DEPARTMENT OF LAND UTILIZATION
89/SMA-79(BWM)
June 14, 1990

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OFC. OF ENVIRONMENTAL QUALITY CONTROL

SPECIAL MANAGEMENT AREA ORDINANCE
CHAPTER 33, ROH
Environmental Assessment/Determination
Negative Declaration

Recorded Owner	:	Harold K. L. Castle Foundation
Applicant	:	Windward Park Inc.
Agent	:	DHM inc.
Location	:	917 Kalanianaole Highway, Kailua, Oahu
Tax Map Key	:	4-2-14: 04
Request	:	To construct a golf driving range and support facilities
Determination	:	Environmental Impact Statement (EIS) Not Required

Windward Park Driving Range

Attached and incorporated by reference is the environmental assessment prepared by the applicant for the project.

On the basis of the environmental assessment, we have determined that an Environmental Impact Statement is not required.

APPROVED Donald Clegg
DONALD A. CLEGG
Director of Land Utilization
City and County of Honolulu
State of Hawaii

DAC:sl
0259N/11

1990-06-23-OA FRA

★WINDWARD PARK GOLF DRIVING RANGE★

Revised Environmental Assessment

WINDWARD PARK, INC. • APRIL 1990

LU 4/90 2857

WINDWARD PARK GOLF DRIVING RANGE

Revised Environmental Assessment

Submitted As Part an Application for a
Special Management Area Use Permit (SMP)

Pursuant to Chapter 343,
Hawaii Revised Statutes and
Title 11, Chapter 200,
Environmental Impact Statement Rules

Prepared by:

DHM Planners inc.
1188 Bishop Street, Suite 2405
Honolulu, Hawai'i 96813

Environmental Planning Consultant for the Applicant:

WINDWARD PARK, INC.

APRIL 1990

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Noise

PACIFIC PLANNING AND ENGINEERING, INC.
Traffic Engineering

UNIVERSITY ASSOCIATES
Air Quality

JOHNSON, TSUSHIMA, LUERSEN AND LOWREY
Architecture

DHM PLANNERS Inc,

Staff Members:
Duk Hee Murabayashi
Eric Parker
Lynn Taguchi

WINDWARD PARK GOLF DRIVING RANGE
REVISED ENVIRONMENTAL ASSESSMENT

PROJECT INFORMATION

PETITIONER:	Lydia Tsui, President Windward Park, Inc. 1017 Kapahulu Avenue, 2nd Floor Honolulu, Hawaii 96816 Phone: 734-2944
AGENT:	Duk Hee Murabayashi (Mrs.) DHM Inc. 1188 Bishop Street, Suite 2405 Honolulu, Hawaii 96813 Phone: 521-9855
LANDOWNER:	Harold K.L. Castle Foundation
LEASEE:	Consolidated Amusement, Co., Ltd.
TAX MAP KEY:	TMK 4-2-14: Parcel 4
PROJECT LOCATION:	917 Kalanianaole Highway, Kailua, Koolaupoko, O'ahu; corner of Kalanianaole Highway and Kapaa Quarry Access Road approximately 13 miles northeast of Honolulu.
PROPOSED ACTION:	Development of a golf driving range for use by the general public
PROJECT AREA:	24.059 acres
DEVELOPMENT TIMETABLE:	To be completed by January 1991

EXISTING LAND USE DESIGNATIONS FOR THE PROJECT AREA

STATE LAND USE:	Urban
DP LAND USE:	Preservation
ZONING:	P-2, General Preservation
SPECIAL MANAGEMENT AREA:	Entire project area falls within the SMA
EXISTING LAND USE:	Drive-in movie theater

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Chapter I

I INTRODUCTION

I.1 Statement of Purpose and Need For Action

It is the intent of Windward Park, Inc. to develop a public golf driving range with 35 practice tees ("stalls"), a putting green, a chipping area, a snack bar/pro shop, a maintenance building, and supporting infrastructure on the present 24.059 acre site of the existing Kailua Drive-in Theater.

Golfing has become one of the most popular sports on Oahu and the island's existing golf courses and driving range facilities are heavily used. This is especially true for golf driving range facilities which are open to the general public. Presently only two completed driving ranges on the Windward side of Oahu are open for public use:

- Bay View Golf Course - 40-50 practice tees; and
- Olomana Golf Links - 12 practice tees.

Because of this limited availability, golfers wishing to utilize golf facilities open to the public are currently faced with crowded play situations and a lack of available playing times. The proposed Windward Park Driving Range is intended to help relieve these demand pressures and provide Windward Oahu's golfers with a new, high-quality golf driving range, with reasonable access and rate conditions.

I.2 Purpose and Content of The Environmental Assessment

This Environmental Assessment (EA) has been prepared to identify and evaluate the existing conditions and potential impacts of the development of the proposed Windward Park Driving Range. The EA is required as part of an application to the City and County of Honolulu, Department of Land Utilization, for a Special Management Area Use Permit (SMP) (see Section VI.2.E). This document has been prepared in accordance with the provisions of Chapter 343, HRS; Title 11, Chapter 200 of the State Department of Health Rules; and Chapter 33, Revised Ordinances of Honolulu which together set forth the requirements for the preparation of an Environmental Assessment for an SMP.

Chapter II

II DEVELOPMENT PROPOSAL

II.1 Location

The Kailua Drive-in Theater property, hereafter referred to as the Subject Property, is located on the Windward side of Oahu, just north of the intersection between Kalanianaole Highway and the Kapaa Quarry Access Road, approximately 2 miles west of Kailua and 13 miles northeast of Honolulu *(see Exhibit II-1)*.

The Subject Property is identified as Tax Map Key 4-2-14: Parcel 4 (see Exhibit II-2).

II.2 Project Description

The proposed Windward Park Driving Range is intended for use by the general public. The approximate operating hours of the driving range will be from 9:00 a.m. - 9:00 p.m. during weekdays with extended hours to approximately 10:30 p.m. on weekends. The following facilities, to be constructed in accordance with the requirements of the Land Use Ordinance (LUO), will be included in the proposed development (see Exhibit II-3):

- Driving Range

  A 10-acre grass driving range with 35 practice tees ("stalls"), a putting green, and a chipping area. For planning purposes, it is estimated that a maximum of 70 persons each hour will utilize the 30-tee driving range - 35 people practicing and 35 people waiting for their turn, assuming that each person takes an average of one-hour practice time. Based on this assumption, a maximum total of between 420-500 people will utilize the driving range each day. However, because usage fluctuates with time of day, the actual rates of usage are expected to be lower than estimated.

  The driving range will be illuminated for night play by high pressure sodium fixtures, mounted on a total of eight (8) 35-foot aluminum poles, located along the hitting line and on either side of the driving range (see Exhibit II-3). Each light pole will have four (4), 300 watt, high pressure sodium fixtures mounted on it. Shields placed on the lighting fixtures will restrict the area illuminated by the lights to the driving range only. The light poles and lighting will not be prominently visible from Kalanianaole Highway or the Kapaa Quarry Access Road.

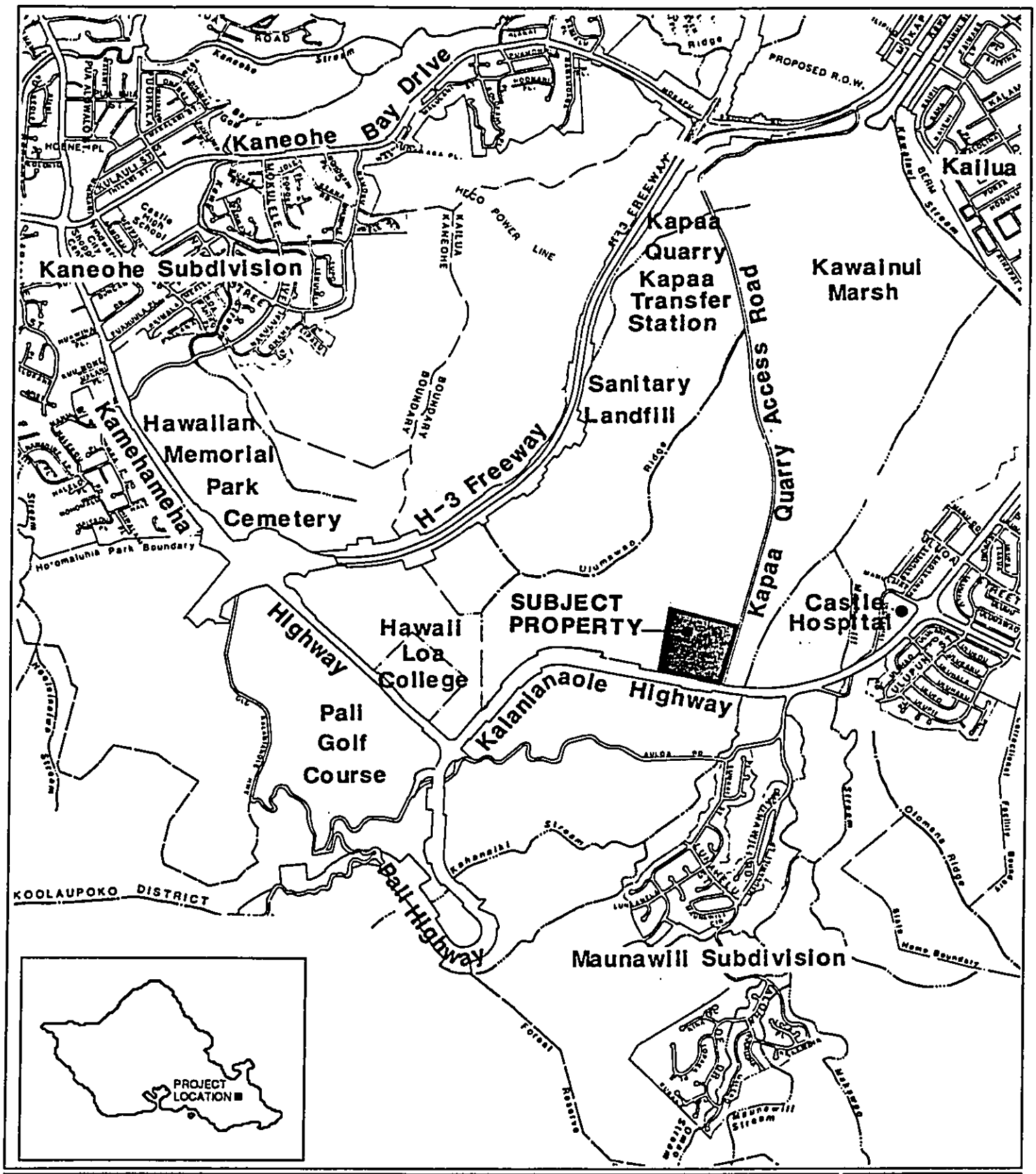

Exhibit II-1

Location Map

WINDWARD PARK DRIVING RANGE

0 1,125 2,250 FEET 4,500

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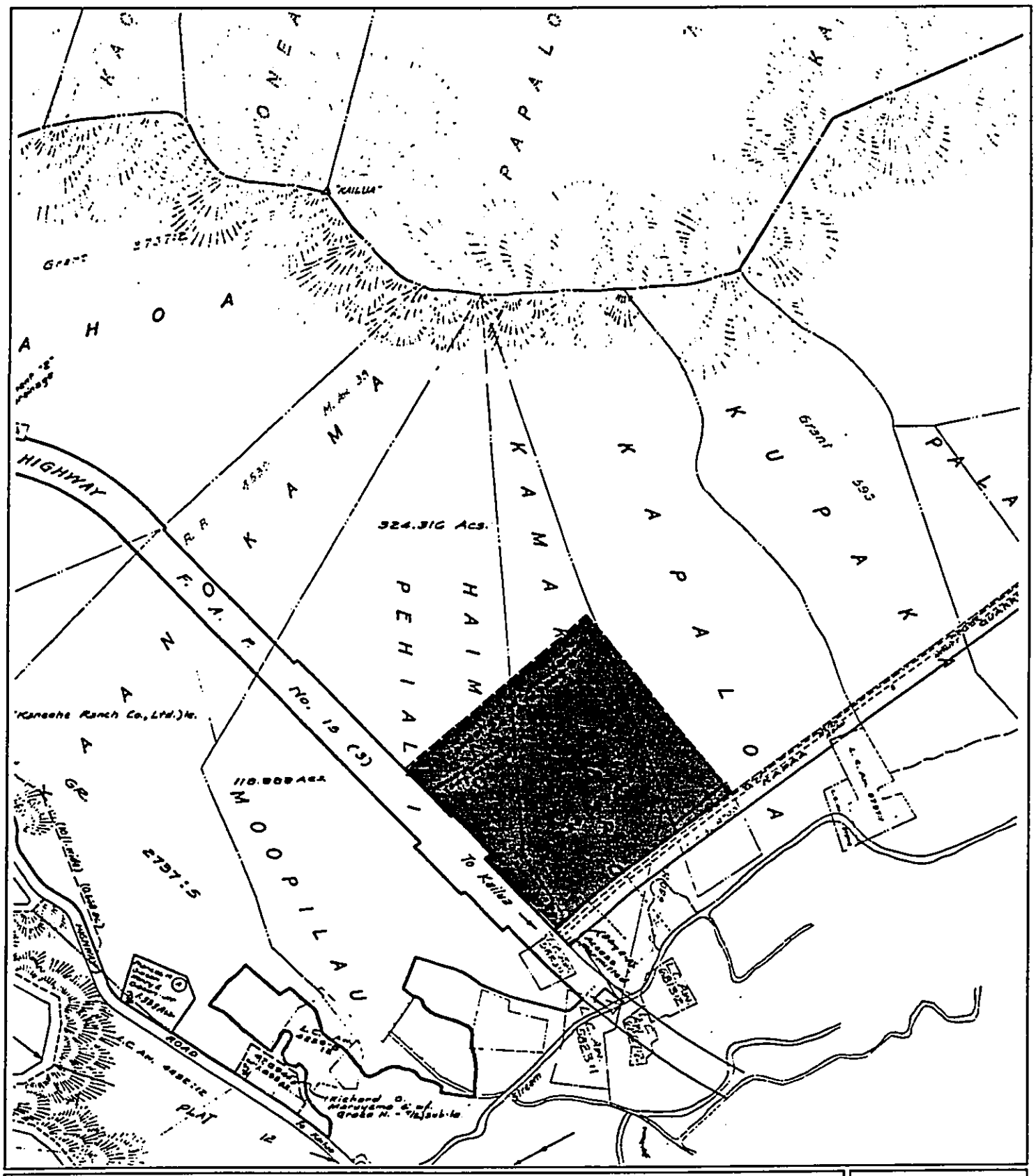

Exhibit II-2

Tax Map (TMK: 4-2-14:4)

WINDWARD PARK DRIVING RANGE

0 300 600 FEET 1,200

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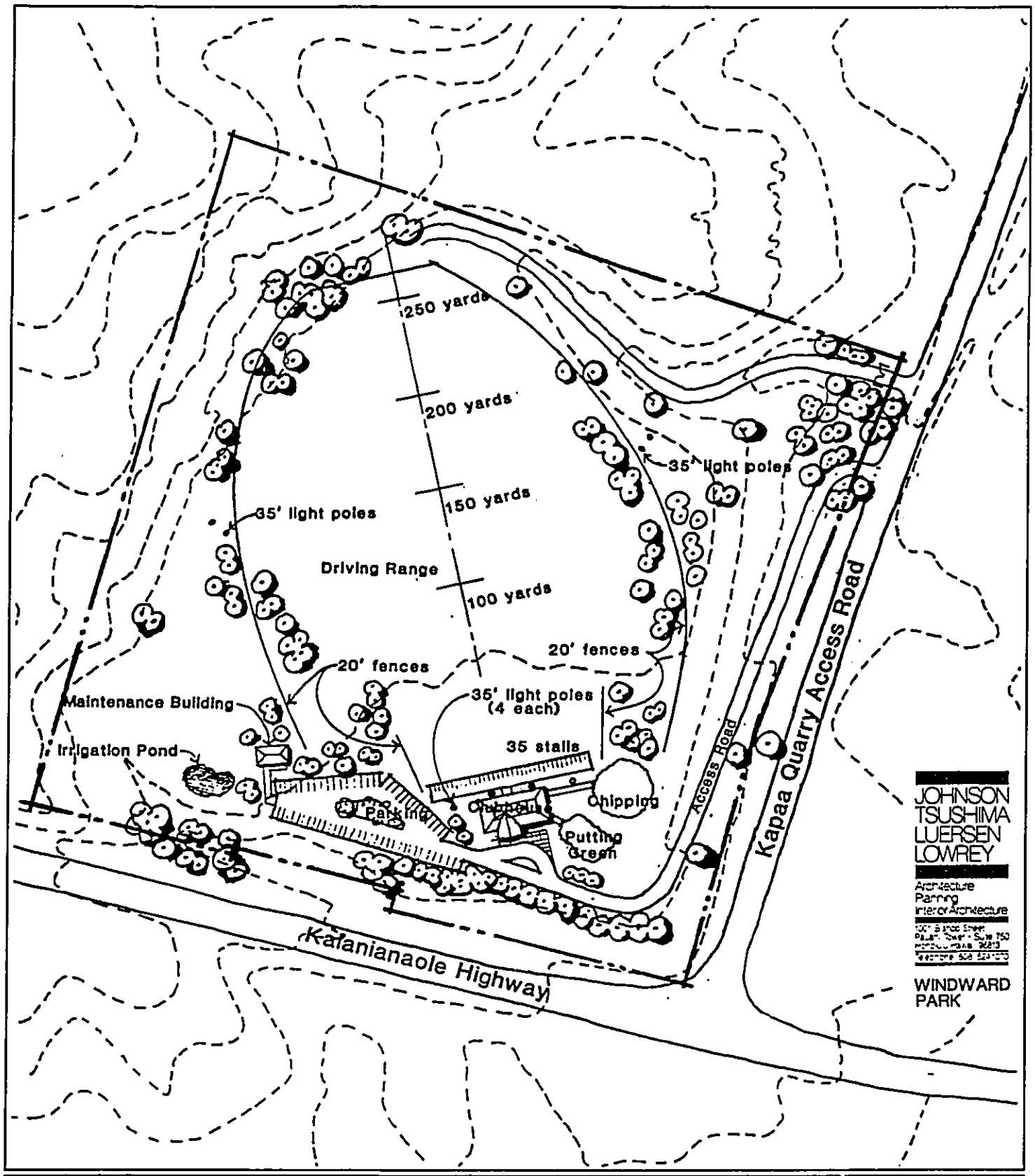

Exhibit II-3

Facilities Site Plan

WINDWARD PARK DRIVING RANGE

0 100 200 FEET 400

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Land Use and
Environmental
Planning

Fences made of a combination of chain-link and netting material will be placed on the perimeter of the driving range to catch misplayed balls (see Exhibit II-3). The fences will be approximately 20 feet in height and will be colored green to blend in with the surrounding landscaping. Vegetation will be planted adjacent to the fences to soften their visual impact on driving range users. The proposed fencing will not be prominently visible from Kalanianaole Highway or the Kapaa Quarry Access Road.

- Pro Shop/Snack Bar

A 5,300 sq. ft. building located in the southeastern corner of the Subject Property. The one-story, 25-foot high, building is designed to reflect Hawaii's outdoor life style with an extensive covered lanai area (see Exhibit II-4). When completed the building will not be prominently visible from adjacent roadway areas. A square footage breakdown of the building by functional area is provided below.

Snack Bar	2,200	sq.ft.
Pro Shop	400	sq.ft.
Support Office	230	sq.ft.
Restroom	400	sq.ft.
Covered Lanai/Walkway	2,070	sq.ft.
Total	**5,300**	**sq.ft.**

- Maintenance Building

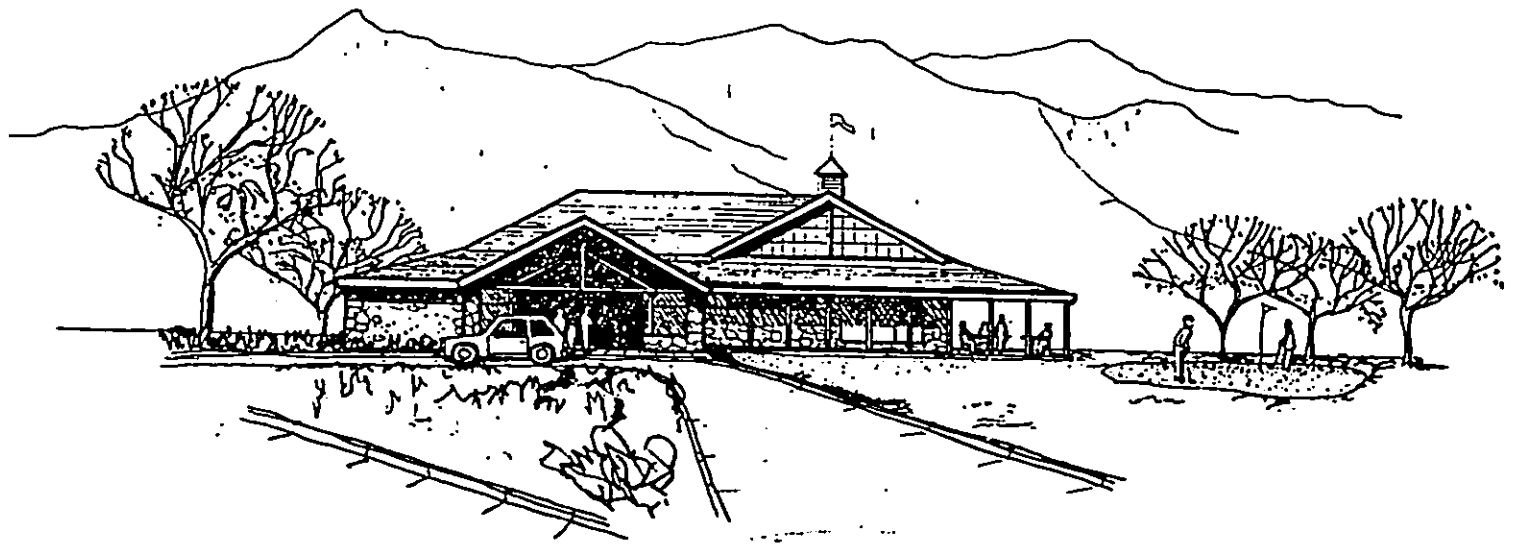
A 1,000 sq. ft. building located in the southwestern corner of the Subject Property. The one-story, 20-foot high, building will be utilized to house maintenance equipment for the proposed driving range.

- Water Retention Basin/Sediment Pond

A water retention/sediment pond will be developed in the southwestern corner of the property adjacent to the parking area. The pond, located at a low point in the property's topography, will serve to filter sediment from storm runoff and function as a water reserve for irrigation.

- Parking/Access Road

In accordance with the parking standards for a driving range specified in the Land Use Ordinance (LUO), an at-grade parking lot with 70 parking stalls will be developed on the



JOHNSON
TSUSHIMA
LUERSEN
LOWREY

Architecture
Planning
Interior Architecture

1001 Bishop Street
Pauahi Tower - Suite 750
Honolulu Hawaii 96813
Telephone 808 524-1070

WINDWARD
PARK

Exhibit II-4

Snack Bar/Pro Shop Character Sketch

WINDWARD PARK DRIVING RANGE

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southern edge of the Subject Property. The parking lot will be located at approximately the same grade as the clubhouse. The parking area will be screened by landscaping planted on the perimeter. Autos occupying the parking lot will not be visible from the Kawainui Marsh or the adjacent roadways. The existing access road on the east side of the Subject Property will be improved and utilized for access to the parking area. The roadway will be landscaped along its entire length. A marker sign fronting the access road on Kapaa Quarry Access Road will be constructed to alert motorists to the site.

II.3 Development Schedule

Construction of the driving range is scheduled to commence in late 1990 and will take approximately 6 months to complete. The driving range will be open to the public approximately 3 months after completion of construction.

II.4 Estimated Cost

The estimated project development cost for the driving range is approximately $4.7 million. Approximately 51 percent of this cost will be devoted to landscaping for the Subject Property. Table II-1 provides a cost breakdown of the proposed project.

Table II-1
Cost Breakdown of the Proposed Windward Park Driving Range

Item	Unit Cost	Total Cost
Grading	30,000 cy @ $5.00/cy	$150,000
Utility Services	Existing	
Pro Shop/Snack Bar	5,300 sf @ $125/sf	$662,500
Maintenance Building	1,000 sf @ $100/sf	$100,000
Roads and Parking Lots	55,000 sf @ $7/sf	$385,000
Landscaping	800,000 sf @ $3/sf	$2,400,000
		$3,697,500
Indirect Costs and Contingency @ 25%		$ 924,375
Total Projected Costs		$4,621,875
		Say $4,700,000

Chapter III

III EXISTING ENVIRONMENTAL CONDITIONS AND ANTICIPATED PROJECT IMPACTS

III.1 Existing Land Uses

Existing Conditions

The Subject Property is presently occupied by Kailua Drive-in Theater. The drive-in screen, parking area, concession stand, and access roads, occupy approximately 83 percent of the property area with the remaining area being devoted to open space (see Exhibit III-1).

The Kailua Drive-in has been in operation since 1963. It operates on a seven nights per week schedule with two features per night. The gates open at 5:30 p.m. (Fri-Sun) or 5:45 p.m. (Mon-Thurs), with the first feature beginning at 6:30 p.m. and ending approximately at midnight. There is one entrance from the Kapaa Quarry Access Road and two exits (one each onto Kapaa Quarry Access Road and Kalanianaole Highway). In the center of the theater parking lot is a one-story concession stand. The maximum capacity of the drive-in is 700 vehicles. There currently are no other regular uses at the drive-in site (e.g. swap meets) although private parties are sometimes arranged.[1]

Project Impacts

The proposed driving range will replace the Kailua Drive-in and will eliminate the use of the Subject Property as a drive-in theater.

III.2 Surrounding Land Uses

Existing Conditions

The Subject Property is bordered on its northern and western sides by the slopes of Ulumawao Ridge, on its southern side by Kalanianaole Highway and on its eastern side by Kapaa Quarry Access Road (see Exhibit III-2). Surrounding land uses include, the HC&D (Kapaa) Quarry, the Kapaa Landfill and the Kapaa Refuse Transfer Station to the north of the Subject Property (refer back to Exhibit II-1, Location Map). To the east across the Kapaa Quarry Access Road is Kawainui

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1 All operating information supplied by Consolidated Amusements, Ltd. during a telephone interview, December 13, 1988.

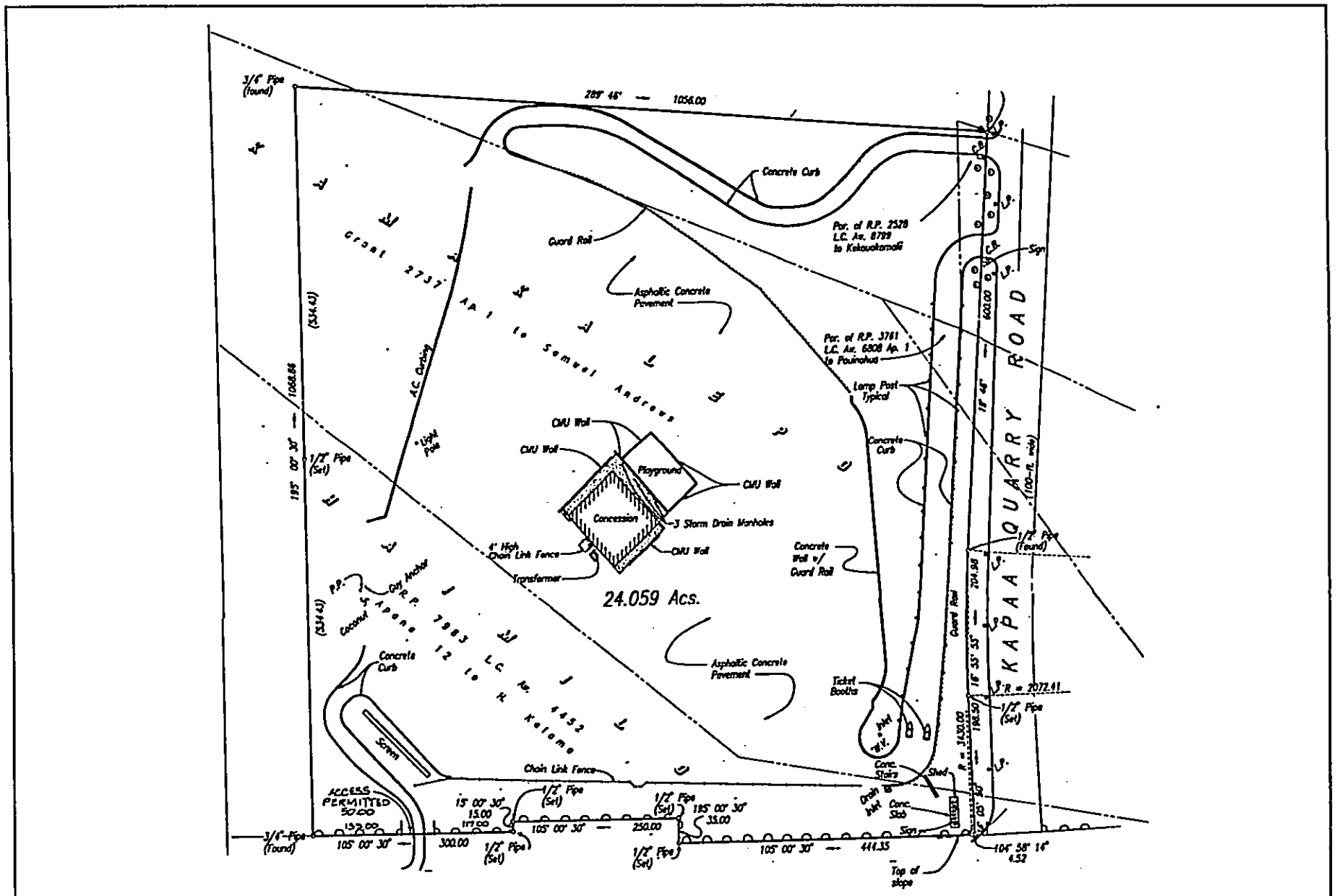

Exhibit III-1

Kailua Drive-In Theater Plot Plan

WINDWARD PARK DRIVING RANGE

0 100 200 FEET 400

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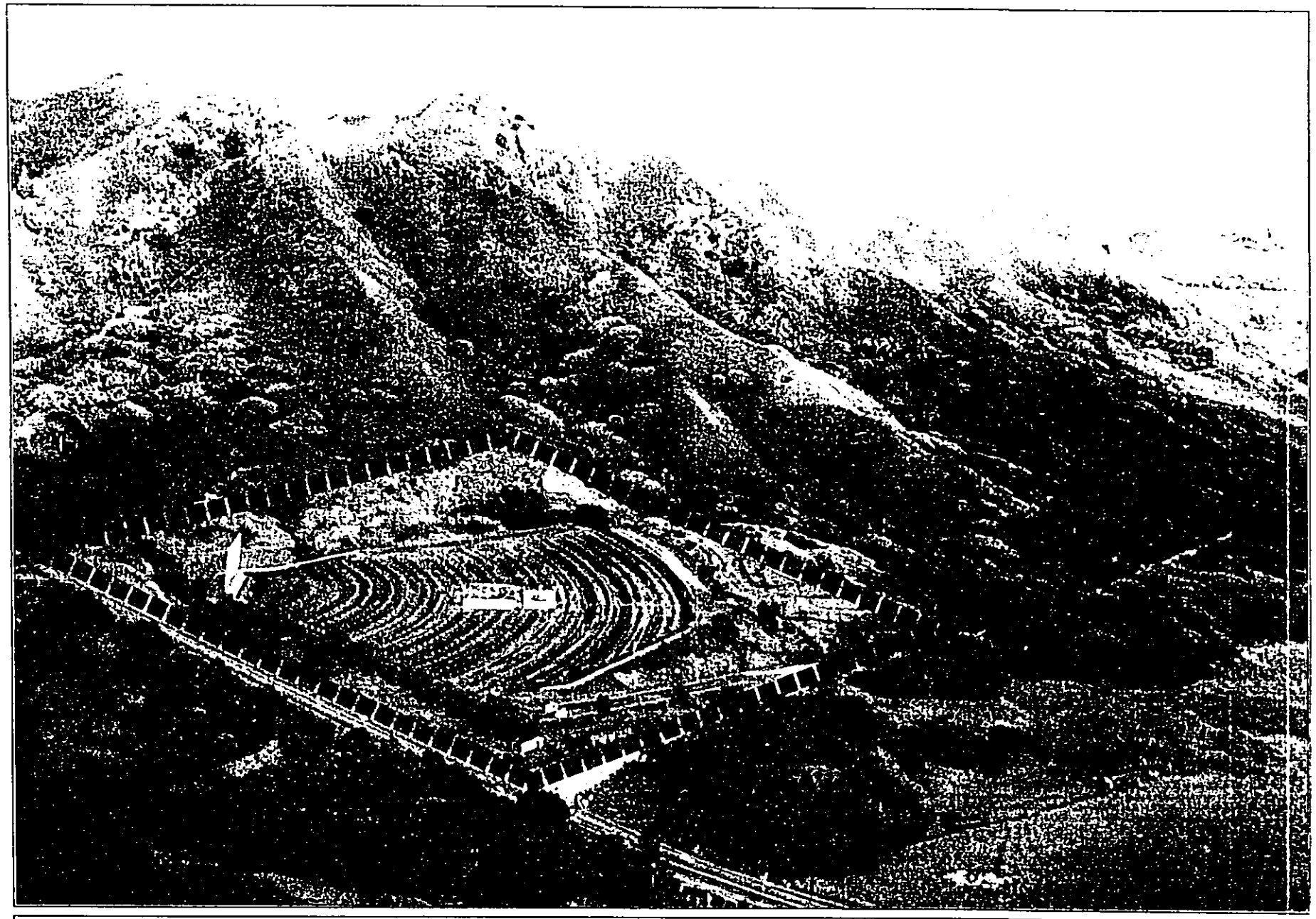

Exhibit III-2

Existing Land Use

WINDWARD PARK DRIVING RANGE

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Marsh, the largest freshwater marsh in the State of Hawaii. Further to the east beyond Kawainui Marsh is the town of Kailua. To the south of the Subject Property across Kalanianaole Highway is the Maunawili subdivision and the site of the Royal Hawaiian Country Club (currently being developed). Located to the west of the Subject Property is the campus of Hawaii Loa College and the Pali Golf Course.

Although the proposed driving range is located outside the primary boundary of Kawainui Marsh, a further discussion of the Marsh is warranted because it is an established wetland system and is an area of environmental and ecological significance (see Exhibits *III-3* and *III-4*).

Kawainui Marsh was declared eligible for listing on the National Register of Historic Places as a historic, cultural and archaeological complex in July of 1979. According to recent published sources of information[2], Kawainui Marsh presently serves several functions. It is a flood-control plain for most of the Kailua area as well as a buffer zone and sink for sediment and nutrients caused by natural and human activity. The Marsh is fed primarily by springs from Maunawili Valley and two major streams, Maunawili and Kahanaiki. It is also a receptacle for treated sewage effluent and, possibly, leachate from Kapaa landfill. In addition, it is a nesting and feeding area for four endangered endemic Hawaiian waterbirds[3] as well as a variety of other non-indigenous birds. Portions of the marsh also function as a passive recreational area.

The Marsh is can be roughly divided into two vegetative types: woody (forest) and marsh meadow. The woody vegetative area consists of koa haole, monkeypod, guava, hau, Java plum and banyan plus forest understory. This area parallels the Quarry Road and is closest to the proposed driving range. The Marsh meadow vegetation consists primarily of bulrush, cattails and grass communities. It is essentially a bog with layers of plants, roots and peat floating on water.

In 1983, a Resource Management Plan for Kawainui Marsh was published by the State of Hawaii in an attempt to establish a framework to manage the resources of Kawainui Marsh. As part of this plan, management objectives and recommended actions were formulated for various resource areas. Within the area of aesthetics, the Kailua Drive-in Theater was identified as a

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2 Department of Planning and Economic Development, State of Hawaii, Resource Management Plan for Kawainui Marsh, March 1983; and Chun, Michael J. and Gordon L. Dugan, Environmental Aspects of Kapa'a Landfill, Kawainui, O'ahu, Hawai'i, Technical Report No. 140, Water Resources Research Center, University of Hawaii at Manoa, September 1981.

3 These are the Koloa (Hawaiian duck), Hawaiian Gallinule, Hawaiian Coot and the Hawaiian Black-necked Stilt, as identified by Berger, pgs. 19-21 (1988).

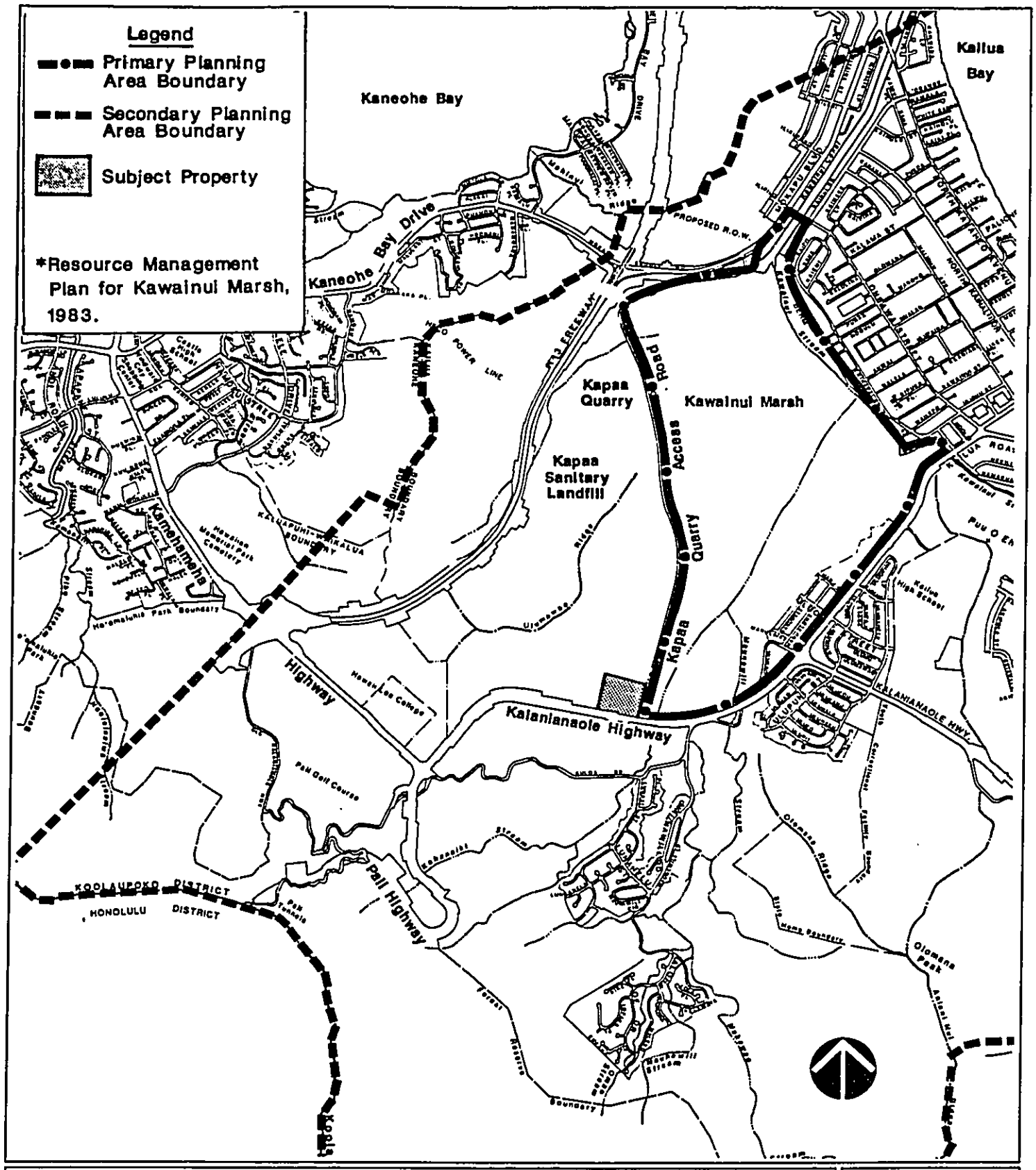

Exhibit III-3

Kawainui Marsh Resource Management Area Map

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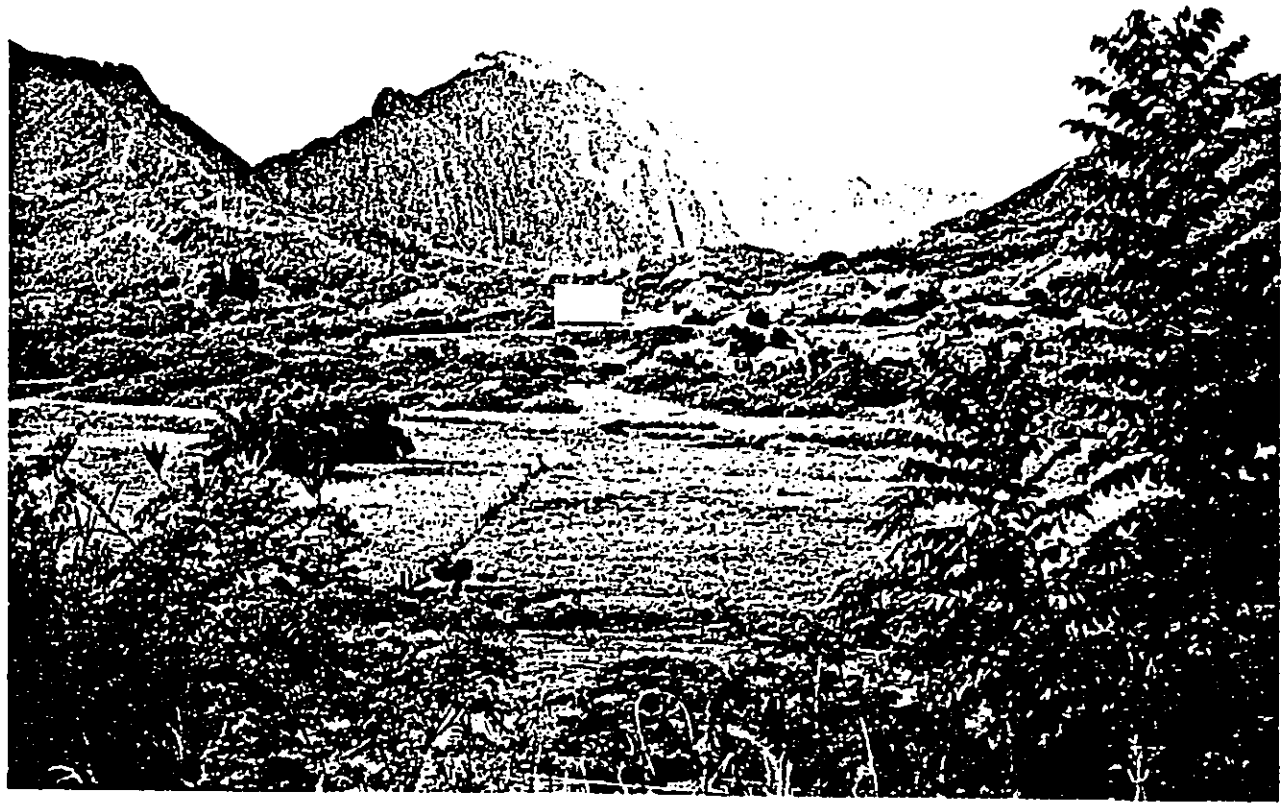

This photo looking west shows the relationship of the southern end of Kawainui Marsh (foreground) to the Kailua Drive-in. Visible is the theater's screen.

Exhibit III-4

Kawainui Marsh

WINDWARD PARK DRIVING RANGE

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land use which was "incompatible with the visual qualities and natural area potential of the marsh." It recommended that opportunities for removal or modification of the theater's screen be explored in order to improve view planes toward and from the Marsh.

Project Impacts

The proposed driving range will not adversely impact any of the Subject Property's surrounding land uses. Removal of the drive-in's screen and illuminated ground sign in conjunction with extensive landscaping of the Subject Property is expected to enhance existing view's from adjacent land uses when the proposed project is completed (see Section III.14).

III.3 Topography

Existing Conditions

The topography of the Subject Property reflects the extensive cutting and filling which was required during development of the Kailua Drive-in in the early 1960s. The elevations of the area occupied by the drive-in parking lot and concession stand are generally flat ranging from approximately 115 feet above mean sea level (msl) along the southern boundary to 150 ft above msl along the northern boundary. On the edges of the Subject Property elevations vary considerably. The northern and western sides of the property rise to elevations of approximately 160 ft. above msl (see Exhibit III-5). On the eastern and southern fringes of the property near the Kapaa Quarry Access Road and Kalanianaole Highway elevations drop to approximately 60 feet above msl. The drive-in screen ground elevation is approximately 130 feet above msl.

Along the northern and western perimeter of the Subject Property extensive erosion has occurred. Topsoil capable of supporting vegetation has eroded away leaving large areas of exposed subsoil (refer to Exhibit III-2).

Project Impacts

Development of the proposed driving range will require an estimated 30,000 cubic yards (cy) of soil to be moved within the Subject Property. The development plan for the driving range places emphasis on minimizing the need for extensive earthwork. Grading will primarily be done to level the area to be occupied by the driving range. Finished grades for this area will

range from approximately 125 feet above msl to 140 feet above msl (see Exhibit III-5). Filling will be required on the northern end of the property near the existing road cut and on the southern end of the property where the proposed parking and clubhouse area will be located. The final grading design will include a swale, that will drain toward the water retention pond, to maintain the existing drainage pattern as much as possible.

During grading operations, soil will temporarily be exposed to the potential erosion forces of the wind and rain. In order to minimize erosion, site preparation will be done during dry periods and soil control measures will be implemented. Vegetative filter strips will be maintained adjacent to Kapaa Quarry Access Road and Kalanianaole Highway to slow any runoff and filter sediments. Temporary siltation berms will be located throughout the development at low points to intercept and filter runoff before it reaches adjacent roadways. These berms will be removed only after landscaping has become established.

In order to prevent the exposure of large contiguous areas to erosion forces, landscaping, ground cover vegetation and/or mulch will be applied to graded areas immediately after grading and clearing operations are completed. In areas where steep slopes exist, a close-weave fiber netting material will be applied to conserve moisture and protect seedlings during the establishment of vegetative cover. In conjunction with grading operations, a watering program will also be implemented to control fugitive dust particulate emissions from the project site.

All construction activities associated with the proposed project will follow strict erosion control measures in accordance with the following government regulations and guidelines:

1) City and County of Honolulu, Department of Public Works, Soil Erosion Standards and Guidelines (1975);

2) City and County of Honolulu, Grading Grubbing and Stockpiling Ordinance No. 3968 (1972);

3) State of Hawaii, Department of Health, Water Quality Standards, Chapter 37-A, Public Health Requirements (1968); and

4) USDA Soil Conservation Service, Erosion and Sediment Control Guide for Hawaii (1968).

Even with strict adherence to erosion control measures, grading and clearing operations may cause a short-term increase in the amount of sediment transported during periods of poor weather conditions (i.e. heavy rains, high wind). However, once grading and clearing operations are complete and vegetative cover is reestablished, the proposed driving range can be expected to reduce the total amount of sediment presently generated from the project site.

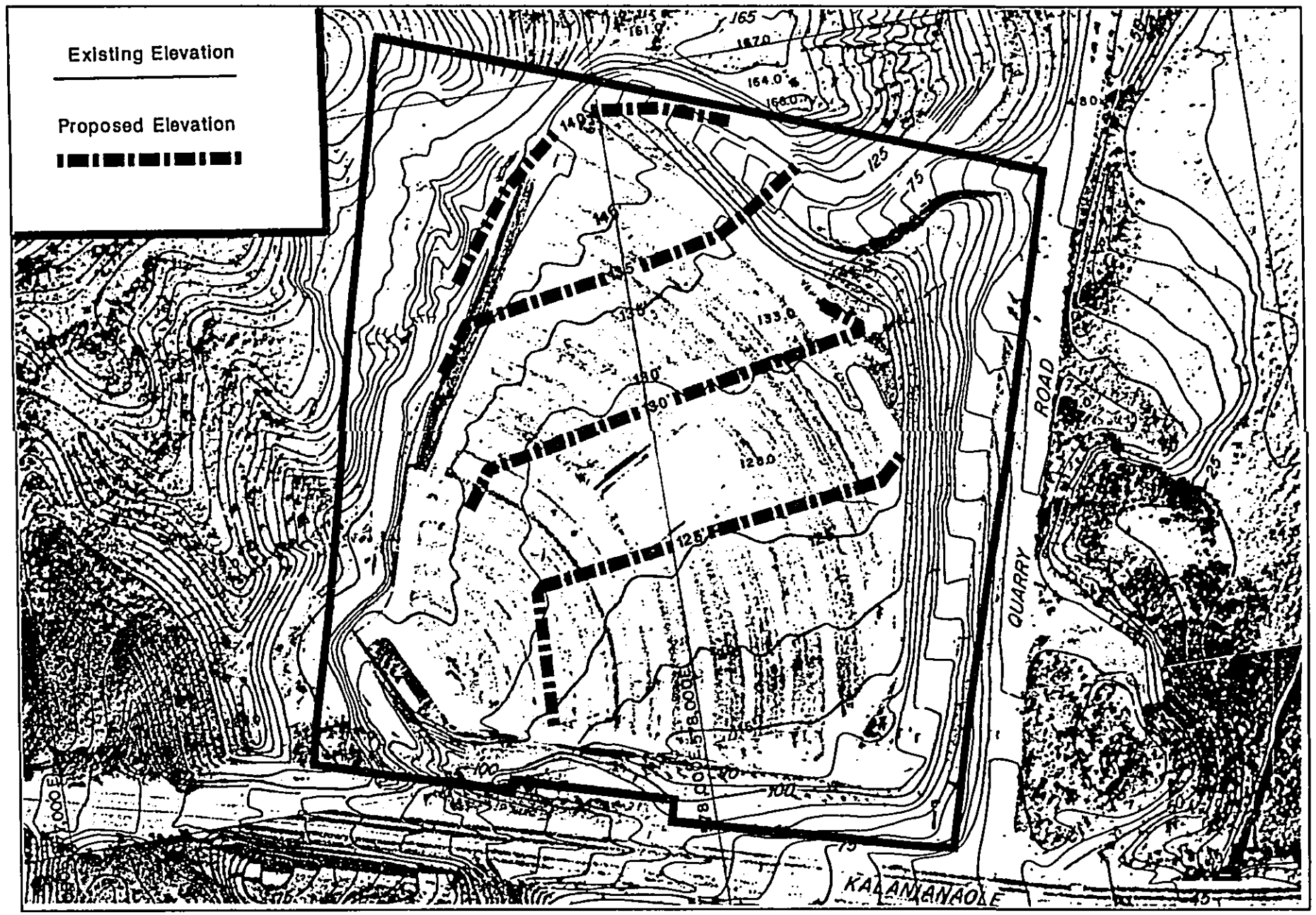

Exhibit III-5

Topographical Map

WINDWARD PARK DRIVING RANGE

0 100 200 FEET 400

Map readings represent feet above mean sea level (msl)

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III.4 Soils

Existing Conditions

According to the Soil Survey of the Soil Conservation Service[4], the soil type for the Subject Property is the Alaeloa series (ALF) (Exhibit III-6). This series consists of well-drained silty clay soils with a medium-high slope. Runoff on this soil is very rapid and the erosion hazard is severe. This soil type has very severe limitations that make it unsuited to cultivation and restrict its use to largely pasture, range, woodland, or wildlife habitat.

The Land Study Bureau[5] classifies the Subject Property as "U" for urban use and does not assign a overall Productivity rating for agricultural use.

Project Impacts

The proposed project will not change the overall soil composition of the Subject Property, although some soil will be redistributed due to grading and leveling. In order to aid revegetation of the Subject Property, the importation of additional topsoil may be required to augment existing topsoil in places were topsoil was removed or erosion has previously occurred. All efforts will be made to minimize the potential for drainage and erosion problems through methods described in Section III.3.

III.5 Climatic Characteristics

Rainfall

According to the State Department of Land and Natural Resources, Division of Water and Land Development, the mean annual rainfall for the Subject Property ranges from approximately 50 to 70 inches. Trade wind showers and winter storms are responsible for most of the rain. The most intense rainfall results from storms and occurs during the period between November-March. Historically, the greatest single 24-hour rainfall near the Subject Property has not exceeded 15 inches.

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4 Soil Conservation Service, Soil Survey of Islands of Kauai, Oahu, Maui, Molokai, and Lanai, State of Hawaii, U.S. Department of Agriculture, August 1972.

5 Land Study Bureau, Detailed Land Classification, University of Hawaii, December 1972.

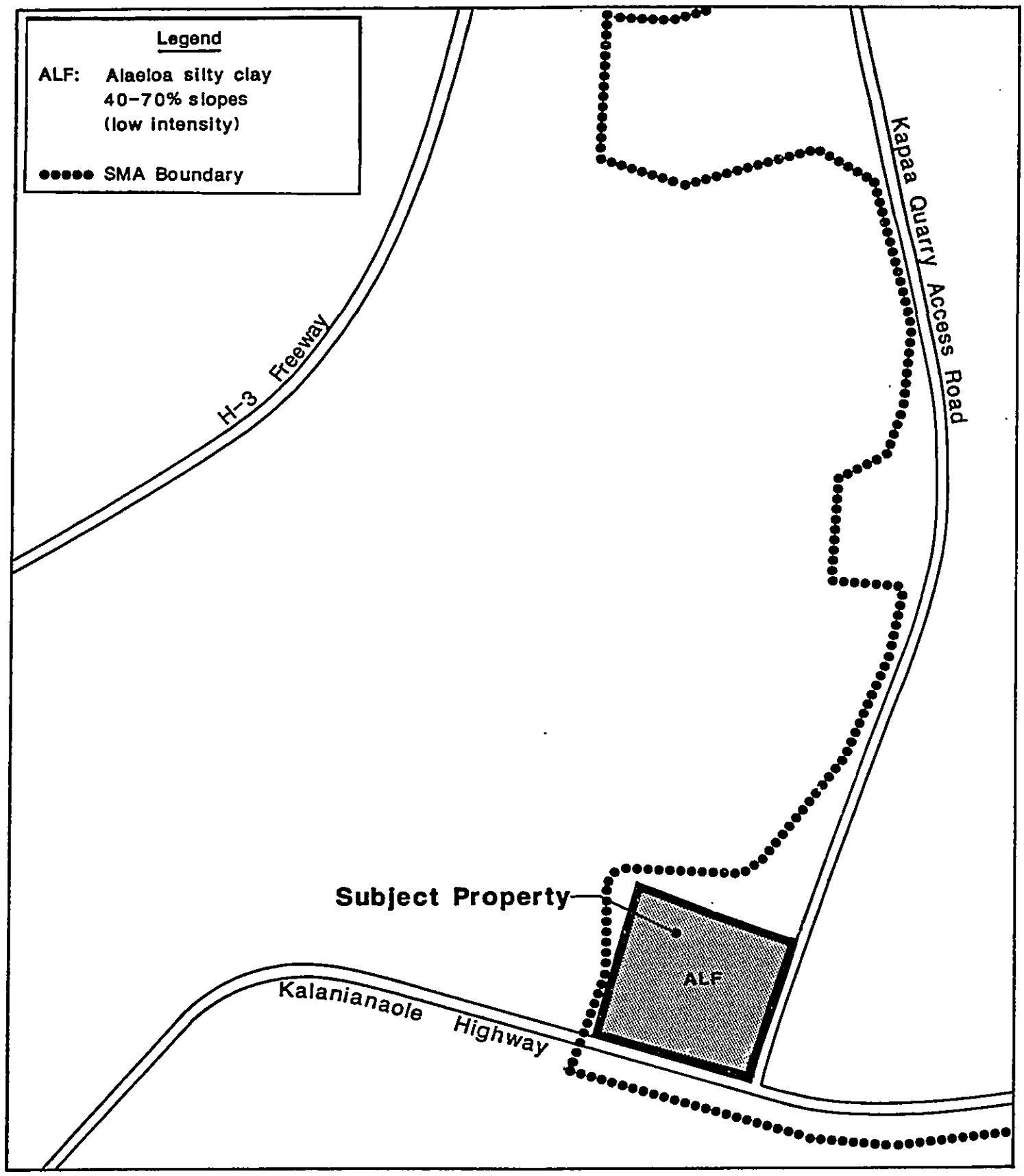

Exhibit III-6

Soil Map

0 450 900 FEET 1800

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Land Use and Environmental Planning

Wind

The prevailing winds for the Subject Property, 90 percent of the year, are the northeasterly trade winds with a mean speed of 10 knots. In general, the prevailing winds have a higher frequency during summer months and are stronger in the afternoon than at night.

Temperature

The temperature at the Subject Property generally varies between 68 to 80 degrees Fahrenheit. The mean annual temperature is approximately 74 degrees. Extreme temperatures may range from as low as 58 degrees to as high as 90 degrees.

III.6 Hydrological Characteristics

Existing Conditions

Groundwater: In high rainfall areas such as the Windward side of Oahu, a significant percentage of the annual rainfall percolates below the ground surface to become groundwater. The groundwater in the Koolau Mountain Range is stored in the permeable basaltic lava flows between relatively impervious basaltic dikes. These dikes were formed by molten rock which solidified in the fissures of the volcano. Generally, the underground flow pattern of the groundwater is toward the ocean as higher level groundwater moves into lower head compartments by either flowing over the top of dikes or leaking through fractures in the dikes. Ultimately the groundwater in this region is either withdrawn through wells and tunnels, is lost to evapotranspiration, or is discharged into the ocean via streams and offshore/coastal springs.

Wetlands: The Subject Property is situated across the Kapaa Quarry Access Road from the Kawainui Marsh. As previously described in Section III.2 the environmentally sensitive marsh serves a number of functions including drainage for storm runoff. The marsh provides approximately 3,000 acre feet of flood storage as part of the Oneawa Channel (Kawainui Channel) design which conveys runoff into Kailua Bay. Two perennial streams enter Kawainui Marsh from Maunawili Valley, with an average total discharge of approximately 7 mgd.

Drainage: There are no records of an existing drainage system on the Subject Property. Currently storm drainage is by overland flow across the drive-in parking area and toward the

Kapaa Quarry Access Road and Kalanianaole Highway. Runoff is then collected in storm drains adjacent to the Kapaa Quarry Access Road and Kalanianaole Highway.

Project Impacts

Development of the proposed driving range will require removal of the existing drive-in theater facilities and grading of approximately 30,000 cubic yards of soil. The Subject Property's topography will shift slightly as the result of the grading activities. Grading will primarily be done to level the area to be occupied by the driving range. Finished grades for this area will range from approximately 125 feet above msl to 140 feet above msl (refer to Exhibit III-5).

Drainage patterns on the Subject Property are expected to remain similar to existing conditions, although the leveling of the property can be expected to reduce peak storm runoff from the Subject Property. Storm runoff will also be substantially reduced by the removal of the nonpermeable drive-in parking surface. This will serve to increase the potential recharge area of the Subject Property by approximately 60 percent.[6] Excess storm runoff will be collected in a drainage swale along the western side of the Subject Property. The swale will collect runoff draining across the Subject Property and channel it into a sediment/water retention pond in the southwestern corner of the property.

Short-term impacts on surface water quality relating to development activities include erosion and sedimentation due to construction area runoff. These impacts will be minimized by strict adherence to the erosion control measures described in Section III.3.

Long-term operational activities are not expected to create any adverse environmental impact on water quality. Activities which have the potential for creating the most environmental concerns regarding water quality and the surrounding marsh area include: the application of fertilizers, pesticides and suspended sediments contained in storm water runoff. These concerns are addressed below.

Fertilizers and Pesticides. Operation of the driving range will require the application of fertilizers to supply turf grass and ornamental plants with nutrients which are deficient in the

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6 The asphalt parking area and access roads of the drive-in occupy approximately 20 acres or 83 percent of the Subject Property. The driving range parking area, accessory buildings, pond and related walkways will occupy approximately 5.5 acres or 23 percent of the Subject Property, resulting in a net increase in permeable ground area of approximately 60 percent.

soil. Pesticides will also periodically be applied to control weeds, disease, and insect pests. All pesticides and fertilizers used will be those approved by the United States, Environmental Protection Agency (EPA).

During high intensity storms or periods of excess watering, fertilizers, herbicides and pesticides, may be subject to movement from the point of application by runoff or percolation. The primary fertilizer elements of concern for possible contamination of surface and ground waters are nitrogen (N) and phosphorus (P). Under normal conditions of irrigation and precipitation, phosphorus attaches itself to soil clays and moves very little if any from the site of application. However, under heavy storm conditions or periods of excess watering recently applied phosphorus may not reach soil clays and be transported in water. The potential for this occurring will be controlled by: (1) channeling site runoff into the sedimentation pond between the driving range and the snack bar; and (2) using a U.S. Weather Bureau Class A Evaporation Pan to measure evaporation and schedule irrigation to prevent excess watering.

The fertilizer component of primary concern is nitrogen. Ammonium nitrogen (NH_4) also has a binding property and moves little in soils. However, once ammonium nitrogen is applied it is rapidly converted to the nitrate form (NO_3) which is not bound to the soil and moves readily with water. The potential for this occurring after application is reduced by the high nitrogen uptake level of turf grasses.[7] Only under conditions where rainfall occurs soon after application of a soluble nitrogen source would there be excessive loss of nitrogen by surface runoff, or percolation below the root zone. Nitrogen movement during periods of heavy rainfall or excess watering will be controlled by (1) using a slow-release nitrogen fertilizer which is in an insoluble form when applied; and (2) using a U.S. Weather Bureau Class A Evaporation Pan to measure evaporation and schedule irrigation to prevent excess watering.

The use of pesticides, including herbicides, insecticides and fungicides will also sometimes be required at the driving range. All pesticides will be applied in accordance with EPA labeling instructions. Pesticides are normally applied only in response to outbreaks of pests. There are few instances in which pesticides other than herbicides are applied to a driving range in a regularly scheduled management program. As a result, the potential impact of insecticides and fungicides on surface and ground water runoff is very limited.

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7 Turf grasses use much more nitrogen than other elements. Based on the clipping composition of turf grass, it has been shown that the turf grasses grown in Hawaii absorb approximately four times as much nitrogen as phosphorus (Green 1986, 1989).

Herbicides used on driving ranges are primarily 33 plus, metribuzin, and MSMA. When properly applied, these herbicides are rapidly broken down and/or attach themselves to soil and organic matter. Because of this, they pose little potential for contamination of surface or ground water.

Suspended Sediments. After the development of the driving range is completed the total amount of erosion and sediment transport presently occurring on the Subject Property can be expected to decrease. Bare subsoil areas presently found on the site will be covered with a layer of topsoil and planted with landscaping, thereby eliminating areas exposed to erosion forces. In order to minimize the potential for any sediment transport while vegetation on the Subject property is becoming established, storm water runoff will be collected on-site in a sediment/water retention pond.

The proposed mitigation measures as well as proper driving range management practices will play a crucial role in minimizing potential impacts on surface and ground waters. Management practices to be followed include:

1) use of an U.S. Weather Bureau Class A Evaporation Pan to measure evaporation and schedule irrigation application, thereby avoiding excess watering;

2) application of slow release fertilizers which will release nitrogen at a rate comparable to that used by the turf;

3) strict adherence to all instructions regarding the handling and application of fertilizers and pesticides;

4) use of only EPA approved fertilizers and pesticides; and

5) selection of a qualified driving range manager.

III.7 Flood Hazards

Existing Conditions

The entire Subject Property is designated Zone D on the Flood Insurance Rate Map (FIRM) (Exhibit III-7).[8] This rating indicates an area in which flood hazards are undetermined. Immediately east of the Subject Property is Kawainui Marsh which has a Zone A designation indicating no base flood elevations have been determined.

Project Impacts

The proposed Windward Park Driving Range will be in compliance with all flood control ordinances and rules and regulations.

III.8 Vegetation

Existing Conditions

The existing vegetation on the Subject Property is limited to various exotic species. Only the perimeter areas around the asphalt parking area of the Kailua Drive-in Theater are maintained in vegetation. Vegetation existing in these perimeter areas includes: koa-haole (Leucaena leucocephala), guava (Psidium guajava), Chinese banyan (Ficus retusa), Christmas berry (Schinus terebinthifolius), Lantana (Lantana camara), broomsedge, molasses grass and sleeping grass. Along the perimeter of the Subject Property paralleling Kalanianaole Highway and Kapaa Quarry Access Road there exists a row of well developed eucalyptus trees which were planted to serve as a wind break and visual screen.

A botanical survey of the open space area immediately adjacent to the Subject Property was conducted on September 24, 1988 by Char & Associates.[9] Although this area will not be directly impacted by the proposed development, this botanical study provides an indication of surrounding vegetation which may indirectly be affected by the introduction of additional plant species associated with the driving range's development. The study concluded that most of the

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8 Flood Insurance Rate Map, Panel 90 of 135, Federal Emergency Management Agency, September 4, 1987.

9 Char & Associates, Botanical Survey, Proposed 18-Hole Golf Course at Windward Park, Kailua, O'ahu, October 1988.

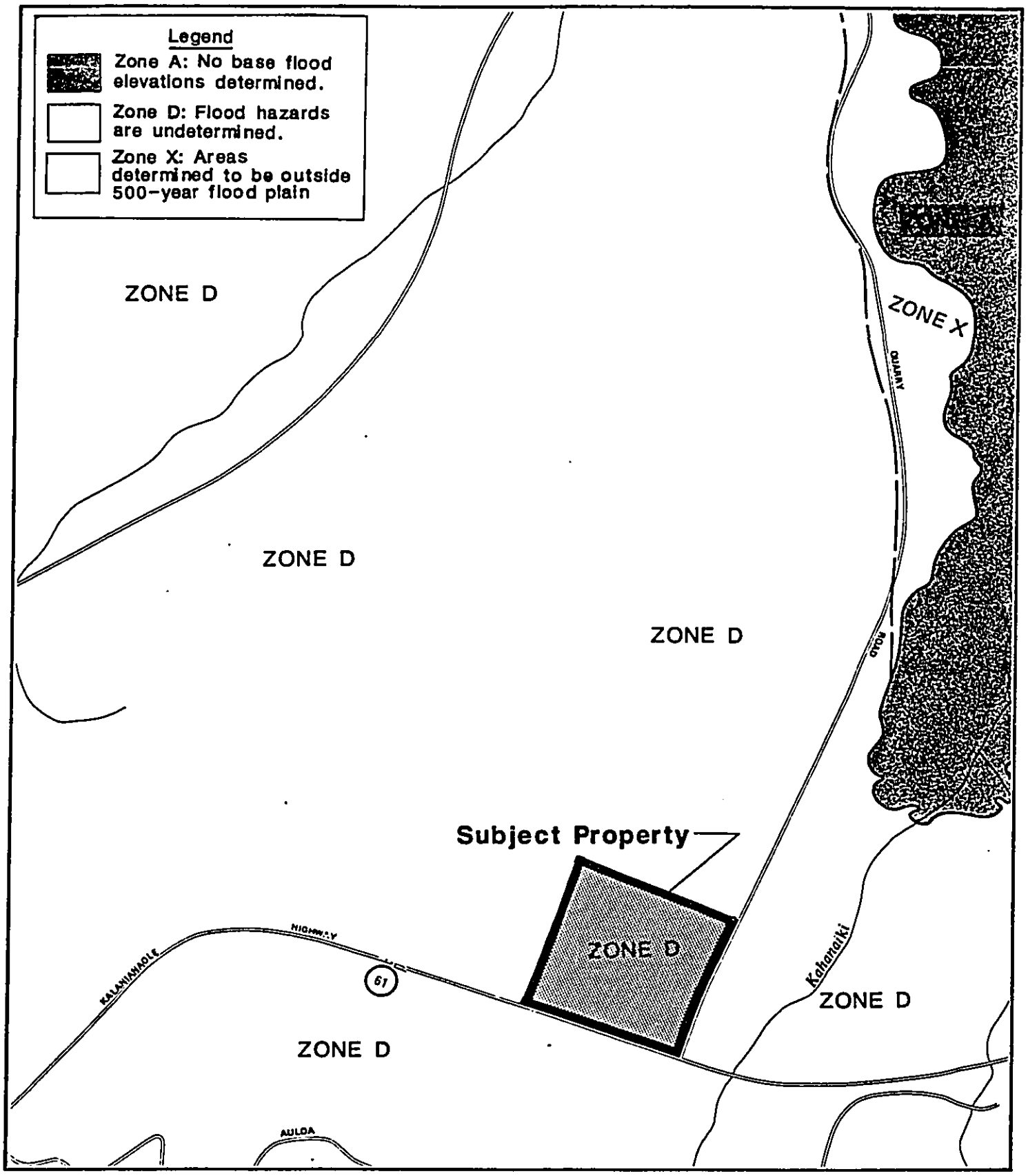

Exhibit III-7

FIRM Map

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Land Use and Environmental Planning

area was dominated by introduced species and was of "little botanical interest." No listed, proposed or candidate threatened or endangered species were found on the site. A brief summary of the study follows.

The basic vegetation type on the land adjacent to the Subject Property is low- to high-stature scrub, grading from small patches of grass on steep ridges to tall-canopy trees in the gulches and low, flat areas.

Low Stature Scrub: Generally 6 feet or less in height, koa-haole and guava trees prevail with some Christmas berry and Java plum. Beneath the scrub is a rich herb layer made up predominantly of broomsedge, golden beard grass, molasses grass, natal redtop, Glenwood grass and foxtail.

Remnant native vegetation found among the low-stature shrub at higher elevations includes ko'oko'olau, huehue, u'ulei and 'akia. Ferns and fern allies are found on slopes which are too steep to support dense vegetation.

High Stature Scrub: Christmas berry, Java plum, guava, octopus, fiddlewood and lantana predominate. Grass in these areas is primarily California or molasses grass.

In the low, level areas, large trees such as monkey pod, Java plum, African tulip, Chinese banyan, mango and kukui predominate. Ground cover is comprised of a variety of grasses and vines.

Project Impacts

The proposed driving range will increase the amount of vegetation on the Subject Property. No native or endangered species of plants will be affected by the property's development. The asphalt parking area will be removed and replaced with grass and landscaping. Portions of the existing vegetation on the perimeter of the Subject Property will be removed during development of the driving range and relocated when appropriate. After grading operations are complete, all of the exposed perimeter areas will be extensively landscaped. Where possible the eucalyptus trees located between Kalanianaole Highway and the Kailua Drive-in will be maintained in their existing location. However, in the event that they must be removed every effort will be made to relocated them on the Subject Property.

III.9 Fauna

A wildlife (terrestrial vertebrate) survey of the Subject Property and adjacent land area[10] was conducted by Andrew J. Berger over a period of 3 days, from September 23 through September 25, 1988. The purpose of the survey was to inventory and describe the existing wildlife, and identify threatened or endangered species. A summary of study follows (see Appendix A for the complete text).

Existing Conditions

Three groups of birds have been recorded on the Subject Property and surrounding land area: introduced, indigenous and endemic.

Introduced Birds. The largest group of birds indentified are those which have been introduced to Hawaii. Eighteen (18) species of introduced birds were recorded during the survey. None of these species are endangered and a number have proven to be serious pests to agriculture in Hawaii. Introduced birds which were identified include, but are not limited to, the cattle egret, pigeon, Chinese and zebra dove, melodious laughing-thrush, red-vented bulbul, white-rumped Shama, Japanese Bush warbler, Indian myna and the Japanese white-eye.

Indigenous Birds. These are species that are native to Hawaii, but also are present in other parts of the world. The Pacific golden plover (Pluvialis dominica fulva) was the only indigenous bird species identified during the survey. A common winter resident on all main Hawaiian Islands, these birds are seen frequenting a variety of open space areas throughout Oahu, including residential lawns and golf courses.

Endemic Birds. These are species that are unique to the Hawaiian Islands and do not live naturally anywhere else in the world. No endemic species of birds were identified on the Subject Property or adjacent land area. However, just east of the Subject Property, four species of endemic waterbirds are known to inhabit Kawainui Marsh. These species consist of the koloa or Hawaiian duck (Anas wyvilliana), 'alae 'ula or Hawaiian gallinule (Gallinula chloropus sandvicensis), 'alae ke'oke'o or Hawaiian coot (Fulica americana alai) and the 'ae'o or Hawaiian stilt (Himantopus mexicanus knudseni).

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10 Berger, Andrew J., Terrestrial Vertebrate Animals of the Proposed Windward Park, Kailua, TMK 4-2-12: 2 & 4, September 1988.

No endemic mammals were found on the Subject Property or adjacent parcel. Introduced species of rats, mice and mongoose as well as feral cats, dogs and pigs are reasonably assumed to be present in the area. Many of these land mammals presently pose a threat to the nesting areas of the Hawaiian waterbirds in Kawainui Marsh.

Project Impacts

The development and operation of the proposed driving range is not expected to have a significant impact on the habitat for bird species found on the Subject Property. None of the bird species identified on the Subject Property are considered endangered and a number are actually destructive pests. After development of the driving range is completed newly landscaped areas will provide potential resting and feeding areas for existing bird species.

The fertilizers and pesticides used in driving range turf grass maintenance will present little hazard to birds frequenting grassed areas on the Subject Property and surrounding marsh and open space areas. Fertilizers applied to driving range grounds are relatively non-toxic unless ingested in large amounts (see application control measures outlined in Section III.6). Herbicide and fungicides used in turf grass maintenance break down rapidly and are of a low to moderate toxicity. The only identified chemicals used in turf grass maintenance in Hawaii which are highly toxic to bird life are organic phosphate insecticides, especially chlorpyrifos (Green 1989). Although toxic, these chemicals have a limited period of application (only when insect pests appear and not on a regular schedule), break down rapidly and move little from the site of application. As a result, the exposure potential is very limited provided proper management practices are followed.

Lighting used to illuminate the driving range for night operation will not impact the feeding and nesting areas of the endangered Hawaiian waterbirds in Kawainui Marsh. The driving range will be illuminated for night play by 300 watt, high pressure sodium fixtures. The fixtures will be mounted on 35-foot aluminum poles located along the hitting line and sides of the driving range (refer back to Exhibit II-3). All of the lights will be shielded to restrict the area illuminated by the lights to the driving range only. At the conclusion of night play the lights will be turned off.

III.10 Archaeological Resources

Existing Conditions

An archaeological reconnaissance survey which included the Subject Property was conducted by the Applied Research Group of the Bishop Museum during the period from October 3, 1988 to October 7, 1988. The study consisted of background research on the history of the area, a walk-through survey to determine the presence or absence of archaeological remains and recommendations regarding future archaeological research.[11] The study identified no surface archaeological sites within the boundaries of the Subject Property (see Appendix B for the complete study).

Project Impacts

Development of the Windward Park Driving Range is not expected to impact any historic or archaeological resources on the Subject Property. The Subject Property has been heavily disturbed by extensive grading during the development of the Kailua Drive-in in the early 1960s. No surface archaeological sites were identified on the property during the archaeological reconnaissance survey of the area.

Despite the fact that the Subject Property has been heavily disturbed, the potential does exist that subsurface remains may be uncovered during development of the driving range.[12] As a precautionary measure construction crews will be alerted to the possibility of archaeological remains. If remains are discovered, the Historic Sites Office of the State Department of Land and Natural Resources will be consulted immediately to determine appropriate mitigation measures.

III.11 Traffic and Access

An assessment of the proposed project's impact on future traffic conditions was conducted by Pacific Planning & Engineering, Inc. in December of 1988.[13] The assessment was originally

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11 Pantaleo, Jeffrey and Paul L. Cleghorn, A Reconnaissance Survey of the Proposed Windward Park, Kailua, O'ahu Island, Applied Research Group, Bishop Museum, February 1989.

12 The reconnaissance survey recorded five archaeological sites on the adjacent parcel of land that were estimated to span both historic and prehistoric eras.

13 Pacific Planning & Engineering, Inc., Windward Park, Traffic Impact Assessment Report, November 1988.

prepared for a development proposal which included development of the Windward Park Driving Range and an 18-hole golf course. Since the completion of this assessment, the development proposal has been revised to include only the development of the proposed driving range. Despite this change, the trip generating potential of the development is not expected to significantly differ from levels projected by the assessment.

The study concluded that the proposed driving range is not expected to have a significant adverse impact on traffic flow along Kalanianaole Highway, at the intersection with Kapaa Quarry Access Road. Recommended improvements were limited to the updating of signal light timing. A summary of the study results follows (see Appendix C for the complete study).

Existing Conditions

The Subject Property is bordered on the east and south sides by roadways. On the south border is Kalanianaole Highway, a State maintained highway with 4-lanes separated by a median guardrail and paved shoulders. This section of Kalanianaole extends from Pali Highway and provides major access to Kailua and areas towards Waimanalo.

The Kapaa Quarry Access Road extends from Kalanianaole Highway north along the east border of the Subject Property to Mokapu Boulevard. It is a 2-lane, 2-way, County-maintained, paved road. The intersection of Kapaa Quarry Access Road and Kalanianaole Highway has a 3-phase signal and no existing crosswalks. Phases are provided for the southbound traffic turning right and left onto Kalanianaole Highway from the Kapaa Quarry Access Road, east and westbound traffic on Kalanianaole Highway, and left-turning traffic onto the Quarry Road from Kalanianaole Highway.

A survey of existing traffic conditions revealed the following:

- morning peak hour traffic heading to Honolulu backs up along Kalanianaole Highway from the upstream intersection with Kamehameha Highway;

- vehicles turning right out of the Kapaa Quarry Road encounter little delay except during periods of heavy queues on Kalanianaole Highway;

- vehicles turning left out of the Kapaa Quarry Access Road onto Kalanianaole Highway did not wait more than one full cycle; and

- truck counts verify the lack of any significant truck effects on the westbound traffic operations.

Based on manual traffic counts, traffic signal timing and observed traffic conditions existing Levels-of-Service (LOS) were determined.[14] Table III-1 depicts the existing LOS for the project area.

Table III-1

Existing Level-of-Service
Kalanianaole Highway at Kapaa Quarry Access Road

Turning Movement		Morning	Afternoon
Kalanianaole Highway			
Eastbound	TH	A	C
	LT	A	E
Westbound	TH	B	C
	RT	A	B
Kapaa Quarry Access Road			
Southbound	LT	A	D
	RT	F	D

TH - Through Traffic
LT - Left Turn Movement
RT - Right Turn Movement

14 LOS is defined as a qualitative measure describing operational conditions within a traffic stream, and their perception by motorists and/or passengers. Six levels of service are defined for each type of facility. These are given letter designations from A to F, with level-of-service A representing the best operational conditions and level-of-service F the worst conditions. LOS A represents free flow of traffic; LOS B is in the range of stable flow, but the presence of other users in the traffic stream begins to be noticeable; LOS C 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; LOS D represents high-density, but stable, flow; LOS E represents operating conditions at or near the capacity level; and LOS F is used to define forced or breakdown flow.

Project Impacts

Using observed traffic counts, existing traffic conditions and the existing LOS, future traffic forecasts with and without the project were estimated for 1991. The weekday afternoon peak hour LOS was used as the basis for forecasting because it represented the worst case condition.

Future traffic along Kalanianaole Highway was forecasted based on trend analysis utilizing 24-hour traffic counts over the past nine years at Department of Transportation (DOT) Station 40. This forecast indicates a 4.7% annual growth in traffic along Kalanianaole Highway.

The LOS analysis (see Table III-2) indicates that traffic along Kalanianaole Highway will not substantially deteriorate over existing conditions. Traffic would not need to stop or be delayed beyond normal driving conditions except for left turn movements from Kalanianaole Highway onto Kapaa Quarry Access Road. This presently operates at a LOS E and would drop to LOS F with the proposed project. All other traffic movements would remain at the same LOS with or without the project.

The traffic signal timing was analyzed to determine if a better balance in the green signal times for all traffic movements could be achieved. The analysis indicated that the overall intersection delay would decrease if the traffic signal cycle length were reduced from 145 to 90 seconds. The left turn movement from Kalanianaole Highway onto Kapaa Quarry Access Road would be expected to improve from LOS E to LOS D. Through movements on Kalanianaole Highway would improve from LOS C to LOS B and turning movements out of Kapaa Quarry Access Road would improve from LOS D to LOS C.

The proposed driving range is not expected to have a significant negative impact on traffic flow on Kalanianaole Highway and the intersection with the Kapaa Quarry Access Road. This is especially true if the recommended improvement of updating the signal timing is implemented. The results indicate that the intersection will operate at or near the same level of traffic operations as present during the morning and afternoon periods. Most of the proposed project traffic is expected to turn right at the intersection onto Kalanianaole Highway towards Honolulu. This right turn movement will encounter some problems due to the already congested flow towards Honolulu. Likewise, due to heavy traffic on Kalanianaole Highway, traffic turning left onto the Kapaa Quarry Access Road will experience average to long delays.

Table III-2

Projected Level-of-Service
Kalanianaole Highway at Kapaa Quarry Access Road

Turning Movement		1988	1991 w/o Project	1991 w/ Project	1991 w/ Project Change Timing
Kalanianaole Highway					
Eastbound	TH	C	C	C	B
	LT	E	E	F	D
Westbound	TH	C	C	C	B
	RT	B	B	B	B
Kapaa Quarry Access Road					
Southbound	LT	D	D	D	C
	RT	D	D	D	C

TH - Through Traffic
LT - Left Turn Movement
RT - Right Turn Movement

III.12 Air Quality

An air quality impact study for the Subject Property was conducted by University Associates, Inc. in December of 1988.[15] A summary of the study follows (see Appendix D for the complete study).

Existing Conditions

The air quality of the Subject Property is affected primarily by Carbon monoxide (CO) generated from vehicle emissions. Sources of CO include motor vehicle traffic along Kalanianaole Highway and Kapaa Quarry Access Road and motor vehicle activity associated with the drive-in theater operation. The State of Hawaii ambient air quality standard (AAQS) for CO is a maximum of 10 milligrams/cubic meter (mgr/cum) or 8.7 parts per million (ppm) not to be exceeded more than one one-hour period each year. There is also a corresponding 8-hour standard of 5 mgr/cum or 4.35 ppm. The National Ambient Air Quality Standards (NAAQS) are

15 University Associates,Inc., Air Quality Impact of the Proposed Windward Park, December 1988.

higher at 40 mgr/cum (34.8 ppm) for a one-hour period and 10 mgr/cum (8.7 ppm) for an 8-hour period.

Measurement survey equipment was located at the Kailua Drive-in entrance near the intersection of Kalanianaole Highway and Kapaa Quarry Access Road for one (1) month from the end of October until the end of November 1988. The measurement period was unusually wet, although the winds were characteristic of the area.

The estimated one-hour maximum CO concentration at the monitoring site for the morning rush hour was 21.7 ppm. The evening rush hour produced a CO concentration of 16.3 ppm for the intersection alone plus 6.0 ppm from the Kailua Drive-in traffic resulting in a total one-hour concentration of 22.3 ppm. Both the morning and evening rush hour concentrations exceeded the State of Hawaii AAQS.

The 8-hour maximum concentration at the monitoring site was 10.6 ppm for the intersection alone plus 0.8 ppm from the Kailua Drive-in. This resulted in an 8-hour maximum concentration of 11.4 ppm which also exceeded the State of Hawaii AAQS of 4.35 ppm for an 8-hour period.

The levels of CO concentration are significantly lower at the closest residences which are approximately 1,500 feet from the Kalanianaole Highway/Kapaa Quarry Access Road intersection. At that location, the intersection traffic contributes approximately 2.3 ppm with the drive-in traffic contributing an insignificant amount.

It should be noted that the fall months (September-November), when the monitoring occurred, are usually a period of low attendance at the Kailua Drive-in. During the summer months attendance is approximately three times higher. As a result, correspondingly higher rates of CO emissions could be expected at the monitoring site during summer months.

Project Impacts

The proposed project will not have a substantial impact on CO emissions. Because of improved emission control equipment and wider usage, the existing CO concentrations from automobile emissions are expected to be less by the year 1991 regardless of whether or not the proposed project is developed.[16] If implemented the project will substantially reduce the maximum CO

emissions during the evening rush hour period from 22.3 ppm to 13.5 ppm (see Table III-3). Maximum CO emissions during the morning rush hour period will also decrease by 1991, but by 0.3 ppm less than if the existing land use was maintained. With the development of the driving range, the eight hour CO emission standard will also decrease by approximately 2.5 ppm from 10.6 ppm to 8.1 ppm.

Table III-3
Estimated Annual CO Concentrations (in ppm) at the Intersection of Kalanianaole Highway and Kapaa Quarry Access Road

	Morning Rush Hour	Evening Rush Hour	8 hour Period
Existing	21.7	22.3	10.6
In 1991 w/ Project	18.4	13.5	8.1
In 1991 w/o Project	18.1	18.2	8.5

Some short-term fugitive dust emissions will arise from grading and dirt moving activities within the project. The EPA (1987) roughly estimates uncontrolled fugitive dust emissions from construction activity at 1.2 tons per acre per month under conditions of "medium" activity and moderate climatic conditions. However, because of the area's relatively wet climate conditions and the planned erosion control program (described in Section III.3) dust emissions from grading activities will be substantially lower than this estimate. The contractor will comply with all applicable State Department of Health Air Pollution Control Regulations regarding fugitive dust emissions.

III.13 Noise Conditions

A noise impact study to predict and evaluate the traffic noise increases associated with motor vehicle traffic to and from the proposed driving range was conducted by Y. Ebisu & Associates in December of 1988.[17] A summary of this study follows (see Appendix E for the complete study).

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16 It is expected, however, that unless new Federal emission standards are enacted, this downward trend will reverse and, as traffic volumes increase, pollutant emissions will rise in the next 10-15 years. Information by Jim Morrow, American Lung Association of Hawaii.

17 Y. Ebisu & Associates, Noise Study for the Proposed Windward Park, Maunawili, Koolaupoko, Oahu, December 1988.

Existing Conditions

Traffic on Kalanianaole Highway and Kapaa Quarry Access Road is the primary source of existing noise for the Subject Property. Existing background ambient noise levels were measured at three locations near the Subject Property (see Exhibit III-8). Because of the high level of traffic during the evening rush hour plus the Kailua Drive-in traffic, the evening traffic is considered the worse case scenario.

The existing levels of traffic noise along Kalanianaole Highway and Kapaa Quarry Access Road are in the "Significant Exposure, Normally Unacceptable" category with an approximate range of 65 to 70 Ldn.[18] This condition is typical along highways and major roads on Oahu. At a 75-foot setback from the centerline of Kalanianaole Highway, the existing traffic noise levels remain a high 65 - 70 Ldn. At a setback distance of 100 - 300 feet, the level of traffic noise decreases by 5 - 10 Ldn due to shielding and distance. This decrease places sound levels in the range of the "Moderate Exposure, Acceptable" to "Minimal Exposure, Unconditionally Acceptable" categories.

The sound level along the Kapaa Quarry Access Road is in an especially high decibel (dB) range. Sound levels range from 82 - 86 dB at a 50 foot setback distance during the off-peak hours of 8:00 a.m. to 4:00 p.m. This is based on an average volume of approximately 60 to 70 heavy trucks per hour along the Kapaa Quarry Access Road. During the interim periods between traffic, background ambient noise levels decrease to a range of 38 - 45 dB.

Project Impacts

Existing and projected noise generated from vehicle traffic on Kapaa Quarry Access Road and Kalanianaole Highway is not expected to have any adverse impact on the proposed driving range. At a setback of 244 feet from the centerline of Kalanianaole Highway and 111 feet from the centerline of Kapaa Quarry Access Road, the future noise level is projected to be 60 Ldn. This would place a land use that is located at an equal or greater setback distance within the sound

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18 The noise descriptor currently used for Federal and State standards is the Day-Night Average Sound Level (Ldn). For the purposes of determining noise acceptability by the Federal government, an exterior noise level of 65 Ldn or lower is considered acceptable. This is a National standard and is used by the State of Hawaii. The Noise Exposure Classes are as follows: 1) Minimal Exposure, Unconditionally Acceptable - not exceeding 55 Ldn; 2) Moderate Exposure, Acceptable - above 55 Ldn but not above 65 Ldn; 3) Significant Exposure, Normally Unacceptable - above 65 Ldn, but not above 75 Ldn; 4) Severe Exposure, Unacceptable - 75 Ldn. "Guidelines for Considering Noise in Land Use Planning and Control," Federal Interagency Committee on Urban Noise, June 1980.

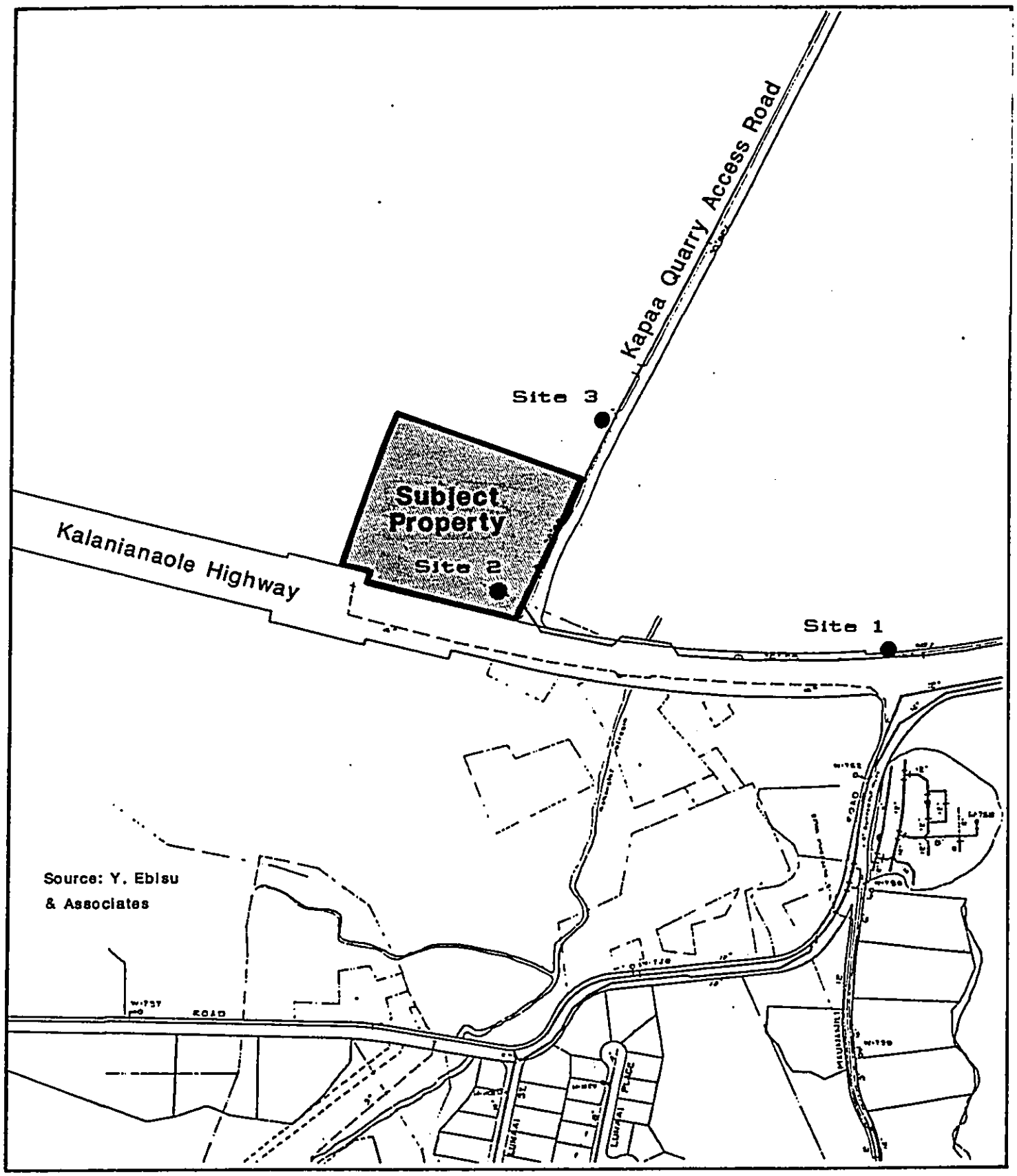

Exhibit III-8
Noise Measurement Sites

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level category of "Moderate Exposure, Acceptable" to "Minimal Exposure, Unconditionally Acceptable." The clubhouse of the proposed development will be setback over 300 feet from centerline of both Kalanianaole Highway and the Kapaa Quarry Access Road.

The future traffic noise in and adjacent to the Subject Property will not be significantly changed by the proposed development due to the relatively low volumes of traffic that will be generated by the project and the reduction in traffic associated with the Kailua Drive-in. By 1991, traffic noise is expected to increase in general from the present level by 0.1-0.7 dB along sections of Kalanianaole Highway and Kapaa Quarry Access Road abutting the Subject Property. Of this total predicted increase, approximately 0.1 - 0.5 dB will be attributable to project related traffic.[19] The remaining increase will be as a result of a general increase in regional traffic.

Discontinuation of the Kailua Drive-in Theater's operation will reduce the amount of vehicle traffic entering and exiting the property during evening period (a maximum of 700 vehicles). This can be expected to result in an approximate 1.0 Ldn decrease in traffic noise levels.

In absolute terms, projected traffic noise levels associated with vehicles accessing the driving range should not exceed 55 Ldn at a 50 foot setback from the roadway centerlines of Kalanianaole Highway and Kapaa Quarry Access Road. This level of projected traffic noise is low when compared with the current traffic noise levels of 65 to 70 Ldn at similar setback distances from the centerlines of these two roadways.

Noise generated by sources other than traffic (e.g. noise from the clubhouse or air conditioning equipment) is not expected to have any impact on nearby residential uses. The closest residential use is over 1,500 feet away from the Subject Property and is separated by the Kalanianaole Highway. The State Department of Health (DOH) community noise standards for Preservation (P-1) zoned land are 55 dB and 45 dB at the property line for the daytime and nighttime periods, respectively. Maximum continuous noise levels from the driving range activities are not expected to exceed 49 and 39 dB at the nearest residential area.

There will be a short-term increase in construction related noise levels for the surrounding area. Construction will take place during Standard General Contractor's Association hours (Monday - Friday 7:00 a.m. - 4:00 p.m. with no weekend work hours being forseen).

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19 A maximum of 85 in and out vehicle trips were projected during the PM peak hour.

Activities associated with the construction phase will comply with the provisions of Tile 11, Administrative Rules of the State Department of Health, Chapter 43, Community Noise Control for Oahu. If anticipated noise levels of the construction activity exceed the allowable level specified by the Department of Health, a Noise Permit will be obtained prior to construction activity being undertaken.

Noise Permits specify certain conditions that must be followed by the facility's contractor including:

- no permit shall allow construction activities creating excessive noise when measured at or beyond the property line for the hours 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 95 dBA at or beyond the property line of the construction site, 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 holidays identified in §11-43-6 of the DOH Administrative Rules; and

- no permit shall allow construction activities which exceed 95 dBA on Saturdays.

The contractor will comply with all conditions specified in the applicable Noise Permit. All vehicles travelling to and from the construction site, including heavy equipment, will also comply with Title 11, Administrative Rules, Chapter 42, Vehicular Noise Control for Oahu.

III.14 Visual Resources

Existing views of the Subject Property from the surrounding areas have been inventoried, both descriptively and through the use of photographs. Short-term and long-term visual impacts of the proposed driving range development are assessed, and measures are proposed to minimize any identified adverse impacts.

Existing Conditions

Views of the Subject Property are available from both primary and secondary vantage points. Primary vantage points are those viewing areas where the Subject Property is most likely to be seen by the public. These vantage points include Kalanianaole Highway, Kapaa Quarry Access Road, the Castle Hospital area, and the southwest fringe of Kawainui Marsh. Secondary vantage points are those viewing areas which are at a greater distance from the Subject Property and/or are viewed by a smaller segment of the public. Potential secondary vantage points include the open space area just north of the Subject Property, the Maunawili residential area, the northeast side of Kawainui Marsh and hiking trials on Mount Olomana and the Koolau Mountains. Exhibits III-9 through III-17 were prepared as part of the visual analysis for the Subject Property. Exhibit III-9 references the location of primary vantage points and corresponding photographs presented in Exhibits III-10 through III-17. Views of the Subject Property after the proposed development is completed are presented in Exhibits III-10, III-11, III-12, and III-15.

Ground elevations for the area occupied by the main facilities of the Kailua Drive-In Theater (i.e. parking area, concession stand) are relatively flat, ranging between 115-150 feet above mean sea level (msl). Direct views of this area from primary vantage points are screened by vegetation (eucalyptus trees and low-lying shrubs) and an earthen berm along the eastern and southern perimeter of the Subject Property.

Portions of the theater's projection screen and illuminated ground sign are visible from most of the primary vantage points (see photo exhibits). The theater screen is sited at a 45-degree angle to Kalanianaole Highway and is approximately 103 feet high above the grade elevation (approximately 130 feet above msl). At a height equivalent to a 10-story building, the top of the white screen is visible over surrounding tree cover. Also visible is the theater's illuminated ground sign which is used to advertise movie events to passing vehicle traffic. Situated at the corner of the intersection of Kalanianaole Highway and Kapaa Quarry Access Road, the sign extends approximately 20 feet above the grade elevation (approximately 80 feet above msl).

Secondary vantage points provide perspective views of the Subject Property and surrounding land areas. Visible from all of the secondary vantage points is the distinct contrast between the white drive-in screen, the soil of eroded areas along the perimeter of the drive-in and the vegetation of surrounding open space areas. From secondary vantage points on hiking trials located on Mount Olomana and the Koolau Mountains the theater screen, concession stand, and triangle shaped asphalt parking area are clearly visible.

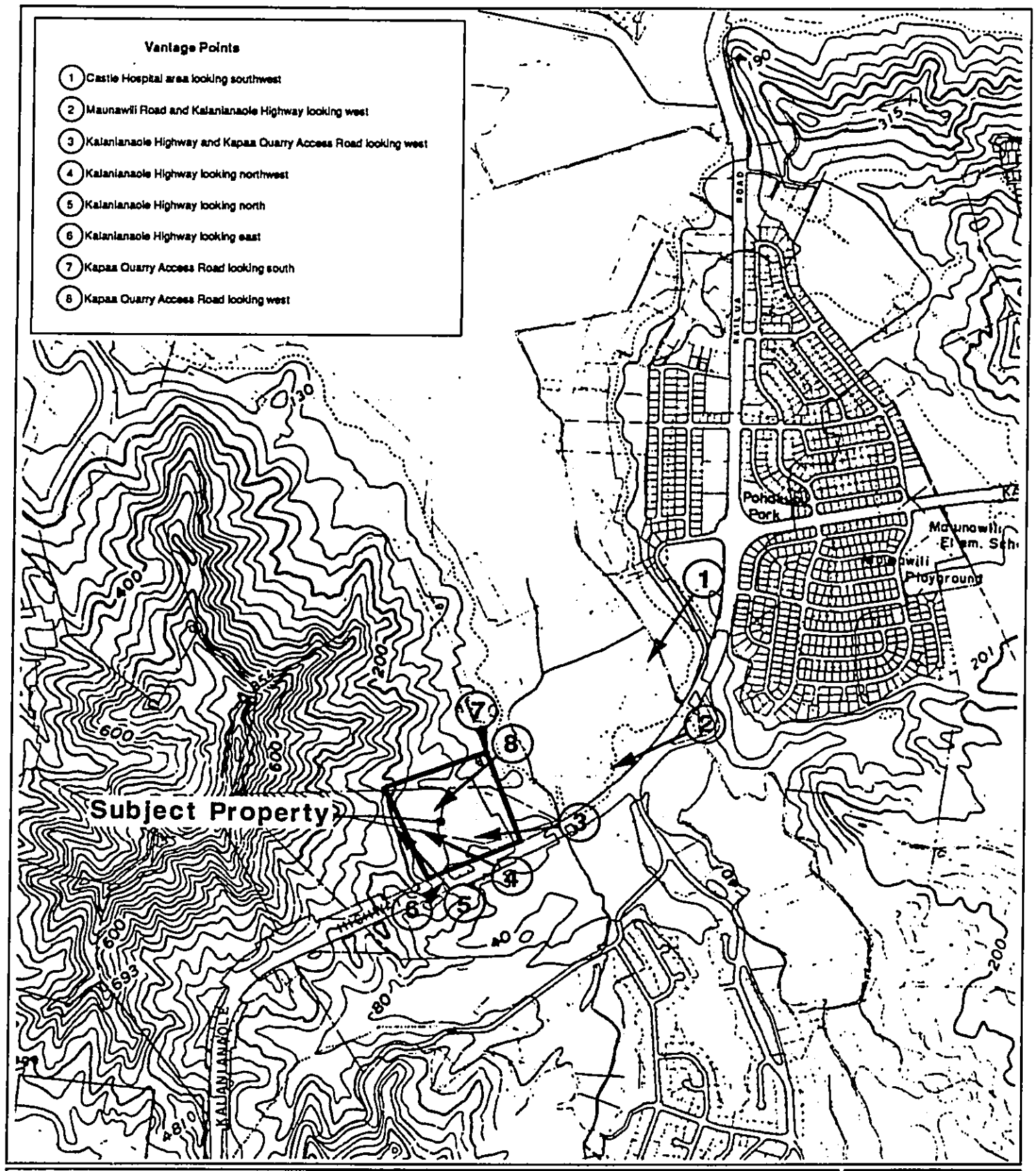


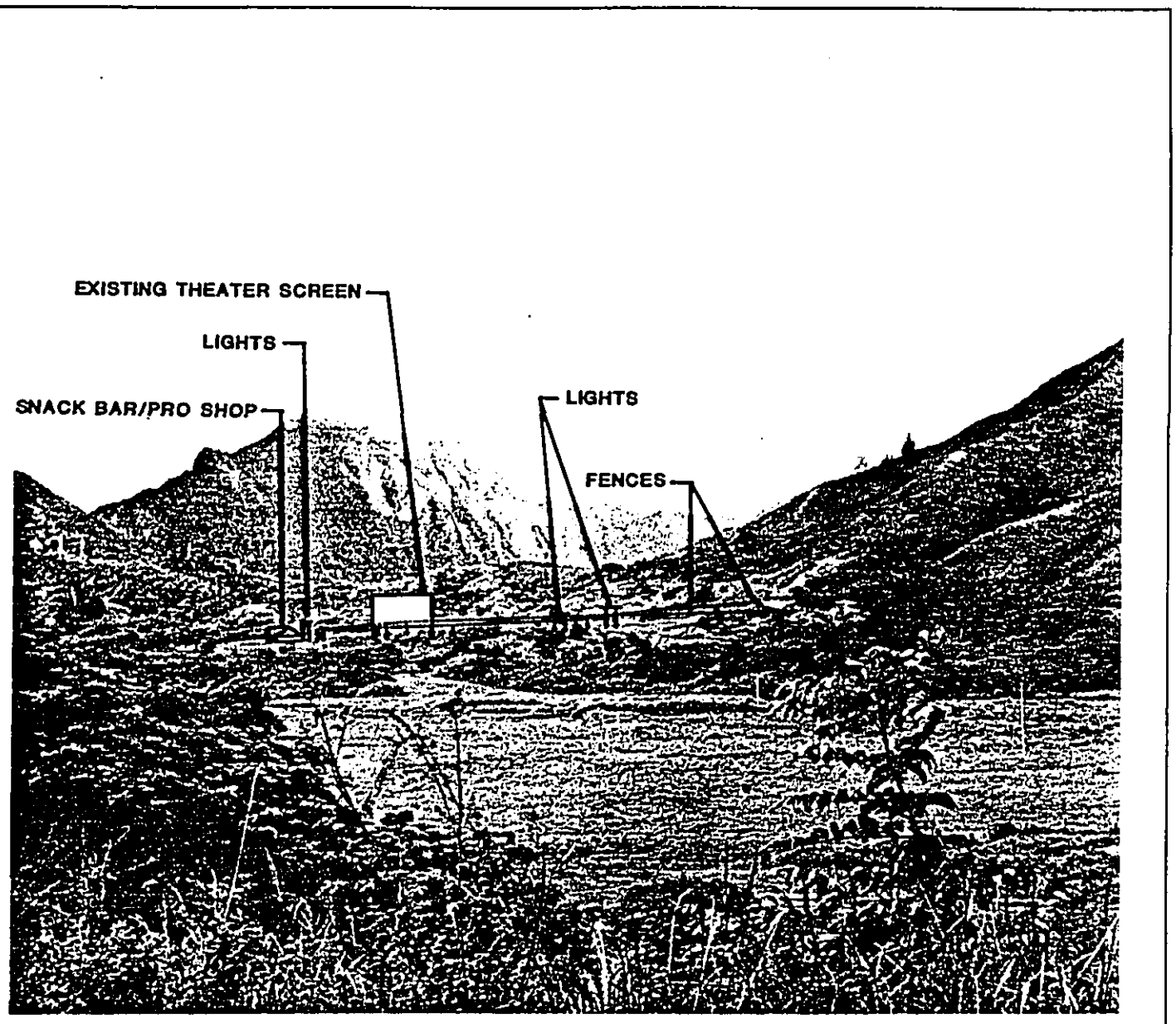
Exhibit III-9

View Study Key Map

WINDWARD PARK DRIVING RANGE

0 500 1,000 FEET 2,000

DHM inc.
Land Use and Environmental Planning



This view of the Kailua Drive-in looking southwest from the Castle Hospital area, shows the relationship of the surrounding land area to the existing theater screen (to be removed) and the proposed driving range development. In the foreground is Kawainui Marsh; to the right is Ulumawao Ridge; and in the background are the Koolau Mountains. Although the proposed fencing is shown to be visible from this vantage point, vegetation surrounding the fencing will substantially reduce any visual impact. The proposed snack bar/pro shop, fencing and lighting are sited in a manner to minimize visual impact and maintain the visual unity of this view from the Castle Hospital area.

Exhibit III-10

Vantage Point ①

WINDWARD PARK DRIVING RANGE

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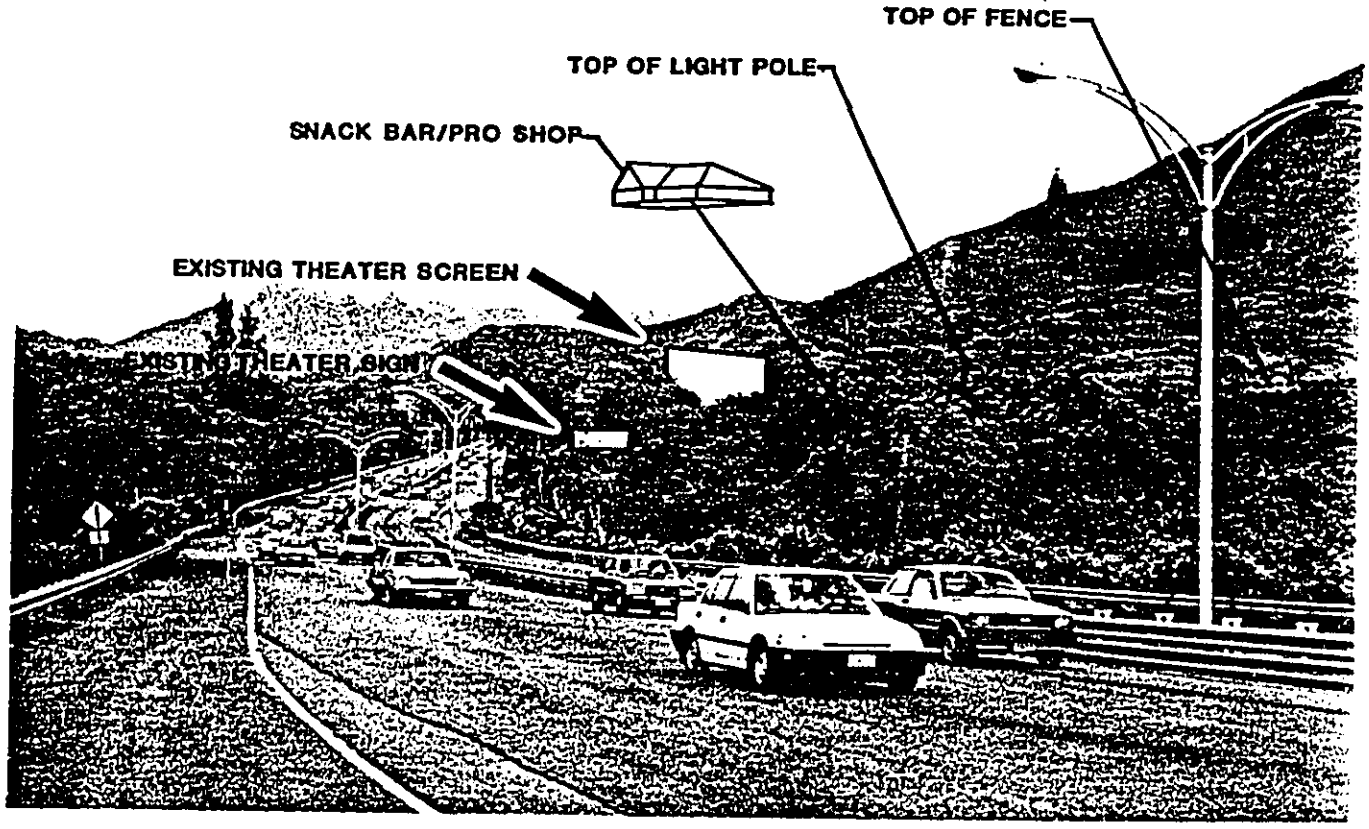
Land Use and Environmental Planning



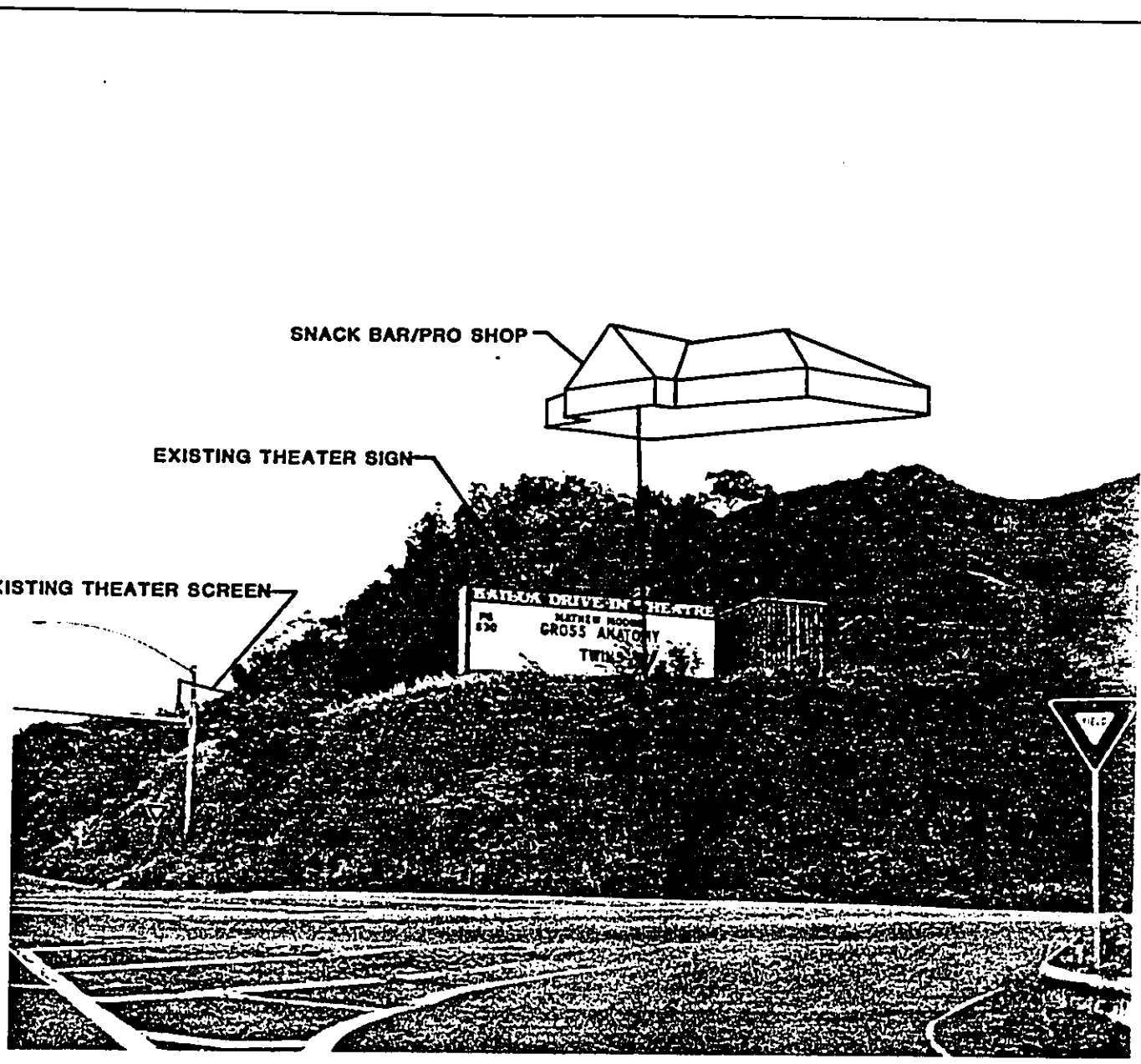
This view of the Kailua Drive-in looking west from the intersection of Maunawili Road and Kalanianaole Highway, shows the relationship of the surrounding land area to the theater screen, illuminated ground sign (both to be removed) and the proposed development. As this photo shows only the top of one of the proposed lights and a portion of the proposed fencing (dashed lines) will be visible. With the removal of the driven-in screen and the ground sign, traffic traveling mauka on Kalanianaole Highway will be provided with the greatest improvement in views. The snack bar/pro shop will not be visible from this vantage point. A scaled sketch of the snack bar/ pro shop has been included to show its relationship to the subject property. The tip of the arrow from the "snack bar/pro shop" sketch represents the location of the building's roof line.

Exhibit III-11

Vantage Point ②

WINDWARD PARK DRIVING RANGE

DHM inc.
Land Use and Environmental Planning



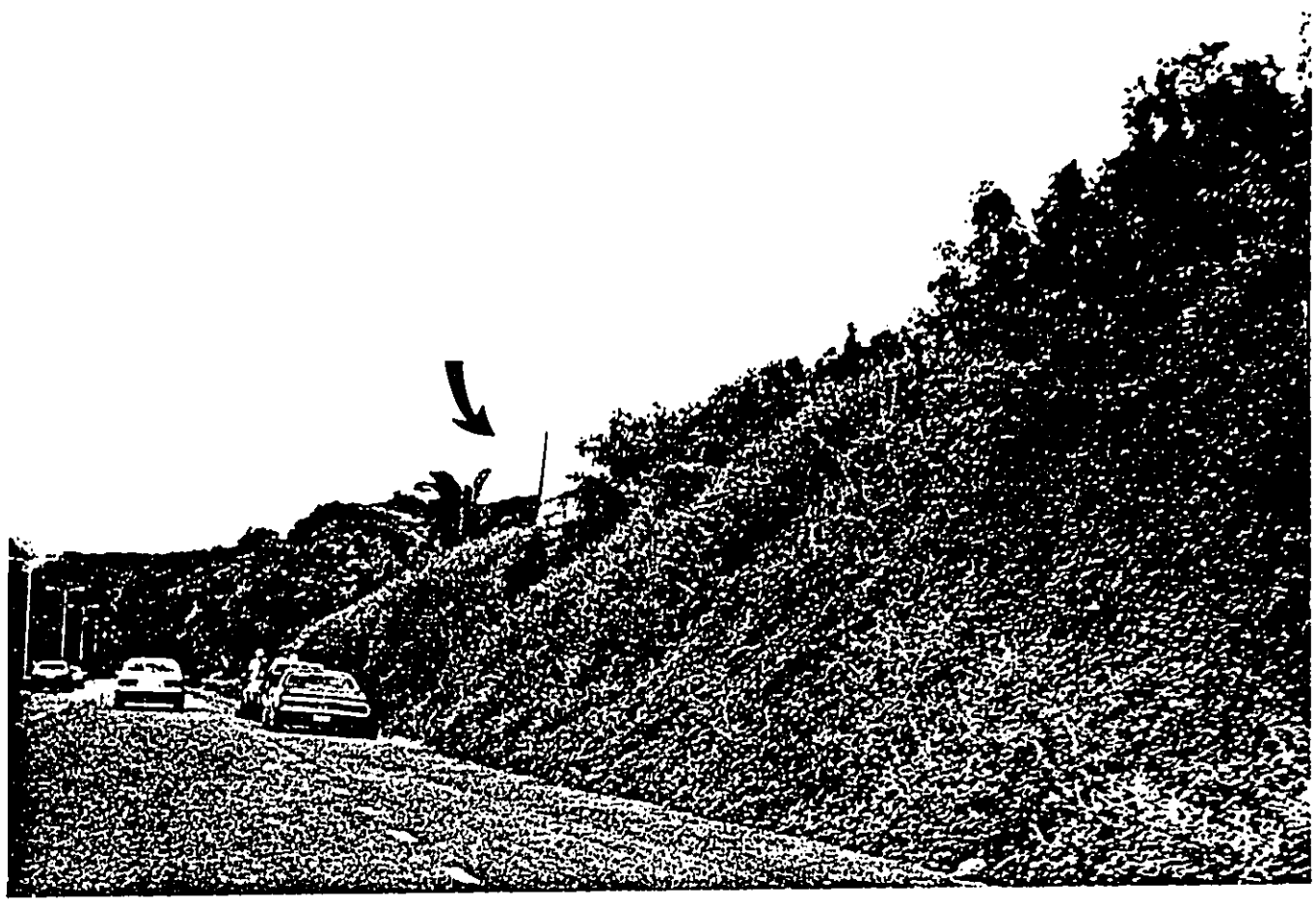
This view of the Kailua Drive-in looking west from the intersection of Kalanianaole Highway and Kapaa Quarry Access Road, shows the relationship of the surrounding land area to the theater's illuminated ground sign, screen (far left) and the proposed development. From this vantage point all of the proposed development will be screened from view. Removal of the sign and adjacent storage shed will serve to improve views of the Subject Property from this vantage point. A scaled sketch of the snack bar/ pro shop has been included to show its relationship to the subject property. The tip of the arrow from the "snack bar/pro shop" sketch represents the location of the building's roof line.

Exhibit III-12

Vantage Point ③

WINDWARD PARK DRIVING RANGE

DHM inc.
Land Use and Environmental Planning



This view of the Kailua Drive-in looking northwest from Kalanianaole Highway, shows the relationship of the theater's screen to the surrounding land area. Vegetation planted along the highway provides a measure of visual relief, however, portions of the screen are clearly visible.

Exhibit III-13

Vantage Point ④

WINDWARD PARK DRIVING RANGE

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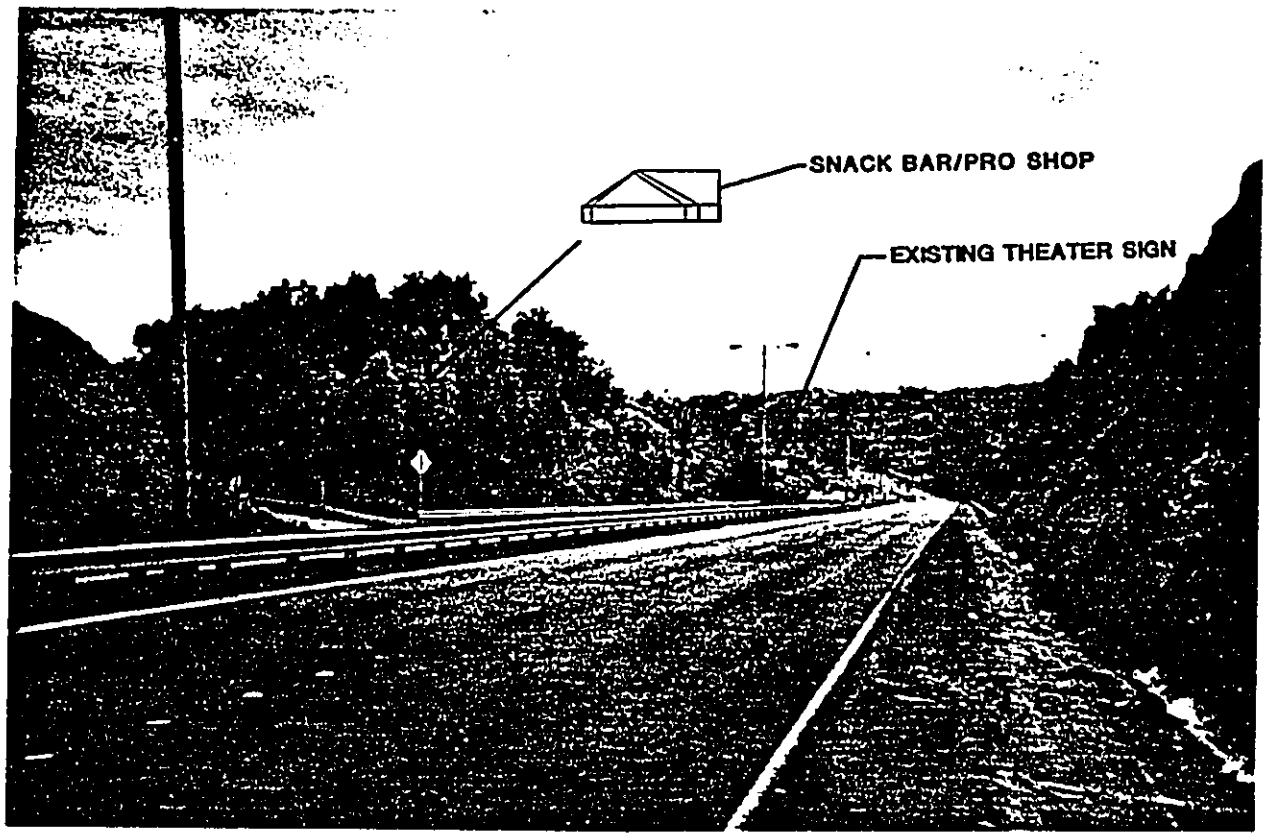
This view of the Kailua Drive-in looking north from Kalanianaole Highway, shows the relationship of the theater's screen to the surrounding land area.

Exhibit III-14

Vantage Point ⑤

WINDWARD PARK DRIVING RANGE

DHM inc.
Land Use and Environmental Planning



This view of the Kailua Drive-in looking east from Kalanianaole Highway shows the relationship of the proposed development to the Subject Property. From this vantage point, none of the proposed development will be visible. The ground sign (far left) will be removed. A scaled sketch of the snack bar/ pro shop has been included to show its relationship to the subject property. The tip of the arrow from the "snack bar/pro shop" sketch represents the location of the building's roof line.

Exhibit III-15

Vantage Point ⑥

WINDWARD PARK DRIVING RANGE

DHM inc.
Land Use and Environmental Planning

This view of the Kailua Drive-in looking south along Kapaa Quarry Access Road shows the large eucalyptus trees which line the entrance road that will be utilized for access to the proposed development (see arrow for the roadway entrance). In the foreground is one of the two exit roads that will be closed when redevelopment is completed. With the exception of the access road, none of the proposed development will be visible from this vantage point.

Exhibit III-16

Vantage Point ⑦

WINDWARD PARK DRIVING RANGE

DHM inc.
Land Use and Environmental Planning

This view of the Kailua Drive-in looking west from Kapaa Quarry Access Road, shows the theater's northern access road. Previous grading cuts in the hilside have failed to revegetate and show signs of advanced erosion.

Exhibit III-17

Vantage Point ⑧

WINDWARD PARK DRIVING RANGE

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Project Impacts

Redevelopment of the Subject Property will create some short-term adverse impacts on the views of the Subject Property. Demolition of the existing drive-in facilities, grading and infrastructure development will be the main visible activities. Existing vegetation and earthen berms will act to screen most direct views but some activities may be visible. These impacts will be short-term, involving only a period between 3 to 4 months.

The proposed project will improve the visual quality of the Subject Property over the long-term. The drive-in screen, concession stand, asphalt parking area and illuminated ground sign will be removed and replaced with a grassed driving range area with extensive landscaping. The driving range facilities (i.e. snack bar/pro shop [25 feet in height] and maintenance building [20 feet]) will be located at the southern end of the Subject Property at a lower grade elevation than the existing drive-in concession stand and will not be visible from vantage points on either Kalanianaole Highway or the Kapaa Quarry Access Road (refer to Exhibits III-11, III-12, and III-15). [20]

The parking area for the driving range will be developed at approximately the same grade elevation as the clubhouse. Existing vegetation and proposed landscaping around the perimeter of the parking area will provide a visual screen from surrounding vantage points. Autos occupying the parking lot will not be visible from the Kawainui Marsh or the adjacent roadways. Access to the driving range parking area will be provided from the existing drive-in access road off of the Kapaa Quarry Access Road. The roadway will be landscaped along its entire length to provide visual relief and minimize runoff. Views of vehicle traffic, an entry sign and roadway lighting fixtures will be associated with the entry road.

Fences made of a combination of chain-link and netting material will be placed on the perimeter of the driving range to catch misplayed balls (refer to Exhibit II-3). The fences will be approximately 20 feet in height and will be colored green to blend in with the surrounding landscaping. Vegetation will be planted adjacent to the fences to soften their visual impact on driving range users. The proposed fencing will not be prominently visible from Kalanianaole Highway or the Kapaa Quarry Access Road (refer to Exhibits III-11, III-12, and III-15). Portions of the proposed fencing may be visible from the Castle Hospital area and some secondary vantage points (refer to Exhibit III-10). The visual impact of this fencing will,

20 The drive-in concession stand stands approximately 25 feet high, including a small projection stand on the top of the building, and has a ground elevation approximately 80 feet higher than the Kapaa Quarry Access Road. The stand is not visible from Kalanianaole Highway or the Kapaa Quarry Access Road.

however, be greatly reduced by both existing vegetation and proposed landscaping along the perimeter of the fencing.

The upper portions of some of the lighting used to illuminate night play will be partially visible from surrounding vantage points. As described in Section II.2, a total of eight (8), 35-foot aluminum poles, will be located along the hitting line and on either side of the driving range. Each light pole will have four (4) high pressure sodium fixtures mounted on it. Although a potion of some of the lighting will be visible, it will not serve create a substantial visual impact (refer to Exhibits III-10, III-11, III-12, and III-15). Vegetation planted along the perimeter of the driving range will reduce the visibility of the lighting. The lighting poles and fixtures will also be coated with an earth-tone finish which will further increase their integration with the surrounding environment

Chapter IV

IV PUBLIC FACILITIES AND SERVICES/PROJECT IMPACTS

IV.1 Domestic (Potable) and Irrigation (Non-Potable) Water

Existing Conditions

The Subject Property is served by a 36-inch water main under the Kapaa Quarry Access Road. Based on Board of Water Supply (BWS) records of water consumption, current water usage by the existing drive-in theater averages approximately 47,777 gallons per month. Depending on theater usage, water consumption has ranged from a low of 30,500 gallons per month to a high of 94,000 gallons per month (see Table IV-1).

Table IV-1
Recorded Monthly Water Usage for the Kailua Drive-In Theater (January-September 1989)[1]

January	94,000
February	49,500
March	49,500
April	30,500
May	30,500
June	43,000
July	43,000
August	45,000
September	45,000

[1] Monthly usage rates represent an average of a two month billing period.

Project Impacts

Water supply for the driving range will be separated into two different systems: a potable water system and a non-potable water system. The potable water system will be utilized for fire protection and domestic supply to the clubhouse. The non-potable water system will be utilized for turf grass and landscape irrigation.

Potable Water: The proposed snack bar/pro shop, and maintenance building will utilize the existing water main on Kapaa Quarry Access Road. Projected domestic water demand for the driving range is not expected to exceed existing peak water usage levels. Projected domestic water demand for the driving range is based on the BWS Water System Standards (1985) and

demand from similar developments. An estimate of the development's average domestic water demand, exclusive of irrigation demand, can be calculated using the BWS water demand rate for resort areas (golf facilities) of 4,000 gallons per acre per day. Based on an approximate area for the snack bar/pro shop, maintenance building and circulation area of 1/2 of an acre, the calculated average demand is 2,000 gallons per day (gpd) or 60,000 gallons per month.[21]

Non-Potable Water: Because driving ranges do not receive heavy foot traffic from golfers as do golf courses, the rate of irrigation required to maintain the turf grass is not as high. Based on irrigation rates for a similar size driving range facility, daily water demand for irrigation is estimated to range from a high of 22,000 gpd during dry periods to a low of 5,000 gpd during wet periods.[22] Areas to be irrigated total approximately 12 acres and include the driving range, chipping area, putting green and landscaping around the snack bar/pro shop.

Turf grass and landscape irrigation will be supplied by a well that is to be developed on the Subject Property. To accommodate peak demand, water from the well will be pumped into the sediment pond/water retention basin that is to be located in the southwestern corner of the property. No municipal water will be used for landscaping purposes.

Development of the well will require a Well Permit from the Department of Land and Natural Resources, Division of Land and Water Development (DOWALD). A Water Withdrawl and Use Permit may also be required from the DOWALD if Windward Oahu is designated as a Water Management Area by the Board of Land and Natural Resources. The decision on this designation is currently pending. All applicable permit requirements will be complied with prior to the well's development.

IV.2 Wastewater System

Existing Conditions

There are currently no municipal wastewater lines servicing the Subject Property. The Kailua drive-in presently utilizes a cesspool for wastewater disposal.

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21 4,000 x 0.50 acres x 30 days = 60,000 gallons

22 From Board of Water Supply water meter consumption records.

The Subject Property is within the "Pass Zone" established by the Board of Water Supply (BWS). The Pass Zone is an area where waste disposal is accepted down to 30 feet below the existing surface. It is also makai of the Underground Injection Control (UIC) line which is administered by the Department of Health to protect Underground Sources of Drinking Water. Areas located makai of the UIC line are outside of an area where a designated protected aquifer is located.

Project Impacts

The driving range facilities will utilize the existing wastewater disposal system. Use of these facilities will be in accordance with the State Department of Health's requirements for wastewater disposal. Based on anticipated driving range usage rates, the total amount of wastewater generated from the driving range is expected to be at or below the amount currently generated by the drive-in theater.[23] It is expected, therefore, that the project will not have a significant impact on the wastewater system.

The possibility of connecting to the existing sewer lines servicing the Maunawili subdivision will be investigated. This will require submitting a Petition for Sewer Connection to the Wastewater Management Division of the Department of Public Works (DPW). An evaluation will then be required by DPW to determine if the existing lines can accommodate the proposed development.

IV.3 Solid Waste

Existing Conditions

Solid waste from the Subject Property is currently collected by a private collection company.

Project Impacts

The proposed project will continue the use of a private solid waste collection service and will be in compliance with applicable solid waste collection requirements. The amount of solid waste

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23 The Drive-in has a maximum 700-car capacity. As presented in Section II.2, it is estimated that a maximum of 70 persons per hour will utilize the 35-tee driving range - 35 people practicing and 35 people waiting for their turn, assuming that each person takes an average of one-hour practice time. Based on this assumption, a maximum total of between 420-500 people will be using the driving range each day.

generated by the proposed development is expected to be at or below the amount currently generated by the Drive-in Theater.

IV.4 Electricity and Telephone

Existing Conditions

Hawaiian Electric Company's (HECO) overhead electrical 46 KV transmission lines enter the Subject Property from the south across Kalanianaole Highway, follow the west and north boundaries of the Kailua Drive-in and exit across the Kapaa Quarry Access Road towards Kawainui Marsh. These transmission lines are fed from the Koolau Substation. Distribution lines include one 12.47 KV solidly grounded overhead conductor which crosses Kalanianaole Highway and feeds into a 12.47 KV solidly grounded underground line at the Kailua Drive-in.[24]

Telephone service is currently provided to the Subject Property from a cable connected to the theater concession stand.

Project Impacts

The proposed project will utilize the existing electrical and telephone infrastructure. Service to surrounding areas will not be impacted.

IV.5 Fire Protection

Existing Conditions

The Subject Property and the surrounding areas are currently serviced by the Olomana Fire Station, a one-engine station, approximately one-half mile away near the Castle Hospital. Second call for the Subject Property is from the Kailua Fire Station, a one-engine and one ladder station, on Kuulei Road approximately 3 miles away.

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24 Information regarding electrical lines are based on Hawaiian Electric Company Transmission and Distribution Line Maps, updated July 7, 1988.

Project Impacts

The proposed project is not expected to have an impact on the present fire prevention facilities and will not affect services to the surrounding areas. The driving range facilities will comply with all required fire code regulations. Fire hydrants to serve the proposed driving range facility will be provided in accordance with applicable codes and ordinances.

IV.6 Police Protection

Existing Conditions

The Subject Property and surrounding land uses are currently under the jurisdiction of the Kailua Police Station located on Kuulei Road in Kailua, approximately 3 miles east of the Subject Property.

Project Impacts

The proposed driving range is not expected to affect police protection to surrounding areas or overextend the current services.

Chapter V

V SOCIO-ECONOMIC CONDITIONS/PROJECT IMPACTS

V.1 Economic Conditions

Existing Conditions

Because figures relating to attendance, gross proceeds and number of employees at the Kailua drive-in are confidential and not available from Consolidated Amusements, Ltd., quantifying the economic impact of its closure is difficult. A national trend indicates a steady decline in the number of drive-in theaters. Hawaii has been no exception to this trend. Factors such as the high price of land, high operating costs and competition from the home VCR market have made drive-ins less profitable. The number of indoor theaters in Hawaii has also been declining. In 1963 there were an estimated 74 theaters in operation. By 1986 this figure had dropped to 42 theaters.[25] As a result of this overall industry decline, it is reasonable to assume that the revenue earning potential of the Kailua Drive-in Theater is less than some years ago.

The Kailua Drive-in is not a employment center. The number of employees at the drive-in varies considerably from one movie to another depending on the popularity of the movie. On average, 3-5 employees staff the drive-in at any given time.

Project Impacts

The primary short-term economic impact from the proposed project will result from the estimated $4.7 million in construction related expenditures. Long-term economic impacts would include the impacts from the operation of the driving range and related tax revenues (i.e. general excise, real property, and income taxes).

The level of economic impact expected from the proposed driving range can be illustrated by the 28 tee Kapiolani Driving Range. The Kapiolani Driving Range is city-owned and is operated by a private concessioner. The concession generated a revenue of $189,000 to the City during the fiscal year of 1985-86, $175,000 for FY 1986-87 and $237,000 for FY 1987-88. The 1989 revenue is projected at $318,000. Although the overall operational finance figures for the Kapiolani Driving Range are not available, it is clear that the operation of such a facility can have a financially positive impact.

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25 Department of Business and Economic Development, The State of Hawaii Data Book 1988, (p. 620).

The increasing trend toward golf play coupled with the decline in drive-in use, suggests that the proposed use of the Subject Property will bring a higher economic benefit to the community than the present use. It is also expected that the proposed driving range alone will employ the equivalent of nine full-time employees. The clubhouse is expected to employ an additional 3-5 full-time employees.

V.2 Employment Displacement

Existing Conditions

The Kailua Drive-in which is operated by Consolidated Amusement Company, Ltd. is presently on the Subject Property under a lease from the landowner. Presently an average of 3-5 employees work at the drive-in.

Project Impacts

When the drive-in is closed, the present theater employees will lose their jobs. To mitigate the potential loss of jobs, Consolidated Amusements, Ltd. has indicated that it will offer other employment opportunities on Oahu to those drive-in employees.

V.3 Population

Existing Conditions

The Subject Property is located within the Kailua-Mokapu Neighborhood as defined by the U.S. Bureau of Census for the Neighborhood Statistics Program[26] and is in Census Tract (CT) 110 (Exhibit V-1). CT 110 does not include Kailua town or the Mokapu area, as indicated by the much smaller population figure. It does include the Maunawili subdivision and the homes next to the Kawainui Marsh.

The resident population of the City and County of Honolulu was 830,600 as of July 1, 1987 representing a 8.2% increase in population since 1980.[27] The Koolaupoko District (Waimanalo

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26 Department of Business and Economic Development, The State of Hawaii Data Book, 1988, 1988.

27 Resident population for the City and County of Honolulu in 1980 was 762,565.

to Kualoa) resident population, which includes the Subject Property, increased from 109,373 in 1980 to 114,900 in 1987. This represents a 6.6% population increase. The Kailua/Mokapu Neighborhood experienced a 1.3% population increase, from 52,906 in 1980 to 53,620 in 1985. Within the Kailua/Mokapu Neighborhood CT 110 experienced a 10.9% increase, from 4,218 in 1980 to 4,733 in 1985.

Project Impacts

The proposed project is not expected to have any impact on the resident population level of the Kailua/Mokapu Neighborhood. The proposed project will enhance recreational opportunities for Windward residents and provide the resident population of the Kailua/Mokapu Neighborhood with greater access to publicly available driving range facilities.

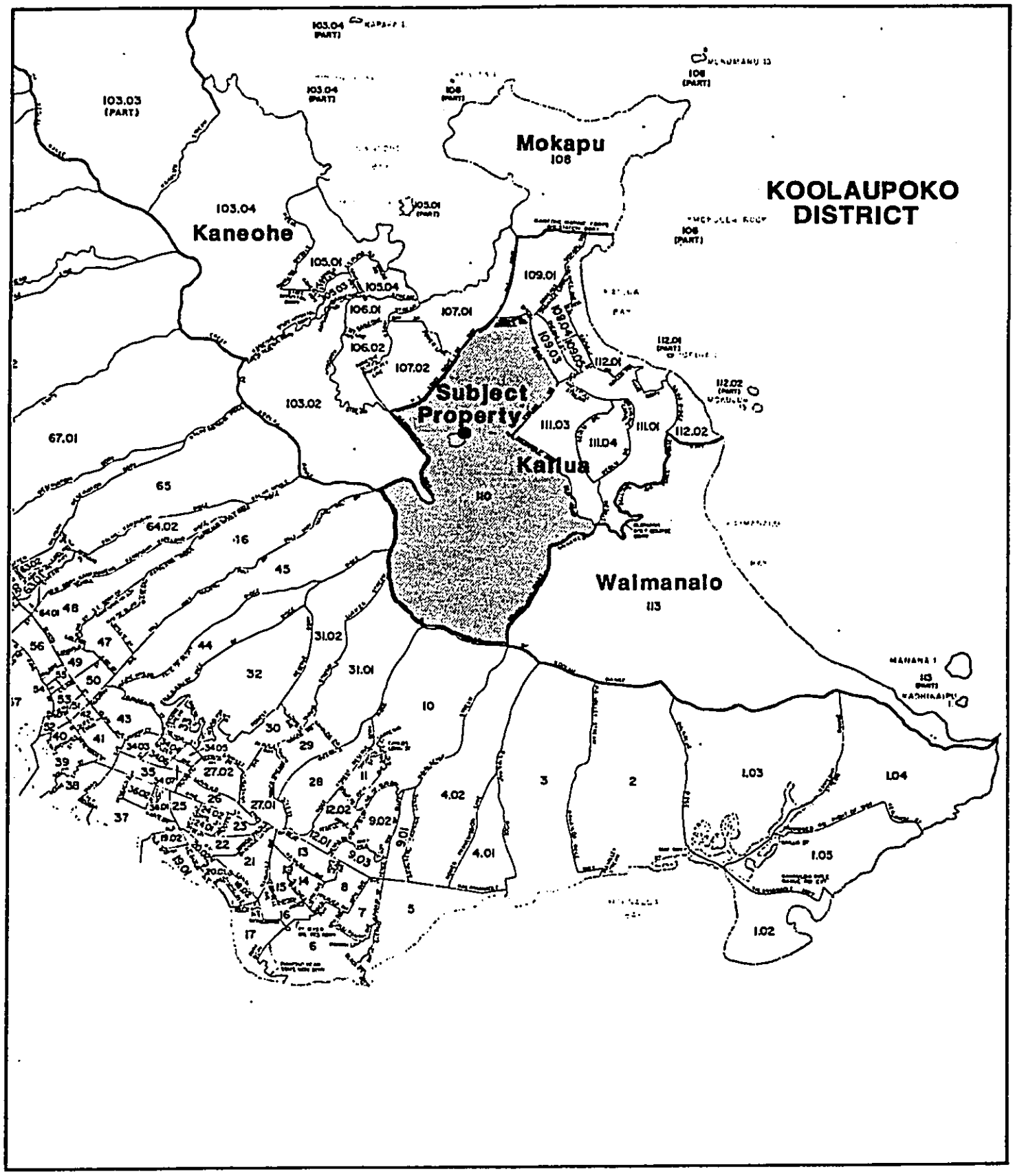

Exhibit V-1

Census Map & Neighborhood Areas

0 1 2 MILES 4

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Chapter VI

V I RELATIONSHIP OF THE PROPOSED ACTION TO LAND USE PLANS, POLICIES AND CONTROLS FOR THE AFFECTED AREA

As discussed throughout this report, the proposed driving range will be developed in such a manner as to ensure its compatibility with the Kawainui Marsh and its sensitive ecological system. The physical attributes of the Subject Property easily lend themselves to the design of a driving range in this area. This is a facility and activity which is compatible with the natural resources surrounding the Subject Property and will not adversely impact these natural resources.

The proposed driving range has a relationship to the following State and City and County of Honolulu plans and policies.

VI.1 State

A. The Hawaii State Plan

Sec. 226-11 Objectives and policies for the physical environment - land-based, shoreline, and marine resources.

(b) To achieve the land-based, shoreline, and marine resources objectives, it shall be the policy of this State to:

(2) Ensure compatibility between land-based and water-based activities and natural resources and ecological systems.

(3) Take into account the physical attributes of areas when planning and designing activities and facilities.

(8) Pursue compatible relationships among activities, facilities, and natural resources.

Sec. 226-12 Objective and policies for the physical environment - scenic, natural beauty, and 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.

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:

(5) Ensure opportunities for everyone to use and enjoy Hawaii's recreational resources.

(6) Assure the availability of sufficient resources to provide for future cultural, artistic and recreational needs.

B. State Land Use Districts

Pursuant to Chapters 183 and 205 HRS, all lands in the State have been classified by the State Land Use Commission into one of four land use districts, Agriculture, Rural, Conservation and Urban. Jurisdiction over the use of land in these districts is divided among State and County governments. Control of Land classified agriculture and rural is divided among the State Land Use Commission and the counties. Land use in the Conservation district is controlled by the Board of Land and Natural Resources (BLNR). Land classified urban is controlled directly by the counties.

The State Land Use designation for the Subject Property is Urban (see Exhibit VI-1). The land area adjacent to the Subject Property on its northern and western sides is designated Conservation. Permissible activities on land designated Urban include golf driving ranges.

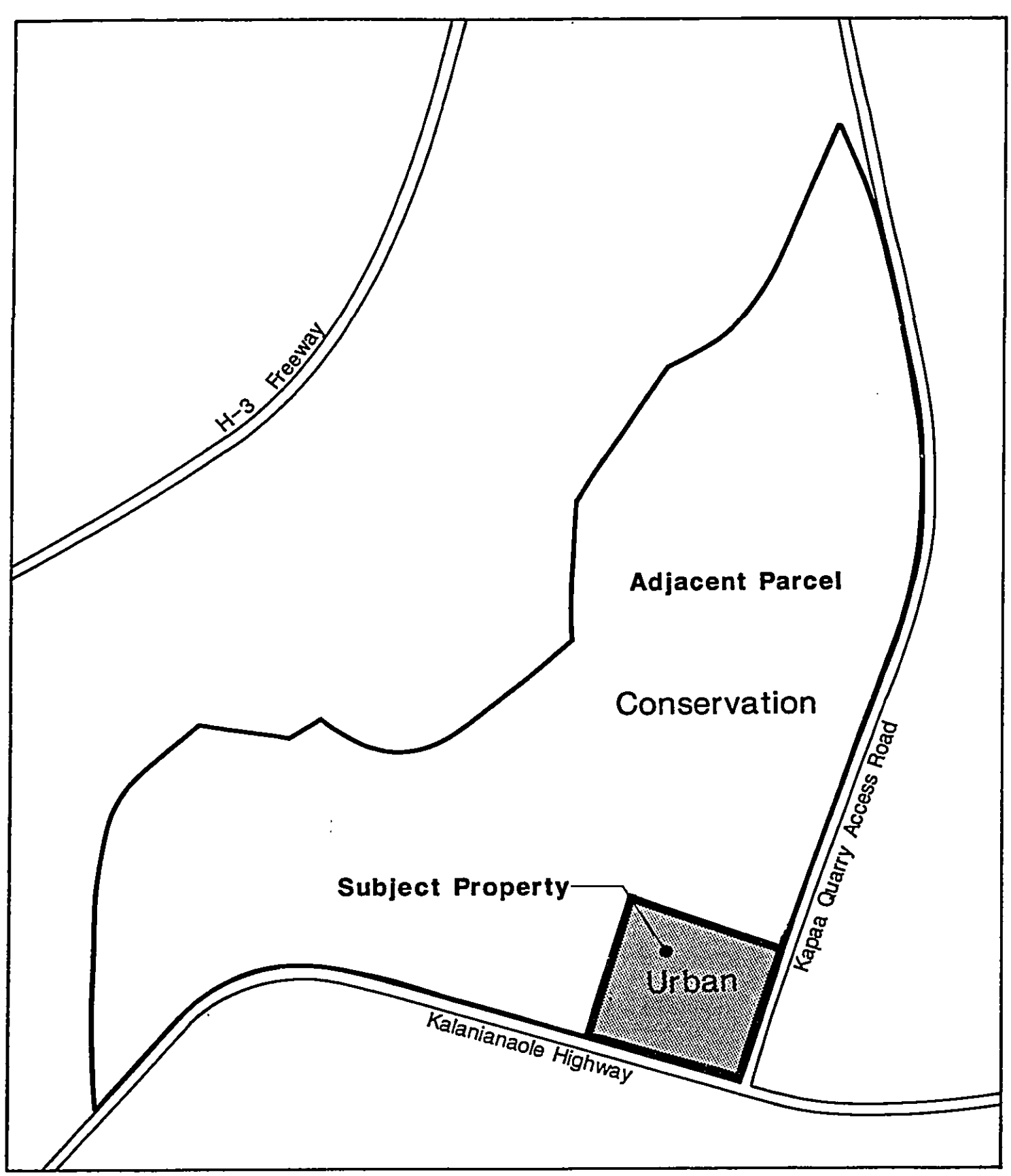

Exhibit VI-1

State Land Use Map

0 450 900 FEET 1800

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VI.2 City and County of Honolulu

A. General Plan

The General Plan for the City and County of Honolulu is a policy document that contains a "comprehensive statement of objectives and policies setting forth the long-range aspirations of Oahu's citizens and providing a broad plan of action to achieve them." Areas which are covered in the plan include, population, economic activity, housing, transportation and utilities, energy, *physical development and urban design, public safety, health and education, culture and* recreation, the natural environment, and government operations. The General Plan was first adopted in 1977 and has since been revised on five separate occasions, with the most recent revisions to the General Plan being adopted by resolution in January of 1989. Relevant objectives and policies of the General Plan that pertain to the proposed project are outlined below.

Economic Activity

Objective A

To promote employment opportunities that will enable all the people of Oahu to attain a decent standard of living.

Policies

- Encourage the growth and diversification of Oahu's economic base.
- Encourage the development of small businesses and larger industries which will contribute to the economic and social well-being of Oahu's residents.

Natural Environment

Objective A

To protect and preserve the natural environment.

Policies

- Protect Oahu's natural environment, especially the shoreline, valleys, and ridges from incompatible development.
- Require development projects to give due consideration to natural features such as slope, flood and erosion hazards, water recharge areas, distinctive land forms, and existing vegetation.
- Design surface drainage and flood-control systems in a manner which will help preserve their natural settings.

- Protect the natural environment from damaging levels of air, water, and noise pollution.

- Protect plants, birds, and other animals that are unique to the State of Hawaii and the Island of Oahu.

- 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.

Policies

- Protect the Island's well-known resources: its mountains and craters; forests and watershed areas; marshes, rivers, and streams; shoreline, fishponds, an bays; reefs and offshore islands.

- Provide opportunities for recreational and educational use and physical contact with Oahu's natural environment.

Physical Development and Urban Design

Objective A

To coordinate changes in the physical environment of Oahu to ensure that all new developments are timely, well-designed, and appropriate for the areas in which they will be located.

Policy

- Coordinate the location and timing of new development with the availability of adequate water supply, sewage treatment, drainage, transportation, and public safety facilities.

- Require new developments to provide or pay the cost of all essential community services, including roads, utilities, schools, parks, and emergency facilities that are intended to directly serve development.

Objective D

To create and maintain attractive, meaningful, and stimulating environments throughout Oahu.

Policy

- Require the consideration of urban design principles in all development projects.

- Require new developments in stable, established communities and rural areas to be compatible with the existing communities and areas.

Culture and Recreation

Objective D

Provide a wide range of recreational facilities and services that are readily available to all residents of Oahu.

Policies

- Develop and maintain a system of regional parks and specialized recreation facilities.
- Encourage the private provision of recreation and leisure-time facilities and services.

B. Kawainui Marsh Resource Management Plan

The Subject Property is within the secondary boundaries of the Kawainui Marsh Resource Management Area as designated by the Kawainui Marsh Resource Management Plan (refer back to Exhibit III-4). In direct response to the Resource Management Plan, every effort has been made to incorporated the following objectives, policies and recommended actions into the design and planning of the proposed project.

Objective: Protect compatible natural, cultural and economic resources through management and control of existing and future land uses.

Policies:

4. Public recreational use of the Marsh should be encouraged consistent with the protection of wildlife and habitat and cultural resources.

5. Development of the Marsh should combine active and passive uses associated with the public enjoyment of open space, wildlife, flora and cultural experiences.

Objective: Provide for recreational activities in the Marsh area.

Policy:

1. The wilderness character of the Marsh and the surrounding area should be promoted through rehabilitation, landscaping and management.

Recommended Actions:

3. The opportunities for removal or modification of the Kailua Drive-in Theater screen should be explored in order to improve view planes toward and from the Marsh.

C. Development Plan

The Development Plans (DP)s for the City and County of Honolulu, provide a relatively detailed framework for implementing the objectives and policies of the General Plan. They set forth desired sequence, patterns and characteristics of future development. A total of eight Development Plan regions have been established for Oahu. The area affected by the proposed project falls under the jurisdiction of the Koolaupoko Development Plan. Established as an ordinance the Development Plans consist of three elements: Common Provisions which outline requirements common to each of the eight regions; Special Provisions which detail requirements specific to a region; and the Development Plan Maps (Land Use and Public Facilities) which graphically depict the intended pattern and sequencing of development.

Development Plan Common Provisions

Section 4, General Urban Design Principles and Controls

(1) Public Views - 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.

(2) Open Space - The city's mountains, hills, shoreline and streams shall be considered as major scenic, open space and recreational resources. Adequate public access to these resources shall be incorporated as part of developments adjacent to them.

Existing natural stream beds and drainage ways shall be retained wherever possible. Where further channelization must occur, materials that are harmonious with the setting, such as stone, shall be used whenever feasible.

(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.

Section 5, General Principles and Controls for Parks Recreation and Preservation Areas

(1) Parks and Recreation Areas - Parks and recreation areas...shall be located and designed so as to be suitable for different and varied neighborhoods and available to all residents of Oahu.

Section 8, Identification of Public Buildings, Public or Private Facilities for Utilities, Terminals and Drainage

(4) Drainage - Whenever practical, drainage improvements shall emphasize natural means and retention of water with minimum reliance on structural means and rapid transport.

Koolaupoko Development Plan Special Provisions

Section 2, Urban Design Principles and Controls for Koolaupoko

(1a) Open Space - The visibility, preservation, enhancement and accessibility of open space areas... shall be given high priority in the design of adjacent and nearby developments in Koolaupoko.

(1b) Public Views - In order to promote pleasing and attractive living environments and panoramic mauka and makai views from public places, views of major landmarks from public places shall be protected whenever possible.

Koolaupoko Land Use Map

The Development Plan land use designation for the Subject Property is Preservation (Exhibit VI-2).

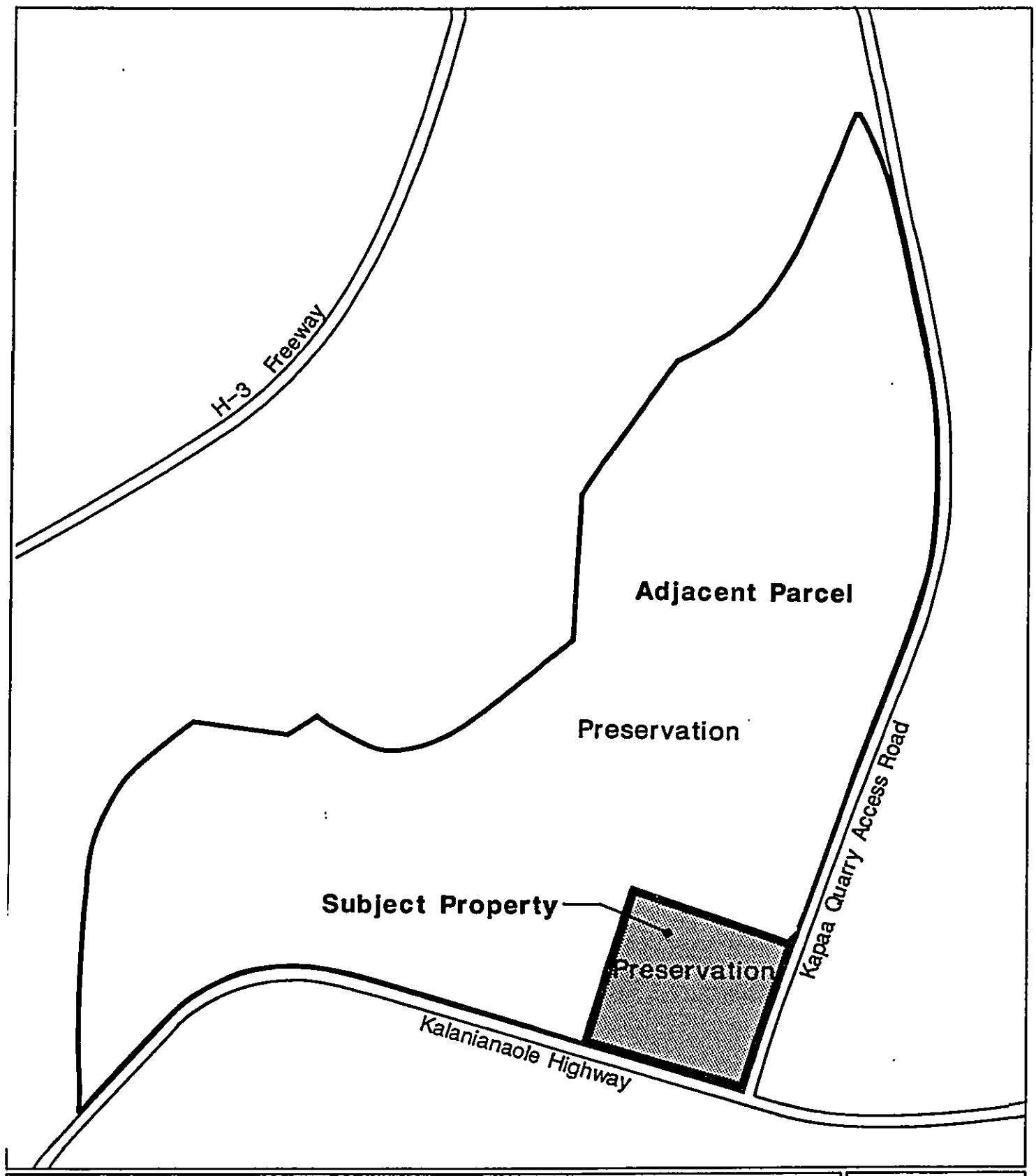

Exhibit VI-2
Development Plan
Land Use Map
WINDWARD PARK DRIVING RANGE

0 450 900 FEET 1,800

DHM inc.
Land Use and Environmental Planning

Koolaupoko Public Facilities Map

Exhibit VI-3 presents the existing DP Public Facilities Map for the Subject Property and the adjacent area. The following proposed improvements on lands in and adjacent to the Project Area are designated:

- Publicly funded development of a transit station (TS) (Kailua Park and Ride Facility) and corporation yard (CY) (Windward Division Bus Facility) on the Subject Property. The exact site for this facility is undetermined. Acquisition and/or development of the facility is programmed to commence beyond a six year time frame.

- Publicly funded development of a park (P), makai of the Subject Property. The site of the park development borders Kawainui Marsh's southern side and extends along Kalanianaole Highway and Kapaa Quarry Access Road. Acquisition and/or development of the facility is programmed to commence beyond a six year time frame.

- Publicly funded development of additional rights-of-way (R) (e.g. roadway expansion) along the portion of Kalanianaole Highway directly adjacent to the Project Area. Acquisition and/or development of this roadway expansion is programmed to commence within a six year time frame.

- Publicly funded development of a sewage pumping station (SPS) southeast of the Project Area. Acquisition and/or development of this pumping station is programmed to commence within a six year time frame.

D. Zoning

Zoning implements the purpose of the General Plan and the Development Plans and is required by statute to be in conformance with Development Plan designations. On Oahu, zoning is administered through two elements: the Land Use Ordinance (LUO), a written text, which is intended to provide reasonable design and development standards for the use of land on Oahu; and twenty-four Zoning Maps which provide specific zoning designations for all land on Oahu under the jurisdiction of the City and County of Honolulu.

The zoning designation for the Subject Property is P-2, General Preservation (Exhibit VI-4). It is the intent of the Land Use Ordinance that Urban lands well-suited to offer visual relief or to serve as outdoor space for the public's use and enjoyment be zoned P-2. Permitted uses within

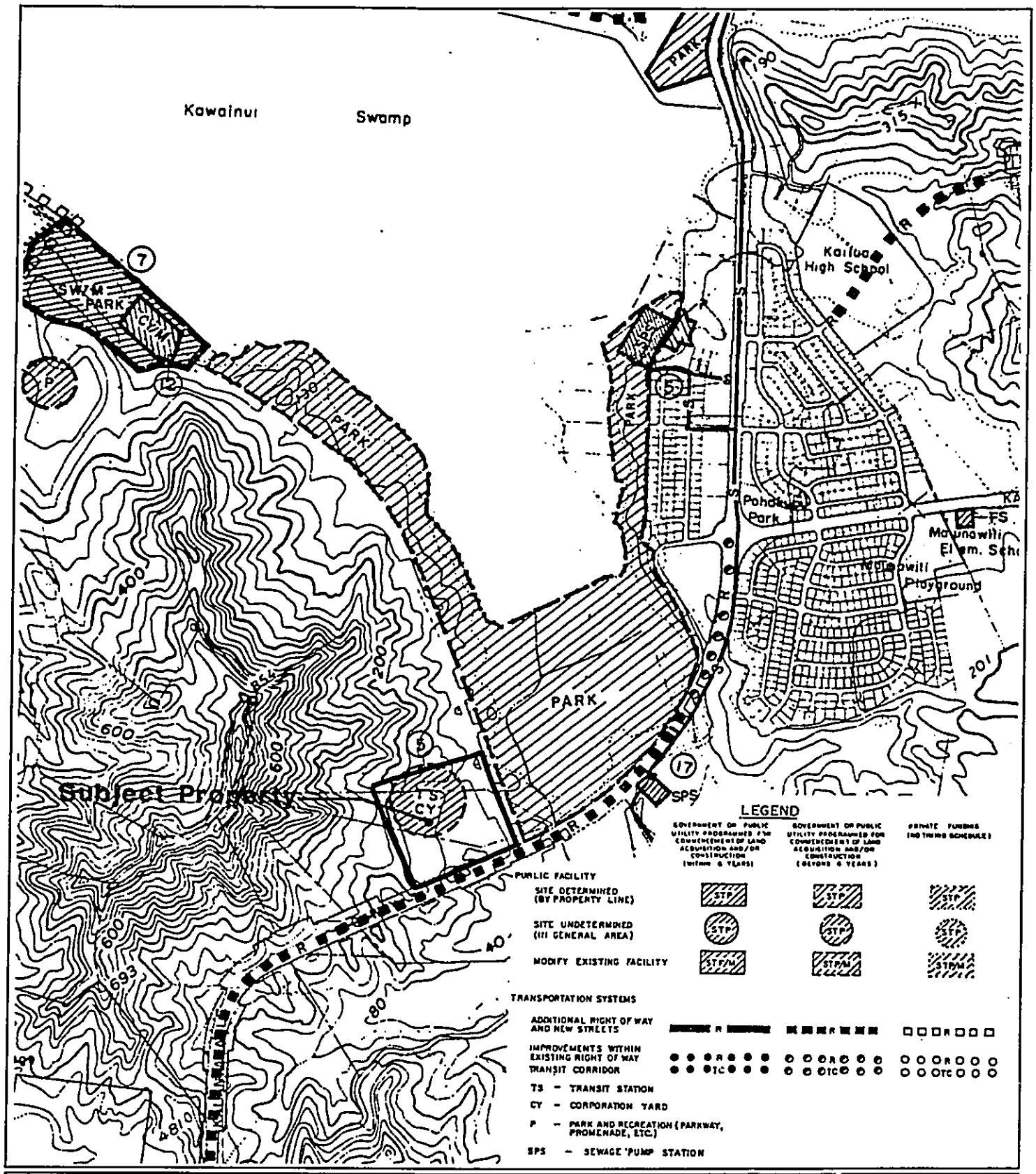

Exhibit VI-3

Development Plan
Public Facilities Map
WINDWARD PARK DRIVING RANGE

0 500 1,000 FEET 2,000

DHM inc.
Land Use and Environmental Planning

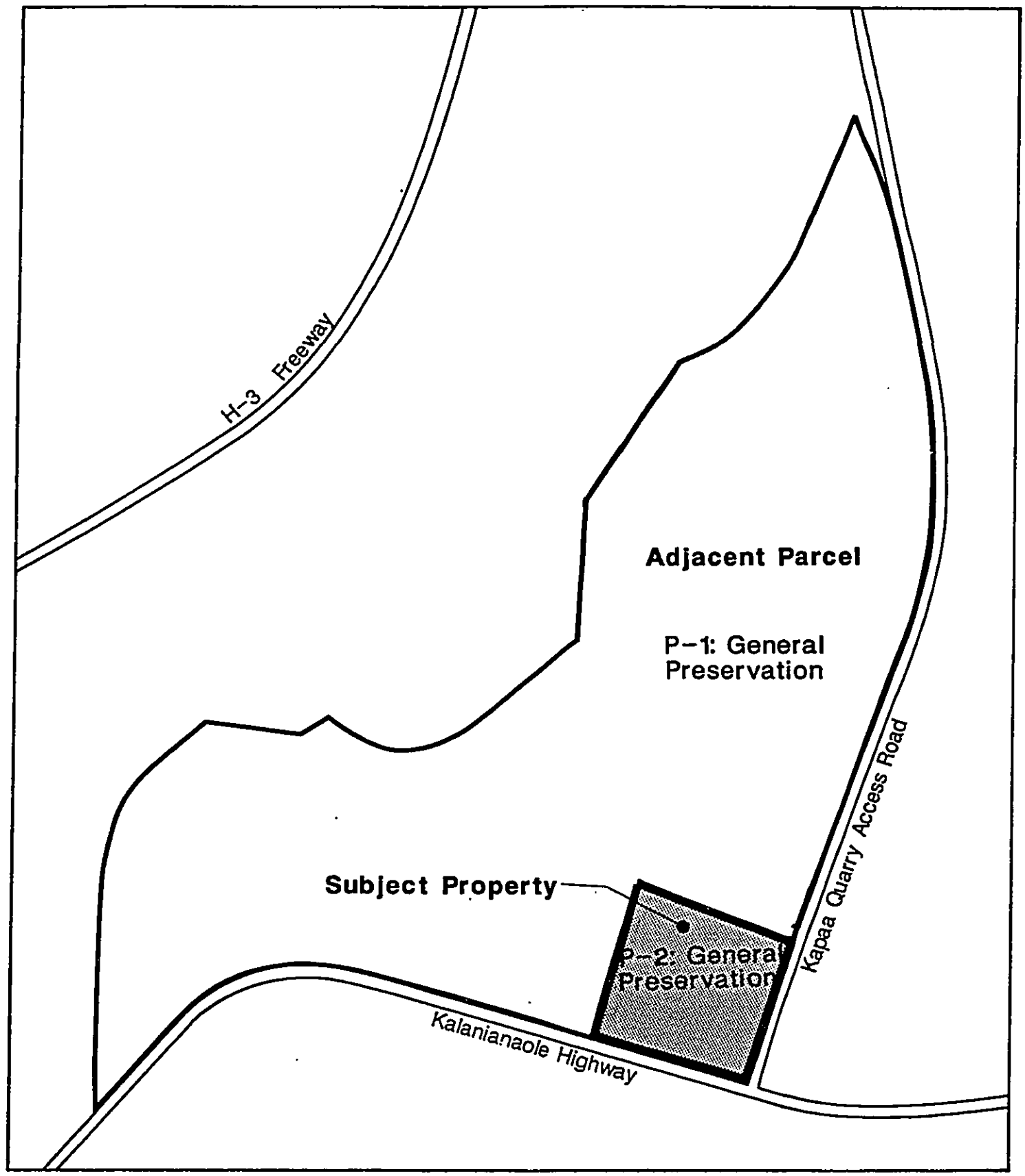

Exhibit VI-4

Zoning Map

0 450 900 FEET 1800

DHM inc.
Land Use and Environmental Planning

this designation include outdoor recreation facilities such as a driving range as a principal use. A clubhouse (e.g. pro shop/snack bar) is permitted as an accessory use provided it is scaled to meet only the requirements of the facility users.

E. Special Management Area

In accordance with the State Coastal Zone Management Program (Chapter 205A-21, HRS), the City and County of Honolulu is charged with designating and administering Special Management Areas (SMA)s for the island of Oahu (see Exhibit VI-5 for the portion of the SMA which will be affected by the proposed driving range). Under Chapter 33, ROH, any "development", as defined by law, determined to be within the SMA boundary requires the issuance of a Special Management Area Use Permit (SMP) from the City and County of Honolulu Department of Land Utilization (DLU) prior to commencing with the project. An SMP will be required for development of the proposed driving range. Issuance of an SMP is required, by statute, to precede any other permit approval.

F. List of Necessary Determinations and Permits

A number of determinations and permits will be required to implement the project. These are listed below along with their responsible agency.

Determinations

1) Determination of whether an Environmental Impact Statement will be required

Determining Agency: City and County of Honolulu, Department of Land Utilization (DLU)

Status: Upon acceptance of this Environmental Assessment, the DLU has 30 days to assess the project's impact on the SMA and determine whether preparation of an EIS will be required (currently being assessed).

Permits

1) Special Management Area Use Permit (SMP)

Responsible Agency: City and County of Honolulu, Department of Land Utilization (DLU)

Status: Application has been submitted and will be processed after a determination is made by the DLU regarding the need for an EIS

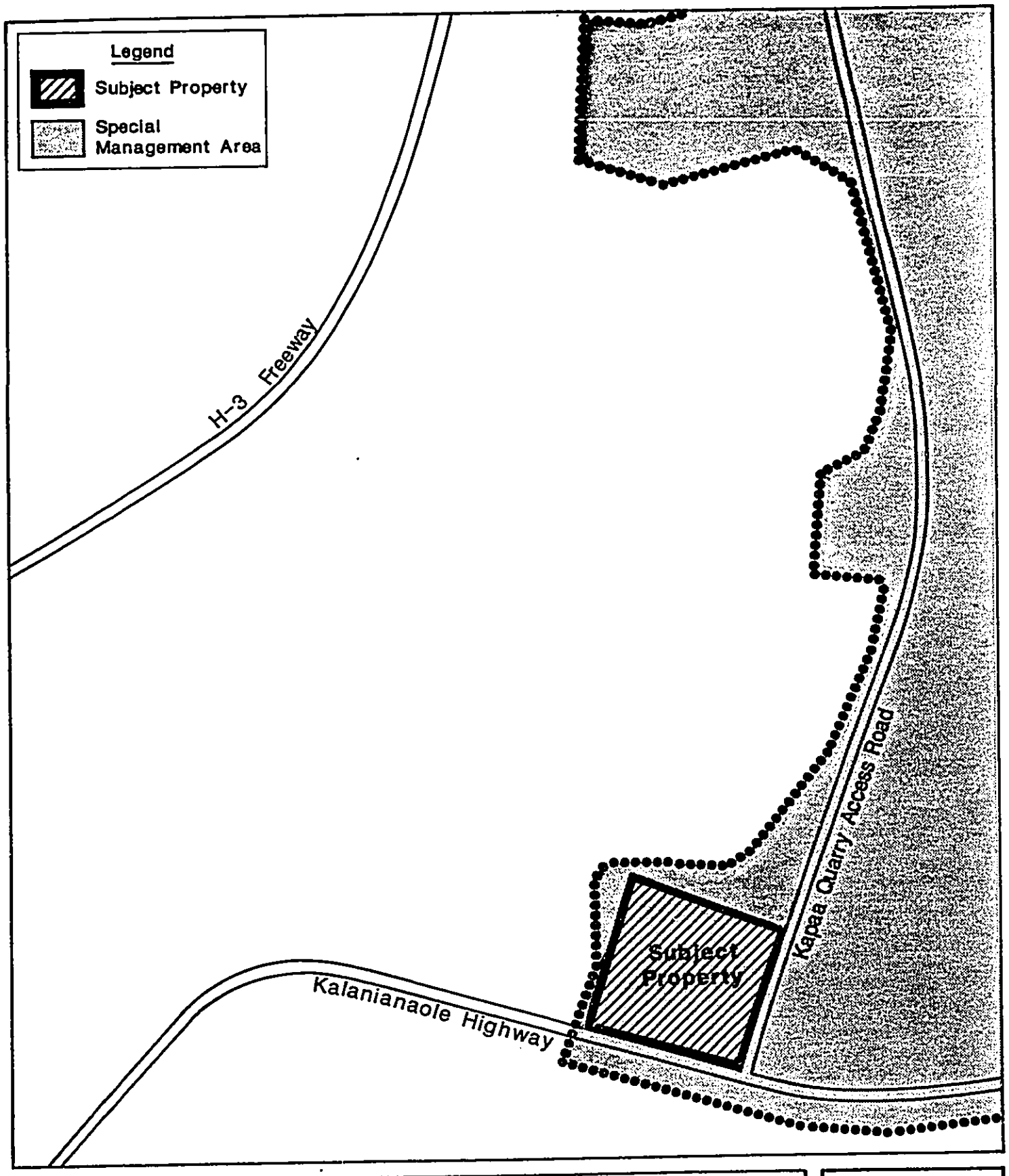

Exhibit VI-5
Special Management Area Map

0 450 900 FEET 1800

DHM inc.
Land Use and Environmental Planning

2) Building Permit for Buildings, Electrical, Plumbing, Sidewalk/Driveway Work and Demolition

Responsible Agency: City and County of Honolulu, Building Department and review by various other city and state agencies

Status: Application will be submitted after approval of the SMP

3) Grading, Grubbing and Stockpiling Permit

Responsible Agency: City and County of Honolulu, Department of Public Works

Status: Application will be submitted after approval of the building permit

4) Well Drilling Permit

Responsible Agency: State of Hawaii, Deaprtment of Land and Natural Resources, Division of Water and Land Development

Status: Application will be submitted after SMP is approved

5) Water Withdrawl and Use Permit

Responsible Agency: State of Hawaii, Deaprtment of Land and Natural Resources, Division of Water and Land Development

Status: May be required if Windward Oahu is designated as a Water Resource Management Area

6) Water System Requirements for Developments

Responsible Agency: Board of Water Supply

Status: Application will be submitted after approval of the building permit

7) Sewer Connection Permit

Responsible Agency: Department of Public Works

Status: Application will be submitted after approval of the building permit

8) Sign Permit

Responsible Agency: City and County of Honolulu, Building Department with review by the DLU

Status: Application will be submitted after approval of the building permit

9) Certificate of Occupancy

Responsible Agency: City and County of Honolulu, Building Department with review by various other agencies

Status: Application will be submitted after building completion

Chapter VII

VII RELATIONSHIP BETWEEN SHORT TERM USES OF THE ENVIRONMENT AND THE MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

Development of the proposed project will result in a long-term environmental and economic gain for the community and the State of Hawaii. The project involves the construction of a golf driving range on the current site of the Kailua Drive-in Theater. Once developed the facility will contribute to meeting the high demand for golf recreational facilities on the island of Oahu.

Short Term Losses

Some short-term losses will occur during the project construction phase. Erosion may occur on the Subject Property while grading operations are being conducted. This will be limited by strictly following the erosion controls measures outlined in this document. Noise levels from the Subject Property can also be expected to increase during construction operations. Additional short-term impacts include the increased generation of fugitive dust, disruption of traffic and a reduction in air quality within close proximity of the construction activity.

Long-Term Losses

Redevelopment of the Subject Property will result in the long-term loss of the site as a drive-in theater.

Long-Term Productivity

The long-term productivity of the proposed driving range will offset these adverse environmental consequences. The long-term productivity of the driving range includes:

1) an increase in the number of publicly available golf recreational areas in Honolulu for residents and visitors;

2) encouraging the development of a activity which is more aesthetically sensitive to the adjacent Kawainui Marsh;

3) improving the visual quality of the area from major vantage points;

4) reducing the rate of erosion on the Subject Property;

5) increasing tax revenue accruing to the City and State; and

6) improving the overall level of security for the immediate area.[28]

28 Because the driving range operation will be open during the day and the early evening hours, the presence of this activity can be expected to improve the level of security over existing conditions.

Chapter VIII

VIII ADVERSE IMPACTS WHICH CANNOT BE AVOIDED

The present drive-in movie entertainment business will be replaced by an outdoor participatory recreational use. For regular patrons of the theater the loss of the drive-in facility will be adverse impact which cannot be avoided.

Chapter IX

IX IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

Development of the driving range will result in an irreversible commitment of investment capital, labor, and construction materials. Once completed the facility will remain there for the life of the project. In the future the project could be demolished and the land area utilized for another purpose.

Chapter X

X SUMMARY OF UNRESOLVED ISSUES

The designation of a portion of the Subject Property on the Public Facilities map for publicly funded development of a transit station (Kailua Park and Ride Facility) and corporation yard (Windward Division Bus Facility) has not been resolved. The exact site for these facilities has not been designated by proposing agencies. Use of the property would require the City and County of Honolulu to acquire the property through negotiation or condemnation proceedings. According to the Public Facility Map, acquisition and/or development of the facility is not programmed to commence with the next 6 years.

There are no additional unresolved issues for this project. All issues have been identified and appropriate mitigative measures proposed.

Chapter XI

XI ALTERNATIVES TO THE PROPOSED ACTION

No Action

If the proposed project is not developed, the existing activity will remain until a more economically viable land use can be planned and approved.

Zoning Change and Intensification of Land Use

One alternative for the Subject Property would be to request a zoning amendment to permit intensified land use activities. Examples would include housing or other commercial ventures.

This alternative would, however, be in direct conflict with the stated objectives and policies of the Hawaii State Plan, the Development Plan and the Kawainui Marsh Resource Management Plan.

Chapter XII

XII AGENCIES, ORGANIZATIONS AND INDIVIDUALS CONSULTED

State

Department of Health
Department of Land and Natural Resources, Historic Sites Section
Department of Transportation, Rights-of-Way Division

City and County of Honolulu

Board of Water Supply
Department of Finance, Real Property Assessment Division
Department of General Planning
Department of Land Utilization
Department of Public Works
- Refuse Collection and Disposal Division
- Drainage Division
- Sewage Division
- Wastewater Management Division

Department of Transportation Services
Honolulu Fire Department
Honolulu Police Department

Others

Consolidated Amusements, Ltd.
Hawaiian Electric Company

Refererences

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Appendix A

BOTANICAL SURVEY

WINDWARD PARK

KAILUA, O'AHU

by

George K. Linney
and
Winona P. Char

CHAR & ASSOCIATES
Botanical / Environmental Consultants
Honolulu, Hawaii

Prepared for: DHM inc.

October 1988

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SUMMARY

On 24 September 1988, a botanical survey was carried out on the site of the proposed Windward Park 18-hole golf course and support facilities. The vegetation on the site consisted primarily of low- to high-statured scrub. In depressions large-statured trees predominated. Above an elevation of 200 feet in low-statured scrub, remnants of the former native vegetation were found, becoming more common at higher elevations. A total of 142 species of vascular plants were found on the site. Of these, 128 (90%) were exotic weeds or deliberately introduced plants, and 14 (10%) were native or presumed-native plants. None of the species found on the site were officially listed as endangered or threatened; nor were any species proposed or candidate for such status.

INTRODUCTION

The study site consists of approximately 221 acres of scrub land, zoned Conservation (General subzone), located inland of Kailua, O'ahu. It is bounded on the eastern side by Kapa'a Quarry Road, on the southern side by Kalanianaole Highway, and on the western and northern sides by the summit ridgeline of Ulumawao Ridge. In the southeast corner, where Quarry Road and Kalanianaole Highway intersect is the 61-acre site of the Kailua Drive-In Theater, zoned Urban and excluded from this study. Along the ridgeline, where the slope is steeper, above 400 feet in the southwest, above 700 feet to the northeast, is a parcel of 66 acres zoned Conservation (Limited subzone), also excluded from the study. On the opposite side of the ridgeline are Hawaii Loa College, the Kapa'a Sanitary Landfill, and Kapa'a Quarry. Immediately below the site is Kawainui Marsh.

There have been four previous vegetation surveys in the vicinity of the present study site (Elliott and Hall, 1977; Smith, 1978; Kores and Davis, 1979; Linney and Char, 1985). Of these, only the Kores and Davis survey is germaine to present site. The others deal with the wetlands of (or associated

with) Kawainui Marsh at the foot of the hill, where the vegetation differs considerably from that of the present study site. Kores and Davis surveyed the 160-acre site of the Kapa'a Quarry, immediately adjacent to the present site. They reportedly found a total of 102 species of vascular plants, though their species list contains only 93. Of these 72 (77%) are exotic or deliberately introduced plants, while 21 (23%) are considered native. There are a number of taxonomic and nomenclatural differences that prevent a straightforward comparison of the two surveys, and misidentifications are always possible, but it is clear that they record 13 native plant species not found during the present survey. These include 4 ferns (Doryopteris decipiens, Elaphoglossum sp., Microlepia setosa, and Pteridium aquilinum) and 9 flowering plants (Carex wahuensis, Styphelia tameiamaieae, Phyllanthus sandwicensis, Plectranthus parviflorus, Erythrina sandwicensis, Mucuna gigantea, Sida fallax, Metrosideros collina, and Peperomia leptostachya). Most of these discrepancies may be attributable to the absence of suitable habitat within the present surveyed area, and others to random distributions and probabilities of being encountered in any given survey. The quarry survey evidently included more distinctive habitats than the present survey. If the present survey were extended to include the "Limited subzone" along the ridgeline, it is expected that 9 of the 13 missing species might be found. Since that portion is to be excluded from development, their presence or absence there is not considered significant to this project.

SURVEY METHODS

A walk-through method was used for this survey. Access to much of the interior of the site was difficult, but facilitated by the presence of a badly eroded four-wheel track that climbed a side ridge from Quarry Road to the summit area near the center of the site. Plants were identified on sight. The few that could not be immediately recognized were brought back for comparison with the standard literature. Taxonomy and nomenclature of the ferns is that of Wagner and Wagner (1987), while flowering plants generally follow Wagner, et al. (in press).

DESCRIPTION OF THE VEGETATION

The basic vegetation type was low- to high-stature scrub, grading on the one hand to small patches of grass (mostly broomsedge, Andropogon virginicus, and golden beard grass, Chrysopogon aciculatus) on steep ridges, and on the other to tall-canopy trees in the gulches and low, flat areas. Component species of the scrub were the same throughout the site; variation in scrub stature seemed to be determined largely by the relative proportions of each component. In low-stature scrub, generally 6 feet tall or less, koa-haole (Leucaena leucocephala) and guava (Psidium guajava) predominated, with somewhat lesser amounts of Christmasberry (Schinus terebinthifolius). Javaplum (Syzygium cumini), somewhat taller, occurred as scattered individuals. Cassia (Senna pendula), noni (Morinda citrifolia), and Lantana camara were common but not major components of the shrub layer.

Beneath the scrub was a very rich herb layer. The predominant grasses were broomsedge, golden beard grass, molasses grass (Melinis minutiflora), Natal redtop (Rhynchelytrum repens), Glenwood grass (Sacciolepis indica), and foxtail (Setaria gracilis). Philippine ground orchid (Spathoglottis plicata) was common where the scub was more open. Other characteristic herbs were Spanish needle (Bidens alba and pilosa), horseweed (Conyza bonariensis), Emilia fosbergii, ironweed (Vernonia cinerea), air plant (Kalanchoe pinnata), partridge pea (Chamaecrista nictitans), rattlepod (Crotalaria pallida), beggar's ticks (Desmodium incanum and tortuosum), sleepinggrass (Mimosa pudica), Koster's curse (Clidemia hirta), 'uhaloa (Waltheria indica), Asiatic pennywort (Centella asiatica), and Stachytarpheta species.

At the higher elevations, remnant native vegetation was found among the low-stature scrub. Native species included ko'oko'olau (Bidens sandvicensis), huehue (Cocculus trilobus), u'ulei (Osteomeles anthyllidifolia), and 'akia (Wikstroemia oahuensis). Also at the higher elevations were small individuals of Formosan koa (Acacia confusa), a common low-elevetion forestry planting. There is little or no evidence that the site was ever intentionally reforested.

Wherever there were soil banks too steep to maintain dense vegetation, ferns and fern allies could be found: Pellaea viridis, gold fern (Pityrogramma austroamericana), silver fern (Pityrogramma calomelanos), and their natural hybrid (electrum fern, Pityrogramma "mckenneyi"), Blechnum occidentale, sword fern (Nephrolepis multiflora), wood fern (Thelypteris dentata and parasitica), pala'a (Odontosoria chinensis), and moa (Psilotum nudum). Lau'ae (Phymatosorus scolopendria) was found on the ground as well as on tree branches in the gulches.

Tall scrub differed from short scrub both in height and species richness. Christmasberry and Javaplum, somewhat taller than koa-haole, predominated. Guava, octopus tree (Schefflera actinophylla), fiddlewood (Citharexylum spinosum) and lantana were also very common. These last three species were more numerous in tall scrub than in short scrub, where they were very minor components. Grass was generally California grass (Brachiaria mutica) or molasses grass, to the exclusion of almost all else. A number of physical differences might account for the differentiation into tall- and low-stature scrub. The most likely is availability of soil moisture. The scrub becomes lower to the seaward, and taller to the landward. Rainfall gradient, protection from exposure to sun and wind, or soil-differences might be involved. Former burning may also be a factor. The patches of broomsedge on the exposed ridges, as well as its presence among the short scrub suggest burning in the past. Broomsedge is a fire-adapted plant, quickly colonizing after a burn, but not able to maintain itself without periodic reburning.

In the gulch bottoms, and other low, level areas, larger stature trees have overgrown the scrub vegetation. These trees are mostly monkey pod (Samanea saman), Javaplum, African tulip (Spathodea campanulata), Chinese banyan (Ficus microcarpa), mango (Mangifera indica), and kukui (Aleurites moluccana). Of lower stature and generally peripheral to the large trees at their upper reaches in the gulches were dense tangles of hau (Hibiscus tiliaceus). Koa haole and Christmasberry were the major understory plants beneath the large trees, and generally the vegetation was very open in the dense shade. Ground cover was composed of dayflower (Commelina diffusa), wandering jew (Zebrina

pendula), basket grass (Oplismenus hirtellus), Chinese violet (Asystasia gangetica), Dicliptera chinensis, Ruellia prostrata, and Wedelia trilobata. In several places the presence of ornamental plants suggested former habitation. In addition to the wandering jew and wedelia already mentioned, these included taro vine (Epipremnum pinnatum), Syngonium podophyllum, banana (Musa X paradisiaca), coconut (Cocos nucifera), Heliconia species, kamani (Calophyllum inophyllum), and Erythrina variegata).

Throughout the site vines were a conspicuous part of the vegetation: taro vine, syngonium, morning-glories (Ipomoea species), Coccinea grandis, bittermelon (Momordica charantia), Caesalpinia bonduc, maunaloa (Canavalia cathartica), huehue, passion flowers (Passiflora species), and maile pilau (Paederia scandens).

One artificial feature on the site should be mentioned. Along Kalanianaole Highway, there is a short piece of hillside that, by local tradition, has been called Christmas Tree Hill. Apparently, residents have been planting their living Christmas trees (Araucaria heterophylla) in this place after the Holiday season has passed. At least some of the trees have been seen bearing ornaments.

THREATENED AND ENDANGERED SPECIES

No listed, proposed, or candidate threatened and endangered species, as designated by the Federal and/or State governments (U.S. Fish and Wildlife Service, 1985; Herbst, 1987) were found on the site. There were no intact native plant communities in or adjacent to the study site, which might be adversely affected by development. However, the remnants of native vegetation at the upper elevations might be worth saving. For the most part, though, they are on land too steep and highly dissected to be amenable to easy development. No trees listed in the Register of Exceptional Trees were found on the site (see Appendix).

RECOMMENDATIONS

There is little of botanical interest on the project site, as most of the area is dominated by introduced species, and certain portions appear to have been disturbed at one time or another. The proposed golf course development is not expected to have a significant impact on the total island populations of the species involved. The native species (both endemic and indigenous) are found in similar environmental conditions throughout the islands. Where feasible, it might be desirable to landscape with native plants that are adapted to the local climatic conditions. 'Akia is already found on the site, and is both tough and decorative. A number of others could also be proposed if the developer is interested. Similarly, large trees (such as monkey pods) in the gulch areas would be of great landscape value. It is recommended that they be incorporated into the landscape plans, wherever possible.

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SPECIES LIST

A list of all the vascular plants found on the site follows. Plants are organized in four groups -- ferns and fern allies, gymnosperms, monocots, and dicots. Within each group, they are further arranged in alphabetical order by family and genus. For each species, an accepted common name is given. The Hawaiian name is given for all native plants if known, and for those exotic plants that are generally known by a Hawaiian name. Biogeographic status is indicated by a letter code. An explanation of abbreviations used (other than author citations) is given below.

SCIENTIFIC NAME

sp. - correct species name not determined

STATUS

E - endemic, native only to the Hawaiian Islands

I - indigenous, considered native to the Hawaiian Islands, but also found elsewhere.

P - Polynesian, not considered native, but thought to have been introduced by the Polynesians prior to 1778

X - exotic, not native, introduced after 1778

SPECIES LIST

SCIENTIFIC NAME	COMMON NAME	BIOGEOGRAPHIC STATUS
FERNS AND FERN ALLIES		
Adiantaceae		
Pellaea viridis (Forsk.) Prantl	pellaea	X
Pityrogramma austroamericana Domin	gold fern	X
Pityrogramma calomelanos (L.) Link	silver fern	X
Pityrogramma X "mckenneyi"	electrum fern	X
Aspleniaceae		
Blechnum occidentale L.	blechnum	X
Nephrolepis multiflora (Roxb.) Jarret ex Morton	sword fern	X
Thelypteris dentata (Forsk.) E. St. John	wood fern	X
Thelypteris parasitica (L.) Iwats.	wood fern	X
Cyatheaceae		
Odontosoria chinensis (L.) J. Sm.	pala'a	I
Polypodiaceae		
Phymatosorus scolopendria (Burm.) Pichi Sermolli	lau'ae	X
Pleopeltis thunbergiana Kaulf.	pakahakaha	E
Psilotaceae		
Psilotum nudum L.	moa	I

SCIENTIFIC NAME	COMMON NAME	STATUS
GYMNOSPERMS		
Araucariaceae		
Araucaria heterophylla (Salisb.) Franco	Norfolk Island Pine	X
FLOWERING PLANTS		
MONOCOTS		
Araceae		
Epipremnum pinnatum (L.) Engl.	taro vine	X
Syngonium podophyllum Schott	syngonium	X
Commelinaceae		
Commelina diffusa N.L. Burm	dayflower	X
Zebrina pendula Schnitzl.	wandering jew	X
Cyperaceae		
Fimbristylis dichotoma (L.) Vahl	fimbristylis	I
Pycreus polystachyos (Rottb.) Beauv.	pycreus	I
Gramineae		
Andropogon virginicus L.	broomsedge	X
Brachiaria mutica (Forsk.) Stapf	California grass	X
Chloris barbata (L.) Sw.	finger grass	X
Chloris divaricata R. Br.	star grass	X
Chrysopogon aciculatus (Retz.) Trin.	golden beard grass	X
Cynodon dactylon (L.) Pers.	Bermuda grass	X
Digitaria insularis (L.) Mez ex Ekman	sour grass	X

SCIENTIFIC NAME	COMMON NAME	STATUS
Digitaria ciliaris (Retz.) Koeler	Henry's crab grass	X
Digitaria violascens Link	crab grass	X
Echinochloa colonum (L.) Link	jungle rice	X
Eleusine indica (L.) Gaertn.	goose grass	X
Eragrostis tenella (L.) Beauv. ex R. & S.	Japanese love-grass	X
Melinis minutiflora Beauv.	molasses grass	X
Oplismenus compositus (L.) Beauv.	basket grass	X
Oplismenus hirtellus (L.) Beauv.	basket grass	X
Panicum maximum Jacq.	Guinea grass	X
Paspalum conjugatum Berg.	Hilo grass	X
Paspalum scrobiculatum L.	rice grass	X
Pennisetum purpureum Schumach.	elephant grass	X
Rhynchelytrum repens (Willd.) C. E. Hubb.	Natal redtop	X
Saccharum cf. *spontaneum* L.	wild sugar cane	X
Sacciolepis indica (L.) Chase	Glenwood grass	X
Setaria gracilis Kunth. in Humb. & Bonpl.	foxtail	X
Setaria verticillata (L.) Beauv.	bristly foxtail	X
Sorghum halepense (L.) Pers.	Johnson grass	X
Sporobolus sp.	dropseed	X
Musaceae		
Musa X *paradisiaca* L.	banana, mai'a	P
Orchidaceae		
Spathoglottis plicata Bl.	Philippine ground orchid	X

SCIENTIFIC NAME	COMMON NAME	STATUS
Palmae		
Cocos nucifera L.	coconut, niu	P
Strelitziaceae		
Heliconia sp.	heliconia, lobster claws	X
DICOTS		
Acanthaceae		
Asystasia gangetica (L.) T. Anders.	Chinese violet, asystasia	X
Dicliptera chinensis (L.) Juss.	dicliptera	X
Ruellia prostrata Poir.	ruellia	X
Amaranthaceae		
Amaranthus spinosus L.	spiny pigweed	X
Amaranthus viridus L.	amaranthus	X
Anacardiaceae		
Mangifera indica L.	mango	X
Schinus terebinthifolius Raddi	Christmasberry	X
Araliaceae		
Schefflera actinophylla (Endl.) Harms	octopus tree	X
Bignoniaceae		
Spathodea campanulata Beauv.	African tulip tree	X

SCIENTIFIC NAME	COMMON NAME	STATUS
Caricaceae		
Carica papaya L.	papaya	X
Casuarinaceae		
Casuarina equisetifolia Stickm.	ironwood	X
Compositae		
Ageratina riparia (Rege.) King & Robinson	Hamakua pamakani	X
Ageratum conyzoides L.	ageratum	X
Bidens alba (L.) DC.	Spanish needle	X
Bidens pilosa L.	Spanish needle	X
Bidens sandvicensis Less.	ko'oko'olau	E
Conyza bonariensis (L.) Cronquist	hairy horseweed	X
Emilia fosbergii D. H. Nicolson	red-flowered emilia	X
Emilia sonchifolia (L.) DC.	purple-flowered emilia	X
Flaveria trinervia (Spreng.) C. Mohr	flaveria	X
Pluchea indica (L.) Less.	pluchea	X
Pluchea symphytifolia (Miller) Gillis	pluchea	X
Sonchus oleraceus L.	sowthistle	X
Synedrella nodiflora (L.) Gaertn.	synedrella	X
Tridax procumbens L.	coatbuttons	X
Vernonia cinerea (L.) Less.	ironweed	X
Wedelia trilobata (L.) Hitchc.	wedelia	X

SCIENTIFIC NAME	COMMON NAME	STATUS
Convolvulaceae		
Ipomoea indica (Burm.) Merr.	koali-'awahia	I
Ipomoea obscura (L.) Ker-Gawl.	yellow bindweed	X
Ipomoea triloba L.	pink bindweed	X
Crassulaceae		
Kalanchoe pinnata (Lam.) Pers.	air plant, bryophyllum	X
Cucurbitaceae		
Coccinea grandis (L.) Voigt	coccinea	X
Momordica charantia L.	bittermelon	X
Euphorbiaceae		
Aleurites moluccana (L.) Willd.	kukui	P
Chamaesyce hirta (L.) Millsp.	hairy spurge	X
Chamaesyce hypericifolia (L.) Millsp.	spurge	X
Chamaesyce prostrata (Ait.) Sm.	spurge	X
Phyllanthus debilis Klein ex Willd.	phyllanthus	X
Ricinus communis L.	castorbean	X
Guttiferae		
Calophyllum inophyllum L.	kamani	P
Clusia rosea Jacq.	autograph tree, fat-pork tree	X
Labiatae		
Hyptis pectinata (L.) Poit.	comb hyptis	X

SCIENTIFIC NAME	COMMON NAME	STATUS
Leguminosae		
Acacia confusa Merr.	Formosan koa	X
Alysicarpus vaginalis (L.) DC.	alysicarpus	X
Caesalpinia cf. bonduc (L.) Roxb.	caesalpinia	X
Cajanus cajan (L.) Millsp.	gundule bean	X
Canavalia cathartica Thouars	maunaloa	X
Chamaecrista nictitans (L.) Moench.	partridge pea, lau-ki	X
Crotalaria pallida Aiton	rattlepod	X
Desmanthus virgatus (L.) Willd.	desmanthus	X
Desmodium incanum DC.	beggars' ticks	X
Desmodium tortuosum (Sw.) DC.	beggars' ticks	X
Desmodium triflorum (L.) DC.	beggarweed	X
Desmodium sandwicense E. Mey.	beggars' ticks	X
Erythrina variegata Stickm.	erythrina, wiliwili haole	X
Indigofera spicata Forssk.	prostrate indigo	X
Leucaena leucocephala (Lam.) deWit	koa-haole	X
Macroptilium atropurpureum (DC.) Urb.	wild bush-bean	X
Macroptilium lathyroides (L.) Urb.	wild bush-bean	X
Mimosa pudica L.	sleepinggrass	X
Samanea saman (Jacq.) Merr.	monkey pod	X
Senna pendula (Humb. & Bonpl. ex Willd.) Irwin & Barneby	cassia	X

SCIENTIFIC NAME	COMMON NAME	STATUS
Malvaceae		
Abutilon grandifolium (Willd.) Sweet	abutilon	X
Hibiscus tiliaceus L.	hau	I
Malvastrum coromandelianum (L.) Garcke	malvastrum	X
Sida spinosa L.	sida	X
Melastomataceae		
Clidemia hirta (L.) D. Don	clidemia, Koster's curse	X
Meliaceae		
Melia azedarach L.	Chinaberry	X
Menispermaceae		
Cocculus trilobus (Thunb.) DC.	huehue	I
Moraceae		
Ficus microcarpa L. f.	Chinese banyan	X
Myrtaceae		
Psidium guajava L.	guava	X
Syzygium cumini (L.) Skeels	Javaplum	X
Oxalidaceae		
Oxalis corniculata L.	yellow wood-sorrel	I?

SCIENTIFIC NAME	COMMON NAME	STATUS
Passifloraceae		
Passiflora edulis Sims	passion fruit, liliko'i	X
Passiflora foetida L.	love-in-a-mist	X
Passiflora suberosa L.	passiflora	X
Passiflora subpeltata Ortega	white passion flower	X
Portulacaceae		
Portulaca oleracea L.	common purslane	X
Proteaceae		
Grevillea robusta A. Cunningh. in R. Br.	silkoak	X
Rosaceae		
Osteomeles anthyllidifolia Lindl.	u'ulei	E
Rubiaceae		
Morinda citrifolia L.	noni	P
Paederia scandens (Lour.) Merr.	maile pilau	X
Spermacoce laevis Lam.	borreria	X
Solanaceae		
Solanum americanum Mill.	popolo	I?
Sterculiaceae		
Waltheria indica L. var. *americana* (L.) R. Br. ex Hosaka	'uhaloa, hi'aloa	I?

SCIENTIFIC NAME	COMMON NAME	STATUS
Thymelaeaceae		
Wikstroemia oahuensis (Gray) Rock	'akia	E
Tiliaceae		
Triumfetta semitriloba Jacq.	Sacramento bur	X
Umbelliferae		
Centella asiatica (L.) Urban	Asiatic pennywort	X
Verbenaceae		
Citharexylum spinosum L.	fiddlewood	X
Lantana camara L.	lantana	X
Stachytarpheta dichotoma (Ruiz & Pavon) Vahl	stachytarpheta	X
Stachytarpheta jamaicensis (L.) Vahl	stachytarpheta	X
Stachytarpheta urticifolia (Salisb.) Sims	stachytarpheta	X

APPENDIX

EXCEPTIONAL TREES ORDINANCE

ORDINANCE NO. (GW) 78-91 BILL NO. 85 (1978)
(Draft No. 2)

A BILL FOR AN ORDINANCE TO AMEND THE REVISED ORDINANCES OF HONOLULU 1969, AS AMENDED, BY ADDING A NEW ARTICLE TO CHAPTER 13 RELATING TO EXCEPTIONAL TREES.

BE IT ORDAINED by the People of the City and County of Honolulu:

SECTION 1. The Revised Ordinances of Honolulu 1969, as amended, is hereby further amended by adding thereto a new Article to Chapter 13 to read as follows; further, the Corporation Counsel is authorized to add the appropriate numbers when codifying the R.O. 1969:

"Article _____

PROTECTIVE REGULATIONS FOR EXCEPTIONAL TREES

_____.1. Declaration of Legislative Intent.

The Council of the City and County of Honolulu desires to provide for better environmental control in order to improve the quality of life of its citizens by enacting protective regulations to safeguard exceptional trees. The purpose of this Article is to preserve exceptional trees within the City and County of Honolulu. The Council finds that not only are trees of value for their beauty, but that they perform an important ecological function in that they prevent soil erosion, purify the air, as well as retard flooding. The Council also finds that inasmuch as trees contribute to the beauty of the island, they are an important element in achieving the objectives of the New General Plan "to protect and preserve the natural environment of Oahu" and "to maintain the viability of Oahu's resort industry."

In the belief that protective regulations to safeguard exceptional trees will promote the health, safety and general welfare of the citizens of the City and County of Honolulu, the City Council enacts this ordinance as a means of preserving the environmental character of the City and County within the provisions of Act 105, Session Laws of Hawaii, 1975. The terms of this Article shall be liberally construed to effectuate the purpose stated herein.

_____.2. Definitions.

The term "exceptional trees," for the purposes of this Article, means a tree or grove of trees with historic or cultural value, or which by reason of its age, rarity, location, size, esthetic quality, or endemic status has been designated by the City Council as worthy of preservation.

_____.3. Arborist Advisory Committee.

There shall be an Arborist Advisory Committee consisting of five members who shall be appointed by the Mayor. The Committee shall include the Director of the Department of Land Utilization, or his designee; one member who shall be actively employed in the practice of landscape architecture, and three other members selected on the bases of active participation in programs of community beautification, or research or organization in the ecological sciences, including ethnobotany or Hawaiiana. The Committee shall be attached to the Department of Parks and Recreation for administrative purposes and the Director shall cause employees of his office to furnish such technical, administrative or clerical services as may be needed by the Committee.

_____.4. Powers and Duties.

The Arborist Advisory Committee shall have the following powers and duties:

(1) To research, prepare, and recommend to the City Council exceptional trees to be protected by city ordinance or regulation.

(2) To advise property owners relative to the preservation and enhancement of exceptional trees.

(3) To recommend to the City Council appropriate protective ordinances, regulations, and procedures.

(4) To review all actions deemed by the City Council to endanger exceptional trees.

_____.5. Procedures.

(1) Any citizen or citizen group may petition the Arborist Advisory Committee to examine a particular tree or grove of trees for the purpose of having it recommended to the City Council for designation as an exceptional tree.

(2) The Arborist Advisory Committee, on at least an annual basis, shall re-examine the exceptional trees and in the event such tree is found to be dangerous or diseased beyond repair, the Council, upon recommendation from the Committee, may remove such tree from the register.

(3) Upon designation by the Council of an exceptional tree, the City Clerk shall notify the property owner and/or the occupant of the property by registered mail that such a designation has been made.

(OCS/092578/CA)

_____.6. Enforcing Authority.

The Building Department, the Department of Land Utilization, and the Department of Public Works shall be charged with the enforcement of this ordinance and shall be clothed with police power to do all acts necessary to ensure that the provisions of this ordinance are not violated including, but not limited to, the issuance of citations for the violation of any provisions of this ordinance. The provisions of this ordinance shall not be superseded by any permit issued by any county agency under any other ordinance.

_____.7. Register of Exceptional Trees.

The following are hereby designated "exceptional trees":

*(1) Adansonia digitata, Baobab (Queen's Medical Center, 1301 Punchbowl Street, TMK: 2-1-35:3).

(2) Adansonia digitata, Baobab (Ala Moana Park, TMK: 2-3-37:1).

*(3) Agathis robusta, Australian Kauri, Queensland Kauri (Foster Botanic Garden, 180 North Vineyard Boulevard, TMK: 1-7-07:2).

(4) Agathis robusta F. Muell., Kauri (Harold L. Lyon Arboretum, 3860 Manoa Road, TMK: 2-9-55:6).

(5) Anacardium occidentale, Cashew Nut (Castle Ranch, 1385 Maunawili Rd., TMK: 4-2-09:1).

(6) Araucaria bidwillii, Bunya-bunya or Monkey Puzzle Tree (Castle Ranch, 1385 Maunawili Road, TMK: 4-2-09:1).

(7) Araucaria cunninghamii Sweet, Hoop Pine (Harold L. Lyon Arboretum, TMK: 2-9-55:6).

*(8) Araucaria cunninghamii, Hoop Pine (Foster Botanic Garden, TMK: 1-7-07:2).

(9) Araucaria excelsa, Norfolk Island Pine (Castle Ranch, 1385 Maunawili Road, TMK: 4-2-01:1).

(10) Arecastrum romanzoffianum, Queens Palm, Monkey Nut (10 in a row) (1071 Young Street, TMK: 2-4-02:27, 3).

(11) Artocarpus incisus, Breadfruit, 'Ulu (Castle Ranch, 1385 Maunawili Road, TMK: 4-2-09:1).

(12) Bertholletia excelsa, Brazil Nut (2616 Pali Highway, TMK: 1-8-08:1).

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* "Champion Trees of Hawaii," in American Forests, May 1974.

(OCS/092578/CA)

*(13) Bombax malabaricum, Red Silk Cotton, Simal Tree (Salmalia malabarica) (Queen's Medical Center, TMK: 2-1-35:3).

(14) Bucida Buceras, Jucaro (Ala Moana Park, TMK: 2-3-37:1).

*(15) Bumelia buxifolia, Ironwood (Foster Botanic Garden, TMK: 1-7-07:2).

(16) Calophyllum inophyllum, Kamani Tree, True Kamani, Alexandrian Laurel (Kualoa Regional Park--corner near Fishpond, makai of Kamehameha Highway, TMK: 4-9-04:1).

*(17) Canarium commune, Pili Nut, Java almond (Foster Botanic Garden, TMK: 1-7-07:2).

(18) Caryota cumingii Loddiges ex Martius, Fishtail Palm (Harold L. Lyon Arboretum, TMK: 2-9-55:6).

*(19) Caryota urens, Wine Palm, Toddy Palm (Wahiawa Botanic Garden, 1396 California Street, TMK: 7-4-17:1).

(20) Casuarina equisetifolia, Ironwood, Australian Pine (along Kalakaua Avenue from Kapahulu Avenue to Poni Moi Road, TMK: 3-1-43:1).

*(21) Catalpa longissima, Yoke Wood, Haiti catalpa (Foster Botanic Garden, TMK: 1-7-07:2).

*(22) Cavanillesia platanifolia, Quipo (Foster Botanic Garden, TMK: 1-7-07:2).

*(23) Cecropia obtusifolia, Trumpet Tree, Guarumo (Paradise Park, 3737 Manoa Road, TMK: 2-9-54:18).

(24) Ceiba pentandra, Kapok Tree (ground of State Department of Agriculture, 1428 South King Street, TMK: 2-4-5:18).

(25) Ceiba pentandra, Kapok Tree, Silk Cotton Tree (2 trees) (Foster Botanic Garden, TMK: 1-7-07:2).

*(26) Couroupita guianensis, Cannonball Tree (Foster Botanic Garden, TMK: 1-7-07:2).

(27) Couroupita guianensis Aubl., Cannonball Tree (University of Hawaii/Manoa Campus, next to parking lot, makai side of Sinclair Library, TMK: 2-8-23:3).

(28) Cyrtostachys lakka Beccari, Sealing Wax Palm (Harold L. Lyon Arboretum, TMK: 2-9-55:6).

*(29) Delonix regia, Royal Poinciana (Castle Ranch, 1385 Maunawili Road, TMK: 4-2-09).

(30) Elaedodendron orientale, False Olive (Foster Botanic Garden, TMK: 1-7-07:2).

(31) Enterolobium cyclocarpum, Earpod (Honolulu Zoo, 151 Kapahulu Avenue, TMK: 3-1-43:1).

(32) Enterolobium cyclocarpum, Earpod Tree (Board of Water Supply--Makiki Pumping Station, TMK: 2-5-20:1).

*(33) Enterolobium cyclocarpum, Earpod, Elephant's Ear (Foster Botanic Garden, TMK: 1-7-07:2).

(34) Enterolobium cyclocarpum, Earpod, Elephant's Ear (Grounds of State Department of Agriculture, 1428 S. King Street, TMK: 2-4-5:18).

(35) Enterolobium cyclocarpum, Earpod Tree (Waialua, TMK: 6-7-01: -).

(36) Erythrina sandwicensis, Wili-wili (Foster Botanic Garden at Koko Head Crater, TMK: 3-9-12:1).

*(37) Eucalyptus deglupta, Mindanao Gum, Bagras Eucalyptus (Wahiawa Botanic Garden, 1396 California Avenue, TMK: 7-4-17:1).

(38) Eugenia malaccensis, Mountain Apple (Castle Ranch, 1385 Maunawili Road, TMK: 4-2-09:1).

(39) Ficus, Banyan (Ala Moana Park, TMK: 2-3-37:1).

(40) Ficus benghalensis, Indian Banyan, Vada Tree (Iolani Palace Grounds, TMK: 2-1-25:2).

(41) Ficus benghalensis, Indian Banyan (Moana Hotel Courtyard, 2365 Kalakaua Avenue, TMK: 2-6-1:12).

(42) Ficus benghalensis, Indian Banyan (two beside the Judiciary Building, TMK: 2-1-25:3).

(43) Ficus benghalensis, Indian Banyan (Parking lot Walina Street, The Food Pantry Ltd., 2370 Kuhio Avenue, TMK: 2-6-21:100).

(44) Ficus elastica Roxb. ex Hornem., Indian rubber tree (University of Hawaii/Manoa campus, next to Campus Way, mauka side of Sinclair Library, TMK: 2-8-23:3).

(45) Ficus macrophylla, Moreton Bay Fig (Waikiki end of Queen Emma Square by St. Andrew's Priory School, 224 Queen Emma Square, TMK: 2-1-18:02).

*(46) Ficus religiosa, Bo Tree, Peepul Tree (Moanalua Gardens Foundation Inc., 1352 Pineapple Place, TMK: 1-1-9:4).

(47) Ficus religiosa, Bo Tree, Peepul Tree, Sacred Tree (2616 Pali Highway, TMK: 1-8-08:1).

(48) Ficus religiosa L., Bo Tree, Peepul Tree, Sacred Tree (University of Hawaii/Manoa campus, mauka end of Hawaii Hall, TMK: 2-8-23:3).

(49) Ficus religiosa, Bo Tree (Foster Botanic Garden, TMK: 1-7-07:2).

(50) Garcinia mangostana, Mangosteen (3 in grove) (Castle Ranch, 1385 Maunawili Road, TMK: 4-2-09:1).

*(51) Guazuma Tomentosa, Guacima (South King Street).

(52) Hernandia ovigera Slickm., Jack-in-a-box fruit tree (University of Hawaii/Manoa campus, mauka-ewa side of Sinclair Library, TMK: 2-8-23:3).

*(53) Hyphaena thebaica, Doumpalm Gingerbread Palm (Foster Botanic Garden, TMK: 1-7-07:2).

(54) Kigelia pinnata, Sausage Tree (1071 Young Street, TMK: 2-4-02:27, 3).

(55) Kigelia Pinnata, Sausage Tree (James W. Tharp, 115 Kuukama Street, Kailua, TMK: 4-3-14:07).

*(56) Lagerstroemia speciosa, Queen Flower, Crepe Myrtle (Foster Botanic Garden, TMK: 1-7-07:2).

(57) Litchi chinensis, Litchi, Lychee (2616 Pali Highway, TMK: 1-8-08:1).

(58) Litchi chinensis, Litchi Nut, Lychee (Castle Ranch, 1385 Maunawili Rd., TMK: 4-2-09:1).

*(59) Lonchocarpus domingensis, Guama, Genogeno (Foster Botanic Garden, TMK: 1-7-07:2).

(60) Macadamia integrifolia, Macadamia Nut Tree, Queensland Nut (2616 Pali Highway, TMK: 1-8-08:1).

*(61) Mammea americana, Mammee apple (Department of Agriculture, 1428 S. King Street, TMK: 2-4-5:18).

(62) Mangifera indica, Mango (pirie) (2616 Pali Highway, TMK: 1-8-08:1).

(63) Manilkara zapota syn. Achras zapota, Chicle Tree (2616 Pali Highway, TMK: 1-8-08:1).

(64) Manilkara zapota syn. Achras zapota (two trees) (1071 Young Street, TMK: 2-4-02:27, 3).

*(65) Manilkara zapota syn. Achras zapota, Chicle (Foster Botanic Garden, TMK: 1-7-07:2).

(66) Manilkara zapota syn. Achras zapota, Chicle Tree (Judiciary Building Ewa Courtyard, TMK: 2-1-25:3).

(67) Metroxylon carolinensis, Ivory Nut Palm (grove of five) (Castle Ranch, 1385 Maunawili Road, TMK: 4-2-09:1).

*(68) Mimusops elengi, Pogada, Elengi Madras Gum Tree (Foster Botanic Garden, TMK: 1-7-07:2).

(69) Pandanus odoratissimus, Red Hala Pandanus (Swanzy Beach Park, TMK: 5-1-12:11).

*(70) Peltophorum inerme, Yellow Poinciana (Queen's Medical Center, TMK: 2-1-35:3).

(71) Phyllanthus emblica, Indian Gooseberry, Emblic, Myrobalan (2616 Pali Highway, TMK: 1-8-08:1).

(72) Pithecellobium dulce, Opiuma, Madras Thorn, Manila Tamarind (Fernhurst YWCA--1566 Wilder Avenue, TMK: 2-4-23:87).

(73) Pritchardia macrocarpa, Dwarf Loulu Palm (Foster Botanic Garden, TMK: 1-7-07:2).

(74) Prosopis pallida, Kiawe, Algaroba, Mesquite (1071 Young Street, TMK: 2-4-02:27, 3).

(75) Psidium cattleianum f. lucidium, Waiawi, Yellow Guava, Yellow Cattley (2616 Pali Highway, TMK: 1-8-08:1).

(76) Pterocarpus indicus, Narra (Tantalus Drive--on curve near #3665, TMK: 2-5-12:06)..

(77) Roystonea aleracea (Jacq.) O. F. Cook, South American Royal Palm (Harold L. Lyon Arboretum, TMK: 2-9-55:6).

*(78) Roystonea oleracea, Cabbage Palm (Foster Botanic Garden, TMK: 1-7-07:2).

(79) Roystonea regia, Royal Palm (Both sides of Royal Palm Drive, Wahiawa, TMK: 7-5-6:17, 18, 19, 20).

(80) Roystonea regia, Royal Palm (30 line old carriage road) (Castle Ranch, 1385 Maunawili Road, TMK: 4-2-09:1).

(81) Samanea saman, Monkeypod Tree, Rain Tree, Ohai (Borthwick, 420 Wyllie Street, TMK: 1-8-6:07).

(82) Samanea saman, Monkeypod Tree (Central Union Church--courtyard Atherton Chapel, 1660 South Beretania St., TMK: 2-8-11:02).

(83) Samanea saman, Monkeypod Tree (Along Paki Avenue, Kapahulu to Monsarrat, TMK: 3-1-43: ___).

(84) Samanea saman, Monkeypod Trees (Moanalua Gardens Foundation, Inc., 1352 Pineapple Place, TMK: 1-1-9:4).

(85) Sapindus saponaria, Soapherry (Ala Moana Park, TMK: 2-3-37:1).

*(86) Spondias mombin, Hog Plum (Foster Botanic Garden, TMK: 1-7-07:2).

(87) Sterculia apetala, Panama (Ala Moana Park, TMK: 2-3-37:1).

(88) Sterculia foetida L., Skunk tree, Java olives, kelumpang, bangar (University of Hawaii/Manoa campus, ewa-makai corner of George Hall, TMK: 2-8-23:3).

*(89) Sterculia urens, Nawa (Queen's Medical Center, TMK: 2-1-35:3).

(90) Swietenia mahagoni, Mahogany Tree (Along Kalakaua between Beretania and Kapiolani Sts.).

(91) Swietenia mahagoni, Mahogany Tree (2616 Pali Highway, TMK: 1-8-08:1).

(92) Tamarindus indica, Tamarind (two trees) (1071 Young St., TMK: 2-4-02:27, 3).

(93) Tamarindus indica, Tamarind (Judiciary Building Ewa Courtyard, TMK: 2-1-25:3).

(94) Terminalia catappa, False Kamani, Tropical Almond (Foster Botanic Garden, TMK: 1-7-07:2).

(95) Thespesia populnea, Milo, Portia Tree (2616 Pali Highway, TMK: 1-8-08:1).

_____.8. Violation and Penalty.

It shall be unlawful for any person, corporation, public agency or other entity to remove or otherwise destroy any tree in the City and County of Honolulu which has been designated "exceptional" without approval from the City Council. Any person who violates this section shall be fined not more than $1,000.~~or imprisoned not more than ninety (90) days, or both.~~ (Am. 10/26/78)

_____.9. Injunctive Enforcement.

Any threatened violation of the provisions of this ordinance is hereby declared to be a public nuisance and may be abated through proceedings for injunctive relief or similar relief in Circuit Court or other court of competent jurisdiction.

_____.10. Severability.

If any section, paragraph, subsection, clause or phrase of this ordinance is for any reason held to be unconstitutional or invalid, such decision shall not affect the validity of the remaining portions of this ordinance.

_____.11. Appeals.

Any person or persons aggrieved by an action of the City Council may within thirty (30) days of such action file an appeal to the Circuit Court.

SECTION 2. Effective Date. This ordinance shall take effect upon its approval.

INTRODUCED BY:

Councilmembers

DATE OF INTRODUCTION:

August 9, 1978
Honolulu, Hawaii

APPROVED AS TO FORM AND LEGALITY:

Deputy Corporation Counsel

APPROVED this 9th day of November, 1978.

~~FRANK F. FASI, Mayor~~ Acting Mayor
City and County of Honolulu

(OCS/092578/CA)

78-91

(GW)
ORDINANCE NO. 81-32

BILL NO. 34 (1981)
(DRAFT NO. 3)

A BILL FOR AN ORDINANCE TO AMEND ARTICLE 13-36, REVISED ORDINANCES OF HONOLULU 1978, RELATING TO EXCEPTIONAL TREES.

BE IT ORDAINED by the People of the City and County of Honolulu.

SECTION 1. Section 13-36.1 Revised Ordinances of Honolulu, 1978, is hereby amended to read:

Section 13-36.1 Declaration Of Legislative Intent.
The Council of the City and County of Honolulu desires to provide for better environmental control in order to improve the quality of life of its citizens by enacting protective regulations to safeguard exceptional trees within the City and County of Honolulu. The Council finds that not only are trees of value for their beauty, but that they perform an important ecological function in that they prevent soil erosion, purify the air, as well as retard flooding. The Council also finds that inasmuch as trees contribute to the beauty of the island, they are an important element in achieving the objectives of the New General Plan "to protect and preserve the natural environment of Oahu" and "to maintain the viability of Oahu's resort industry."

<u>While the Council recognizes the limitations inherent in the enforcement of this ordinance on Federal and State property, exceptional trees located on such property are included herein, as a statement of this Council's firm resolve to protect those unique assets to our environment, wherever they might be located on Oahu. Further, it is hoped that this statement of resolve will encourage these Federal and State officials entrusted with the care of designated exceptional trees, to take appropriate steps for their protection.</u>

In the belief that protective regulations to safeguard exceptional trees will promote the health, safety and general welfare of the citizens of the City and County of Honolulu, the City Council enacts this ordinance as a means of preserving the environmental character of the City and County within the provisions of Act 105, Session Laws of Hawaii, 1975. The terms of this article shall be liberally construed to effectuate the purpose stated herein. (Am.Ord.78-91)

SECTION 2. Section 13-36.7.(66), Revised Ordinances of Honolulu 1978, is hereby amended to read:

"(66) [Manilkara zapota syn. Achras zapota, Chicle Tree] Agathis robusta, Australian Kauri, Queensland Kauri (Judiciary Building Ewa Courtyard, TMK: 2-1-25:3)."

SECTION 3. Section 13-36.7, Revised Ordinances of Honolulu 1978, is hereby amended by adding the following:

"(96) Hibiscus tiliaceous, Hau Tree (Hawaiian), (Halekulani Hotel, sea side of the dining room, TMK: 2-6-04: 8).

(97) Pseudobombax ellipticum, Pink Bombax (Queens Medical Center, front lawn, TMK: 2-1-35: 3).

(98) Canarium vulgare, Pili Nut Tree (two trees) (Washington Place, TMK: 2-1-18: 1).

(99) Kigelia pinnata, Sausage Tree (Coast Guard Station on Kalanianaole Highway, Aina Haina, TMK: 3-5-46: 13).

(100) Santalumfreycinetianum; Sandalwood Tree (behind Tripler Hospital, TMK: 1-1-12: 15).

(101) Samanea saman, Monkeypod Tree (Lanikai, TMK: 4-3-06: 102).

(102) Ficus benghalensis; Indian Banyan (Kuhio Beach Park, TMK: 2-6-01: 4)."

SECTION 4. Section 13-36.8, Revised Ordinances of Honolulu 1978, is hereby amended to read:

[13-36.8. Violation and Penalty.

It shall be unlawful for any person, corporation, public agency or other entity to remove or otherwise destroy any tree in the City and County of Honolulu which has been designated "exceptional" without approval from the City Council. Any person who violates this section shall be fined not more than $1,000.]

"13-36.8. Regulations

(a) Tree removal or destruction:

It shall be unlawful for any person, corporation, public agency or other entity to remove or otherwise destroy any tree in the City and County of Honolulu which has been designated "exceptional" without approval from the City Council.

(b) Tree maintenance:

1. It shall be unlawful for any person, corporation, public agency or other entity to alter the characteristic shape of any "exceptional" tree or remove any branch without first obtaining a permit issued by the Department of Parks and Recreation.

2. The Department of Parks and Recreation shall have the necessary powers to make Rules and Regulations, pursuant to Chapter 91 of the Hawaii Revised Statutes, to establish the criteria, standards, and conditions under which a permit may be issued."

SECTION 5. Section 13-36-9, Revised Ordinances of Honolulu 1978, is hereby amended to read:

[13-36.9. Injunctive Enforcement.

Any threatened violation of the provisions of this ordinance is hereby declared to be a public nuisance and may be abated through proceedings for injunctive relief or similar relief in Circuit Court or other court of competent jurisdiction.]

"13-36.9. Violation, Penalty and Injunctive Enforcement.

(a) Any person who violates Section 13-36.8 shall be subject to a fine of not more than $1,000.

(b) In addition, any threatened violation of the provisions of this Article, or of any Rule or Regulation promulgated pursuant to Section 13-36-8(b), is declared to be a public nuisance such proceedings for injunctive or other civil relief as may be necessary to carry out the intent of this Article."

SECTION 6. Material to be repealed is bracketed. New material is underscored. When revising, compiling, or printing this ordinance for inclusion in the Revised Ordinances of the City and County of Honolulu, the Corporation Counsel need not include the underscoring, the brackets, or the bracketed material.

(OCS/031281/VB)

81-32

SECTION 7. This Ordinance shall take effect upon its approval.

INTRODUCED BY:

Tom Nekota

Mufi Hannemann

Councilmembers

DATE OF INTRODUCTION:

MARCH 18, 1981

Honolulu, Hawaii

APPROVED AS TO FORM & LEGALITY:

Deputy Corporation Counsel

APPROVED this 5th day of May, 1981.

EILEEN R. ANDERSON, Mayor
City and County of Honolulu

81-32
A-34

(OCS/031281/VB)

Appendix B

APPENDIX B

TERRESTRIAL VERTEBRATE ANIMALS OF THE PROPOSED WINDWARD PARK, KAILUA

BY ANDREW J. BERGER

Terrestrial Vertebrate Animals of the Proposed Windward Park, Kailua, TMK 4-2-12: 2 & 4.

By Andrew J. Berger

This report was prepared at the request of Mrs Duk Hee Murabayashi (letter dated September 9, 1988, and telephone conversation September 22, 1988), President of DHM Inc., Honolulu. My field studies were conducted on September 23, 24, and 25. 1988.

The Habitat

The hilly project site is covered by a large number of introduced trees, shrubs. vines, and grasses, as well as by herbaceous plants. One of the most conspicuous of the dominant tree species is shower tree (Cassia sp.). Other exotic plants include the common ironwood (Casuarina equisettifolia), hau (Hibiscus tiliaceus), koa haole (Leucaena glauca), paperbark tree (Melaleuca leucadendron), guava (Psidium sp.), Christmas-berry tree (Schinus terebinthifolius), oleander (Nerium indicum), sensitive plant (Mimosa pudica), wedelia (Wedelia trilobata), and California grass (Brachiaria mutica).

There is no endemic ecosystem on or anywhere near the project site. Therefore, there are no endemic forest birds on or near the site.

Amphibians and Reptiles

There are no endemic amphibians or land reptiles in the Hawaiian Islands. All, therefore, have been introduced by man.

I. Amphibians

1. Giant Neotropical Toad (Bufo marinus). This toad was first introduced to the Hawaiian Islands in 1932 "when Dr. C. E. Pemberton brought 148 adult toads from Puerto Rico. Eighty of these were liberated in a taro patch near Waipio, Oahu, and 68 were released in a swampy part of Manoa Valley" (Oliver and Shaw, 1953:77). The toads were successful, and "in a little over two years more than 100,000 descendents of the original stock were distributed through Dr. Pemberton's activities throughout the islands." Hunsaker and Breese (1967) wrote that this toad was the "commonest species of amphibian" in Hawaii. The neotropical toad is found throughout the general area, but they must return to lower elevations where there is water for their breeding activities.

2. Gold and Black Poison Frog (Dendrobates auratus).

This frog was introduced to Oahu to "assist in the control of insect pests." Oliver and Shaw state that the species was released in upper Manoa Valley in 1932. Hunsaker and Breese (1967) wrote that "additional plantings with subsequent establishment have been made in Waiahole Valley, and the population has been observed to fluctuate in size at this locality again according to the amount of water available." McKeown (1978) said that this frog is found in well-foliated, moist valleys on both Leeward and Windward Oahu." He added that, in summer and fall, "these frogs spend their time in moist places such as under debris, logs, stones, tangled root systems or under elevated valley homes." I did not see any of these frogs and

I believe that the ridges are too dry to sustain a population of this frog.

3. American Bullfrog (Rana catesbeiana).

"This was probably one of the first species of amphibians to be introduced into the Hawaiian Islands and may have been one of the frogs that was imported prior to 1867" (Oliver and Shaw, 1953). The frogs were abundant enough to be harvested commercially by 1900. Tinker (1941) wrote that "the University of Hawaii has organized 'frog clubs' to encourage the production of frogs for food." The species is not nearly so common now, presumably because of the draining of so many wetland areas and, perhaps also, because of the widespread use of pesticides during recent decades. There is no habitat for this water dependent frog in the project area.

4. Wrinkled Frog (Rana rugosa)

This frog was introduced to Hawaii from Japan in 1896 (McKeown, 1978). It is most common in mountain streams, although Shallenberger (1977:245) found this species at Punahoolapa Pond on the north shore of Oahu. McKeown noted that the wrinkled frog and the bullfrog rarely are found together because the latter species is such an aggressive feeder. There is no subitable habitat for the wrinkled frog in the Project area.

II. Reptiles

1. Blind Snake (Typhlops braminus).

"This small, secretive snake was apparently introduced

from the Philippines in the dirt surrounding plants that were brought in for landscaping the campus of the Kamehameha Bpys School in Honolulu. It was first found there in January of 1930" (Oliver and Shaw, 1953). By 1967, Hunsaker and Breese wrote that "it now appears to occupy the lowland area over the entire island." These blind, worm-like snakes are rarely seen until they are flooded from their underground burrows by heavy rain or unless one looks for them under branches and other debris on the ground. I did not search for these snakes because they are of no significance for an impact assessment.

2. Skinks and Geckos. Eleven species of skinks (family Scincidae) and geckos (family Gekkonidae) occur on Oahu. All are foreign to the islands, all are insect eaters, and all adapt well to both urban and rural habitats. Their presence is irrelevant to an impact statement.

Birds

Three groups of birds are found in the Hawaiian Islands: 1. introduced or exotic, 2, indigenous, and 3. endemic. All of the birds found within the boundaries of the project site are introduced or alien birds.

I. Introduced Birds

More than 170 species of alien birds have been intentionally introduced to the Hawaiian Islands (Berger, 1981). I found the following species on the project site or on lands adjacent to it. I include birds seen "on lands adjacent" to the site for several reasons. First, the site is surrounded by areas of other land

uses; secondly, my studies were conducted on only three days in late September; and thirdly, some of the bird species seen adjacent to the project site visit it from time to time and will certainly move in when the golf course is built.

Family Ardeidae, Herons and Egrets

1. Cattle Egret (Bubulcus ibis).

This species was imported to Hawaii from Florida to aid "in the battle to control house flies, horn flies, and other flies that damage hides and cause lower weight gains in cattle" (Breese, 1959). A number of birds were released on Oahu in 1959 and 22 additional birds were released during July 1961. Thistle (1962) reported that the population of cattle egrets on Oahu exceeded 150 birds by July 1962. The population has increased greatly since that time. Personnel of the State Division of Forestry and Wildlife counted 621 egrets on Oahu during their January 1986 census (Walker, et al., 1986). There is a rookery on the lands of the Kaneohe Marine Corps Air Station and the birds fan out for their daytime feeding activities. They are especially common in Kawainui Marsh and in the Kapaa Sanitary Landfill area. I saw a number of egrets flying over the project site, and they will feed on the fairways of the proposed golf course.

Family Columbidae, Pigeons and Doves

2. Feral Pigeon or Rock Dove (Columba livia).

The pigeon probably was the first exotic bird introduced to the Hawaiian Islands; their importation has been traced back to 1796. Schwartz and Schwartz (1949) found heavy parasitism of

feral pigeons by tapeworms, and they stated that tapeworm infestation retards proper nutrition "and occludes the intestine, produces undesirable toxins, and hinders breeding," Navvab Gojrati (1970) reported infection by bird malaria, Haemoproteus, and Leucocytozoon in pigeons at the Honolulu Zoo. Kishimoto and Baker (1969) reported finding the fungus Cryptococcus neoformans in 13 out of 17 samples of pigeon droppings collected on Oahu. The full significance of their findings has not been determined in Hawaii, but, in man, this fungus causes a chronic cerebrospinal meningitis. Hull (1963:468) remarked that "in all but the cutaneous form the prognosis is very grave."

Small flocks of pigeons occur sporadically in the area but it is not certain whether they are feral birds or come from a nearby pigeon loft.

3. Spotted or Chinese Dove (Steptopelia chinensis)

This Asian dove was introduced to the Hawaiian Islands at an early date; the exact date is unknown, but the birds are said to have been very common on Oahu by 1879. The species is now very common on all of the islands and is classified as a game bird in Hawaii.

This dove also is called the lace-necked dove because of the conspicuous bands of white spots on the back of the neck. Although this species occurs where the rainfall exceeds 100 inches per year, the highest densities are found in drier areas where the introduced kiawe or mesquite (Prosopis pallida) is one of the dominant plants. Schwartz and Schwartz (1949), for

example, reported densities as great as 100 birds per square mile in dry areas on Molokai. This dove is common on the project site and in all surrounding areas where the vegetation is not too dense.

4. Barred Dove or Zebra Dove (Geopelia striata)

This species is called the zebra dove in its native habitat in the Orient and Australia. This species is said to have been introduced to Hawaii sometime after 1922 (Bryan, 1958). It now is common to abundant on all of the islands. This dove also prefers the drier areas, and Schwartz and Schwartz (1949) reported densities as high as 400 to 800 birds per square mile in some areas on Oahu (e.g., Barber's Point to Makaha).

The zebra dove also is classified as a game bird in Hawaii, but, because of its small size, few birds have been shot in recent years (Saito and Walker, 1984). For example, 6,963 zebra doves were shot by hunters during the 1969-1970 game bird season; only one bird was reported during the 1983-1984 season.

One study of the food habits of the barred dove in Hawaii revealed that the diet consists of 97 percent seeds and other plant materials; the 3 percent animal matter included several species of beetles, weevils, and wireworm larvae. Kocan and Banko (1974) reported on zebra doves from the Big Island that were infected with trichomonas; this parasite has "catastrophic" effects on doves in North America. The zebra dove is common in all relatively open sections of the project area and surrounding habitat.

Family Tytonidae, Barn Owls

5. Barn Owl (Tyto alba pratincola)

The first barn owls were imported from California and released on Hawaii Island during April 1958. Barn owls were released at Hauula, Oahu, on two different occasions. Seven birds were imported from the San Diego Zoo and released during September 1959; 11 additional owls were imported from the San Antonio Zoo, Texas, and released at Hauula during October 1959 (Tomich, 1962). As with the mongoose much earlier, the barn owls were introduced in thehopes that they would prey upon the abundant rats in the sugarcane fields. No food habits study has been conducted of the barn owls on Oahu, but, on Hawaii island, Tomich (1971) found that almost 90 percent of the barn owl pellets that he examined contained only the remains of house mice. He commented that, although the barn owl sometimes feeds on rats, it is not likely a significant factor in the economic control of rats in Hawaii. Moreover, Byrd and Telfer (1980) reported that barn owls on Kauai and Kaula Island had killed more than 100 seabirds and their chicks.

No study of the spread of the barn owl from the Hauula region since 1960 has been conducted, but the birds have been seen or found injured or dead in both the windward and leeward sides of the islands. This owl is nocturnal in habits, and I did not see any during my daytime field studies. It is reasonable to assume, however. that one or more birds forages over this area for food.

The remaining introduced birds belong to the order Passeriformes, which includes all of the socalled songbirds.

Family Timaliidae, Babblers and Laughing-thrushes

6. Melodious Laughing-thrush (Garrulax canorus)

Long called the Chinese thrush in Hawaii, this species is a babbler and not a member of the thrush family (family Turdidae). The Chinese name is *Hwa-mei*. It was introducdd to the islands many years ago as a favorite cage bird. "A number obtained their freedom at the time of the great fire in the Oriental quarter of Honolulu in 1900, and took to the hills behind the City" (Caum, 1933).

This babbler is now found in both the Koolau and the Waianae mountains. It seems to prefer the wetter areas where there are thickets and clumps of dense vegetation. The birds have a loud, attractive song and more often are heard rather than seen. It is widespread in the project area and adjacent areas where the habitat is suitable.

Family Pycnonotidae, Bulbuls

7. Red-vented Bulbul (Pycnonotus cafer)

Although all members of the bulbul family are listed as "prohibited entry" by the State Quarantine Division of the Department of Agriculture, two species are now well established on Oahu. The history and spread of the red-vented bulbul since the mid-1960s has been discussed by Berger (1975, 1981). Bulbuls are a scourge to both fruit and flower growers, because they eat not only ripe fruits, peppers but also buds and flowers. This

bulbul now is one of the most conspicuous species in the project area.

Family Turdidae, Thrushes and Solitaires

8. White-rumped Shama (Copsychus malabaricus)

According to Caum (1933), this attractive thrush was first released on Oahu by the Hui Manu in 1932. Bryan (1958) said that this species was releassed on Kauai in 1931 and that it was established on that island and in the Tantalus region of Oahu. Shama is the Indian name for this thrush, which is native to India, Nepal, Burma, Malayasia, and throughout Indochina.

The Shama is now a common bird on both leeward and windward sides of Oahu. The birds prefer lush vegetation, and they usually first are noted because of their loud and attractive song. They are found especially throughout the lower sections of the project area.

Family Sylviidae, Old-world Warblers

9. Japanese Bush Warbler (Horeites cantans)

This warbler, which is native to Japan and Formosa, was first released on Oahu in 1929 (Caum, 1933). The Japanese name is Uguisu. Berger (1975b) summarized our knowledge of the distribution of this species on Oahu. These are shy and secretive birds, typically occuring in habitats with dense underbrush. Their song period lasts from January to mid-July, and they were not singing during my September field studies. During past field work in this area, however, I have found this species there.

Family Sturnidae, Starlings and Mynas

10. Common Indian Myna (Acridotheres tristis)

The common myna, which is native to Sri Lanka, India, Nepal, and adjacent regions, "was introdiced from India in 1965 by Dr. William Hillebrand to combat the plague of armyworms that was ravaging the pasture lands of the islands. It has spread and multiplied to an amazing extent; reported to be abundant in Honolulu in 1879, it now is extremely common throughout the Territory" (Caum, 1933). The myna is still common to abundant especially in lowland areas of the inhabited islands, being most common in residential and urban areas, especially in the vicinity of man and his buildings. It also is a very common bird at the Kapaa Sanitary Land fill and along the quarry road.

Family Zosteropidae, White-eyes and Silver-eyes

11. Japanese White-eye (Zosterops j. japonicus)

Caum (1933) wrote that the Japanese white-eye, or Mejiro, was first imported from Japan to Oahu by the Territorial Board of Agriculture and Forestry in 1929. Later importations were made by the Hui Manu and by private individuals. Singing contests were held with the white-eye.

The white eye rivals the house sparrow and the European starling in North America as a successful exotic species, and the white-eye now undoubtedly is the most common song bird in the islands (Berger, 1981). It now is found from sea level to tree line on Maui and Hawaii, and it is found in the driest habitats

(e.g., Kawaihae, Hawaii) and in areas with 300 or more inches of rain per year. The white-eye is ubiquitous throughout windward Oahu, There is no habitat where I did not find this species.

Family Ploceidae, Weaverbirds and their Allies

This is a large family of birds, predominantly Old-world in natural distribution. The best known example in Hawaii is the house sparrow. However, since the mid-1960s more than 15 different species of this family have been intentionally or accidentally released on Oahu (Elepaio, 1966: 79; 33, 1972: 81-82; Berger, 1981).

12. Red-eared or Common Waxbill (Estrilda troglodytes)

Also called the black-rumped waxbill, this species was first reported at Diamond Head on January 2, 1966. Little has been published on this species in Hawaii but its range has expanded considerably since 1966 and has been reported in a number of widely separated areas on Oahu (see, for example, Pyle, 1988). I saw this species in the lower part of the Kapaa Landfill area. It is not an inhabitant of dense thickets or forests, but sometimes is found on golf courses.

13. Spotted Munia or Ricebird (Lonchura punctulata)

Also called the nutmeg mannikin, this Asian species was released in Hawaii by Dr. William Hillebrand about 1865 (Caum, 1933). Caum wrote that the ricebird "feeds on the seeds of weeds and grasses and does considerable damage to green rice."

Rice is no longer grown in Hawaii, but the ricebird has become a serious pest by eating the seeds of experimental crops of sorghum (see under house finch). The ricebird is another abundant species on all of the islands, and is sometimes seen in very large flocks. It is widespread in windward Oahu in open areas where there are weed seeds. They also are prolific breeders and I have found nests in every month of the year.

14. Java Sparrow or Java Ricebird (Padda oryzivora)

This species is thought to have been endemic to Java and Bali, but it was introduced to many other areas long ago, from the Philippines to Sri Lanka. Caum (1933) wrote that this species may have been introduced to Oahu about 1865 by Dr. William Hillebrand and that the species may have been brought in again about 1900. In any event, these birds did not survive.

Throp (1969) reported that Java sparrows nested and raised young on Diamond Head during late 1968 or early 1969. Since that time, the increase in numbers and the range expansion of the Java sparrow on Oahu has been very impressive (Berger, 1975b). Like the other seed-eaters, this sparrow does not inhabit dense thickets or forests but inhabits open areas wherever there is a supply of weed seeds. They now are common in windward Oahu, inhabiting lawns in residential areas, golf courses, and along roads.

15. House Sparrow (Passer domesticus)

Incorrectly sometimes called the English sparrow, this species has a wide distribution in Europe, Asia, and the British Isles. This sparrow was first imported to Oahu in 1871, when

nine birds were brought in from New Zealand (where they had been introduced earlier from England). Caum (1933) wrote that the species was reported to be numerous in Honolulu in 1879. In North America, the house sparrow (first introduced in Brooklyn, New York, in 1852) became a serious pest and tens of thousands of dollars were spent in attempting to control the populations (Dearborn, 1912). In India, as well, the house sparrow causes "collosal damage to the food-grains in standing crops and storages"(Rana and Idris, 1986).

The house sparrow apparently never became a pest in Hawaii. It is omnivorous in diet, eating weed seeds as well as insects and their larvae. The house sparrow typically is found in the vicinity of man and his buildings but they also forage in outlying areas and are found along the Quarry Road.

16. Red-crested Cardinal (Paroaria coronata)

This species traditionally has been called the Brazilian Cardinal (a petstore name) in Hawaii, but the native range includes Uruguay, Paraguay, Brazil, and parts of Bolivia and Argentina. The species was released in Hawaii on several occasions between 1928 and 1931 (Caum, 1933).

The red-crested cardinal is a common species in urban, residential, and outlying areas on Oahu. It occurs in relatively open areas at lower elevations, where it inhabits the same type of habitat occupied by the cardinal. It does not penetrate heavily forested areas but is found along the edges of the

project site.

17. Cardinal (Cardinalis cardinalis)

This species has been given a number of vernacular names: Virginia cardinal, Kentucky cardinal, Kentucky Redbird. Its native range is the eastern part of North America east of the Plains and northward into Ontario. The cardinal was released several times in Hawaii between 1929 and 1931 (Caum, 1933, Berger, 1975d.). The cardinal has a wide distribution in windward Oahu, in residential areas, shrub-grown fields, and in the introduced forests of the project region.

18. House Finch (Carpodacus mexicanus frontalis)

Also known as the Papayabird in Hawaii, the house finch was introduced from California "prior to 1870, probably from San Francisco" (Caum. 1933). The house finch now is a very common species in Hawaii in both urban and rural areas on all of the islands, and probably is the second most common song bird species in the State.

Although the birds sometimes eat ripe papaya and other soft fruits, the house finch is predominantly a seed-eater. House finches and ricebirds caused great damage to experimental sorghum crops planted on Kauai and Hawaii during 1971-1972. "A report by the Senate Committee on Ecology, Environment, and Recreation says that ricebirds and linnets [house finch] caused a 30 to 50 percent loss in the sorghum fields at Kilauea on Kauai last year. . . . Seed eating birds at Kohala ate about 50 tons

of sorghum grain in a 30-acre experimental field that was expected to produce 60 tons" (Honolulu Advertiser, March 14, 1972, page B-2). Hence, the growing of small grain crops in the islands is not a promising potential for the much talked-about "diversified agriculture" in the state. Other seed-eating birds have become widely established on some of the islands. On Oahu, the Java sparrow and the warbling silverbill (Lonchura malabarica cantans) also are seed-eating birds (see, Conant, 1984; Pyle, 1986, 1987). The house finch is widely distributed in windward Oahu, including the project region.

II. Indigenous Birds

These are species that occur in the Hawaiian Islands but whose total range includes other islands in the Pacific Basin or in Siberia or North America. These are the black-crowned night heron, 22 species of seabirds, and a number of migratory species that spend their winter or nonbreeding season in the islands.

1. There is no habitat on the project site for the native black-crowned night heron (Nycticorax n. hoactli).

2. Seabirds. None of the 22 native seabirds nest on or occupy the project site. Groups of 10 to 15 great frigatebirds (Fregata minor palmerstoni) do frequently soar over Kawainui Marsh, but are of no concern regarding the proposed project.

3. Migratory species. The most conspicuous of these is the lesser golden plover (Pluvialis dominica fulva), which occurs from sea level to 10,000 feet elevation on Maui and Hawaii.

The birds frequent lawns in residential areas, golf courses, weedy pastures, open areas in the mountains, and mud flats along the shore. They will certainly inhabit the golf course when completed. I saw one bird on the exit road from the Kailua Drive-In Theater.

None of the other winter residents would occur on the project site. They inhabit mountain streams and the shore line.

III. Endemic Birds

These are birds that are restricted to the Hawaiian Islands; they are unique to the islands. At least 40 percent of these unique birds are extinct and another 40 percent are classified as threatened or endangered with extinction. Most of these endangered Hawaiian birds are forest birds, and there is no habitat for these species at the low elevation of the project site.

There is no suitable habitat for any of the endangered Hawaiian waterbirds on the project site. Four species, however, inhabit Kawainui Marsh. I believe it important to discuss these species, in part to demonstrate how little value this marsh is in its present condition.

A pond or marsh is a stage in ecological succession, and the Hawaiians found it necessary periodically to clean the ponds of excess vegetation. Men, women, and children worked on the clearing project, which took about three days at Kawainui (Kekoowai, 1922). After such maintenance activities ceased

the aquatic vegetation and introduced trees, shrubs, and grasses gradually encroached again, and the Kawainui area has long been referred to as a swamp or marsh. In writing about the need for bird sanctuaries on Oahu as long ago as 1957, King (1957) said that "in addition to the above open-water areas, there is Kawainui Swamp (665 acres), property of the children of H. K. L. Castle, which is being partially drained and is so badly choked with vegetation that except for providing refuge to a few gallinule it is not of much use to water-fowl." Now 30 years later, the area is still more overgrown with exotic plants. (Witness the severe flood that engulfed the Coconut Grove area of Kailua, during January 1988.)

About 99 percent of the vegetation in the marsh region consists of exotic or introduced plants. This marsh vegetation today consists largely of sedges (Cyperus sp.), rushes (Scirpus sp.), California grass (Brachiaria mutica), and Honohono grass (Commelina diffusa). There are several stands of cattail (Typha angustata) around the largest pond. Water hyacinth (Eichornia sp.) and duckweed (Spirodela polyrhiza) grow in profusion in some of the smaller pockets of water, and such plants as primrose willow (Jussaia suffruticosa) occur around the margins of the ponds. A dozen widely scattered paperbark trees grow in somewhat drier areas that supports grasses. Banana (Musa sp.), castor bean (Ricinus communis), Indian pluchea (Pluchea indica), hau (Hibiscus tiliaceus), and koa haole (Leucaena glauca) have invaded the edges of the marsh in some areas.

There is, therefore, very little good habitat for the endangered Hawaiian waterbirds. The following species have been recorded there.

Family Anatidae, Ducks, Geese, and Swans

1. Koloa or Hawaiian Duck (Anas wyvilliana).

Once common on all of the major islands, the Koloa became extinct on all of them except Kauai during this century. Swedberg (1967) discussed the history of the Koloa on all of the islands and the factors thought responsible for their extinction. Koloa that were raised at Pohakuloa on the Big Island by the State Disision of Fish and Game were released in Kawainui Swamp on several occasions in an attempt to reestablish the species on Oahu. Some 32 birds were released during January 1969 (Honolulu Star-Bulletin. January 16. 1969. p. G-2); 21 birds were released on November 29, 1974; 29 were released in Kawainui Swamp on February 27, 1976, and an additional 29 birds were releasad there on March 4. 1976 (information obtained from the State Division of Fish and Game). Most of the birds released there left the area for better habitat.

Family Rallidae, Rails, Coots, and Gallinules

2. Hawaiian Gallinule (Gallinula chloropus sandvicensis)

Gallinules are predominantly birds of freshwater ponds, marshes, irrigation ditches, reservoirs, and taro patches. The birds require dense marginal vegetation, and they are seldom seen on deeper, more open bodies of water.(U.S. Fish & Wildlife Service, 1985).

The ecology of the nesting of the gallinule has been discussed by Byrd and Zeillemaker (1981). Gallinules are the most difficult of the waterbirds to census because they are wary and quickly hide in vegetation when disturbed by an observer walking through the vegetation. Like the other Hawaiian waterbirds, the gallinule is classified as an endangered species by the U.S. Fish & Wildlife Service.

3. Hawaiian Coot (Fulica americana alai).

Coots occupy the same general habitat as gallinules, but they prefer more open water and they often are found on brackish water. They obtain their food near the surface and also by diving, so that they prefer deeper water than do gallinules. Coots are more duck-like in appearance and they have lobed toes. Habitat for the coot was drastically reduced when Ka'elepula Pond was dredged to form Enchanted Lake. As many as 1,000 coots were seen on that pond during the 1940s. A total of 1,973 coots were counted in the entire state during January 1986 (Walker, et al., 1986).

Family Recurvirostridae, Stilts and Avocets

4. Hawaiian Black-necked Stilt (Himantopus h. knudseni)

The stilt is the fourth Hawaiian waterbird that is classified as an endangered species. One of the basic reasons for its present status is (as for the other waterbirds) the destruction (by draining and filling) of the marsh and pond habitat needed by these birds for feeding and nesting. Most of Kawainui Marsh is now unsuitable for the stilt, but the birds

have been seen feeding in the drainage ditches, in grassy areas during high water levels, and at the entrance to the Kailua channel.

I will refer to the waterbirds again in the conclucions of this study.

Mammals

I. Endemic Mammals

The only endemic land mammal in the Hawaiian Islands is the Hawaiian bat (Lasiurus cinereus semotus), a subspecies of the North American hoary bat. The Hawaiian bat occurs primarily on Kauai and Hawaii (Tomich, 1986; Kramer, 1971; Ten Bruggencate, 1983). For Maui and Oahu, "the bats seem to appear only during the months from August to December." I know of no evidence that there is a resident population of bats on Oahu.

II. Introduced Mammals

All of the introduced species of mammals in Hawaii have proven highly detrimental to man, his buildings, his agricultural crops and/or to the endemic forests and their animal life, None is an endangered species and none is of any concern as far aa detrimental effects resulting from the proposed project. It would, in fact, be a great boon to the islands if it were possible to exterminate all of them.

With the possible exception of the house mouse (Mus musculus), all of the smaller alien mammals prey on birds, their eggs, and young. These small mammals include the roof rat (Rattus rattus), Polynesian rat (Rattus exulans), Norway rat (Rattus norvegicus), and the small Indian mongoose (Herpestes auropunctatus),

as well as feral cats (Felis catus) and feral dogs (Canis familiaris). Because all of the rodents are serious pests, I did not bother to set night-time traplines in order to sample the populations. It is reasonable to assume that all of them occur in the project region (Tomich, 1986; Kramer, 1971), and their occurence is irrelevant to an impact assessment.

The Polynesian ancestors of the Hawaiian people brought pigs (Sus scrofa) with them, and Captain Cook and later ship captains also released English pigs on the islands. In 1925, the central forest of Oahu was "riddled with wild pigs which were destroying the undergrowth." In writing about the Kilauea Forest on Hawaii island, Mueller-Dombois et al. (1981) noted that this was the "best intact example of this forest type remaining in the state" and that "the effect of feral pig is very noticeable, and there is little doubt that the widespread pig digging in the Kilauea forest has been a major factor in reducing the native ground vegetation." However, I saw no evidence of pigs in the project area.

Most of the large alien mammals were released by Captains Cook and Vancouver more than 200 years ago. Cattle (Bos taurus), goats (Capra hircus), sheep (Ovis aries), and pigs have been destroying the Hawaiian forests since 1300, and they continue to do so today. There are none of these large mammals in the project site or near it today.

Summary and Conclusions

1. The vast majority (more than 95 percent) of the plants in the project area are introduced or alien species, a number of which are pest species. More than 4,500 exotic flowering plants have been introduced to the Hawaiian Islands (St. John, 1973). There is no semblance of any native ecosystem anywhere near the project site. The change in use of the site, therefore, will have no adverse effects on any native ecosystem.

2. Because there are no endemic amphibians or land reptiles in the Hawaiian Islands, all of those that are present are alien or introduced species. Some (e.g., the bullfrog) pose a threat to the endangered Hawaiian waterbirds; the neotropical toad has poison glands that are a threat to dogs and to young children. All of these introduced animals are irrelevant to an impact assessment.

3. None of the 18 species of introduced birds discussed in this report is an endangered species and a number have proven to be serious pests to agriculture in Hawaii. The destruction to sorghum crops by the ricebird and the house finch has been discussed above. The two species of doves and the myna have been implicated in the spread of the seeds of such noxious plants as Lantana camara. The Japanese white-eye and the red-vented bulbul cause considerable damage to ornamental flowers and to fruit crops (see Keffer, et al., 1976). The barn owl has been reported to kill seabirds on Kauai, and probably kills other birds on other islands. It seems reasonable to conclude that

these alien bird species are of no concern in an environmental impact assessment.

4. Changes inthe land use, including clearing of the forest, would provide more habitat for the wintering golden plover. It will have no effect on any of the other migratory birds.

5. Changes in the land use will have absolutely no effect on any of the seabirds

6. In the distant past, Kawainui was a very large fish pond, covering about 450 acres (Summers, 1964:22). By comparison, fishponds in Waikiki were said by Cobb (1902:429) to vary from 1.3 to 13 acres (see, also, Kikuchi, 1976). There is, however, only a very small portion of Kawainui Marsh that is now of any value to the four species of endangered Hawaiian waterbirds. The marsh now is mostly choked by introduced plants, thus providing very little suitable habitat for the waterbirds. The Hawaiian Waterbirds Recovery Plan (U.S. Fish & Wildlife Service, 1985), with reference to Kawainui Marsh, said: "Expansion of open water areas would facilitate use by all four waterbirds, which now use the area in small numbers. This area should be transferred from the City and County of Honolulu to the State Department of Land and Natural Resources for habitat development and management." The chief point here is that the potential of Kawainui Marsh for the waterbirds is great, but it is of little value at this time for them. In any event, change in the

land use of the project site would have absolutely no detrimental effects on the marsh or its waterbirds. Waste water plants from Maunawili now drain into the marsh, and it probably is reasonable to assume that drainage from the Kapaa Landfill and the automobile junk yard do as well.

7. Although the Pueo or Hawaiian owl (Asio flammeus sandwichensis) does occur on Oahu, it is an uncommon species there and I know of no records of its being seen in the vicinity of the project site even though I have a considerable amount of field work in windward Oahu. Scott et al. (1986) wrote that the Pueo "was most often seen in grasslands, shrublands, and montane-parklands."

8. The only endemic land mammalin Hawaii is the Hawaiian hoary bat, now classified as an endangered species. I know of no evidence that there is a resident population on the island of Oahu.

9. All of the remaining mammals in the project region are introduced species and all are serious pests to man, his buildings, products, agriculture, and to the native fauna. The three species of rats prey on the nests of ground-nesting birds and even some tree-nesting birds and the mouse and the rats cause great damage to homes and businesses. The very common diurnal mongoose is a serious predator on some of the endangered waterbirds as well as on poultry and other

domestic birds. If it were possible to exterminate all of the alien mammals, it would be a great benefit to the Hawaiian Islands. There presence, therefore, in and adjacent to the project site is irrelevant to an environmental impact assessment.

10. In view of the above summary, I can see no biological reason for not changing the land use of the project site.

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Appendix C

APPENDIX C

A RECONNAISSANCE SURVEY
OF THE PROPOSED WINDWARD PARK
KAILUA, O'AHU ISLAND

BY BISHOP MUSEUM

MS. 020289

A RECONNAISSANCE SURVEY OF THE PROPOSED WINDWARD PARK, KAILUA, O'AHU ISLAND (TMK 4-2-14:2 and 4)

by

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Public Archaeology Section
Applied Research Group
Bishop Museum

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ABSTRACT

A archaeological reconnaissance survey was conducted on the proposed windward park in the Kailua *ahupua'a* of the island of O'ahu. Five archaeological sites were recorded that have been estimated to span both prehistoric and historic eras. The two prehistoric sites are an agricultural complex and a possible *heiau* or large habitation site. The three historic sites consist of three walls. All five sites appear to be significant in terms of their potential to produce important information regarding the prehistory and history of the area. One of the prehistoric sites (G6-85) also appears to be significant because it may be associated with important events in the area and as an architectural achievement. Recommendations are presented at the conclusion of the report for an intensive archaeological survey as the next phase of work.

INTRODUCTION

Under contract to DHM, Inc., the Applied Research Group, Bishop Museum, conducted an archaeological reconnaissance survey of the proposed Windward Park parcel (TMK 4-2-14:2 and 4), located in Kailua *ahupua'a*, Ko'olaupoko, on the windward side of O'ahu Island. Specifically, the project area extends across the southern and eastern slopes of Kapa'a Ridge, west of the Kapa'a Sanitary Landfill road, and north of Kalaniana'ole Highway and the Kailua Drive-In (Fig. 1). The archaeological survey was conducted by the senior author and Ann Charvet-Pond during October 3 to 7, 1988.

SCOPE OF WORK

The scope of work for this project consisted of three general tasks:

1. Background research consisting of literature, document, and map searches of Kailua *ahupua'a*.

2. Fieldwork consisting of a walk-through survey to determine the presence or absence of archaeological remains with limited subsurface testing where warranted.

3. Formulation of recommendations regarding further archaeological work.

ENVIRONMENTAL SETTING

The project area is situated in the low hills to the west of Kawainui Marsh in the Kailua *ahupua'a*, Ko'olaupoko District, O'ahu, between the 100 to 700 ft. elevations. Rainfall averages 75 to 100 in. per year with heavier precipitation during the winter months. The summer tradewind season is warmer and dryer with occasional orographic showers (Armstrong 1973).

Boulders are numerous along the slopes, and in many places they have been incorporated into terrace walls and stone piles, but also occur as natural boulder alignments in dry stream beds.

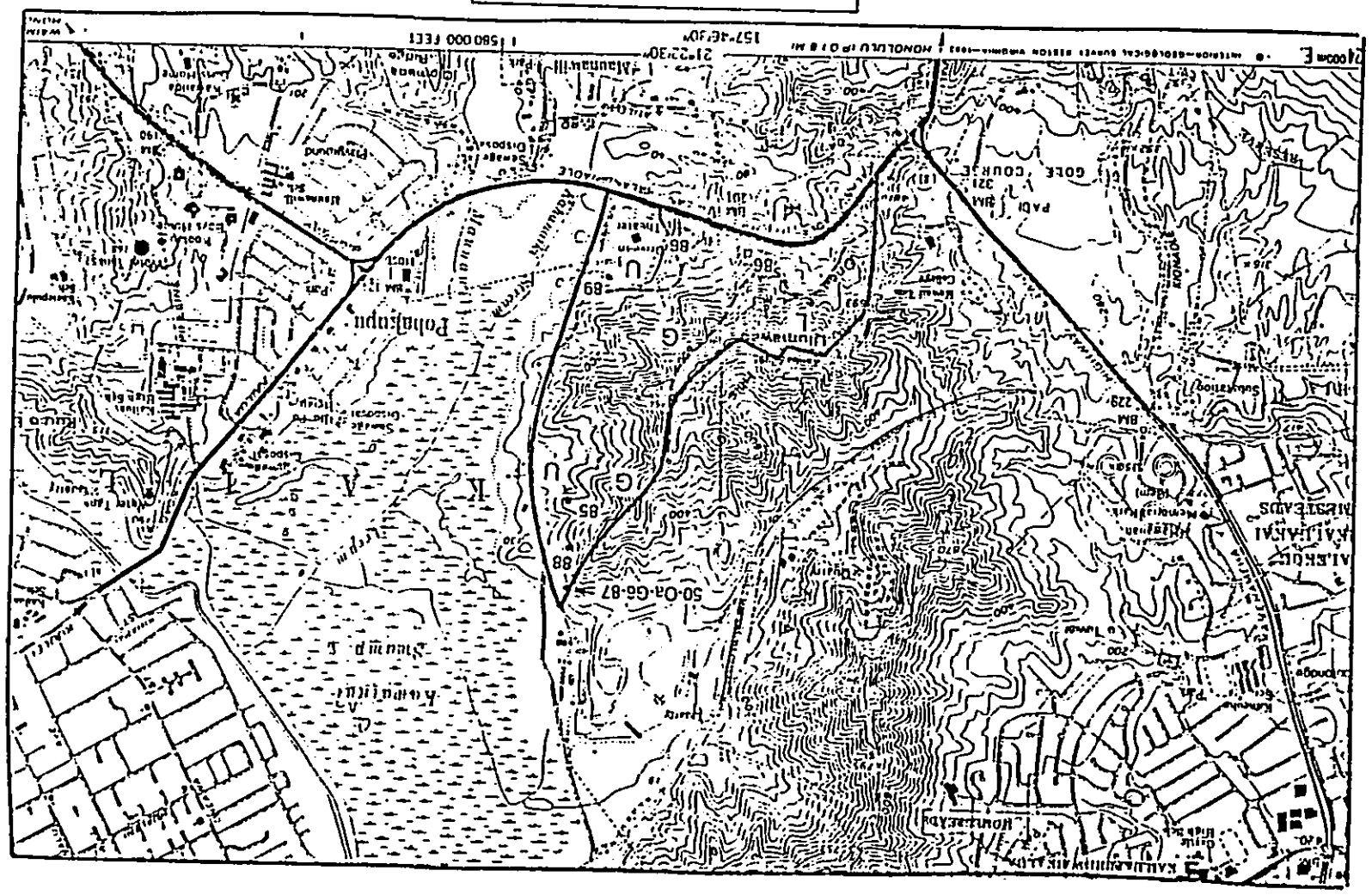


FIG. 1. LOCATION OF PROJECT AREA.

Vegetation in the survey area consists of dense *hau* (*Hibiscus tiliaceus*) thickets, *koa haole* (*Leucaena glauca*), *laua'e* fern (*Microsorium scolopendria*), Christmas-berry (*Schinus terebinthifolius*), Java plum (*Eugenia cuminii*), *noni* (*Morinda citrifolia*), monkeypod (*Samanea saman*), ti (*Cordyline fruticosa*), feral papaya, and Chinese banyan (*Ficus retusa*). Undergrowth tends to be dense, except near dry stream beds and in recently bulldozed areas. Arbitrary networks of dirt paths and jeep roads appear throughout the project area where the topography permits access.

BACKGROUND

HISTORICAL RESEARCH

Kailua *ahupua'a* formerly contained extensive agricultural terrace systems (*lo'i*) reaching as far as 1.5 miles inland from the margins of Kawainui Marsh, according to Handy (1940). Traditionally the predominant crop was taro, but by the mid-19th century many of the terraces had been abandoned or converted to the cultivation of other crops, among them rice and sugar.

Sugar had been the focus of considerable interest to the Hawaiian agrarian community from the early 19th century. Between 1878 and 1950 the terraces in Kailua were under intensive cultivation by the Hawaiian Sugar Planters' Association (Smith 1978; U.S. Army Engineers 1981). The Hawaii Sugar Planters' utilized the central portions of the terrace system, while the inland terraces were abandoned and the lower ones reverted to swamp. Rice cultivation had become a significant part of the agricultural economy in Hawaii by the 1860s and its importance was to increase as the century progressed. Abandoned taro fields and reclaimed wastelands in Kailua were in rice (Allen-Wheeler 1981), including portions of Kawainui Marsh (Coulter and Chun 1937).

The introduction of grazing livestock to Hawai'i, including cattle, horses, goats, and sheep, profoundly altered traditional land use patterns. In Kailua *ahupua'a*, the raising of livestock almost inevitably involved Mauna-

wili and Kaneohe Ranches. Of particular relevance to the project area is Kaneohe Ranch Co. Ltd. (historically a major leaseholder of the subject parcels).

> [Kaneohe Ranch] lands were originally part of some 20,000 acres belonging to Queen Kalama. Title to this land passed to Judge C. C. Harris. His daughter, Mrs. Nannie R. Rice, inherited the land from him. About 1890 J. P. Mendonca leased lands for cattle raising . . . marking the beginning of the ranch. In 1907 James B. Castle bought stock in the ranch, and ten years later his son, Harold K. Castle, purchased the property from Mrs. Rice (Devaney et al. 1982).

According to Henke (1929) "Kaneohe Ranch included some 12,000 acres and carried 2,000 head of cattle [but] by the late 1920s the grazing area had been reduced to only 4,000 acres with about 500 Angus cattle."

A considerable body of literature exists that suggests that grazing by cattle and other livestock had deleterious effects on the environment. Large tracts of forested lands were defoliated resulting in irreparable loss of native flora and fauna, thus opening the land to exotic or noxious introductions. Ranch lands in the project area include frequent dense thickets of Christmas-berry (*Schinus terebinthifolius*) which "in Hawaii grows like a weed and is often found in waste land" (Neal 1965). This "weedy" vegetation, as well as the remnants of barbed-wire fencing and tumbled rock walls (see below), suggests the probable presence of livestock on the subject parcels in former times.

Kailua *ahupua'a* has a somewhat complicated land history in that many of its *'ili* (subdivisions of major land divisions or *ahupua'a*) have several *lele* (geographically separate parcels) making research of land ownership and land use in Kailua difficult. There are ten *'ili*, or *lele* of *'ili*, wholly or partially within the boundaries of the project area. At the time of Mahele, the great land division of 1848, most of the lands of Kailua were awarded to Queen Kalama, the widow of Kamehameha III, although certain lands were reserved to

the Crown and the Government. All documentary evidence indicates that the lands within the project area were either the Queen's lands, Crown lands, or Governments lands.

PREVIOUS ARCHAEOLOGICAL WORK

In 1933, McAllister conducted a survey of archaeological sites in the Ko'olaupoko District of O'ahu (McAllister 1933). McAllister listed several sites near the subject project area, including two *heiau*.

Site 359 Pahukini Heiau

This site was described by McAllister (1933:228) as a "large, walled structure approximately 110 x 175 feet in interior dimensions, located across the top of a ridge." Today, it exists within the Kapa'a Landfill, surrounded by a chain-link fence.

Site 360 Holomakani Heiau

McAllister described this site to have been "on the mountain side of Kawainui fishpond but destroyed and the land used for agriculture" (McAllister 1933:229).

Site 370 Kawainui Marsh

McAllister recorded this site as "a pond belonging to the Ali'i" (McAllister 1933:227). This marsh was once a large inland fishpond, where according to oral traditions the goddess Hauwahine resided.

Additional archaeological and historical research conducted in the area include: Johnson and Kikuchi (1963), Devaney et al. (1976), Kelly and Clark (1980), Allen-Wheeler (1981), Kelly and Nakamura (1981), Athens (1983), Toenjes and Donham (1985), and Allen-Wheeler (pending). The reader is referred to these works for additional information on the area.

THE SURVEY

METHODS

A systematic walk-through survey of the project area was conducted with the aid of aerial photographs, topographic and planning maps, and compasses. Beginning along the eastern side, the survey team traversed the Kapa'a Ridge in transects approximately 10 to 15 m apart, depending on the degree of ground visibility and slope. Due to time limitations, steeper slopes and heavy vegetation could not be investigated with the same degree of intensity as the other areas. Consequently, the results presented here should be interpreted with these limitations in mind.

When an archaeological site was found, the immediate vicinity was carefully searched for additional features, as well as surface artifacts. The site was then cleared of vegetation, if necessary, so that it could be sketch mapped, photographed, and described. All original field notes, maps, and photographs are stored in the Department of Anthropology, Bishop Museum.

RESULTS

Five archaeological sites were recorded during the reconnaissance survey, including a possible *heiau* or habitation site; rock walls; a linear rock mound; and a probable agricultural complex. These are described below.

Site 50-OA-G6-85*

This site consists of two features: a large, rock-faced terrace and an L-shaped terrace.

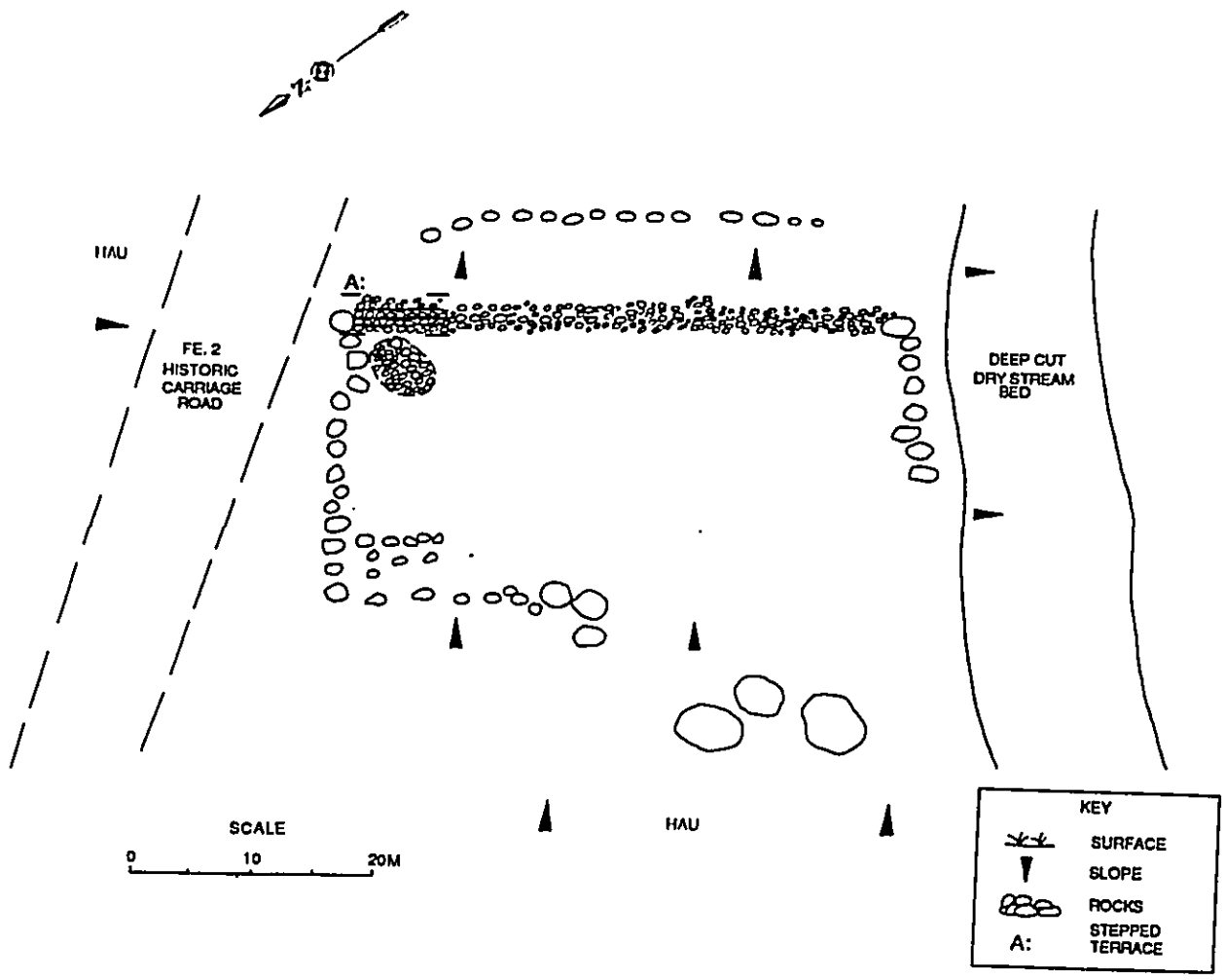
*Bishop Museum site numbering system: 50 = State of Hawai'i, OA = O'ahu, G = Ko'olaupoko District, 6 = Kailua *ahupua'a*, 85 = discrete site number per *ahupua'a*.

Feature 1 is a high, rock-faced, terrace with possible paved sections. It is situated on a moderate slope, on the north edge of a deep-cut dry stream bed and over-looking Kawainui Marsh. The surface of the terrace is relatively level and soil-filled, though possible sections of pavement were observed in the northwest area as exposures of angular and subangular basalt cobbles scattered on the surface. Also located in the northeast corner within this structure is an oval-shaped rock mound approximately 2.5 m long and 1.5 m wide. Vegetation surrounding Feature 1 includes *koa haole*, *noni*, several large monkeypod trees, occasional *lilikoi*, guava, papaya, ti, *hau*, and Christmas-berry.

The east retaining wall is 49.0 m long, 2.2 to 3.0 m high, with an overall width of 6.5 m, incorporating three steps (Fig. 2). It is constructed of angular and subangular basalt boulders with cobble fill. The bottom step is tumbled. The south alignment is atop by a deep-cut slope extending down to a dry stream bed. This alignment is constructed of large angular and subangular basalt boulders 15.3 m long; the alignment may have been originally longer, but the west end maybe tumbled. The north rock alignment is disturbed by vegetation and by a dirt road. It is constructed of angular and subangular basalt boulders 27.0 m long and 0.4 m high. The west rock alignment is discontinuous, interrupted by large angular basalt boulders, possibly used for facing terraces. Approximately 10.0 m downslope from the east terrace is a single stacked 20.0-m-long terrace, retained by an alignment constructed of angular and subangular basalt boulders.

A segment of a dirt road is located along the northeast of Feature 1 and crosses to the south at the 200-ft contour line, and downslope to the east along the base of the deep-cut dry stream bed.

Feature 2 is an L-shaped terrace located northwest of Feature 1, upslope along the dirt road. It is constructed of angular and subangular cobbles, measures 2 m long, and is situated on a high ridge. It may have functioned as a horticultural or habitation area. Vegetation associated with this feature is *laua'e* fern and ti plants.



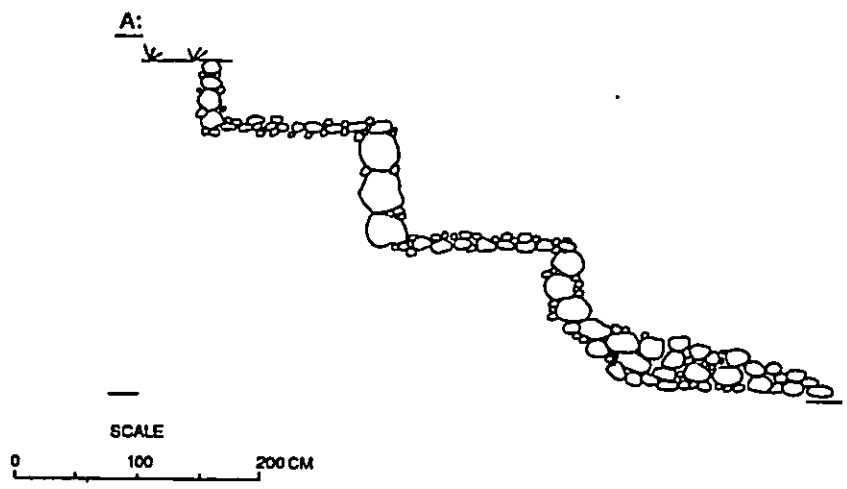


Fig. 2. PLAN AND PROFILE OF SITE 50-OA-G6-85.

Site 50-OA-G6-86

This site consists of two rock walls.

Feature 1 is a 50-m-long rock wall, 0.5 to 0.8 m high, constructed of stacked angular and subangular basalt boulders. The northwest section is collapsed and the southwest section is obscured by vegetation. It may have functioned as a boundary marker. Surrounding vegetation includes a large monkeypod tree, young Java plum trees, *noni*, and abundant wait-a-bit bushes.

Feature 2 is a core-filled rock wall approximately 15.0 m long, 0.8 m wide, and 0.5 m high, and constructed of angular and subangular basalt boulders. The upslope end is obscured by *hau*, while the downslope end is collapsed. Surrounding vegetation includes *hau*, Christmas-berry, swordfern, and guava.

Site 50-OA-G6-87

This site consists of two features: a rock wall and a mound.

Feature 1 is a rock wall approximately 75.0 m long, 0.5 to 0.6 m high, and 0.5 m wide with a collapsed downslope end. Upslope, the wall measures 0.5 to 1.0 m high, and constructed of large basalt angular and subangular boulders, with cobble fill. Paralleling the rock wall is a barbed wire fence strung on wooden and metal posts. A cow tibia was found downslope in association with the barbed wire fence.

Documentary evidence indicates that this wall is on or close to the boundary separating the lands of Papaloa and Oneawa. This wall may have functioned as an *'ili* boundary marker or a cattle wall.

Feature 2 is a rock mound 1.5 by 3.0 by 0.5 m high located north of Feature 1. It is irregularly shaped, and constructed of piled angular and subangular basalt cobbles.

Site 50-OA-G6-88

Site 50-OA-G6-88, a linear mound of angular and subangular basalt cobbles, is located upslope of Kapa'a quarry road. The mound is approximately 2.0 m wide, less than 0.3 m high, and extends 30.0 m before being covered by dense Christmas-berry. This may be the remnants of a collapsed wall.

Site 50-OA-G6-89

This complex consists of five features: a terrace, two alignments, a mound, and a C-shaped alignment. It is bounded by a dry stream bed to the north, Kapa'a quarry road to the east, Kailua Drive-In to the south, and a steep ridge to the west. Surrounding vegetation includes *hau*, *noni*, Chinese banyan, *koa haole*, feral papaya, and various grasses and weeds.

Feature 1 is a rock-faced terrace constructed of two courses of angular and subangular basalt boulders. It is situated perpendicular to the dry stream bed and measures 0.6 m high and 2.5 m long. A possible extension at the south end is demarcated by angular and subangular basalt boulders, 0.5 m high, and 2.7 m long. This feature was probably a small irrigated agricultural terrace.

Feature 2 is a 3.0-m-long by 0.6 m high boulder alignment of angular and subangular basalt boulders. The alignment is associated with Feature 1 and possibly functioned as a stream retention wall. There is some evidence for similar types of alignments possibly occurring further upstream.

Feature 3 is an oval-shaped rock mound (1.7 by 1.3 m) constructed of angular and subangular basalt boulders. It is located upslope from Feature 1 atop a raised soil mound.

Feature 4 is a C-shaped rock alignment 3.4 m long, 0.8 m high, and constructed of angular and subangular basalt boulders with cobble fill. Two of the boulders are in an upright position. While this feature may have functioned as a temporary habitation site, a single shovel test revealed no cultural deposit.

Feature 5 is an alignment 7.0 m long and 1.0 to 0.6 m high, and constructed of angular and subangular basalt boulders with cobbles filling the insticies. It is located in a *noni* patch perpendicular to the dry stream bed but not connected to it. There are large colluvial deposited basalt boulders scattered throughout the area.

Several crude, possible terraces were observed in the dry stream bed, but were not recorded due to their marginal nature.

DISCUSSION, EVALUATION, AND RECOMMENDATIONS

The five archaeological sites recorded during this project, appear to span both prehistoric (before the arrival of Captain Cook in 1778) and historic eras. The three sites, G6-86, -87, and -88, that date to the historic period, are probably related to land boundaries, one of which may have been associated with an *'ili*. One of the prehistoric sites (G6-89) may have functioned as an agricultural system. The other possible prehistoric site (G6-85) may have functioned as either a religious site (a *heiau*) or a habitation site for a person of high status--further research is needed to more precisely determine the function of this site. These five sites are important in that they have the potential to add to our knowledge about the area.

Table 1 presents an evaluation of the five archaeological sites recorded during the current survey. Initial significance assessments are based on brief surface inspections and shovel testings. Four sites, G6-86, -87, -88, and -89, appear to be significant because of their information content and their potential to contribute to our knowledge about the history of the area (Criterion D). Site G6-85 appears to be significant for its information content (Criterion D) as well as its possible association with important events in the area (Criterion A).

An intensive survey is recommended as the next phase of research to include: instrument aided locational and detailed plan mapping, and subsurface testing of pertinent archaeological features. Specific recommendations for each recorded site are as follows:

Table 1

WINDWARD PARK SURVEY,
SUMMARY OF SITES

BPBM No. (50-0A-G6)	State No. (50-80-11)	Type	Probable Function	No. of Features	Condition	Estimated Age	NRHP Criteria*
-85	-2033	Stepped terrace	Habitation or religion	2	Good	Prehistoric	A, D
-86	-2034	Wall	Boundary	2	Fair	Historic	D
-87	-2035	Rock wall	*'Ili* boundary	2	Good	Historic	D
-88	-2036	Rock mound (remnant wall?)	Boundary	1	Fair	Historic	D
-89	-2037	Structural complex	Agricultural	5	Good	Prehistoric	D

*Based on criteria of the National Register of Historic Places:

Criterion A specifies association with events or broad patterns important in the history of an area (e.g., Contact, the development of the state system of government, the expansion of agriculture into upland areas).

Criterion B reflects association with persons important in the history of an area (e.g., Queen Lili`uokalani).

Criterion C applies to sites that reflect architectural achievements (e.g., extensive terracing, certain roads, and historic period buildings).

Criterion D specifies that the site has yielded or has the potential to yield information significant for our understanding of traditional culture, history, prehistory, and/or foreign influences on traditional culture and history.

Site 50-0A-G6-85, a possible *heiau* or habitation structure, requires vegetation clearing, mapping, and testing in order to determine its function, age, and to allow for a more comprehensive evaluation of significance. This site may be recommended for preservation, pending results of further investigations.

For Site 50-0A-G6-86, mapping and testing procedures will be implemented at the rock wall features.

Site 50-0A-G6-87, a rock wall, requires clearing, mapping, and testing in order to clarify its potential function as a boundary for the *'ili* located on Kapa'a Ridge.

Site 50-0A-G6-88, a linear rock mound, requires clearing, mapping, and testing in order to determine its function and age.

Site 50-0A-G6-89, a terrace complex, requires clearing, mapping, and testing in order to clarify its function, age, and association with local settlement patterns.

Although final determination of site disposition must await results of the intensive survey, the proposed procedure will probably constitute adequate mitigation for Sites G6-86 through -89. Site G6-85 may be selected for *in situ* preservation if warranted.

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Appendix D

APPENDIX D

TRAFFIC IMPACT ASSESSMENT REPORT
FOR WINDWARD PARK
MAUNAWILI, KOOLAUPOKO, OAHU, HAWAII

BY PACIFIC PLANNING & ENGINEERING, INC.

TRAFFIC IMPACT ASSESSMENT REPORT

FOR WINDWARD PARK

MAUNAWILI, KOOLAUPOKO, OAHU, HAWAII
TMK: 4-2-14:2 & 4

December 1988

Prepared for:

Windward Park, Inc.

Prepared by:

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

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INTRODUCTION

Pacific Planning & Engineering, Inc. (PPE) was engaged to undertake a study to identify and assess future traffic impacts to the intersection of Kalanianaole Highway and Kapaa Quarry Road by the proposed Windward Park. This report presents the findings and recommendations of the traffic study.

The report includes a description of the proposed project, existing roadways, traffic conditions, methodology used in developing trip generation and an assessment of traffic impacts resulting from the project.

Project Description

Windward Park, Inc., is proposing to develop an eighteen hole championship golf course at Maunawili, Koolaupoko, Oahu, Hawaii. Figure 1 shows the general project location. The project site is located on 221 acres of conservation district land identified by Tax Map Keys: 4-2-14: 2 & 4.

The proposed development consists of an 18 hole golf course, a driving range with 20 stalls, an informal dining area with 120 seating capacity, supporting kitchen and bar facilities, pro shop, lockers and shower facilities, and twenty vacation cabins. Windward Park's golf course is expected to be used by the general public and tourists. A portion of the tourists are expected to be transported by tour vans to and from the facility. The entire development is planned to be completed in late 1991.

This traffic study report identifies and evaluates the probable impact of the forecasted traffic generated by the proposed golf course. The analysis primarily focuses on the traffic impact at the intersection of Kalanianaole Highway and Kapaa Quarry Road. The study describes the impacts during the afternoon peak hour when traffic from the project is expected to have the most effect on the operation of the intersection of Kalanianaole Highway with Kapaa Quarry Road.

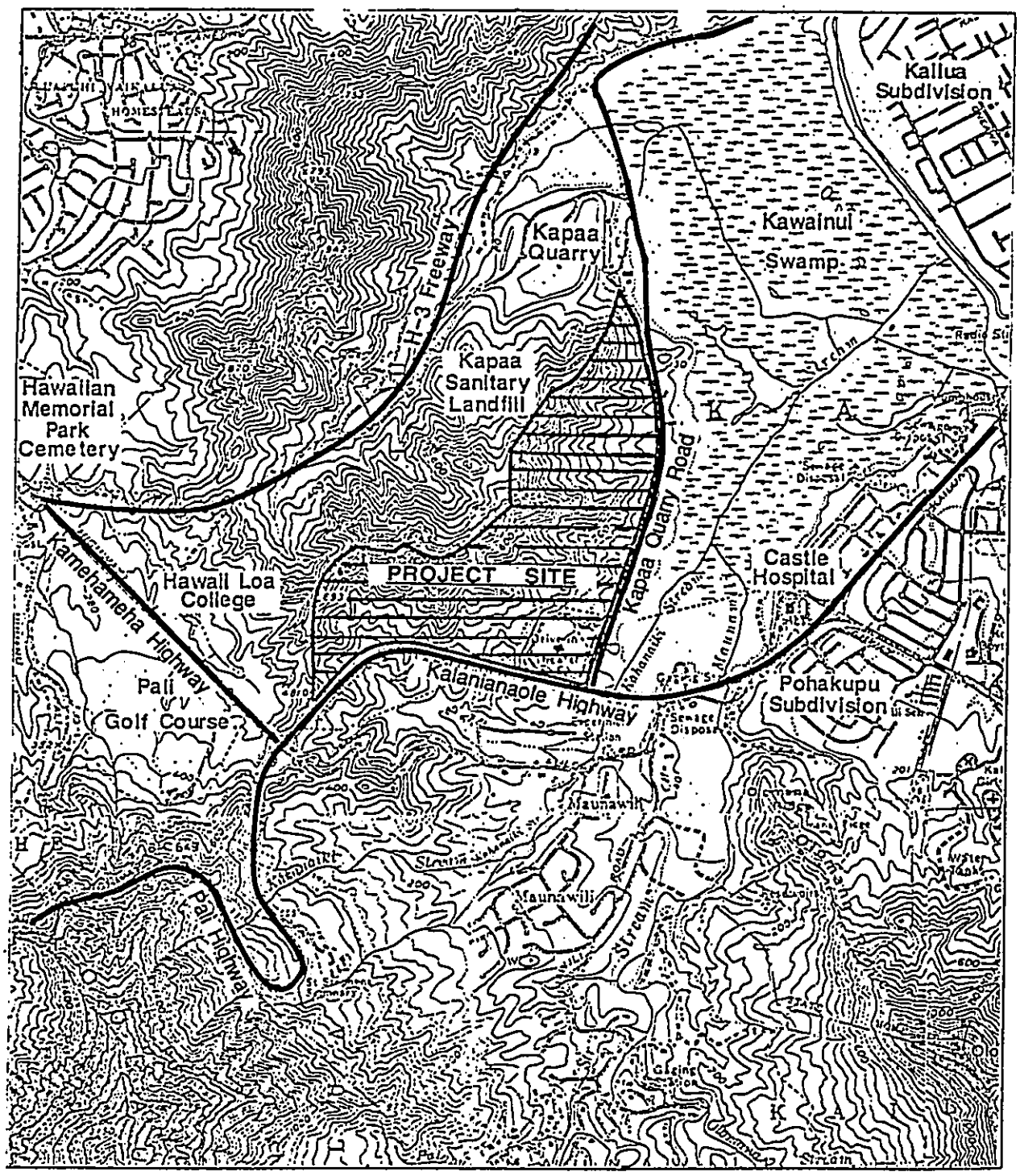


Figure 1. Project Location Map

A review of State Department of Transportation (DOT) traffic count data for Station 40 along Kalanianaole Highway near Castle Hospital and station C-323-A on Pali Highway near the tunnel, indicate that the peak periods generally occurs between 6 to 8 am and 4 to 6 pm, on weekdays. Analysis were conducted for both time periods as a means to identify the more critical condition for the purpose of traffic impact assessment.

EXISTING CONDITIONS

Area Conditions and Roadway System

The proposed project is located on both urban and conservation district land in a largely mountainous area with a land fill, and an existing drive-in theater. The Kailua Drive-In Theater is located on the southeastern corner of the property, and the northwestern corner of Kapaa Quarry Road at Kalanianaole Highway. The drive-in operates seven days a week with gates opening at 5:30 pm Friday through Sunday and at 5:45 pm Monday through Thursday. Generally, the last movie ends between midnight-12:30 am with vehicles leaving the lot soon after. Entrance to the drive-in is from the Kapaa Quarry Access Road. Vehicles can exit the drive-in on either the Kapaa Quarry Access Road or Kalanianaole Highway. There is a 700 vehicle maximum capacity for the drive-in. Occasionally, the drive-in is rented for the use of private parties and it is not the current location of any swap meet nor is such usage planned.

Development of the proposed project will be over the site of the Kailua Drive-In as well as in the surrounding area. Traffic currently generated by the drive-in will no longer be a factor when the project is built.

To the east lies Kawainui Marsh Regional park, to the south lies Maunawili, to the west is located Hawaii Loa College and Pali Golf Course, and to the north is the completed segment of H-3. There are no urban-type uses existing in the general area, nor any other planned for the future. Thus, future traffic on Kalanianaole Highway would not be affected by the immediately adjacent land area to the proposed golf course.

Vehicular access to the proposed golf course and vacation homes will be mainly via Kapaa Quarry Road from the existing intersection with Kalanianaole Highway.

Roadway Conditions

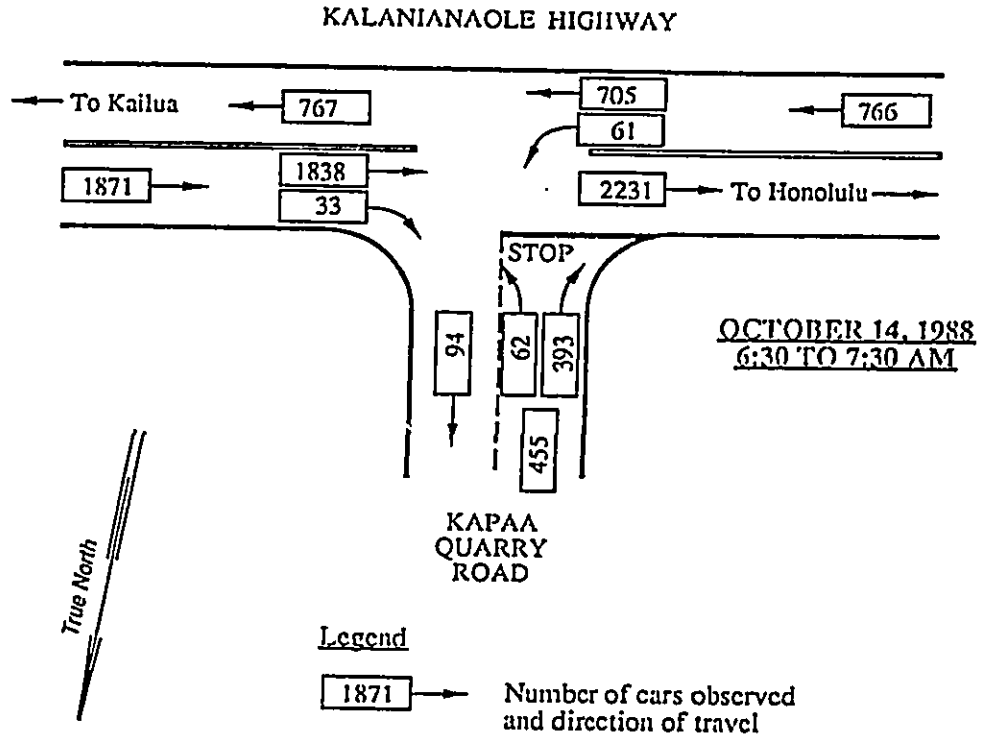
Kalanianaole Highway is a State-maintained highway with four lanes separated by a median guardrail, and paved shoulders. Exclusive left turn lanes are provided for vehicles turning off Kalanianaole Highway at intersections. The posted speed of Kalanianaole Highway is 35 miles per hour (mph) along this section of the highway. This section of the highway extends directly from Pali Highway at the intersection with Kamehameha Highway and provides major access to Kailua and areas toward Waimanalo.

Kapaa Quarry Road is a two-lane, two-way, County-maintained, paved road. The roadway has 12 foot lanes with 4 to 6 foot grassed shoulders. From its intersection with Kalanianaole Highway, it generally heads north to an intersection with Mokapu Boulevard. The intersection lies just east of the interchange with H-3.

The T-intersection of Kalanianaole Highway with Kapaa Quarry Road is signalized with three phases. No crosswalks exist. Phases are provided for the southbound traffic turning right and left onto Kalanianaole Highway from Kapaa Quarry Road, east and westbound traffic on Kalanianaole Highway, and left-turning vehicles turning onto the quarry road. The landfill access road is located about 1.3 miles north of the intersection with Kalanianaole Highway. Sight distances at the intersection are excellent.

Observed Traffic Conditions

Traffic counts along Kalanianaole Highway were obtained from the State DOT. Additional turning movement counts were taken at the intersections of Kalanianaole Highway with Kapaa Quarry Road by Pacific Planning and Engineering, Inc., on Friday, October 14, 1988, between 6:30 and 7:30 am and between 4:30 and 5:30 pm. Figure 2 shows the traffic counts at the intersection during the morning and afternoon peak hours.



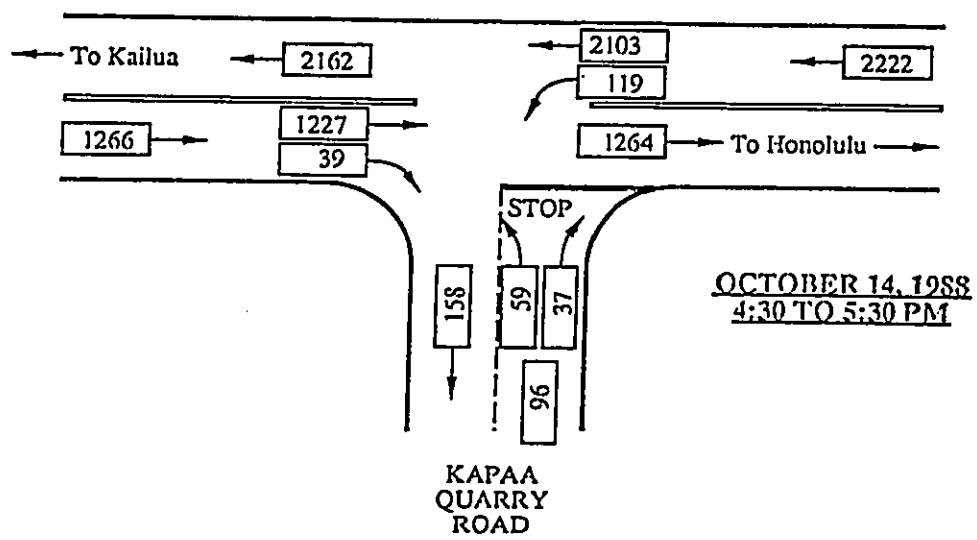


Figure 2. Observed Turning Movements

Manual counts were taken of passenger cars, trucks, buses, bicycles, motorcycles and pedestrians by turning movements and approaches (See Appendix B). During the field counts, the weather was clear and the pavement was dry. The survey was conducted to establish a baseline condition to compare against estimated future traffic.

The following observations were noted at the intersection of Kalanianaole Highway and the Kapaa Quarry Road during the field surveys:

1. Morning peak hour traffic heading to Honolulu backs up along Kalanianaole Highway from the upstream intersection with Kamehameha Highway.
2. Vehicles turning right out of Kapaa Quarry Road encounter little delay, except during periods of heavy queues on Kalanianaole Highway.
3. Vehicles turning left out of Kapaa Quarry Road onto Kalanianaole Highway did not wait more than one full cycle.
4. Truck counts verify the lack of any significant truck effects on the westbound traffic operations.
5. Cars turning left from Kalanianaole Highway onto Kapaa Quarry Road often crossed the southbound stop line.

Level-of-Service Analysis of Existing Traffic

The intersection of Kalanianaole Highway and the existing driveway was analyzed to determine its Level-of-Service (LOS) using the field data from the manual traffic count, the present traffic signal timing, and analysis techniques for signalized intersections from the Highway Capacity Manual (HCM) Special Report 209 (1985 Edition).

The analysis considers physical roadway elements, signal timing, traffic volumes, and other variables. The LOS is determined by the expected amount of vehicle delay for each of the traffic movements of the intersection under study. LOS is classified into six categories ranging from short delays (LOS A) to long traffic delays, greater than 60 seconds (LOS F). Appendix A provides the definitions for each LOS category. At the

intersection of Kalanianaole Highway with Kapaa Quarry Road, the results of LOS analysis are shown in Table 1 below.

Table 1. Level-of-Service--Kalanianaole Hwy @ Kapaa Quarry Road

Turning Movement		Morning	Afternoon
Kalanianaole Highway			
Eastbound	TH[1]	A	C
	LT[2]	A	E
Westbound	TH	B	C
	RT[3]	A	B
Kapaa Quarry Road			
Southbound	LT	A	D
	RT	F	D

[1]Through Traffic [2]Left Turn Movement [3]Right Turn Movement

In the morning peak hour, vehicles turning right from Kapaa Quarry Road onto Kalanianaole Highway encountered long delays (LOS F). All other movements operated at excellent level-of-service with little or no delay.

In the afternoon peak hour, eastbound vehicles turning left from Kalanianaole Highway onto Kapaa Quarry Road encountered long delays (LOS E) and vehicles heading through the intersection along Kalanianaole Highway encountered average delay (LOS C). Southbound vehicles turning left and right from Kapaa Quarry Road onto Kalanianaole Highway encountered long delays (LOS D). Westbound vehicles turning right from Kalanianaole Highway onto Kapaa Quarry Road encounter little delay (LOS B) and vehicles heading through the intersection along Kalanianaole Highway encounter average delays (LOS C).

Analysis for both time periods was conducted to identify the more critical condition for the purpose of traffic impact assessment. Based on the results, the weekday afternoon peak hour was used as a basis for forecasting because it represents the worst case condition.

TRAFFIC IMPACT ANALYSIS

Study Methodology

The focus of the analysis is to determine the impact of the project generated traffic at the intersection of Kalanianaole Highway and the proposed Kapaa Quarry Road, when the development is completed in 1991.

Twenty-four hour traffic counts at the DOT traffic count Station 40 were obtained from the State DOT Highways Division. Manual traffic counts were also taken by Pacific Planning & Engineering, Inc., at the intersection of Kalanianaole Highway with the Kapaa Quarry Road on October 14, 1988.

Future traffic forecasts with and without the project were estimated for 1991 when the development is expected to be opened. The weekday afternoon peak hour was used as a basis for forecasting because it represents the worst case condition. The State DOT 24-hour traffic count station near the project site indicates that traffic is heavier during 4 to 6 pm. The estimated traffic impact is calculated by adding the expected golf course traffic to the estimates of future traffic on Kalanianaole Highway.

Future Highway Improvements

The State Department of Transportation is planning to improve the highway system between the Windward and Leeward sides of the island by building the H-3 Freeway to provide an additional access from the Kaneohe/Kailua area to the Honolulu area. The H-3 Freeway is expected to be completed in the year 1995. Since these improvements will be completed after this project, they were not considered for this report.

The State DOT is presently considering implementing contra-flow lanes on Pali Highway during the morning and afternoon peak hours. The effects of the proposed contra-flow project cannot be stated at this time since the specific alternative has not yet

been identified and none selected. There is a question as to whether a project will be implemented. Based on our general review of the consultant report for the project, Windward Park would not have any major impact on the operation of the reported alternatives still under general consideration by the DOT and impacted communities.

Future Ambient Traffic

Future ambient traffic along Kalanianaole Highway was forecasted based on trend analysis, as shown on Figure 3. The analysis used twenty-four-hour traffic count data over the last nine years on Kalanianaole Highway near Kailua Road and Ulukahiki Street (DOT traffic count station 40). This count station was selected because it is the closest station (approximately a mile east of the project site) and the most representative of the traffic on Kalanianaole Highway.

The results of the trend analysis indicates a 4.7% annual growth in daily traffic on Kalanianaole Highway. This method of estimating future traffic based on past trends was deemed adequate for estimating 1991 traffic along Kalanianaole Highway because of the short term nature of the forecast, and the lack of any substantive development in the area.

Trip Generation

One method to estimate the number of trips generated by the proposed project is based upon trip rates established in the Institute of Transportation Engineers, "Trip Generation Report" (Fourth Edition) 1987. These average vehicle trip rates are based on average conditions and used to calculate vehicle trips entering and exiting different land uses. Caution is noted, however, in the ITE Report on the the application of such average rates. In specific conditions, the Report advises a careful evaluation of " ... special characteristics of the site or the surrounding area."

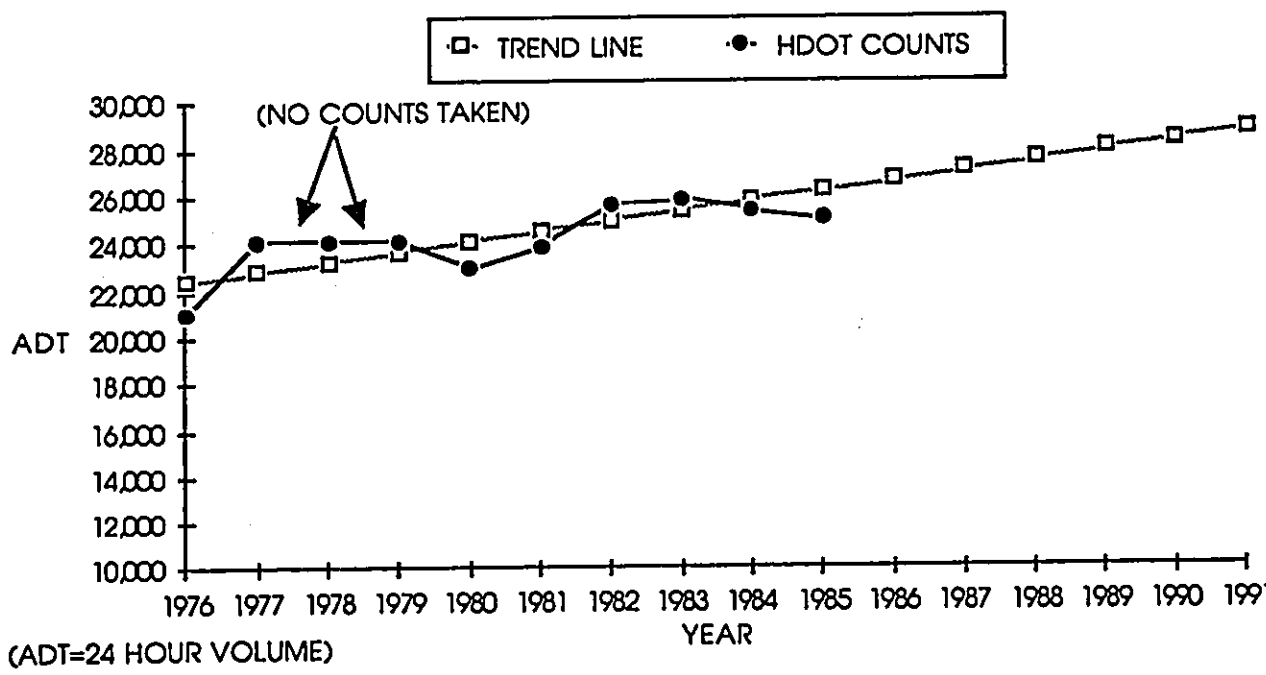


Figure 3. Recorded and Projected Traffic on Kalanianaole Highway

Due to the expected international market for the golf course, the standard ITE rates for Golf Course Use were reviewed for possible adjustment for local conditions. In order to access the applicability of the ITE rates, traffic counts from a similar golf course on Oahu were used to establish independent rates.

The ITE rates are used to calculate vehicles entering and exiting the project during the afternoon peak hour when ambient traffic counts are the heaviest. Vehicle trips are generated based on the type and the amount of the land use. This development consists of the following land uses including an 18 hole golf course, a club house, and 20 vacation cabins. Based on the land uses and the rates it was estimated that 17 vehicles would be entering and 68 exiting the golf course facilities. Six vehicles would be entering and 5 exiting the vacation cabins.

Pearl Country Club golf course was used to obtain independent rates due to its similar market. Pearl golf course is open to the general public and caters to international tourists. On Wednesday, March 9, 1988, between 4:15 and 5:15 pm, 34 vehicles were observed entering and 40 vehicles leaving the golf course. Several of the vehicles observed were vans carrying from 5 to 20 tourists.

A comparison of the standard ITE rates and the rates observed at the local golf course was then made. The results indicate that actual vehicle trips observed at Pearl County Club golf course registered about 30% lower than estimates based on ITE trip generation rates. The ITE rates are based upon empirical data gathered from many different types of courses including municipal, private, 18-hole, 9-hole, with clubhouse, and without clubhouse. Generally the data for Golf Course Use was taken in suburban areas on the mainland USA.

Due to the location and the expected users of the proposed golf course, the independent trip rates obtained at Pearl County Club were deemed more representative of vehicular traffic at the proposed golf course. Therefore, the independent trip rates for the golf course and the ITE trip rates for the vacation cabins were used to estimate traffic generated by the project. The project is estimated to generate 40 trips entering and 45 exiting during the afternoon peak hour.

Trip Distribution

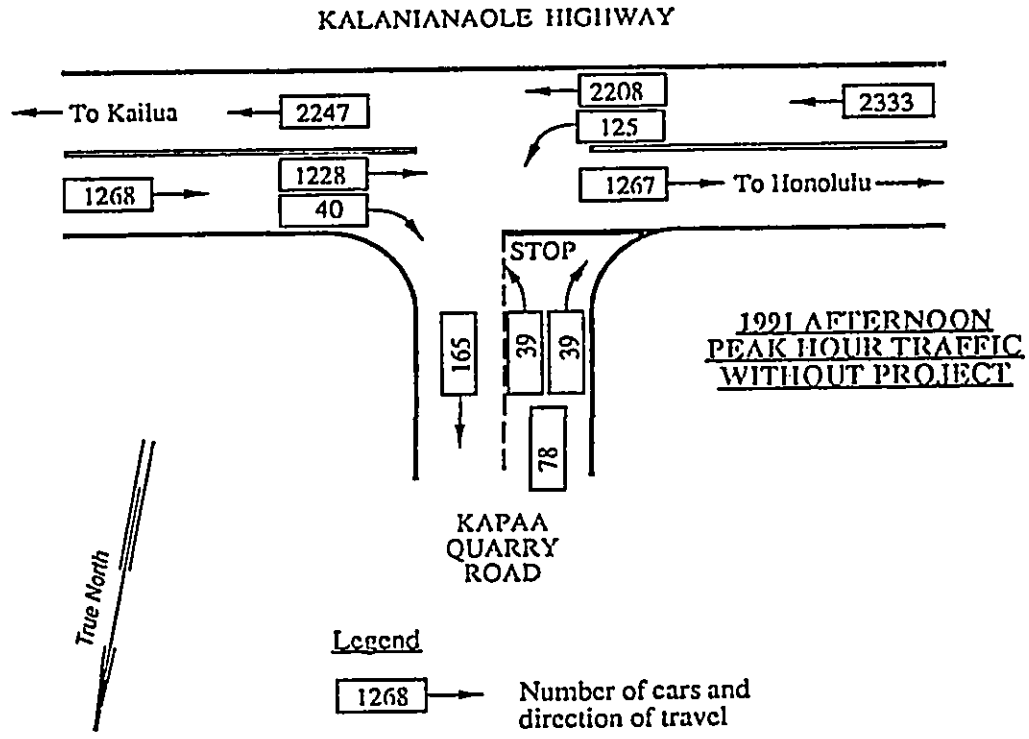
It is assumed that the majority of the vehicles will be arriving from the Honolulu or Kailua direction. Based on the distribution of population, it was estimated that 81% of the vehicles will be arriving from the West or Honolulu direction with 19% from the east direction.

The results of the traffic assignment is given in Table 2, and Figure 4. Referring to Figure 4, it can be seen that the largest volume increases are for the northbound left turn into the Kapaa Quarry Road, and the right turn out of the Kapaa Quarry Road heading South towards Kaneohe.

Table 2. Afternoon Peak Hour Forecast Traffic--Kal Hwy @ Kapaa Quarry Rd

Turning Movement	1988	1991 w/o Golf Course	1991 w/ Golf Course
Kalanianaole Highway			
Westbound TH[1]	2103	2208	2208
LT[2]	119	125	157
Eastbound TH	1227	1228	1228
RT[3]	39	40	48
Kapaa Quarry Road			
Southbound LT	59	62	71
RT	37	39	75

[1]Through Traffic
[2]Left Turn Movement
[3]Right Turn Movement



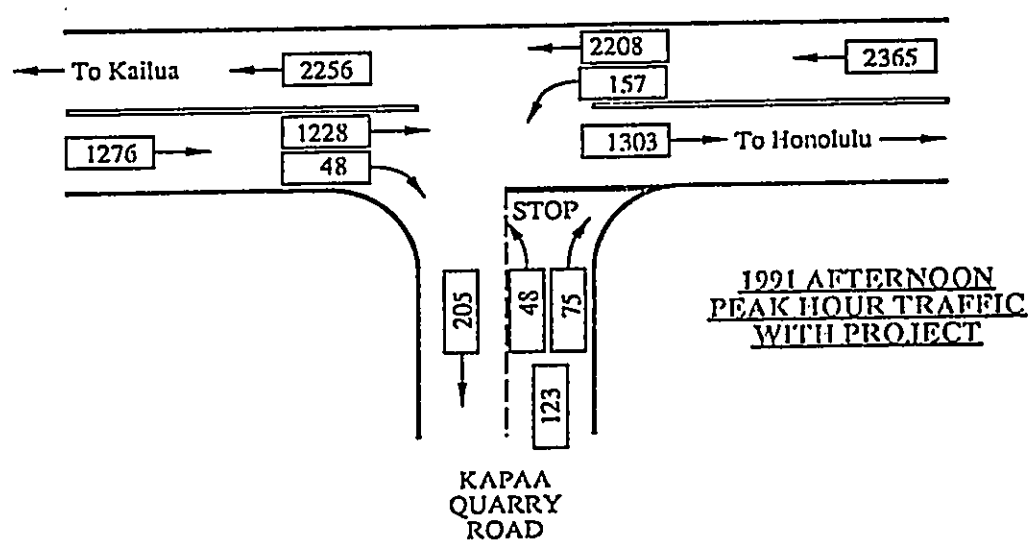


Figure 4. Projected 1991 Traffic Without and With Golf Course
Afternoon Peak Hour

Traffic Impacts

Impacts on traffic resulting from the proposed Windward Park are measured by the change in Level-of-Service (LOS) at the study intersection with and without the project for the afternoon 4:30-5:30 pm peak hour in the year 1991.

Based on the forecasted traffic and present traffic signal timing, the intersection of Kalanianaole Highway with Kapaa Quarry Road was analyzed to determine the LOS for the traffic movements. The analysis was done in accordance with the latest Highway Capacity Manual analysis techniques (Special Report 209, 1985). The results of the LOS analysis are shown in Table 3.

Table 3. Level-of-Service--Kalanianaole Highway @ Kapaa Quarry Road

Turning Movement		1988	1991 w/o Golf Course	1991 w/ Golf Course	1991 w/ GC Change Timing
Kalanianaole Highway					
Eastbound	TH	C	C	C	B
	LT	E	E	F	D
Westbound	TH	C	C	C	B
	RT	B	B	B	B
Kapaa Quarry Road					
Eastbound	LT	D	D	D	C
	RT	D	D	D	C

[1]Through Traffic [2]Left Turn Movement [3]Right Turn Movement

The results indicate that traffic along Kalanianaole Highway will not need to stop or be delayed beyond normal driving conditions except for the left turn movement from Kalanianaole Highway onto Kapaa Quarry Road, which presently operates at LOS E and drops to LOS F with the project. All other movements remain at the same level-of-service as present.

Improvement Analysis

To improve the level-of service at the study intersection, the present traffic signal timing was analyzed with the objective of achieving a better balance in the green times for all the traffic movements.

The analysis indicates that by decreasing the overall traffic signal cycle length from 145 to 90 seconds and providing about 8% more green time to the left turn movement from Kalanianaole Highway onto Kapaa Quarry Road, the overall intersection delay is expected to decrease. Operational analysis worksheets are shown in Appendix C.

The results are shown on Table 3 on the previous page. The left turn movement from Kalanianaole Highway onto Kapaa Quarry Road is expected to improve from LOS E to LOS D. Through movements on Kalanianaole Highway improve from LOS C to LOS B and turning movements out of Kapaa Quarry Road improve from LOS D to LOS C.

CONCLUSION AND RECOMMENDATIONS

The proposed Windward Park project is not expected to have a significant adverse impact on traffic flow along Kalanianaole Highway, at the intersection with Kapaa Quarry Road. As a result, no improvements other than updating of the signal timing is recommended.

Traffic flow quality analysis which measures the expected change in delay time to all traffic was conducted for the intersection of Kalanianaole Highway with Kapaa Quarry Road for the conditions with and without the project. The results indicate that the intersection will continue to operate at or near the same level of traffic operations as present during the morning and afternoon periods.

Most of the forecast traffic exiting the golf course is projected to turn right onto Kalanianaole Highway heading West towards Honolulu. While the number of vehicles will be negligible in the morning peak hour, the right turn movement will encounter problems due to the already congested flow from the downstream Kamehameha Highway intersection and on Pali Highway inbound towards Honolulu.

Due to heavy traffic on Kalanianaole Highway travelling in both directions, traffic turning left from Kalanianaole Highway onto Kapaa Quarry Road will experience average to long delays. However, the projected "D" level-of-service for this turning movement is acceptable. Because of the frequent crossing of the southbound stop line by left-turning vehicles, relocation of the stop line should be further evaluated.

The effects of the planned H-3 Freeway and the proposed contra-flow project were not considered in this report as previously stated. The H-3 Freeway is expected to be completed after the proposed Windward Park. The effects of the proposed contraflow project cannot be stated at this time since the specific alternative has not yet been selected.

One of the positive impacts of this project will be the removal of traffic generated by the drive-in theatre resulting in a net overall decrease in the number of vehicles entering and exiting from the project site. Although the present drive-in theatre traffic occurs after the pm peak hour, it does have an adverse impact for a short duration when nearly 700 vehicles attempt to exit onto Kalanianaole Highway at the same time.

APPENDIX A

DEFINITION OF LEVEL-OF-SERVICE

AND

LEVEL-OF-SERVICE FOR SIGNALIZED INTERSECTIONS

APPENDIX A
DEFINITION OF LEVEL-OF-SERVICE

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.

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

Level-of-service A 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.

Level-of-service B 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.

Level-of-service C 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.

LEVEL OF SERVICE FOR SIGNALIZED INTERSECTIONS

Level of service for signalized intersections is defined in terms of *delay*. Delay is a measure of driver discomfort, frustration, fuel consumption, and lost travel tim. Specifically, level-of-service criteria are stated in terms of the average stopped delay per vehicle for a 15-minute analysis period.

Level-of Service A describes operations with very low delay, i.e., less than 5.0 sec per vehicle. This occurs when progression is extremely favorable, and most vehicles arrive during the green phase. Most vehicles do not stop at all. Short cycle lengths may also contribute to low delay.

Level-of-Service B describes operations with delay in the range of 5.1 to 15.0 sec per vehicle. This generally occurs with good progression and/or short cycle lengths. More vehicles stop than for LOS A, causing higher levels of average delay.

Level-of-Service C describes operations with delay in the range of 15.1 to 25.0 sec per vehicle. These higher delays may result from fair progression and/or longer cycle lengths. Individual cycle failures may begin to appear in this level. The number of vehicles stopping is significant at this level, although many still pass through the intersection without stopping.

Level-of-Service D describes operations with delay in the range of 25.1 to 40.0 sec per vehicle. At level D, the influence of congestion becomes more noticeable. Longer delays may result from some combination of unfavorable progression, long cycle lengths, or a high *v/c* ratios (volume of cars to capacity of intersection). Many vehicles stop, and the proportion of vehicles not stopping declines. Individual cycle failures are noticeable.

Level-of-Service E describes operations with delay in the range of 40.1 to 60.0 sec per vehicle. This is considered to be the limit of acceptable delay. These high delay values generally indicate poor progression, long cycle length, and high *v/c* ratios. Individual cycle failures are frequent occurrences.

Level-of-Service F describes operations with delay in excess of 60.0 sec per vehicle. This is considered to be unacceptable to most drivers. This condition often occurs with oversaturation, i.e., when arrival flow rates exceed the capacity of the intersection. It may also occur at high v/c ratios below 1.00 with many individual cycle failures. Poor progression and long cycle lengths may also be major contributing causes to such delay levels.

REFERENCE: Highway Capacity Manual (Special Report 209, 1985)

APPENDIX B

MANUAL TRAFFIC COUNT DATA

APPENDIX B

MANUAL TRAFFIC COUNT DATA

Location: Kalanianaole Highway @ Kapaa Quarry Road

Date: October 14, 1988

Time (pm)	Kalanianaole Westbound		Kalanianaole Eastbound		Kapaa Quarry Road. Southbound		Total All Approaches
	RT	TH	TH	LT	RT	LT	
4:30-4:45	10	304	532	31	19	18	914
4:45-5:00	13	276	547	29	6	16	887
5:00-5:15	10	333	523	29	6	14	915
5:15-5:30	6	314	501	30	6	11	868
Peak Hour Total	39	1227	2103	119	37	59	3584

Note:

There were a total of 3551 cars, 23 City Transit buses, and 12 trucks counted during the Friday 4:30-5:30 pm peak hour on October 14, 1988.

APPENDIX C

SIGNALIZED INTERSECTION ANALYSIS

FOR

INTERSECTION OF

KALANIANAOLE HIGHWAY WITH KAPAA QUARRY ROAD

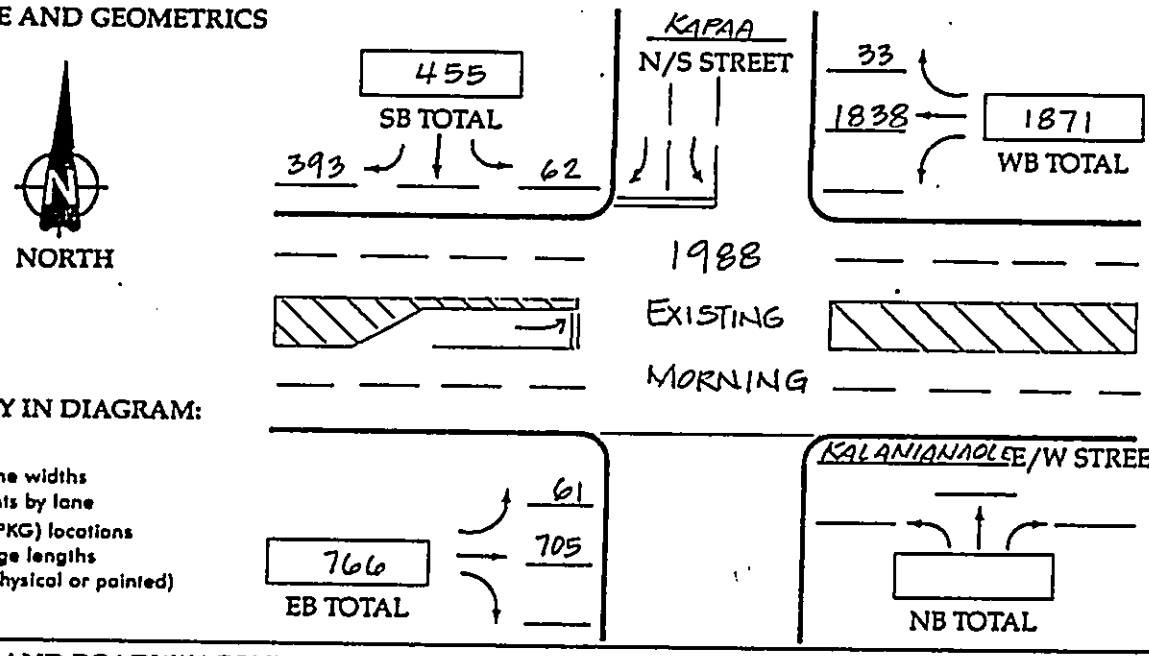
INPUT WORKSHEET

Intersection: KALANIANAOLE HWY / KAPAA QUARRY RD Date: _____

Analyst: _____ Time Period Analyzed: 6:30 - 7:30 AM Area Type: ☐ CBD ☒ Other

Project No.: WINDWARD PARK City/State: _____

VOLUME AND GEOMETRICS



IDENTIFY IN DIAGRAM:

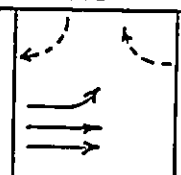
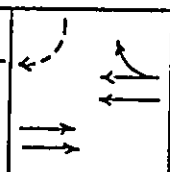
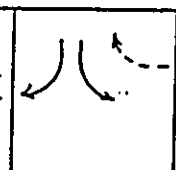
1. Volumes
2. Lanes, lane widths
3. Movements by lane
4. Parking (PKG) locations
5. Bay storage lengths
6. Islands (physical or painted)
7. Bus stops

TRAFFIC AND ROADWAY CONDITIONS

Approach	Grade (%)	% HV	Adj. Pkg. Lane		Buses (N_B)	PHF	Conf. Peds. (peds./hr)	Pedestrian Button		Arr. Type
			Y or N	N_m				Y or N	Min. Timing	
EB	-2	0	N	0	0	0.69 0.79	0	N	-	3
WB.	0	0	N	0	0	0.94 0.63	0	N	-	3
NB	-	-	-	-	-	-	-	-	-	-
SB	0	0	N	0	0	0.86 0.77	0	N	-	3

Grade: + up, − down
HV: veh. with more than 4 wheels
N_m: pkg. maneuvers/hr
N_B: buses stopping/hr
PHF: peak-hour factor
Conf. Peds: Conflicting peds./hr
Min. Timing: min. green for pedestrian crossing
Arr. Type: Type 1-5

PHASING

DIAGRAM								
Timing	G= 15 Y+R=13	G= 84 Y+R=62	G= 30 Y+R=16	G= . Y+R=	G= Y+R=	G= Y+R=	G= Y+R=	G= Y+R=
Pretimed or Actuated								

Protected turns ——↗ Permitted turns ——- Pedestrian Cycle Length 146 Sec

VOLUME ADJUSTMENT WORKSHEET

1 Appr	2 Mvt	3 Mvt Volume (vph)	4 Peak Hour Factor PHF	5 Flow Rate vp (vph)	6 Lane Group	7 Flow rate in Lane Group vg (vph)	8 Number of Lanes N	9 Lane Utilization Factor U	10 Adj. Flow v (vph)	11 Prop. of LT or RT Plt or Prt
EB	LT	61	0.69	88		88	1	1.00	88	1
	TH	705	0.79	892		892	2	1.00	892	0
	RT					0	0	0.00	0	
WB	LT					0	0	0.00	0	1
	TH	1838	0.94	1955		1955	2	1.00	1955	0
	RT	33	0.63	52		52	1	1.00	52	
NB	LT	0				0	0		0	0
	TH	0				0	0		0	0
	RT	0				0	0		0	
SB	LT	62	0.86	72		72	1	1.00	72	1
	TH									
	RT	393	0.77	510		510	1	1.00	510	

SATURATION FLOW ADJUSTMENT WORKSHEET

LANE GROUPS		3	4	ADJUSTMENT FACTORS								13
1 Appr	2 Lane Group Movements	Ideal Sat. Flow (pcphgpl)	No. of Lanes N	5 Lane Width fw	6 Heavy Veh fhv	7 Grade fg	8 Pkg fp	9 Bus Block fbb	10 Area Type fa	11 Right Turn frt	12 Left Turn flt	Adj. Sat. Flow Rate s (vphg)
EB		1800	1	1.00	1.00	1.01	1.00	1.00	1.00	1.00	0.95	1727
		1800	2	1.00	1.00	1.01	1.00	1.00	1.00	1.00	1.00	3636
WB												
		1800	2	1.00	0.99	1.00	1.00	1.00	1.00	0.99	1.00	3528
		1800	1	1.00	0.99	1.00	1.00	1.00	1.00	1.00	0.85	1515
NB												
SB		1800	1	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1800
		1800	1	1.00	1.00	1.00	1.00	1.00	1.00	0.99	0.85	1515

CAPACITY ANALYSIS WORKSHEET

LANE GROUP		3. Adj. Flow Rate v (vph)	4. Adj. Sat. Flow Rate s (vphg)	5. Flow Ratio v/s	6. Green Ratio g/C	7. Lane Group Cap c (vph)	8. v/c Ratio X	9. Critical ? Lane Group
1 Appr.	2. Lane Group Movements							
EB		88	1727	0.051	0.103	178	0.494	x
		892	3636	0.245	0.678	2465	0.362	
WB		0						
		1955	3528	0.554	0.575	2029	0.964	x
		52	1515	0.034	0.575	871	0.060	
NB								
SB		72	1800	0.040	0.205	369	0.195	
		357	1515	0.236	0.205	311	1.148	x
C=	90		52		0.883			

Cycle Length, C=
146 sec

Lost Time Per Cycle, L=
10 sec

Σ (v/s)= 0.84

Xc=(Σ (v/s)xC)/(C-L)= 0.90

LEVEL-OF-SERVICE WORKSHEET

Lane Group		First Term Delay				Second Term Delay				Total Delay and LOS		
1 Appr.	2. Lane Group Move-ments	3. v/c Ratio X	4. Green Ratio g/C	5. Cycle Length C (sec)	6. Delay d1 (s/veh)	7. Lane Grp Cap c (vph)	8. Delay d2 (s/veh)	9. Prog Factor PF	10. lane Group Delay (s/veh)	11. Lane Group LOS	12. Appr Delay (s/veh)	13. Appr LOS
EB		0.494	0.103	0	0.00	178	1.78	1.00	1.78	A	0.19	A
		0.362	0.678	0	0.00	2465	0.04	0.85	0.03	A		
WB											7.76	B
		0.964	0.575	0	0.00	2029	9.38	0.85	7.97	B		
		0.060	0.575	0	0.00	871	0.00	1.00	0.00	A		
NB											NA	NA
SB		0.195	0.205	0	0.00	369	0.03	1.00	0.03	A	86.42	F
		1.148	0.205	0	0.00	311	98.62	1.00	98.62	F		

Intersection Delay= 18.51 sec/veh
Intersection LOS= C

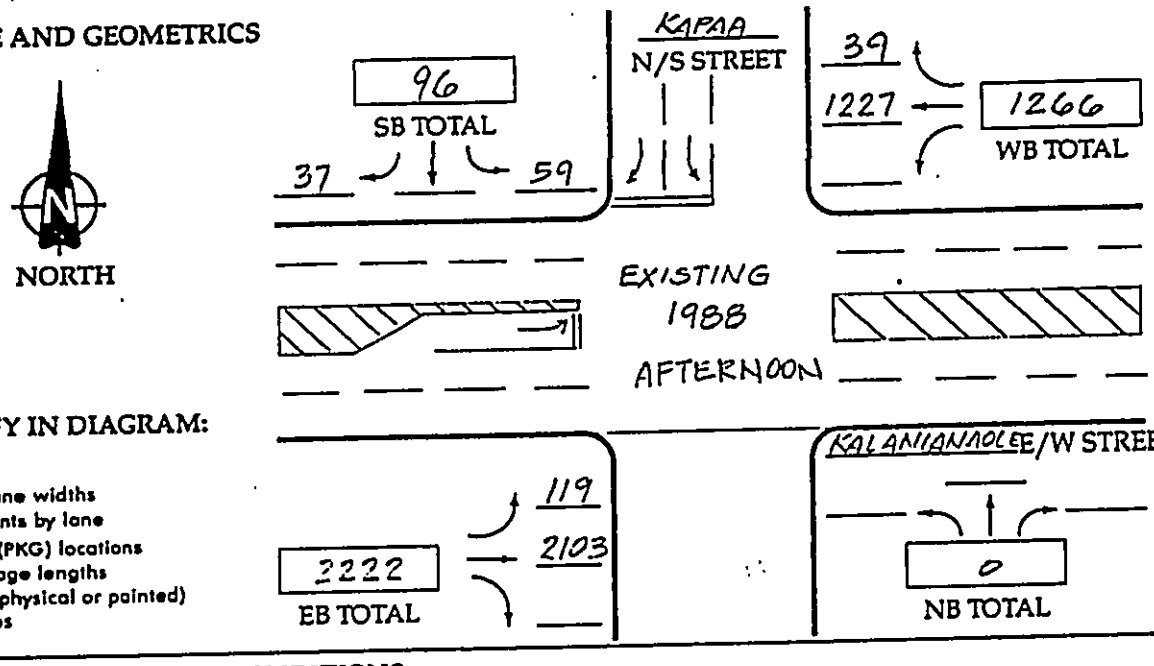
INPUT WORKSHEET

Intersection: KALANIANAOLE HWY / KAPAA QUARRY RD Date: _____

Analyst: _____ Time Period Analyzed: 4:30 - 5:30 PM Area Type: ☐ CBD ☒ Other

Project No.: WINDWARD PARK City/State: _____

VOLUME AND GEOMETRICS



IDENTIFY IN DIAGRAM:

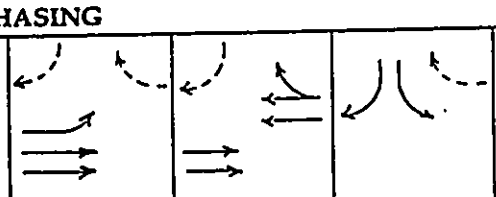
1. Volumes
2. Lanes, lane widths
3. Movements by lane
4. Parking (PKG) locations
5. Bay storage lengths
6. Islands (physical or painted)
7. Bus stops

TRAFFIC AND ROADWAY CONDITIONS

Approach	Grade (%)	% HV	Adj. Pkg. Lane Y or N	Adj. Pkg. Lane N_m	Buses (N_B)	PHF	Conf. Peds. (peds./hr)	Pedestrian Button Y or N	Pedestrian Button Min. Timing	Arr. Type
EB	-2	0	N	0	0	0.96	0	N	-	3
WB	0	2	N	0	0	0.92 0.75	0	N	-	3
NB	-	-	-	-	-	-	-	-	-	-
SB	0	0	N	0	0	0.82 0.49	0	N	-	3

Grade: + up, − down
HV: veh. with more than 4 wheels
N_m: pkg. maneuvers/hr
N_B: buses stopping/hr
PHF: peak-hour factor
Conf. Peds: Conflicting peds./hr
Min. Timing: min. green for pedestrian crossing
Arr. Type: Type 1-5

PHASING

DIAGRAM								
Timing	G = 15 Y+R = 131	G = 84 Y+R = 62	G = 30 Y+R = 116	G = Y+R =	G = Y+R =	G = Y+R =	G = Y+R =	G = Y+R =
Prelimed or Actuated								

Protected turns ——→ Permitted turns - - -→ --------Pedestrian Cycle Length 146 Sec

VOLUME ADJUSTMENT WORKSHEET

1 Appr	2 Mvt	3 Mvt Volume (vph)	4 Peak Hour Factor PHF	5 Flow Rate vp (vph)	6 Lane Group	7 Flow rate in Lane Group vg (vph)	8 Number of Lanes N	9 Lane Utilization Factor U	10 Adj. Flow v (vph)	11 Prop. of LT or RT Plt or Prt
EB	LT	119	0.96	124		124	1	1.00	124	1
	TH	2103	0.96	2191		2191	2	1.00	2191	0
	RT					0	0	0.00	0	
WB	LT					0	0	0.00	0	1
	TH	1227	0.92	1334		1334	2	1.00	1334	0
	RT	39	0.75	52		52	1	1.00	52	
NB	LT	0				0	0		0	
	TH	0				0	0		0	
	RT	0				0	0		0	
SB	LT	59	0.82	72		72	1	1.00	72	1
	TH									
	RT	37	0.49	76		76	1	1.00	76	

SATURATION FLOW ADJUSTMENT WORKSHEET

LANE GROUPS				ADJUSTMENT FACTORS								
1 Appr	2 Lane Group Movements	3 Ideal Sat. Flow (pcphgpl)	4 No. of Lanes N	5 Lane Width fw	6 Heavy Veh fhv	7 Grade fg	8 Pkg fp	9 Bus Block fbb	10 Area Type fa	11 Right Turn frt	12 Left Turn flt	13 Adj. Sat. Flow Rate s (vphg)
EB		1800	1	1.00	1.00	1.01	1.00	1.00	1.00	1.00	0.95	1727
		1800	2	1.00	1.00	1.01	1.00	1.00	1.00	1.00	1.00	3636
WB												
		1800	2	1.00	0.99	1.00	1.00	1.00	1.00	0.99	1.00	3528
		1800	1	1.00	0.99	1.00	1.00	1.00	1.00	1.00	0.85	1515
NB												
SB		1800	1	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1800
		1800	1	1.00	1.00	1.00	1.00	1.00	1.00	0.99	0.85	1515

CAPACITY ANALYSIS WORKSHEET

LANE GROUP		3. Adj. Flow Rate v (vph)	4. Adj. Sat. Flow Rate s (vphg)	5. Flow Ratio v/s	6. Green Ratio g/C	7. Lane Group Cap c (vph)	8. v/c Ratio X	9. Critical ? Lane Group
1 Appr	2. Lane Group Movements							
EB		124	1727	0.072	0.116	200	0.620	x
		2191	3636	0.603	0.678	2465	0.889	
WB								
		1334	3528	0.378	0.562	1983	0.673	x
		52	1515	0.034	0.562	851	0.061	
NB								
SB		72	1800	0.040	0.205	369	0.195	x
		46	1515	0.030	0.205	311	0.148	
C=	55		12		0.883			

Cycle Length, C= 146 sec

Σ (v/s)= 0.49

Lost Time Per Cycle, L= 17 sec

Xc=(Σ (v/s)xC)/(C-L)= 0.55

0.932

LEVEL-OF-SERVICE WORKSHEET

Lane Group		First Term Delay				Second Term Delay				Total Delay and LOS		
1 Appr.	2. Lane Group Move-ments	3. v/c Ratio X	4. Green Ratio g/C	5. Cycle Length C (sec)	6. Delay d1 (s/veh)	7. Lane Grp Cap c (vph)	8. Delay d2 (s/veh)	9. Prog Factor PF	10. lane Group Delay (s/veh)	11. Lane Group LOS	12. Appr Delay (s/veh)	13. Appr LOS
EB		0.620	0.116	146	46.71	200	4.02	1.00	50.73	E	16.95	C
		0.889	0.678	146	14.48	2465	3.21	0.85	15.04	C		
WB											14.95	B
		0.673	0.562	146	17.12	1983	0.64	0.85	15.10	C		
		0.061	0.562	146	11.02	851	0.00	1.00	11.02	B		
NB											NA	NA
SB		0.195	0.205	146	36.52	369	0.03	1.00	36.55	D	36.36	D
		0.148	0.205	146	36.16	311	0.02	1.00	36.18	D		

Intersection Delay= 16.98 sec/veh
Intersection LOS= C

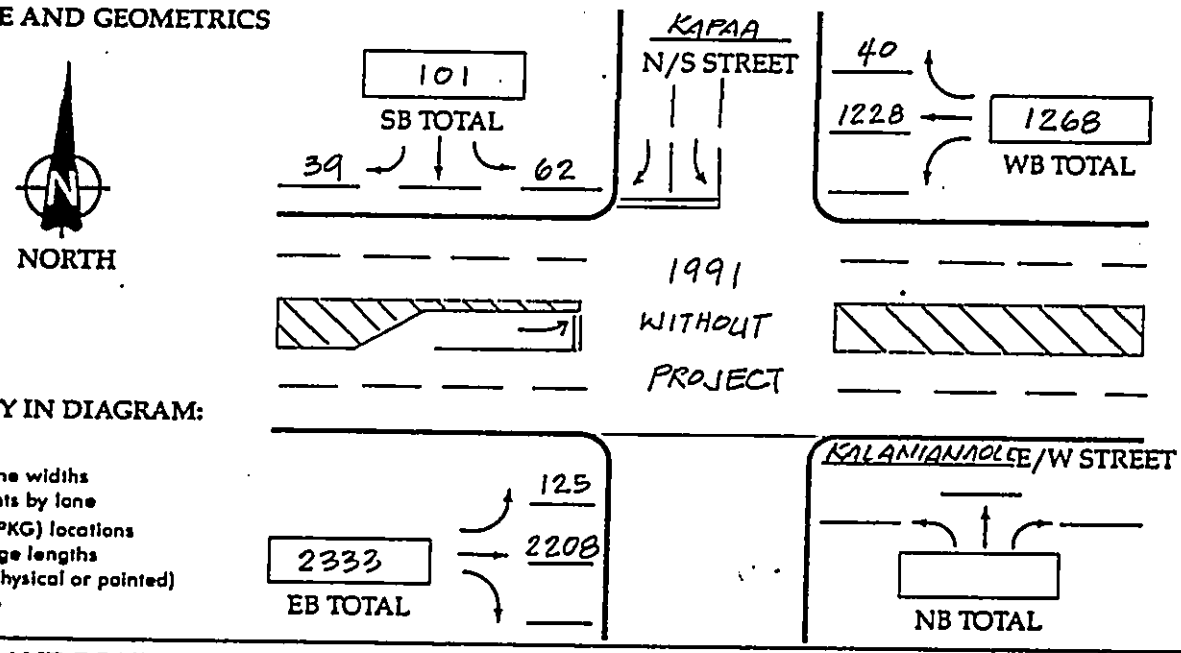
INPUT WORKSHEET

Intersection: KALANIANAOLE HWY / KAPAA QUARRY RD Date: _____

Analyst: _____ Time Period Analyzed: 4:30 - 5:30 PM Area Type: ☐ CBD ☒ Other

Project No.: WINDWARD PARK City/State: _____

VOLUME AND GEOMETRICS



IDENTIFY IN DIAGRAM:

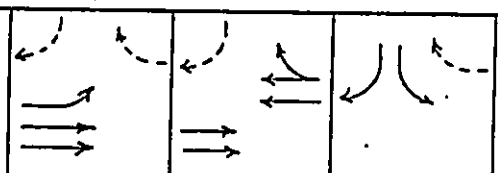
1. Volumes
2. Lanes, lane widths
3. Movements by lane
4. Parking (PKG) locations
5. Bay storage lengths
6. Islands (physical or painted)
7. Bus stops

TRAFFIC AND ROADWAY CONDITIONS

Approach	Grade (%)	% HV	Adj. Pkg. Lane Y or N	Adj. Pkg. Lane N_m	Buses (N_B)	PHF	Conf. Peds. (peds./hr)	Pedestrian Button Y or N	Pedestrian Button Min. Timing	Arr. Type
EB	-2	0	N	0	0	0.96	0	N	-	3
WB	0	2	N	0	0	0.92 0.75	0	N	-	3
NB	-	-	-	-	-	-	-	-	-	-
SB	0	0	N	0	0	0.82 0.49	0	N	-	3

Grade: + up, − down
HV: veh. with more than 4 wheels
N_m: pkg. maneuvers/hr
N_B: buses stopping/hr
PHF: peak-hour factor
Conf. Peds: Conflicting peds./hr
Min. Timing: min. green for pedestrian crossing
Arr. Type: Type 1-5

PHASING

DIAGRAM								
Timing	G= 15 Y+R=131	G= 84 Y+R=62	G= 30 Y+R=116	G= Y+R=	G= Y+R=	G= Y+R=	G= Y+R=	G= Y+R=
Pretimed or Actuated								

Protected turns ⟶ Permitted turns ⇢ Pedestrian

Cycle Length 146 Sec

VOLUME ADJUSTMENT WORKSHEET

1 Appr	2 Mvt	3 Mvt Volume (vph)	4 Peak Hour Factor PHF	5 Flow Rate vp (vph)	6 Lane Group	7 Flow rate in Lane Group vg (vph)	8 Number of Lanes N	9 Lane Utilization Factor U	10 Adj. Flow v (vph)	11 Prop. of LT or RT Plt or Prt
EB	LT	125	0.96	130		130	1	1.00	130	1
	TH	2208	0.96	2300		2300	2	1.00	2300	0
	RT					0	0	0.00	0	
WB	LT					0	0	0.00	0	
	TH	1228	0.92	1335		1335	2	1.00	1335	0
	RT	40	0.75	53		53	1	1.00	53	1
NB	LT	0				0	0		0	
	TH	0				0	0		0	
	RT	0				0	0		0	
SB	LT	62	0.82	76		76	1	1.00	76	1
	TH									
	RT	39	0.49	80		80	1	1.00	80	1

SATURATION FLOW ADJUSTMENT WORKSHEET

LANE GROUPS				ADJUSTMENT FACTORS								
1 Appr	2 Lane Group Movements	3 Ideal Sat. Flow (pcphgpl)	4 No. of Lanes N	5 Lane Width fw	6 Heavy Veh fhv	7 Grade fg	8 Pkg fp	9 Bus Block fbb	10 Area Type fa	11 Right Turn frt	12 Left Turn flt	13 Adj. Sat. Flow Rate s (vphg)
EB		1800	1	1.00	1.00	1.01	1.00	1.00	1.00	1.00	0.95	1727
		1800	2	1.00	1.00	1.01	1.00	1.00	1.00	1.00	1.00	3636
WB												
		1800	2	1.00	0.99	1.00	1.00	1.00	1.00	0.99	1.00	3528
		1800	1	1.00	0.99	1.00	1.00	1.00	1.00	1.00	0.85	1515
NB												
SB		1800	1	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1800
		1800	1	1.00	1.00	1.00	1.00	1.00	1.00	0.99	0.85	1515

CAPACITY ANALYSIS WORKSHEET

LANE GROUP		3. Adj. Flow Rate v (vph)	4. Adj. Sat. Flow Rate s (vphg)	5. Flow Ratio v/s	6. Green Ratio g/C	7. Lane Group Cap c (vph)	8. v/c Ratio X	9. Critical ? Lane Group
1 Appr.	2. Lane Group Movements							
EB		130	1727	0.075	0.116	200	0.650	x
		2300	3636	0.633	0.678	2465	0.933	
WB								
		1335	3528	0.378	0.562	1983	0.673	x
		53	1515	0.035	0.562	851	0.062	
NB								
SB		76	1800	0.042	0.205	369	0.206	x
		48	1515	0.032	0.205	311	0.154	
c=	48.857142857		13		0.883			

Σ (v/s)= 0.50

Cycle Length, C=
146 sec

Xc=(Σ (v/s)xC)/(C-L)= 0.57

Lost Time Per Cycle, L=
17 sec

0.932

LEVEL-OF-SERVICE WORKSHEET

Lane Group		First Term Delay				Second Term Delay				Total Delay and LOS		
1 Appr.	2. Lane Group Move-ments	3. v/c Ratio X	4. Green Ratio g/C	5. Cycle Length C (sec)	6. Delay d1 (s/veh)	7. Lane Grp Cap c (vph)	8. Delay d2 (s/veh)	9. Prog Factor PF	10. lane Group Delay (s/veh)	11. Lane Group LOS	12. Appr Delay (s/veh)	13. Appr LOS
EB		0.650	0.116	146	46.89	200	4.95	1.00	51.84	E	19.70	C
		0.933	0.678	146	15.66	2465	5.37	0.85	17.88	C		
WB											14.94	B
		0.673	0.562	146	17.12	1983	0.64	0.85	15.10	C		
		0.062	0.562	146	11.03	851	0.00	1.00	11.03	B		
NB											NA	NA
SB		0.206	0.205	146	36.61	369	0.04	1.00	36.65	D	36.43	D
		0.154	0.205	146	36.21	311	0.02	1.00	36.23	D		

Intersection Delay= 18.69 sec/veh
Intersection LOS= C

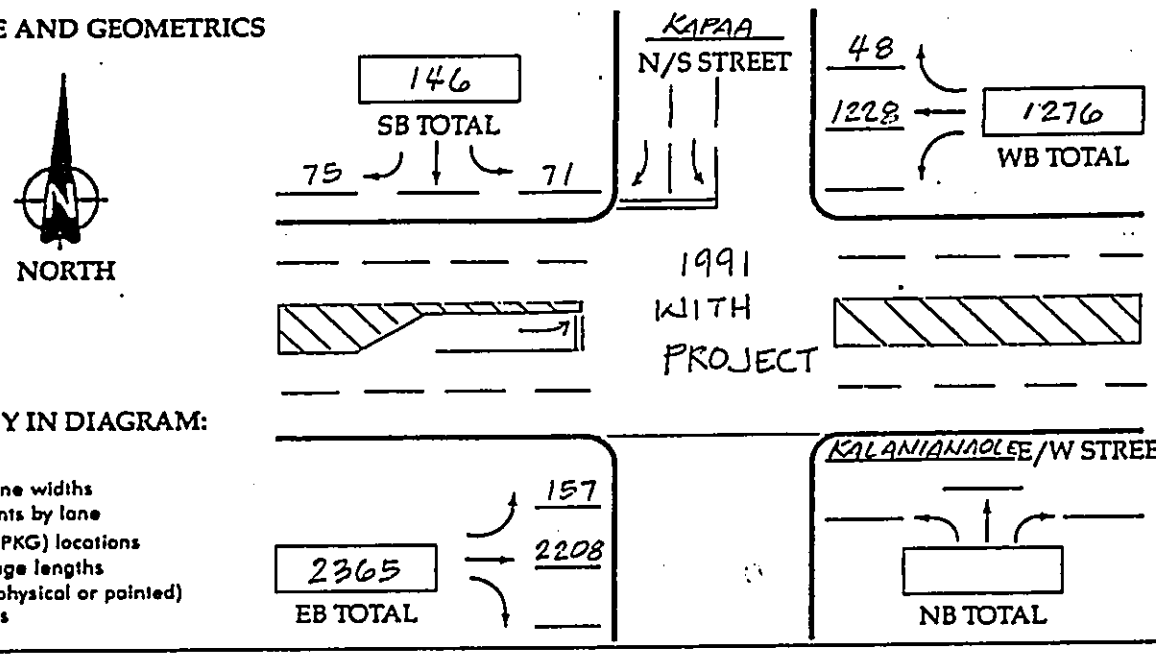
INPUT WORKSHEET

Intersection: KALANIANAOLE HWY / KAPAA QUARRY RD Date: _____

Analyst: _____ Time Period Analyzed: 4:30 - 5:30 PM Area Type: ☐ CBD ☑ Other

Project No.: WINDWARD PARK City/State: _____

VOLUME AND GEOMETRICS



IDENTIFY IN DIAGRAM:

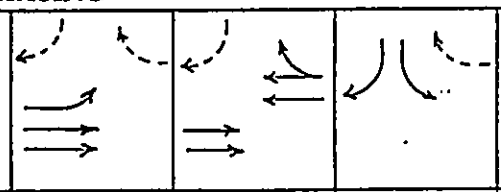
1. Volumes
2. Lanes, lane widths
3. Movements by lane
4. Parking (PKG) locations
5. Bay storage lengths
6. Islands (physical or painted)
7. Bus stops

TRAFFIC AND ROADWAY CONDITIONS

Approach	Grade (%)	% HV	Adj. Pkg. Lane Y or N	Adj. Pkg. Lane N_m	Buses (N_B)	PHF	Conf. Peds. (peds./hr)	Pedestrian Button Y or N	Pedestrian Button Min. Timing	Arr. Type
EB	-2	0	N	0	0	0.96	0	N	-	3
WB.	0	2	N	0	0	0.92 0.75	0	N	-	3
NB	-	-	-	-	-	-	-	-	-	3
SB	0	0	N	0	0	0.82 0.49	0	N	-	3

Grade: + up, − down
HV: veh. with more than 4 wheels
N_m: pkg. maneuvers/hr
N_B: buses stopping/hr
PHF: peak-hour factor
Conf. Peds: Conflicting peds./hr
Min. Timing: min. green for pedestrian crossing
Arr. Type: Type 1-5

PHASING

DIAGRAM								
Timing	G = 15 Y+R = 13	G = 84 Y+R = 62	G = 30 Y+R = 116	G = Y+R =	G = Y+R =	G = Y+R =	G = Y+R =	G = Y+R =
Prelimed or Actuated								

Protected turns ⤳ Permitted turns ⤳ --------Pedestrian Cycle Length 146 Sec

VOLUME ADJUSTMENT WORKSHEET

1 Appr	2 Mvt	3 Mvt Volume (vph)	4 Peak Hour Factor PHF	5 Flow Rate vp (vph)	6 Lane Group	7 Flow rate in Lane Group vg (vph)	8 Number of Lanes N	9 Lane Utilization Factor U	10 Adj. Flow v (vph)	11 Prop. of LT or RT Plt or Prt
EB	LT	157	0.96	164		164	1	1.00	164	1
	TH	2208	0.96	2300		2300	2	1.00	2300	0
	RT					0	0	0.00	0	
WB	LT					0	0	0.00	0	1
	TH	1228	0.92	1335		1335	2	1.00	1335	0
	RT	48	0.75	64		64	1	1.00	64	
NB	LT	0				0	0		0	
	TH	0				0	0		0	
	RT	0				0	0		0	
SB	LT	71	0.82	87		87	1	1.00	87	1
	TH									
	RT	75	0.49	153		153	1	1.00	153	

SATURATION FLOW ADJUSTMENT WORKSHEET

LANE GROUPS				ADJUSTMENT FACTORS								
1 Appr	2 Lane Group Movements	3 Ideal Sat. Flow (pcphgpl)	4 No. of Lanes N	5 Lane Width fw	6 Heavy Veh fhv	7 Grade fg	8 Pkg fp	9 Bus Block fbb	10 Area Type fa	11 Right Turn frt	12 Left Turn flt	13 Adj. Sat. Flow Rate s (vphg)
EB		1800	1	1.00	1.00	1.01	1.00	1.00	1.00	1.00	0.95	1727
		1800	2	1.00	1.00	1.01	1.00	1.00	1.00	1.00	1.00	3636
WB												
		1800	2	1.00	0.99	1.00	1.00	1.00	1.00	0.99	1.00	3528
		1800	1	1.00	0.99	1.00	1.00	1.00	1.00	1.00	0.85	1515
NB												
SB		1800	1	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1800
		1800	1	1.00	1.00	1.00	1.00	1.00	1.00	0.99	0.85	1515

CAPACITY ANALYSIS WORKSHEET

LANE GROUP		3. Adj. Flow Rate v (vph)	4. Adj. Sat. Flow Rate s (vphg)	5. Flow Ratio v/s	6. Green Ratio g/C	7. Lane Group Cap c (vph)	8. v/c Ratio X	9. Critical ? Lane Group
1 Appr.	2. Lane Group Movements							
EB		164	1727	0.095	0.116	200	0.820	
		2300	3636	0.633	0.678	2465	0.933	x
WB								
		1335	3528	0.378	0.562	1983	0.673	
		64	1515	0.042	0.562	851	0.075	
NB								
SB		87	1800	0.048	0.205	369	0.236	
		92	1515	0.061	0.205	311	0.296	x
C=	52		22		0.883			

Σ (v/s)= 0.69

Cycle Length, C= 146 sec

Xc=(Σ (v/s)xC)/(C-L)= 0.78

Lost Time Per Cycle, L= 17 sec

0.932

SIGNALIZED INTERSECTIONS

LEVEL-OF-SERVICE WORKSHEET

Lane Group		First Term Delay				Second Term Delay				Total Delay and LOS		
1 Appr.	2. Lane Group Move-ments	3. v/c Ratio X	4. Green Ratio g/C	5. Cycle Length C (sec)	6. Delay d1 (s/veh)	7. Lane Grp Cap c (vph)	8. Delay d2 (s/veh)	9. Prog Factor PF	10. lane Group Delay (s/veh)	11. Lane Group LOS	12. Appr Delay (s/veh)	13. Appr LOS
EB		0.820	0.116	146	47.91	200	15.48	1.00	63.39	F	20.91	C
		0.933	0.678	146	15.66	2465	5.37	0.85	17.88	C		
WB											14.92	B
		0.673	0.562	146	17.12	1983	0.64	0.85	15.10	C		
		0.075	0.562	146	11.11	851	0.00	1.00	11.11	B		
NB											NA	NA
SB		0.236	0.205	146	36.85	369	0.06	1.00	36.91	D	37.28	D
		0.296	0.205	146	37.33	311	0.16	1.00	37.49	D		

Intersection Delay= 19.82 sec/veh
Intersection LOS= C

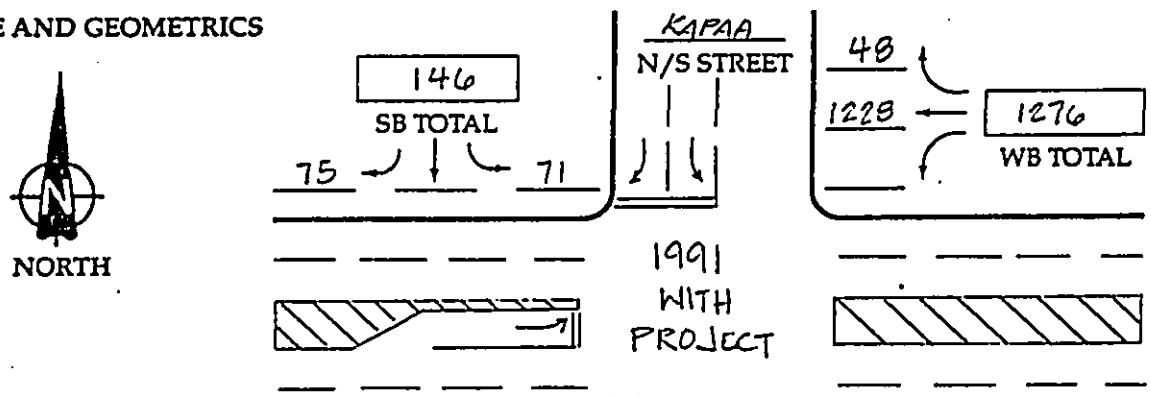
INPUT WORKSHEET

Intersection: KALANIANAOLE HWY / KAPAA QUARRY RD Date:

Analyst: Time Period Analyzed: Area Type: ☐ CBD ☒ Other

Project No.: WINDWARD PARK City/State:

VOLUME AND GEOMETRICS



IDENTIFY IN DIAGRAM:

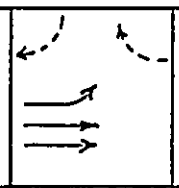
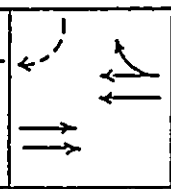
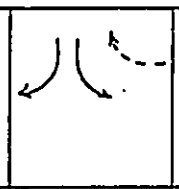
1. Volumes
2. Lanes, lane widths
3. Movements by lane
4. Parking (PKG) locations
5. Bay storage lengths
6. Islands (physical or painted)
7. Bus stops

TRAFFIC AND ROADWAY CONDITIONS

Approach	Grade (%)	% HV	Adj. Pkg. Lane Y or N	Adj. Pkg. Lane N_m	Buses (N_b)	PHF	Conf. Peds. (peds./hr)	Pedestrian Button Y or N	Pedestrian Button Min. Timing	Arr. Type
EB	-2	0	N	0	0	0.96	0	N	-	3
WB.	0	2	N	0	0	0.92 0.75	0	N	-	3
NB	-	-	-	-	-	-	-	N	-	3
SB	0	0	N	0	0	0.82 0.49	0	N	-	3

Grade: + up, − down
HV: veh. with more than 4 wheels
N_m: pkg. maneuvers/hr
N_b: buses stopping/hr
PHF: peak-hour factor
Conf. Peds: Conflicting peds./hr
Min. Timing: min. green for pedestrian crossing
Arr. Type: Type 1-5

PHASING

DIAGRAM								
Timing	G = 18 Y+R = 72	G = 43 Y+R = 47	G = 6 Y+R = 84	G = . Y+R =	G = Y+R =	G = Y+R =	G = Y+R =	G = Y+R =
Prelimed or Actuated								

Protected turns | Permitted turns | -------Pedestrian | Cycle Length 90 Sec

VOLUME ADJUSTMENT WORKSHEET

1 Appr	2 Mvt	3 Mvt Volume (vph)	4 Peak Hour Factor PHF	5 Flow Rate vp (vph)	6 Lane Group	7 Flow rate in Lane Group vg (vph)	8 Number of Lanes N	9 Lane Utilization Factor U	10 Adj. Flow v (vph)	11 Prop. of LT or RT Plt or Prt
EB	LT	157	0.96	164		164	1	1.00	164	1
	TH	2208	0.96	2300		2300	2	1.00	2300	0
	RT					0	0	0.00	0	
WB	LT					0	0	0.00	0	1
	TH	1228	0.92	1335		1335	2	1.00	1335	0
	RT	48	0.75	64		64	1	1.00	64	
NB	LT	0				0	0		0	
	TH	0				0	0		0	
	RT	0				0	0		0	
SB	LT	71	0.82	87		87	1	1.00	87	1
	TH									
	RT	75	0.49	153		153	1	1.00	153	

SATURATION FLOW ADJUSTMENT WORKSHEET

LANE GROUPS				ADJUSTMENT FACTORS								
1 Appr	2 Lane Group Movements	3 Ideal Sat. Flow (pcphgpl)	4 No. of Lanes N	5 Lane Width fw	6 Heavy Veh fhv	7 Grade fg	8 Pkg fp	9 Bus Block fbb	10 Area Type fa	11 Right Turn frt	12 Left Turn flt	13 Adj. Sat. Flow Rate s (vphg)
EB		1800	1	1.00	1.00	1.01	1.00	1.00	1.00	1.00	0.95	1727
		1800	2	1.00	1.00	1.01	1.00	1.00	1.00	1.00	1.00	3636
WB												
		1800	2	1.00	0.99	1.00	1.00	1.00	1.00	0.99	1.00	3528
		1800	1	1.00	0.99	1.00	1.00	1.00	1.00	1.00	0.85	1515
NB												
SB		1800	1	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1800
		1800	1	1.00	1.00	1.00	1.00	1.00	1.00	0.99	0.85	1515

CAPACITY ANALYSIS WORKSHEET

LANE GROUP		3. Adj. Flow Rate v (vph)	4. Adj. Sat. Flow Rate s (vphg)	5. Flow Ratio v/s	6. Green Ratio g/C	7. Lane Group Cap c (vph)	8. v/c Ratio X	9. Critical ? Lane Group
1 Appr.	2. Lane Group Movements							
EB		164	1727	0.095	0.218	376	0.436	
		2300	3636	0.633	0.678	2465	0.933	x
WB								
		1335	3528	0.378	0.460	1623	0.823	
		64	1515	0.042	0.460	697	0.092	
NB								
SB		87	1800	0.048	0.205	369	0.236	
		92	1515	0.061	0.205	311	0.296	x
C=		44	22		0.883			

Σ (v/s)= 0.69

Cycle Length, C=
90 sec

Xc=(Σ (v/s)xC)/(C-L)= 0.80

Lost Time Per Cycle, L=
12 sec

0.932

LEVEL-OF-SERVICE WORKSHEET

Lane Group		First Term Delay				Second Term Delay				Total Delay and LOS		
1 Appr.	2. Lane Group Move-ments	3. v/c Ratio X	4. Green Ratio g/C	5. Cycle Length C (sec)	6. Delay d1 (s/veh)	7. Lane Grp Cap c (vph)	8. Delay d2 (s/veh)	9. Prog Factor PF	10. lane Group Delay (s/veh)	11. Lane Group LOS	12. Appr Delay (s/veh)	13. Appr LOS
EB		0.436	0.218	90	23.11	376	0.53	1.00	23.64	C	13.49	B
		0.933	0.678	90	9.65	2465	5.37	0.85	12.77	B		
WB											15.54	C
		0.823	0.460	90	16.05	1623	2.53	0.85	15.79	C		
		0.092	0.460	90	10.41	697	0.00	1.00	10.41	B		
NB											NA	NA
SB		0.236	0.205	90	22.71	369	0.06	1.00	22.77	C	23.03	C
		0.296	0.205	90	23.01	311	0.16	1.00	23.17	C		

Intersection Delay= 14.75 sec/veh
Intersection LOS= B

Appendix E

APPENDIX E

AIR QUALITY IMPACT
OF THE PROPOSED WINDWARD PARK

BY UNIVERSITY ASSOCIATES, INC.

Air Quality Impact of the Proposed Windward Park

Prepared for:

DHM, Inc.
1188 Bishop Street, Suite 2405
Honolulu, HI 96813

by

University Associates, Inc.
4336 Lanihale Place
Honolulu, HI 96816

December 15, 1988

List of contents and tables

Summary.

This report estimates the impact the proposed Windward Park golf course will have on ambient air quality in the area. The eastern and southern boundaries of the project are Kapaa Quarry Access Road and Kalanianaole Highway on the windward side of the island of Oahu about half a mile east of the town of Kailua. The project will replace the Kailua Drive-in theater presently operating at the site. As vehicular traffic is the by far largest contributor to air pollution in the area, the impact of the major pollutant from this source, carbon monoxide (CO) is investigated. An one month measurement survey showed a maximum one hour CO concentration during evening rush hour of 6 ppm at the theater ticket boot. Theater operators estimate three times more cars during the summer high season.

A diffusion model, Caline4, estimates that by the time the pollutants reach the Kapaa Quarry Access Road - Kalanianaole Highway intersection, they will be diluted by a factor of three. Thus it is estimated that the Drive-in can, during high season, contribute as much as 6 ppm at the intersection.

The diffusion model was also used to estimate present concentrations at the intersection as caused by the traffic there. For the morning rush hour the model estimates a maximum of 21.7 ppm and for the evening rush hour 16.3 ppm from intersection traffic alone. Adding the Drive-in, the evening value becomes 22.3 ppm or about the same as in the morning.

The State of Hawaii has an one hour annual maximum air quality standard for CO of 8.7 ppm (10 mgr/cum) which is therefore violated at the intersection. The state has also an 8 hour standard of half the one hour standard or 4.35 ppm. The estimated eight hour maximum concentration at the intersection is 10.6 ppm to which the Drive-in contributes 0.8 ppm.

The proposed project would replace the Drive-in with a golf course to be finished in 1991. If kept at its present level of operation, the Drive-in would, in 1991, add 5 ppm to an intersection traffic caused concentration of 13.2 ppm producing a total evening rush hour maximum of 18.2 ppm without the project as compared with 13.5 ppm with the project. The morning rush hour estimate in 1991 is about the same with or without the project, 18.3 ppm. Though State standards would still be violated at the intersection, the proposed project would significantly reduce evening rush hour CO concentrations. The closest residence to the intersection is about 1500 feet away where, at the most, the intersection contributes about 2.3 ppm. At this distance the Drive-in contributes only an insignificant amount.

1. Introduction.

This report estimates the effects the proposed Windward Partner's golf course project at the present Kailua Drive-in theater site will have on the ambient air quality.

A. LOCATION AND TERRAIN

The Kailua Drive-in theater is located at the corner of Kalanianaole Highway and Kapaa Quarry Access Road. It operates every evening from 17:30 to 22:30. The site is about half a mile from Kailua on the windward side of the island of Oahu. Kalanianaole Highway is one of two main arteries serving the windward communities and it is generally congested during morning and afternoon rush hour. Both the highway and Kapaa Quarry Access Road are bounded by the steep Koolau mountains on one side. Going west towards Honolulu the highway rises rather sharply from the intersection. Eastward the highway is level as is Kaapa Quarry Access Road. The elevation of the site is about 100 ft.

B. CLIMATE

The climate in the area is dominated by the easterly trades causing frequent orographic rains. During southerly flow (Kona) orographic precipitation from clouds formed on the other side of the Koolaus can drift into the area. Occasional winter storms associated with frontal passages can cause torrential rains in the area. The annual rainfall is about 70 inch. During weak trades a drainage flow often reverses the surface air flow at night. Under these conditions the air is very stable and wind speeds low causing dilution of pollutant to be at a minimum. The air flow would follow land contours. There are no site specific weather data available from the site.

C. AMBIENT AIR QUALITY STANDARDS

The major source of air pollutants in the area is traffic. The main pollutant generated by cars is carbon monoxide (CO). The State of Hawaii has set a standard of 10 milligram/cubic meter (mgr/cum) (8.7 ppm) not to be exceeded more than one one hour period each year. There is also a corresponding 8 hour standard of 5 mgr/cum (4.35 ppm). The national ambient air quality standard (NAAQS) is 40 mgr/cum (34.8 ppm) for one hour and 10 mgr/cum (8.7 ppm) for an 8 hour period.

D. PERMANENT AIR QUALITY MONITORING IN THE AREA

These is no permanent air pollution monitoring near the site. The closest monitoring site for CO, located in Honolulu, is not representative of the area. Besides vehicular pollutants there are no other significant sources in the area.

2. Air quality at the Drive-in.

In order to asses air quality in the area, a measurement survey was conducted at the Kailua Drive-in entrance from the end of October to the end of November 1988. CO is very likely to be the only air pollutant to violate its standards since the major source of pollutant in the area is traffic. This pollutant was therefore selected for monitoring during the survey.

A. SURVEY INSTRUMENTATION

An Ecolyzer II with an electrochemical sensor was used to continuously monitor CO. The instrument has a good linear response and the major source of error is drifting calibration and interference by other gases. Interference was reduced to non significant levels by filtering the air before the sensor. Calibration drift was reduced by calibrating the instrument for span and zero every three hours. The response to the calibration gases was recorded and a linearly time dependent calibration curve used. Based on the recorded calibration values, this procedure should result in an accuracy considerably better than 1 ppm. The data were averaged during one minute and recorded by an electronic data logger which also switched in the calibration gases at the selected intervals. The precision of the logger is less than a tenth of a percent. During calibrations, which lasted for three minutes for each gas, the logger tagged the data so they would not be included in hourly averages calculated by a computer. The CO readings are probably within +/- 0.2 ppm. The intake for the CO sampler was about eight ft above road level at the ticket boot at the theater entrance.

Besides CO, wind speed and direction were recorded. The wind speed sensor was an NRG type 40 Maximum ligth weight pulsed counter anemometer which was wind tunnel calibrated before the survey and should be accurate to within 0.2 mph above 2 mph. The direction sensor, an NRG 200 series Wind Vane uses a potentiometer to transmit wind direction to within a few degrees. The instruments were mounted four feet above the roof of the ticket booth.

B. DATA PRESENTATION

A number of problems and damage to the sensors caused them to malfunction parts of the time. Though data were collected continuously during the period, only data for the theater operation hours (Table 1), the morning traffic rush hour (Table 2) and the evening traffic rush hour (Table 3) are included in this report. These tables gives hourly mean CO concentration and wind speed and the direction at the last minute of the period. The data are for the hour ending at the given hour.

C. ANALYSIS OF THE DATA

Table 4 shows weather conditions during the survey. The period was unusually wet but winds were reasonably representative of late fall. High CO concentration occurred with weak to moderate trades during the middle and the end of the period. Maximum concentrations during theater operations occurred generally during the first hour of operations when most of the cars arrived at the theater. A second maximum sometimes occurred around 2000 when winds were at a minimum and the direction reverses as a result of a drainage flow from the west bucking weak easterly trades. This situation characterized Nov 26 at the end of the period when the highest evening rush hour (1700-1800) concentration of almost 6 ppm was measured followed by 8.7 ppm for the hour ending at 2000. As theater attendance is generally low during late fall and the weather was unusually wet during the survey period, higher concentrations are likely during other periods of the year. The theater owners estimated up to three times more cars during the summer which would likely result in an exceedence of State AAQS at the monitoring site.

3. CO concentrations at the Kalanianaole Highway-Kapaa Quarry Access Road intersection.

The nearest area where pollutants from the Drive-in might significantly contribute to already high concentrations, is the intersection between Kalanianaole Highway and Kapaa Quarry Access Road about 100 ft SE of the theater entrance.

A. CONTRIBUTIONS FROM THE DRIVE-IN

The diffusion model used for air quality simulations for the project, Caline4, yielded a threefold reduction in concentration between the ticket booth and the intersection for input representative of summer time Drive-in conditions. This ratio will thus yield an estimated maximum concentration contribution during the evening rush hour at the intersection of about the maximum measured at the booth during the low season of 6 ppm.

During morning traffic rush hour (Table 2) the site measured as much as 3.5 ppm with very low winds from the intersection. Caline4 estimated a concentration ratio between a receptor at the intersection and one at the Drive-in of about 3 to 1 based on morning rush hour traffic at the intersection. Using this ratio, the maximum intersection concentration during the morning rush hour period would be about 10 ppm. For the evening hour before the theater opens, 1600-1700, the maximum measured concentration (disregarding the 19.2 ppm at 1700 on Nov 27) is 2.2 ppm (Table 3) which, using the same ratio, becomes 7 ppm. Annual maxima estimated in next section for the intersection without contributions

from the Drive-in are 21.7 ppm for the morning rush hour and 16.3 ppm for the afternoon rush hour. Considering all the assumptions that go into the diffusion model, the estimates based on measured concentrations at the ticket booth and modeled maxima agree fairly well.

B. CONTRIBUTIONS FROM INTERSECTION TRAFFIC

In order to estimate the effect the Drive-in presently has on concentrations at the intersection and the effect the proposed development will have there in 1991, a numerical simulation was carried out using the EPA recommended Caline4 model for mobile sources. This model is originally developed for flat terrain, which is not a good description of the area around the Drive-in, but the model can be modified to include a limited mixing width along the sides of the roads as would result from a mountain side next to the road. This option was adopted in the calculations. The site variables used in the simulations are given in Table 5.

The intersection version of the model treats each flow direction of a road separately. Table 6 gives values for each link used in the simulations. Emission rates were taken from EPA's MOBILE3 model which estimates an emission of 69.9 gr/mile in 1988 and 54.4 gr/mile in 1991 at a constant speed of 16 mph. The idle emission is reduced from 15.4 gr/min in 1988 to 12.9 gr/min in 1991. Acceleration and deceleration rates of 0.8 and 0.6 m/s/s respectively and a queue length of 7 m/car were used to calculate stopline distances for the model. No accumulation of traffic was assumed. Receptors were located 5 meters from road sides in down wind directions assumed parallel to the roads. Resulting estimated concentrations are shown in Table 7.

C. COMBINED EFFECT

Table 7 sums the contributions from the Drive-in and the intersection traffic. Though the Drive-in opens at 1730, when the evening rush hour is assumed to be over, a survey in 1985 found almost as heavy traffic during the hour ending at 1830, when generally the highest Drive-in concentrations were found, as during the conventional evening rush hour. Thus it is justified to add maximum evening rush hour traffic to the maximum from the Drive-in. Besides an 1 hour annual maximum standard there is also a standard for an 8 hour maximum. EPA recommends a "persistence factor" of 0.6 to convert 1 hour maxima to 8 hour maxima. This factor is used in Table 7.

Concentration estimates were made for receptor locations next to the roads. The nearest residence is located some 1500 ft from the site and Caline4 estimates that the intersection contributes 2.3 ppm there. The Drive-in does not contribute significantly there.

4. Conclusions and suggested mitigating measures.

The State of Hawaii AAQS for CO is 10 mgr/cum (8.7 ppm) for one one hour period per year and 5 mgr/cum (4.35 ppm) for one eight hour period. Both standards are in all likelihood exceeded at the Kalanianaole Highway - Kapaa Quarry Access Road intersection where an one hour maximum of 21.7 ppm is estimated for the evening rush hour and 10.6 ppm for an eight hour period. To the evening concentration the Drive-in traffic contributes about 6 ppm. Present morning concentrations are sligtly lower with no Drive-in contribution.
With the proposed golf course replacing the Drive-in in 1991., the evening maximum from intersection traffic is 12 ppm with no contribution from the Drive-in and reduced 1991 emissions. The morning rush hour maximum will be reduced to 18.4 ppm because of the lower emissions. This period is essentially not affected by the project.
Keeping the Drive-in operating at its present level in 1991 would add 5 ppm to an evening rush hour intersection concentration of 13.2 ppm, making the total 18.2 ppm. Morning rush hour maximum concentration without the project will be about the same, 18.1 ppm.
The impact of the project on the eight hour standard is obviously less since the theater only operates during one of the eight hours.
National standards are not exceeded at the intersection.
Mitigation measures for the intersection include car pooling, mass transit, more jobb opportunities on the wind ward side and a two level road crossing.

Table 1

Hourly mean CO concentrations and wind speeds at the Kailua Drive-in theater ticket boot during theater operation hours for the 1988 survey.

	CO conc., ppm					Wind speed, mph				
Hour	18	19	20	21	22	18	19	20	21	22
29 Oct	0.6	0.0	0.8	0.4	0.5	5.8	5.7	5.2	4.1	1.7
30 Oct	0.1	0.1	0.1	0.2	0.0	2.6	3.4	2.6	1.0	0.5
31 Oct	-	-	-	-	-	2.8	2.1	0.6	0.5	2.0
1 Nov	-	-	-	-	-	3.3	3.8	1.9	2.6	4.5
2 Nov	-	-	0.8	-	-	0.8	0.4	1.3	0.8	0.4
3 Nov	-	-	-	-	-	1.5	2.2	4.3	3.0	3.1
4 Nov	1.6	1.4	2.5	0.6	-	2.6	1.7	2.1	2.5	-
5 Nov	1.2	0.5	0.3	0.2	0.4	2.2	4.9	4.0	2.5	2.0
6 Nov	0.7	0.4	0.2	0.2	0.2	5.4	6.9	5.6	4.1	1.8
7 Nov	0.2	0.0	0.0	0.2	0.0	8.0	5.8	6.3	6.9	7.3
8 Nov	0.2	0.1	0.1	0.2	0.0	10.3	7.2	7.5	7.8	6.5
9 Nov	0.1	0.0	0.8	0.3	0.2	8.2	8.3	9.4	8.3	8.0
10 Nov	4.7	2.4	1.6	0.8	0.4	7.4	7.5	7.8	7.7	6.8
11 Nov	0.2	0.1	0.2	0.2	0.4	5.4	6.2	6.2	8.0	7.3
12 Nov	0.7	0.2	0.8	0.1	0.0	-	-	-	-	-
13 Nov	0.0	0.0	0.3	0.0	0.1	-	-	-	-	-
14 Nov	4.0	7.1	2.1	0.9	1.2	-	-	-	-	-
15 Nov	2.4	0.5	0.3	1.3	1.3	-	-	-	-	-
16 Nov	3.1	0.9	1.4	1.3	0.8	0.5	1.3	0.6	0.4	0.4
17 Nov	2.4	0.5	0.3	1.3	1.3	-	-	-	-	-
18 Nov	3.3	0.5	0.3	0.0	0.0	-	-	-	-	-
19 Nov	0.0	0.0	0.0	0.0	0.0	-	-	-	-	-
20 Nov	0.0	0.0	0.0	0.0	0.0	-	-	-	-	-
21 Nov	0.0	0.0	0.0	0.0	0.0	-	-	-	-	-
22 Nov	-	-	-	0.0	0.0	-	-	-	-	-
23 Nov	0.2	0.1	0.4	0.0	0.1	-	-	-	-	-
24 Nov	0.5	0.3	0.3	0.2	0.4	7.4	7.5	7.0	5.4	2.9
25 Nov	5.1	0.7	5.6	1.4	1.9	3.9	5.5	2.7	2.5	0.8
26 Nov	5.9	5.5	8.7	4.7	2.0	0.7	0.5	0.5	0.4	0.8
27 Nov	4.8	1.2	0.9	0.3	0.5	1.8	1.0	3.1	2.9	3.0

Table 2

Hourly mean CO concentrations, wind speeds and directions at the Kailua Drive-in theater ticket booth during the morning traffic rush hour for the 1988 survey period.

	CO conc., ppm			Wind speed, mph			Wind dir., deg			Day
Hour	07	08	09	07	08	09	07	08	09	
30 Oct	0.0	0.0	0.2	3.6	4.4	7.1	51	62	70	Sun
31 Oct	-	-	-	4.0	8.1	8.0	80	81	73	Mon
1 Nov	-	-	-	0.9	5.9	7.4	78	84	77	Tue
2 Nov	-	-	-	1.0	6.6	7.1	52	96	97	Wed
3 Nov	-	-	-	0.4	0.3	0.4	200	200	200	Thu
4 Nov	-	-	-	5.4	6.4	5.8	201	200	216	Fri
5 Nov	-	-	-	-	-	-	-	-	-	Sat
6 Nov	0.1	0.1	0.0	0.8	0.8	1.2	108	214	278	Sun
7 Nov	0.0	0.0	0.0	5.5	8.1	7.5	239	58	98	Mon
8 Nov	0.0	0.0	0.0	6.8	8.8	9.9	129	126	125	*Tue
9 Nov	0.1	0.1	0.3	8.0	9.9	9.6	126	130	127	Wed
10 Nov	0.0	0.0	0.1	8.8	10.3	11.6	119	128	289	Thu
11 Nov	0.0	0.0	0.0	8.8	10.0	9.9	148	148	146	*Fri
12 Nov	0.0	0.0	0.0	7.5	9.2	8.7	138	150	144	Sat
13 Nov	0.1	0.1	0.1	6.6	8.4	8.2	132	136	143	Sun
14 Nov	0.0	0.0	0.3	-	-	-	-	-	-	Mon
15 Nov	0.2	0.0	0.0	-	-	-	-	-	-	Tue
16 Nov	2.5	1.8	0.8	-	-	-	-	-	-	Wed
17 Nov	2.8	1.0	0.2	0.4	2.9	6.1	-	-	-	Thu
18 Nov	2.3	1.3	0.3	-	-	-	-	-	-	Fri
19 Nov	0.5	0.7	0.2	-	-	-	-	-	-	Sat
20 Nov	0.1	0.1	0.0	-	-	-	-	-	-	Sun
21 Nov	0.0	0.0	0.0	-	-	-	-	-	-	Mon
22 Nov	0.1	0.0	0.1	-	-	-	227	223	226	Tue
23 Nov	0.2	0.1	0.1	-	-	-	255	262	224	Wed
24 Nov	0.0	0.0	0.0	-	-	-	226	234	232	*Thu
25 Nov	0.0	0.0	0.0	0.5	1.0	4.0	223	246	237	Fri
26 Nov	0.9	1.3	0.3	2.2	1.8	5.1	249	269	240	Sat
27 Nov	1.1	1.5	0.4	0.5	0.6	2.7	43	42	218	Sun
28 Nov	3.5	0.8	0.5	0.4	2.5	3.5	68	227	227	Mon

* =holiday

Table 3

Hourly mean CO concentrations, wind speeds and directions at the Kailua Drive-in theater ticket booth during the evening traffic rush hour for the 1988 survey period.

	CO conc., ppm			Wind speed, mph			Wind dir., deg			Day
Hour	16	17	18	16	17	18	16	17	18	
29 Oct	0.0	0.0	0.6	6.5	5.3	5.8	77	65	256	Sat
30 Oct	0.1	0.0	0.1	6.1	4.8	2.6	80	80	239	Sun
31 Oct	-	-	-	3.5	3.9	2.8	74	80	76	Mon
1 Nov	-	-	-	5.6	5.7	3.3	89	87	88	Tue
2 Nov	-	-	-	3.7	2.4	0.8	81	71	68	Wed
3 Nov	-	-	-	0.9	1.4	1.5	191	232	195	Thu
4 Nov	-	-	-	2.9	3.0	2.6	200	204	216	Fri
5 Nov	-	-	1.2	-	-	2.2	-	-	202	Sat
6 Nov	0.1	0.2	0.7	6.8	5.2	5.4	219	221	235	Sun
7 Nov	0.0	0.0	0.2	7.3	7.5	8.0	133	120	125	Mon
8 Nov	0.1	0.1	0.2	9.7	8.7	11.6	124	121	122	*Tue
9 Nov	0.0	0.0	0.2	9.0	10.3	10.2	120	112	119	Wed
10 Nov	0.1	0.1	0.1	7.3	9.4	10.8	128	131	127	Thu
11 Nov	1.2	1.0	4.6	9.3	8.7	7.5	147	147	144	*Fri
12 Nov	0.0	0.0	0.2	7.4	7.2	5.4	141	133	140	Sat
13 Nov	0.1	0.1	0.7	8.5	7.5	-	175	-	-	Sun
14 Nov	0.0	0.0	0.1	-	-	-	-	-	-	Mon
15 Nov	0.0	0.1	4.0	-	-	-	-	-	-	Tue
16 Nov	0.2	1.0	3.0	-	-	-	-	-	-	Wed
17 Nov	0.2	0.5	2.4	2.9	1.7	0.4	-	-	-	Thu
18 Nov	0.3	0.2	1.1	-	-	-	-	-	-	Fri
19 Nov	0.1	0.2	3.3	-	-	-	-	-	-	Sat
20 Nov	0.0	0.0	0.0	-	-	-	-	-	-	Sun
21 Nov	-	-	-	-	-	-	-	-	-	Mon
22 Nov	0.0	0.0	0.0	-	-	-	222	232	226	Tue
23 Nov	0.1	0.0	0.2	-	-	-	261	226	231	Wed
24 Nov	0.1	0.0	0.4	-	4.9	7.4	226	226	228	*Thu
25 Nov	0.2	0.8	5.1	0.2	2.0	3.9	222	230	248	Fri
26 Nov	0.3	2.2	5.9	3.9	1.8	0.7	236	218	207	Sat
27 Nov	0.4	19.2	4.8	4.0	2.9	1.8	231	223	241	Sun

* = holiday

Table 4

Synoptic scale weather during the 1988 survey period.

30 Oct - 3 Nov: Moderate trades with a few showers.
4 Nov - 7 Nov: Southerly winds with heavy rains.
8 Nov - 10 Nov: Strong dry trades.
11 Nov - 15 Nov: Moderate trades with a few showers.
16 Nov - 17 Nov: Weak trades with heavy showers.
18 Nov - 20 Nov: Moderate trades with a few showers.
21 Nov - 22 Nov: Strong trades with heavy showers.
23 Nov - 25 Nov: Strong trades with some showers.
26 Nov - 28 Nov: Variable winds with showers.

Table 5

Caline4 site variables used in the simulations at the Kalanianaole Highway - Kapaa Quarry Access Road intersection.

Variable	Value used	Comments
Wind speed	0.5 mps	Measured during the survey
Wind direction	Parallel to the roads	Gives maximum concentrations
Stability class	F - morning E - evening	Estimated maximum stability at the site
Mixing height	1000 m	Unimportant
Wind dir. st.deviation	15 deg morning 25 deg evening	Estimated for the site
Roughness length	100 cm	Estimated for the site - unimportant
Ambient concentration	1 ppm	Estimated back ground concentration
Temperature	22C - morning 25C - evening	Estimated for the site

Table 6

Caline4 link variables used in the simulations at the Kalanianaole Highway - Kapaa Quarry Access Road intersection.

	Kalanianaole Highway				Kapaa Quarry Access Road	
	West of inters.		East of inters.			
	Traffic going		Traffic going			
	West	East	West	East	South	North
Max idle time, sec	116	116	116	116	30	30
Min idle time, sec	0	0	0	0	0	0
Cruising speed, mph	45	35	35	35	35	35
Acc./Dec. time, sec	35	25	25	25	25	25
Car/lane/cy.	45	15	38	15	18	14
Car/lane/cy. delayed	19	3	11	3	14	4
Mixing width driver side, m	0	30	0	0	30	0
Morning cars/hour						
Existing	2231	766	1871	767	455	94
1991 w/o project	2343	804	1965	806	478	99
1991 with project	2353	849	1975	807	490	154
Evening cars/hour						
Existing	1264	2222	1266	2162	96	158
1991 w/o project	1267	2333	1268	2247	78	165
1991 with project	1303	2365	1276	2256	123	205

Table 7

Estimated annual 1 and 8 hour maximum CO concentrations at the intersection of Kalanianaole Highway and Kapaa Quarry Access Road in ppm with and without the project.

	Intersection contribution	Drive-in contribution	Total
Morning rush hour existing	21.7	-	21.7
Evening rush hour existing	16.3	6.0	22.3
8 hour existing	9.8	0.8	10.6
Morning rush hour in 1991 w/o project	18.1	-	18.1
Evening rush hour in 1991 w/o project	13.2	5.0	18.2
8 hour in 1991 w/o project	7.9	0.6	8.5
Morning rush hour in 1991 with project	18.4	-	18.4
Evening rush hour in 1991 with project	13.5	-	13.5
8 hour in 1991 with project	8.1	-	8.1

Appendix F

APPENDIX F

NOISE STUDY
FOR THE PROPOSED WINDWARD PARK
MAUNAWILI, KOOLAUPOKO, OAHU

BY Y. EBISU & ASSOCIATES

NOISE STUDY
FOR THE PROPOSED WINDWARD PARK
MAUNAWILI, KOOLAUPOKO, OAHU

PREPARED FOR
DHM INC.

BY
Y. EBISU & ASSOCIATES

DECEMBER, 1988

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CHAPTER 1. SUMMARY

The existing and future traffic noise levels in the vicinity of the proposed Windward Park development were evaluated for their potential impact along roadways which would service the project. The future traffic noise levels associated with project traffic are anticipated to be very low.

Due to the relatively low volumes of anticipated project traffic, risks of adverse noise impacts from traffic noise are considered to be low, and the proposed project should not cause adverse noise impacts along the roadways servicing the development. For these reasons, special traffic noise mitigation measures are not considered necessary.

Risks of adverse noise impacts from clubhouse activities are also low due to the probable use of total closure and air conditioning of the facility. In addition, existing State Department of Health noise regulations will place relatively low limits on the levels of noise which may emanate from the project facilities. These low limits, coupled with the large buffer distances to the nearest residences, will minimize risks of adverse noise impacts from the clubhouse facilities. For these reasons, special noise mitigation measures are not considered necessary for the clubhouse.

CHAPTER II. PURPOSE

The purpose of this noise study was to predict and evaluate the traffic noise increases associated with motor vehicle traffic to and from the proposed Windward Park golf course and recreational facility. The proposed development is located in the vicinity of the existing Kailua Drive-In Theater, and will include an 18-hole golf course, a driving range with 20 stall positions, a clubhouse/dining area and supporting facilities with 100 parking stalls, and 20 vacation cabins. The scope of the noise study was limited to evaluations of potential noise impacts on existing residences and noise sensitive receptors within the project environs resulting from increased noise levels from project traffic and on-site recreational activities associated with the proposed project.

CHAPTER III. NOISE DESCRIPTORS AND THEIR RELATIONSHIP TO LAND USE COMPATIBILITY

The noise descriptor currently used by federal agencies to assess environmental noise is the Day-Night Average Sound Level (Ldn). This descriptor incorporates a 24-hour average of instantaneous A-Weighted Sound Levels as read on a standard Sound Level Meter. The minimum averaging period for the Ldn descriptor is 24 hours (by definition). Additionally, sound levels which occur during the nighttime hours of 10:00 PM to 7:00 AM are increased by 10 decibels (dB) prior to computing the 24-hour average by the Ldn descriptor. A more complete list of noise descriptors is provided in APPENDIX B to this report.

TABLE 1, derived from Reference 1, presents current federal standards and acceptability criteria for residential land uses exposed to various levels of environmental noise. Noise levels typical of communities on Oahu are shown in FIGURE 1. As a general rule, noise levels of 55 Ldn or less occur in rural areas, or urbanized areas which are shielded from high volume streets. In urbanized areas, Ldn levels generally range from 55 to 65 Ldn, and are usually controlled by motor vehicle traffic noise. Residences which front major roadways are generally exposed to levels of 65 Ldn, and as high as 72 Ldn when the roadway is a high speed freeway. Due to noise shielding effects from intervening structures, residences which are located within interior lots are usually exposed to lower noise levels of 60 Ldn or less.

For the purposes of determining noise acceptability for funding assistance from federal agencies (FHA/HUD and VA), an exterior noise level of 65 Ldn or lower is considered acceptable. This standard is applied nationally (see Reference 2), including Hawaii. Because of our open-living conditions, the predominant use of naturally ventilated dwellings, and the relatively low exterior-to-interior sound attenuation afforded by these naturally ventilated structures, an exterior noise level of 65 Ldn does not

TABLE 1

EXTERIOR NOISE EXPOSURE CLASSIFICATION
(RESIDENTIAL LAND USE)

Noise Exposure Class	Day-Night Sound Level	Equivalent Sound Level	Federal Standard (1)
Minimal Exposure	Not Exceeding 55 Ldn	Not Exceeding 55 Leq	Unconditionally Acceptable
Moderate Exposure	Above 55 Ldn But Not Above 65 Ldn	Above 55 Leq But Not Above 65 Leq	Acceptable (2)
Significant Exposure	Above 65 Ldn But Not Above 75 Ldn	Above 65 Leq But Not Above 75 Leq	Normally Unacceptable
Severe Exposure	Above 75 Ldn	Above 75 Leq	Unacceptable

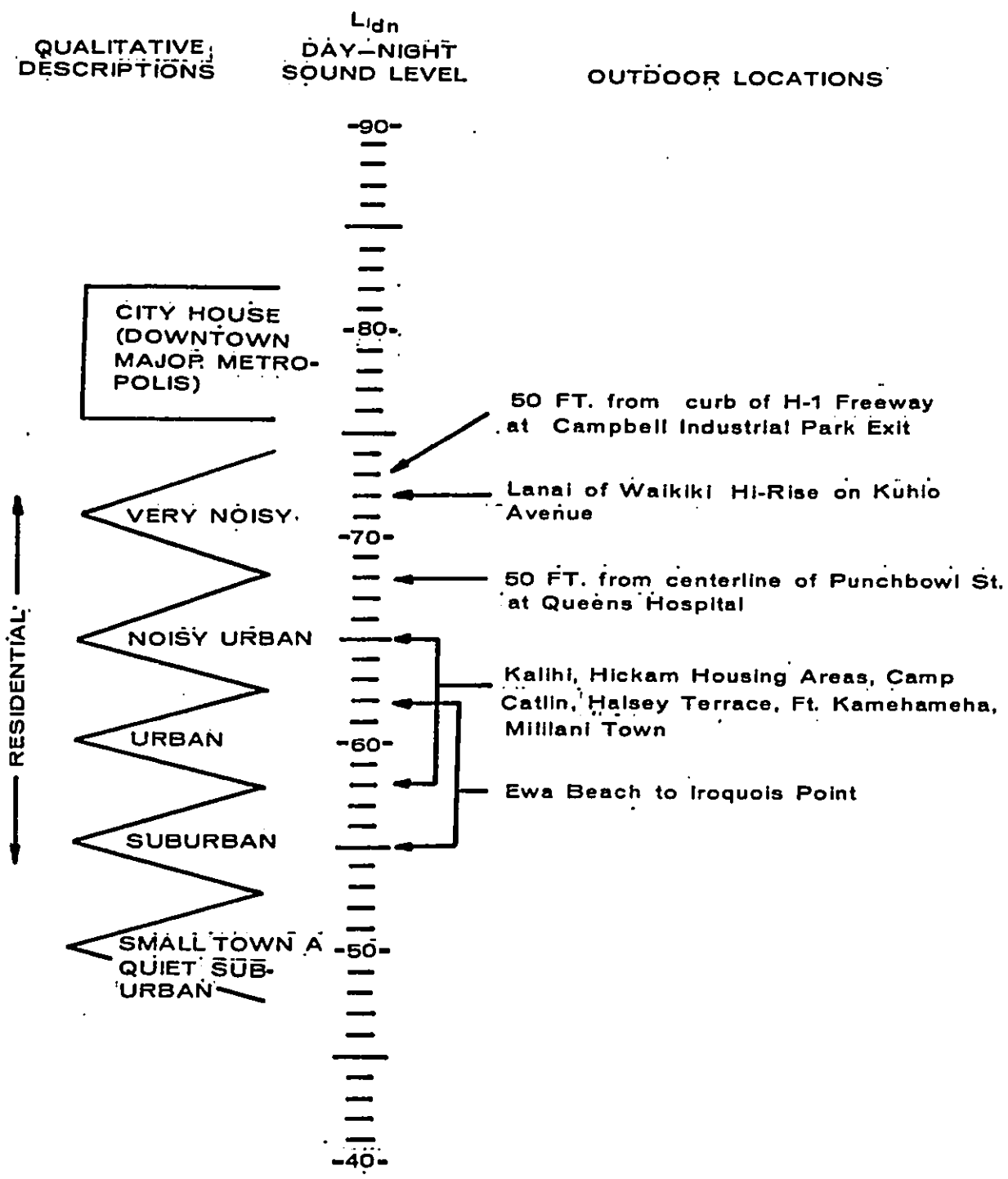
Notes: (1) Federal Housing Administration, Veterans Administration, Department of Defense, and Department of Transportation.

(2) FHWA uses the Leq instead of the Ldn descriptor. For planning purposes, both are equivalent if: (a) heavy trucks do not exceed 10 percent of total traffic flow in vehicles per 24 hours, and (b) traffic between 10:00 PM and 7:00 AM does not exceed 15 percent of average daily traffic flow in vehicles per 24 hours.

Source: Reference 1.

FIGURE 1

RANGE OF EXTERIOR BACKGROUND AMBIENT NOISE LEVELS



eliminate all risks of noise impacts. For these reasons, and as recommended in Reference 3, a lower level of 55 Ldn is considered as the "Unconditionally Acceptable" (or "Near-Zero Risk") level of exterior noise. However, after considering the cost and feasibility of applying the lower level of 55 Ldn, government agencies such as FHA/HUD and VA have selected 65 Ldn as a more appropriate regulatory standard.

State Department of Health (DOH) noise regulations (References 4 and 5) apply on the island of Oahu, and are intended to minimize noise impacts from stationary as well as motor vehicle noise sources. These regulations would apply to all noise sources within the boundaries of the project site, as well as to light and heavy vehicles which would travel to and from the site on public roadways (or trafficways). Unless the routes used by heavy vehicles to and from the project site are designated as truck routes by the Director of Health, heavy vehicles traveling to and from the project facilities will be required to comply with the vehicle noise emission limits of Reference 5. The most stringent limit of Reference 5 is the requirement that heavy vehicles of 10,000 pounds or greater gross weight not emit noise levels exceeding 73 dBA at 50 FT distance if operated during the hours from 10:00 PM to 6:00 AM on a public trafficway.

CHAPTER IV. GENERAL STUDY METHODOLOGY

Existing background ambient noise levels were measured at three locations in the project environs to provide a basis for developing the project's traffic noise contributions along the two major roadways which will service the proposed development: Kalanianaole Highway and Kapaa Quarry Road. The locations of these three measurement sites are shown in FIGURE 2. Measurements were performed on a Thursday and Friday (November 30 and December 1, 1988) during the PM peak traffic period as well as during an off-peak period during the morning. The results of the noise measurements were also compared to calculations of existing traffic noise levels to validate the computer model used. These noise measurement results, and their comparisons with computer model predictions are summarized in TABLE 2.

Traffic noise calculations for the existing conditions as well as noise predictions for the Year 1991 following completion of the proposed development were performed using the Federal Highway Administration (FHWA) Noise Prediction Model (Reference 6). Traffic data entered into the noise prediction model were: hourly traffic volumes; average vehicle speeds; and estimates of traffic mix. The traffic study for the project (Reference 7), Hawaii State DOT traffic counts and vehicle type classification data at the intersection of Kalanianaole Highway and Kailua Road (Reference 8), Hawaii State DOT traffic counts at the intersection of Kalanianaole Highway and Kapaa Quarry Road (Reference 9), and estimates of refuse vehicle traffic on Kapaa Quarry Road (Reference 10) were the primary sources of data inputs to the model. For existing and future traffic, it was assumed that the PM peak hour Leq(h) was between 1 to 2 dB less than the 24-hour Ldn. This assumption was based on computations of the hourly Leq and 24-hour Ldn of traffic noise along Kalanianaole Highway and Kapaa Quarry Road.

The projected increases in traffic noise levels attributable

FIGURE 2

Locations of Noise
Measurement Sites

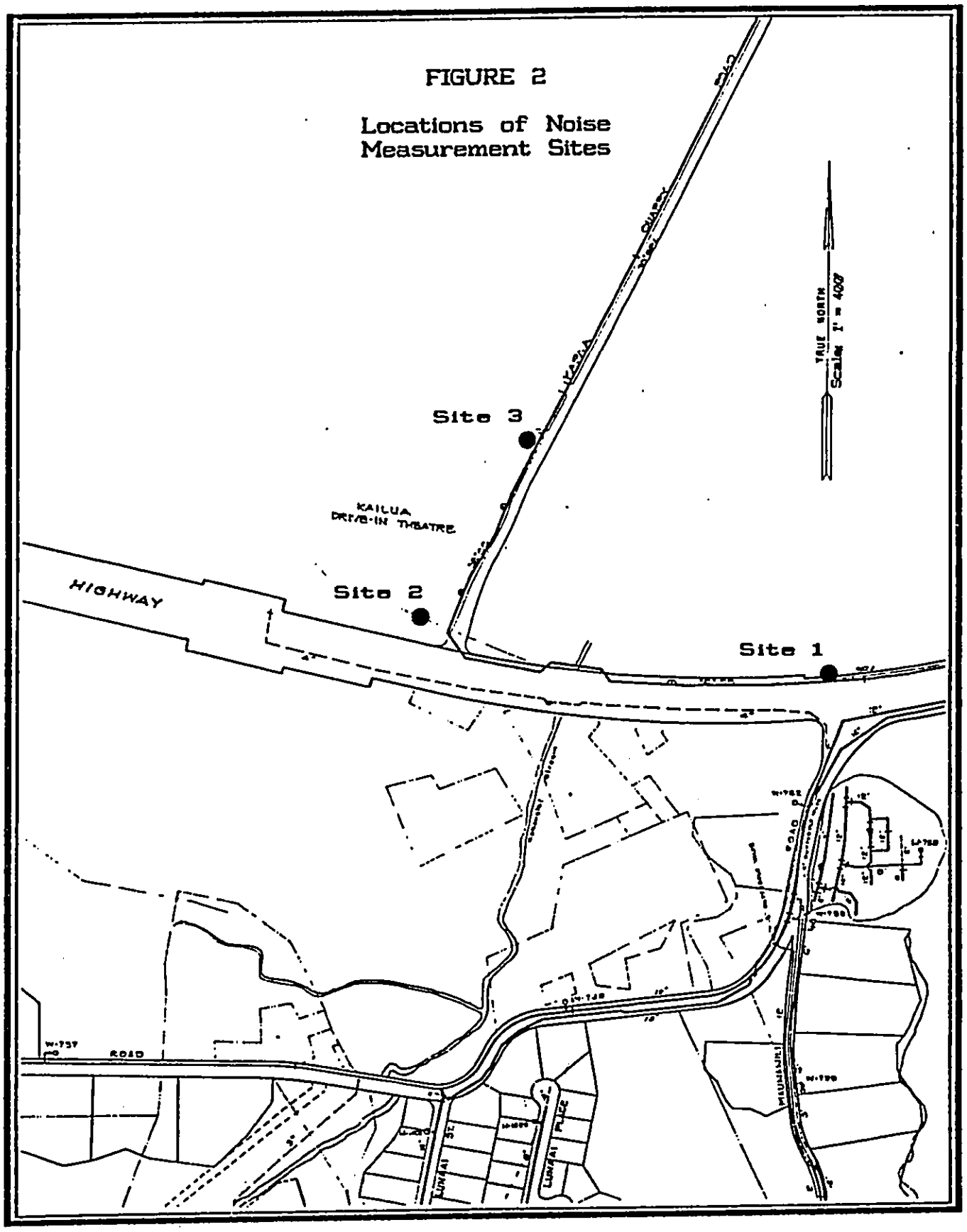


TABLE 2

TRAFFIC NOISE MEASUREMENTS
(NOVEMBER 30 & DECEMBER 1, 1988)

Location	Time of Day (HRS)	Ave.Speed (MPH)	—Hourly Traffic Volume— Auto	Med.Truck	Heavy Truck	Measured Leq (dB)	Predicted Leq(dB)
1. 76 FT from centerline of Kalanianaole Hwy. across street from Maunawili Road.	1630 TO 1715	39	3,359	34	34	64.9	64.9
1. 76 FT from centerline of Kalanianaole Hwy. across street from Maunawili Road.	1000 TO 1035	41	2,180	33	33	64.7	64.6
2. 150 FT from centerline of Kalanianaole Hwy. at Kailua Drive-In Theater.	1720 TO 1745	42	3,416	34	34	63.7	64.0
2. 150 FT from centerline of Kalanianaole Hwy. at Kailua Drive-In Theater.	1100 TO 1120	42	2,388	36	36	64.0	63.3
3. 50 FT from centerline of Kapaa Quarry Road at Kailua Drive-In Entrance Road.	1552 TO 1620	40	199	5	23	62.4	61.9
3. 50 FT from centerline of Kapaa Quarry Road at Kailua Drive-In Entrance Road.	1120 TO 1142	40	50	5	79	67.7	66.6

to project related traffic were calculated, and noise impact risks evaluated. The relative contributions of non-project and project related traffic to the total noise levels were also calculated, and an evaluation of possible traffic noise impacts was made.

The possibility of adverse noise impacts from on-site activities were evaluated by comparing allowable noise levels along the property lines of the project (Reference 4) with existing background ambient noise levels in the project environs and with the existing separation distances (or buffer space) to the nearest noise sensitive neighbors.

CHAPTER V. EXISTING NOISE ENVIRONMENT

The existing traffic noise levels along the Rights-of-Way of Kalanianaole Highway and Kapaa Quarry Road are high, and in the "Significant Exposure, Normally Unacceptable" category at approximately 65 to 70 Ldn along the Right-of-Way. This condition is typical along highways and major roadways of Oahu (see FIGURE 1). Traffic noise levels along the a highway Right-of-Way generally represent the worst case (or highest) levels due to the close proximity of the Right-of-Way to the noise sources. Traffic noise levels at 100 to 300 FT setback distances from the highway centerline are generally in the "Minimal Exposure, Unconditionally Acceptable" to "Moderate Exposure, Acceptable" categories, with 5 to 10 Ldn lower noise levels resulting from shielding and distance effects. An exception occurs for elevated receptor locations which are not shielded from the roadway by intervening terrain features or man-made structures. Because the lands immediately adjacent to both Kalanianaole Highway and Kapaa Quarry Road in the vicinity of the project are vacant, risks of adverse noise impacts from existing levels of traffic are considered to be minimal.

Results of calculations of existing traffic noise levels along Kalanianaole Highway and Kapaa Quarry Road during the PM peak hour period are shown in TABLE 3. The traffic volumes used for the PM peak hour period were obtained from Reference 7. TABLE 4 presents the calculated setback distances between the roadway centerlines and the iso-noise contours associated with the 60, 65, and 70 Ldn levels of existing traffic noise. FIGURES 3, 4, and 5 depict the hourly variations of existing traffic noise levels [Leq(h)] at 100 FT setback distance from the three roadway sections which would service the proposed development. The traffic noise levels shown in the tables only apply when unobstructed line-of-sight conditions exist to the roadways. These conditions would generally occur along the Right-of-Way, within any open space fronting the roadway, at the upper levels of any man-made

TABLE 3

COMPARISONS OF EXISTING AND FUTURE TRAFFIC NOISE LEVELS
ALONG ACCESS ROADS TO PROJECT SITE
(50 FT FROM ROADWAY CENTERLINES)

LOCATION	SPEED (MPH)	VPH	***** HOURLY LEQ IN dB **** AUTO	MT	HT	ALL VEH
EXISTING PM PEAK HR. TRAFFIC:						
Kalanianaole Hwy. (Hon. Side)	42	3,486	66.9	58.3	63.4	68.9
Kalanianaole Hwy. (Kailua)	39	3,428	65.6	57.1	62.5	67.7
Kapaa Quarry Road	40	254	54.2	50.2	61.5	62.5
CY 1991 PM PEAK HR. TRAFFIC:						
Kalanianaole Hwy. (Hon. Side)	42	3,668	67.1	58.5	63.6	69.1
Kalanianaole Hwy. (Kailua)	39	3,532	65.7	57.3	62.6	67.9
Kapaa Quarry Road	40	351	55.7	51.6	61.9	63.2
Entrance Road to Project	30	74	44.6	36.6	43.1	47.3

Notes: (1) Assumed traffic mix of 98% autos, 1% medium trucks, and 1% heavy trucks used for non-project traffic on Kalanianaole Hwy.

(2) Assumed traffic mix of 87.5% autos, 2.5% medium trucks, and 10% heavy trucks used for non-project traffic on Kapaa Quarry Road.

(3) Assumed traffic mix of 98% autos, 1% medium trucks, and 1% heavy trucks used for project traffic.

TABLE 4

EXISTING AND FUTURE DISTANCES TO 60, 65, AND 70 Ldn CONTOURS

STREET SECTION	60 Ldn SETBACK (FT) EXISTING	60 Ldn SETBACK (FT) FUTURE	65 Ldn SETBACK (FT) EXISTING	65 Ldn SETBACK (FT) FUTURE	70 Ldn SETBACK(FT) EXISTING	70 Ldn SETBACK(FT) FUTURE
Kalanianaole Hwy. (Hon. Side)	236	244	109	113	51	53
Kalanianaole Hwy. (Kailua)	197	201	92	93	43	43
Kapaa Quarry Road	100	111	46	51	21	24
Entrance Road to Project	N/A	10	N/A	4	N/A	2

Notes:

(1) All setback distances are from the roadways' centerlines.
(2) See TABLE 3 for traffic volume, speed, and mix assumptions.
(3) Ldn assumed to be 1.2 dB greater than PM Peak Hour Leq along Kalanianaole Highway and 2 dB greater than PM Peak Hour Leq along Kapaa Quarry Road.
(4) Setback distances are for unobstructed line-of-sight and soft ground conditions.

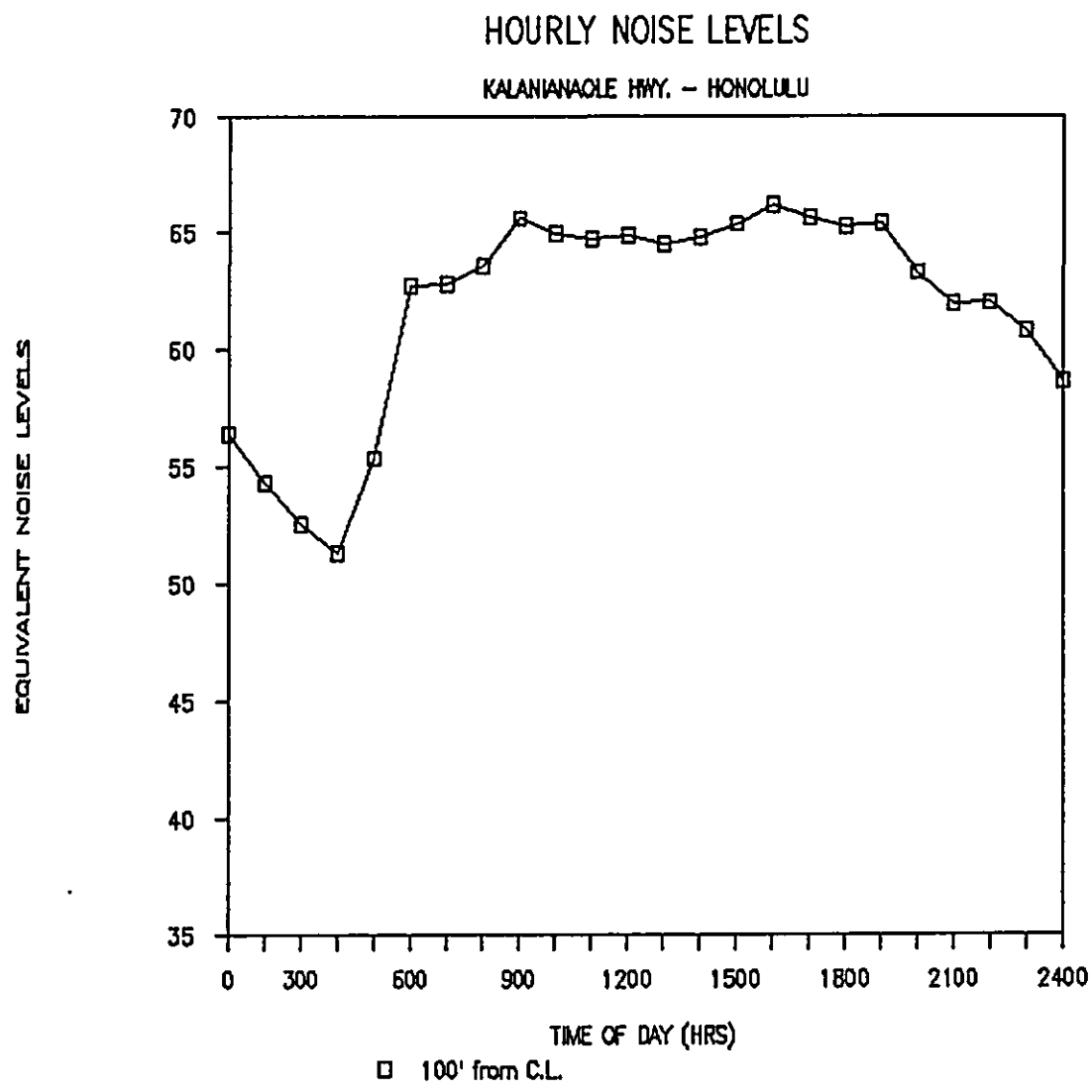


FIGURE 3

HOURLY VARIATIONS OF TRAFFIC NOISE AT 100 FT SETBACK DISTANCE FROM THE CENTERLINE OF KALANIANAOLE HWY. TOWARD HONOLULU (CY 1986)

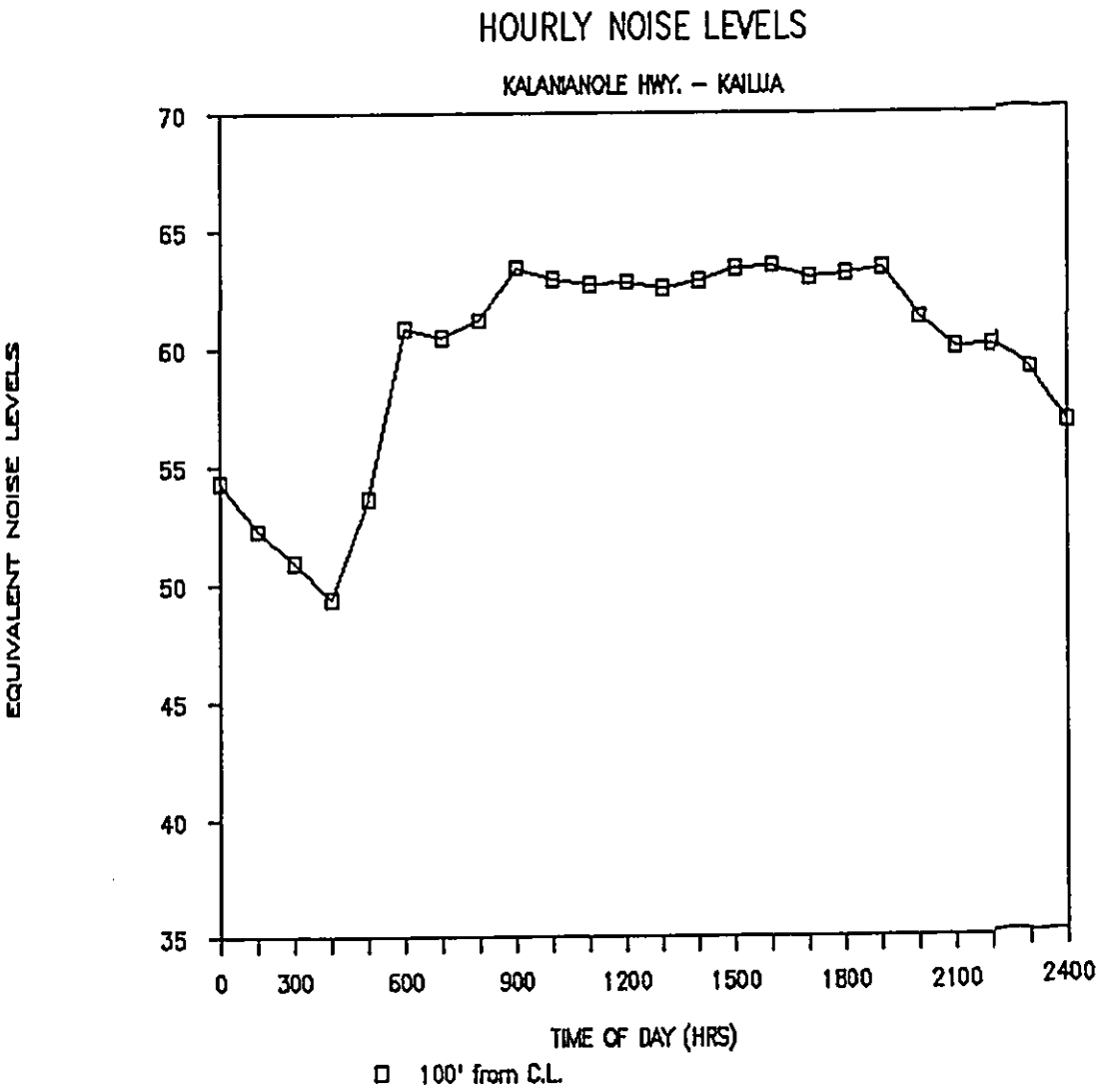


FIGURE 4

HOURLY VARIATIONS OF TRAFFIC NOISE AT 100 FT SETBACK DISTANCE FROM THE CENTERLINE OF KALANIANAOLE HWY. TOWARD KAILUA (CY 1986)

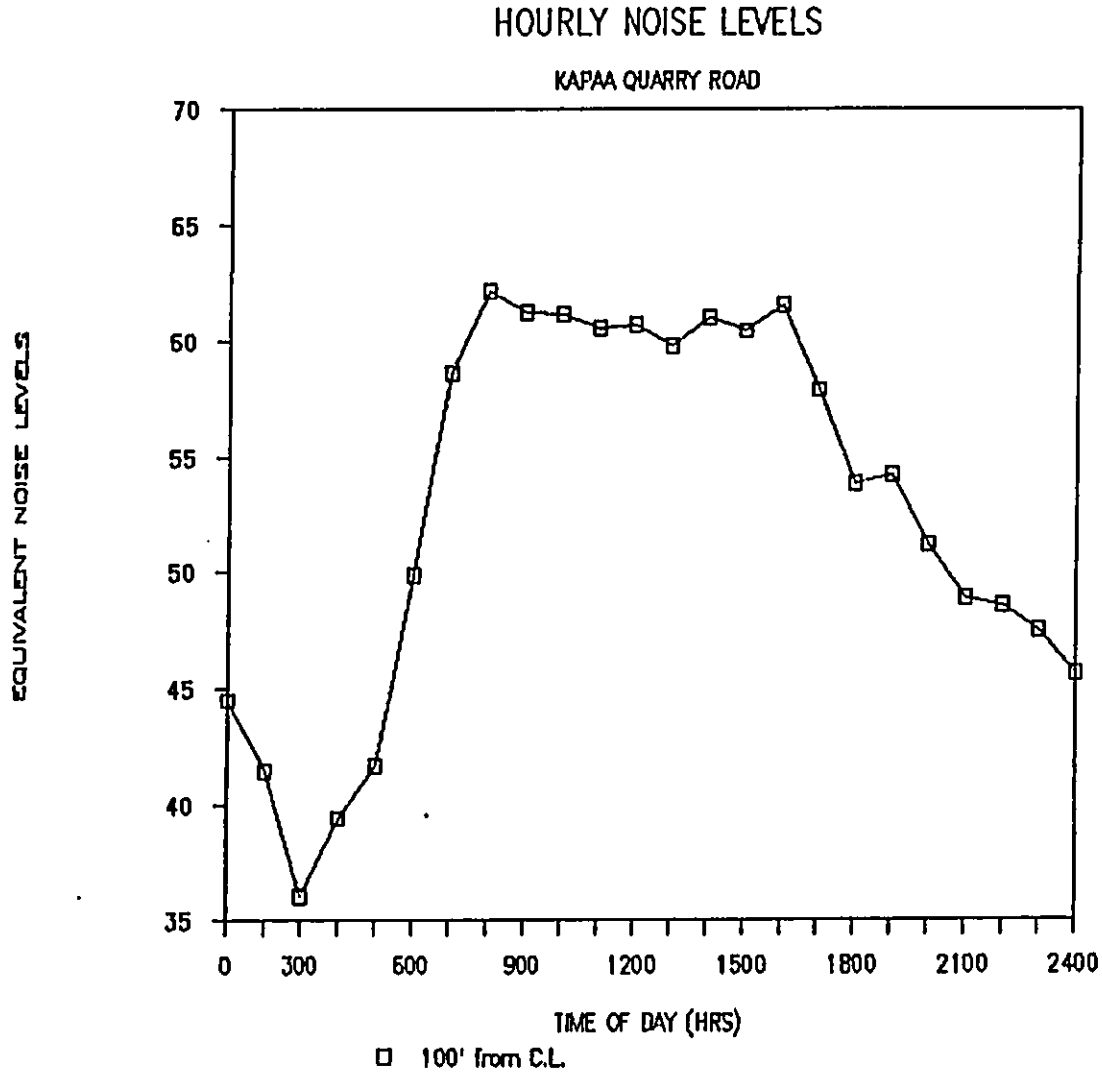


FIGURE 5

HOURLY VARIATIONS OF TRAFFIC NOISE AT 100 FT SETBACK DISTANCE FROM THE CENTERLINE OF KAPAA QUARRY ROAD (CY 1986)

structure or natural terrain feature.

The existing traffic noise levels along Kalanianaole Highway are high (between 65 and 70 Ldn) at approximately 75 FT setback distance from the highway centerline (baseline). Maximum noise levels (Lmax) associated with heavy truck traffic on the highway are in the order of 79 dB at this setback distance. Minimum background ambient noise levels of approximately 48 dB occur between periods of traffic flow.

The existing traffic noise levels along Kapaa Quarry Road are high during the daytime hours of approximately 7:00 AM to 5:00 PM because it is a major truck route between Kalanianaole Highway and the Kapaa Landfill and Kapaa Quarry. Heavy truck traffic and hourly noise levels along the roadway are greatest during the off peak hours between 8:00 AM and 4:00 PM, when average volumes of approximately 60 to 70 heavy trucks per hour occur along the roadway. Maximum noise levels associated with heavy truck traffic on the roadway are in the order of 82 to 86 dB at 50 FT setback distance from the roadway's centerline. During the quiet periods between traffic, background ambient noise levels along the roadway are controlled by the sound of birds, wind, and distant traffic, and ranges from 38 to 45 dB.

CHAPTER VI. FUTURE TRAFFIC NOISE ENVIRONMENT

Predictions of future traffic noise levels were made using the traffic volume assignments of Reference 7. The future projections of project and non-project traffic on the roadways which would service the project are shown in TABLE 3 for the PM peak hour of traffic in CY 1991. TABLE 4 summarizes the predicted increases in setback distances to the 60, 65, and 70 Ldn traffic noise contour lines along the roadways servicing the project and attributable to increases in project and non-project traffic by CY 1991.

From TABLE 3, minimal project plus non-project traffic noise increases of 0.1 to 0.7 dB are predicted to occur between the current period and 1991 along the sections of Kalanianaole Highway and Kapaa Quarry Road which are expected to service the proposed development. Increases in traffic noise along these two roadways attributable to project traffic range from 0.1 to 0.5 dB, which are considered to be minimal. The future traffic noise environment in the project environs will not be significantly changed by the proposed development due to the relatively low volumes of traffic expected to be generated by the project, and the reduction of evening and nighttime traffic associated with the present movie shedules of Kailua Drive-In Theater.

Along the entrance roads to the proposed development on Kapaa Quarry Road, a maximum of 85 in and out trips were projected during the PM peak hour (see Reference 7). Of these 85 total trips, 74 were associated with golf course and clubhouse traffic, and 11 were associated with the vacation cabin traffic. Maximum traffic noise levels are predicted to be less than 50 Leq(h) at 50 FT setback distance from the centerline of the entrance roadway to the project. Based on the maximum of 100 parking stalls planned for the clubhouse facility, an anticipated maximum of 100 vehicle trips is predicted during the period immediately following a social function at the clubhouse. This volume of traffic is

significantly less than the potential 700 vehicle trips currently possible with traffic exiting the Kailua Drive-In immediately following either of the two nighttime movie features per day. Projected volumes of traffic associated with the proposed golfing and clubhouse activities are expected to be significantly lower than those associated with the existing theater operations. Expected reductions in total traffic noise along the three roadway sections are not expected to be large (in the order of 1 Ldn) due to the dominating influence of regional rather than local traffic on Kalanianaole Highway and Kapaa Quarry Road.

CHAPTER VII. DISCUSSION OF PROJECT RELATED TRAFFIC NOISE IMPACTS AND POSSIBLE NOISE MITIGATION MEASURES

The increases in traffic noise levels attributable to the project are predicted to be less than 0.5 dB (or Ldn) along the two existing roadways which are expected to service the project. An increase in traffic noise of less than 0.5 dB should not be perceptible and is not considered to be significant. The discontinuation of operations at the Kailua Drive-In Theater should result in a decrease in traffic noise levels by approximately 1 Ldn.

In absolute terms, projected traffic noise levels associated with the project along Kalanianaole Highway and Kapaa Quarry Road should not exceed 55 Ldn at 50 FT setback distance from the roadways' centerlines. This level of project related traffic noise is very low when compared to current traffic noise levels of 65 to 70 Ldn at similar setback distances from the centerlines of these two roadways.

Due to the relatively low volumes of anticipated project traffic, and the reduction in current traffic associated with the drive-in theater operations, risks of adverse noise impacts from project traffic are considered to be low, and special noise mitigation measures are not considered necessary.

CHAPTER VIII. OTHER NON-TRAFFIC NOISE CONSIDERATIONS

Adverse noise impacts from the clubhouse activities are not anticipated due to the normally available option of total closure and air conditioning of the facility's dining and social function areas. In addition, because the property is zoned Preservation (P-1 and P-2), continuous noise levels which cannot be exceeded at the property line of the development are 55 and 45 dB during the daytime and nighttime periods, respectively (Reference 4). With these constraints on noise emissions from clubhouse activities, maximum continuous noise levels from the clubhouse activities should not exceed 49 and 39 dB during the daytime and nighttime periods, respectively, at the nearest residence. The restrictions on noise levels imposed by the State DOH noise regulations, plus the large buffers (900+ FT) between the development site and the nearest residence, should be adequate to minimize risks of adverse noise impacts from the clubhouse activities, and special noise mitigation measures should not be required.

APPENDIX A. REFERENCES

(1) "Guidelines for Considering Noise in Land Use Planning and Control;" Federal Interagency Committee on Urban Noise; June 1980.

(2) "Environmental Criteria and Standards, Noise Abatement and Control, 24 CFR, Part 51, Subpart B;" U.S. Department of Housing and Urban Development; July 12, 1979.

(3) "Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety;" Environmental Protection Agency (EPA 550/9-74-004); March 1974.

(4) "Title 11, Administrative Rules, Chapter 43, Community Noise Control for Oahu;" Hawaii State Department of Health; November 6, 1981.

(5) "Title 11, Administrative Rules, Chapter 42, Vehicular Noise Control for Oahu;" Hawaii State Department of Health; October 27, 1981.

(6) Barry, T. and J. Reagan, "FHWA Highway Traffic Noise Prediction Model," FHWA-RD-77-108, Federal Highway Administration, Washington, D.C., December 1978.

(7) "Traffic Impact Assessment Report - Windward Park;" Pacific Planning & Engineering, Inc.; November, 1988.

(8) April 17-18, 1985 24-Hour Traffic Counts and Vehicle Type Classification, Station 40, Kalanianaole Highway at Kailua Road and Ulukahiki Street; State Department of Transportation.

(9) January 14-15, 1986 24-Hour Traffic Counts, Station 33-A, Kalanianaole Highway at Kapaa Quarry Road; State Department of Transportation.

(10) Estimates of Refuse Vehicles at Kapaa Landfill, April thru July, 1987; Refuse Division, Department of Public Works, City & County of Honolulu.

APPENDIX B

EXCERPTS FROM EPA'S ACOUSTIC TERMINOLOGY GUIDE

Descriptor Symbol Usage

The recommended symbols for the commonly used acoustic descriptors based on A-weighting are contained in Table 1. As most acoustic criteria and standards used by EPA are derived from the A-weighted sound level, almost all descriptor symbol usage guidance is contained in Table 1.

Since acoustic nomenclature includes weighting networks other than "A" and measurements other than pressure, an expansion of Table I was developed (Table II). The group adopted the ANSI descriptor-symbol scheme which is structured into three stages. The first stage indicates that the descriptor is a level (i.e., based upon the logarithm of a ratio), the second stage indicates the type of quantity (power, pressure, or sound exposure), and the third stage indicates the weighting network (A, B, C, D, E.....). If no weighting network is specified, "A" weighting is understood. Exceptions are the A-weighted sound level and the A-weighted peak sound level which require that the "A" be specified. For convenience in those situations in which an A-weighted descriptor is being compared to that of another weighting, the alternative column in Table II permits the inclusion of the "A". For example, a report on blast noise might wish to contrast the $L_C dn$ with the LAdn.

Although not included in the tables, it is also recommended that "L_{PN}" and "L_{EPN}" be used as symbols for perceived noise levels and effective perceived noise level, respectively.

It is recommended that in their initial use within a report, such terms be written in full, rather than abbreviated. An example of preferred usage is as follows:

> The A-weighted sound level (LA) was measured before and after the installation of acoustical treatment. The measured LA values were 85 and 75 dB respectively.

Descriptor Nomenclature

With regard to energy averaging over time, the term "average" should be discouraged in favor of the term "equivalent". Hence, L_{eq}, is designated the "equivalent sound level". For L_d, L_n, and L_{dn}, "equivalent" need not be stated since the concept of day, night, or day-night averaging is by definition understood. Therefore, the designations are "day sound level", "night sound level", and "day-night sound level", respectively.

The peak sound level is the logarithmic ratio of peak sound pressure to a reference pressure and not the maximum root mean square pressure. While the latter is the maximum sound pressure level, it is often incorrectly labelled peak. In that sound level meters have "peak" settings, this distinction is most important.

"Background ambient" should be used in lieu of "background", "ambient", "residual", or "indigenous" to describe the level characteristic of the general background noise due to the contribution of many unidentifiable noise sources near and far.

With regard to units, it is recommended that the unit decibel (abbreviated dB) be used without modification. Hence, dBA, PNdB, and EPNdB are not to be used. Examples of this preferred usage are: the Perceived Noise Level (L_{PN} was found to be 75 dB. L_{PN} = 75 dB.) This decision was based upon the recommendation of the National Bureau of Standards, and the policies of ANSI and the Acoustical Society of America, all of which disallow any modification of bel except for prefixes indicating its multiples or submultiples (e.g., deci).

Noise Impact

In discussing noise impact, it is recommended that "Level Weighted Population" (LWP) replace "Equivalent Noise Impact" (ENI). The term "Relative Change of Impact" (RCI) shall be used for comparing the relative differences in LWP between two alternatives.

Further, when appropriate, "Noise Impact Index" (NII) and "Population Weighted Loss of Hearing" (PHL_x) shall be used consistent with CHABA Working Group 69 Report Guidelines for Preparing Environmental Impact Statements (1977).

TABLE I: A-Weighted Recommended Descriptor List

	Term	Symbol
1.	A-Weighted Sound Level	L_A
2.	A-Weighted Sound Power Level	L_{WA}
3.	Maximum A-Weighted Sound Level	L_{max}
4.	Peak A-Weighted Sound Level	L_{Apk}
5.	Level Exceeded x% of the time	L_x
6.	Equivalent Sound Level	L_{eq}
7.	Equivalent Sound Level over Time (T) (1)	$L_{eq(T)}$
8.	Day Sound Level	L_d
9.	Night Sound Level	L_n
10.	Day-Night Sound Level	L_{dn}
11.	Yearly Day-Night Sound Level	$L_{dn(y)}$
12.	Sound Exposure Level	L_{SE}

(1) Unless otherwise specified, time is in hours (e.g. the hourly equivalent level is L_{eq} (1)). Time may be specified in non-quantitative terms (e.g., could be specified a $L_{eq(WASH)}$ to mean the washing cycle noise for a washing machine.)

TABLE II: Recommended Descriptor List

	TERM	A-WEIGHTING	ALTERNATIVE(1) A-WEIGHTING	OTHER WEIGHTING (2)	UNWEIGHTED
1.	Sound (Pressure) (3) Level	L_A	L_{pA}	L_B, L_{pB}	L_p
2.	Sound Power Level	L_{WA}		L_{WB}	L_W
3.	Max. Sound Level	L_{max}	L_{Amax}	L_{Bmax}	L_{pmax}
4.	Peak Sound (Pressure) Level	L_{Apk}		L_{Bpk}	L_{pk}
5.	Level Exceeded x% of the time	L_x	L_{Ax}	L_{Bx}	L_{px}
6.	Equivalent Sound Level	L_{eq}	L_{Aeq}	L_{Beq}	L_{peq}
7.	Equivalent Sound Level Over Time(T) (4)	$L_{eq(T)}$	$L_{Aeq(T)}$	$L_{Beq(T)}$	$L_{peq(T)}$
8.	Day Sound Level	L_d	L_{Ad}	L_{Bd}	L_{pd}
9.	Night Sound Level	L_n	L_{An}	L_{Bn}	L_{pn}
10.	Day-Night Sound Level	L_{dn}	L_{Adn}	L_{Bdn}	L_{pdn}
11.	Yearly Day-Night Sound Level	$L_{dn(y)}$	$L_{Adn(Y)}$	$L_{Bdn(Y)}$	$L_{pdn(Y)}$
12.	Sound Exposure Level	L_S	L_{SA}	L_{SB}	L_{Sp}
13.	Energy Average value over (non-time domain) set of observations	$L_{eq(e)}$	$L_{Aeq(e)}$	$L_{Beq(e)}$	$L_{peq(e)}$
14.	Level exceeded x% of the total set of (non-time domain) observations	$L_{x(e)}$	$L_{Ax(e)}$	$L_{Bx(e)}$	$L_{px(e)}$
15.	Average L_x value	L_x	L_{Ax}	L_{Bx}	L_{px}

(1) "Alternative" symbols may be used to assure clarity or consistency.

(2) Only B-weighting shown. Applies also to C,D,E,..... weighting.

(3) The term "pressure" is used only for the unweighted level.

(4) Unless otherwise specified, time is in hours (e.g., the hourly equivalent level is $L_{eq(1)}$). Time may be specified in non-quantitative terms (e.g., could be specified as $L_{eq(WASH)}$ to mean the washing cycle noise for a washing machine)).