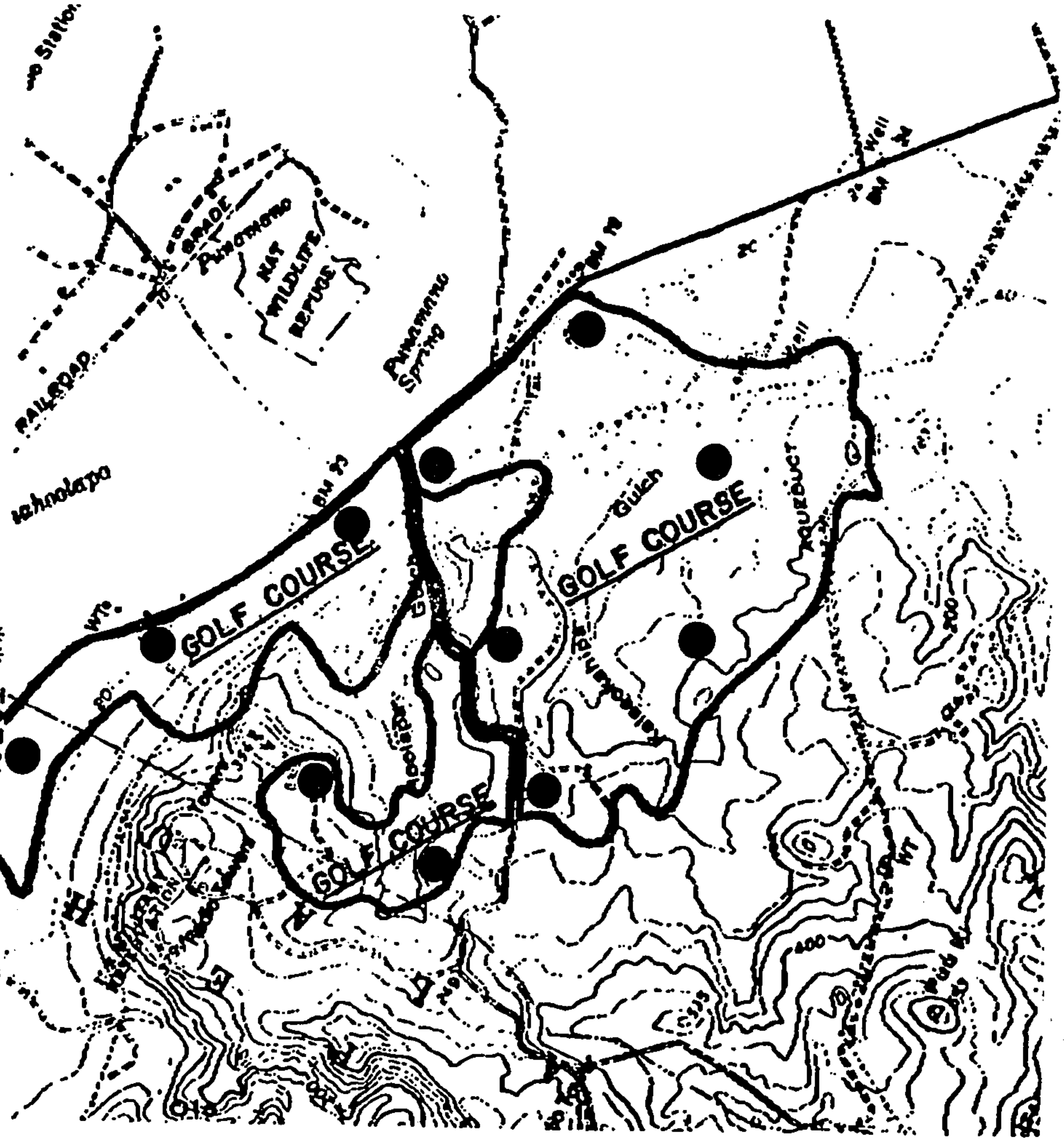

Fig. 1. Proposed golf course sites at Punamano, Kahuku. Census stations marked by solid circles.

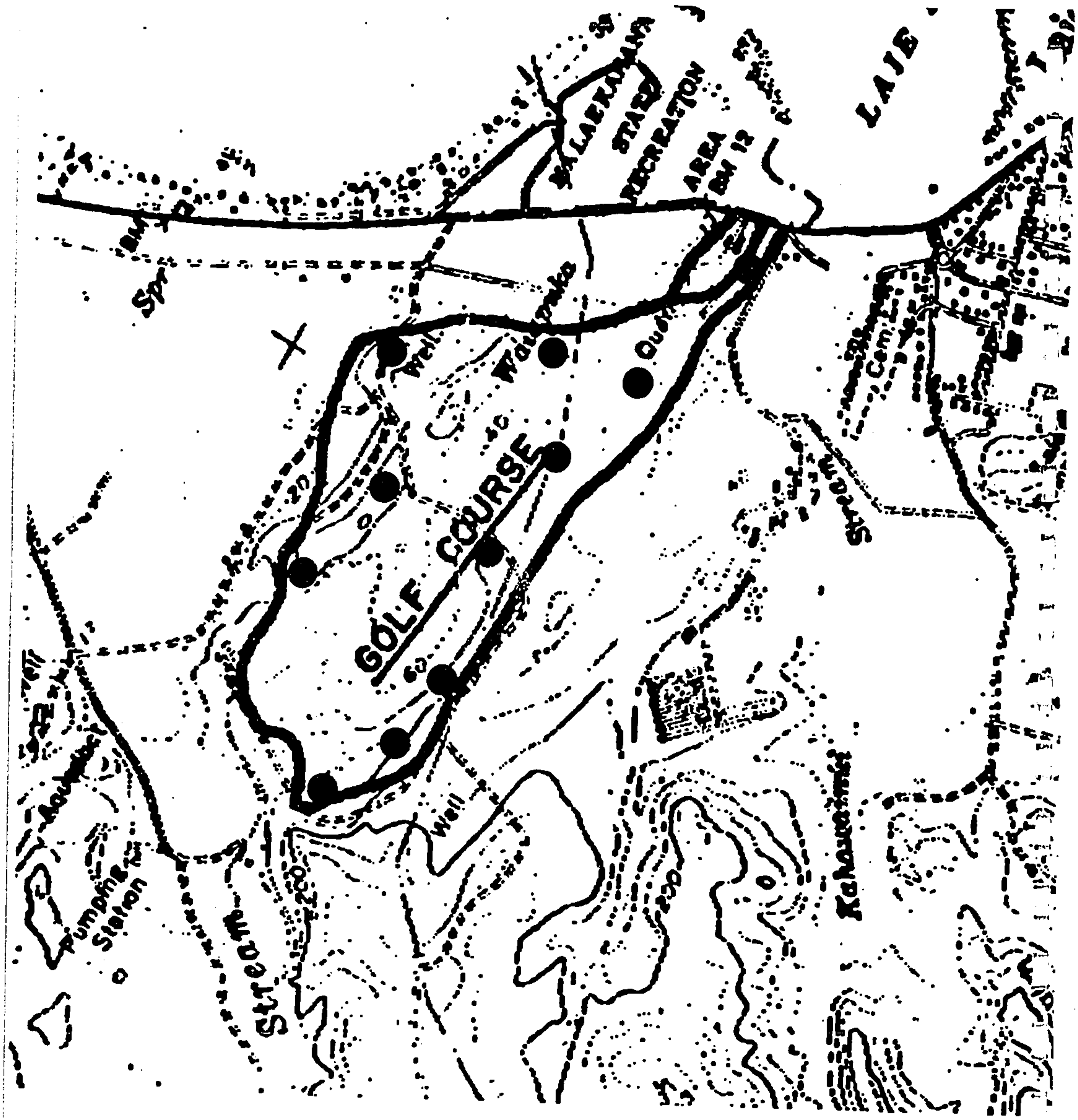

Fig. 2. Proposed golf course site at Malaekahana, Kahuku.
Census stations marked by solid circles.

TABLE 1

Relative abundance of exotic birds recorded on proposed golf course sites at Punamano and Malaekahana.

COMMON NAME	SCIENTIFIC NAME	RELATIVE ABUNDANCE* Punamano	Malaekahana
Cattle Egret	_Bulbucus ibis_	C = 6	C = 8
Ring-necked Pheasant	_Phasianus colchicus_	R = 2	R = 5
Spotted Dove	_Streptopelia chinensis_	U = 3	C = 5
Zebra Dove	_Geopelia striata_	A = 11	A = 12
Common Myna	_Acridotheres tristis_	A = 12	C = 9
Japanese White-eye	_Zosterops japonicus_	A = 14	A = 11
Japanese Bush-warbler	_Cettia diphone_	U = 2	A = 10
Northern Cardinal	_Cardinalis cardinalis_	U = 2	U = 3
Red-crested Cardinal	_Paroaria coronata_	U = 2	C = 6
White-rumped Shama	_Copsychus malabaricus_	U = 2	U = 4
Red-vented Bulbul	_Pycnonotus cafer_	A = 16	A = 12
House Sparrow	_Passer domesticus_	---	R = 4
House Finch	_Carpodacus mexicanus_	R = 10	C = 8
Java Sparrow	_Padda oryzivora_	---	R = 2
Nutmeg Mannikin	_Lonchura punctulata_	R = 18	C = 8
Common Waxbill	_Estrilda astrild_	C = 9	C = 9

* (see page 10 for key to relative abundance symbols)

KEY TO TABLE 1

Relative abundance = determined by frequency on eight minute counts in appropriate habitat.

A = abundant (10+)

C = common (5-10)

U = uncommon (1-5)

R = rare or recorded but not on census stations (number which follows is total recorded during the field survey)

- = species not recorded at that site

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PROFESSIONAL VITA

Phillip Lloyd Bruner
Assistant Professor of Biology
Director, Museum of Natural History
BYU-Hawaii
Laie, Hawaii 96762

Biographical Data

Born: Salt Lake City, Utah 4-8-44
Resided in Hawaii since 1966

Educational Preparation

B.S. Biology Church College of Hawaii 1970
M.S. Zoology Louisana State University 1974
Graduate work University of Hawaii 1976-1986

Work Experience

Academic Advisor and part time instructor BYU-H 1974-1978
Assistant Professor of Biology and Director, Museum of Natural History at BYU-H 1978-present
Environmental Consultant

Research

1970-1971 Ornithological survey of French Polynesia
1976,1978 " " " Micronesia
1977 " " " Samoa, Fiji, Tonga
1979-present Behavorial ecology study of the wintering behavior of Pacific Golden Plover at BAFS, Oahu
1984 Ornithological survey of Austral Islands, French Polynesia
1985,1987 " " " Southern Marquesas Islands, French Polynesia
1986-present Morphometric study of Black-crowned Night Heron in Hawaii.

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Other associated professional experience:

President, Hawaii Audubon Society 1986,1987
Animal Species Advisory Commission - State of Hawaii 1988-1992

Previous Ornithological Survey/Work Experience

Contractor: Ahuimanu Productions
Project:
1- Ornithological survey of Hawaiian Wetlands. 1977.
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Contractor: The Hawaii State Dept. of Planning and Economic Develop.
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6- An avifaunal and feral mammal survey of property for the Kahuku Seafood Farms, Oahu. 1980.
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Contractor: Belt, Collins and Associates (cont.)
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APPENDIX M

MARKET ASSESSMENT FOR THE PROPOSED COUNTRY COURSES AT KAHUKU

John Zapotocky

Market Assessment for the Proposed COUNTRY COURSES AT KAHUKU

Punamano Area Containing 54 of a Planned 72 hole Golf Complex

Prepared For:
The Estate of James Campbell

Prepared By:
John Zapotocky, Consultant

December 1989

TABLE OF CONTENTS

Executive Summary

The Estate of James Campbell proposes to develop a 72 hole golf complex in the Koolauloa Development Plan area to be known as the "Country Courses at Kahuku". Of the proposed 72 holes, 54 holes will be located at Punamano. The other 18 holes of the complex are located at Malaekahana. Because more than a mile separates the two areas proposed in the complex and the different physical attributes of the sites, two separate amendment proposals to the Koolauloa Development Plan have been made. A market assessment for each of the two development plan proposals is being prepared. However, in the case of the market assessment, the entire "Country Courses at Kahuku" complex is being treated as a single entity. All of the proposed courses will serve the same demand and the development of each course within the complex will have an impact on the supply available for the market area. Therefore although two separate reports will be prepared for submittal with the respective amendment package, the interrelationships of the entire complex will be addressed in each report.

The proposed "Country Courses at Kahuku" Punamano facilities consist of three 18 hole championship golf courses and support facilities. These facilities are expected to provide a resort golf experience to the golfers using the Facilities, i.e., an enjoyable yet challenging round of golf. Each of the golf courses is to be unique with characteristics and holes that are memorable yet maintained in a condition which will improve scores, i.e., mowing and maintenance patterns which provide a certain amount of forgiveness of golf shots which tend to be off the mark.

Two clubhouses and will serve the three courses and a driving range and two putting greens as well as an appropriate amount of parking will be provided.

Demand for golf nationwide has been increasing for the past thirty years. This growth is expected to continue based on the following: higher incomes; an aging population; early retirement; more leisure time; flex time, and more residential mobility. Two studies undertaken in 1986 projected growth in demand for golf participation from zero to five percent annually, so far empirical evidence indicates that actual growth is taking place closer to the upper end of the projections. These growth projections suggest a need to increase the supply of golf facilities significantly on a nationwide basis through the year 2000.

Demand for golf in the State of Hawaii has also exhibited strong growth for the same reasons golf nationwide has grown.

In addition, golf demand in Hawaii has grown due to the development of a resort golf industry. Thus, growth in golf demand in Hawaii is driven by two distinct factors: growth in visitor demand for golf and growth in resident demand for golf. The largest growth in the Hawaiian golf has come from the resort aspect with the number of resort courses increasing from two in 1965 to twenty in 1985.

This growth in the resort golf business is expected to continue due to the following: projected growth in the volume of visitors over time; higher golf participation rates among visitor populations; an upscaling of the resort industry in Hawaii; the trend for an increasing percentage of visitor accommodations to be located in resort destination areas; and an increase in the number of eastbound visitors, particularly the Japanese, who have demonstrated a strong desire to play golf when visiting the Hawaiian islands.

Existing destination resorts have found through experience that golf demand is seasonal. The three months of January, February and March account for over 30% of play on resort course. Further, the maximum theoretical capacity of a resort course is approximately 73,000 rounds while the maximum practical capacity of a resort course is approximately 50,000 rounds due to the seasonality factor.

Experience has shown that guest units at Hawaiian destination resort generate a wide range of golf demand depending on the resort and availability of golf facilities. A survey of selected resorts found resort hotel units generated from .08 rounds per day at Wailea to .4 rounds per day at Mauna Kea. In addition, resort condominiums generate between .07 and .11 rounds per day.

A survey conducted for this study showed that approximately 1.5 million rounds were played, in 1988, on Oahu's 19 non military golf courses. Of these, approximately 1.24 million or 79% were played by residents and .27 million or 21% were played by visitors. Based on this information the average rounds played in 1988, by Oahu's average resident (non military) and visitor population was 1.81 and 3.58 rounds respectively. Using the 1988 average round information and the projected growth rates for resident and visitor population as estimated by State planners through the year 2000, alternate demand scenarios were generated by incorporating growth rates of 0%, 2%, 5%, and 10%. Use of these assumptions indicated demand for additional golf courses of three (3), eight (8), eighteen (18), and forty four (44) respectively.

A number of factors evident in the Oahu golf industry: Courses operating at maximum capacity; Escalating green fees; Institution of a telephone lottery for municipal course starting times; A comparison with the rates of play on the Island of Maui; the strong interest in the development of new golf facilities by the municipality and by private land owners and developers, and, the extrapolation of past trends suggest that there is currently an existing shortfall in the supply of golf facilities. The consultant estimates that this shortfall could range between eight to sixteen golf courses assuming the same average existing number of rounds per course on Oahu. The shortfall would increase dramatically if the average play per course were to be reduced.

There are currently three golf courses under construction on Oahu with an additional forty one sites planned or being discussed a potential golf course sites. However, based on a number of considerations including the ability to achieve needed governmental approvals, the physical constraints of the sites under consideration, and the ability of potential developers to obtain financing, the consultant estimates that less that half of these potential courses could be developed by the year 2000.

Thus, a range of demand of excluding the 0% and 10% growth scenarios would indicate that Oahu would need from sixteen (16) to thirty four (34) new courses by the year 2000 against a maximum supply of twenty two (22) new courses.

Demand for the Country Courses at Kahuku is expected to come primarily from increased visitor golf demand. The expansion plans of the Kuilima Resort Company are expected to provide the critical mass of visitor units necessary to support the Country Courses at Kahuku. While there is no local (Hawaii State Model) that demonstrates the feasibility of a conglomeration of golf facilities such as those proposed at the Country Courses at Kahuku, there are Mainland (U.S.) models including Pinehurst, North Carolina, and Pebble Beach, California which demonstrate successful operations. In addition, this success can be achieved through the use of golf demand factors per visitor unit already experienced at Hawaii destination resorts. Further, there are island nations i.e., Bermuda and the Bahamas which offer a high concentration of golf facilities.

Assuming the development of visitor accommodations at the Kuilima Resort takes place as projected by the Kuilima Resort Company, the Country Courses at Kahuku would be totally absorbed by the year 1998. The three courses at Punamano would be absorbed between 1996 and 1998. These projections include the development of the course planned by the Kuilima Resort Company within the resort proper and at Malaekahana. They also include absorption of additional capacity at the Kahuku Municipal Course.

One factor which is expected to be particularly beneficial to the resident golfing public is that resort oriented golf courses have a significant amount of excess capacity at times other than the traditional peak season (January, February, and March). Given the difference between the theoretical capacity of resort courses of 73,000 rounds and their practical capacity of 50,000 rounds, the three Country Courses at Kahuku - Punamano are likely to result in the availability of 60,000 rounds which could be used during the off peak times. Golf course managers are aware of the value of this resource and often promote its use by the resident population.

Development of the Country Courses at Kahuku is expected to be beneficial to the marketing of the Kuilima Resort. The concentration of golf facilities is expected to enhance golf marketing through availability, variety, accessibility and versatility. There are also expected to be operational benefits to the clustering. Existing and planned uses in the area are expected to be compatible with the proposed golf course developments. Employment generated by the Country Course at Kahuku - Punamano is expected to be 150 full time equivalent jobs.

The proposed "Country Courses at Kahuku" - Punamano has a number of advantages, from a marketing standpoint, over other golf courses proposed in the North Shore and Koolauloa Development Plan areas.

1. By virtue of their location, less than a mile east of the entrance to the Kuilima resort, the Punamano Courses have better access to resort guests at the Kuilima Development than any other existing or proposed golf course save the two located within the Kuilima Resort proper.

2. The size of the Punamano site and its dedication to strictly golf activities, will allow the golf course designer to maximize the recreational golf aspects of the site.

3. The site possesses natural beauty and at various locations within the site excellent ocean and mountain panoramas will add to the enjoyment of the basic recreational experience.

4. The existing Turtle Bay and Kahuku Courses are already attracting in excess of 100,000 (non-Kuilima Complex) golf rounds annually and the North Shore and Koolauloa areas are already known for their recreational amenities, including: major beach parks; major visitor attractions, i.e., Polynesian Cultural Center and Waimea Falls Park; ocean recreation, including surfing and boating (Haleiwa Harbor); and equestrian activities including polo at Mokuleia and other activities along the entire coast.

5. Will build on the strength of the existing Turtle Bay Resort in attracting golf business while at the same time attracting golfers to the resort.

The proposed Country Courses at Kahuku will help to satisfy the growing demand for golf of Oahu's visitor and resident populations. The development will help to preserve the long term viability of Hawaii's and Oahu's resort industry. At the same time the Country Courses at Kahuku will foster the development of a niche market (golfing visitors) which will be beneficial for the Hawaiian visitor industry as well as for the approved Kuilima Resort Development.

Market Assessment For COUNTY COURSES AT KAHUKU PUNAMANO AREA Containing 54 Of A Planned 72 Hole Golf Complex

I. INTRODUCTION

The Estate of James Campbell proposes to develop a 72 hole golf complex in the Koolauloa Development Plan area to be known as the "Country Courses at Kahuku". Of the proposed 72 holes, 54 holes will be located at Punamano. The other 18 holes of the complex are located at Malaekahana. Because more than a mile separates the two areas proposed in the complex and the different physical attributes of the sites, two separate amendment proposals to the Koolauloa Development Plan have been made. A market assessment for each of the two development plan proposals is being prepared. However, in the case of the market assessment, the entire "Country Courses at Kahuku" complex is being treated as a single entity. All of the proposed courses will serve the same demand and the development of each course within the complex will have an impact on the supply available for the market area. Therefore, although two separate reports will be prepared for submittal with the respective amendment package, the interrelationships of the entire complex will be addressed in each report.

The proposed "Country Courses at Kahuku" (Punamano) are located in Koolauloa opposite the easterly end of the Kuilima Resort and on the southern side of Kamehameha Highway. The property is bounded on the east by the State of Hawaii's Kahuku Agricultural Park; on the south by the U. S. Army Training Area at Kahuku; on the west by various agricultural operations; and on the north by the Kamehameha Highway and the Kuilima resort.

Access to the site is from Kamehameha Highway. The site is extremely well located to attract golfers from the Kuilima resort. The proposed "Country Courses at Kahuku" are expected to be complementary to and supportive of existing and proposed golf operations within the Kuilima Resort Complex.

The purpose of this report is to assess the demand for the proposed "Country Courses at Kahuku".

II. DESCRIPTION OF PROPOSED PUNAMANO GOLF FACILITIES

The proposed "Country Courses at Kahuku" Punamano facilities consist of three 18 hole championship golf courses and support facilities. These facilities are expected to provide a resort golf experience to the golfers using the Facilities, i.e., an enjoyable yet challenging round of golf. Each of the golf courses is to be unique with characteristics and holes that are memorable yet maintained in a condition which will improve scores, i.e., mowing and maintenance patterns which provide a certain amount of forgiveness of golf shots which tend to be off the mark.

Golf Courses - Three 18 hole championship courses are planned. Each course is expected to be unique in character due to the varied terrain and topography in the area as well as to the various elevations on each course. Based upon the existing topography, the course located in the northwest portion of the site would be the least difficult due to the relatively flat conditions. The course located in the north east portion of the site would be more difficult due to the combination of flatlands and foothills, while the course in the southern portion of the site would be the most difficult due to the hilly and mountainous conditions. The incorporation of golf design features into the various courses is expected to mitigate or make more difficult terrain features where appropriate.

Clubhouses - Two clubhouses will serve the three Punamano courses. Clubhouse (1) will serve the two 18 hole golf courses located in the southeastern area of the site. This clubhouse will be approximately 17,000 to 20,000 square feet. Incorporated into the clubhouse would be a starting facility, proshop, lockers, restaurant/lounge, restrooms, an administrative office and storage and maintenance facilities for 180 golf carts. Note: Approximately 10,000 sq. ft. of the clubhouse area will be dedicated to cart storage.

Clubhouse (2) will serve the 18 hole golf course located on the northwest side of the site would be approximately 10,000 to 12,000 square feet. Incorporated into the clubhouse would be a starting facility, proshop, lockers, restaurant/lounge, restrooms, and cart storage and maintenance facilities for 90 golf carts. Note: Cart storage is expected to account for approximately 5,000 square feet or approximately or one half of the clubhouse area.

Driving Ranges - Clubhouse 1 will be served by a driving range and putting green. Clubhouse 2 will have a putting green but no driving range.

Parking - Clubhouse 1 and 2 will be provided with an appropriate number of parking stalls.

III. GOLF - DEMAND

A. BACKGROUND

According to the State of Hawaii Data Book, 1986, there are fifty-seven golf courses in the State of Hawaii. These courses are further broken down by type; seven municipal; nineteen resort; seventeen public; nine military and five private. During the past ten years almost all of the golf course development has taken place as an integral part of resort or other land development projects. This situation follows closely the national experience.

The City and County of Honolulu which, for all practical purposes, encompasses the Island of Oahu, contains 28 golf courses consisting of: four municipal, three resort, eight public, nine military and four private courses. Thus Oahu, which accounts for approximately 80% of the State's population, contains less than 50% of the State's golf courses. Further, Oahu, which has an average visitor census of approximately 50% to 60% of the State total, contains only 15% of the State's resort golf courses. In addition, the nine military golf courses included in the Oahu total are restricted (for all practical purposes) to active military, retired military, their dependents and selected civil servants that account for less than 20% of Oahu's population.

At the present time, municipal golf courses on Oahu are operating at capacity, the four private country clubs have waiting lists, the military courses are said to be at capacity, and the public daily fee courses are at capacity with continuing fee increases anticipated.

While a number of new courses have been proposed, only three new courses — the Ko Olina (resort/daily fee) Course, Minami Course (private) and the City's West Loch Course (municipal) — are under construction. These three courses are expected to be open in 1990.

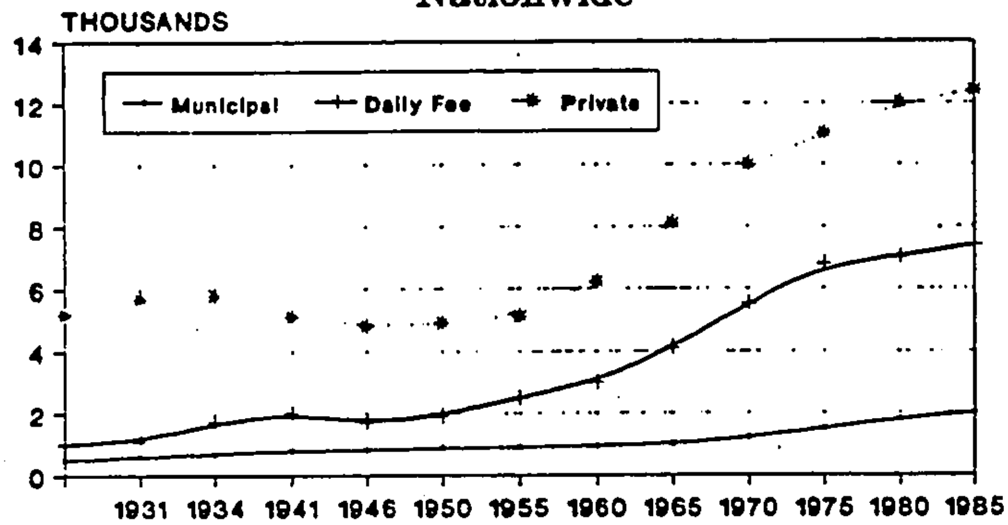
B. NATIONAL GOLF TRENDS

Statistics provided in the National Golf Foundation's publication Golf Facilities in the United States, 1985 attest to the growth of golf in the United States over the past 30 years. Between 1955 and 1985 the number of golf courses in the country grew from 5,218 to 12,346, a 136% increase. At the same time, population grew from 164 million to 237 million, a gain of only 44%. The number of private facilities has decreased from approximately 54% to 39%, indicating a broadening of the participation in the sport to include a wider spectrum of the American population (See *Exhibit 1*).

At a 1986 symposium sponsored by the National Golf Foundation, a nationally recognized organization of golf related operators, managers, manufacturers and related affiliates, Dr. John F. Rooney of Oklahoma State University presented a paper on the *Demand for Golf in the Year 2000*. The

EXHIBIT 1

Growth In Facilities
Number Of Golf Facilities
Nationwide



Trends

- Over the past decade, the total number of facilities has grown about nine percent.
- During the past ten years, municipal facilities have increased by 21 percent compared to daily fee facilities which have increased by 11 percent. Private facilities have grown at the slowest rate of seven percent.
- Twenty-five years ago, private courses comprised 50 of the total number of facilities. In 1985, private courses make up 39 percent of the total number.

Source: National Golf Foundation
Golf Facilities in the United States, 1985

paper presented historical data on the growth of golf in the United States and those factors which would be predictive of future growth. Dr. Rooney estimated that in 1986 there were 17,500,000 golfers being accommodated by 12,500 golf facilities. (See *Exhibit 2*)

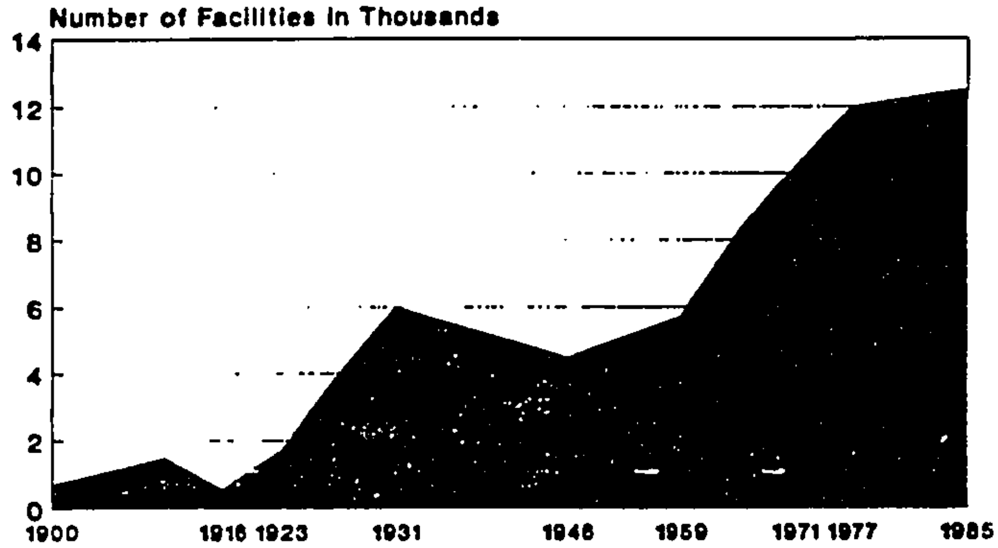
Growth generators for the future were projected to be: higher incomes; aging population; early retirement; more leisure time; flex time and residential mobility. Using alternate growth rates ranging from 0% to 5% and including only the known demographic changes in the population results in a range of 19,900,000 to 41,450,000 golfers by the year 2000. (See *Exhibit 3*) Thus in the short time between now and 2000 golf demand nationally would rise between 10% and 100%+.

At the same symposium in a paper titled *The Crisis in Public Golf Course Development*, Dr. Robert Adams of the University of New Hampshire attempted to quantify the demand for new golf facilities. Dr. Adams' research indicated that golf facilities nationwide are in tight supply (thus frustrating the desire for golf among the "wider spectrum" of golfers identified previously) and that the availability of public golf facilities declined in 23 of 50 states, including Hawaii. (See *Exhibit 4*) Dr. Adams, using the same, alternate scenarios cited in Dr. Rooney's paper, but eliminating the 5% scenario, developed projected increases in golf facilities to maintain present levels of course availability. The results of his analysis showed the need for a range of 1,400 to 7,900 courses by the year 2000 if growth rates of 0% and 3% were assumed respectively. (See *Exhibit 5*) Annualized, these projections would result in increased golf course inventory of 100 to 560 per year. Need for additional facilities is expected to be the greatest in the south and the west, where population growth has outstripped new golf facilities in the recent past.

According to *Golf Participation in the United State, 1988 Edition* published by the National Golf Foundation in August of 1988, both participation and the number of rounds increased between 1986 and 1987. Participation increased by 9% and rounds by 3%. This report was one of the first opportunities to measure the validity of the initial growth projections contained in the aforementioned studies.

EXHIBIT 2

Growth of U.S. Golf Facilities



Source: G. Cornish and R. Whitten
The Golf Course and NGF

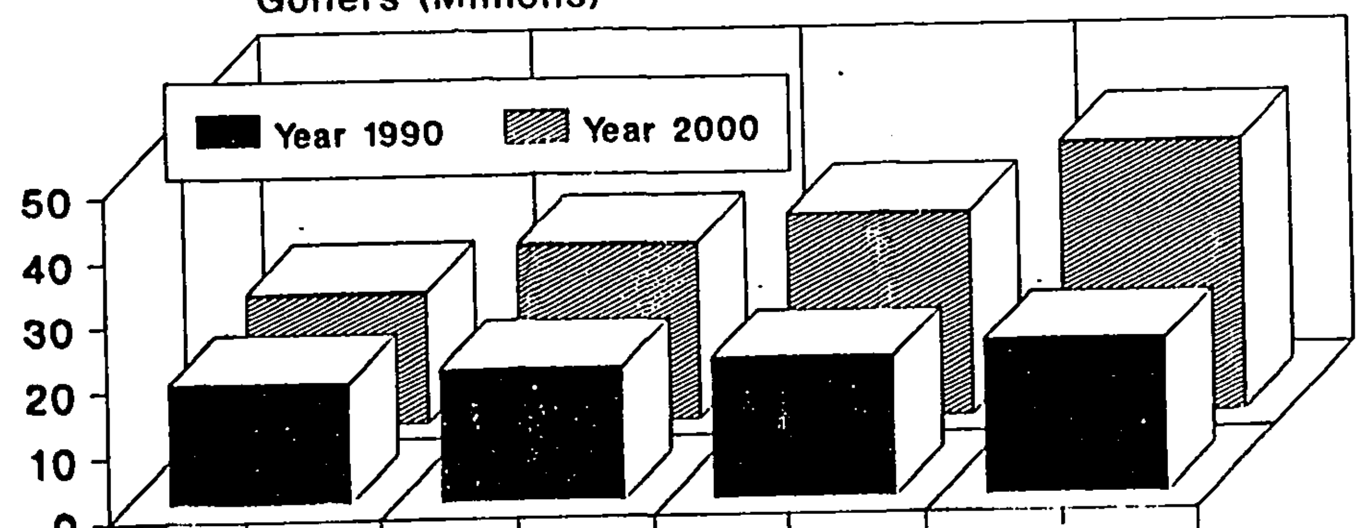
Golf Growth: 1960 - 1986

	1960	1970	1980	1986
Number of Facilities	6,400	10,200	12,000	12,500
Number of Golfers	5.0M	11.2M	15.1M	17.5M
Annual Facility Growth Rate		4.7%	1.5%	0.7%
Annual Golfer Growth Rate		8.5%	2.1%	1.1%

Source: NGF/Market Facts, Inc.

EXHIBIT 3

Potential Growth in Golf Participation

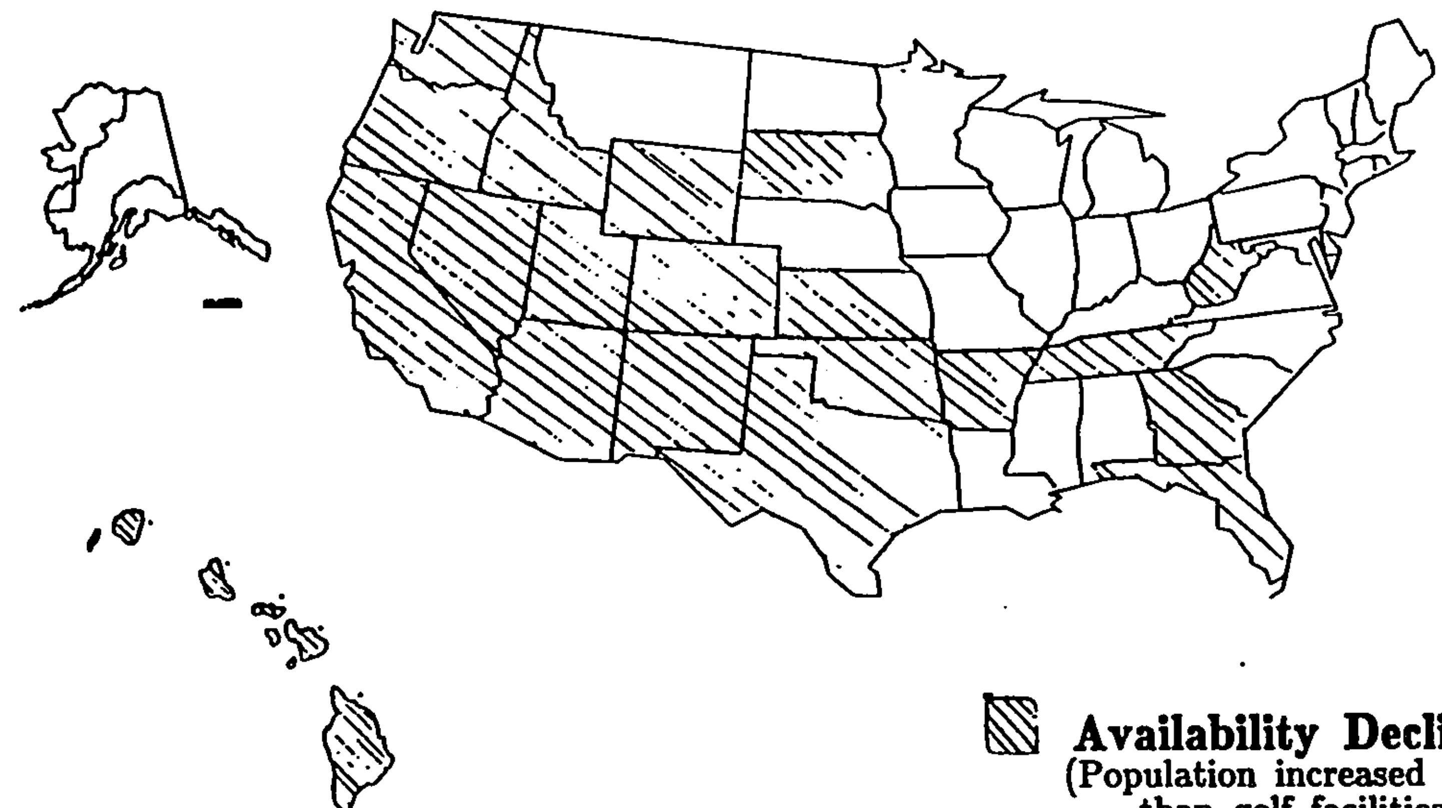


	0%	2%	3%	5%
Year 2000	19.937	26.836	31.062	41.45
Year 1990	18.464	20.385	21.4	23.56

Source: National Golf Foundation
Golf Projections 2000: Golf Summit '86 Research Presentation

EXHIBIT 4

States that Declined in Availability of Public Golf Facilities: 1975 - 1985



Source: U.S. Bureau of the Census and NGF

EXHIBIT 5

COURSE DEVELOPMENT REQUIRED TO MEET POTENTIAL GROWTH

Year:	Today	2000	2000	2000
% Growth in Golf Population		@ 0% Growth	@ 2% Growth	@ 3% Growth
Number of Golfers	17,500,000	19,900,000	26,800,000	31,100,000
Number of Courses[1] That must be added to Maintain Current Availability[2]	0	1,399	5,420	7,926
Required Average Yearly Increase in Number of Courses to 2000[3]	–	100/year	387/year	566/year

[1] Course = 18-Hole Equivalents
[2] Current Availability = 58 Courses/100,000 Golfers
[3] Average Yearly Growth 1983-1985 = 116 Courses/Year (Not 18-Hole Equivalents)

SOURCE: Market Facts, Inc. and NGF

Similar projections have been made by others. The following quote from an article in the January 1987 issue of Urban Land Magazine illustrates the point.

"Golf will be a major beneficiary of the aging of the population. A disinterested baby boom generation slowed golf play growth considerably in the 1970s. However, as this generation moves into the 35- to 54-year-old age bracket group with the highest golf participation rate—and as growth accelerates in the 65-and-over population—the group exhibiting the highest per capita play—golf will benefit greatly. Today there are approximately 6 million golfers in the 35- to 54-year-old age bracket. By 1990, there will be approximately 7.2 million, and by 2000, golfers in that age group will swell to over 9 million, a 50 percent increase in 15 years. In addition, golf is becoming increasingly popular with women."

Thus, the number of golfers is expected to increase significantly by 1995 (See *Figure 1*). And, because of the aging population, golf demand (number of rounds) will rise at an even faster rate. Moreover, with a growing retirement population, golf demand during mid-week periods should accelerate, a major factor in improving the profitability of golf course operations.

FIGURE 1

GROWTH IN GOLF PLAY

Year	Number (Millions)	Percent Increase	Number of Rounds (Millions)	Percent Increase
1985	18.1	—	440	—
1990	19.1	5.5	466	5.9
1995	19.9	4.2	491	5.4

Source: Economics Research Associates

The awareness of golf has grown, in part, due to its prime time weekend television exposure supported by major sponsors who target their message at the middle income and affluent market. Golf awareness has also grown due to an increase in junior golf programs and the emergence of golfers as sports heroes.

C. GOLF TRENDS IN THE STATE OF HAWAII

Golf in the State of Hawaii has also exhibited strong growth for many of the same reasons identified as golf generators nationally. Hawaii has been identified as one of the states in the nation with high golf intensity. (See *Exhibit 6*) The most explosive growth in golf in Hawaii during the past 20 years has been the development of the resort golf industry. This growth is described more fully later in the text.

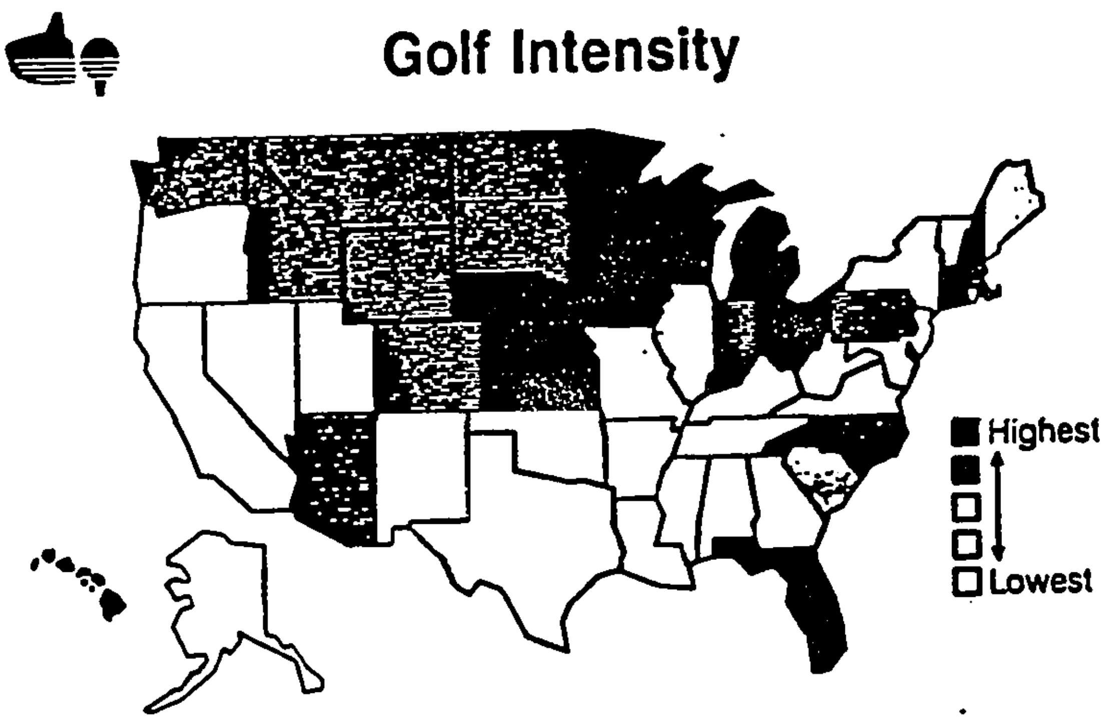
Golf growth in Hawaii is expected to come from two distinct factors: growth in the demand by residents and growth in the demand by tourists.

Demand for golf by residents is expected to grow at rates consistent with national trends. Based on the Department of Planning and Economic Development's M-K Series projections, the median age of Hawaii's population is expected to increase from 30.5 in 1985 to 35.3 in the year 2010 with the 35-54 year old population group increasing by 52% and the over 65 population group by 90%. The aging of the population follows national trends. Demand for golf by tourists is expected to continue to increase with the growth of the visitor industry and may accelerate as the mix of Hawaii's visitors shift towards the up-scale market.

1. Resort Golf

The growth in golf as a leisure time activity has translated into the growth of golf as an activity for tourists. In 1955, none of the golf courses in the State of Hawaii could be classified as being resort

EXHIBIT 6
GOLF INTENSITY



Source: Rooney, Adams Golf Involvement Index courses; in 1965 only the Mauna Kea and the Kaanapali Golf Facilities could be classified as resort courses; by 1985 there were 20 golf courses in the state classified as resort golf courses.

An examination of golf courses by island (See *Exhibit 7*) indicated that resort courses have developed on the neighbor islands to a greater degree than on Oahu when measured against average visitor census or visitor expenditures by county (*Exhibits 8* and *9*). This can probably be explained by the fact that growth of the neighbor island visitor industry has taken place more recently and, to a large degree has focused around destination resorts. Proposed additions to Oahu's visitor plant such as West Beach and the Kuilima Expansion include golf facilities as prominent features of the proposed resort development plans. A recent study[1] commissioned by the State Legislature stated that Hawaii attracted approximately 200,000 golfers in 1985 and that they expended $30,000,000 at the state's resort golf courses.

The development of destination resorts in Hawaii, starting with the development of Kaanapali on Maui over 20 years ago, have followed a more or less standard formula for success. In general, resorts have been sited in coastal areas with prevailing good weather and provided a variety of self-contained recreational amenities, including ocean activities, golf course(s), tennis facilities, shopping and various other amenities. In the early years golf and other recreational facilities were considered to be necessary cost centers for the resort development. Costs for these amenities were generally allocated to parcels for sale or lease and were recovered by sales of developable land within the resort. The basic reason for this assumption was that golf course fees and demand was relatively low in comparison to golf course operating and capital costs. During the past five years there has been an increase in the level of demand, and fees have been increased to allocate scarce playing times on an economic basis. Golf course operations have become self-supporting and, in a number of cases, profitable. This change in demand at Hawaiian resort courses is the result of maturation of the Hawaiian destination resort industry.

As destination resorts have matured, the number of resort units providing potential golf users has increased, occupancy rates have improved and generally planned densities for developments have been reduced with a consequent upscaling of accommodations These factors have encouraged the growth of the golf playing visitors.

Another factor encouraging the expansion of the golf playing visitor market has been the expansion, availability and marketing of resort golf facilities. The islands of Maui and Hawaii have led the state in the expansion of golf facilities. Twenty years ago on Maui, there was a single golf facility at the "infant" Kaanapali Resort. Today there are

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1 Coopers & Lybrand, *A Master Plan for the Continued Development of Hawaii as a Sports Center*, February 1987.

EXHIBIT 7

GOLF COURSES, BY ISLANDS: 1984

Island and type of operation	Number of courses: Total	9-hole	18-hole	27-hole	Number of holes
State total ..	57	12	44	1	927
Hawaii	11	2	9	-	180
Public 1/	4	2	2	-	54
Municipal	1	-	1	-	18
Resort	6	-	6	-	108
Maui	10	2	8	-	162
Private	1	1	-	-	9
Public 1/	1	1	-	-	9
Municipal	1	-	1	-	18
Resort	7	-	7	-	126
Lanai	1	1	-	-	9
Public 1/	1	1	-	-	9
Molokai	2	1	1	-	27
Public 1/	1	1	-	-	9
Resort	1	-	1	-	18
Oahu	28	5	23	-	459
Private	4	-	4	-	72
Public 1/	8	1	7	-	135
Municipal	4	1	3	-	63
Military	9	3	6	-	135
Resort	3	-	3	-	54
Kauai	5	1	3	1	90
Public 1/	1	1	-	-	9
Municipal	1	-	1	-	18
Resort	3	-	2	1	63

1/ Privately owned courses open to the public on daily-fee basis.

Source: Bill Gee, 1984 Hawaiian Golf Almanac (Hawaii Junior Golf Association), pp. 3 and 8.

EXHIBIT 8

WESTBOUND VISITOR ARRIVALS, BY COUNTIES VISITED: 1982 TO 1987

[Covers westbound visitors staying overnight or longer anywhere in the State, and any overnight or non-overnight interisland trips reported by these visitors. Based on a 20-percent sample through 1983 and a 10-percent sample thereafter]

Year	State total 1/	City and Co. of Honolulu	Hawaii County	Kauai County	Maui County
1982 ...	3,278,525	2,589,190	678,170	733,295	1,550,080
1983 ...	3,396,115	2,591,635	712,380	691,940	1,644,605
1984 ...	3,721,380	2,901,320	760,940	814,590	1,854,690
1985 ...	3,708,610	2,828,640	697,380	832,580	1,831,110
1986 ...	4,256,390	3,146,030	786,930	1,014,650	2,001,870
1987 ...	4,204,010	3,078,500	782,550	1,032,840	1,908,780

1/ Because many visitors visited more than one county, county data sum to totals greater than the State totals shown here.

Source follows next table.

AVERAGE VISITOR CENSUS, BY COUNTIES: 1982 TO 1987

[Unlike the preceding table, this table includes eastbound and northbound visitors (all of whom have been included with the City and County of Honolulu) as well as westbound visitors. Based on a 20-percent sample through 1983 and a 10-percent sample thereafter]

Year	State total	City and Co. of Honolulu	Hawaii County	Kauai County	Maui County
1982 ...	105,310	73,445	6,725	7,050	18,090
1983 ...	108,045	66,695	8,690	7,990	24,670
1984 ...	118,660	67,370	7,570	10,930	32,790
1985 ...	116,700	65,280	8,040	11,470	31,910
1986 ...	132,910	73,870	9,870	14,840	34,330
1987 ...	134,270	74,660	10,210	15,510	33,890

Source: Hawaii Visitors Bureau, release dated March 1988 and records.

EXHIBIT 9

ESTIMATED EXPENDITURES BY VISITORS TO HAWAII, BY COUNTIES: 1970 TO 1987

[Millions of dollars. Interisland air fares have been distributed on a prorata basis. Expenditures by eastbound visitors have been included with the City and County of Honolulu. Excludes expenditures by Hawaii residents]

Year	State total	City and County of Honolulu	Other counties			
			Total	Hawaii	Kauai	Maui
1970	595	442	153.0	53.4	45.1	54.5
1971	705	507	198.0	67.7	56.1	74.2
1972	840	609	231.0	77.0	61.9	92.1
1973	1,020	777	243.0	81.9	63.2	97.9
1974	1,225	928	297.5	99.3	73.9	124.3
1975	1,360	1,004	355.9	114.6	87.2	154.1
1976	1,640	1,213	427.2	126.8	101.8	198.6
1977	1,845	1,377	468.5	131.2	109.9	227.4
1978	2,146	1,569	577.0	152.9	137.9	286.9
1979	2,537	1,867	669.8	162.0	159.1	348.7
1980	2,875	2,097	777.5	187.6	189.3	400.6
1981	3,200	2,394	805.9	179.2	197.3	429.4
1982	3,700	2,748	951.8	200.9	210.6	540.3
1983	3,974	2,653	1,320.9	277.2	250.8	792.9
1984 1/ ...	4,582	2,895	1,686.6	248.9	359.4	1,078.3
1985 1/ ...	4,884	3,084	1,799.5	285.9	407.9	1,105.7
1986 1/ ...	5,500	3,444	2,056.2	343.8	516.9	1,195.5
1987 1/ ...	6,600	4,370	2,229.6	381.8	580.1	1,267.7

1/ Preliminary estimate.
Source: Hawaii Visitors Bureau, "Neighbor Island Statistics," tabular release dated March 1988.

seven resort golf courses with a number of new facilities in the planning stages. Unlike a tennis court, each golf course is unique. Avid golfers seek opportunities for experiencing a number of championship facilities, thus encouraging them to return year-after year. This has also resulted in word of mouth advertising upon their return home. Maui has marketed its golf on a national (U.S.) basis under the heading "Maui Golf Coast".

a. Future Prospects

Future prospects for growth in demand for Hawaiian resort golf look extremely bright for the following reasons: **a)** Continued maturation of the Hawaii destination resort industry; **b)** Favorable demographic trends in the United States (primary source of the Hawaiian visitor market); and, **c)** Growth of eastbound tourist business (primarily Japanese) who also exhibit a high propensity for golf.

i. Maturing Industry

While golf course play at selected resorts shown in *Exhibit 10* shows a matching of play with resources, it does not take into account that, with the exception of Kaanapali, the resort developments shown have reached less than 50% of their ultimate size in terms of total units.

Further, Wailea and Kaanapali benefit from the availability of neighboring courses such as Makena and Kapalua, respectively, where development of visitor accommodations (hotels and condos) is, at a very early stage, comprising only 20 to 30% of ultimate development. It should be noted that all of the resort facilities shown in *Exhibit 10* are planning additional golf courses.

EXHIBIT 10

RESORT AND NUMBER OF GOLF COURSES	ACTUAL ROUNDS FY 1989	DESIRED MAXIMUM ROUNDS[1]	TWO TIERED PRICING[2]	ROUNDS RESERVED FOR HOTELS[3]	% ROUNDS FROM RESORT COMPLEX	COMMENTS
Princeville 1 Course	70,000[4]	50,000	$85/$75	100	over 50%	Additional course is under construction
Kaanapali 2 Courses	107,000	108,000	No	No[5]	60%	Additional course is under consideration for N. Beach Expansion
Wailea 2 Courses	105,000	110,000	$105/$60	90	70%	Additional course is under consideration
Mauna Lani 1 Course	45,000	44,000	$100/$60	No	66%	Additional course is being designed

1– Desired Maximum Rounds refers to rounds which the operator feels are achievable under current conditions due to seasonality of play. Theoretical maximum capacity is approximately 70,000 rounds per course.

2– Two tiered Pricing refers to a policy of pricing which discriminates in favor of complex (resort) guests. Resorts have priority reservations policies which give priority to hotels in making reservations for golf play. Operators have seasonal pricing policies. Rates shown are for high season. Kaanapali did not offer low season rates in 1987 or 1988.

3– Wailea and Princeville have guaranteed availability for hotel guests. Kaanapali provides no guarantee but gives reservation priority. Mauna Lani owns both resort and hotel. In 1989, Shinwa (Wailea Resort Owner) acquired the Stofer Wailea Beach Hotel.

4– Princeville course is 27 holes and capable of higher level of play; however, management considers the course the principal recreational asset and therefor wishes to maintain the lower level of play. Note Figure from 1987 Hotel closed for renovation in 1988/1989.

5– While no two tiered pricing is available, a coupon book allowing the bulk purchase of 15 plays allows for lower priced golf for complex and local residents.

SOURCE: John Zapotocky, Consultant

ii. Growth of Eastbound Tourist Business

Eastbound tourists are expected to account for a larger and larger share of the Hawaiian visitor industry. The Japanese are well known for their "national golf obsession". Japanese interest in golf is attested to by the purchase of a number of Oahu and neighbor island golf courses by Japanese investors in recent years. To date, the Japanese golfer has been a significant but not overwhelming factor in Hawaiian golf play, but this is expected to change. As the Japanese tourist market grows and the market matures, more and more Japanese visitors can be expected to take advantage of the availability and affordability (compared with Japan) of Hawaiian golf.

From 1980 to 1987 westbound tourists increased by 38% while eastbound tourists increased by 79%. (See *Exhibit 11*) This, coupled with the fact that Japanese visitors, the primary component of eastbound visitors, spend, on the average, substantially more per trip than westbound visitors, indicates a trend towards higher average visitor spending. The average Japanese tourist spends (1989 est.)

EXHIBIT 11

VISITOR ARRIVALS AND AVERAGE VISITOR CENSUS: 1964 TO 1987

[For earlier years, 1921-1963, see Data Book 1987, table 210]

Year	Visitors staying overnight or longer			Average number of visitors present		
	Total	West-bound 1/	Other	Total	West-bound 1/	Other
1964	563,925	460,290	103,635	16,037	14,901	1,136
1965	686,928	567,218	119,710	17,369	16,057	1,312
1966	835,456	686,886	148,570	20,918	19,271	1,647
1967	1,124,818	893,103	231,715	27,630	24,898	2,732
1968	1,314,571	1,015,844	298,727	32,335	28,784	3,551
1969	1,527,012	1,181,029	345,983	37,198	33,088	4,110
1970	1,746,970	1,326,135	420,835	36,943	32,028	4,915
1971	1,818,944	1,430,325	388,619	40,889	36,504	4,385
1972	2,244,377	1,782,737	461,640	50,143	45,098	5,045
1973	2,630,952	2,067,861	563,091	59,578	53,407	6,171
1974	2,786,489	2,184,620	601,869	63,535	56,939	6,596
1975	2,829,105	2,207,417	621,688	66,308	59,495	6,813
1976	3,220,151	2,551,601	668,550	75,532	68,225	7,307
1977	3,433,667	2,763,312	670,355	83,030	75,684	7,346
1978	3,670,309	3,030,999	639,310	92,034	85,028	7,006
1979	3,960,531	3,139,455	821,076	98,676	89,678	8,998
1980	3,934,504	3,046,132	888,372	96,497	86,788	9,709
1981	3,934,623	2,974,791	959,832	95,968	85,449	10,519
1982	4,242,925	3,278,525	964,400	105,310	94,740	10,570
1983	4,368,105	3,396,115	971,990	108,045	97,395	10,650
1984	4,855,580	3,721,380	1,134,200	118,660	106,260	12,400
1985	4,884,110	3,708,610	1,175,500	116,700	103,820	12,880
1986	5,606,980	4,256,390	1,350,590	132,910	118,110	14,800
1987	5,799,830	4,204,010	1,595,820	134,270	116,780	17,490

1/ Arriving from the Mainland United States or Canada. Based on a 20-percent sample through 1983 and a 10-percent sample thereafter.

Source: Hawaii Visitors Bureau, Annual Research Report (annual) and records.

approximately $586 per day vs. $119 for U.S. tourists. Thus while Japanese tourists made up 22% of the visitors to Hawaii, they accounted for 43% of all visitor expenditures. The impact would have been even greater except that the average length of stay for eastbound tourist is about one half of that for westbound tourists.

It is anticipated that the eastbound tourist market. particularly the Japanese market will continue to grow over the long term. In the short term the Japan Ministry of Transport in September of 1987 announced *The Ten Million Plan — A Plan to Double the Number of Japanese Outbound Travelers*. This plan aimed at reducing Japan's foreign trade surplus is expected to double the number of Japanese that travel to foreign countries during the next five years. The program is a comprehensive effort on the part of the Japanese government to encourage foreign travel through: expanding destinations; promoting longer holidays; establishing the International Tourism Development Institute; offering incentives to promote travel. The incentives include: simplifying visa requirements; expansion of the working holiday program; increasing the tax exemption from 100,000 to 200,000 yen ($800 to $1,600 at current exchange rates); and providing tax incentives.

While there is no specific goal for increasing tourism to Hawaii as part of the program, it is logical to assume that with its existing tourist infrastructure and the familiarity of Japanese tourists with the Hawaiian vacation experience, Hawaii should be a major participant in the increase in Japanese foreign tourism. There has been exceptionally strong growth in Japanese tourism to Hawaii since inception of *Ten Million Plan*. Note: The Ten Million Plus Program is expected to achieve its goal in approximately half the anticipated time, i.e., 1990 vs. a projected 1992.

Over the longer term, it is anticipated that the number of eastbound visitors will increase substantially. The Department of Business and Economic Development Series M-K projections dated November 1988 assume that Japanese tourists will account for 25% of the visitor arrivals by 2005 vs. the 20% assumed in the previous M-F projections. In addition, the M-K projections assume a higher growth rate for tourism than the previous M-F projections.

iii. Potential Impact of Japanese Tourists on Golf Demand

In order to estimate the potential impact of Japanese golfers the consultants undertook a survey of Japanese golf play on the island of Maui. The reason for using the island of Maui is that it is noted for its availability of golf, seven resort courses to serve approximately 2,000,000 visitors versus three on Oahu for approximately 4,000,000 visitors[2]. (See *Exhibits 12* and *13*.)

While Japanese travel (overnight or longer) totaled only 8% of total overnight or longer visitors to Maui[3], it accounted for 77,000 or 22.2% of the 348,000 rounds of resort golf played on Maui in 1987. In 1985, the Maui courses estimated that the Japanese golfers accounted for only a negligible amount of the play. It should be noted that there is a significant amount of Japanese play on Oahu golf courses, however, for the most part Oahu golf courses are operating at capacity and until new golf facilities are opened and the supply of golf times are increased, increases in golf play by visitors must necessarily come from reductions in golf availability to local residents. The historic reliance by local golf facilities on local golfers and club play as well the potential for negative publicity have resulted in a relatively stable balance of play. In most cases Maui resort courses with the exception of the months of January, February and March operate at less than full capacity so that increases in play can be accommodated.

Beginning in the second quarter of 1988, the Hawaii Visitors Bureau added a question relating to golf participation in its regular surveys[4] of Japanese visitors. For the three quarters ending in December 1988, the survey indicated that 12% of the Japanese visitors played golf.

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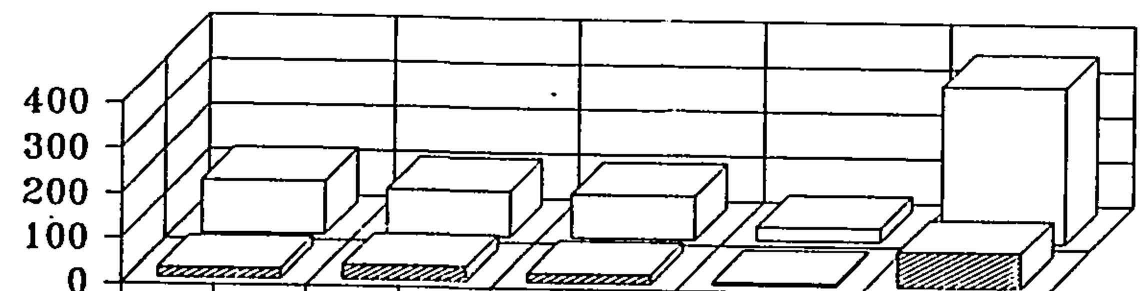
2 Hawaii Visitor's Bureau *1987 Annual Research Report*. May 1988.

3 IBID.

4 Hawaii Visitor's Bureau *1988 Study of Japanese Visitors to Hawaii*. April 1989.

Exhibit 12
Japanese Golf Demand
Maui Island 1987



	Kapalua	Kaanapali	Wailea	Seibu	TOTAL
Rounds	118	102	98	30	348
Est. Japanese Rounds	21.24	30.6	19.6	5.7	77.14
Est % Japanese Play	18	30	20	19	22

Resort Golf Rounds

Est. Japanese Rounds   Rounds

Estimated Number of Japanese Visitor Arrivals Maui 1987: 164,300
Est Rounds per Japanese Visitor: 0.47

EXHIBIT 13

Japanese Golf Demand
Maui Island 1987
Resort Golf Courses

Maui Resort Golf Courses	Rounds	Estimated Japanese Play (%)	Estimated Japanese Rounds
Kapalua	118,000	18%	21,240
Kaanapali	102,000	30%	30,600
Wailea	98,000	20%	19,600
Seibu	30,000	19%	5,700
Total	348,000		77,140
Percent of Resort Rounds		22.2%	

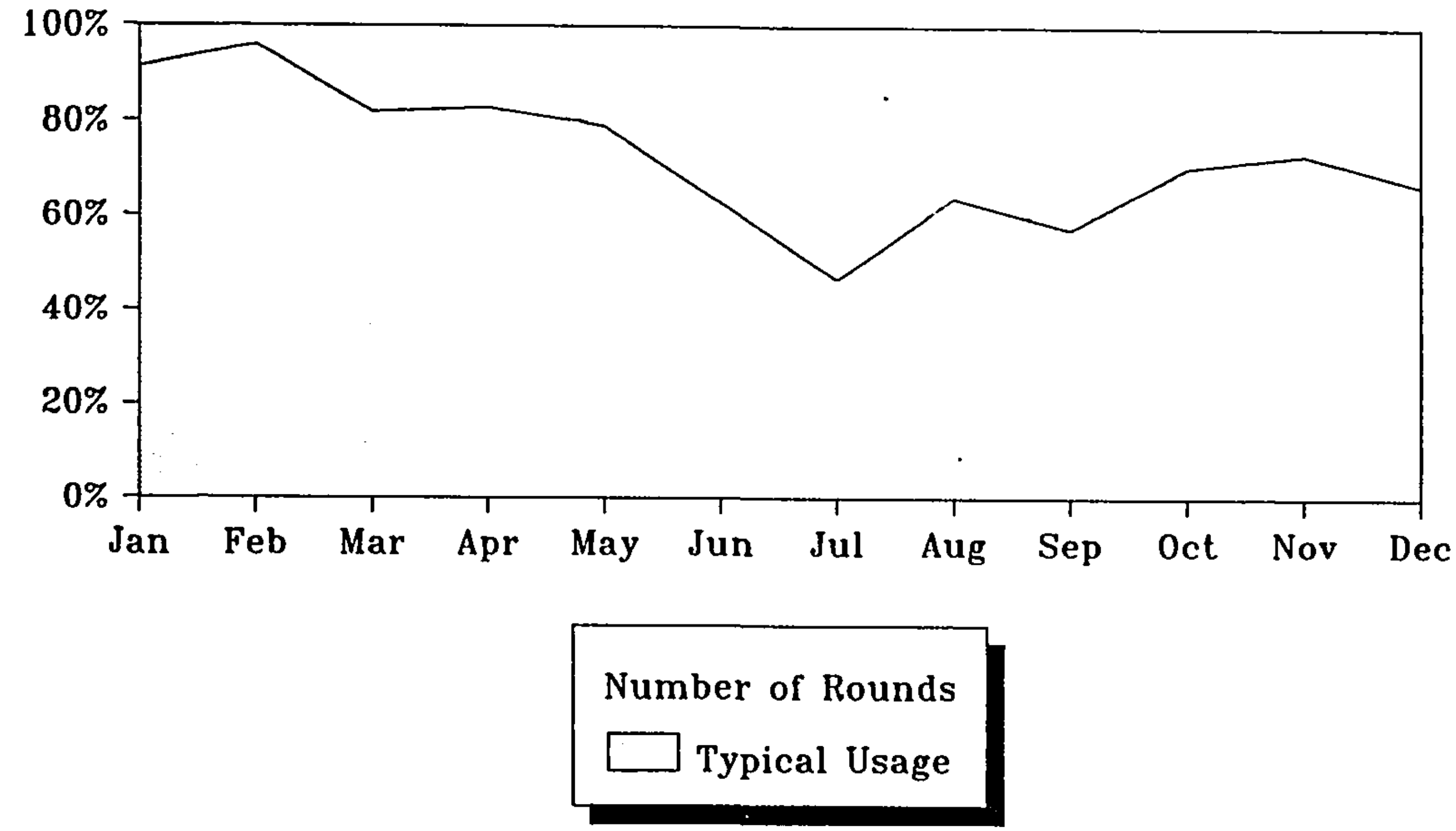
Estimated Number of Japanese Visitor Arrivals Maui 1987: 164,300

Estimated Rounds per Japanese Visitor Arrival: .47

b. Seasonality of Resort Golf

Maintaining the quality of resort play has been stressed time and again by resort management and development executives. Review of desirable annual levels of play and desirable daily levels of play indicate a wide discrepancy between a desirable annual level of play versus the theoretical annual level of play at the stated desired daily level. The reason for this situation is that demand for resort golf is seasonal in nature (See *Exhibit 14*). In fact, it is not unusual at Hawaiian resort developments for January through March to account for in excess of 30% of total annual rounds played. Note: The percentage of rounds played during the high season understates the demand during that time due to the fact that many requests for starting times go unsatisfied during that period. This seasonality has been recognized by resort managers for many years. The competition for high season starting times at many resorts has led to the allocation of these starting times. Many courses have supplemented existing priority of reservation schedules with high and low season rates as well as pricing policies designed to give favorable treatment to guests of the complex. As the

Exhibit 14
Typical Utilization of Mature Hawaiian Resort Golf Facilities



Source: John Zapotocky, Consultant

marketing strategies have become more sophisticated for the high season times, low season times have been getting extra attention, benefitting local players with lower rates and more starting times. (Resort managers have become increasingly aware of the large number of starting times which go unused during the low season and have been attempting to attract both tourist and local play to tap this unused resource.

c. Number of Rounds Available Per Golf Course

Golf course capacity itself is the product of a number of physical and aesthetic considerations. Resort courses in Hawaii have in general limited play to between 175 and 215 rounds per day. At this level of play, golfers can enjoy the game at a leisurely pace with only a minimum of waiting and with minimum interaction with others playing on the course. Assuming an average of 200 rounds per day and 365 playing days per year, the capacity of resort courses should be at 73,000 rounds annually. Experience has shown that demand for golf from resort guests is strongest during the winter months. (*Exhibit 14*) In addition, demand for golf is also skewed in favor of morning times. Therefore, resort courses are generally operated below capacity during most of the year. A yearly average of 50,000 rounds per year is considered achievable and desirable by resort golf operators.

d. Range of Demand - Hawaiian Resorts

Exhibit 15 indicates the range of demand for selected Hawaiian Island resorts. Based on the information provided in *Exhibit 15*, rounds of golf generated by resort hotels per day ranges between .08 per room at Wailea and .4 at Mauna Kea. Resort condominiums provide between .07 and .11 rounds per day.

EXHIBIT 15

GOLF DEMAND FOR RESORT HOTEL AND RESORT RESIDENTIAL DEVELOPMENT AT SELECTED DESTINATION RESORTS IN HAWAII

	ANNUAL ROUNDS PER HOTEL ROOM	ANNUAL ROUNDS PER RESORT RES. UNIT
ISLAND OF HAWAII[1]		
Mauna Kea Beach Hotel	145	
Mauna Lani Bay Hotel	70	
Mauna Lani Resort Res.		36
ISLAND OF MAUI[2]		
Wailea Development Company		
Hotels	30	
Resort Residential		39
ISLAND OF KAUAI[3]		
Princeville Development Company		
Hotels	125	
Resort Res. Owners		31
Resort Res Guests		19

1. Belt, Collins & Associates, *Final EIS Revised Master Plan for Manua Lani Resort*, June 1985 and Updated Information from Mauna Lani Planning Staff.

2. Unpublished Information Wailea Development Co. Operating Plan Assumptions.

3. Princeville Development Co., *Projection of Golf Rounds at Princeville Due to Phases One and Two Development*, Land Use Commission Filing 1985.

NOTES:

HOTELS: Information presented above shows hotel generated rounds on a daily basis ranging from .4 rounds per room at Mauna Kea to .08 round per room at Wailea.

RESORT RESIDENTIAL: Information presented above shows resort residential units generating between .11 rounds per unit at Wailea and .07 rounds per unit at Princeville.

SOURCE: John Zapotocky, Consultant

IV. GOLF DEMAND (ISLAND OF OAHU)

A. OAHU GOLF SURVEY (EXCLUDING MILITARY)

The rounds of golf played on Oahu's 19 non-military courses in 1988 were surveyed in March of 1989. The survey included private membership courses, resort courses, privately owned daily fee courses and municipal courses. The purpose of including all types of courses with the exception of military courses was to determine how much golf was played by non-military residents and visitors. Military courses were excluded, because in most cases, civilians are prohibited from obtaining starting times unless guests of military personnel, their dependents or retirees. To the extent that civilian play is actually occurring, the amount is offset by the number of rounds played by military, dependents and retirees on Oahu's resort, municipal, private and daily fee courses. The results of this survey showed that during 1988 approximately 1,500,000 rounds were played on Oahu's non military courses. Of the total approximately 1,240,000 rounds or 79% were played by residents and 270,000 rounds or 21% were played by visitors. (See *Exhibit 16*)

B. ESTIMATE OF NUMBER OF ROUNDS PLAYED PER VISITOR AND PER RESIDENT IN 1988,

Estimates for the non-military resident population and visitor population for 1988 were developed using the same methodology used in the Department of General Planning report "Golf Course Development on Oahu" dated July 1989. The estimates indicated that in 1988 1.81 rounds were played by the average resident and 3.58 rounds were played by the typical visitor. (See *Exhibit 17*) Note: The average rounds figure is based on average daily visitor population and __not__ actual visitors.

C. ESTIMATE OF GOLF COURSE DEMAND THRU YEAR 2000

The consultant developed demand projections thru 2000 using estimated alternate rates of growth in the demand for golf of 0%, 2%, 5% and 10%. Resident and visitor population estimates developed by the State of Hawaii Department of Business and Economic Development in the "Population and Economic Projections for the State of Hawaii to 2010" (Series M-K) dated November 1988 serve as the base assumptions for the consultants projections. The increased rounds was divided by the average play on the Oahu golf courses surveyed to determine the future demand for golf courses on Oahu. The results of these calculations showed that the City and County of Honolulu would require the following number of new courses by year 2000 under the 0%, 2%, 5% and 10% growth scenarios: 2.5, 7.5, 17.8, and 44.1 respectively. (See *Exhibits 18, 19, 20* and *21*) Given the strong growth in demand for golf nationally and the expected growth in the percentage of Hawaii visitors from Japan a reasonable yet conservative estimate of the number of courses needed is expected to range within the 2% and 5% growth factors.

EXHIBIT 16

Oahu Golf Courses (non-Military)
Total Rounds
Year 1988

	Course/Location	Type	YR Rounds Per Site #	Avg Rounds Per Week	Tourist Rounds-yr	Percent	Resident Rounds-yr	Percent
1	Ala Wai Golf Course	Public	188,000	3,615	7,187	4%	180,813	96%
2	Kahuku Golf Course *	Public	48,000	923	2,760	6%	45,240	94%
3	Pali Golf Course	Public	144,000	2,769	3,038	2%	140,962	98%
4	Ted Makalena G.C.	Public	165,000	3,173	307	0%	164,693	100%
5	Bay View Golf Center *	Daily Fee	12,000	231	0	0%	12,000	100%
6	Hawaii Kai Champ	Daily Fee	53,000	1,019	28,500	54%	24,500	46%
7	Hawaii Kai Exec	Daily Fee	53,000	1,019	28,500	54%	24,500	46%
8	Honolulu C.C.	Private	70,000	1,346	7,000	10%	63,000	90%
9	Mid-Pacific Country Club	Private	59,700	1,148	0	0%	59,700	100%
10	Mililani Golf Club	Daily Fee	94,000	1,808	42,300	45%	51,700	55%
11	Moanalua Golf Course (est) *	Semi-P ^	45,000	865	0	0%	45,000	100%
12	Oahu Country Club (1985)	Private	45,000	865	0	0%	45,000	100%
13	Olomana Golf Links	Daily Fee	94,000	1,808	5,640	6%	88,360	94%
14	Pearl Country Club	Daily Fee	80,000	1,538	8,000	10%	72,000	90%
15	Waialae Country Club	Private	80,000	1,538	0	0%	80,000	100%
16	Hawaii Country Club	Semi-P ^	83,000	1,596	16,600	20%	66,400	80%
17	Makaha Valley C.C.	Daily Fee	70,000	1,346	24,500	35%	45,500	65%
18	Sheraton Makaha Resort & C.C.	Resort	58,000	1,115	53,360	92%	4,640	8%
19	Turtle Bay Hilton & C.C.	Resort	65,000	1,250	42,250	65%	22,750	35%
	OVERALL TOTAL		1,506,700	28,975	269,942		1,236,758	
	OVERALL AVERAGE *		86,097	1,656	15,425	21%	70,672	79%

Notes:

City course data from "Proposed Golf Course Number 2," page 15 and from Cipro Golf Consultants

* Nine Hole Courses Counted as Half Courses in Average Calculation

^ Hawaii Country Club (HCC) and Moanalua Golf Course (MGC) have some characteristics of private clubs. HCC has a limited number of members, but the course is open on a daily fee basis, MGC is open to the public on weekdays only.

EXHIBIT 17

Oahu Golf Courses
Visitor/Resident Rounds
Based on 1988 Rounds
Based on 1988 Visitor/Resident Estimates

Population Group	Total Population	Total # Rounds	Rounds per Group
Resident *	683,700	1,236,758	1.81
Visitors ^	75,300	269,942	3.58
Total		1,506,700	

Notes:
Non-military resident population excludes military personnel, dependents, retirees and their dependents.
* From "Golf Course Development on Oahu, City & County of Honolulu, 1989, page 18.
^ Extrapolated from data in Department of Business and Economic Development, "Population an Projections for the State of Hawaii to 2010", November 1988, pages 4, 18;
# City course data from "Proposed Golf Course Number 2," page 15 and from Cipro Golf Consultants

EXHIBIT 18

Oahu Golf Courses
Estimated Demand 1990 – 2000
Residents/Visitors
Based on Forecast Visitor/Resident Populations
December 1989

Year	Estimated Population #		Total Estimated Demand for Rounds^		Total Estimated Rounds	Estimated Increase in Rounds	Growth Need ^^	Cumm. Demand
	Resident	Visitor	Resident	Visitor				
1989	693,800	78,600	1,255,028	281,772	1,536,800			
1990	703,900	82,100	1,273,298	294,319	1,567,617	30,817	0.36	0.36
1991	713,660	83,540	1,290,953	299,481	1,590,435	22,817	0.27	0.62
1992	723,420	84,980	1,308,608	304,644	1,613,252	22,817	0.27	0.89
1993	733,180	86,420	1,326,263	309,806	1,636,069	22,817	0.27	1.15
1994	742,940	87,860	1,343,918	314,968	1,658,887	22,817	0.27	1.42
1995	752,900	89,300	1,361,935	320,130	1,682,066	23,179	0.27	1.69
1996	757,180	90,800	1,369,677	325,508	1,695,185	13,120	0.15	1.84
1997	761,660	92,300	1,377,781	330,885	1,708,666	13,481	0.16	2.00
1998	766,140	93,800	1,385,885	336,262	1,722,148	13,481	0.16	2.15
1999	770,620	95,300	1,393,989	341,640	1,735,629	13,481	0.16	2.31
2000	775,100	96,800	1,402,093	347,017	1,749,110	13,481	0.16	2.47

Notes:

Department of Business and Economic Development, Population and Economic Projections for the State of Hawaii to 2010, November 1988, pages 4, 18;
1989 Projection from "Golf Course Development on Oahu, City & County of Honolulu, 1989, page 18.

^ Calculated by using the average rounds per individual times the estimated population of the group

^^ Calculated by taking the projected increase in rounds and dividing it by the average annual rounds played on courses on Oahu

EXHIBIT 19

Oahu Golf Courses
Estimated Demand 1990 – 2000
Assuming 2% Annual Growth Factor
Residents/Visitors
Based on Forecast Visitor/Resident Populations
December 1989

Year	Estimated Population #		Average Rounds ^ (2%)		Total Estimated Rounds	Estimated Increase in Rounds	Growth Need ^^	Cumm. Demand
	Resident	Visitor	Resident	Visitor				
1989	693,800	78,600	1.85	3.66	1,567,536			
1990	703,900	82,100	1.88	3.73	1,630,949	63,413	0.74	0.74
1991	713,660	83,540	1.92	3.80	1,687,782	56,833	0.66	1.40
1992	723,420	84,980	1.96	3.88	1,746,236	58,454	0.68	2.08
1993	733,180	86,420	2.00	3.96	1,806,353	60,117	0.70	2.77
1994	742,940	87,860	2.04	4.04	1,868,176	61,823	0.72	3.49
1995	752,900	89,300	2.08	4.12	1,932,165	63,989	0.74	4.24
1996	757,180	90,800	2.12	4.20	1,986,180	54,015	0.63	4.86
1997	761,660	92,300	2.16	4.28	2,042,015	55,835	0.65	5.51
1998	766,140	93,800	2.21	4.37	2,099,288	57,274	0.67	6.18
1999	770,620	95,300	2.25	4.46	2,158,036	58,748	0.68	6.86
2000	775,100	96,800	2.29	4.55	2,218,295	60,258	0.70	7.56

Notes:

Department of Business and Economic Development, Population and Economic Projections for the State of Hawaii to 2010, November 1988, pages 4, 18;
1989 Projection from "Golf Course Development on Oahu, City & County of Honolulu, 1989, page 18.

^ Calculated by using the average rounds per individual times the estimated population of the group

^^ Calculated by taking the projected increase in rounds and dividing it by the average annual rounds played on courses on Oahu

EXHIBIT 20

Oahu Golf Courses
Estimated Demand 1990 – 2000
Assuming 5% Annual Growth Factor
Residents/Visitors
Based on Forecast Visitor/Resident Populations
December 1989

Year	Estimated Population #		Average Rounds ^ (5%)		Total Estimated Rounds	Estimated Increase in Rounds	Growth Need ^^	Cumm. Demand
	Resident	Visitor	Resident	Visitor				
1989	693,800	78,600	1.90	3.76	1,613,640			
1990	703,900	82,100	1.99	3.95	1,728,298	114,658	1.33	1.33
1991	713,660	83,540	2.09	4.15	1,841,127	112,829	1.31	2.64
1992	723,420	84,980	2.20	4.36	1,960,918	119,791	1.39	4.03
1993	733,180	86,420	2.31	4.58	2,088,085	127,167	1.48	5.51
1994	742,940	87,860	2.42	4.80	2,223,067	134,982	1.57	7.08
1995	752,900	89,300	2.55	5.04	2,366,835	143,769	1.67	8.75
1996	757,180	90,800	2.67	5.30	2,504,560	137,725	1.60	10.35
1997	761,660	92,300	2.81	5.56	2,650,702	146,142	1.70	12.05
1998	766,140	93,800	2.95	5.84	2,805,197	154,495	1.79	13.84
1999	770,620	95,300	3.09	6.13	2,968,515	163,317	1.90	15.74
2000	775,100	96,800	3.25	6.44	3,141,151	172,636	2.01	17.74

Notes:

\# Department of Business and Economic Development, Population and Economic Projections for the State of Hawaii to 2010, November 1988, pages 4, 18;
1989 Projection from "Golf Course Development on Oahu, City & County of Honolulu, 1989, page 18.

^ Calculated by using the average rounds per individual times the estimated population of the group

^^ Calculated by taking the projected increase in rounds and dividing it by the average annual rounds played on courses on Oahu

EXHIBIT 21

Oahu Golf Courses
Estimated Demand 1990 – 2000
Assuming 10% Annual Growth Factor
Residents/Visitors
Based on Forecast Visitor/Resident Populations
December 1989

Year	Estimated Population #		Average Rounds ^		Total Estimated Rounds	Estimated Increase in Rounds	Growth Need ^^	Cumm. Demand
	Resident	Visitor	Resident	Visitor		-----10%-----		
1989	693,800	78,600	1.99	3.94	1,690,480			
1990	703,900	82,100	2.19	4.34	1,896,817	206,337	2.40	2.40
1991	713,660	83,540	2.41	4.77	2,116,869	220,052	2.56	4.95
1992	723,420	84,980	2.65	5.25	2,361,962	245,094	2.85	7.80
1993	733,180	86,420	2.91	5.77	2,634,906	272,944	3.17	10.97
1994	742,940	87,860	3.20	6.35	2,938,819	303,913	3.53	14.50
1995	752,900	89,300	3.53	6.99	3,277,870	339,051	3.94	18.44
1996	757,180	90,800	3.88	7.68	3,633,780	355,910	4.13	22.57
1997	761,660	92,300	4.27	8.45	4,028,946	395,166	4.59	27.16
1998	766,140	93,800	4.69	9.30	4,466,808	437,862	5.09	32.25
1999	770,620	95,300	5.16	10.23	4,951,952	485,144	5.63	37.88
2000	775,100	96,800	5.68	11.25	5,489,457	537,505	6.24	44.12

Notes:
Department of Business and Economic Development, Population and Economic Projections for the State of Hawaii to 2010, November 1988, pages 4, 18;
1989 Projection from "Golf Course Development on Oahu, City & County of Honolulu, 1989, page 18.
^ Calculated by using the average rounds per individual times the estimated population of the group
^^ Calculated by taking the projected increase in rounds and dividing it by the average annual rounds played on courses on Oahu

D. EXISTING SHORTFALL OF GOLF COURSE ON OAHU

A number of factors argue strongly that there is an existing shortfall of golf facilities on Oahu including the following: 1) Existing golf courses operating at maximum capacity; 2) Escalating greens fees; 3) Institution of a telephone lottery system for allocating golf rounds at municipal courses; 4) Much higher levels of play by both residents and visitors in Maui county, the State's second largest visitor market; 5) The flurry of activity among land owners and developers to develop new golf course properties, and 6) Extrapolation of past trends.

1. Courses Operating at Capacity

Most of the golf courses on Oahu are operating at or near capacity. While there is a large variance in rounds played at various courses, it is primarily due to the type of golf course (9, 18 hole, municipal, resort, private) and the level of service and golfing enjoyment each attempts to provide.

2. Escalating Green Fees

While the recent doubling of fees at municipal courses cannot be attributed exclusively to the shortage of courses, the fact that it was accomplished with a minimal decline in play is some indication of the level of demand. In addition, the daily fee and resort courses have seen escalating revenues in recent years as a result of increased green fees and the institution of tiered pricing policies where visitors are charged higher prices than residents.

3. Municipal Telephone Lottery

The city instituted a system under which calls for starting times were picked randomly by computer. This system was instituted due to the percentage of golfers complaining about the difficulty in getting starting times. An analysis of the system, *Playing Favorites: An Analysis of the Dial-a-Time Telephone Reservations System for Honolulu's Municipal Golf Courses*, November 1989, indicated that on the average Oahu's three 18 hole municipal course receive approximately 38,000 calls daily for approximately 1,300 available times. Note: since the calls are randomly selected by computer, it is estimated that most of these calls are multiple calls, however, it is considered one indication of excess demand whenever an allocation system must be implemented.

4. Comparison with Maui Play

The consultant conducted a study of the golf play on the Island of Maui. The results of that study indicated that the average individual in the visitor population played 12.06 rounds while the resident played 2.79 rounds in 1989. (See *Appendix 1*) Thus, the typical Maui visitor played 3.3 times and resident played 1.5 times more golf that Oahu visitors and residents, respectively. Given that the green fee structure is somewhat compatible between the two counties, the most plausible explanation for this tremendous differential in play is the supply of golf facilities. *Figure 2* shows a shortfall depending on the assumption of 16 to 20 courses.

Figure 2

	Oahu Non-Military Population[1] 1989	Rounds/ Person Maui[2] 1989	Total Demand	Oahu[3] Average Course Rounds	Maui[4] Average Course Rounds
Resort	683,700	2.79	1,907,523		
Visitor	75,300	12.06	908,114		
Total Demand			2,815,641		
Existing Average Play for 18-Hole Courses				86,097	57,312
Demand for Golf Courses				32.7	49.1
Existing Courses (18-Hole Equivalent				17	17
Shortfall				15.7	32

1 - *Exhibit 17*

2 - *Appendix I*

3 - *Exhibit 16*

5. **Proposed New Golf Facilities**

Appendix 2 shows the golf courses currently proposed or mentioned as possible sites for golf Facilities. The fact that so much interest exists is testimony to the existing shortfall of these types of facilities.

6. **Extrapolation of Past Trends**

The consultant projected golf course demand based on the relation between population and golf holes between 1950 and 1980. (See *Appendix 2-A*). Based on this projection, 597 golf holes would be required by 1990 against an existing inventory of 459 holes leaving a shortfall of 138 holes or 7.6 18 hole courses.

7. **Summary**

The above mentioned factors offer strong evidence that there is currently an existing shortfall in golf facilities on Oahu. The consultant has used two methods to determine the exiting shortfall of courses. Assuming the trend in past relationships between population and golf holes continue the shortfall is 8 courses. Assuming, lack of supply, prevents Oahu visitors and residents from playing at the same rate as Maui residents and visitors would indicate on existing shortfall of sixteen (16) 18-hole courses.

Thus the range of the existing shortfall estimated by the consultant is 8 to 16 18-hole golf courses.

V. FUTURE SUPPLY OF GOLF COURSES ON OAHU

Municipal courses on Oahu are some of the busiest in the country and the world. (See *Exhibit 22*) Public pressure has been increasing to construct new municipal courses and several alternative sites are under consideration. There is strong interest in development of private courses with over forty courses under consideration by various developers. Others may be under consideration that have not been announced. (See *Appendix 2*)

While the potential supply of 44 new courses looks overwhelming in light of the number of existing courses it must be viewed in terms of the likelihood of development and the long term demand for golf on Oahu.

A number of factors suggest that not all of the courses will be built, including: unsuitable infrastructure, including water availability and access; incompatibility with surrounding uses: incompatibility with city and state use guidelines; and the inability to obtain the necessary financing.

In the opinion of the consultant, less than half of the proposed courses will be developed prior to the year 2000.

EXHIBIT 22

CITY & COUNTY OF HONOLULU
MUNICIPAL GOLF COURSES
FY 1986, FY 1987 and FY 1988

	1986	1987	1988
Ala Wai	197,000	198,000	188,000 [1]
Pali	144,000	140,000 [2]	144,000
Makalena	155,000	165,000	165,000
Kahuku	38,000	42,000	48,000
TOTAL	534,000	545,000	545,000

[1] - Ala Wai Course undergoing major renovation in FY 1988 and FY 1989.
[2] - Increased rainouts experienced in 1987.

NOTES:
The City has started construction of a new municipal golf course in the West Loch area. The first full year of operation for this course is estimated to be Fiscal Year 1990 if no snags develop during the construction phase of the project. The City's golf administrator believes that a total of eight municipal golf courses would be needed to accommodate the current level of demand at municipal golf courses.

According to the *Golf Course Operating Survey* June 1986, prepared jointly by the National Golf Foundation and the Professional Golfing Association of America, average total rounds for municipal golf courses in the United States were 50,000 on 18-hole courses and 18,000 on 9-hole courses.

SOURCE: Dave Mills, Golf Administrator, City & County of Honolulu

VI. GOLF DEMAND FOR THE COUNTRY COURSES AT KAHUKU

A. RESIDENTIAL

The Koolauloa and North Shore development plan areas are expected to be the primary market area for the "Country Courses at Kahuku" golf development. However, the bulk of this demand is expected to come from the development of the Kuilima Resort area. Residential population targets set in the Kooalauloa and North Shore development plan areas by the City and County of Honolulu's adopted general plan have been reduced in order to preserve the rural character of the areas.

The Koolauloa and North Shore development plan areas currently contain approximately 3% of Oahu's population and 5% of Oahu's golf facilities. There are currently two golf courses located within the North Shore and Koolauloa development plan areas, the Turtle Bay Resort and Country Club course (a resort course) and the Kahuku Golf Course, (a nine hole municipal facility). Play at the Turtle Bay course is 75% tourists and 25% resident play. The bulk of the tourist play at the Turtle Bay course consists of groups and individuals staying within the Waikiki tourist complex although the existing hotel and condominium facilities provide between 25% and 30% of the play. In fiscal 1989, 93% of the play at the Kahuku Municipal course was local residents. While records of the residence location (by development plan area) are not kept, a significant amount of the play at the course is from residents outside the Koolauloa and North Shore DP areas. Patronage at the Kahuku Course has increased dramatically during the past 4 years from 38,000 rounds in 1985 to over 59,000 rounds in 1989. One factor in this 50% growth has been the fact that the city's other municipal courses are at maximum capacity and therefore Kahuku is benefiting from the excess demand at the other municipal courses. However, the large number of rounds being played by golf clubs at the existing Kahuku and Turtle Bay courses indicated an islandwide demand by residents for golf at the Kahuku location.

The resident population growth in the Koolauloa and North Shore area is expected to keep pace with the population growth for the island as a whole. General Plan population targets for the Koolauloa and North Shore areas suggest that the population percentages for the two areas will continue at close to 3% through the year 2010. Thus the consultant believes that increased residential demand will increase at the same rate at the growth in population and golf demand on Oahu in general.

B. RESORT

The concept of the "County Courses at Kahuku" is to utilize the projected resort capacity of the Kuilima development as the primary demand for the golf supply being created in the area. The "Country Courses at Kahuku," and the courses being developed in conjunction with the Kuilima resort, will allow the Kuilima resort to become known as <u>the</u> golf resort in Hawaii.

Probably the best example of the golf centered resort concept is the Pinehurst Hotel in Moore County, North Carolina which has seven golf courses as part of its facilities. The hotel, which consists of 445 resort units including 220 hotel rooms and 225 condominium units, operated as resort units, is known nationally and internationally as a golf mecca. Telephone interviews with marketing and operating personnel of the Pinehurst Hotel suggest that well over 80% of the guests staying at the hotel play golf.

The Pinehurst golf complex consists of 2 championship and 5 resort courses. The range of difficulty as well as the range of fees vary widely in order to attract a wide spectrum of golfers. Thus golfers from beginners to pros and with income levels demanding budget golf to luxury golf are accommodated.

Following this concept other golf course development proposed in the North Shore and Koolauloa areas would be supportive of and add to the potential success of the proposed resort golf complex by building the concentration of golf courses in the area and therefore increasing the area's attractiveness to golfers.

The Pinehurst Hotel was the catalyst and continues to be the heart of a resort community of 60,000 people which supports 30 golf courses within a 15 mile radius with 8 more courses planned or under construction. While there are other resort related activities available in the Pinehurst area, there is a sufficient mass of golf courses in the Pinehurst area that they are the primary draw.

There are a number of golf oriented resorts across the United States. A survey of characteristics of selected golf based resorts is contained in *Exhibit 23*. In each of the resorts surveyed, golf is the primary attraction of the resort with at least 50% of resort guest participating in golf. As can be seen from *Exhibit 23* each of the resorts surveyed provided the following:

- A variety of golf experiences as well as enough golf courses to insure the availability of starting times for their guests.
- The availability of instructional schools
- Conference rooms to attract the business golfer.
- Tournaments to enhance prestige as well as generate publicity for the facilities.
- In three out of the four resorts surveyed a wide range of fees to accommodated the disposable income of a wide range of golfers.
- Incorporated tennis facilities to provide variety for the golfer as well as for non-golf but sports oriented companion.

The Kuilima Resort expansion, which is now underway with the start of construction of the second Kuilima golf course scheduled for January of 1990 can generate the demand for a Pinehurst like resort. An important

EXHIBIT 23

COUNTRY COURSES AT KAHUKU

Characteristics of Selected U.S. Golf Resorts
December 1989

	The Lodge at Pebble Beach	The Boulders	La Quinta Hotel Golf and Tennis Resort	Pinehurst Hotel and Country Club
Location:	Pebble Beach, California	Carefree, Arizona	La Quinta, California	Pinehurst, N.C.
Resort Market:	Montery-Carmel-Pebble Beach	Phoenix-Scottsdale	Palm Springs	South East North Carolina
Visitor Units:	391	135 ^^^	269 – 1,500 more planned	220 Hotel – 445 total includes condos, villas
Golf Residentail Lots in project:	Yes	Yes	Yes	Yes
Accommodations:	Luxury	Luxury	First Class/Luxury	Luxury
Associated Golf Holes:	90	27	54	126
Course Type:	3 tournament, 2 resort	3 nine-hole resort	2 resort, 1 club	2 championship, 5 resort
Charge for 18 Holes:	$35–145 ^^	$50–75 ^	$60 ^	$35–100
Golf Tournaments:	Annual	Yes	Yes	Yes
Instructional Schools:	Yes	No	Yes	Yes
Other Facilities:	Full-service hotel Tennis (21 courts) Conferences (18 rooms)	Full-service hotel Tennis (6 courts) Conferences (6 rooms)	Full-service hotel Tennis (30 courts, Stadium) Conferences (12 rooms) Convention Center	Full-service hotel Tennis (28 courts) Conferences (7 rooms)

^ Includes cart rental and other charges.
^^ Cart rental additional.
^^^ Includes 15 golf frontage residences managed by hotel.

SOURCE: John Zapotocky, Consultant, based on telephone interviews conducted in December 1989.

consideration in the demand for golf is whether the golf amenity at the resort is heavily promoted and in sufficient supply to accommodate the potential resort populations. A resort which is promoted as a golf resort is likely to be much more attractive to golfers than a resort which happens to have a golf amenity too.

The base information contained in *Exhibit 15* indicates that Hawaiian resort hotels generate from .08 golf rounds per hotel room per day at Wailea to .4 golf rounds per hotel room per day at Mauna Kea. In addition, resort condominiums units generate golf rounds ranging from .07 rounds per unit per day at Princeville to .11 rounds per unit per day at Wailea. Assuming that the mid point of these ranges is applied to the existing and projected units at the Kuilima resort development, resort hotel units could be expected to generate .24 rounds per unit per day while resort condominium units would generate .09 rounds of golf per unit per day. These relationships would be achieved over time as the existing mix of play and golf facility availability would not permit such relationships to occur.

Exhibits 24, 25, and *26* indicate the absorption of the four golf facilities proposed in the "Country Courses at Kahuku" development over a five year period beginning in 1994 and ending in 1998. No provision has been made for a lag in demand due to the need to achieve stabilized occupancy rates. Even during the initial startup period, hotel and resort wide occupancies of 100% can be achieved for short periods particularly during the peak tourist seasons. If golf facilities were scheduled to be available once stabilized occupancies were expected there is a strong possibility that the resort would be unable to fulfill the golf expectations of visitors at a time when the ability to perform is most crucial.

As indicated in the exhibits, courses planned and programmed by the Kuilima Resort Company, developer of the Kuilima Resort, as well as the existing Kahuku municipal golf course have been incorporated into the estimates.

EXHIBIT 24

Country Courses at Kahuku
Estimated Demand
1990 – 2000

Year	Hotel Rooms	Potential (1) Rounds 24.00%	Condos	Potential (2) Rounds 9.00%	Existing(3) Non Project Resident/ Visitor	Total Golf Demand
1990	486	58 (4)	368	33	296	388
1991	486	58 (4)	368	33	308	399
1992	1,549	186 (4)	368	33	316	535
1993	1,549	186 (4)	368	33	328	547
1994	1,549	372	368	33	336	741
1995	1,549	372	568	51	350	773
1996	2,585	620	768	69	362	1,051
1997	2,585	620	968	87	370	1,078
1998	2,585	620	1,168	105	382	1,107
1999	2,585	620	1,368	123	393	1,137
2000	3,000	720	1,368	123	405	1,248

(1) Comparable to ratio of golf rounds to hotel rooms upper end Hawaii resort hotels.
(2) Estimated average rounds per Hawaii resort condominium John Zapotocky, Consultant
(3) Existing non project rounds @ Kuilima and Kahuku Municipal Golf Course

EXHIBIT 25

Country Courses at Kahuku
Estimated Supply of Golf Rounds
1990 – 2000

Year	Existing(1) Kahuku Municipal	Kuilima Resort Existing	Course 2	Malaekahana	Country Courses at Kahuku Punamano #1	#2	#3	Malaekahana	Grand Total Supply
1990	190	180							370
1991	190		180						370
1992	190	150	150						490
1993	190	150	150						490
1994	190	150	150	115				140	745
1995	190	150	150	115				140	745
1996	190	150	150	115	140	140		140	1025
1997	190	150	150	115	140	140		140	1025
1998	190	150	150	115	140	140	140	140	1165
1999	190	150	150	115	140	140	140	140	1165
2000	190	150	150	115	140	140	140	140	1165

(1) Assumes Kahuku Course maximum play at 85% equivelent rounds of 18 hole muni. course
(2) KPMG Peat Marwick "Market Assessment Country Courses at Kahuku" February 1989
Note: KPMG study prepared for Kuilima Resort Company owner developer Kuilima Courses.
(3) Consultant Estimate desirable level play on resort courses 50,000 rounds anually

EXHIBIT 26

Country Courses at Kahuku
Comparison Estimated Supply and Demand
1990 – 2000

Year	Total Golf Demand	Grand Total Supply	(Shortfall) Excess
1990	388	370	(18)
1991	399	370	(29)
1992	535	490	(45)
1993	547	490	(57)
1994	741	745	4
1995	773	745	(28)
1996	1,051	1,025	(26)
1997	1,078	1,025	(53)
1998	1,107	1,165	58
1999	1,137	1,165	28
2000	1,248	1,165	(83)

VII. ADVANTAGES OF IMPLEMENTING THE "PROPOSED COUNTRY COURSES AT KAHUKU" — MARKETING/OPERATIONAL

A. SYNERGY OF GOLF COURSE CONCENTRATION

Development of the "Country Courses at Kahuku" golf complex will result in an acceleration of demand for golf facilities. Throughout this report, numerous references are made to the existing relationships between golf play and resort development. However, development of the "Country Courses at Kahuku" will result in a totally new relationship between and among resort development and resort golf development. Numerous examples can be cited of development itself creating demand. Local examples include: the development of Ala Moana Shopping Center; development of the James Campbell Industrial Park; and the development of the Hilton Hawaiian Village. In each case prior to the development of the actual facilities no market for their products and services existed or could have been demonstrated. However, the creation of these developments, led to changes in past patterns and practices, which redefined and increased the demand. In a similar manner development of the "Country Courses at Kahuku" are expected to result in an increase in demand as follows:

1. Availability

Golf availability for guests of the Kuilima Resort will exceed that of any existing or planned resorts in Hawaii.

2. Variety

Golf variety of eight courses: the existing Turtle Bay course and two others planned by the Kuilima Resort Company; the four proposed; and the existing municipal course will provide Kuilima guests with a range of playing options unmatched anywhere in Hawaii.

3. Accessibility

The availability and variety described above will be achieved within a ten minute drive of the resort.

4. Versatility

a. Tournaments

The concentration of golf facilities at the Kuilima Resort would allow professional golf tournaments, i.e., the Tournament Players Association (TPA), the Ladies Professional Golfers Association (LPGA) and the Seniors to be held with little or no negative impacts on resort golfing activities.

Many Hawaii based resort developments including the Turtle Bay Resort and Country Club at Kuilima have hosted various professional golf tournaments, however, in the past, this has come at a very high price to the resort. Golfing activities for resort guests have all but been eliminated for two weeks where a single course is involved, as the various activities, i.e., pro-am's, practice rounds, as well as the actual tournament preempt use of the course by non-tournament guests. In addition, maintenance requirements, i.e., increasing the areas of roughs as well as the toughening of the playing conditions in general, impede the ordinary relaxed conditions typically found on resort courses.

Ordinary play is further disrupted both before and after the tournaments as construction of communications facilities, camera towers, and providing power at appropriate locations throughout the course, result in areas being disturbed or placed out of play. Additional damage to the course usually results from spectators attending the tournament.

With eight courses in the immediate vicinity the use of a single course for tournament purposes would have only a minimal impact on golf availability.

In addition, private groups sponsoring tournaments in conjunction with conventions or other activities would have much easier access to playing facilities with less impact on other resort guests.

b. Maintenance

Golf courses periodically undergo major maintenance or renovation. Most resort operators are reluctant to close down a course for these events due to the impact on resort guests. Thus, renovations and maintenance have been done on a piecemeal basis, often with long term disruption of the golf experience in order to remain open while work is done.

Concentration of the golf facilities in the Kuilima area will result in maintenance decisions being made which minimize the impact on the resort golfer. This would allow renovations and maintenance to be undertaken in the most economic manner, consistent with maintaining the golfing experience at all times.

VIII. COMPATIBILITY WITH EXISTING AND PLANNED USES AND CONDITIONS

The "Country Courses at Kahuku" - Punamano are compatible with existing and planned uses in the area. As discussed earlier in the text, existing and planned uses include resort development, agricultural development and military training areas. Bordering the southeast portion of the site a wastewater treatment facility is being constructed. Golf courses and these current and planned uses coexist at numerous locations on Oahu and throughout the Hawaiian Islands. No negative impacts on golf course marketability are expected from any of the existing or proposed uses.

The Kahuku area is known for windy conditions. However, given the existing levels of play at the Kahuku Municipal and the Turtle Bay courses this factor has not been an impediment to marketing golf times in the past. Further, golf course designers can mitigate wind impact on golf play by design and landscape features.

IX. EMPLOYMENT

Appendix 3 estimates employment at each golf course at 50 persons. Thus the three golf course at Punamano are expected to employ approximately 150 persons. While this number of employees tends to be at the lower end of the employment spectrum for resort courses, the nearby Kuilima Resort is expected to provide much of the support activities normally associated with stand alone golf facilities including major eating facilities, conference rooms and meeting facilities, and alternate recreation facilities such as tennis. In addition there is the possibility of economies of scale in the operations, particularly in the administrative areas. Centralized accounting, management and reservations systems would minimize administrative and clerical jobs.

X. SUMMARY

The proposed "Country Courses at Kahuku" — Punamano have a number of advantages, from a marketing standpoint, over other golf courses proposed in the North Shore and Koolauloa Development Plan areas.

1. By virtue of their location, less than a mile east of the entrance to the Kuilima resort, the Punamano Courses have better access to resort guests at the Kuilima Development than any other existing or proposed golf course save the two located within the Kuilima Resort proper.

2. The size of the Punamano site and its dedication to strictly golf activities, will allow the golf courses designer to maximize the recreational golf aspects of the site.

3. The site possesses natural beauty and at various locations within the site excellent ocean and mountain panoramas will add to the enjoyment of the basic recreational experience.

4. The existing Turtle Bay and Kahuku Courses are already attracting in excess of 100,000 (non-Kuilima Complex) golf rounds annually and the North Shore and Koolauloa areas are already known for their recreational amenities, including: major beach parks; major visitor attractions, *i.e., Polynesian Cultural Center and Waimea Falls Park;* ocean recreation, including surfing and boating (Haleiwa Harbor); and equestrian activities including polo at Mokuleia and other activities along the entire coast.

5. Will build on the strength of the existing Turtle Bay Resort in attracting golf business while at the same time attracting golfers to the resort.

The proposed Country Courses at Kahuku will help to satisfy the growing demand for golf of Oahu's visitor and resident populations. The development will help to preserve the long term viability of Hawaii's and Oahu's resort industry. At the same time the Courtry Courses at Kahuku will foster the development of a nitche market (golfing visitors) which will be beneficial for the Hawaiian visitor industry as well as for the approved Kuilima Resort Development.

APPENDIX 1

Maui County Golf Courses **
Visitor/Resident Rounds
Based on 1989 Rounds
Based on 1989 Visitor/Resident Estimates

POPULATION GROUP	TOTAL POPULATION	TOTAL ROUND ^	ROUNDS PER GROUP
Resident *	89,900	250,423	2.79
Visitor #	33,890	408,668	12.06
TOTAL		659,091	

NOTES:

* DBED "Population and Economic Projections State of Hawaii to 2010 (Series M-K)" Nov. 88 p. 4
# DBED "Population and Economic Projections State of Hawaii to 2010 (Series M-K)" Nov. 88 p. 18
^ Data for 1989 rounds as per Cipro GOlf Consultants
** Does not include Molokai (Del Monte) or Lanai (Castle & Cooke) courses

Average Rounds/Course

TOTAL ROUNDS	NUMBER OF COURSES^^	AVERAGE PER ROUNDS
659,091	11.5	57,312

^^ Eighteen Hole Equivalent

Source: John Zapotocky, Consultant

Appendix 2

Planned or Proposed Golf Courses: City & County of Honolulu

STATUS, GOLF COURSE (DEVELOPER)	HOLES	DISTRICT	DP AREA
Under Construction			
Ko'Olina (West Beach Estates)	18	Ewa	Waianae
West Loch (City & County of Honolulu)	18	Ewa	Waianae
Minami (Minami Corp.)	18	Windward	Koolau Poko
Close to Construction			
Myers/Seibu Golf Course (Myers Corp.)	27	Ewa	Waianae
Royal Hawaiian Country Club #1 (Y Y Valley Corp.)	18	Windward	Koolau Poko
Puuloa (H. Horita Realty, Puuloa Homes Inc.)	18	Ewa	Waianae
Turtle Bay Expansion (Kulima Development Co.)	18	Kahuku	Koolau Loa
Waikele (Amfac Properties)	18	Waipahu	Central Oahu
Needs Some Additional Discretionary Approval			
Kapolei (State of Hawaii Housing Authority)	18	Ewa	Waianae
Makakilo (Finance Realty)	18	Ewa	Waianae
Royal Kunia #1 (Halekua Development Co.)	18	Ewa	Central Oahu
Royal Hawaiian Country Club #2 (Y Y Valley Corp.)	18	Windward	Koolau Poko
Kipapa Ridge Estates (City & County of Honolulu)	9	Ewa	Central Oahu
Needs Substantial Discretionary Approval, Under Review			
Ewa Gentry (Gentry Pacific Corp)	18	Ewa	Waianae
Ko'Olina #2 (West Beach Estates)	18	Ewa	Waianae
Ko'Olina #3 (West Beach Estates)	18	Ewa	Waianae
Royal Kunia #2 (Halekua Development Co.)	18	Ewa	Central Oahu
Waikane (Waikane Development Co.)	27	Windward	Koolau Poko
Kailua Drive-In (Windward Development Co)	18	Windward	Koolau Poko
Lihi Lani Recreational Community (Ohbayashi Hawaii Corp)	36	North Shore	North Shore
Punamano (Campbell Estate)	54	Kahuku	Koolau Loa
Malaekahana (Campbell Estate)	18	Kahuku	Koolau Loa
Ewa Marina (HASEKO Hawaii)	27	Ewa	Waianae
Waihee Valley (City & County of Honolulu)	18	Windward	Koolau Poko
Waiawa (Gentry Companies)	36	Ewa	Central Oahu

Appendix 2

Planned or Proposed Golf Courses: City & County of Honolulu

STATUS, GOLF COURSE (DEVELOPER)	HOLES	DISTRICT	DP AREA
No Official Submittals			
Ohikilolo (Alpha Kai)	18	Waianae	Waianae
Lualuale (Sanjiro Nakode)	18	Waianae	Waianae
Haleiwa (SDZ Land Co.)	9	Waialua	North Shore
Kahuku (City & County of Honolulu)	18	Kahuku	Koolau Loa
Waikane (Undetermined)	18	Windward	Koolau Poko
Heeia (Undetermined)	18	Windward	Koolau Poko
Heeia Kea (Nanatome Hawaii, Inc.)	18	Windward	Koolau Poko
Bay View Expansion (Pacific Atlas Hawaii)	18	Windward	Koolau Poko
Malaekahana (Asahi Jyuken)	18	Kahuku	Koolau Loa
Application Denied or Withdrawn			
Maili Kai (Kaiser Cement Co)	18	Waianae	Waianae
Waianae Kai (H. Horita Investment Inc)	27	Waianae	Waianae
Mokuleia (Mokuleia Land Co.)	36	Waialua	North Shore
Waialua (Oceanic Properties, Inc)	18	Waialua	North Shore

SOURCE: Decision Analysts Hawaii, Inc.
December 1989

APPENDIX 2–A

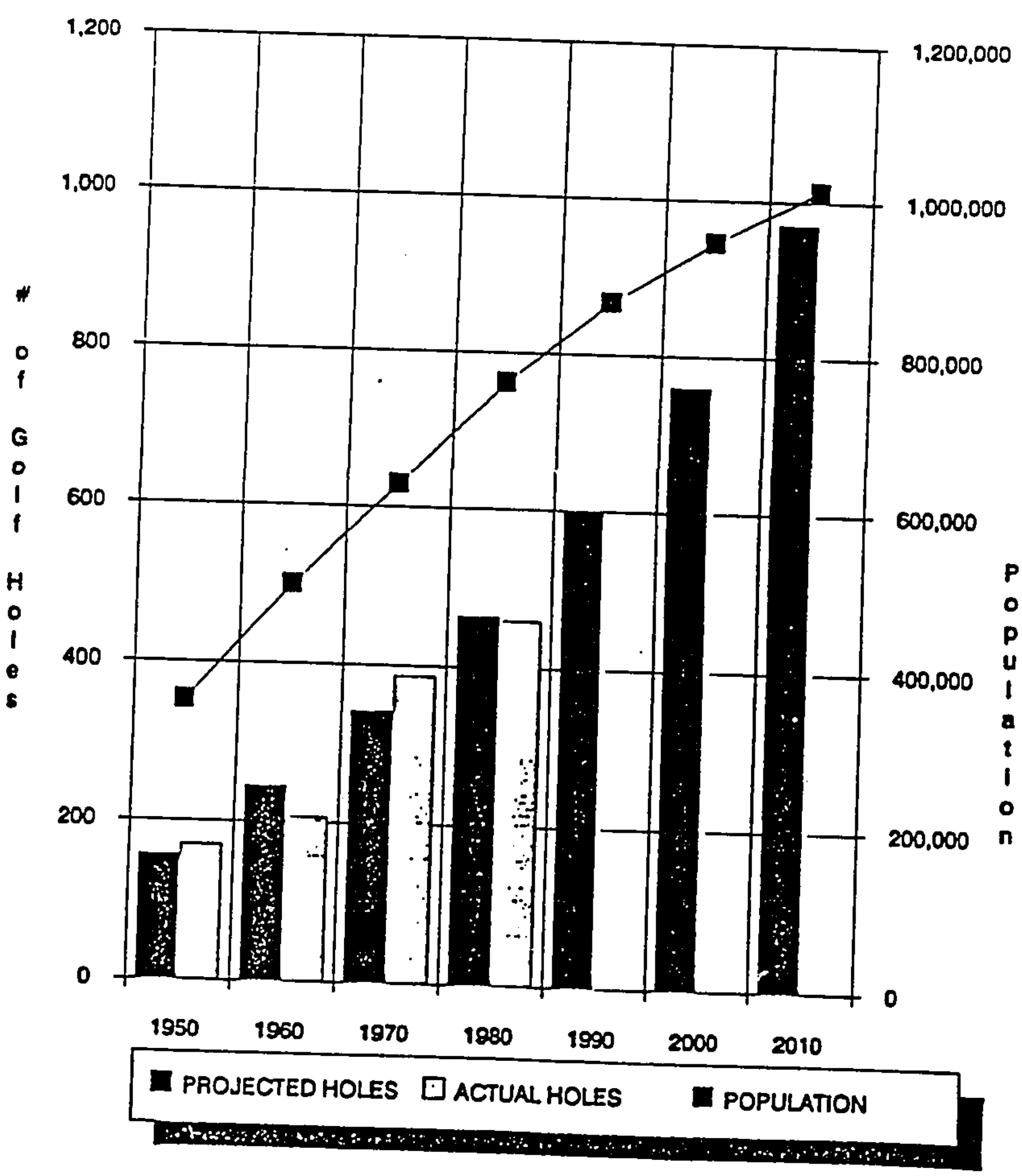
Oahu Golf Demand Projections Based on Population and Golf Holes 1950–1980

Source: *Market Assessment for Waiola*
John Zapotocky, Consultant
March 1989

NUMBER OF PERSONS PER HOLE
Using a Linear Regression Analysis And Projection

YEAR	PERSONS PER HOLE		GOLF HOLES		POPULATION
	ACTUAL	PROJECTED	PROJECTED	ACTUAL	
1950	2,064	2,243	157	171	353,020
1960	2,417	2,043	245	207	500,409
1970	1,629	1,843	342	387	630,528
1980	1,661	1,644	464	459	762,565
1990		1,444	597		861,600
2000		1,244	750		932,800
2010		1,044	957		999,500

Golf Holes on Oahu Projections Based On Persons Per Hole



APPENDIX 3

Golf Course Employment

Golf course employment has been estimated by the consultant to be fifty persons. The following is a general breakdown of the golf course employment and is assumes a minimum level of staffing as follows:

Maintenance crew of fifteen including a superintendent, an assistant superintendent, two mechanics and eleven maintenance workers.

Pro Shop staff of fifteen including a golf pro, two assistant pros, cart mechanics, cashiers/starters, cart washers, marshals, janitors and an accounting clerk.

Snack Bar/Restaurant staff of twenty people.

Resort golf courses providing a high level of service often range between forty and fifty persons exclusive of food operations.

As the "Country Courses at Kahuku" proposes to provide a range of golfing experiences and is expected to include both high maintenance resort courses as well as lower maintenance golf facilities, and the fact that if the facilities are under single ownership some economics of scale could be achieved, the consultant has opted to retain the conservative estimate of 50 persons per course.

JOHN ZAPOTOCKY, CONSULTANT
Pacific Tower, Suite 660
1001 Bishop Street
Honolulu, Hawaii 96813

Telephone:
Office: (808) 533-2929
Home: (808) 621-7617

FAX:
(808) 521-5410

JOHN ZAPOTOCKY, CONSULTANT, Honolulu, Hawaii — **1985 - Present**

Principal. Independent consultant specializing in real estate related assignments. Services provided include financial analysis, market assessments, real estate related environmental assessments and environmental impact statements and specific research assignments. Assignments undertaken as the primary contractor, in partnership with other consultants and as a subcontractor. Representative clients and assignments during the past year include:

City Dept. of Housing & Community Development[2] .... Waiola Planned Community Market Assessment

Halekua Development Co.[1] .... Royal Kunia Phase II Market Assessment

West Beach Estates[2] .... Ko Olina Phase II Market Assessment

ANA Hotels Hawaii, Inc.[2] .... Makaha Expansion Market Assessment

VMS Realty Partners[1] .... Planned Community Economic Model

K. G. Hawaii. Inc.[1] .... Ko Olina Phase II Economic Model

Estate of James Campbell[2] .... Kahuku Master Plan Market Assessment

Hawaii States Properties[2] .... Makena Surf Expansion Market Assessment

[1] Prime Contractor
[2] Sub-Contractor

MOKULEIA HOMESTEADS, Honolulu, Hawaii — **1979 - 1984**

General Manager. Managed development activities for the $80 million 3,000 acre proposed agricultural/residential community on the site of the former Dillingham Ranch in Mokuleia. Coordinated planners, engineers, attorneys and consultants to obtain infrastructure and subdivision approvals. Met and negotiated with government agencies and achieved approvals for a $5 million water system and a $4 million sewer system. Reviewed bids, selected contractors and administered contracts for drilling of three water wells with a total capacity of 4.5 million gallons per day. Prepared annual budgets for both development and operation activities. Other responsibilities included miscellaneous real estate transactions related to operations, i.e., pasture leases, polo field lease, and guesthouse rentals; and management responsibility for fifteen ranch employees.

WAILEA DEVELOPMENT COMPANY, Kihei, Maui **1975 - 1979**

Project Coordinator. Coordinated development of the Wailea Ekolu project, a $25 million 150-unit luxury condominium within the 1,200 acre Wailea Resort Community. Responsibilities included feasibility analysis, coordination of the design process, preparation of exhibits and communications for government approval authorities. Supervised preparation of sales and condominium documentation and participated in development of the marketing plan. Simultaneously worked on the Wailea Kai project, a $10 million 100-lot residential subdivision, and the Wailea Elua II project, a $20 million 66-unit luxury resort.

Financial Administrator. Supervised the preparation of annual and long-range plans and responsible for cash planning. Participated in the redesign of the accounting reports in order that they be more effective management tools. Supervised the day-to-day financial and accounting activities of the company.

Director of Planning and Budget Analysis. Prepared annual and long-range plans. Performed variance analysis on financial reports. Analyzed financial statements of prospective tenants for the Wailea Town Center, a 50,000 square foot commercial project.

KAISER AETNA (KACOR), Honolulu, Hawaii **1973 - 1975**

Manager, Administration & Contract Control. This position encompassed four primary areas of responsibilities: escrow, contract administration, architectural control and office management.

Manager, Hawaii Kai Golf Courses. Directly responsible for all planning and operations. Prepared operating and capital budgets. Directed operations through three department heads who in turn supervised forty persons. Responsible for developing and implementing the marketing program.

EDUCATION: College of Business Administration
University of Hawaii

1974: Postgraduated work in Finance
1973: M.B.A.
1969: B.A. in Economics

PROFESSIONAL AND VOLUNTEER ORGANIZATIONS: Land Use Research Foundation
(Mokuleia Representative)
Hawaii Society of Corporate Planners
(President Fiscal Year 1983)
Kukui Plaza Owners Association
(Director)