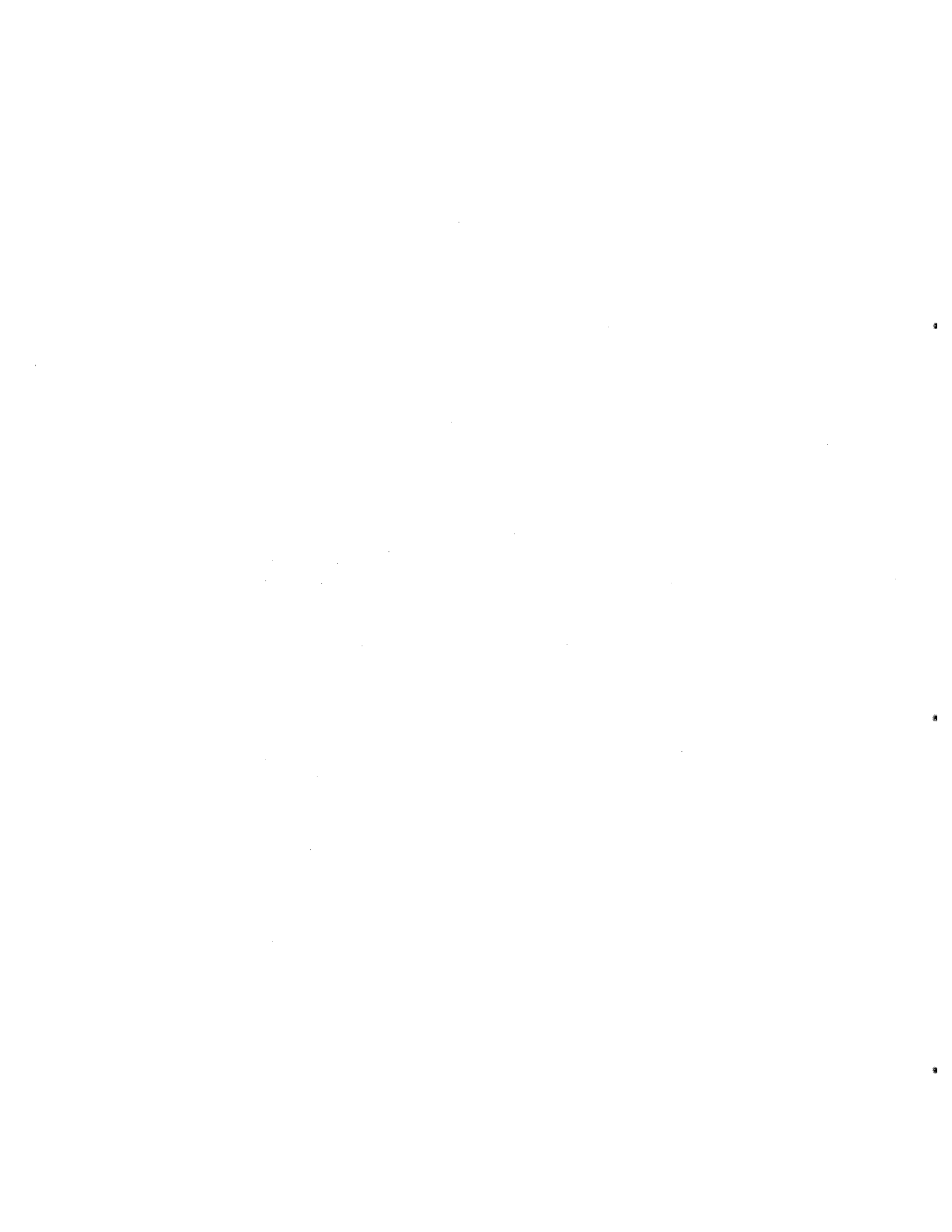


DIAMOND HEAD STATE MONUMENT

e.i.s. & planning report

Department of Planning and Research
City of San Francisco
2000 Market Street, Suite 1000
San Francisco, California 94102



DIAMOND HEAD STATE MONUMENT

final e. i. s. & planning report

JUNE 1979

Prepared by:
Division of State Parks,
Outdoor Recreation &
Historic Sites

Prepared for:
Department of Land &
Natural Resources
State of Hawaii



GEORGE R. ARIYOSHI Governor

BOARD OF LAND AND NATURAL RESOURCES

Susumu Ono, Chairman	Member at Large
Moses W. Kealoha	Oahu Member
Stanley W. Hong	Member at Large
Roland Higashi	Hawaii Member
Thomas S. Yagi	Maui Member
Takeo Yamamoto	Kauai Member

Susumu Ono Chairman
SUSUMU ONO

8/9/79
Date

"On the seventh day out we saw a dim vast bulk standing up out of the wastes of the Pacific and knew that that spectral promontory was Diamond Head, a piece of this world which I had not seen before for twenty-nine years. So we were nearing Honolulu, the capital city of the Sandwich Islands--those islands which to me were Paradise; a Paradise which I had been longing all those years to see again. Not any other thing in the world could have stirred me as the sight of that great rock did.

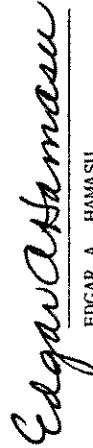
Mark Twain

PREFACE

This Planning Report of Diamond Head State Monument was prepared by the staff of the Division of State Parks, Outdoor Recreation and Historic Sites between June 1977 and June 1979, in accordance with directives from the Governor and State Legislature, and with the concurrence of the Diamond Head Citizen Advisory Committee. We, the undersigned, agree with the findings and recommendations cited herein.



JAMES J. YAMASHIRO
Administrator
Division of State Parks



EDGAR A. HAMASU
Chairman
Citizen Advisory Committee

ACKNOWLEDGMENTS

State Parks personnel who worked on this project over the duration of report preparation include:

Project Manager: Clyde Y. Hosokawa

Research and Planning Assistants:

Keith S. Nitta	(Jun 1977 - Jun 1978)
Dean S. Nakagawa	(Feb 1979 - Mar 1979)
Steven E. Sagucio	(Jul 1977 - May 1979)
Wayne H. Souza	(Jan 1979 - Mar 1979)

Illustrators:

Gail M. Kaito	(Jun 1979 - Aug 1979)
Michael S. Shiroma	(Nov 1978 - Aug 1979)

The dedicated members of the Diamond Head Citizen Advisory Committee have been most helpful, over a period of nearly two years, in the development of the final conceptual plan for the Diamond Head State Monument. They carefully evaluated alternative concepts, suggested modifications and new ideas, and participated in the preparation of this planning report. As the individuals' names are listed in Table 10 (p. 55) they will not be repeated here.

Several other resource persons as well as civic and government organizations also provided valuable input; they are listed on p. 73.

Janet Gordon-Roach served as Editor and Publisher of this report. The typist was Betsy Sakamoto.

C O N T E N T S

	Page	Page	
INTRODUCTION	1		
BACKGROUND INFORMATION		ANALYSIS (continued)	
PHYSICAL CHARACTERISTICS	3	DESIGN CONSIDERATIONS	41
Location, Description, and Significance	3	Physiography	41
Topography	4	Soil	41
Geology	6	Hydrology	41
Soils	9	Flora and Fauna	42
Climate	10	Climate	43
Hydrology	13	Transportation	43
Flora	13	Utilities	43
Fauna	17	Historic Values	44
HISTORY	20	Impact on Present Users	44
Names	20	PLANNING	
Legends	20	OBJECTIVE AND RESPONSIBILITIES	47
Heiaus and Burial Caves	20	INTERIM DEVELOPMENT PLAN	47
Government Use	21	CONCEPTUAL ALTERNATIVES	48
Significant Events of the Past Century	22	Conceptual Scheme I	49
RELATIONSHIP WITH SURROUNDINGS	24	Conceptual Scheme II	50
FACILITIES AND RELATED DEVELOPMENTS	25	Conceptual Scheme III	51
Existing Improvements	25	Conceptual Scheme IV	52
Access and Traffic	25	Conceptual Scheme V	53
Utilities	27	PUBLIC FEEDBACK	54
GOVERNMENT DEVELOPMENTS AROUND DIAMOND HEAD	31	CITIZEN ADVISORY COMMITTEE	55
City and County of Honolulu	31	PLAN POLICIES	56
State of Hawaii	31	FINAL CONCEPTUAL PLAN	56
U.S. Government	32	LAND ACQUISITION SCHEDULE	61
PRESENT PUBLIC ACTIVITIES IN THE CRATER	32	RELOCATION PLAN	62
ANALYSIS		DEVELOPMENT PLAN	63
POTENTIAL USES OF THE MONUMENT	33	Landscaping	63
Recreational Activities	33	Interpretive Center	63
Non-Recreational Activities	35	Interior Picnic Areas	64
RELATIONSHIP TO TOTAL DLNR PROGRAMS	35	Exterior Picnic Area	65
LEGAL GUIDELINES	36	Trail System	65
City and County	36	Upper Slopes	65
State of Hawaii	37	Dryland Habitat	65
U.S. Government	40	Project Nursery and Maintenance Yard	66
Government Rules and Regulations	40	Linear Parkway	66
		Tunnel Lookout	66
		Tunnels	66
		Interior Roadways and Parking	66
		Comfort Stations	66
		Caretaker Residence	67

PLANNING (continued)

	Page
DEVELOPMENT PHASING AND COSTS	67
Phase I	67
Phase II and Subsequent Development	68
Project Expenditures (1975 - 1980)	68
ENVIRONMENTAL IMPACTS	68
Short-Term Impacts	68
Long-term Impacts	69
OPERATION AND MANAGEMENT OF DIAMOND HEAD STATE MONUMENT	70
Interpretive Program	70
Landscape Program	71

APPENDIXES

Agencies and Organizations That Provided Input	73
Resource Persons	73
Mission and Position of State Department of Defense and Hawaii National Guard	74
Function and Role of FAA Facilities in Diamond Head Crater	75
Bibliography	76
Responses to EIS Preparation Notice	78

TABLES

Table	
1 Area of proposed expanded Diamond Head State Monument	3
2 Flora of Diamond Head crater	14
3 Birds that do or may exist in Diamond Head crater	19
4 Diamond Head State Monument facility inventory	26
5 Peak hour traffic on exterior roadways around Diamond Head crater	28

TABLES (continued)

	Page
Table	
6 Average daily Diamond Head crater road traffic in 1978	29
7 Helicopter (military) traffic, landings and take-offs	29
8 Status report of Capital Improvement Program No. 803, Project No. F-37, Diamond Head State Monument	38
9 Land classification system for Diamond Head State Monument	42
10 Citizen Advisory Committee	55
11 Operation and management criteria for land classes within Diamond Head State Monument	71

ILLUSTRATIONS

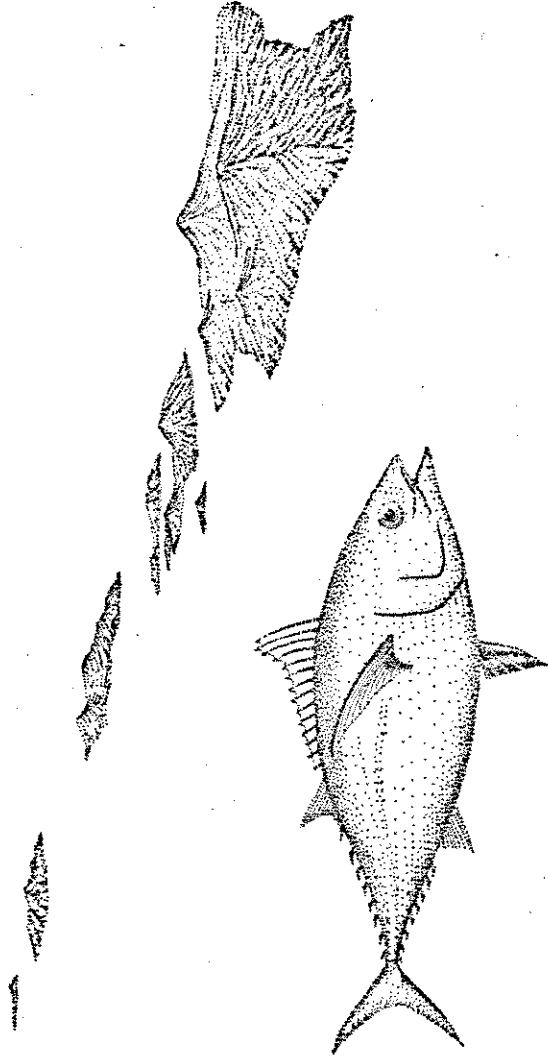
Figure	
1 Aerial View of Diamond Head, with Original 145-Acre Monument Configuration Outlined	1
2 Development Process Flow Chart	2
3 Proposed Expanded Diamond Head State Monument	4
4 Location of Diamond Head with Respect to Surrounding Residential Districts	5
5 Topography and Outaway Sketch of Diamond Head Crater	6
6 Profile of Geologic Strata through Diamond Head cone and crater	8
7 Soil Map	9
8 State Conservation Land Use District	24
9 Historic, Cultural and Scenic District No. 2	25

ILLUSTRATIONS (continued)

Figure	Page
10 Existing Improvements in and around Diamond Head Crater	27
11 Traffic Count Stations around Diamond Head	29
12 Existing Utilities in the Crater Area	30
13 Honolulu Comprehensive Zoning	40
14 Diamond Head Conservation District Sub-Zones	41
15 Land Classifications for Management Purposes	43
16 Hiker Permit Statistics	45
17 Interim Development Plan	47
18 Conceptual Scheme I	49
19 Conceptual Scheme II	50

ILLUSTRATIONS (continued)

Figure	Page
20 Conceptual Scheme III	51
21 Conceptual Scheme IV	52
22 Conceptual Scheme V	53
23 Final Conceptual Plan	57
24 Three-Year Phase of Implementation	58
25 Five-Year Phase of Implementation	59
26 Ten-Year Phase of Implementation	60
27 Land-Acquisition and Easement Map	61
28 Development Plan	63
29 Sketch Showing Relationship of Information and Interpretive Center, Parking, Roadway, and Interior Picnic Areas	64
30 Sketch of Comfort Station	67



INTRODUCTION

Diamond Head State Monument was first officially established under Executive Order 2000 by Hawaii's Governor Quinn in 1962. This early designation covered about 145 acres in a horseshoe configuration preserving the famous profile and the south and west exterior slopes from the crater rim down to Diamond Head Road, as shown in Fig. 1.

The interior of the crater had been closed to the public from 1906 until 1968, when it was opened to crater festivals and hiking under permit from the State Department of Defense. In 1976 the Division of State Parks, Outdoor Recreation and Historic Sites, under the direction of the Department of Land and Natural Resources, became the agency generally responsible for the planning and management of the Monument.

In 1977, in accordance with executive and legislative directives, this study was initiated to plan, define, and develop the proposed enlarged Diamond Head State Monument with provisions for public recreation. An interim plan and alternative recreational development proposals were presented for public review in August and September 1977, and a Citizen Advisory Committee was formed in October 1977 to help develop the final plan. A development-process flow chart is provided in Fig. 2, showing the steps in the procedure and the points at which public input and review are incorporated into the process.

The final conceptual plan and the resulting development plan and time schedule presented in this

report represent the culmination and consensus of that process. They thus constitute the recommendations of the many individuals--both staff and interested citizens--and agencies that participated in the effort.

Fig. 1. AERIAL VIEW OF DIAMOND HEAD, WITH ORIGINAL 145-ACRE MONUMENT CONFIGURATION OUTLINED.

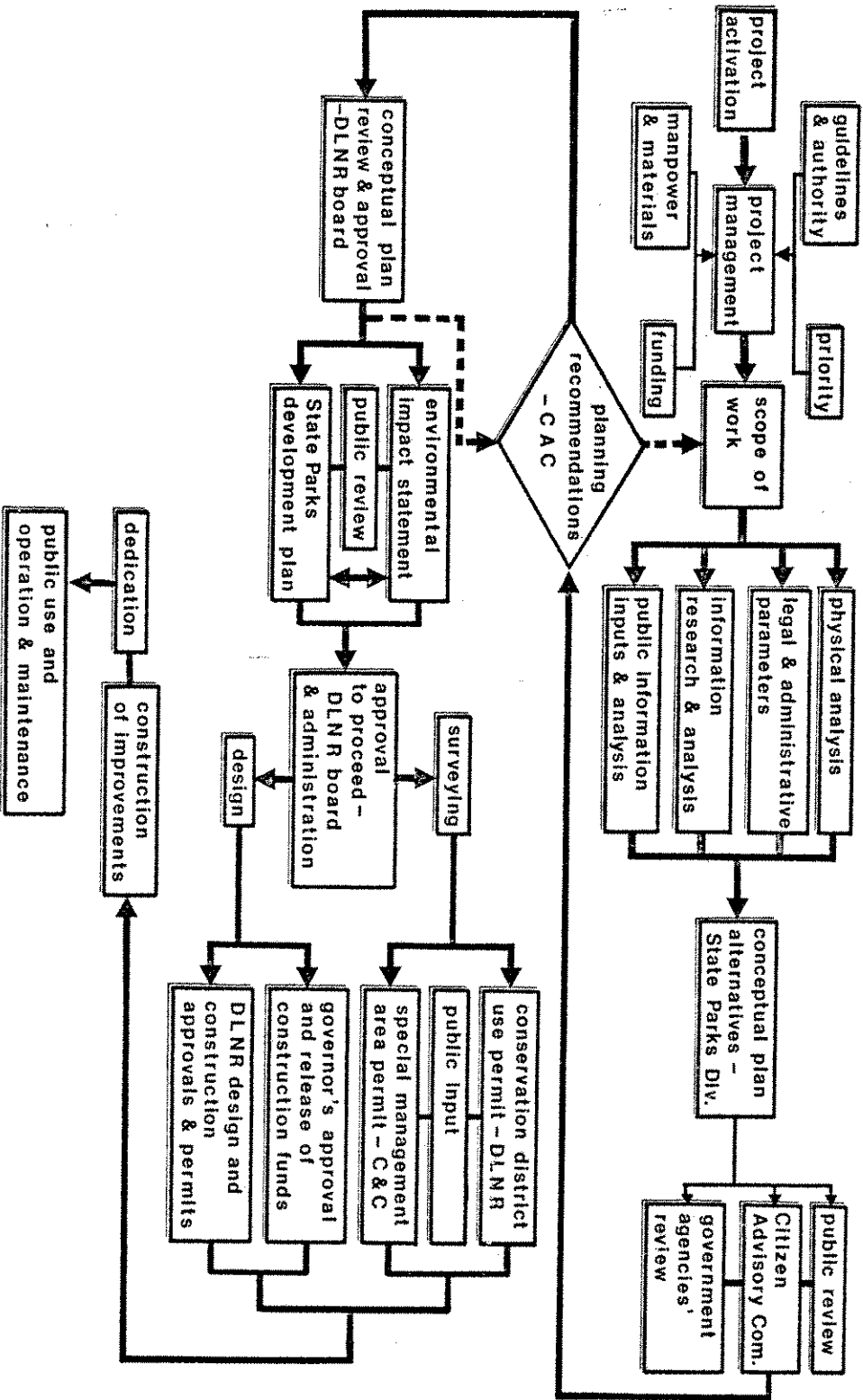
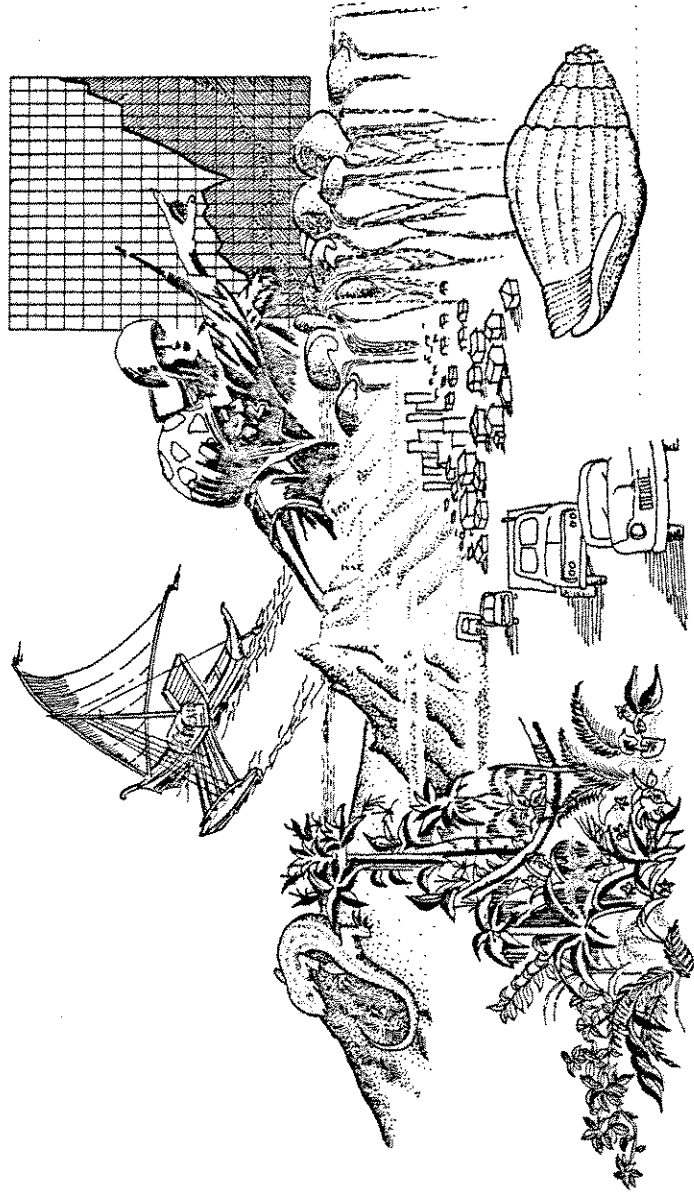


Fig. 2. DEVELOPMENT PROCESS FLOW CHART.



BACKGROUND INFORMATION

PHYSICAL CHARACTERISTICS

LOCATION, DESCRIPTION, AND SIGNIFICANCE

Diamond Head, on the southeast coast of the Island of Oahu, and southeast of urban Honolulu and Waikiki, is a prominent natural landmark that can be viewed from the sea, from the air, and from much of urban Honolulu. The crater is also known as Leahi, its Hawaiian name.

The most familiar profile of Diamond Head, shown on the cover, is known worldwide. Views from the east and north provide different, but no less distinctive profiles, recognized by residents and even by many visitors.

The proposed expanded area of the Monument will include those State lands adjoining and within Diamond Head Road and lying east of Kapiolani Park, incorporating acreage as shown in Table 1 and Fig. 3 (tax keys shown). Around the perimeter of Diamond Head lie the Kahala, Kaimuki, Kapahulu, and Diamond Head residential areas (Fig. 4). A short walk from central Waikiki through Kapiolani park brings the visitor to the foot of the slopes of Diamond Head.

Geologically speaking, Diamond Head is an extinct volcanic crater, with a variable-height rim surrounding the recessed interior area, which is accessible via two man-made tunnels. The interior is an extensive open space, including a large fenced area that contains several structures presently occupied by the United States Federal Aviation Administration (FAA) and the Hawaii National Guard (HNG). The remainder of the crater is undeveloped open

Table 1. AREA OF PROPOSED EXPANDED DIAMOND HEAD STATE MONUMENT

Tax Map Key (T/MK)	Area (acres)	Agency
Existing Monument		
3-1-42:14	145.323	State Dept. of Land and Natural Resources (DLNR)
Proposed Expansion		
3-1-42: 6	303.263	State Dept. of Defense (DOD)
:21	19.250	DOD
:23	.230	DOD
:24	.230	DOD
:25	.918	DOD
:10	2.941	U. S. Army
:20	6.103	DOD
: 8	.980	DLNR
: 7	4.916	City/County Board of Water Supply (BWS)
:17	6.465	DLNR
:26	.014	BWS
:15	3.110	FAA
:16	.290	FAA
:11	22.591	U. S. Army
3-1-35:22	6.40	BWS
3-1-35:23	2.64	BWS
Subtotal	380.341	
TOTAL	525.664	

space except for a recently added comfort station for Monument visitors.

The highest point, on the southwest rim of Diamond Head, known as Leahi Point, presents a spectacular panorama in all directions as a reward for the climb via a steep trail and stairway system.

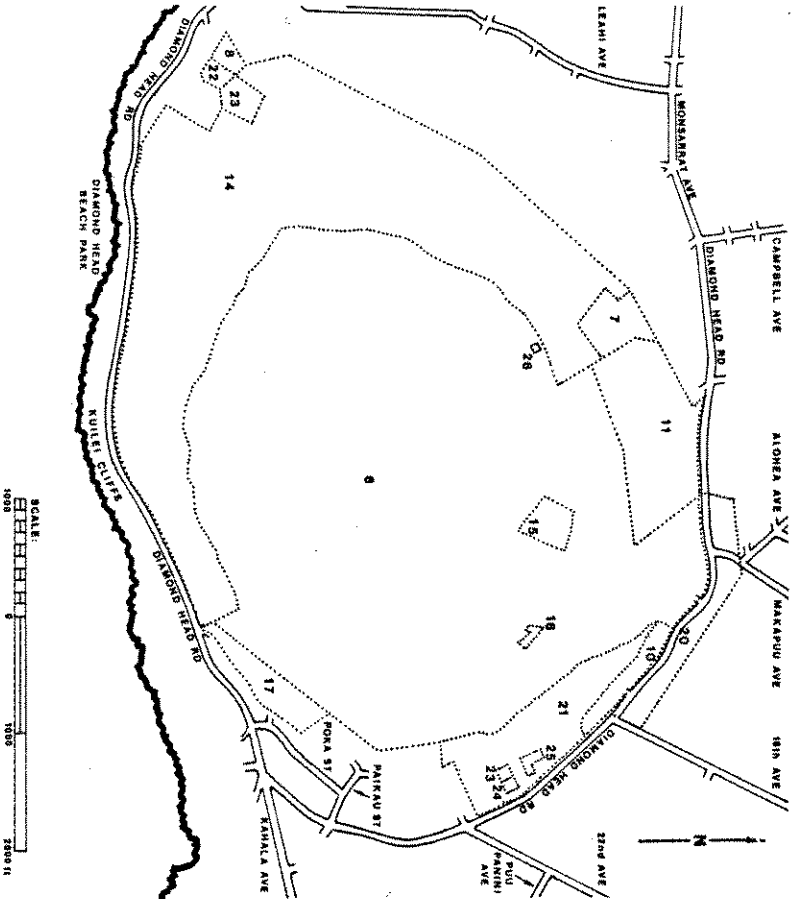


Fig. 3. PROPOSED EXPANDED DIAMOND HEAD STATE MONUMENT. Numbers indicate Tax Map Keys.

TOPOGRAPHY

Diamond Head Crater is a broad, saucer-shaped crater situated on the Honolulu plain, bounded on the south by the ocean, as shown in Fig. 5. The nearly level floor of this roughly circular crater is much broader than the rim is high--its diameter is about two-thirds of a mile (3520 ft), while its highest point, on the southwest rim, is 761 ft.

The principal departure from the circular form occurs as an elongation of the southwest rim to the highest point, in a direction about S 60°W, and the longer axis of the crater is approximately 15 percent greater than the shorter axis.

The elevation of about one-fourth of the total perimeter of the rim is below 400 ft, slightly more than half is between 400 and 500 ft, and the remainder is more than 500 ft in elevation. The lowest point, on the southeast side, is about 320 ft above sea level.

The crater floor has slopes running from 2 to 12 percent; about half are 6 percent or less. The lowest point of the crater, due east of the center--covering an area of less than 5 percent of the floor--is less than 200 ft above sea level. Slightly more than half the floor area is below 300 ft.

Two thirds of the crater rim is a sharply crested, circular ridge of 500- to 800-ft width at its base. The slopes in general are steep, the outside slope being dissected into alternating ravines and spurs. The remaining one-third of the rim, including all those parts of the crest rising above 500 ft, is somewhat less regular, much more massive, and much more deeply dissected. It is the only part of the crater that shows any considerable amount of dissection of the inside rim.

The massive rim of Diamond Head is eroded by numerous deep, narrow ravines that follow radial courses down the steep surface. Most of the ravine bottoms are only 2 to 3 ft wide--in some places but a few inches. The steeper portions of some ravine channels contain series of potholes. The side walls



Fig. 4. LOCATION OF DIAMOND HEAD WITH RESPECT TO SURROUNDING RESIDENTIAL DISTRICTS.

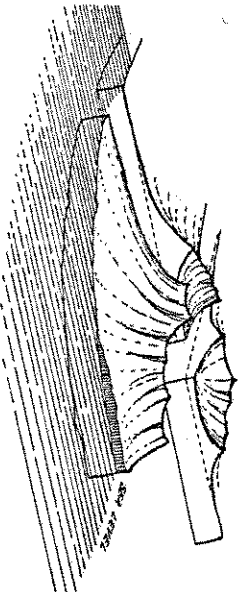
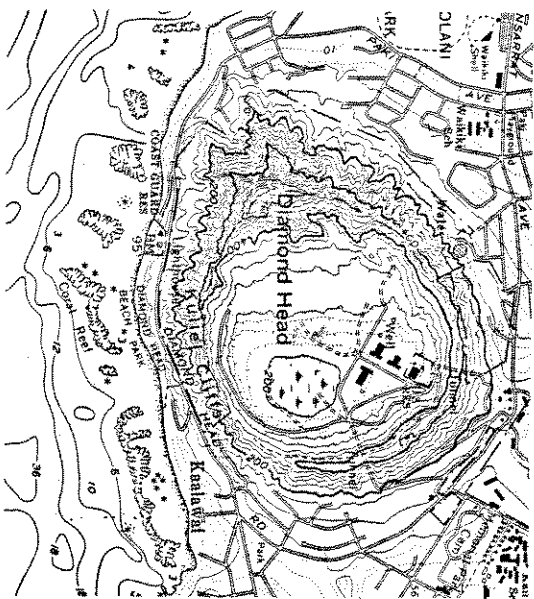


FIG. 5. TOPOGRAPHY AND CUTAWAY SKETCH OF DIAMOND HEAD CRATER.

of the channels are generally fairly smooth, except near their tops.

Most of the cliffs at the heads of the majority of the ravines rise 50 to 200 ft, nearly or quite to the crest of the crater rim and range from slopes of 70 degrees to vertical or slightly overhanging declivities. The smaller ravines head in rounded, funnel-like covers, above which are graded slopes of spurs.

Between the ravines are long, narrow, radial spurs having longitudinal slopes averaging 30 to 35 degrees, but in places these are cut back at the base so that the slope becomes 40 to 45 degrees. The slopes of these spurs are covered by beds of calcareous talus breccia that mantle them, in some places, up to within 100 to 150 ft of the adjacent rim crest.

GEOLOGY

Diamond Head is the best known of the pyroclastic craters of the world, and is an ideal example of the class. Its significance is such that Diamond Head has been designated as a "Registered Natural Landmark" by the Federal Government.

SUMMARY

Following the erosion of the Koolau Range and the formation of a long line of sea cliffs extending from Makapuu Head to Pearl Harbor, the eruption of Diamond Head took place well over 150,000 years ago. At that time the sea stood about 40 ft higher than now and probably extended to the base of the Koolau Range; thus the site of Diamond Head was covered, in part at least, with off-shore coral reefs. It is probable that, during the eruption, tuff (rock composed of the finer parts of volcanic detritus) was deposited over the reefs in the area north of Diamond Head in amounts sufficient to connect the crater with the main mass of the Koolau Range by a neck of land. From what is known of the configuration of the Kaimuki lava, formed at a later date, it seems unlikely that this connection was broken before the formation of the Kaimuki crater. With

that renewal of volcanic activity, many thousands of years later, the main vent of Diamond Head remained dormant, but three other vents not known to have been active previously opened--Kaimuki, Mauumae, and Kupikipikio. The lavas of Kaimuki and Mauumae established two separate crater masses, and the Mauumae lavas made more permanent the neck of land that joined Diamond Head to the Koolau Range. Lava from the Kupikipikio dike added considerably to the height of Kupikipikio Point and gave greater stability to the original reef-rock mass over which it was erupted.

The sea remained about 40 ft higher than now for a rather brief period, during which wave action cut cliffs in the tuff, and then receded to a position not more than 12 ft above the present level. Further recession of the sea to its present position, and the continuation of weathering and erosion to the present day, are the closing geologic events of the Diamond Head region.

THE PYROCLASTIC VOLCANO

The Greek word "pyroclastic" means "fragmented by fire." Hot volcanic materials, such as pockets of magma (molten rock), persist deep within the rocks of volcanic regions. The magma can move about from one pocket to another and even rise to the surface on occasion. Gases generated by magma usually work their way to the surface through cracks or, more slowly, through porous rocks, and escape. When water runs down through the cracks in any quantity, however, thereby coming into direct contact with the hot magma, great amounts of steam are generated with explosive force. The force of this steam breaks through the overlying rocks, fragment-

ing both them and the hot volcanic materials. All of this pulverized material, and even much larger rocks, can be blown high into the air with the steam. Dust and smaller particles may also be converted into a mud-like material, or simply moist ash, by the steam. Falling back to the surface of the ground, the finer ejected material forms stratified layers that harden and, with time, are consolidated into rock-like material called tuff.

Geologists have recorded 30 eruptions of the pyroclastic type in the southeastern region of Oahu. All of these have occurred within a radius of 12 miles of Honolulu and are, therefore, referred to as the "Honolulu volcanic series." Several of these eruptions formed craters similar to Diamond Head; these are well known--Ulupau, Aliamanu, Punchbowl, Tantalus, Round Top (Ualakaa), and the series from Manana to Koko Head. The fact that several of these craters can be connected by a straight line indicates that they may have been formed along fissures or fault lines.

THE FORMATION OF DIAMOND HEAD

In the case of Diamond Head, ground water, both fresh and salt, filtered through the sub-ocean or sub-reef materials, came in contact with hot rocks and molten magma, and generated explosive steam. There was probably a violent earthquake and a deafening roar, and then the explosion blew a hole up through the layers of limestone, shattering it also into small fragments. Moistened by steam and ground water, these materials were blown miles into the air with great clouds of steam.

This activity continued for a few hours, perhaps

a day or so, and then quieted down. As the material settled back to earth, it fell most abundantly around the throat through which it had been ejected, forming a cone (Fig. 6). Some of the material formed layers down the inside walls, plugging the throat; others formed layers down the outside of the cone. Since the northeast tradewinds were blowing, more of the detritus settled in a southwesterly direction, making that the highest part of the cone. While the material was soft, much of it was eroded away. Later on, dust, ash, and volcanic mud became compacted and cemented into beds of tuffs, which are hard, but not as hard as basalt or lava rock.

In later years, the sea level again rose and eroded away a mile or more of the southern slope of the crater into a sea cliff.

While there is a surprising amount of agreement between the accounts of Diamond Head given by various geologists, there are some differences of opinion on the formation of this volcano, centering on: 1) the time at which the explosive eruptions took place; 2) the nature of the landscape at that time—whether

the site was under water or on a raised limestone reef, and whether or not it was covered with vegetation; and 3) the duration of the period of explosions, or how long it took to form Diamond Head.

STRUCTURAL GEOLOGY OF DIAMOND HEAD

Seven principal rock formations are found in the Diamond Head region. The oldest of these is the Koolau basalt, which makes up the main mass of northeast Oahu. Next is a complex series of calcareous sandstones, conglomerates, and eolian calcareous sandstones. The Diamond Head tuff is third in the age sequence, followed by the Kaimuki basalt, the Kupikiipiko basalt, and the Kupikiipiko black ash. The exact age relationships of these last three are not known, though they are believed to be essentially contemporaneous. The youngest rock in the region, excluding modern alluvium and talus, is the calcareous talus breccia found on the lower, exterior makai slopes of the crater.

Blocks of marine limestone are found in the tuff

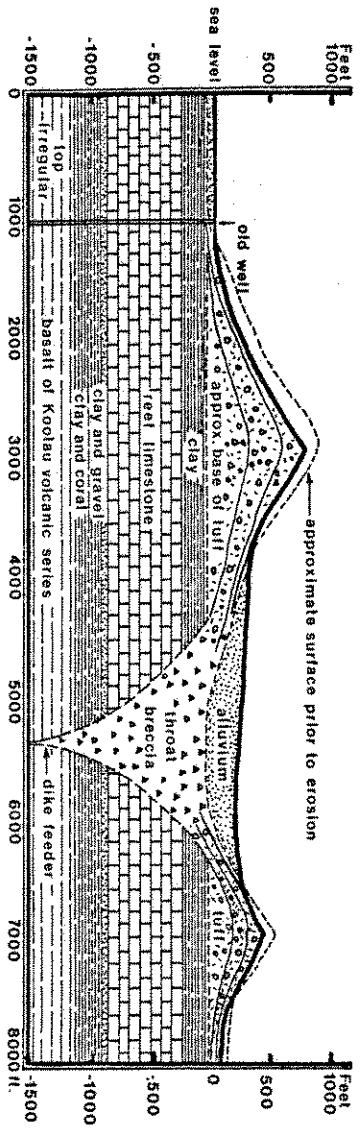


Fig. 6. PROFILE OF GEOLOGIC STRATA THROUGH DIAMOND HEAD CONE AND CRATER.

of Diamond Head. Fragments ranging from less than half an inch to more than 3 in. in diameter occur indiscriminately in all parts of the mass, indicating that the ejection broke through coral limestone. All available evidence leads to the belief that limestone is generally present beneath the surface in the entire area of the Diamond Head-Kaimuki projection.

The areal extent of the Diamond Head tuff is roughly Kapiolani Park to the west, Kilauea Street to the north, Luawai Street to the east, and along Kaimanahala to the ocean on the south. The tuff varies in depth, with the deepest sections located along the leeward (southwest) slopes of the crater.

Talus breccia with thicknesses of 5 to 25 ft, and exceptionally to 50 ft, mantles extensive areas of the exterior slopes of Diamond Head. It extends to within a vertical 100 ft of the rim crest on some of the spurs, though considerable areas above the 200-ft contour line are above it. The bedding, crude and irregular, is shown chiefly by the calcareous laminae that separate the materials accumulated during different stage of deposition.

SOILS

The soils of Oahu--which have developed from volcanic materials that include lava, ash tuff, and cinders--are inherently rich in iron, magnesium and aluminum, but deficient in phosphorus.

Diamond Head soils consist largely of one-time volcanic ash and lapilli altered to palagonite, but contain, in addition to the magmatic debris, a considerable quantity of talus breccia that formed and

was cemented by calcium carbonate when the sea level was 40 ft higher than its present level. Occasional blocks of Koolau basalt and numerous fragments of coral limestone from the reef that covered the original volcano site can also be found.

The Makalapa clay series predominates in the alluvium within the crater (Fig. 7). These soils are mildly alkaline in their dark grayish-brown, 8-in.-thick surface layer and mildly to moderately alkaline in their 18-to-36-in. lower layer. They are overlaid

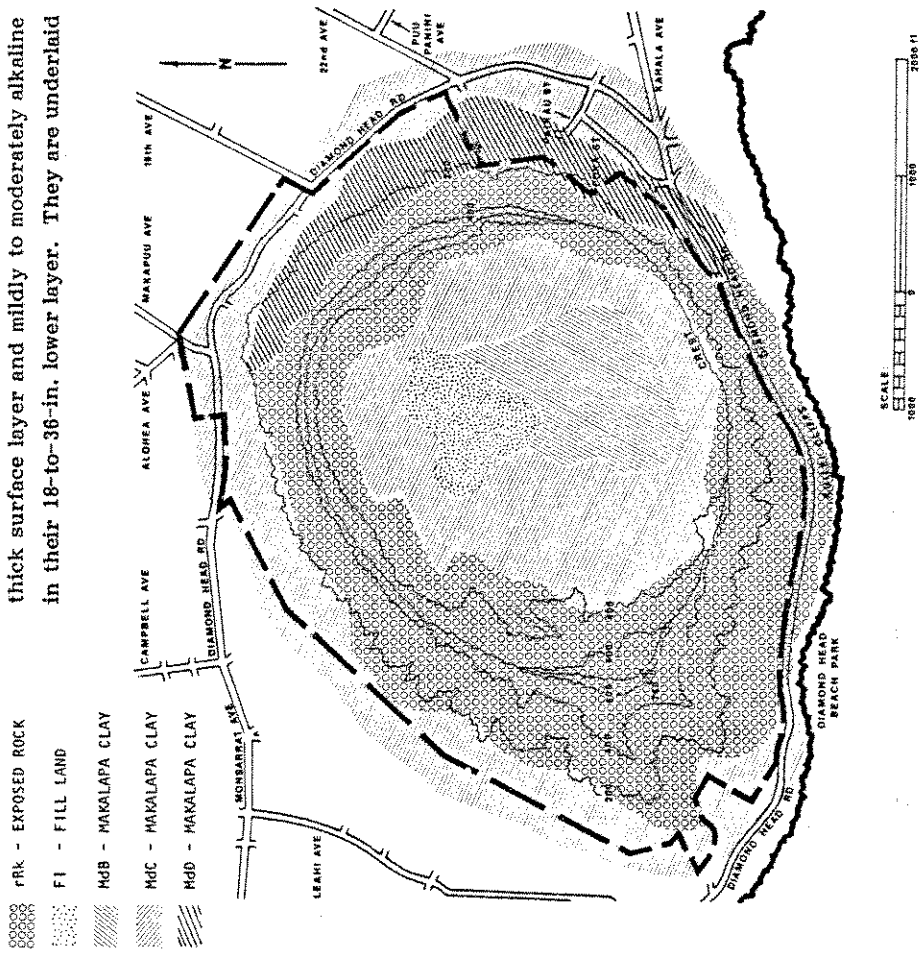


Fig. 7. SOIL MAP.

by light-gray to dark grayish-brown, weathered, volcanic tuff. The Makalapa clay series is divided into three types, described below.*

The MdB soils come from the shallower slopes (2 to 6 percent) of the crater. Their clay components are very sticky and plastic and therefore very difficult to work. Their shrink-swell potential is high and they crack widely on drying. The permeability and runoff of MdB are slow and the erosion hazard is slight. The available water capacity is about 1.4 in. per foot of soil. Roots can penetrate to the volcanic tuff beneath.

The MdC soil is similar to the MdB except that it occurs on fans (6- to 12-percent slope). Runoff is slow to medium and the erosion hazard is slight to moderate.

On the MdB soil (12- to 20-percent slope) runoff is medium and the erosion hazard is moderate.

Particularly beneath the developed area in the crater's interior, fill of miscellaneous composition and various depths has been added, as shown in Fig. 7.

CLIMATE

Diamond Head crater is situated within the leeward-lowlands climatic subregion of Oahu. In general, the climate is characterized by a two-season year, by mild and fairly uniform temperatures, by generally humid conditions, and by a dominance of tradewind flow (although the slopes of the crater may negate this flow). Dry weather

prevails except for occasional light tradewind showers, which drift over from the mountains to windward, and for periods of major storms. In some leeward areas, an afternoon sea breeze is common, especially in summer.

SEASONS

The two seasons recognized are the seven-month winter season (October through April) and a five-month summer season (May through September). Summer is definitely the warmer season, with an overwhelming dominance of tradewinds, rarity of rainstorms, and thus lower average monthly rainfall.

TEMPERATURE

The average-temperature range in leeward Oahu is small. The warmest month is August, with an average temperature of 78.4°F; the coldest is February, at 71.9°F. Temperatures above 95°F are infrequent.

WIND

As in all mountainous areas, the wind conditions at Diamond Head crater are complex. The high rim of the crater certainly distorts and disrupts the general wind flow, but how it affects the wind situation within the crater is not well known.

The most prominent feature of the air circulation is the northeast tradewind flow toward the southwest. Tradewinds averaging more than 14 mph dominate the flow of air across wide reaches of the lowlands. Light trades permit a diurnal cycle of land and sea breezes. Extremely high winds are unusual inside the crater. The trades prevail 80 to 90 percent of the time from May through September; from

*Data on the three Makalapa clay types was drawn from the USDA Soil Conservation Service *Soil Survey*, Aug 1972.

October through April, they blow across the islands only 50 to 80 percent of the time on the average.

Local wind regimes may either reinforce or oppose the general flow of air, depending on the local circumstances. Extremely high winds occur only occasionally, and then only as a result of a major storm, the passage of a cold front, or an unusual local situation. The major storms are chiefly events of the winter season and may yield very high winds from any direction.

HUMIDITY AND CLOUD COVER

Under tradewind conditions, the moisture content of the air is relatively high. The relative humidity commonly averages 60 to 70 percent, with nighttime values frequently between 70 and 80 percent, afternoon values commonly between 50 and 55 percent and seldom below 40 percent. Winter humidities are somewhat higher than summer ones and, in terms of daily variations, the maximum values occur with the minimum temperatures during the late night and early morning.

The Diamond Head area is basically sunny. The heavy masses of clouds that frequently cling to the Koolau Range crest are usually fragmented by the trade winds, which sweep the shreds rapidly over Diamond Head and out to sea. Only during extended Kona storms, which occur two or three times a year, mostly in the winter, may an overcast persist over Diamond Head for more than a day.

RAINFALL

The mean annual rainfall for Diamond Head is about 25 in., with a pronounced contrast between the rainy winter season and the drier summer sea-

son. Most of the winter rainfall occurs in general storm situations, while most summer rainfall consists of brief tradewind showers.

The heaviest storm rains frequently occur in localities that do not have the greatest average rainfall, and it is not uncommon during such storms for relatively dry areas such as Diamond Head crater to receive within a single day, or even a few hours, totals approaching their mean annual rainfall.

At all times of the year in leeward Oahu, rainfall is most likely to occur during the night or early morning (59 percent*) and least likely to occur during midafternoon; in general, this diurnal variation is far more pronounced in summer than in winter.

The amount of rainfall is highly variable from one year to another, however. The precipitation of a particular month may vary by 200 to 300 percent over a period of years; in Honolulu, in a 62-year period, for example, the extreme values were 46 and 10 in. Rainfall variability is far greater during the winter, when occasional storms may contribute appreciably to rainfall totals, than during summer, when tradewind showers provide most of the rain. With such wide swings in precipitation, it is inevitable that there will be occasional drought years, in which the winter rains fail--in which there are only two or one, or even no rainstorms of real magnitude. Such a deficiency of winter storms hits hardest the normally dry areas, such as Diamond Head, which depend chiefly on winter rains and receive little precipitation from the summer tradewind showers. In these localities the small amount of rainfall that occurs during the usual dry summer season is insufficient to prevent severe drought.

* Loveridge, 1924.

STORMS

Most of the time, Oahu weather is dominated by the tradewinds; non-tradewind conditions are quite different. Four classes of non-tradewind disturbances produce major storms affecting the state-- cold-front storms, Kona storms, hurricanes and tropical storms, and storms associated with upper-level low-pressure systems.

Cold-front storms occur during the winter when a cold front sweeps across the islands, bringing locally heavy showers and gusty winds. Only one or two, or as many as six, eight, or more cold-front storms may occur in a year. Perhaps once every three or four years, on the average, a cold-front storm will produce winds strong enough to do scattered damage to trees, crops, and houses.

Kona storms, like cold-front storms, are features of the winter season, occurring when a storm eddy, or low, moves past the islands, bringing widespread heavy rains, often accompanied by strong southerly winds. The rainfall in a well-developed Kona storm is more widespread and more prolonged than in the usual cold-front storm. If the Kona storm is accompanied by high winds, the winds are usually steadier and more prolonged, but not as strong as the extreme winds of the cold-front storm. An occasional entire winter may pass without a single well-developed Kona storm; more often, however, one or two such storms a year occur, and rarely four or five. Kona rains, lasting from several hours to several days, may fall steadily, but the longer-lasting ones are characteristically interrupted by intervals of lighter rain or even partial clearing, as well as by intense showers superimposed upon the more moderate regime of continuous, steady rain.

True tropical storms, of which the hurricane is the most intense, rarely strike the Hawaiian Islands, but they may pass close enough to yield heavy rains, high winds, and great waves crashing against the coasts. Only four true hurricanes have struck the state since 1950, although at least as many others have passed within 200 miles or so during the past decade. Tropical storms, similar to hurricanes but with less intense winds (below 74 mph), are more frequent. Hurricanes and tropical storms are not limited to the winter season--they are most likely to occur from July through December.

Storms associated with upper-level low-pressure systems often resemble a Kona storm and may be mistaken for one, except for the absence of the persistent and sometimes strong southerly winds that frequently accompany Kona storms. The surface winds during these events may be from any direction, and are often light.

Intense local rainstorms, other than tradewind storms, are small events that occur most typically in the late afternoon or early evening at any time of year. Waterspouts and other funnel clouds are not uncommon in the Hawaiian area. About 20 of them are reported in the average year, although probably at least as many more are sighted but not reported. Occasionally a waterspout will drift onshore and do some damage. Small tornadoes have been known to form over the islands with the same effect, but these phenomena appear to be far less violent than the worst of their counterparts in the mainland United States. Lightning and thunder of the violence common in some areas of the mainland are quite uncommon in Hawaii.

HYDROLOGY

Hydrology is the science devoted to the investigation of the properties, distribution, and circulation of water in the atmosphere, on the surface of land, and in the soil and underlying rocks. It incorporates wide fields of study--geology, topography, soils, and climate are essential elements affecting the hydrographic nature of an area. As these elements are already addressed separately in this report, we shall limit the hydrology of the study area to surface and ground water.

SURFACE WATER

The source of surface water in this area is precipitation. Though relatively dry, this area may receive heavy rains during a winter storm. When this occurs, runoff is maximum because of the shallow soil depths and soil type (Makalapa clay series) on the crater slopes. This water runoff creates problems of erosion and mudslides onto the roadways in the interior.

Drainage both inside and out is along radial lines in the narrow, steep-sided ravines. No streams flow, except for brief periods following heavy rains. The interior drainage runs to the lowest point, where it ponds and either is pumped out of the crater, evaporates, or percolates through the ground. During the rainy winter seasons a pond sometimes occupies the lowest part of the crater floor for two or three weeks at a time; however, flooding appears to have been less frequent in recent years. This change may be related to a periodic fluctuation of rainfall or a progressive change toward drier condi-

tions. There is a slim possibility that the change may be in some way connected with the general lowering of the ground-water level in the Honolulu region in recent years.

GROUND WATER

In Hawaii, ground-water sources fall into one of four categories: 1) lens-shaped bodies of fresh water floating on salt water, either freely or confined by the coastal caprock under artesian pressure; 2) brackish water where there is no fresh-water lens, or in the transition zone between salt water and the fresh lens; 3) water impounded at higher elevations by volcanic-dike systems; and 4) water perched on impervious strata. The crater ground water is in the fourth category; the lens is shallow and the tuff, which is much less permeable than the basalt, limestone, and recent alluvium, serves as a caprock or retaining member.

FLORA

The flora of Diamond Head consists predominantly of man-induced exotics, with a few native species (Table 2). All are plants that are adapted to semiarid conditions, with seasons of growth and semi-dormancy. The areas of vegetation can be subdivided into four major zones, which are influenced primarily by their geologic and physiographic makeup. These zones, listed in order of their increasing ability to retain soil moisture, are: 1) the steep rockland slopes, 2) the soil-covered upper slopes and ridge, 3) the lower slopes and crater floor, and 4) the seasonal wetland.

Table 2. FLORA OF DIAMOND HEAD CRATER

Scientific Name	Common Name	Zones			
		Steep Rockland Slopes	Soil-Covered Upper Slopes and Ridges	Lower Slopes and Crater Floor	Seasonal Wetlands
<i>Amaranthus spinosus</i> L.	Spiny amaranth			X	
<i>Bidens cuneata</i> Sherff	Cuneate bidens (koko'olau) **		X		
<i>B. cynapiifolia</i>	West Indian beggar's tick			X	
<i>Bracharia mutica</i> (For-sk.) Stapf	California grass				X
<i>Chloris divaricata</i> R. Br.	Star grass				X
<i>C. inflata</i> Link	Swollen fingergrass			X	
<i>Commelina benghalensis</i> L.	Hairy honohono				X
<i>Cucumis dipsaceus</i> Ehrenb. ex Spach	Wild cucumber				X
<i>Cyperus trachysanthos</i> H. & A.	Sticky galingale				X
<i>Desmanthus virgatus</i> (L.) Willd.	Slender mimosa				X
<i>Echinochloa colonum</i> (L.) Link	Jungle rice	X			X
<i>Emilia sonchifolia</i> (L.) DC.	Floras paintbrush	X			
<i>Euphorbia hirta</i> L.	Garden spurge	X			
<i>Gossypium tomentosum</i> Nutt. in Seem	Hawaiian cotton (ma'o) **				X
<i>Heteropogon contortus</i> (L.) Beauv. ex R. & S.	Pili grass *	X			
<i>Ipomoea cairica</i> (L.) Sweet	Koali *		X		
<i>Leucaena leucocephala</i> (Lam.) de Wit	Haole koa	X		X	X
<i>Lipochaeta</i> sp.	Nehē **		X		
<i>Mahuastrum coromandelianum</i> (L.) Garcke	False mallow		X	X	
<i>Merreria aegyptia</i> (L.) Urban	Hairy merreria				X
<i>Panicum maximum</i> Jacq.	Guinea grass				X
<i>Phaseolus lathyroides</i> L.	Cow pea				X
<i>Prosopis pallida</i> (Hump. & Bendl. ex Willd.) HBK	Kiawe			X	
<i>Santalum ellipticum</i> Gaud.	Coastal sandalwood **		X		
<i>Schida adamantis</i> St. John	Schida **		X		
<i>Setaria verticellata</i> (L.) Beauv.	Bristly foxtail			X	
<i>Sida cordifolia</i> L.	'Ilima *		X	X	
<i>Xanthium saccharatum</i> Wallr.	Cocklebur (kikania)			X	X

* Native plants

** Proposed endangered plants

STEEP ROCKLAND SLOPES ZONE

This zone, characterized by exposure of bedrock, with very shallow soil that is mostly confined to crevices, supports what is referred to as a *haole-koa/pili*-grass community, which can be easily recognized by the sparse distribution of plants.

The extremely dry, shallow soil supports only low shrubs and herbs, dominated by *pili* grass [*Heteropogon contortus* (L.) Beauv. ex R. & S.] with Floras paintbrush [*Emilia sonchifolia* (L.) DC.] and garden spurge [*Euphorbia hirta* L.]. Taller, woody species are restricted to the crevices, which contain more soil and retain more moisture; this layer is dominated by *haole* *koa* [*Leucaena leucocephala* (Lam.) de Wit]. Coastal sandalwood (*'iiti-ahi*) [*Santalum ellipticum* Gaud.] occurs in this zone.

SOIL-COVERED UPPER SLOPES AND RIDGES ZONE

The substratum supporting this zone is primarily a thin layer of soil over bedrock, with deeper soil confined to crevices; the moisture content is very low. The vegetation occupying this zone is the *haole* *koa* community, readily recognizable by thickets of *haole* *koa* with a thick, well-developed but species-poor, herb understory dominated by *'iiti* [*Sida cordifolia* L.]. In areas without an overstory, small patches of *pili* grass may occur. Cuneate *bidens* or *koko'olau* [*Bidens cuneata* Sherff], *nehe* [*Lipochaeta* sp.], and *schidea* [*Schidea adamantis* St. John] may also be found in this zone.

LOWER SLOPES AND CRATER FLOOR ZONE

A soil depth ranging from 27 to 49 in. over the volcanic tuff--considerably thicker than the other two

zones--characterizes this vegetation zone. The soil-moisture content varies from dry to moist. Three vegetation communities cover this zone--*kiawe/haole* *koa*; slender-mimosa/swollen-fingergrass; and grassland.

The *kiawe/haole* *koa* community is the most extensive and at one time covered the entire zone, until disruptive events (i.e., the intrusion of man) caused parts of the forest land to revert to pioneer conditions--a slender mimosa/swollen fingergrass community. The *kiawe/haole* *koa* community is species-poor and almost exclusively exotic in composition, consisting of four stories. The upper story with its *kiawe* [*Prosopis pallida* (Hump & Benpl. ex Willd.) HBK.] dominates the forest community. The second story is dominated by *haole* *koa*, the third mainly by *'iiti* with a few false mallow [*Melvastrum coromandelianum* (L.) Gareke] and swollen fingergrass [*Chloris inflata* Link], and the ground level by seedlings of *haole* *koa* and West Indian beggar's tick [*Bidens cynapiifolia* HBK.]. The bristly foxtail [*Setaria verticillata* (L.) Beauv.] is also found here.

The slender-mimosa/swollen-fingergrass community occurs on the moderately dry-to-moist soils of the gentle eastern and southeastern slopes. Slender mimosa [*Desmanthus virgatus* (L.) Willd.] and swollen fingergrass are the dominant species; spiny amaranth [*Amaranthus spinosus* L.] is locally dominant.

The grassland community covers large areas of the south and southeast edge of the crater floor, in which swollen fingergrass is the dominant species; other species are sparse. The soil-moisture content of this area ranges from dry to moist. The "sensitive

plant" or *pua hilahila* [*Mimosa pudica* L.] appears here also.

SEASONAL WETLAND ZONE

This vegetation zone is situated in the lowest portion of the eastern floor of the crater, where the heavy winter rains cause ponding of fresh water in an irregular basin and the raising of the ground-water table in the surrounding area to within a few inches of the surface. After a period of weeks, the standing and ground water evaporates and the area reverts to its dry state, with the exception of a small, man-made pond that retains its standing water throughout the rainy season.

This zone is composed of three vegetation communities. Along the western and southwestern edge of the seasonally inundated area, where the ground is slightly raised and very moist, the swollen-finger-grass/spiny-amaranth community developed. In addition to these dominant species, associated species include *Koahi* [*Ipomoea catrica* (L.) Sweet], Guinea grass [*Panicum maximum* Jacq.], and hairy merremia [*Merrremia aegyptia* (L.) Urban]. Star grass [*Chloris divaricata* R. Br.] is restricted to depressions where the ground-water table is only a few inches below the surface.

The star-grass community occurs east of the seasonally inundated area and is characterized by a high ground-water table after periods of heavy rain. Star grass, the dominant species, is associated with Guinea grass. In areas with raised ground, the soil is drier and provides a habitat for species of the semi-arid region. Commonly occurring on these drier sites are: Hawaiian cotton or *ma'o* [*Gossypium tomentosum*

Nutt. in Seem], wild cucumber [*Cucumis dipsaceus* Ehrenb. ex Spech], 'ilima, hairy *hono'hono* [*Commelina benghalensis* L.], hairy merremia, cow pea [*Phaseolus lathyroides* L.], *koahi*, and sow thistle [*Sonchus oleraceus* L.].

The star-grass/cocklebur community occupies the lowest area of the crater floor, where it is seasonally inundated; the man-made pond was excavated in this low area. Star grass and cocklebur (or *kikania*) [*Xanthium saccharatum* Waltr.] are the dominant species; associated species include Guinea grass, sticky galangale [*Cyperus trachysanthos* H. & A.], and jungle rice [*Echinochloa colonum* (L.) Link]. California grass [*Brachiaria mutica* (Forsk.) Stapf] is restricted to the man-made pond. The aquatic microflora of the seasonal water body is not known.

ENDANGERED PLANT SPECIES

No listed endangered plant species are known to occur in Diamond Head crater, but at least three proposed endangered species (1976 Federal Register) are found inside and on the slopes of Diamond Head: 1) the Hawaiian cotton or *ma'o*, 2) *cunene* *biden*s, and 3) *schida*a. Two other native plants, the coastal sandwood and the *nehe*, may be the taxa of those species listed on the proposed endangered plant list.

NOXIOUS PLANTS

Of utmost concern is the potential fire hazard from the semi-arid vegetation on the slopes and crater floor. The grasses present the greatest fire hazard---because of the dry nature of the area, the dry stems of the grasses decompose at a very slow

rate; thus the amount of fuel increases after each season's growth.

Four plant species are considered to be noxious. The kiawe, on the lower slopes and crater floor, is a potential hazard to park users because its stiff thorns, which are abundant on the youngest branches, can easily cause puncture wounds, even through rubber slippers and rubber-soled shoes.

Bristly foxtail, also found scattered on the lower slopes and crater floor is a serious pest when mature. The barbed thistles of the fruiting body stubbornly cling to clothing and to the hair of animals.

The "sensitive plant" has vicious barbs, which point backward along every stem and are difficult to dislodge.

The other known noxious plant is cocklebur, in the wetlands; its tenacious bur is troublesome in wood or in the hair of animals. The plants, especially the seedlings, are poisonous to livestock.

PLANTS OF SPECIAL INTEREST

Several plants of Diamond Head crater have attractive flowers; others are noteworthy for their ornamental fruits or unusual food-gathering habit. The hibiscus family is represented by three of its members; their showy flowers include the bright yellow blossom of the Hawaiian cotton, the orange-yellow flower of the 'i'lima, which is highly prized for lei-making, and the small orange flower of the false mallow. The 'i'lima stands out in the landscape after heavy rains, when it flowers in masses. Also of interest are the capsules of the Hawaiian cotton,

which contain brownish cotton fibers firmly attached to its seeds.

Other plants with attractive flowers include the nehe with its small, bright-yellow, composite flower head on a long stalk; the hairy *honohono* with its showy blue flowers; and Floras paintbrush, which resembles a paintbrush with its orange-to-lilac, tassel-like flower head attached to a long, slender stem. When mature, the flower head of Floras paintbrush changes into pappus, or tiny fruits tipped with a tuft of fine white hairs.

The coastal sandalwood is a partial parasite, obtaining some of its food by attaching its roots to other plants and extracting nourishment from them. The wild cucumber is known for its curious and ornamental fruit, which is a yellow, oblong (1- to 2-in. long) gourd closely covered with flexible bristles.

FAUNA

Although no surveys have been taken of the fauna at Diamond Head crater, personal communications with resource people in the respective fields yielded the following information.

VERTEBRATES

Birds

The varied habitats of Diamond Head crater provide homes for at least 26 species of birds; ten other species may possibly exist here also. The avian life is predominantly urban birds, introduced to the islands from other lands.

The Na La'au Arboretum area is noted as the home of exotic finches, many of which are found only in this area in the state. The diversity and numbers of finches are probably due to caged-bird releases and the setting up of bird-feeding stations by residents of the area. The birds that do and may exist in Diamond Head crater are listed in Table 3.

Mammals

All seven mammals occurring in this area are introduced animals that can be commonly associated with such habitats as provided by these wildlands: black rat [*Rattus rattus*], brown rat [*R. norvegicus*], Hawaiian rat [*R. exulans hawaiiensis*], house mouse [*Mus musculus domesticus*], the feral dog [*Canis familiaris*], mongoose [*Herpestes auropunctatus*], and the feral cat [*Felis catus*]. The dogs may in reality be unleashed pets rather than feral dogs.

INSECTS

Little is known about the insect life. Night mosquitoes [*Culex quinquefasciatus*], day mosquitoes [*Aedes albopictus*], bronze bottle flies (*Phaenicia cuprinal*), and other insects common to coastal wildland sites, such as bees and grasshoppers, also occur at the site.

ENDANGERED SPECIES

The Hawaiian short-eared owl, pueo [*Asio flammeus sandwichensis*], is the only known endangered species which may possibly include this site as part of its range.

NOXIOUS SPECIES

The bees, the night mosquito, the day mosquito, and the bronze bottle fly are considered noxious species. Bees can be a nuisance and can also pose a health hazard to visitors who are sensitive or allergic to their sting. Acute allergic reaction to a sting can occasionally occur.

The greatest vector problem is the night-active mosquito, which is a perpetual problem. It breeds in the ponds on the crater floor, especially after heavy rains, and the larvae change into mosquitoes with a range of 3 to 5 miles, thus affecting the neighboring areas. This night mosquito has a cycle of 7 to 10 days; thus, if the standing water persists more than 10 days, another cycle begins and continues until the water evaporates.

The day mosquito, which bites only during the day, is considered a limited problem since its range is only 100 to 300 ft, and it is found only in shady areas. The habitat of the larvae is the standing water that collects in the tree holes and rock holes on the upper slopes after heavy rains.

The bronze bottle fly is a problem only when large quantities of garbage are left uncollected for three days or more, such as after a large festival. This fly lays its eggs in the decaying garbage; on hot days, the eggs hatch and the larvae metamorphose in about three days. This large population of flies then becomes a potential health hazard and a nuisance for a couple of weeks. Flies carry many illnesses, such as dysentery, diarrhea, and food poisoning, because they breed in filthy places and then alight on food.

Table 3. BIRDS THAT DO OR MAY EXIST IN DIAMOND HEAD CRATER

Scientific Name	Common Name	Category	Scientific Name	Common Name	Category
Family ANATIDAE † <i>Anas acuta</i>	Pintail Duck (<i>Kofoa mapu</i>)	Indigenous, migratory	Family PLOCEIDAE (continued)	Warbling Silverbill	Exotic
† <i>A. wyvilliana</i>	Hawaiian Duck (<i>Kofoa</i>)	Endemic, endangered	* <i>Lonchura malabarica</i>	Black-headed Munia (Black-headed Mannikin)	Exotic
† <i>Spatula clypeata</i>	Shoveler (<i>Kofoa moha</i>)	Indigenous, migratory	<i>L. punctulata</i>	Spotted Munia (Ricebird)	Exotic
Family CHARADRIIDAE <i>Pterodroma dominica fulva</i>	Pacific Golden Plover (<i>Kofoa</i>)	Indigenous, migratory	<i>Padda oryzivora</i>	Java Sparrow	Exotic
Family COLUMBIDAE <i>Columba livia</i>	Feral Pigeon	Exotic	<i>Passer domesticus</i>	House Sparrow (English Sparrow)	Exotic
<i>Geopelia striata</i>	Barred Dove	Exotic	* <i>Urvaeginthus bengalus</i>	Red-cheeked Cordon bleu	Exotic
<i>Streptopelia chinensis</i>	Lace-necked Dove	Exotic	† <i>Vidua macroura</i>	Pin-tailed Whydah	Exotic
<i>Zenaidura macroura</i>	Mourning Dove	Exotic	Family PYCNONOTIDAE <i>Pycnonotus cafer</i>	Red-vented Bulbul	Exotic
Family FRINGILLIDAE <i>Cardinalis cardinalis</i>	Finches, Sparrows Cardinal (Northern, Kentucky, & North American)	Exotic	† <i>P. jocosus</i>	Red-whiskered Bulbul	Exotic
<i>Carpodacus mexicanus</i>	House Finch (Linnet, Papaya Bird)	Exotic	Family STRIGIDAE † <i>Asio flammeus</i>	Hawaiian Short-eared Owl (<i>Pueo</i>)	Endemic
* <i>Paroaria capitata</i>	Yellow-billed Cardinal	Exotic	<i>sandwichensis</i>		
<i>P. coronata</i>	Red-crested Cardinal (Brazilian)	Exotic	Family STURNIDAE <i>Acridotheres tristis</i>	Indian Mynah	Exotic
† <i>Serinus mozambicus</i>	Yellow-fronted Canary (Green Singing Finch)	Exotic	Family SYLVIIDAE <i>Copsychus malabaricus</i>	Shama Thrush	Exotic
* <i>Sicalis flaveola</i>	Saffron Finch	Exotic	Family TIMALIIDAE † <i>Leiothrix lutea</i>	Red-billed Leiothrix	Exotic
* <i>Tiaris olivacea</i>	Yellow-faced Grassquit	Exotic	Family TYTONIDAE † <i>Tyto alba pratticola</i>	Barn Owl	Exotic
Family LARIDAE † <i>Gygis alba</i>	White (Fairy) Tern (<i>Mamu O Ku</i>)	Indigenous	Family ZOSTEROPIDAE <i>Zosterops japonica</i>	White Eye (<i>Mejiro</i>)	Exotic
Family MIMIDAE <i>Mimus polyglottos</i>	Mockingbird	Exotic			
Family PLOCEIDAE * <i>Amandava amandava</i>	Weaver Finches	Exotic			
* <i>Estrelida caerulescens</i>	Red Munia (Strawberry Finch)	Exotic			
* <i>E. melipoda</i>	Lavender Fire-Finch	Exotic			
* <i>E. troglodytes</i>	Orange-cheeked Waxbill	Exotic			
	Red-eared Waxbill	Exotic			

†May possibly exist in the Diamond Head area

*Is restricted to the Na La'au Arboretum area

According to Harris Melend of the Hawaiian Humane Society, there have been no animal problems in the Diamond Head crater area that he can recall. Therefore, the feral cats and the reported feral dogs are not an existing animal problem; they must be considered a potential problem, however, since conditions are ever changing.

HISTORY

NAMES

"Lā'āhi" was the Hawaiian name of the crater. Although a number of variations appear in the accounts of the name, only two seem to have wide acceptance today. The first assumes that the Hawaiians saw some resemblance between the volcano's famous profile and the forehead (lāe) of the tuna ('āhi), a rather important element in their Hīhood. Hence the translation "forehead of the 'āhi." The second explanation assumes that the name might have been based on the phrase "Lāe Ahi" "fire head-land" or "Lei Ahi" "wreath of fire", reflecting the ancient Hawaiian practice of keeping a wood fire burning on the crest of Diamond Head to guide canoe fleets bound for the island.

In either case, Leahi was the term most widely used when the European and American seafarers came to the islands for the first time and, in many circles, the name continues to be used today.

Captain Portlock, on his voyage here in 1786, named this promontory Point Rose, in honor of his voyage's patron, George Rose. In the early 19th

century, sailors found, near the volcano's base, crystalline rocks--calcite crystals that cemented the volcanic tuff--which they mistook for diamonds. "Point Rose" was then discarded in favor of a variety of names, all of which had the word "Diamond" in them. The name Diamond Head endures until today.

LEGENDS

The oldest of the Hawaiian legends about Leahi naturally concerned the fire goddess, Pele. It seems that Namakaokahai, her jealous older sister, drove Pele and another sister, Hī'āka, away from home. The two ousted goddesses went first to the island of Kauai, where the eruption of Puu Ka Pele attested to the fact that they were there. They then came to Oahu, first to Salt Lake and then to Leahi. But when the sea put out the fire of Leahi, which they had created, Pele and Hī'āka moved on to the southeast--to Molokai, then to Haleakala on Maui, and finally to Mauna Kea, Mauna Loa, and the Kilauea volcanoes on the island of Hawaii, where, it is said, they continue to live.

HEIAUS AND BURIAL CAVES

Papaenaena Heiau and four other heiaus were built on or in close proximity to Diamond Head.

Papaenaena Heiau, located on the eastern exterior slope of Diamond Head, was one of the most famous in Hawaiian history; not only criminals, but at least one king as well, were sacrificed there.

Thomas Thrum, the noted Hawaiian historian, wrote that there are no precise accounts of just when Papaenaena Heiau was built. It is thought possible that

Maui King Kahekill erected Papaenaena in recognition of his conquest of Oahu and also for the purpose of executing the King of Oahu on a heiau which had not been defiled by the sacrifice of his own ancestor. Papaenaena Heiau figured importantly in 1804, when the temple priests recommended a 10-day tabu and the sacrifice of 400 pigs, 400 coconuts, 400 branches of plantains, and three human victims to appease the gods after King Kamehameha's ill-fated effort to conquer Kauai.

The walls of Papaenaena Heiau could be seen from Waikiki, and many travelers in the early part of the 19th century visited it. According to Thrum, however, the heiau had been demolished by Kanaina in 1856, and its stones were used for fence and road work in the vicinity of Waikiki.

Pahu-a-Maui Heiau, located near the site of the present Diamond Head Lighthouse, was attended by fishermen and seamen, and priests made offerings while watching for schools of fish in the channel.

Kapua Heiau, near Kapiolani Park, is mostly destroyed; however, fragments of a wall show it to have been approximately 240 ft square.

Kupalaha Heiau, also near Kapiolani Park, was obliterated long ago but may have been connected with Papaenaena Heiau.

Diamond Head (Ahi) Heiau was located on the peak of Diamond Head, where the navigation fire was tended. The shrine was dedicated to the god of the winds as a protection against sudden, violent updrafts which could put out the fire.

In addition to heiaus, burial caves have been found in some of the upper, vertical portions of the crater's interior slopes.

GOVERNMENT USE

The U. S. Government bought 729 acres of Diamond Head from the public domain in 1906. For nearly 44 years, from 1906 to 1950, Diamond Head was closed to the public at large and was occupied exclusively by the military, which constructed extensive facilities within the crater. Bunkers, gun mounts, battery and storage tunnels, communication rooms, and observation posts were built prior to 1941.

During World War II, barracks for hundreds of soldiers were constructed on the crater floor, but after the war ended, the soldiers departed, and the U. S. Army turned Ft. Ruger and Diamond Head over to the Hawaii National Guard (HNG) in 1950.

Through the 1950s and most of the 1960s, the HNG and the FAA demolished old structures and built new facilities. Housing tracts were developed in the east Diamond Head area.

In the late 1960s, crater festivals became the big event, and also as urbanization crept around the crater and government development threatened the crater itself, preservation and conservation became the focus of efforts to stop the desecration of the view and lands of Diamond Head. Preservation, conservation, and public use are now the strong trends, so that the Monument will be available for people to enjoy in the future.

SIGNIFICANT EVENTS OF THE PAST CENTURY

A sequence of the major events associated with Diamond Head since 1898 has been compiled for presentation below.

1898 - Joint Resolutions of Annexation gave fee title of Hawaiian government lands to the U. S. Government.

1900 - Hawaii became a Territory and, in accordance with the Organic Act, the Federal Government was given power to take Territorial lands.

1906 - The Federal Government acquired Diamond Head for the exclusive use of the military.

1950 - The U. S. Army turned Diamond Head land over to the Hawaii National Guard under permit. The Na Iai'au Arboretum was started by George Munro.

1955 - President Eisenhower turned Diamond Head land over to the Territory of Hawaii for Defense and Civil Defense.

1958 - Governor William Quinn of Hawaii turned over some crater land to the Civil Aeronautics Administration (FAA).

1959 - The Statehood Admissions Act gave Federal agencies five years to review and justify their continuing need for crater lands.

Hawaii became a State in accordance with the Admissions Act.

1962 - Governor Quinn established Diamond Head Monument by Executive Order No. 2000, to

acknowledge the exceptional natural value of the crater and the need for its preservation. The area covered by that order included only 145.323 acres, all on the outer slopes (see Fig. 1).

The State Department of Defense gained the crater interior and mauka exterior lands of Diamond Head.

1963 - Diamond Head was included in the Conservation Land Use District by the State Land Use Commission.

A Quit Claim Deed by the U. S. Army released restrictions on Diamond Head.

1964 - The County General Plan designated Diamond Head as "preservation" lands.

1965 - Diamond Head Monument was designated by Legislative Act 249 (SLH 1965) as an historic site to be administered by the Department of Land and Natural Resources (DLNR).

1967 - Pacific Planners Corporation was hired by DLNR for planning (visual and historical).

1968 - Diamond Head was designated as a National Natural Landmark.

The Board of Land and Natural Resources established extended boundaries for Diamond Head Monument and initiated action for legislation, designation, and management of the Monument.

Senate Resolution No. 16 requested the State and County to acquire land to preserve the visual and historical aspects of Diamond Head.

- 1969 - The first Annual Sunshine Music Festival was held in the crater.
- The County of Oahu amended its General Plan to include park and recreation use on the exterior slopes of Diamond Head.
- Diamond Head was included in a Preservation District under the Comprehensive Zoning Code.
- The first Diamond Head Task Force report was completed on the future use of Diamond Head.
- 1970 - The State Legislature barred the State Department of Defense (DOD) from constructing new facilities within the crater.
- A Senate Resolution requested the State Parks Division to develop historic preservation plans for Diamond Head.
- Another Senate Resolution requested the City and County to create a Historic, Cultural and Scenic District which would include Diamond Head.
- 1971 - The report "Preservation of Diamond Head to State Monument" was presented to the Legislature by DLNR (in accordance with the 1970 Senate Resolution).
- 1974 - The Legislature funded \$250,000 to the DOD for planning and construction of public access and facilities for Diamond Head.
- 1975 - Enlargement of Diamond Head State Monument was proposed, to include all adjacent State lands and to open the same for public access, recreation, and enjoyment (Act 182).
- House Concurrent Resolution No. 47 established the policy to develop a park for Diamond Head.
- Funds were appropriated for planning a State Park for Diamond Head.
- The Diamond Head Historic, Cultural and Scenic District No. 2 was established by the City and County of Honolulu.
- 1976 - Diamond Head State Monument was included under the State's Historic Preservation Law.
- Funds were appropriated for master planning. A consultant contract was negotiated, then was dropped as it was too expensive.
- 1977 - Funds were appropriated for planning for adjacent State lands.
- Public access and recreation planning were started for the Monument.
- 1978 - Governor George Ari'oshi dedicated Diamond Head State Monument interim facilities and opened the crater for public recreational use.
- 1979 - Planning of Diamond Head State Monument was completed. An Executive Order will formally transfer much of Diamond Head State lands to the DLNR for expansion of the existing Monument.
- Construction of roadway, trails, and parking improvements, a new water line for irrigation needs, grading, and landscaping to include the exterior of the crater were initiated.

RELATIONSHIP WITH SURROUNDINGS

Diamond Head's relationship with the surrounding environs is critical. The crater is a National Natural Landmark and a State Monument mainly to preserve the exterior visual aspects. Because of public desire to preserve the natural appearance and view aspects, the crater was placed and remains within the State Conservation Land Use District (Fig. 8) and also within the City/County Diamond Head Historic, Cultural and Scenic District No. 2 (Fig. 9). The Conservation District limits types of land uses and activities, while the Historic, Cultural and Scenic District protects the view of the Monument. The Monument is thus stabilized, and "mounted" into an essentially permanent setting--a large, undeveloped, natural feature ringed with urban developments of low-rise homes, parks, and government facilities such that the natural appearance of the crater can be viewed and appreciated from Koko Head to Ewa, from miles out at sea, or from the air, as a true symbol of Hawaii and aloha.

The relationship of development within the Monument to that outside is also significant. The FAA controls most of the air traffic in the Central Pacific Ocean through its facilities in the crater. The Emergency Operations Center (EOC) and Military Emergency Centers (MEC) also in the crater are the centers of State government and communications during situations of war or disaster. Daily emergen-

cies around Honolulu are also handled through Diamond Head from a repeater site for police, ambulance, and firefighting personnel. Water from as far away as Halawa is stored along the slopes for the Kapahulu and Kapiolani residential areas.

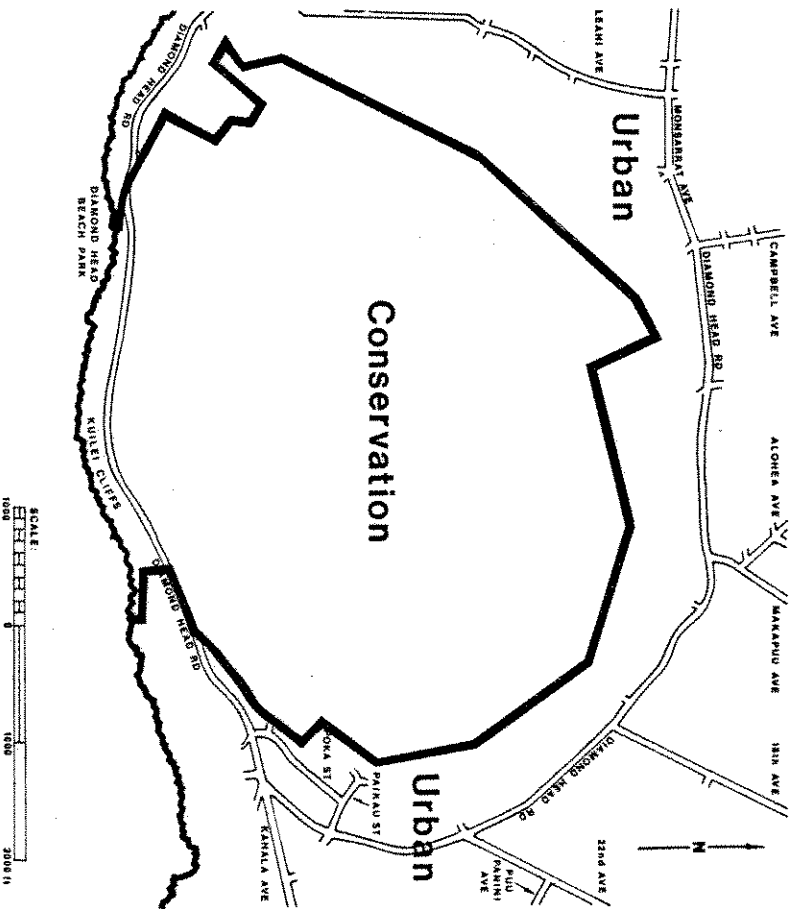


Fig. 8. STATE CONSERVATION LAND USE DISTRICT.

rim are bunkers, gun emplacements, tunnels, antennas, and other structures.

Around the crater exterior, largely on the mauka and eastern slopes, are the old U. S. Government military buildings, most of which are or will be abandoned as the HNG relocates. Two County reservoirs shown are still in use, and a third is abandoned. A County Park is being developed along the southern makai section, and Kapiolani Community College is planning campus facilities along the northern mauka slopes. The HNG is expanding its complex on the eastern slope, near the existing residential area, and the western slopes support the neglected Na La'au Arboretum and a residential area.

ACCESS AND TRAFFIC

Access to Diamond Head crater presently is available via one major roadway (Diamond Head Road), a series of trails, and the air (helicopter). Vehicular traffic--automobiles, trucks, vans, and busses--predominates.

The major secondary roads around Diamond Head are Monsarrat, Kahala, Makapuu, and 18th Avenues. The traffic-carrying capacity for these secondary roads--500 vehicles/hour/lane--has never been exceeded (Table 5); the traffic counts were made at six locations (Fig. 11). The roadway entries to Diamond Head are off Diamond Head Road near 18th Avenue and Makapuu Avenue. No on-street parking is allowed along Diamond Head Road except along the Kulei Cliffs, on the makai side of the crater. The bus system has two routes (No. 3 and 14) along Diamond Head Road.

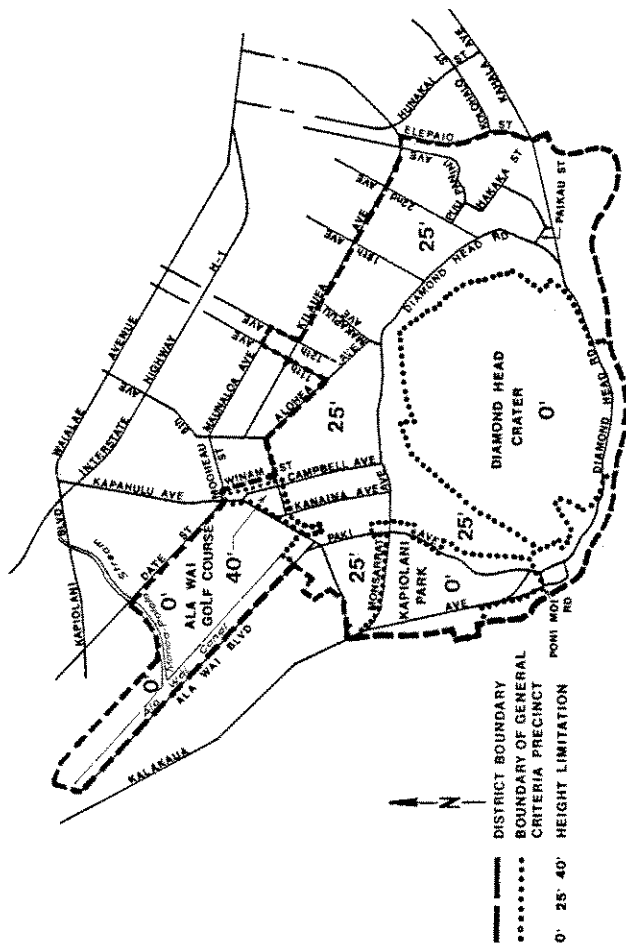


Fig. 9. HISTORIC, CULTURAL AND SCENIC DISTRICT NO. 2.

FACILITIES AND RELATED DEVELOPMENTS

EXISTING IMPROVEMENTS

Many structures and facilities presently exist around and within Diamond Head crater (Table 4 and Fig. 10). A series of large buildings within the crater houses the facilities of the HNG and the FAA. A State Parks comfort station adjoins remnants of abandoned rifle and pistol ranges. Scattered around the

Table 4. DIAMOND HEAD STATE MONUMENT FACILITY INVENTORY

Facility/Structure	Location	Agency (Tenant)	Present Use	Disposition (next 5 years)
Bldg 5, 31	DH Rd & Makapuu Rd	5 - U Hawaii 31 - DLNR (HCT)*	5 - abandoned 31 - theater; shops, storage	Demolition Demolition
Bldg 16, 33, 34	DH Rd & Makapuu Rd	DOD to DLNR	DOD base yard	DHSM* base facility
Bldg 11, 14	DH Rd (Kapaehulu)	US Army	Support of Cannon Club	Unknown
Cannon Club	DH Rd (Kapaehulu)	US Army	Military service club	Status quo
Bldg 20, 49	DH Rd (Kapaehulu)	DOD to DLNR	DOD maintenance bldg	Temporary use by State
Bldg 69, 22, 59, 32	DH Rd nr Makapuu Rd	DOD to DLNR	Abandoned	Demolition
Bldg 18	DH Rd across proposed entry to KCC ¹	DOD to DLNR	CU*(to leave, end of 1979)	Probable restoration for Monument use
Bldg 6, 24	DH Rd below Battery Harlow	DOD to DLNR (CD)*	6 - CD shop 24 - CD office	6 - demolition 24 - temporary use by HCT
Bldg 76, 95, 96	Ext* below Kapaehulu tunnel	DOD to DLNR	DOD storage	Demolition as required
Bldg 99	Ext nr Battery Harlow	DOD to DLNR (CD, Stan Harter)	Living quarters	Demolition
Tunnels MO - M6	Ext slope & roadway	DOD (CD) & FAA	Emergency storage	Status quo
Bldg 40, 41, 42	DH Rd nr 18th Ave	US Army to DLNR (HARC)*	Living quarters	Demolition
Battery Harlow	Ext slope	DOD (Govt agencies)	Emergency storage	Status quo
Crater tunnels	Kahala side Kapaehulu side	DOD to DLNR (FAA leases Kapaehulu tunnel)	Access to crater	Status quo Kahala - public use Kapaehulu - military, FAA
Birrkimer EOC	Mauka Int* slope	DOD (CD)	Emergency hq*	Status quo
Tunnel 407	Makai int-to-ext slope	DOD (Govt agencies)	Emergency hq	Status quo
FAA Bldg	Crater floor, mauka	FAA	FAA air traffic control center	Status quo
Bldg 301, 303, 304	Crater floor, mauka	DOD	Armory, maintenance, & office	Status quo
Comfort Station	Crater floor	DOD to DLNR	Public sanitary facility	Status quo
Misc tunnels, bunkers, antennas	Crater slopes & rim	DOD & FAA, many to DLNR	DOD storage; FAA communications; abandoned	Status quo on most; demolition or renovation as required
Misc bldg, structures, etc	Throughout crater	DOD to DLNR	Mostly abandoned	Demolition if not required
Water reservoirs (3)	2, ext mauka slope; 1, int slope (west)	BWS (ext) DOD to DLNR	Ext - 1 used, 1 abandoned Int - abandoned	Status quo or renovation
Utility poles & wires	Throughout Monument	DOD to DLNR (seasements to utility companies)	Utility services, electricity & telephone	Status quo w/removal of unrequired (future, all subsurface)
Roadways/parking	Throughout Monument	DOD to DLNR	Transit routes	Renovation
Rifle & pistol ranges	Crater floor	DOD to DLNR	Open fields/abandoned	Grading & landscaping
Na La'au Arboretum	West ext slope	DLNR	Abandoned	Trail improvements
FAA link site (L-5)	Mauka crater rim	FAA	Communications	Status quo

* Abbreviations: HCT = Honolulu Community Theater; DHSH = Diamond Head State Monument; KCC = Kapioalani Community College; CU = Credit Union;
CD = Civil Defense; HARC = Hawaii Association of Retarded Citizens; ext = exterior; int = interior; hq = headquarters

tween the extension of Campbell Avenue clockwise to Poka Street. All other trails above the Kullei Cliffs and Na La'u Arboretum are extremely hazardous and end at the cliffs. No count is available on the number of hikers utilizing the outside-to-interior trails, but it has been noted that these trails are more heavily utilized during crater festivals, when admissions are charged at the tunnel access points.

Helicopters enter and land within Diamond Head crater periodically (Table 7), dropping off and picking up VIPs. This traffic is minimal and is being curtailed by requirements for permits and valid military operations.

UTILITIES

All major utilities such as water, electricity, gas, telephone, and sewerage, are available around the outside of Diamond Head (Fig. 12). In the crater, however, the water and sewage lines and the storm-drainage system are currently maintained by the State DOD.

WATER

The County Board of Water Supply (BWS) 12-in. water main located along Diamond Head Road is presently tapped and metered near the Base Chapel (outside the crater) for all the water requirements within the Monument (bounded by Diamond Head Road). A 6-in. line feeds most of the crater exterior and an 8-in. line supplies the crater, including Battery Birkhimer, the FAA facility, the HNG buildings 301, 303, 304, and Tunnel 407, the State Parks lawn and comfort station, all inside, and the Cannon

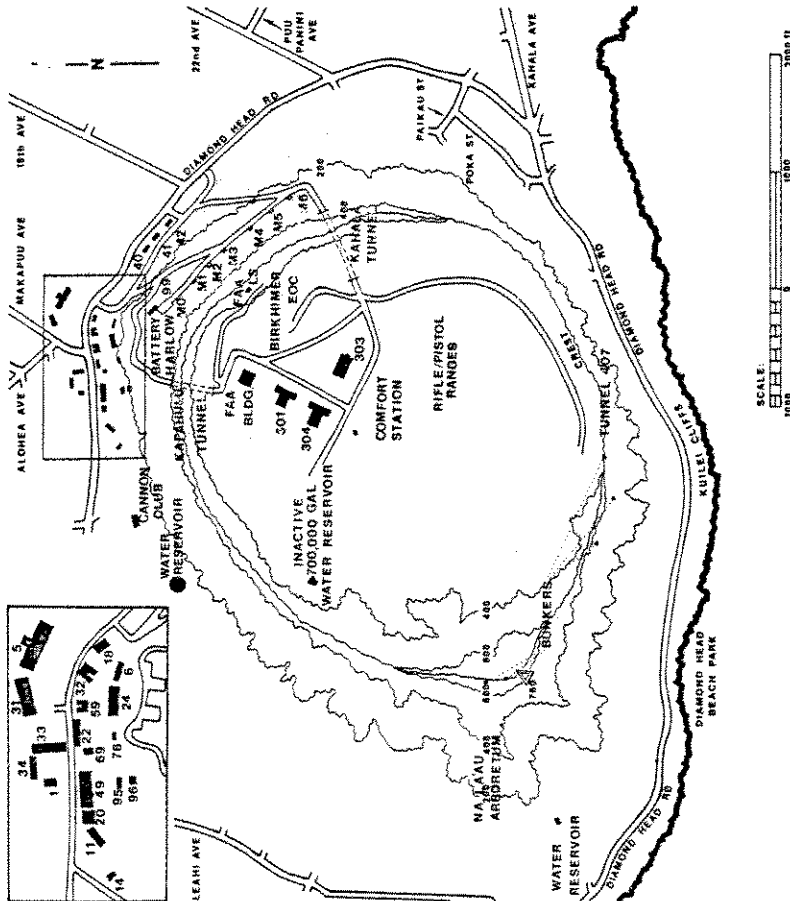


Fig. 10. EXISTING IMPROVEMENTS IN AND AROUND DIAMOND HEAD CRATER.

Vehicular access into the crater is through two tunnels, one of which is narrow and unsuitable for large vehicles. Peak traffic situations occur when government personnel enter for work in the morning and leave in the afternoon. Recreational users form a steady stream between mid-morning and early afternoon (Table 6), with no peak period.

The trails along the exterior slopes of the crater are fairly steep and are very dangerous to access into the crater. Entry trails are located be-

Table 5. PEAK HOUR TRAFFIC ON EXTERIOR ROADWAYS AROUND DIAMOND HEAD CRATER

Roadway	Site No.	Road Width (ft)	No. of Lanes*	Theoretical Carrying Capacity (v/hr)**	Average Usage (v/hr)	Date of Test	Time		Direction of Test Flow	Peak Usage (v/hr)
							a.m.	p.m.		
Kahala Ave.	1	80	3	1500	547	Thu - 5-23-74		3-4 4-5 5-6	Ewa Both ways Koko Head	323 780 484
								10-11 10-11 11-12	Koko Head Both ways Ewa	385 610 246
Kalakaua Ave.	2	108	4	2000	409	Mon - 11-26-73		2-3 5-6 5-6	Ewa Koko Head Both ways	166 150 829
								10-11 11-12 11-12	Ewa Koko Head Both ways	141 542 680
Monsarrat Ave.	3	80	3	1500	628	Tue - 12-10-74		4-5 4-5 4-5	Ewa Koko Head Both ways	614 801 1415
								7-8 7-8 9-10	Ewa Both ways Koko Head	866 1116 307
Diamond Head Rd.	4	56	2	1000	352	Mon - 12-11-72		3-4 5-6 5-6	Ewa Koko Head Both ways	272 476 672
								7-8 7-8 11-12	Ewa Both ways Koko Head	389 549 283
								5-6 5-6 5-6	Ewa Koko Head Both ways	297 502 799
								7-8 11-12 11-12	Ewa Koko Head Both ways	370 404 688
								4-5 4-5 4-5	Ewa Koko Head Both ways	699 487 1186
								7-8 7-8 11-12	Ewa Both ways Koko Head	606 779 340

* Approximately, accounting for periodically parked cars.

** Vehicles per hour = 500 v/hr x no. of lanes (more accurate in highway capacity manual).

Table 6. AVERAGE DAILY DIAMOND HEAD CRATER ROAD TRAFFIC* IN 1978

Source	Days	Composition	Peak Hours	Total Trip Count†
HMC	Mon-Fri	80-120 autos	6:30-7:00 a.m. 3:45-4:15 p.m.	600
FAA	Sat-Sun	Autos & trucks**	Scattered	400
	Mon-Fri	Mainly autos, some trucks	5:45-6:55 a.m. 3:30-4:30 p.m.	250†
	Sat-Sun	Autos		100
Tour Companies	Mon-Sun	2/3 vans, 1/3 buses	Scattered, 9:30 a.m. - 3:00 p.m.	60
	Mon-Sun	2/3 sightseers, short stay; 1/3 hikers, park for day	Scattered, 8:00 a.m. - 4:00 p.m.	120

* Crater opened to traffic at 6:00 a.m., closed at 6:00 p.m.

† Entering and leaving counted as separate trips.

** Weekend training, normally 2 times per month.

† Also 50 - 80 cars shift at midnight.

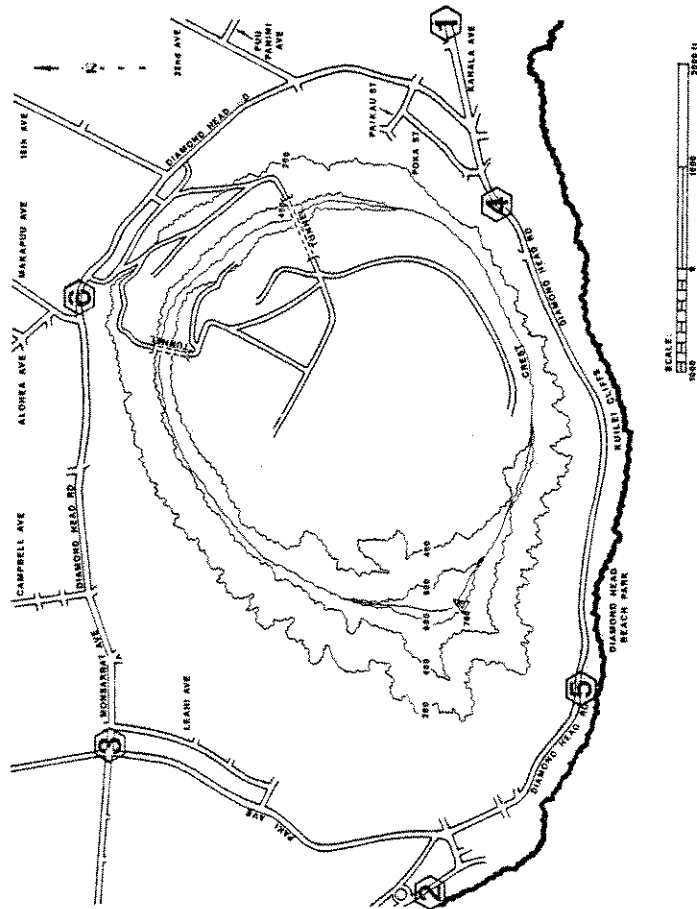


Fig. 11. TRAFFIC COUNT STATIONS AROUND DIAMOND HEAD.

Club outside. An old 700,000-gallon reservoir within the crater is presently disconnected.

There is heavy use of water from the 8-in. line, and water shortages have occurred because of the inadequate size and low head pressure. Water needs for landscaping have been programmed for early mornings and evenings; however, shortages still occur which are very critical for the delicate air-conditioning requirements of the FAA systems.

Table 7. HELICOPTER (MILITARY) TRAFFIC, LANDINGS AND TAKE-OFFS

Year	Month	No. of Actions	Year	Month	No. of Actions
1977	Jul	13	1978	Jan	7
	Aug	23		Feb	7
	Sep	8		Mar	11
	Oct	3		Apr	5
	Nov	3		May	2
Dec	8	Jun		2	
TOTAL		58		Jul	5
				Aug	1
				Sep	9
				Oct	8
				Nov	1
				Dec	2
			TOTAL		60

ELECTRICITY

The Hawaiian Electric (HECO) main power lines are along Makapuu and Aloha Avenues. The electrical system for the crater, maintained by HECO, is brought via overhead lines to the tunnel next to Battery Harlow; the lines are underground through the tunnel and then overhead again within the crater. An overhead line also climbs the muckai outer slope of the crater for the electrical requirements of Tunnel 407. Light standards abound along roadways with overhead lines. There is no shortage of electrical power.

GAS

Honolulu Gas Company has mains along Aloha and Makapuu Avenues as well as Kahala Avenue. Current service is provided only to the crater exterior, to such facilities as the Cannon Club and the presently limited facilities of Kapiolani Community College.

TELEPHONE/COMMUNICATIONS

The Hawaiian Telephone lines follow the HECO pole system along Aloha and Makapuu Avenues and upslope to and within the crater. The system is adequate, with 300 telephone connections for the crater; no further requirements are programmed through 1980.

The military maintains buried cables and antennas for communications requirements of the Emergency and Civil Defense headquarters.

The FAA also maintains some buried cable, antennas, and other communications facilities to support the Air Traffic Control Center.

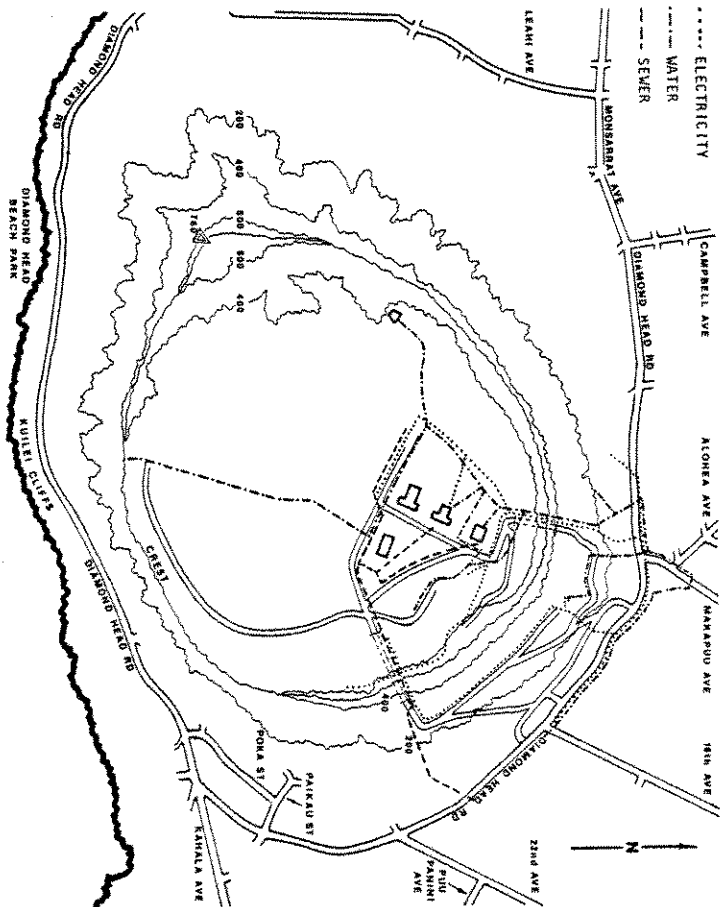


Fig. 12. EXISTING UTILITIES IN THE CRATER AREA.

SANITARY SEWER

The County sewer line for the crater is located along Puu Panini Street near 22nd Avenue. Almost all the sewage from the buildings comprising the former Fort Ruger Military Reservation is connected to this one tie-in point. The HNG presently pumps all the sewage from the crater in a 6-in. line which has a 4-in. portion through Kahala tunnel. The system is old but adequate for present use.

DRAINAGE SYSTEM

The drainage system is not a public utility, however, since it normally is an expected government service. Swales and basins in the crater are used to channelize the excess water, which is then pumped by HNG pumps to the crater exterior near the 22nd Avenue extension and into the county drainage system.

2. Reservoir at Makalei Place - to be abandoned and the property probably turned over to DLNR for Monument use
3. Pumping Station next to Diamond Head Light-house - no changes anticipated
4. Radio antenna site on north crater rim - no changes anticipated
5. Water tunnel along Diamond Head Road (Kapa-hulu)- no changes anticipated
6. Other - consideration of the development of a new reservoir within the Monument.

DEPARTMENT OF HOUSING AND COMMUNITY DEVELOPMENT

Urban Renewal Project in Kapahulu - continuation of improvements to public streets and new sidewalks.

GOVERNMENT DEVELOPMENTS AROUND

DIAMOND HEAD

Many developments are being planned or initiated around the Monument--the planned new Kapiolani Community College campus, roadway improvements, bikeways, and new as well as renovated existing facilities. All levels of government are involved, and the following developments are foreseen in the next five years.

DEPARTMENT OF PUBLIC WORKS

1. East Kaimuki Improvement District - improvements to streets, etc. programmed
2. Diamond Head Road - development of a bikeway proposed.

STATE OF HAWAII

DEPARTMENT OF DEFENSE

- i. Facilities between Trouseau St. and 18th Ave. - to be relinquished to DLNR and the University of Hawaii
2. Facilities between 18th Ave. and Paikau St. - development of military facilities to be continued, especially those being relocated from areas to be included into the Monument and parkway
3. Facilities within tunnels and bunkers within and around the crater - increased usage and some renovations and construction because of relocation of facilities transferred to DLNR
4. Facilities within the crater - no changes anticipated.

CITY AND COUNTY OF HONOLULU

DEPARTMENT OF PARKS AND RECREATION

Kuiliee Cliffs Park and Expansion of Kapiolani Park - to be expanded and further developed, using the "Kapiolani Regional Park Master Plan," 1975, as a reference.

BOARD OF WATER SUPPLY

1. Reservoir at extension of Campbell Ave. - no changes anticipated

UNIVERSITY OF HAWAII

Kapiolani Community College - planned development of a 48-acre campus with a projected student enrollment of 5000 on old Fort Ruger grounds; a Master Plan and Environmental Assessment currently in preparation.

DEPARTMENT OF LAND AND NATURAL RESOURCES

1. Hawaii Association for Retarded Citizens (HARC) (lease), East Diamond Head area - development of a new classroom being considered with desired expansion of area; buildings 40 - 42 under present permit (near 18th Ave.) programmed for demolition
2. Variety Club, S.E.C.O. (lease), East Diamond Head Road - no changes anticipated
3. Fish and Game Division, offshore waters - no development planned; however, a Marine Fisheries Management Program has been enacted (Reg. 45) for the Waikiki-Diamond Head shoreline.
4. DOD baseyard near Makapuu Ave. (TMK 3-1-42:20) - transfer to State Parks for use in maintenance of Diamond Head Monument; strip of land mauka of Diamond Head Road between 18th and Makapuu Ave. to be used to widen Diamond Head Road at intersection of facing entries to Monument and planned KCC campus
5. Red Cross, near 18th Ave. - no changes anticipated.

U. S. GOVERNMENT

DEPARTMENT OF TRANSPORTATION

1. FAA (TMK 3-1-42:15, 16) - some visible changes to current structures; some antennas along crater rim to be removed, others re-

- placed; cable trays to link site to be evaluated for possibility of underground ducts
2. U. S. Coast Guard, Lighthouse - no changes anticipated.

DEPARTMENT OF AGRICULTURE

Institute of Pacific Islands Forestry, Diamond Head Road near 18th Ave. - land will be held during search for alternative site; a new facility will be built here if no alternate site is available.

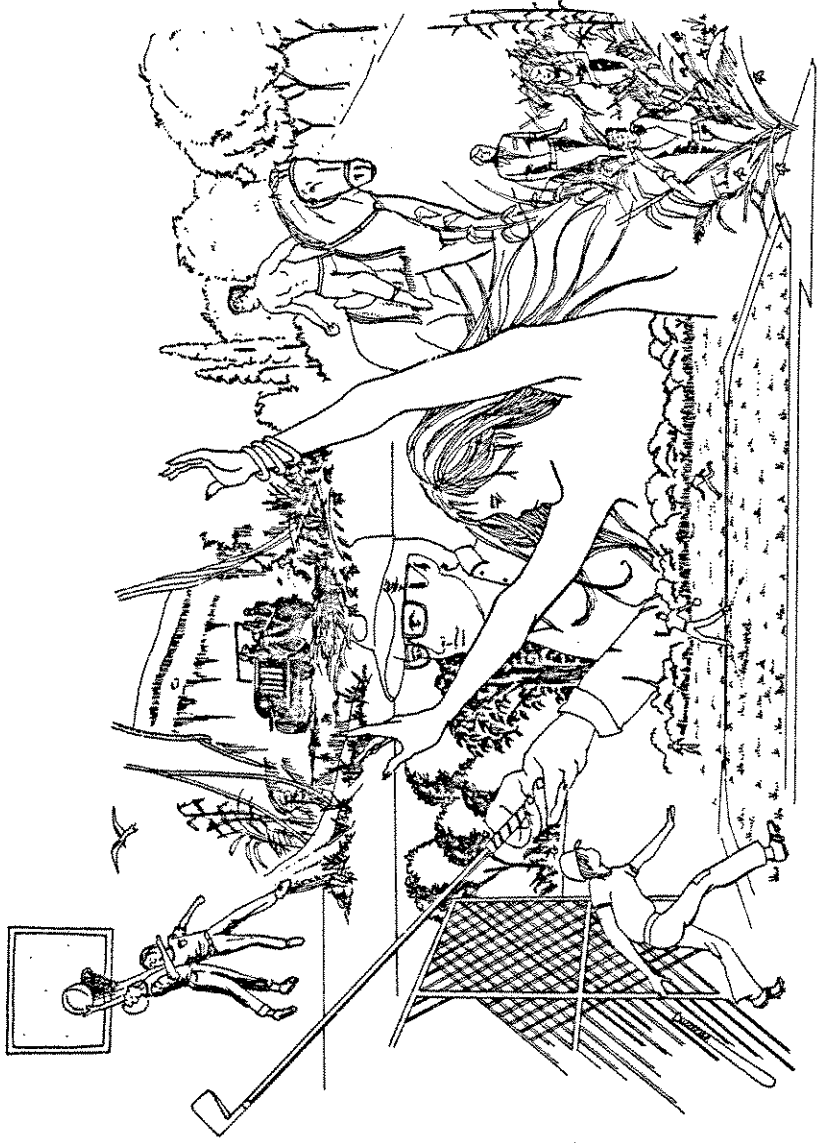
DEPARTMENT OF DEFENSE

U. S. Army Cannon Club, Kapahulu side of crater - no major changes anticipated.

PRESENT PUBLIC ACTIVITIES IN THE CRATER

Since 1969 there have been crater festivals-- usually on New Year's Day and the Fourth of July. These are the only occasions on which great numbers of the public have utilized the interior of the crater.

With the tunnels open to public access every day from 6 a.m. to 6 p.m., hikers and sightseers take advantage of the opportunity to enter and scale the interior slopes to reach Point Leahi because of its commanding panoramic views in all directions. These individuals or small groups usually represent the comparatively small numbers of daily public users of the crater.



ANALYSIS

POTENTIAL USES OF THE MONUMENT

Under Governor Quinn's Executive Order 2000 in 1962, Diamond Head was established as a State Monument with emphasis on preservation. The DLNR Division of State Parks, which was given the responsibility of management in 1975, has considered mainly passive recreation activities, as defined by the Statewide Comprehensive Outdoor Recreation Plan (SCORP), requiring few structural facilities. The Historic Preservation Law (Chapter 6E, Hawaii Revised Statutes, 1976) constrains most alternatives for the use of Diamond Head State Monument to preservation and recreation.

This study is therefore constrained to consider only passive recreational activities and the acceptable intensity of such recreational development and use of the interior of the crater and preservation of the visual exterior of the proposed enlarged Diamond Head State Monument.

RECREATIONAL ACTIVITIES

A wide variety of recreational activities--tennis, swimming, handball, hiking, frisbee, baseball, camping, surfing, and picnicking, to mention a few--is usually considered in planning the development of any park. If the activity cannot appropriately be applied to the specific site, however, it is normally eliminated from consideration. Diamond Head State Monument has a further development

restraint--preservation and restoration of natural and open-space features.

The Diamond Head study area is situated in SCORP Area 21 (Hawaii Kai - Punchbowl), which is the most densely populated area in the state. Containing more than a quarter-million residents, this area includes a major portion of metropolitan Honolulu as well as the island's primary tourist destination area, Waikiki. A moderate resident population growth is expected in this area over the next ten years.

Related to the area's high population is the large number of recreation facilities and areas in this district--36 parks, fields, playgrounds, and recreation centers of various sizes and accommodating a wide variety of activities, and 26 schools and libraries--all presently in active use within a 2-mile radius of Diamond Head.

The 1975 SCORP report indicated that, even with these extensive existing and planned new parks and other facilities, the total recreation potential for SCORP Area 21 is inadequate. Diamond Head was not planned at the time of that report; however, the Monument is more appropriately suited to passive recreational activities, with a relevant educational and interpretive center to facilitate the understanding of and appreciation for the natural-history aspects of the crater.

Some of the potentially compatible recreational uses considered for Diamond Head are discussed briefly below.

PICNICKING

Picnicking can take place within a semi-wild or developed park area. Fire hazards and containment, however, are important considerations in selecting sites. Support facilities include picnic tables and benches, barbecue grills, comfort stations, as well as landscaping with trees and lawn areas. This activity and its support facilities could be compatible with the objectives for the Monument.

CAMPING

Often well suited to semi-wild, semi-open land, camping may involve anything from primitive tents and tarps to cabins with extensive support facilities such as showers and changing areas, comfort stations, landscaping, and water for public use and fire protection. The natural vegetation and endangered species in the crater are highly flammable throughout most of the year, however, and there is little or no fire protection in the crater. Further, support-facility requirements would be difficult to provide within the natural setting.

FORMAL PLAY/ACTIVE GAMES

Informal play and many sports and games are suitable for open-lawn areas and require few support facilities. Areas for such activities would be suitable because of the level and gently sloping ground of the crater floor, which would permit such use.

WALKING AND JOGGING

These activities can occur within any park, as in most cases no formal, paved path is required. Since they are widely practiced all over the island and do

not require extensive support facilities, these activities would be compatible in Diamond Head.

HIKING

Hiking is an activity highly compatible in mountainous areas and would be particularly suitable within the crater because of the magnificent panoramic views from the crest. The poor condition of the existing trail, however, with hazards of steep, steep slopes, loose footings, etc., are negative aspects also being considered.

BICYCLING

Because bicycling can utilize most roadways and pathways anywhere, a bikeway is being considered for the exterior crater circumference.

HORSEBACK RIDING

Riding facilities have existed in Kapiolani Park and are currently in Koko Crater. Riding trails and the extensively used hiking trails, however, could conflict, and the activity would require extensive stable and maintenance facilities. Health hazards are also a negative aspect.

HARD-COURT ACTIVITIES

Such facilities as tennis, basketball, and volleyball courts, which require extensive development, are deemed incompatible with the desired passive use of the crater and the nature experience.

GOLF AND OTHER LARGE RESTRICTED-LAND-USE ACTIVITIES

Most of these require artificial environments involving the destruction of extensive areas of natural

settings. They are thus considered incompatible with the objectives of the Monument.

FESTIVALS AND OTHER LARGE EVENTS

Crater festivals and some other large organized events that have been permitted within the crater since 1969 are being evaluated for future inclusion in the Monument program. Erosion, fires, health problems, and vandalism were by-products of past large events, especially when admission was charged. Trespassing, traffic congestion, and parking problems were created in the exterior areas adjacent to the crater entrance.

NON-RECREATIONAL ACTIVITIES

There are many potential non-recreational uses of the crater beyond the existing military, Civil Defense, and FAA functions, which are currently allowed. Helicopter landings and restaurant functions, for example, are considered non-recreational. Such activities are not presently prohibited, but they are discouraged, and controlled through requirements for: 1) compliance with State Parks Rules and Regulations, and 2) Conservation District and Special Management Area permits. Some exemptions to non-recreational use restrictions--such as a Monument maintenance facility and Civil Defense emergency center--will be allowed.

RELATIONSHIP TO TOTAL DLNR PROGRAMS

Diamond Head State Monument is a small part of the total program structure of the DLNR; its current priority is 35th of the 170 CIP projects, a drop from

4th during fiscal year 1977-1978. The drop reflects the Department's 1979 priority on water research and development.

The DLNR has approximately \$50 million for all the CIP projects, with less than \$18 million for FY 1978-1979. CIP funds for Diamond Head initially totaled \$1 million, with a balance of \$725,000 now remaining, mainly for construction. Of this balance, \$250,000 is programmed for expenditure in FY 1978-1979 to initiate Phase I construction of the approved Development Plan.

The DLNR has 16 programs, as listed below.

- DLNR 101 - Public Land Management
- 111 - Conveyances and Recording
- 141 - Water Development and Irrigation
- 153 - Commercial Fishery
- 172 - Forestry Product Development
- 401 - Fish and Wildlife
- 402 - Forests and Open Space
- 403 - Mineral Resources
- 404 - Water Resources
- 801 - Historical and Archaeological
- 803 - Other Natural Features
- 804 - Inland Based Activities
- 805 - Other Ocean Based Activities
- 809 - General Administration for Culture and Recreation
- 810 - Prevention of Natural Disasters
- 906 - Natural Physical Environment

Diamond Head is currently Project F-37 under LNR 803, which has the objective: "To enrich the leisure time of people of all ages by making available for appreciation and study other unique features of the State." Activities under LNR 803 include main-

tenance of irreplaceable and significant geologic, scenic, botanical, and zoological features of State Parks.

Projects under LNR 803 are usually assigned to the Division of State Parks, Outdoor Recreation and Historic Sites. A summary of the CIP status of Project F-37 is presented in Table 8.

Diamond Head as a State Monument, under Chapter 6E of the Hawaii Revised Statutes, is the only officially designated monument within the State. Others under consideration, and being handled in the same manner, are: the Royal Mausoleum and Iolani Palace on Oahu, and Lava Tree Park on Hawaii. All are under the jurisdiction of the DINR Division of State Parks.

This Planning Report on Diamond Head defines the function, role, and plans of the DLNR in maintaining and developing Diamond Head State Monument. This section examines the elements--such as: legal guidelines, design considerations, historic values, and potential uses--that must be analyzed and evaluated before an appropriate Master Plan can be developed.

LEGAL GUIDELINES

As a land-use area, Diamond Head falls under the following descriptions and considerations, all of which limit the scope of the planning process.

City and County

Historic Cultural and Scenic District No. 2
Comprehensive Zoning Code (CZC)

Special Management Area
General Plan

State of Hawaii
State Monument
Conservation District
General Plan
SCORP Report

U. S. Government
National Natural Landmark

CITY AND COUNTY

HISTORIC, CULTURAL AND SCENIC DISTRICT NO. 2,
DIAMOND HEAD DISTRICT (ORD. #77-123)

This zoning (see Fig. 9) designates "Areas wherein natural and man-made objects of beauty and historic, cultural, architectural and scenic significance may be preserved, enhanced and perpetuated." Typically, exceptions to any planning regulations must be obtained through the Director of the Department of Land Utilization; however, exceptions may not exceed underlying zoning code restrictions.

Examples are: Hawaii Capitol HC&SD No. 1 and the City Hall Area.

COMPREHENSIVE ZONING CODE

The Preservation District Zone (P1, CZC Sec. 21-301) establishes the underlying zoning, designed "to protect and preserve park lands, wilderness areas, open spaces, beach reserves, scenic areas and historic sites." The residential district zonings (R-3 and R-6, CZC Sec. 21-523 and 21-553) also apply to

portions of the crater exterior which permit dwelling units under restrictions (Fig. 13).

Examples are: the Koolau and Waianae mountains.

SPECIAL MANAGEMENT AREA

This designation (Ord. 4529) sets out to "Main-

Maintain the underdeveloped areas where needed for recreation, scenic, education, and scientific use in a manner that protects resources and is of maximum benefit to the GENERAL PUBLIC.

All requests must be handled through the Director of the DLU.

Examples are: Kapiolani Park and Hanauma Bay.

GENERAL PLAN

The General Plan consists of a series of objectives and policy statements. Diamond Head, as a Preservation District, falls under policy statements dealing with preservation.

STATE OF HAWAII

STATE MONUMENT

State Parks criteria define State Monuments as: "Areas, usually limited in size, established primarily to preserve objects of historic and/or scientific interest, and places commemorating important persons or historic events. The only facilities usually provided are those required for the safety and comfort of the visitors, such as access, parking, water, sanitation, interpretive devices, and sometimes facilities for picnicking and other recreational facilities."

CONSERVATION DISTRICT

The Conservation District (DLNR Regulation 4) is one of four districts into which the State of Hawaii has been classified by the State Land Use Commission. All uses within the district must be approved by the Board of Land and Natural Resources. "The Conservation District is intended to and presently functions as a management tool for both the conservation and preservation of certain valuable resources. Only in isolated instances is strict preservation the need and intent, i.e., Diamond Head" (see Fig. 8) (Land Use District and Regulations Review, 1969).

Figure 14 shows three differentiations within the Diamond Head Conservation District. The objective of the "G" subzone is to designate open space where specific conservation use may not be defined but where urban use would be premature. The "P" subzone objective is to protect valuable resources such as significant historic and geological features. The "R" subzone objective is to develop, with proper management, areas to ensure sustained use of the natural resources of the area.

GENERAL PLAN

The statement of Program Objectives (DLNR) pertaining to Diamond Head is as follows:

(LNR 803) - To enrich the leisure time of people of all ages by making available for appreciation and study other unique features of the State... In the future, emphasis will be placed on interpreting these features.

SCORP REPORT

The SCORP, which deals with all existing and proposed recreational areas, lists among its purposes:

Table 8. STATUS REPORT OF CAPITAL IMPROVEMENT PROGRAM NO. 803, PROJECT NO. F-37, DIAMOND HEAD STATE MONUMENT

Project Description	Act/Item	Appropriation		Status of Funding to 12-31-78		
		\$	Symbol	Allotted (\$)	Unallotted (\$)	Expended (\$)
State DOD, Diamond Head Crater Improvements, Oahu. Plans for development in accordance with the recommendations of the Diamond Head Crater Task Force. (Appropriated \$57,000)	Balance transferred to DLNR: 68/71, Part III, Sec. 4, G-10	55,782	B-71-820-C	55,782	0	56,802
State DOD, Diamond Head Crater Improvements, Oahu. Planning and incremental construction of improvements to Diamond Head Crater to improve access and provide facilities for greater public utilization. Project will include construction of interior circulation roads, parking areas, and restrooms on the interior of the crater; improvements to the exterior access roadways; and widening of the main access tunnel. (Appropriated \$250,000)	218/74, Sec. 6	75,000 constr.	B-74-801-C	0	75,000	0
(To DLNR) Diamond Head State Park, Oahu. Plans and construction for incremental improvements to Diamond Head Crater and State lands to improve access and provide facilities for greater public utilization, including improvement of exterior roadways, development of parking facilities near the crater, landscaping and marking and improvement of trails within the State Monument.	195/75, Part VI, IV-B-24-1 Transfer Act 218/74, Sec. 6, I-13	10,000 175,000	B-75-506-C B-74-498-C	10,000 175,000	0 0	0 135,948
(To DLNR) Diamond Head. Master Plan of this existing park. Anticipated improvements may include trail development, parking, landscaping and an interpretive program. Construction of restroom and immediate needs.	226/76, Sec. 88A, H-6	15,000 design	B-76-431-C	15,000	0	13,160

Table 8 continued

Project Description	Act/Item	Appropriation		Status of Funding to 12-31-78		
		\$	Symbol	Allotted (\$)	Unallotted (\$)	Expended (\$)
(To DLNR) Diamond Head State Monument, Oahu. Development of a Long Range Master Plan for all State lands surrounding Diamond Head Crater Park.	9/SS-77, Sec. 2, III-C-1	75,000	B-77-489-C	0	75,000	0
(To DLNR) Diamond Head. Master Plan of this existing park. Anticipated improvements may in- clude trail development, parking, land- scaping and an interpretive program. Construction of restrooms and other immediate needs.	243/78, Sec. 5, H-17 FY 1977-78 FY 1978-79	30,000 design 350,000 constr.	B-77-446-C B-78-442-C	30,000 0	0 350,000	0 0
(To DLNR) Diamond Head State Park, Oahu. Plans for park development along Monsarrat Avenue.	244/78, Sec. 2, III-C-1	75,000	B-78-507-C	0	75,000	0
(To DLNR) Diamond Head State Park, Oahu. Plans and construction for the development of pas- sive recreation park facilities in and around Diamond Head.	244/78, Sec. 2, III-C-2	150,000	B-78-508-C	0	150,000	0
	TOTALS	1,010,782		285,782	725,000	205,910

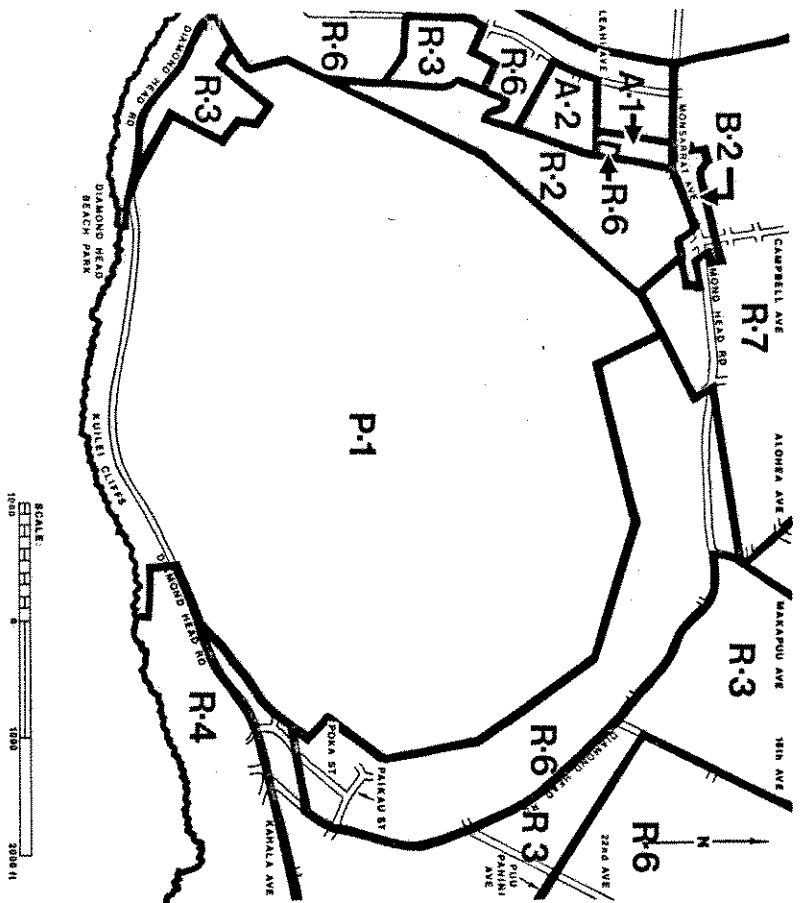


Fig. 13. HONOLULU COMPREHENSIVE ZONING.

- Identify recreational demand and need by State, County, and Planning Area.
- Provide statewide and regional recommendations for development and preservation of recreation and open-space resources.
- Diamond Head is not included in the 1975 SCORP report projects; it is, however, included in the 1979 SCORP report.

U. S. GOVERNMENT

The National Natural Landmark title is bestowed as an honor upon an outstanding natural landmark by the Federal government.

The objectives of the natural landmark program are to encourage the preservation of sites importantly illustrating the geologic and ecologic character of America; to enhance the educational and scientific value of sites so preserved; to strengthen the cultural appreciation of the natural history of America among people, and to foster a greater concern and involvement in the conservation of America's natural heritage among Federal, State, and local governments, citizens organizations and individuals.

There are no rules or regulations for this special award, and conservation is the responsibility of the owner (State of Hawaii).

Examples include: Barringer Meteor Crater, Arizona; White Pinehollow, Iowa; Tinker Creek Gorge, Ohio; San Andreas Fault, California.

GOVERNMENT RULES AND REGULATIONS

Each level of government has established legal requirements with regard to zoning, management, facilities, and use of Diamond Head under the respective designations--City/County Historic, Cultural and Scenic District; State Monument, and National Natural Landmark. Each of them can be considered as a development-and-use constraint.

The land classification system shown in Table 9 and Fig. 15 was designed to deal with the environmental setting and how its modification may affect recreational experiences. It is also a development-

ment-and-use constraint that indirectly sets minimum design standards for facilities--e.g., parking, roadway width, etc.

With regard to State and Federal lands and easements, the Development Plan will be based on the assumption that all other County, State, and Federal lands within the proposed expansion will be turned over to State Parks as part of the Monument. Otherwise these parcels will require easements of their own, as contemplated for the tunnels and bunkers for civil defense emergencies.

DESIGN CONSIDERATIONS

PHYSIOGRAPHY

Although Diamond Head is considered a dormant volcano, its next eruption could occur hundreds of years from now. Of immediate concern is the physiographic condition in which two-thirds of the crater rim is sharply crested, creating potential falling-rock conditions to residential areas below on the exterior, and people hiking trails in the interior. The outside upper slopes, which are sharply dissected into deep gullies, and the crumbly texture of the volcanic materials both inside and outside of the crater are serious hazards.

SOIL

The inherent qualities of Makalapa clay (low permeability, high shrink-swell potential, high plasticity) in themselves become a limiting factor for development. Areas with slight-to-moderate slopes have been disturbed somewhat, especially in the bottom lands, where fill material and exposed rocks cover the crater floor.

HYDROLOGY

Intermittent heavy rains during winter storms cause sheet drainage that forms a pond on the crater floor; this problem is currently corrected by hydraulic pumps. Establishing a more natural habitat would require channeling this water in a less obtrusive manner. Sources of underground water are limited or nonexistent for irrigation and other uses.

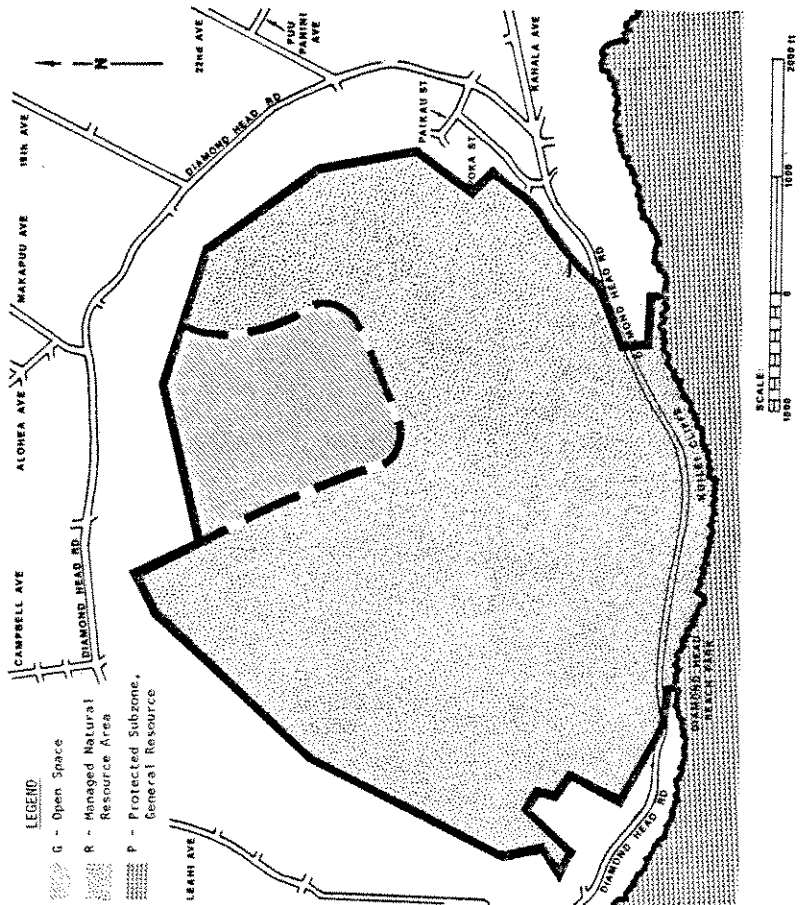


Fig. 14. DIAMOND HEAD CONSERVATION DISTRICT SUB-ZONES.

Table 9. LAND CLASSIFICATION SYSTEM FOR DIAMOND HEAD STATE MONUMENT

Class	Description	Location	Activities
I High Density and General Outdoor Recreation	Relatively small enclaves confined to level areas and moderate slopes to provide outdoor opportunities in attractive, natural-to-man-made settings	Inside crater, near access tunnel; outside crater, just off Diamond Head Road near access tunnel	Passive daytime activities--family outings and picnicking, sightseeing
II Natural Environment	Buffer zone between Class I and Class III lands; reforested crater floor and lower wooded slopes	Lower portions of both inside and outside slopes of crater, except for mauka end, where it includes the upper slopes also	Hiking and nature-study walks
III Outstanding Natural Features	Highly visible rim area and upper slopes, with natural wild landscape	Upper slope, cliff, and crest portions of crater except for Class II lands at mauka end	Study of natural features, ecological systems; sightseeing; hiking to reach panoramic view sites along crest and at Leahi Point lookout
IV Historical and Cultural Features	Sites associated with the history, tradition, or cultural heritage of National, State, or local interest, and of enough significance to merit preservation or restoration	None known at present, but further research and evaluation may reveal a few	Study of identified features; sightseeing

FLORA AND FAUNA

Both the soil characteristics and the semi-arid conditions limit the kinds of plants that grow in Diamond Head. These factors limit the flora to hardy plants, most of which are exotics, although some have developed a dormancy period in order to survive. The dryness also creates a potential fire hazard.

Despite the number of exotic plants, several proposed endangered species still have footholds in this habitat. Their survival remains questionable if man tampers with their environment. As far as is known at present, no registered endangered plants are found in the Monument area.

The Hawaiian short-eared owl (*pueo*) and Hawaiian duck (*koioa*) are the only suspected endangered fauna that inhabit this area. Most of the remaining fauna are exotic.

Along the crater rim turbulent winds are created by the merging updrafts from the crater floor and crater exterior. Lengthy trails along this rim are not recommended because of these unpredictable turbulences. Occasional strong winds also sweep the valley floor, kicking up small dust storms during the dry months.

TRANSPORTATION

Because of the projected increase of traffic along Diamond Head Road in the section serving Diamond Head State Monument and the projected Kapiolani Community College, a wider roadway is programmed, which will create a corridor through the proposed linear parkways. Present dimensions of the two tunnels will also limit access traffic into the crater.

Helicopter landings are restricted by permit and to a new National Guard helipad with flight patterns to minimize noise levels.

UTILITIES

All present electricity and telephone lines leading into the crater are buried only through the tunnels; both exterior and interior lines are overhead, creating an adverse visual impact. These utilities are adequately maintained and supplied. However, water is not adequate, and supply facilities are proposed in the initial phase of development. This resource is carefully monitored because of periodic cutbacks in water supply. A gas line is located only on the crater exterior, leading to the Cannon Club.

The sewerage system is presently adequate but may not be if public use of the crater increases ap-

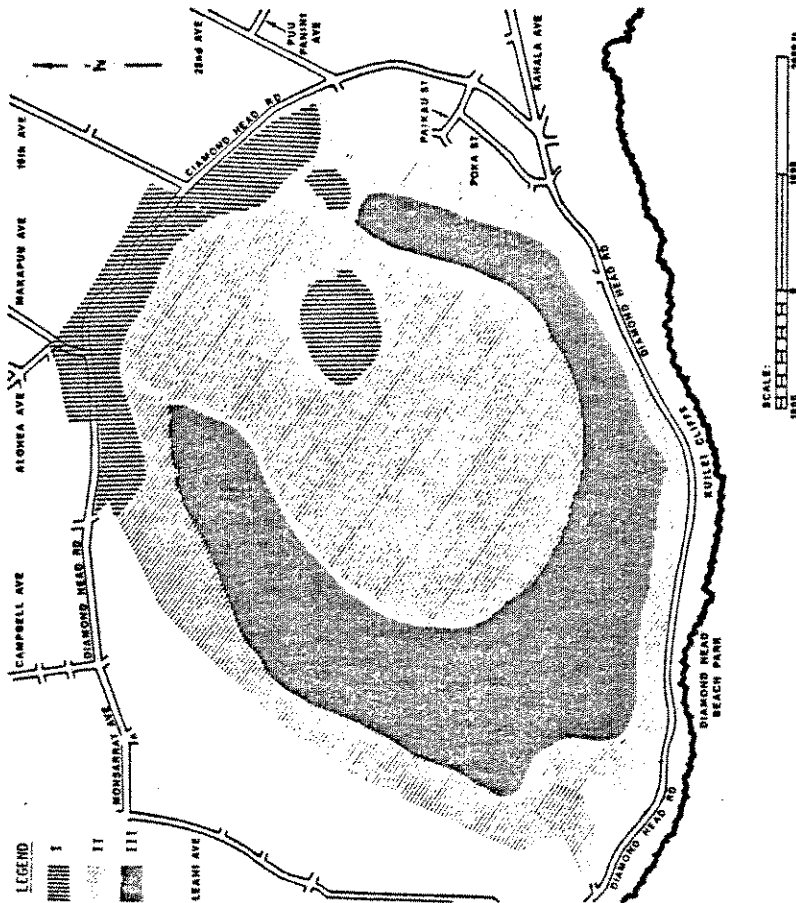


Fig. 15. LAND CLASSIFICATIONS FOR MANAGEMENT PURPOSES.

CLIMATE

Passing tradewind showers and winter storms are annual weather hazards to the user, for whom slippery conditions are more treacherous on the upper, steeper slopes. The pronounced wet and dry seasons in general, however, cause the greatest overall effects on the physical environment. Subtle relationships of soil to vegetative growth directly influence development constraints and recreational pursuits.

precipably. Drainage of excess rainwater that ponds is a problem, because mosquitoes breed in water left standing for more than two or three days.

HISTORIC VALUES

As Diamond Head is more than 100,000 years old and man has been on Oahu more than 1400 years, there are long-period historic values. Although the entire crater is a historic site as well as a natural landmark, the historic program envisioned for the Monument is mainly geological.

At present, no significant Hawaiian archaeological sites are known to remain in the Monument. For any specific development or restoration, more archaeological research would be required. Although five heiaus were supposed to have existed on or around Diamond Head, none are visible today. Any important historical or archaeological discoveries made during development will be displayed and interpreted in the proposed information and interpretive center.

The military installations--bunkers, battery and storage tunnels, communications rooms, and observation posts--constructed prior to World War II may perhaps be noteworthy for preservation; a thorough evaluation needs to be conducted to determine their significance. As most are less than 50 years old, they do not merit retention solely on architectural or historic values in accordance with the criteria established by the State Historic Preservation Office. Their permanence of construction would be a constraint in determining whether to demolish or preserve them.

The Division of State Parks, in developing public use of the crater, considers utilization of several existing structures. The Credit Union building (bldg. 18) is considered for renovation along with several bunkers and tunnels. Though not historically significant, these did play an important part in the activities in Diamond Head between 1906 and the present. Care will be taken to conceal most such existing and proposed new structures, however, in order to maintain a more natural environment.

IMPACT ON PRESENT USERS

The many present users of land within the proposed enlarged area of Diamond Head State Monument include: U. S. Navy, FAA, State Parks, HNG, Civil Defense, City/County Police, as well as the utilities with their easements for water, electricity, and telephone. All of these users will be greatly affected by the establishment of the proposed new Monument boundaries and policies associated with its management.

The HNG is affected the most because of policies to stop further construction within the crater and the limited availability of land on the exterior as a result of other agencies' developments and residential subdivisions. The HNG has developed and continues to develop new facilities in the East Diamond Head exterior area. All facilities and structures along Diamond Head Road between the Cannon Club and 18th Ave. (excluding Battery Harlow and the storage bunkers) are being vacated and returned to the State by the HNG, most for inclusion into the Monument. Facilities and structures that remain must be utilized for what they were originally intended or risk being included also.

The HNG is also the agency in charge of land being utilized by the Civil Defense, the military, and other tenants, who are also affected by the policies of the Monument. For example, the Civil Defense Agency is moving into Birkhimer EOC from buildings on the exterior.

The FAA, though excluded from the Monument, is affected in many ways. The main roadway, parking areas, and other developments are within the jurisdiction of the Monument. Current water shortages have been a problem for the FAA because of requirements for recreational purposes. The FAA structures and operations will be under pressure to maintain a low profile in accordance with the rules of the Conservation District and Special Management Area.

The current State Park uses within the crater include sightseeing, festivals, and hiking. Promoters of new festivals may be affected with smaller open areas and more restrictive rules and regulations.

Hikers will be greatly affected by new Monument rules and regulations. Since hiking statistics have been taken by State Parks in 1976 (Fig. 16), the number of hikers has continued to increase to more than 1000 per month, with many having no valid permits. This heavy usage has caused severe erosion of trails and degradation of the ecological system. Park

management will impose more restrictive hiking regulations.

The current small numbers of sightseeing tour busses, vans, and private vehicles will probably increase if the natural flora is reestablished, lookouts are constructed, and an Interpretive Center is established.

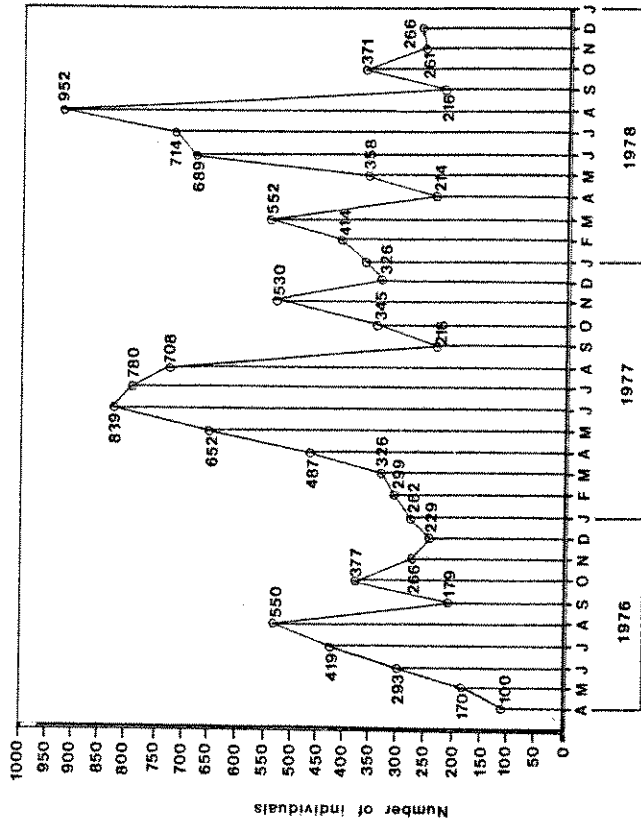
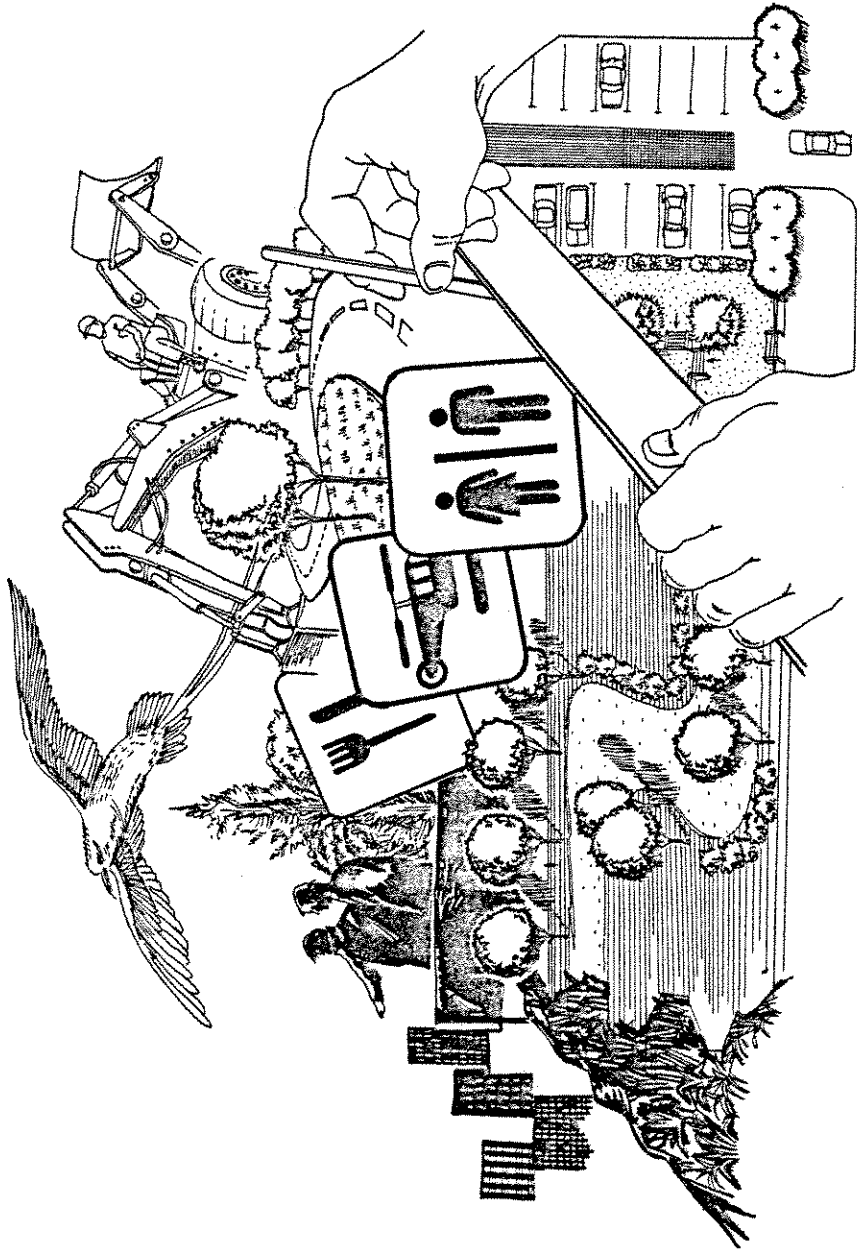


Fig. 16. HIKER PERMIT STATISTICS.



PLANNING

OBJECTIVE AND RESPONSIBILITIES

The objective of the Department of Land and Natural Resources in proposing the expansion of Diamond Head State Monument, in accordance with Act 182, Session Laws of Hawaii 1975, is to preserve and protect, and to include restoration of, Diamond Head crater while providing public recreational opportunities.

The Division of State Parks (of DLNR) was given the responsibility of management of portions of the crater in 1975, with the understanding that in the near future the lands would be acquired, so that the Parks Division rules and regulations would be applicable along with the enforcement.

An additional responsibility was imposed that State Parks staff develop an interim plan for managing and developing the Monument and provide the required controls, health, safety, and maintenance requirements for current users until a final development plan could be designed, approved, and implemented.

INTERIM DEVELOPMENT PLAN

The details of this plan (Fig. 17), which was presented at public hearings in August 1977, are outlined below.

1. That State Parks plan the land use of the existing (145-acre) and proposed enlarged (525-acre) State Monument, including State DOD areas, with participation from civic groups, tenants, affected Federal and State agencies, and Kapiolani Community College personnel.

2. That responsibility for management of crater festivals, hiking, and public access within certain areas of the crater be transferred to State Parks.
3. That State DOD appropriations be transferred to State Parks for development of the crater for public use.
4. That State Parks plan recreational use and development within the crater and exterior of Diamond Head on vacant State lands.
5. That State Parks assign park personnel to clean, clear, and maintain the crater, including trails.

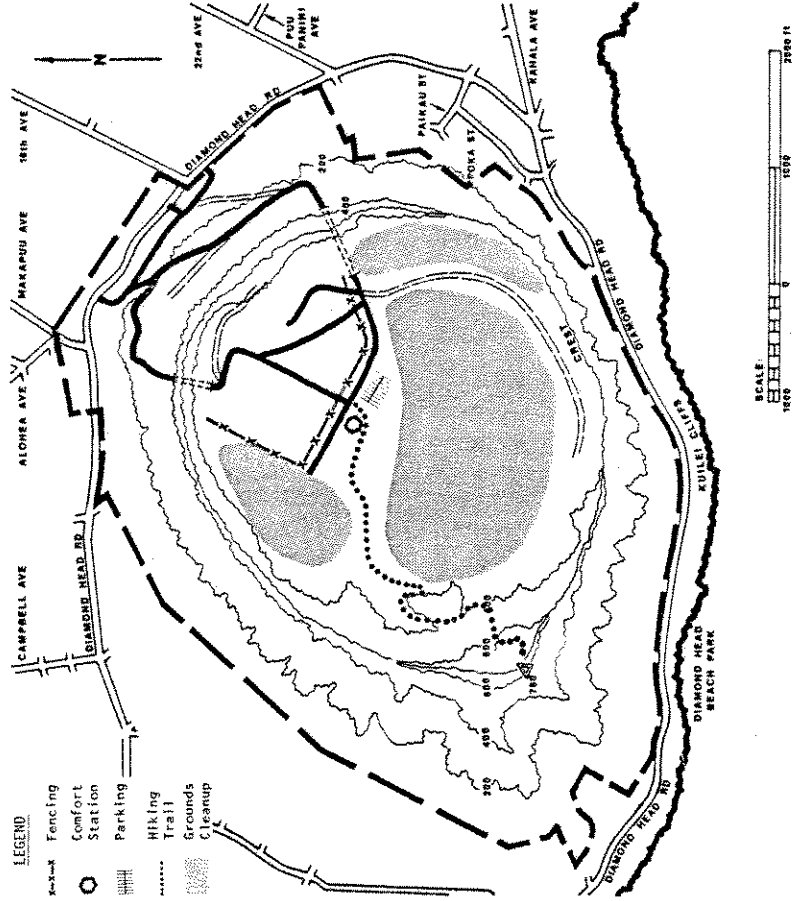


Fig. 17. INTERIM DEVELOPMENT PLAN.

6. That State Parks provide temporary, portable sanitary facilities, tables, and trash receptacles for public use.
7. That State Parks construct a permanent comfort station with walkway, benches, drinking fountain, and landscaping for hikers and other users.
8. That State Parks construct fencing around existing National Guard areas and demolish the unrequired helpad.
9. That unrequired State DOD land be transferred to DLNR for inclusion into the State Monument.
10. That State Parks assume full management, budgeting, and control of the Diamond Head State Monument.

An Environmental Assessment was prepared for the Interim Development Plan and was approved by the Office of Environmental Quality Commission in October 1977. Special management-area and conservation-district use permits were issued after public hearings. The Governor gave his approval to proceed with the construction of interim sanitary facilities, fencing, and landscaping in December 1977. By February 1978, a construction bid of \$102,000 was approved, and in March Governor Ariyoshi officially broke ground for construction. The interim facilities were completed and dedicated in August 1978 and are currently in public use. State Parks issues hiking and other permits into the public areas along with providing maintenance and management.

The Interim Plan provides that State Parks will continue the planning and development program until the Master Development Plan is approved and all lands and responsibilities are transferred.

CONCEPTUAL ALTERNATIVES

State Parks was also charged with designing a long-range master development plan by means of a variety of conceptual development alternatives.

Conceptual alternatives are activity land-use schematics based on the project objective, policies, and evaluations of physical, social, cultural, and economic data. Alternative conceptual schematics are the first design attempts in the process toward a detailed master development plan and subsequent construction plans.

The conceptual alternatives for Diamond Head State Monument, as outlined below, were presented in three public meetings in July and August 1977. The meetings--scheduled for evenings at the McCully-Molihini Library, Kamuki Regional Library, and Waikiki-Kapahulu Library--were conducted to initiate citizen participation and feedback.

CONCEPTUAL SCHEME I

This scheme (Fig. 18) provided extensive facility development, a "Recreational Complex." The crater exterior would remain untouched except for probable development between 18th and 22nd Avenues. The

theme of this concept was to combine active and passive recreational opportunities. Active uses included a variety of hard-court and field sports, while the passive uses included hiking, picnicking, and camping. Educational uses included interpretive facilities, a nature center/zoo, amphitheater, etc.

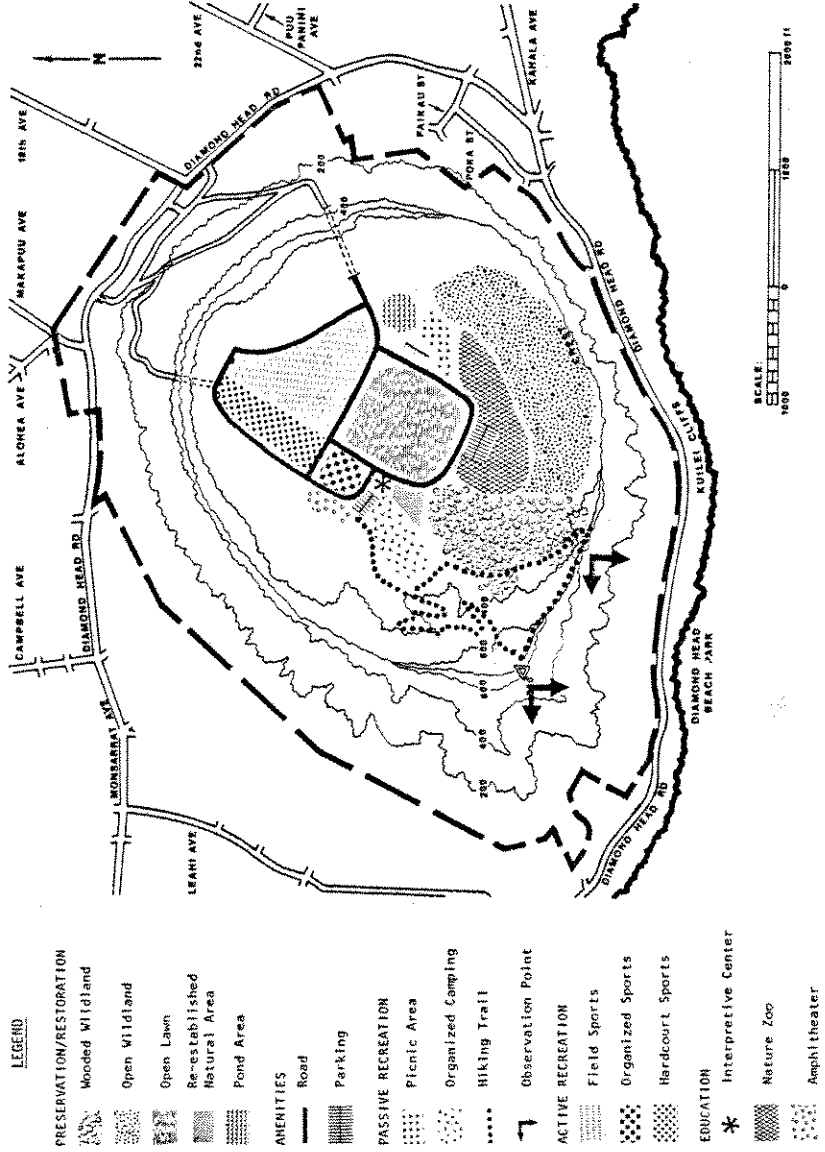


Fig. 18. CONCEPTUAL SCHEME I.

CONCEPTUAL SCHEME II

Extensive passive recreational development of the crater was the basis of this scheme (Fig. 19), which is a variation of the 1969 Crater Task Force recommendation. Much of the crater would be graded and landscaped. Activities provided would be hiking, picnicking, and camping, with an interpretive center for educational purposes.

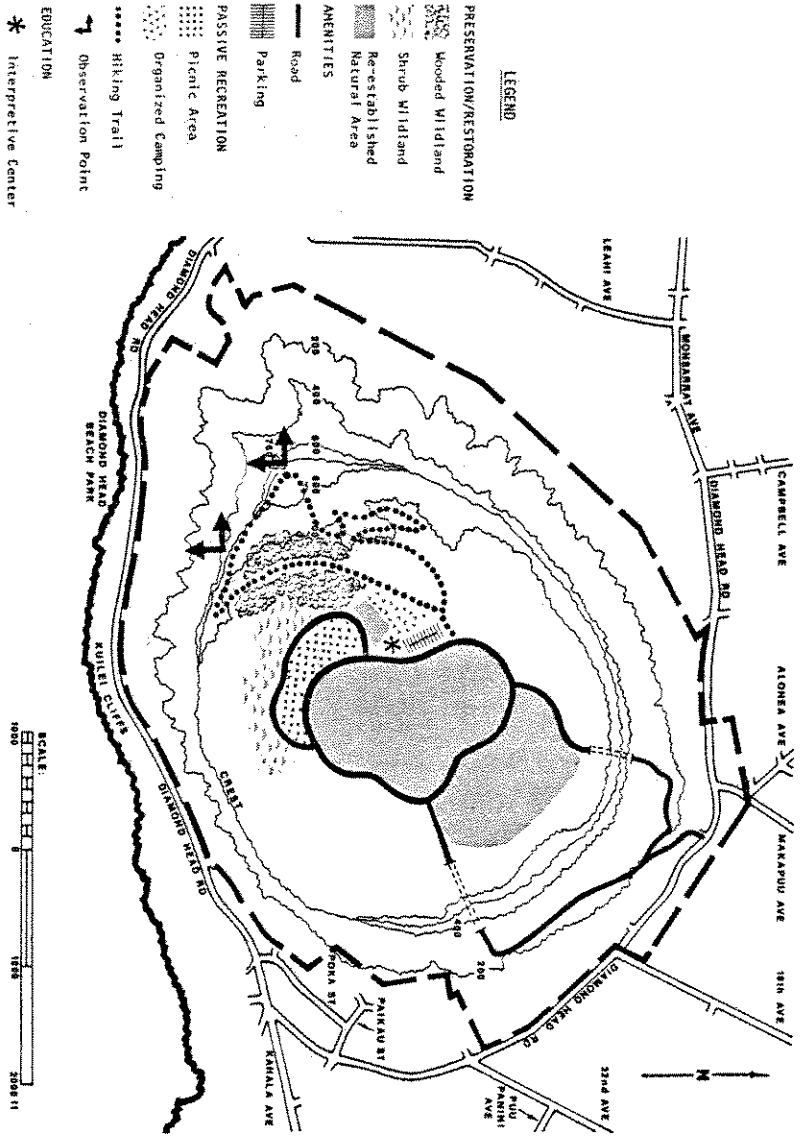


Fig. 19. CONCEPTUAL SCHEME II.

CONCEPTUAL SCHEME III

This scheme provided for reforestation of much of the crater area into a natural wild appearance, with a meadow and seasonal wetlands. Vehicular access would be minimal and provided only at the fringes (Fig. 20). Walk-in camping and hiking were the activities foreseen, with an appropriate interpretive center for educational values. Active recreational development would be provided along the crater exterior between Makapuu and 22nd Avenues.

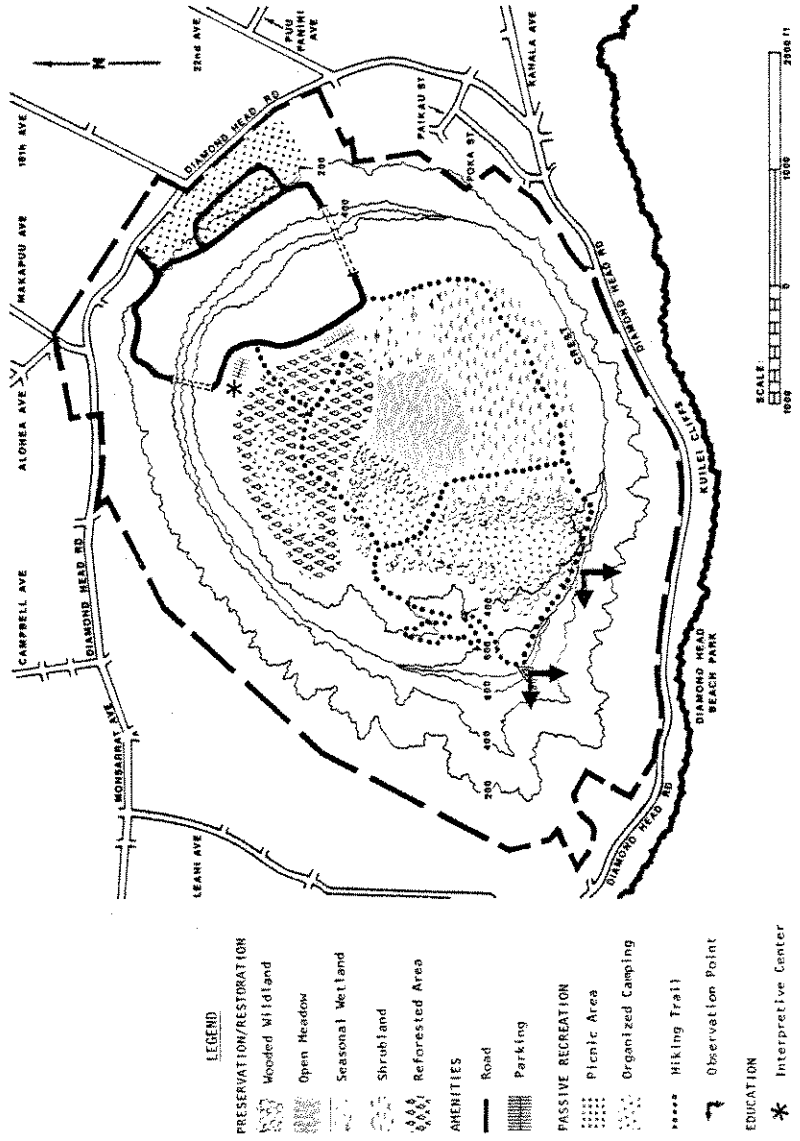


Fig. 20. CONCEPTUAL SCHEME III.

CONCEPTUAL SCHEME IV

The crater would be extensively restored to a semi-wilderness state in this scheme (Fig. 21), which provided for maximum preservation and restoration of the crater, with no vehicular access into the interior. Hiking, camping, and picnicking activities would be provided, and an interpretive center. A passive recreational park would be developed around the crater exterior between Makapuu and 22nd Avenues.

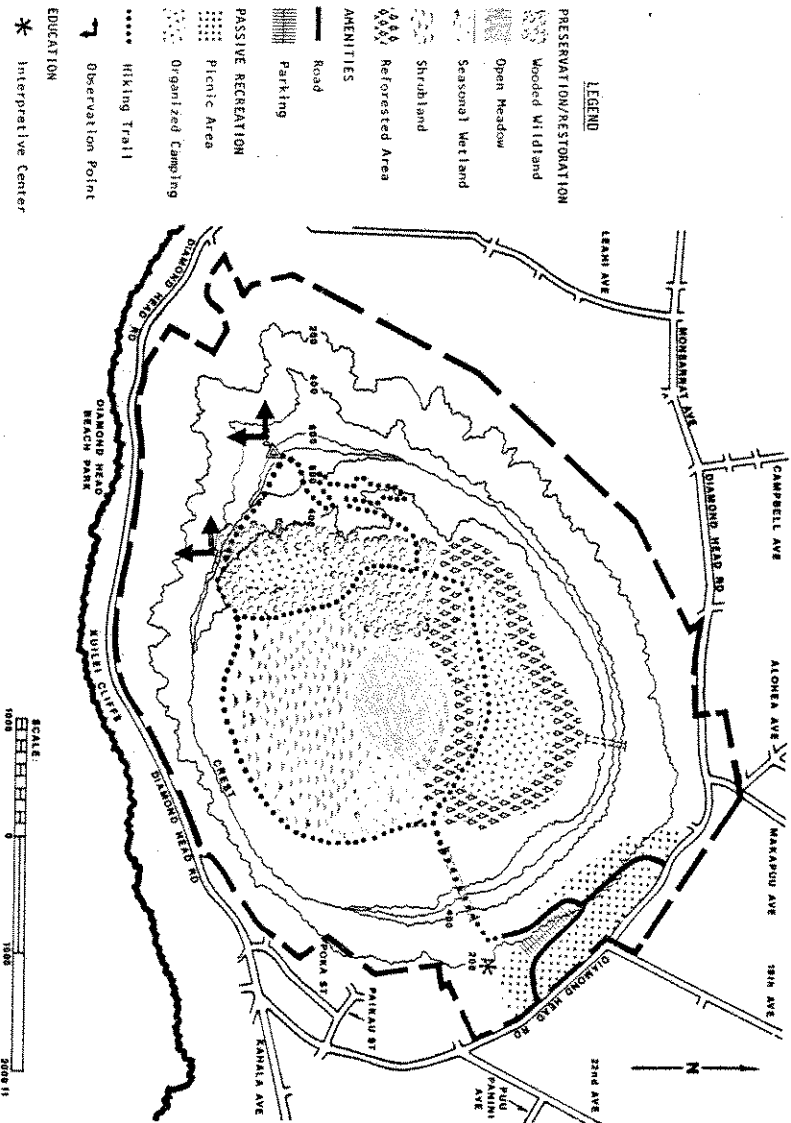


Fig. 21. CONCEPTUAL SCHEME IV.

CONCEPTUAL SCHEME V

This scheme provided for reforestation, a meadow, and seasonal wetlands as in Scheme III, but not as extensive (Fig. 22). Existing roadways would be utilized as well as existing structures suitable for park use. Activities would be hiking and sightseeing, and an interpretive center would be established. This scheme also provided for an approach to the long-term phase-out of existing military and FAA activities in the crater.

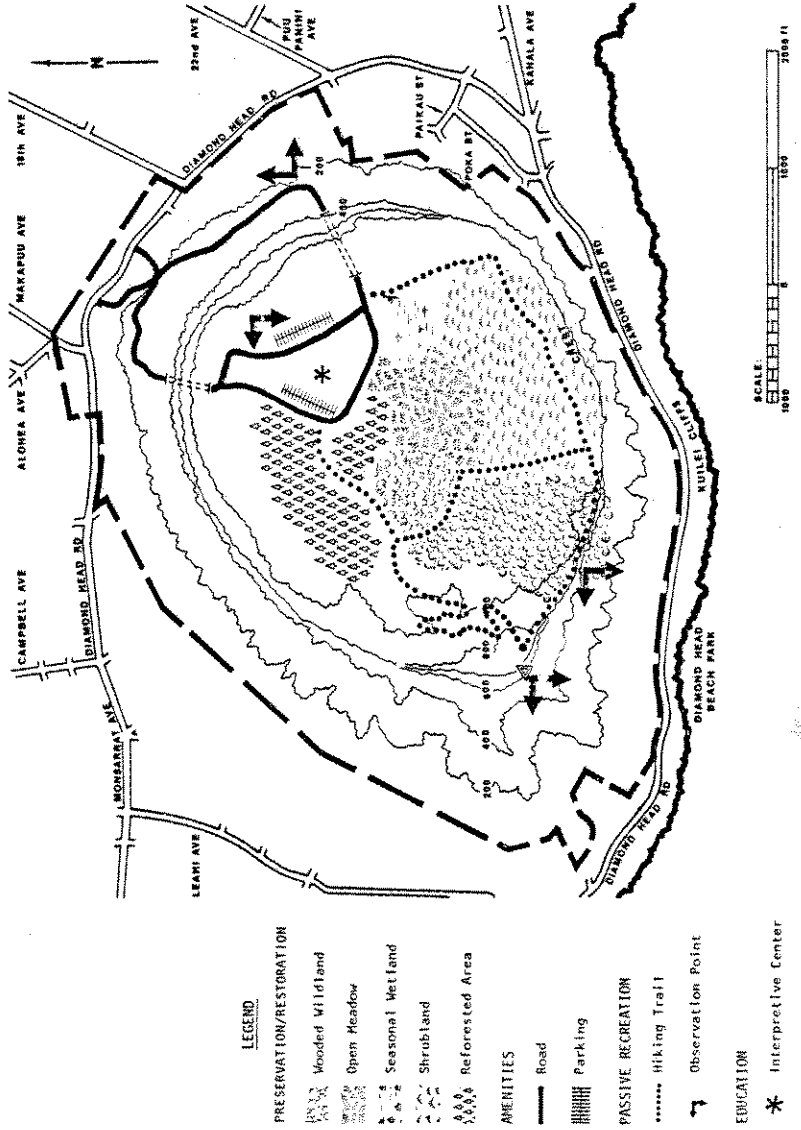


Fig. 22. CONCEPTUAL SCHEME V.

PUBLIC FEEDBACK

The public presentations of the conceptual-plan alternatives during summer 1977 drew an influx of environmental and design feedback from interested citizens. Many responses were written, some were oral, during the second round of three public meetings conducted in September 1977. Many concerns were expressed by adjoining property owners on the security of private property, devaluation of private property, and increased traffic. Other concerns from the public were on the types and extent of new developments within the area. Many suggestions, some contradictory, were offered to assist in developing an acceptable final plan:

1. That the State enforce rules more effectively and maintain the properties under State jurisdiction.
2. That sidewalks, jogging paths, and bikeways be incorporated into any design of the area.
3. That crater festivals or large events be allowed to continue within the Monument.
4. That no vehicles be allowed within the crater.
5. That the Monument boundaries include all State lands surrounding Diamond Head.
6. That the Park be self-sustaining (pay for itself).
7. That State property on the exterior be sold for housing development.
8. That active recreation such as tennis courts, skateboard runs, etc., be considered in the design of the interior park.
9. That a tramway to the summit be considered.

10. That the former lake within the crater be reestablished.
11. That all Government structures be removed from within the crater.
12. That underground utilities be installed within the crater.
13. That a security guard or caretaker be stationed within the crater.
14. That more hiking trails be developed within the Monument.
15. That the crater be left alone.
16. That the State develop a Land-Use Master Plan of all State lands around Diamond Head prior to any irreversible decisions or commitments.
17. That the State lead in developing aesthetic visual corridors on the eastern side of Diamond Head.
18. That crater festivals and any other large events not be allowed within the crater.
19. That the handicapped be considered in designing trails and recreational structures.
20. That the exterior and interior of the crater be landscaped, including along Diamond Head Road.
21. That a citizen's advisory committee be established for planning State lands within and surrounding the Monument.

The consensus by people who reviewed the conceptual-plan alternative through the six public meetings and three additional community association presentations favored modifications of Schemes III and V. On October 14, 1977, the recommendations were presented to the Land Board, which decided that a task force would be established to work out an acceptable long-range plan.

CITIZEN ADVISORY COMMITTEE

The Diamond Head Citizen Advisory Committee (CAC), organized in October 1977, included interested citizens of the community, special-interest organizations, and representatives of government agencies (Table 10), many of whom had served on the 1969 task force which considered "the future use of Diamond Head Crater." The purpose of this CAC was to assist in the design of a final conceptual plan for Diamond Head State Monument.

The 1977 CAC was empowered to review all new proposals for the Monument and recommend necessary additions or deletions so that a final conceptual plan could be presented to the Board of Land and Natural Resources for approval. This same concept of a CAC will be continued to coordinate all future planning and development of the Monument and environs.

The CAC members met twice a month for more than a year, considering many current problems on the extent and use of Diamond Head as a Monument, including recreational activities. Their recommendations were oriented toward passive recreational activities, with elimination of all unnecessary roadways and structures. The CAC unanimously adopted the final conceptual plan and development plan as proposed in March 1979, with the understanding that Diamond Head should eventually become a State Monument with open space and recreational use.

The objective of the final plan was stated as, "the establishment of a semi-wild interior park and development of an exterior park for family picnic outings." This objective was the basis of the approved Conceptual Plan policies stated below.

Table 10. CITIZEN ADVISORY COMMITTEE

Citizens

1. Gerry Ching, Historic Hawaii Foundation
2. Susanna Cheung, Variety Club School
3. Richard Kimball, East Diamond Head Assn.
4. Julie Kimura, Walters & Kimura, Inc.
5. Jack Larsen, House of Representatives
6. Aaron Levine, Oahu Development Conference
7. Cynthia Marnie, The Outdoor Circle
8. Willis Moore, Sierra Club
9. Yukio Naito
10. Richard Paglinawan
11. Haydn Phillips, American Institute of Architects
12. Lucile Pfaltzgraff, The Outdoor Circle
13. Betty Ann Rocha
14. Adeline Schutz, Kahala Community Assn.
15. Sidney Snyder, Save Diamond Head Assn.
16. Tamotsu Tanaka, Kapahulu Community Assn.
17. Gordon Tyau
18. Mildred Walston, League of Women Voters
19. Alice Woolaway, Save Diamond Head Assn.

Government Agencies

1. Dept. of Education, State of Hawaii (DOE)
2. Dept. of Defense, State of Hawaii (DOD)
3. Dept. of Accounting & General Services, State of Hawaii (DACS)
4. University of Hawaii
5. Dept. of Land Utilization, City/County of Honolulu
6. Dept. of Parks & Recreation, City/County of Honolulu
7. Federal Aviation Administration, United States Government (FAA)

PLAN POLICIES

The policies established for the management and development of Diamond Head State Monument, as outlined below, are directed toward fulfilling the objective stated above.

1. That all recreational development be directed toward passive activities as defined in SCORP: "Informal activities that require less intensive use and development of a site (i.e., picnicking, sunbathing, hiking)."
2. That all major actions planned by the DINR within and adjoining the Monument require an approved Environmental Impact Statement or Assessment prior to initiation.
3. That no new permanent buildings or structures be constructed within the Monument unless required for public health, sanitation, or safety of users, or the maintenance and management support of the Monument. Further, that the visual impacts be considered in locations, design, and landscaping.
4. That large crater festivals be phased out as park development takes place within Diamond Head crater, and any large commercial use that may detrimentally affect the environment of the crater be restricted.
5. That the DINR acquire all available unused or unrequired Federal lands adjoining or within Diamond Head and secure the phase-out of State DOD and FAA structures within the Monument as feasible.
6. That all other agencies with land fronting Diamond Head Road between the two gatehouses be urged to coordinate their beautification efforts with the Green Landscaped Corridor Plan developed by the DINR, and that safety features be provided for pedestrian and non-motorized transportation around the crater on Diamond Head Road and into the crater.
7. That no civilian aircraft be permitted to land anywhere within the Monument or to fly so low as to create a noise or dust nuisance or endanger people on the ground.

FINAL CONCEPTUAL PLAN

On the basis of the objective and policies worked out by the Diamond Head CAC, the Final Conceptual Plan was designed (Fig. 23) and approved by the CAC in June 1978. This plan restores the interior of the crater to an essentially semi-wild state, with reforested areas, an extensive wildland, and meadowlands. Public access will be through two tunnels, but the short length of road will do little more than connect them and lead to the interpretive center, restrooms, and parking area, all concentrated between the tunnels. The major portion of the crater will be left in or restored to its wild natural state. Only the trails will be improved, with safety being the paramount consideration.

There will be easements on the outer slopes of the crater and trails will be developed for safe use by hikers.

The following paragraphs represent the staged progression to reach full development in approximately 20 years, as approved by the CAC.

The first three years will be utilized to establish the executive order for the Monument and develop recreational uses. The exterior parkway, roadway improvements, landscaping, burial of all utilities, and the development of trails will be given priority in this period (Fig. 24).

During the subsequent two years the peripheral government parcels are to be included into the Monument for resource management. The interpretive

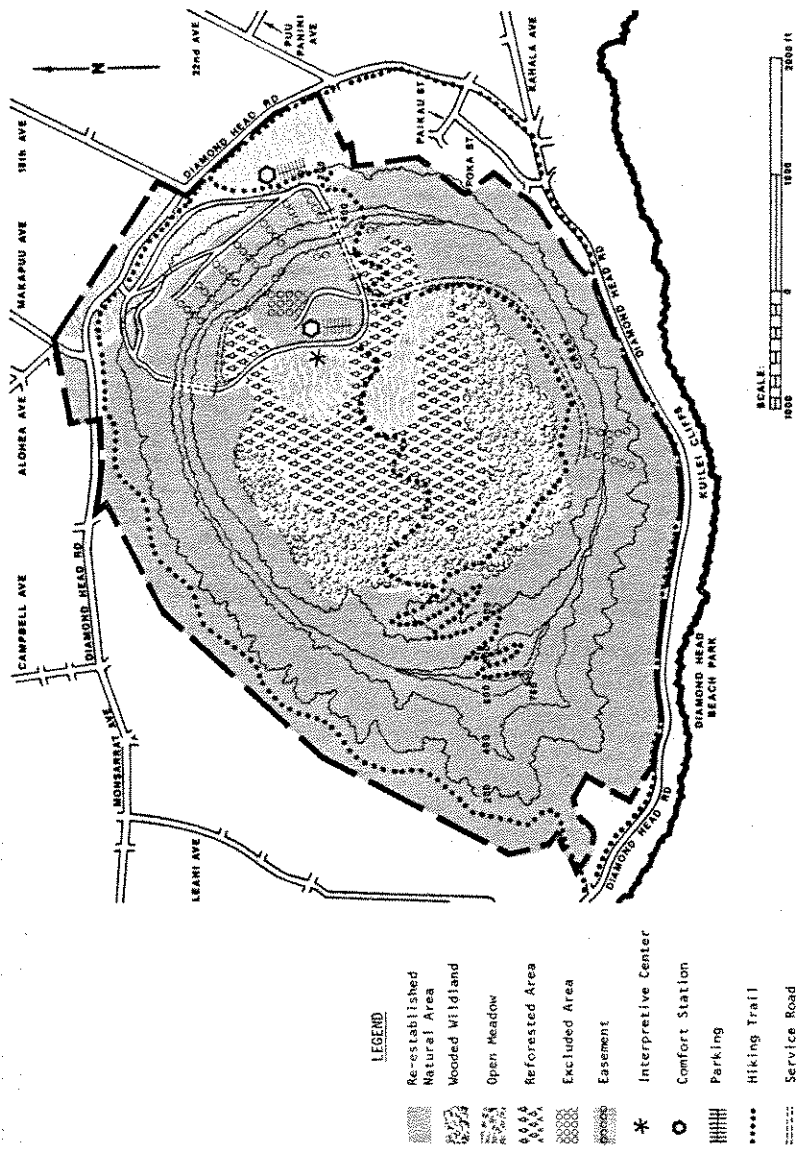


Fig. 23. FINAL CONCEPTUAL PLAN.

center and parking area are planned for construction as well as reforestation of the crater interior. The exterior park will be initiated with parking and comfort stations, and new trails are planned (Fig. 25).

The 10-year projection is for acquisition of the slopes above the Cannon Club and of properties within the crater as feasible. The roadways will be modified and more areas replanted (Fig. 26).

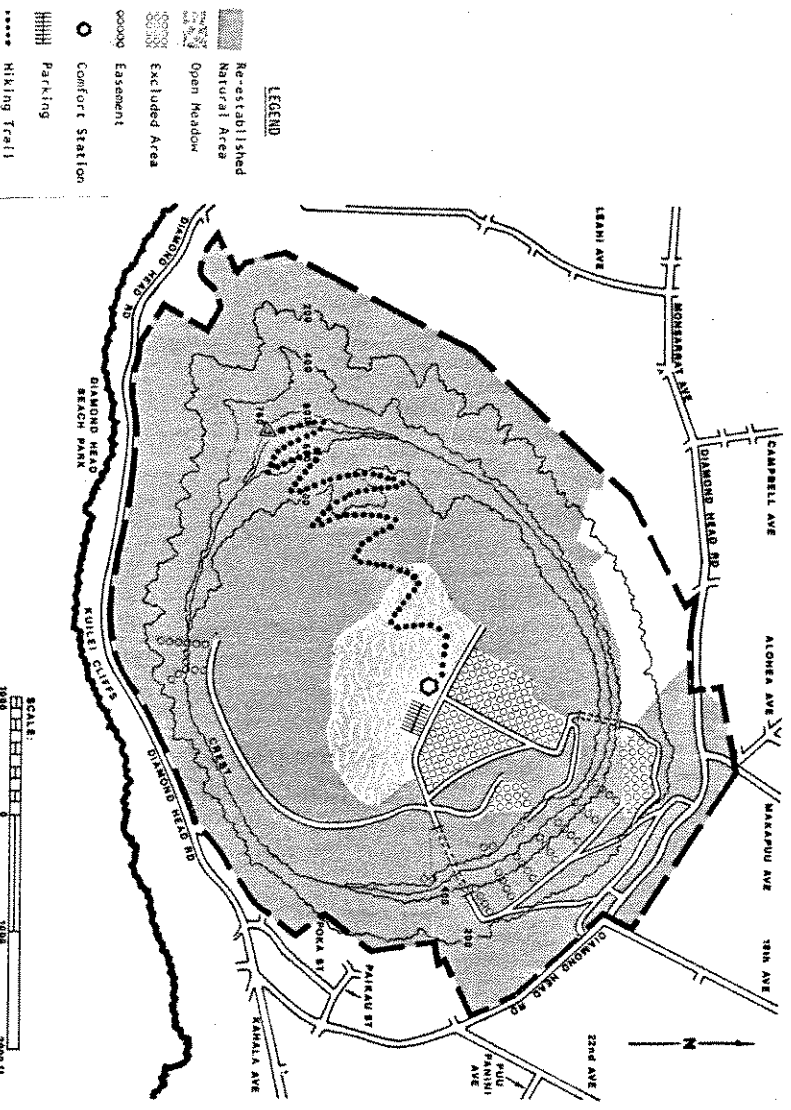


Fig. 24. THREE-YEAR PHASE OF IMPLEMENTATION.

The final plan will be the full recreational development of the Monument, with inclusion of Civil Defense facilities as feasible (Fig. 23). The interpretive center and parking are to be relocated and unrequired roadways removed.

An alternative of the Final Conceptual Plan phasing is the possibility of varying the timetable of

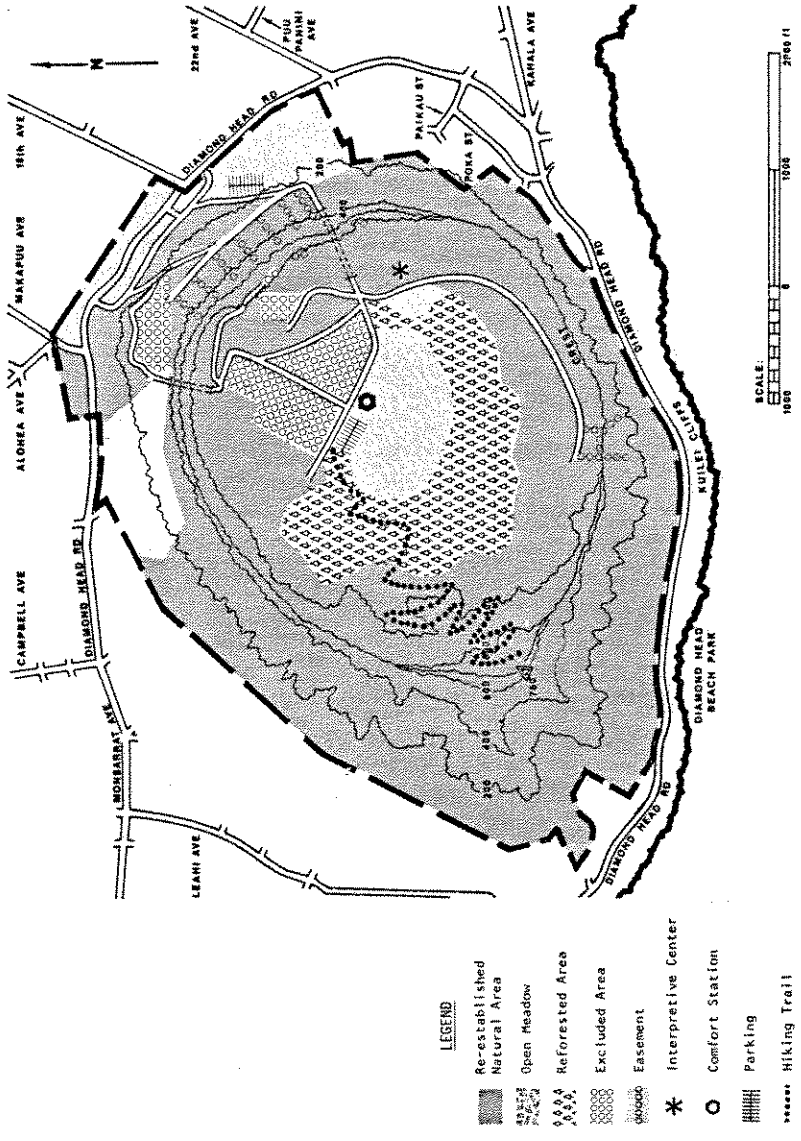


Fig. 25. FIVE-YEAR PHASE OF IMPLEMENTATION.

the Plan to provide flexibility in response to unforeseen situations. If, for valid reasons, the Monument development or acquisitions cannot proceed in accordance with the phasing above, DLNR State Parks would pursue appropriate actions and/or alternatives while continuing to move toward the objective of ultimate development of the Monument in the shortest possible time.

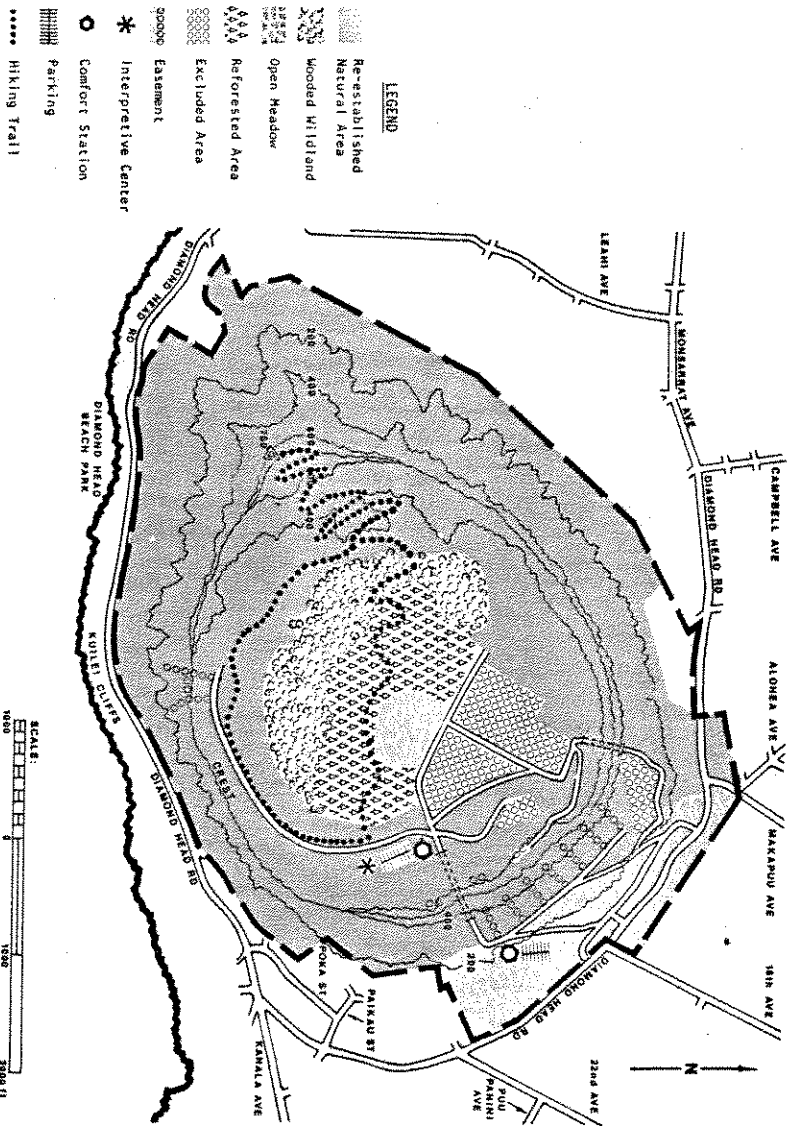


FIG. 26. TEN-YEAR PHASE OF IMPLEMENTATION.

LAND ACQUISITION SCHEDULE

Diamond Head State Monument currently comprises 145 acres along the southern exterior slope of the crater, including the summit (TMK 3-1-42:14). In accordance with Act 182, SLH 1975, "all State lands within and adjacent to the monument shall be returned to the Department for inclusion within the monument, except for land upon which is situated a structure in active use for the purposes originally disposed of."

Land-acquisition proceedings are necessary for the identification, determination, and transfer of all lands deemed desirable and/or available for inclusion into the Monument. The land-acquisition and easement map (Fig. 27) identifies the intentions of the DLNR in establishing the boundaries and/or jurisdiction of the State Monument.

The first priority of land inclusion to the Monument would be parcels 1 through 6 (Fig. 27). These areas are currently under the Governor's Executive Order (1997) to the State DOD. Parcel 1 is a large, high-resource, undeveloped area to be preserved and also utilized for recreational development. Parcel 2 is to be subdivided for urban-type park development. Parcel 3 is currently leased to the FAA for parking purposes. Parcel 4 is an undeveloped fringe area. Parcel 5 is to be utilized for a maintenance facility and parcel 6 for a linear parkway.

Parcels 7 through 9 present little problem for acquisition. Parcel 7 is under negotiation to be acquired from the U. S. Army. Parcel 8 is an undeveloped parcel of Board of Water Supply (BWS)

land used as access to its adjoining reservoir site, parcel 9; the reservoir may be declared surplus in the near future.

Parcel 10 is currently a section of the U. S. Army Cannon Club (Presidential Executive Order No. 6408) and is required for access and utility easement requirements for the Monument. Parcel 11 is also a part of the Cannon Club and is desirable to ensure preservation of the slope and profile of Diamond Head. The military has expressed interest

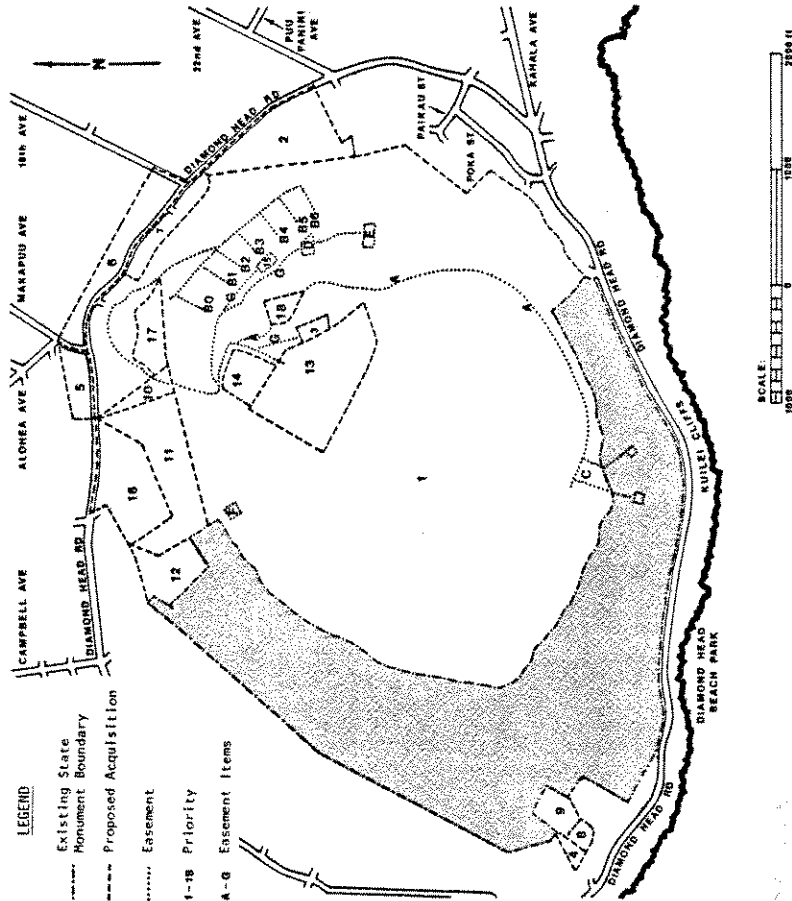


Fig. 27. LAND ACQUISITION AND EASEMENT MAP.

in but not commitment to this subdivision. Parcel 12 is an active reservoir site for the BWS (Executive Order No. 605). The Monument should include the area only for management of the land while the facility is in active use.

Parcels 13 through 18 require long-range acquisition proceedings over areas in active use. Parcel 13 contains the State DOD facilities within the crater. Parcels 14 and 15 are the FAA facilities (Executive Order No. 1832). Parcel 16 is the Cannon Club. Parcel 17 is Battery Harlow, utilized by the State DOD. Parcel 18 is Battery Birkhimer, the Emergency Operating Center (EOC), a facility for the State Government in cases of emergency, and is maintained also by the State DOD.

In addition to parcel divisions there are several easements (A through G on Fig. 27) granted for various reasons. Easement A consists of the roadway easements granted to other agencies. Easements B0 through B6 are tunnels utilized by the Civil Defense for storage; an exclusive easement will be granted to the State DOD for these. Easement C is tunnel 407, which will also be an exclusive easement to the State DOD. Easements D and E are bunker easements for the State DOD. Easement F is a radio tower site for the BWS. Easement G includes the roadway and tunnel easements to the FAA (Executive Order No. 1832).

After all acquisition proceedings are completed, there will be a total of more than 525 acres of land in the Diamond Head State Monument.

RELOCATION PLAN

Many of the existing facilities in the crater and on its outer slopes will be demolished or the tenants will be relocated from structures to be utilized by the DLNR, or when the land-acquisition program is implemented. The State DOD, University of Hawaii, and the Civil Defense Agency are handling their own relocations from the exterior mauka slope of the crater. The remaining three tenants--Honolulu Community Theater (HCT) (bldg. 31), Hawaii Association of Retarded Citizens (HARC) (bldg. 40-42), and Jack Harter (bldg. 99)--are scheduled for eventual termination of their existing revocable permits, issued by the DLNR, as development is phased within their respective areas. No relocation expenses or promise of alternate locations are anticipated for these tenants. Alternate areas on the Ruger Theater grounds can be made available on a temporary basis, however, until permanent facilities are found or developed.

The HCT (Ruger Theater) has been notified that its permit may be terminated soon, as building 31 is programmed for demolition. The HARC was informed in 1978 of their eventual removal from the site. Restrictions were placed on their total maintenance or upkeep of the buildings, although tentative agreements were made for their permission to stay two to three years since their location will not hinder the initial crater development. The HCT is planning to relocate to building Z4 and the HARC to an area near the Cannon Club.

Stan Harter, the Civil Defense communication coordinator, resides in a wooden frame building more than 35 years old, in fair condition, located halfway up the exterior *mauka* slope of the crater. His tenancy was established in 1963 to have the coordination near the statewide EOC. Although the State DOD currently has no requirement for his immediate proximity to the EOC, his tenancy is being examined since there is no immediate development of the area.

DEVELOPMENT PLAN

This development plan (Fig. 28) reflects a modified "wilderness" area with various uses consistent with its land-classification system (see Table 9 and Fig. 15). The plan evolved from the Final Conceptual Plan. There are no alternatives to this development plan as it was unanimously approved by the Diamond Head CAC.

LANDSCAPING

Landscaping of the Monument includes reforesting and replanting major areas of the Monument with hardy, maintenance-free plants to present a rustic, natural setting without a manicured appearance. (Class II environment). Selected natural areas will be placed under special management and protection to ensure the survival of native and endangered plants and their habitats (portions of Class II and III environments).

Other areas, with high accessibility to public use, will be landscaped and maintained as park areas (Class II and III environments).

INTERPRETIVE CENTER

This Center is to be strategically placed between the two entrance tunnels, just inside the crater, and will be designed with a rustic character to blend with its surroundings and conform to the wilderness-area concept (Fig. 29). The structure should provide wide broad window areas to reveal the panoramic outdoor scene for interpretive purposes as well as provide fire-watch security for the entire interior of the crater. Access to the Center will be twofold--

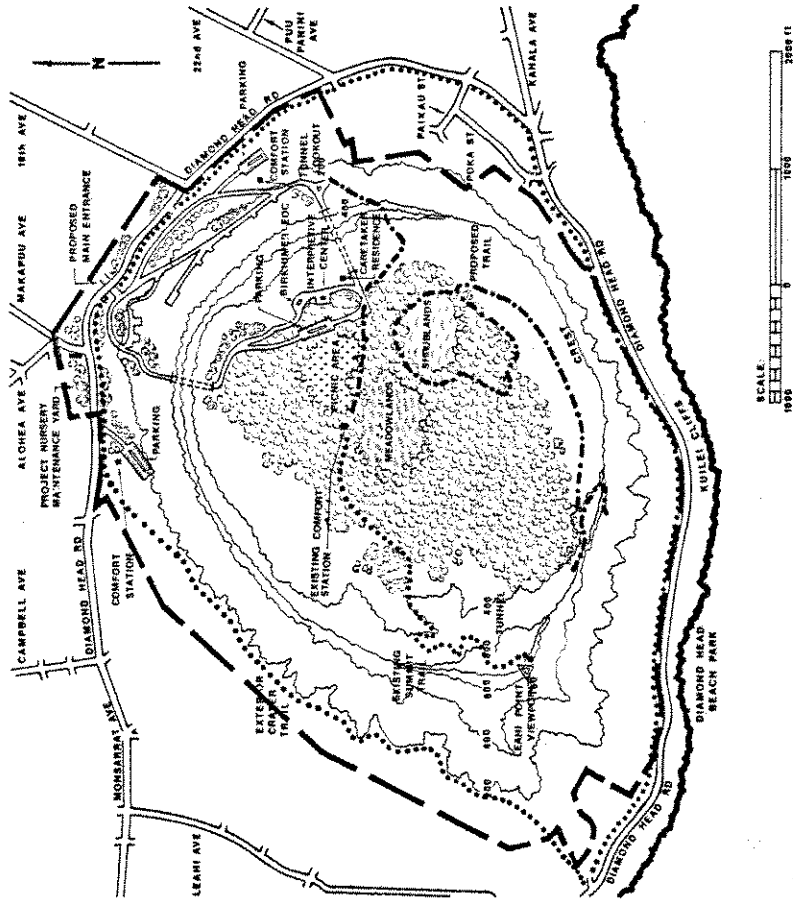


Fig. 28. DEVELOPMENT PLAN.

the existing lower parking area will face the main entrance, and the present service road to Birkhimer EOC will facilitate access for the physically handicapped. Birkhimer EOC, which is nearby, overlooks the entire crater floor and will provide historical enrichment to the Center (Class I environment).

No interpretive program has yet been developed for this scenic, natural and historic landmark and one will be required for the Center. The interpretive program will most likely stress the geology, historical use, and interesting flora of the crater.

INTERIOR PICNIC AREAS

A wooded open space across the road from the Interpretive Center will serve as a low-density picnic site (see Fig. 29) for visitors and hikers; it is basically a walk-in site for day users. Careful design considerations should be implemented to relate this area to its surroundings without introducing a fire hazard to the naturally dry foliage of the crater. No cooking facilities will be provided, but a rustic stone wall should be built as a fire-break between the two sections of the area (Class I and II environments).

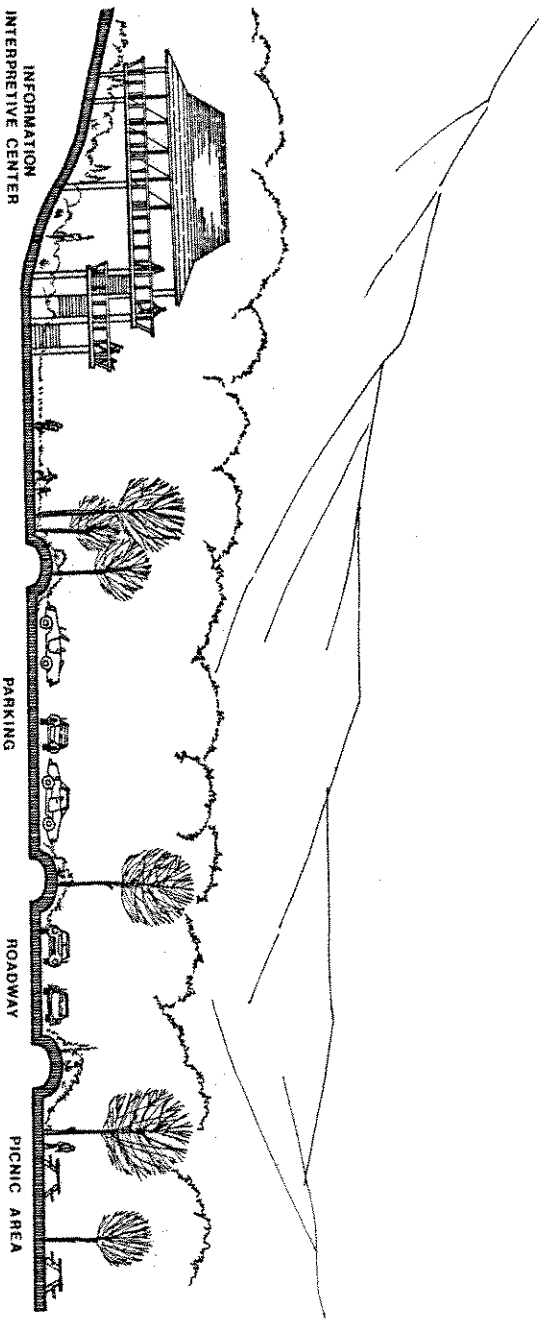


Fig. 29. SKETCH SHOWING RELATIONSHIP OF INFORMATION AND INTERPRETIVE CENTER, PARKING, ROADWAY, AND INTERIOR PICNIC AREAS.

EXTERIOR PICNIC AREA

This more developed site is geared for large gatherings because of its accessibility by car. Yet it also creates a transitional setting for the Monument area by its natural landscaping. With careful management, this area could be utilized 24 hours a day by the public without compromising its natural beauty (Class I environment).

TRAIL SYSTEM

Basically the trail system includes two separate entities satisfying different needs and purposes. Their impact on the land, recreation experience, and degree of development, however, are integral factors to determine the design capacity for each system.

EXTERIOR TRAIL SYSTEM

An urban-trail/jogger/bicycle path in the environments of two different land classes, this trail traverses the mauka end of the Monument (Class I), and along the existing trail on the lower ewa-makai slopes (Class II, although the latter easement is classified as Class I). Since it ties in to an existing jogger path, it should conform to the latter's minimum design standards. Several access points need to be provided for neighborhood linkages and security purposes. The width of this path should accommodate an emergency vehicle but still retain a rustic character.

INTERIOR TRAIL SYSTEM

This trail system encompasses the present and to-be-expanded trail system within the crater, covering Class II and III environments. Its varied modification should reflect the design criteria without affecting the hiker's recreation experience.

The limited number of trails leading into the Class III area (including Leahi Point, see below) should be labelled as hazardous areas. The upper slopes of this area are eroded, with crumbly footing and sparse vegetation, and endangered plants in the area additionally justify limited access.

UPPER SLOPES

These areas are mostly included in the Class III area, in which the environment merits special attention and care in management to insure the preservation of its natural condition.

Leahi Point is the summit, a major hiker destination. Here a closely monitored management program is required because of endangered plants in the surrounding area. The observation point needs to be refurbished while still maintaining a low profile and rustic character.

DRYLAND HABITAT

The low, dryland habitat, though covering essentially the entire interior of the crater, is monitored only in the lower areas. This zone includes

the existing Kiawe forest, the seasonal pond area, the meadowlands, and the reforested area, in which the general characteristics are grassland/shrub/small-tree vegetation, basically reflecting the natural ecosystems for this area. Plants selected to supplement the existing flora should have low maintenance and low water demands. The program for this area should be under expert guidance.

This zone makes an excellent study area, as each portion evolves its own characteristics. The forest areas, with their varied landscapes, would be for the more venturesome. Design of facilities here should be minimal, just enough to satisfy the basic recreational potential of a Class II environment. Service roads, firebreaks, and other fire-control devices should be unobtrusively implemented into the design. The distinctive zones are described below.

Existing Kiawe forest - Its mature stands of trees will be basically left intact.

Dry-lake area - this seasonal wetland, primarily of grass and shrubs, will be found in the lowest spot in the crater.

Meadowlands - the present lawn area will gradually revert to a natural plant succession, which is described on p. 15.

Reforested area - introduced plants should be natural in this dryland situation.

PROJECT NURSERY AND MAINTENANCE YARD

This combined facility will be designed to propagate and establish dryland native plants for the crater floor and to maintain the overall Monument. As a project nursery, it will function as a temporary facility outside the crater until all reforestation and other planting are completed (Class I environment).

LINEAR PARKWAY

The linear parkway along Diamond Head Road will be a landscaped corridor with trees, grass, and shrubbery. All overhead utility lines and poles will be eliminated (Class I environment).

TUNNEL LOOKOUT

This existing parking and view facility outside the crater will be improved to handle the anticipated influx of visitors to the area (Class I environment).

TUNNELS

The two major tunnels that access the crater will undergo little change except that traffic circulation will be one-way via the Kapaehulu tunnel and exit through the Kahala tunnel, for which a pedestrian walkway is also programmed. All other tunnels, including Birkhimer and 407, will continue as storage areas and government emergency centers.

INTERIOR ROADWAYS AND PARKING

The paved roadway network within the Monument will be limited to corridors required for public access. Parking will be limited to the few designated parking lots with planned overflows for events on the landscaped open areas (Class I environment).

COMFORT STATIONS

Sanitary facilities will be provided as minimal support for the daily public use of the Monument (Fig.

(30). Portable chemical lavatories should supplement these facilities for large events and usage requiring additional facilities (Class I and II environments).

CARETAKER RESIDENCE

This structure will be unobtrusively located in the immediate vicinity of the Interpretive Center, so that the caretaker can provide 24-hour security (Class I fringe environment).

DEVELOPMENT PHASING AND COSTS

Actual project costs usually vary from estimated costs as a result of changes in scope of work and time frame. The total development costs for Diamond Head State Monument are expected to be in excess of existing appropriations--projected recreational construction alone is in excess of \$2,000,000, with Phase I set at \$750,000. Development of the Diamond Head State Monument is programmed over a 20-year period, depending on the availability of funds, design criteria, and the development priorities of the DLNR. Current funding restrictions for this project were set at \$250,000 during fiscal year 1977-1978.

For additional information on development items and phasing, refer to the Conceptual Plan (pp. 56 through 60 and Figs. 23 through 26).

PHASE I (\$750,000)

1. Construction of improved roadways, lookout, and parking area. The roadway is to have a centralized entry from Diamond Head Road and a vehicle turn-around and parking area within the crater.
2. Construction of a new water main into the crater to replace the existing inadequate system. Rehabilitation of a reservoir for irrigation requirements and construction of an irrigation system are included in this item.
3. Demolition or removal of unrequired structures (poles, buildings, etc.) on the crater exterior.
4. Grubbing, grading, and landscaping portions of the crater floor and the exterior along Diamond Head Road.
5. Initiation of construction of a drainage system in the interior of the crater.

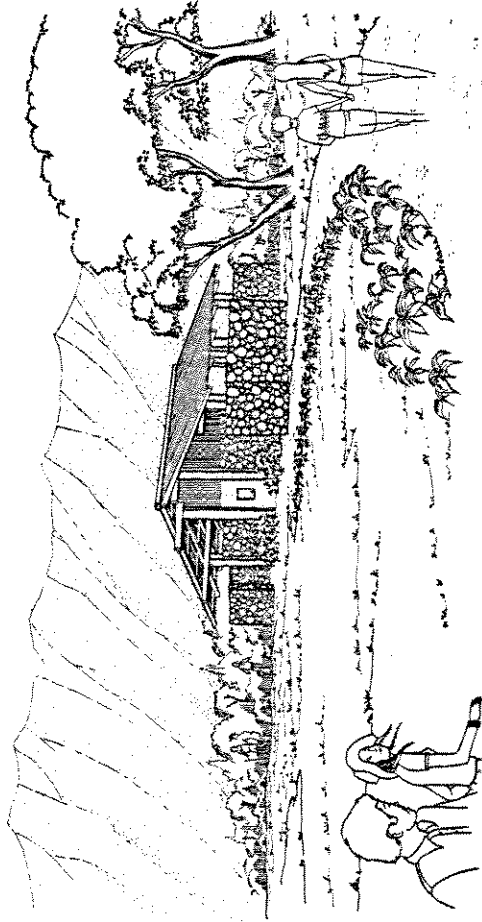


Fig. 30. SKETCH OF COMFORT STATION.

6. Improvement of existing sections and construction of new portions of the Summit Trail to Leahi Point.
7. Rehabilitation of buildings 16, 33, 34, and 49 for use as a maintenance base facility for Diamond Head State Monument; rehabilitation of building 18 for use as a park management and information office.

PHASE II AND SUBSEQUENT DEVELOPMENT

1. Burial of all utilities within and surrounding the Monument.
2. Demolition and removal of all nonrecreational and remaining unrequred structures within the Monument.
3. Continued grading and landscaping both inside and outside the crater.
4. Improvement of existing trails.
5. Construction of the Interpretive Center and other park structures.
6. Provision of other improvements as required.

PROJECT EXPENDITURES (1975 - 1980)

Interim Development	\$ 60,000	SCFT Program
Interim Construction	110,000	Contractor
Planning	35,000	Staff
Surveying	25,000	Consultant
Design (Estimated)	40,000	(\$30,000, Consultant)
Phase I (Projected)	750,000	Contractor
TOTAL	\$1,020,000	

ENVIRONMENTAL IMPACTS

The anticipated influx of visitors will impose an appreciable adverse impact on the crater--particularly in the erosion and compacting of trail and picnic areas, increase of fire hazard, destruction of flora, and generation of solid wastes--in addition to the unavoidable increase of traffic congestion with its attendant noise and dust along Diamond Head Road near the Monument entrance.

SHORT-TERM IMPACTS

Noise, dust, and traffic congestion caused by construction activities are expected to be the major short-term impacts and will be limited to the daytime hours of the construction period. Efforts will be made to minimize them. Equipment noise can be minimized by requiring the contractor to use proper noise-muffling devices on his equipment and by limiting the hours of his operations. Traffic congestion and noise caused by contractors' equipment and workers' vehicles will be minimized by restricting vehicular access and by providing inside-crater parking for such equipment and vehicles.

Dust and erosion can be mitigated by water sprinkling, incremental clearing, and immediate replanting of exposed areas. Removal of some vegetation will be necessary for the development of the Monument; whenever possible, however, the trees and shrubs currently on the site will be incorporated into the landscape plan.

LONG-TERM IMPACTS

VEHICULAR IMPACTS

Development of the Monument over a 20-year period means that intensified construction-workers' traffic along Diamond Head Road will continue, though intermittently, over many years. To reduce the impact on local residents, the Monument's main entrance will be shifted during the initial phase of work, and a third lane will be developed on Diamond Head Road for turning into and out of the Monument roadway. Road construction and improvements will be kept to a minimum by following existing alignments and utilizing the large existing parking lot at the outside of the Kahala tunnel.

Traffic- and parking-control measures will be utilized to minimize noise and maintain the transitional environment of the crater exterior and the desired wilderness experience inside the crater.

All access to the crater by helicopter will be terminated except for emergency purposes.

The linear parkways that will serve as main frontages to the entrance areas of both the Monument and the developing KCC campus will be divided primarily by Diamond Head Road, which will then be cut by the access roads feeding into the Monument and the campus. This intersection will be subject to intermittent, heavy traffic more with the increase in the capacity of the campus than from Monument contractors and visitors. Unlike KCC, Monument visitor traffic will have no particular peak-time hours, other than occasional group tours arriving in busses and vans, which will be restricted to the Kahala-tunnel access area.

IMPACTS ON FLORA

Present conditions will be altered somewhat by the introduction of the proposed dryland forest along the lower slopes while maintaining the existing vegetation--*kiawe* forest and shrub-grassland community--on the upper slopes. Every effort will be made to sustain the wilderness concept during that transition period.

The proposed area for reforestation lies on the crater floor. Much of this has been disrupted over the years and now supports a *haole-koa*/grassland community that dries seasonally, with other areas of open lawn. The conversion of this exotic-plant area to hardier native vegetation will not only improve the natural quality of the landscape but will at the same time reduce the fire hazard in the area. Endangered species will be brought under proper management control, also, so that the overall environmental impact in this regard should be considered highly favorable.

All trails through forested areas and farther up in the wilder, steeper terrain will be designed and constructed to have minimum visual impact, even when being used, and to withstand the anticipated wear and tear of hikers over an extended period of time.

SOLID WASTE

Present disposal facilities in the Monument are inadequate for the anticipated increase in solid-waste materials resulting from the expected visitor influx, both inside and outside of the crater, and particularly in the picnic areas.

Measures will be developed to handle the problem in compliance with the standards and guidelines of Chapter 46, HRS, Department of Health.

OPERATION AND MANAGEMENT OF DIAMOND HEAD STATE MONUMENT

The overall objective of the operation and management functions is protection of the integrity--both scientific and aesthetic--of the higher, steeper, and more prominent portions of the crater rim, with the prohibition of any development, management, or use that may impinge on that integrity. This objective includes the management of all adjacent lands that provide the setting for this feature so that uses of these lands will in no way detract from but rather contribute to the effective preservation and public enjoyment of this primary feature.

Assurance that management programs will lead toward this objective will be achieved primarily by administrative procedures within the Division of State Parks and the DLNR. Table II presents the respective management criteria for the four land classes as described in Table 9. Any significant management or use changes must be cleared with the DLNR through its Division of State Parks.

In addition, scientific, aesthetic, and interpretive experts are to be encouraged to inspect the Monument periodically to assure practicable compliance with the objective stated above. All of these processes should be coordinated with a group of concerned

citizens and government agencies such as now constitute the Diamond Head Citizen Advisory Committee.

The maintenance of the Monument park will require a caretaker for evening security and six or more additional caretakers to maintain the following:

- 12 acres of meadowland
- 40 acres of mixed landscaping (trees, shrubs, and grass)
- 3 major parking lots
- 5 comfort stations
- 3 major lookouts
- 3 miles of roadway shoulder
- 4+ miles of trails
- 80 acres of crater wildland
- 300+ acres of steeply sloping terrain

In addition to the above caretakers, a professional interpreter and assistant will be required for the Interpretive Center; and two nursery personnel, a maintenance-yard person, and a custodian for the base-yard facilities and Interpretive Center will be needed.

The crater hours of operation will continue to be 6 a.m. to 6 p.m. for public use, seven days a week. The exterior linear parkway and park will not be restricted to hours of public use.

INTERPRETIVE PROGRAM

No interpretive program has yet been developed for this scenic, natural, and historic landmark. All three components need to be "displayed" to enrich the visitor's experience of this "urban wilderness," rather than merely provide a scenic lookout cushioned with green space. A committee of knowledgeable experts should be gathered to resolve the basic questions--What needs to be interpreted? And how?

LANDSCAPE PROGRAM

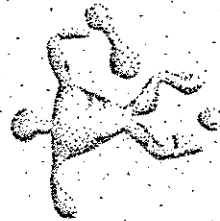
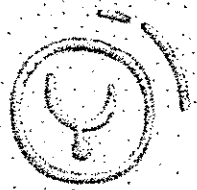
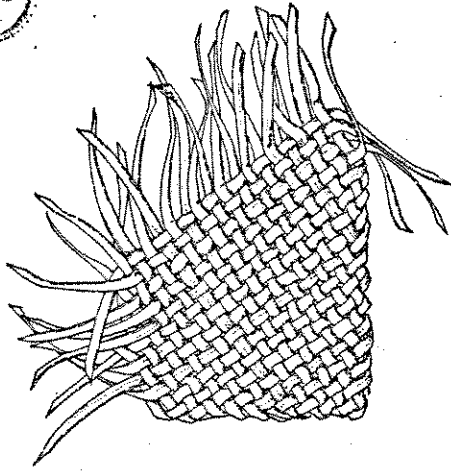
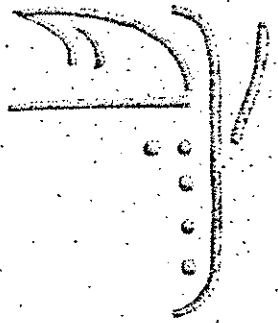
The landscape program affects the entire "natural" setting and its recreational activities. From the replanted areas of the crater bottomlands to the proposed endangered plants of the upper slopes, these all require a task force of horticulturists, naturalists, and landscape architects to oversee the fragile environment. Reverting to the "natural condition," which is harsh and dry, could be a costly program without proper guidance. The landscape program

should include:

1. Selection of hardy, readily-available (or easily propagated) plants, native to a low dryland area, relatively maintenance-free, requiring little or no irrigation at the outset
2. Establishment of a project nursery
3. Plant propagation and maintenance techniques that ensure a high survival rate
4. Management of the wilderness landscape to maintain a wilderness setting without a manicured appearance and to minimize fire hazards
5. Management of the proposed-endangered-plant community.

Table 11. OPERATION AND MANAGEMENT CRITERIA FOR LAND CLASSES WITHIN DIAMOND HEAD STATE MONUMENT

Land Class	Operation and Management Criteria
I High Density Recreation and General Outdoor Recreation	The site will be moderately to highly developed to provide various services for the comfort and convenience of the users. Utilities, maintenance, management, and support facilities--information and interpretive center, public restrooms, and any other necessary major structures, two-way roads, major parking areas, developed picnicking facilities, and such other concentrated general recreational developments--are subject to these criteria.
II Natural Environment	Development will be managed to retain the attractiveness of the natural setting. A reforestation program of an upland forest for the crater floor is planned, enhancing its role as a buffer zone and a natural area. Fire-hazard conditions must restrict some activities because of possible threats to the upper slopes; for example, overnight camping has been ruled out. Minimum facilities are emphasized, with the requirement that they remain unobtrusive in the landscape.
III Outstanding Natural Areas	Development will be limited to the minimum required for public safety, health, and enjoyment consonant with protection of the features. Access roads and facilities other than trails and comfort stations should be kept outside the immediate vicinity of these features. Visitors will be encouraged to walk to the feature. Improvements are to harmonize with and not detract from the natural setting.
IV Historical and Cultural Features	Preservation and restoration of such features are the primary management concerns in this class. Limited access to the features should be allowed, but on-site development should be limited to prevent overuse and to refrain from detracting from the historic or cultural values of the sites. Some effort should be made to provide suitable interpretation of their significance to the public.



APPENDIXES

AGENCIES AND ORGANIZATIONS
THAT PROVIDED INPUT

STATE OF HAWAII

Dept. of Land & Natural Resources (DLNR)
Div. of Fish & Game
Div. of Forestry
Div. of Land Management
Div. of Water and Land Development
Planning Office
Dept. of Accounting & General Services
Dept. of Defense
Dept. of Health
Dept. of Planning & Economic Development
Dept. of Transportation
Office of Environmental Quality Control
University of Hawaii

CITY AND COUNTY OF HONOLULU

Dept. of Land Utilization
Dept. of Parks & Recreation
Dept. of Public Works
Dept. of Transportation Services
Board of Water Supply
Fire Dept.
Police Dept.

UNITED STATES GOVERNMENT

U.S. Army Support Command
Federal Aviation Administration
Institute of Pacific Islands Forestry, Dept. of
Agriculture

ORGANIZATIONS

Black Point Community Assn.
East Diamond Head Assn.
Hawaii Assn. for Retarded Citizens
Hawaiian Electric Co.
Hawaiian Telephone Co.
Hawaiian Trail & Mountain Club

Historic Hawaii Foundation
Kahala Community Assn.
Kapahulu Community Assn.
Neighborhood Board No. 2
Neighborhood Board No. 3
Oahu Development Conference
The Outdoor Circle
Puu Panini Assn.
Save Diamond Head Assn.
Sierra Club
22nd Ave. Community Assn.

RESOURCE PERSONS

David Butchard, Agriculturist
Carolyn Corn, Botanist, Div. of Forestry, State DLNR
Stan Harter, Communications Coordinator, Civil De-
fense Agency, State DOD
Frank Howarth, Entomology Dept., Bishop Museum
George H. Komatsu, Supervisor, Seaport & East Metro
Sect., Vector Control Branch, State Dept. of Health
Jack Larsen, Representative, 8th District, State
House of Representatives
Harris Melemai, Hawaiian Humane Society
Victor Tanimoto, Forest Entomologist, Div. of For-
estry, State DLNR
Wayne Tomoyasu, Engineering Officer, State DOD
David H. Woodside and Timothy Barr, Wildlife Biolo-
gists, Div. of Fish & Game, State DLNR

MISSION AND POSITION OF
STATE DEPARTMENT OF DEFENSE AND
HAWAII NATIONAL GUARD

The State of Hawaii Department of Defense plans and provides for the defense, safety, and welfare of the people of the State in case of war and/or natural or man-made disaster. The State DOD includes State Civil Defense, the Hawaii Army National Guard, and the Hawaii Air National Guard (the latter two combined form the Hawaii National Guard).

The mission of the Hawaii National Guard is twofold: 1) to provide personnel trained and equipped to protect life and property in the State of Hawaii as well as preserve peace, order, and public safety, and 2) to provide the U.S. Army and Air Force with reserve units trained, equipped, and ready for call to Federal active duty in a national emergency.

Birkhimer EOC and Battery 407, both in Diamond Head crater, were designed and developed to function as emergency operating centers. Birkhimer would serve as the seat of State government in the event of a natural disaster or outbreak of war, as it is underground and shielded from a nuclear attack that might be di-

rected at any of the major armed-forces centers, and has electrical power, mechanical ventilation, as well as radio and other communications equipment. It is also fairly accessible for the Governor and the rest of the State staff and the Civil Defense staff whose presence would be required in a disaster situation. Battery 407 is suitably located and is provided with technical systems to serve as headquarters for the Hawaii National Guard.

In addition, the other National Guard facilities within the crater were constructed with Federal funds and are constrained by Federal-State agreements which require usage of the facilities for a minimum term of 25 years. Although some of these 25-year terms will expire in the early 1980s, the Federal government will not fund replacement facilities as the existing buildings would still be functional. Therefore, it is not possible at the present time to predict accurately the time that DOD facilities will be vacated and when the land will be available for inclusion into the Monument.

Thus, because the location is ideal and the technical facilities are developed in permanent and secure structures, the State DOD and Hawaii National Guard plan to retain and continue operating these facilities in Diamond Head crater.

FUNCTION AND ROLE OF FAA FACILITIES
IN DIAMOND HEAD CRATER

The existing FAA electronic equipment and physical plant--the Honolulu Air Route Traffic Control Center in Diamond Head crater and a related communications link located on the crater rim--provide air traffic control for the entire Pacific basin. These facilities have been consistently maintained in top condition and have recently been upgraded and modernized to meet our presently identified needs for a safe environment for air traffic in the Pacific basin for the foreseeable future.

The FAA supports the Diamond Head State Monument and its development as a park and will make every effort to be a good neighbor to the park and its users in consonance with FAA's mission. The fact that the facilities have recently been upgraded and modernized also means, however, that there is no present technological or operational reason for relocating the facilities; therefore the FAA cannot expect to receive funding for such relocation within a specific period such as the 20-year timetable indicated in the Diamond Head Monument Draft Plan. When technological or other needs justify relocation, every effort will be made to expedite such action. The FAA will also consider the ultimate goal of removing non-park-related facilities from the crater in future FAA planning.

BIBLIOGRAPHY

- Aotani and Hartwell Assoc., Inc. 1976. *State Comprehensive Outdoor Recreation Plan*. For State Dept. of Planning and Economic Development. Dec 1975.
- Apple, Russell A. "Evaluation of Diamond Head Tuff Cone." Dec 1967.
- Au, Henry Tuck. "Traffic Impact Statement, East Honolulu Community College." Oct 1974.
- California Committee on Planning for Recreation, Park Areas and Facilities. "Guide for Planning Recreational Parks in California." 1956.
- Community Planning Inc. and Aotani & Oka Architects, Inc. "Diamond Head Development Plan." For Diamond Head Improvement Assn. Dec 1967.
- Degener, Otto. *Flores Kaunakoa*. New York. 1932.
- Degener, Otto. "Plants of Hawaii National Park." Edwards Brothers, Inc. Ann Arbor. 1945.
- Fogg, George E. "Park Planning Guidelines." 1975.
- Gagne, Wayne C. Preliminary report to assist in the zoning and protection of natural areas by the State of Hawaii. (Unpubl, 1973).
- Hawaii, State of Dept. of Defense. (DOD) "Task Force Report on the Future Use of Diamond Head Crater." Jan 1970.
- DOD, Hawaii National Guard (HNG). "Environmental Impact Statement, 200-Man Addition to an Existing 400-Man Plus Armory." Jun 1973.
- DOD, HNG. "Environmental Impact Assessment, Organizational Maintenance Shop." Feb 1975.
- DOD, HNG. "Environmental Statement of Non-Impact for State Facilities Maintenance Shop. Jun 1975.
- DOD, HNG. "Environmental Impact Statement, 100-Man Plus Armory and Administrative Building." Jul 1979.
- Dept. of Health, Health Education Office. "Healthy Camping." 3rd Printing. 1975.
- Dept. of Land and Natural Resources (DLNR). "Recreation Program Handbook." Mar 1978.
- DLNR. "Annual Report to the Governor." Jun 1976.
- DLNR. "Conservation District Inventory--Island of Oahu." 1977.
- DLNR. "Existing Conservation District Boundary Maps." Verified, Mar 1979.
- DLNR. "Rules and Regulations." Jun 1976.
- DLNR. "Regulation No. 4, Amended." Jun 1978.
- DLNR, Div. of Fish and Game. "Annotated Checklists of the Birds and Mammals of Hawaii." 1975.
- DLNR, Div. of State Parks, Outdoor Recreation and Historic Sites. "Preservation of Diamond Head State Monument." Rept. to the Sixth Legislature, State of Hawaii. 1971.
- Dept. of Planning and Economic Development (DPED). "The State of Hawaii Data Book, 1977." Nov 1977.
- Dept. of Transportation (DOT). "Traffic Summary, Island of Oahu, 1972." 1973.
- Legislature. "Hawaii Revised Statutes, 1976, with 1978 Supplements." 1978.
- Legislature. "Session Laws of Hawaii." Sessions 1971 through 1979.
- University of Hawaii (UH). "Environmental Assessment for Relocation of Kapiolani Community College to Fort Ruger." 1978.
- UH, Dept. of Botany. "Puako Holo Heiau National Historic Site Plant Survey." Tech. Rept. #15. Feb 1977.
- UH, Dept. of Geography. "Atlas of Hawaii." 1973.
- UH, Ecology Class. "Micro-environments investigations in Diamond Head Crater. (1967).
- UH, Land Study Bureau. "Detailed Land Classification--Island of Oahu." Dec 1972.

- Hawaiian Sugar Planters' Association. "Handbook of Hawaiian Needs." 1966.
- Honolulu, City and County of. (C&C) "Existing Zoning Maps." Verified, Aug 1977.
- C&C. "1978 Cumulative Supplement of the Comprehensive Zoning Code 1969." 1978.
- C&C, Board of Water Supply. "2020 Plan." Feb 1971.
- C&C, Dept. of General Planning. "An Analysis of the Public Concern for Diamond Head." May 1971.
- C&C, Dept. of Parks and Recreation. "Environmental Impact Assessment/Determination, Kullei Cliffs Site Improvements." Feb 1976.
- Hosaka, Edward Y., and Alan Thistle. "Noxious Plants of the Hawaiian Ranges." US Ag. Ext. Bull. 62. Jun 1954.
- Macdonald, Gordon A., and Agatin T. Abbott. *Volcanoes in the Sea*. UH Press. 1970.
- Maciolek, John. "Annotated Classification of Hawaiian Inland Waters." 1976.
- McAllister, J. Gilbert. *Archaeology of Oahu*. Bishop Museum Bull. 104. 1930.
- Neal, Marie C. *In Gardens of Hawaii*. UH Press, Reprint, 1968.
- Oahu Development Conference. "Diamond Head." C 1969.
- Oahu Development Conference. "ODC Planning Issues," in *Scenic Zoning for Diamond Head*. IV, No. 1. Winter 1971.
- Pacific Planners Corp. "Diamond Head Study." For DLNR. Mar 1968.
- Parks Engineering, Inc. "A Master Plan Study for Kapiolani Park." For Honolulu, City & County of. Dec 1975.
- Rutledge, Albert J. "Anatomy of a Park." 1971.
- Stearns, Harold T., and Knute N. Vaksvik. "Geology and Ground-Water Resources of the Island of Oahu, Hawaii." May 1935.
- Stewart, C. S. *Journal of a Residence in the Sandwich Islands during the Years 1823, 1824, and 1825*. UH Press. 1970.
- Thrum, Thomas G. *Hawaiian Annual 1938*. Honolulu. 1937.
- United States Government
 Dept. of Agriculture, Soil Conservation Service in cooperation with UH Ag. Ext. Station. "Soil Survey of Islands of Kauai, Oahu, Maui, Molokai and Lanai, State of Hawaii." Aug 1972.
- Dept. of Agriculture. "Erosion and Sediment Control Guide for Urbanizing Areas in Hawaii." 1976.
- Dept. of Commerce. "Climate of the States: Hawaii," in *Climatology of the United States*. No. 60-51. 1967.
- Dept. of Interior. "Outdoor Recreation Space Standards." Mar 1970.
- Dept. of Interior. "A Summary of Outdoor Recreation in America, 1972-1978." Dec 1973.
- Dept. of Interior. "Plants/People, and Environmental Quality." 1972.
- National Register of Historic Places*. 1976.
- Weather Bureau. "Temperatures and Wind Speeds in Diamond Head." 1965.
- Weather Bureau. "Climatological Data--Hawaii Section, Years 1942-1975."
- Watanabe, Ikuo. "Will Diamond Head Ever Erupt Again?" 1975.
- Wentworth, Chester A. "Proclastic Geology of Oahu." 1926.

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

PACIFIC ASIA REGION
P. O. BOX 50109
HONOLULU, HAWAII 96850

JUL 27 0 56 AM '79
34RMS



GEORGE R. ABAYOH
GOVERNOR



STATE OF HAWAII

DEPARTMENT OF DEFENSE
OFFICE OF THE ADJUTANT GENERAL

COMMENTS: A. Federal Assets - Honolulu, Hawaii - 06816
PROJECT: HPL, State Diamond Head Road, Honolulu, Hawaii 96816

HIENG

20 JUL 1979

JUL 23 10 22 AM '79

VALERIE A. SIEBENMANN
ADJUTANT GENERAL
STATE OF HAWAII

Mr. James J. Yamashiro
State Parks Administrator
Department of Land and Natural Resources
Division of State Parks
P. O. Box 621
Honolulu, Hawaii 96809

Dear Mr. Yamashiro:

We have reviewed the draft copy of the Diamond Head State Monument Final Report. We concur with the report without comment.

Sincerely,

A. P. Perry
A. P. PERRY
Acting Chief, Airway Facilities Division, APC-400

ADMIN.
I. ADMIN.
DIR. ASST.
DR. *W. Perry*
ASST. DIR.
SER. MGT. BR.
PHYSICAL STAFF
BUS. OFF. STAFF
FIN. STAFF

COMMUNICATIONS & REC.
TRAINING
FILE
FOLLOW UP
INFO
SLE KEE
SIGNATURE

Mr. James Y. Yamashiro
State Parks Administrator
Department of Land and Natural Resources
State Parks Division
P. O. Box 621
Honolulu, Hawaii 96809

Dear Mr. Yamashiro:

Thank you for the draft copy of the final report. As requested, we have reviewed the section dealing with the position of our department. We have made some minor changes in the text and a revised copy is forwarded for your information and use.

If there are any questions regarding this matter, please call me at 737-6733.

Yours truly,

Wayne R. Tomoyasu
WAYNE R. TOMOYASU
Major, CE, HARRC
Constr. & Engr. Officer

Enclosure

CHIEF ADMIN.
 DEPARTMENT OF LAND UTILIZATION
CITY AND COUNTY OF HONOLULU
 650 SOUTH KING STREET
 HONOLULU, HAWAII 96813 • (808) 533-4411
 PLAN. BR. 1/3
 RES. MGT. BR.
 CLERICAL STAFF
 INST. SITES SEC.



August 6, 1979

Department of Land & Natural
 Resources
 Division of State Parks
 State of Hawaii
 P.O. Box 621
 Honolulu, Hawaii 96809

ATTENTION: Mr. Clyde Hosokawa
 Gentlemen:

Diamond Head Monument Planning Report
 Preliminary Draft Environmental Impact Statement
 Consultation Period

We have reviewed the above and have the following comments:

1. What is the status of the three proposed endangered plant species listed on the 1976 Federal Register? What measures are being taken to protect them?
2. It is stated that the existing sewerage system is "old but adequate for present use". Would it be adequate for the proposed expanded public usage? If not, what is proposed to accommodate the expanded use?
3. In the drainage section, Page 44, please clarify the statement, "the drainage system is not a public utility, however; since it normally is an expected government service".
4. The report states that water shortages have occurred in the crater area, due to the heavy usage of water, and from inadequately sized and low head pressure waterlines. What is being planned to correct this situation in lieu of the many proposed landscaping plans for the interior crater area, and "that there is little or no fire protection in the crater"?
5. What, if any, mitigating measures are being planned to correct poor conditions of the existing hiking trails?

Department of Land & Natural
 Resources
 Page 2

TYRONE T. KUSAO
 DIRECTOR
 LU779-2988 (LC)
 79/EC-3

6. The section on Special Management Area, Page 54, should be revised. The purpose of Ordinance No. 4529 is:

"It is the City and County of Honolulu's policy to preserve, protect, and where possible, to restore the natural resources of the coastal zone of Hawaii. Special controls on development within an area along the shoreline are necessary to avoid permanent loss of valuable resources and fore-closure of management options, and to insure that adequate public access is provided to public owner or used beaches, recreation areas, and natural preserves, by dedication or other means."

7. It is stated on Page 65, under Transportation, that a "wider roadway is programmed". How wide? When is it programmed?

8. Page 67, it should be noted that "a low profile" in the crater and slopes of Diamond Head are controlled by the Diamond Head Historic, Cultural and Scenic District, Ordinance No. 77-123 and Special Management Area.

9. What was the Environmental Assessment prepared in October, 1977, Page 71, for? A Negative Declaration? A Special Management Permit granted in the Diamond Head Crater by the City Council in February, 1978, was to construct a temporary comfort station and fence and to demolish and relocate an existing helipad.

10. Some attempt should be made to project visitor counts, since this would definitely have impacts on existing and planned facilities, e.g., restrooms, parking and bus loading areas.

Thank you for the opportunity to comment. Please call Mrs. Lorrie Chee of my staff at 523-4256, if you have any questions.

Very truly yours,

TYRONE T. KUSAO
 Director of Land Utilization

TTK:sl



STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES

DIVISION OF STATE PARKS
P. O. BOX 621
HONOLULU, HAWAII 96808

DIVISIONS:
CONSERVATION
FISH AND GAME
FORESTRY
LAND MANAGEMENT
STATE PARKS
WATER AND LAND DEVELOPMENT

August 13, 1979

TO: Tyrone T. Kusao, Director
Department of Land Utilization

FROM: James J. Yamashiro
State Parks Administrator
Division of State Parks

SUBJECT: Draft "Diamond Head State Monument Planning Report"
and Environmental Impact Statement Dated 18 July
1979.

This is in response to your letter LU 7/79-2988(LC),
79/JEC-3 dated August 6, 1979 concerning your review of the
subject document in accordance with Chapter 343, Hawaii Revised
Statutes. Questions answered below refer to the numerical
sequence of your comments. All page numbers quoted in the
answers refer to the "Diamond Head State Monument Final E. I. S.
and Planning Report" enclosed.

1. The Division of State Parks is aware of the proposed en-
dangered plants and has planned all development accor-
dingly to ensure their survival. See page 65 under Upper
Slopes, page 69 under Impacts on Flora, and page 71 under
Landscape Program.
2. The existing sewerage system within the crater was con-
structed over 15 years ago to service the facilities of
the National Guard and F. A. A. The sewerage system on
the crater exterior was developed over 50 years ago. The
systems are adequate with few modifications for the pro-
posed development of the Monument which includes heavy
public use of sanitary facilities.
3. Drainage refers to storm drains, channeling and collection
systems usually provided and maintained by the County De-
partment of Public Works as a government service. Drain-
age and sewerage is explained in the section dealing with
public utilities since they are essential services for
any development and should be planned as integral elements.
4. Water pressure fluctuations have been experienced by the
F. A. A. during periods of heavy usage. The main problem
is not really pipe diameter and capacity but rather water
pressure due to elevation since the F. A. A. installation
is higher in elevation than either the outside water main

Page two

5. The trail to the summit is the only trail currently being
designed for corrective action to make it safer for public
use. See page 68 under Phase I Construction. Design
includes added railings, trail patching, new trail loops
by-passing existing bunkers and tunnels, and a summit
lookout. Some existing trails are programmed to be
closed and managed for the purposes of either reesta-
blishing vegetation and healing the erosion scars, or
limiting access to hazardous areas and endangered plant
habitats.
6. The section quotes policy "A" of Ordinance 4529 out of
context which illustrates our desired direction for the
development of Diamond Head State Monument. Your quote is
correct (Ordinance 4529, Section 1, Purpose); and it will
be included in future revisions.
7. There are plans to widen Diamond Head Road between 18th
Avenue and Makapuu Avenue at the new proposed entrances
for the Kapiolani Community College and the State Monu-
ment to allow for a third lane for vehicle turn-in. All
existing driveways will be closed between the two avenues
to minimize congestion. The roadway widening and driveway
relocations are programmed under Phase I and should be
implemented within the next three years.
8. The "low profile" as suggested concerns the existing
F. A. A. development, activity and maintenance of same,
and has no bearing on new development or heights of
structures. Maintaining a "low profile" in this instance
means keeping out of the limelight so as not to focus
attention on existing development. Ordinance 77-123 does
apply.
9. The Environmental Assessment prepared in October 1977 was
for the development of interim public use facilities within
Diamond Head. A Negative Declaration was later filed on
the same development as requisite for the S.M.A. permit
needed for the construction of the comfort station, etc.
10. Visitor counts for Diamond Head State Monument cannot be
projected since there is no firm experience on which to
base projections. Table 6 and Figure 16 provide usage
figures for 1978, however; usage is expected to increase
significantly upon completion of development. A design
limit is being planned for public use. Equipment to count
vehicular traffic and personnel to monitor public use and
impact on the environment will be incorporated in the de-
velopment of the Monument.

Page three

Thank you very much for your comments. If you have any further questions, do not hesitate to call on us.

Very truly yours,

for Gene C. Leonard,
James J. Yamashiro
State Parks Administrator

Encl.

Department of Land and Natural Resources - Internal Comments

Division of Fish & Game:

1) The project is located inland away from the influence of the ocean and therefore will have no adverse effect on the marine environment. However, we note that in Section 3 "ANALYSIS" (page 27) the program objective for LNR 805 appears to be confused with the objective outlined for LNR 804. Also, we believe that the program title for LNR 805 has been revised to "LNR-Ocean-Based Activities" (rather than "Other"). Further, under the section titled "Potential Uses of the Monument (3-4)," ocean-oriented activities such as swimming, beach camping, fishing, boating, etc., are addressed, which implies that these activities will occur within the proposed State Monument site. It appears highly unlikely that these activities will occur due to the site's location away from the sea.

2) The subject document is very thorough and accurate with respect to wildlife (fauna) although as stated, more work could be done on inventorying birds. The fact that intermittent ponds occur after heavy rains suggests the floor of the crater may have potential as migratory and resident waterbird habitat, although it is doubtful that pintail ducks, shoveller ducks and Hawaiian ducks use the area now except very rarely. It is suggested that some thought be given to developing a permanent pond or series of ponds using rain runoff or pumped water to create such habitat. This would fit in nicely with the recreational and esthetic themes proposed. Birdwatching and educational activities seem appropriate.

Planning Office:

Approval in concept only, limited to crater interior and area of the Monument.

Land Management Division:

Land Management Division concurs with the recommendation of the Diamond Head Task Force that large crater festivals should be phased out and that all other commercial uses that may be detrimental to the environment of the crater should be restricted. The festivals, as stated on page 4 under Potential Uses of the Monument, create undesirable by-products such as erosion, fires, health problems, vandalism, trespassing, traffic and parking problems; and as stated on page 6 under Fauna, create a breeding ground for the bronze bottle fly in the accumulated garbage.

Division of Forestry:

Diamond Head Crater has the distinction of having some very unique plants in and on the crater rim. In addition to sandalwood and native cotton plants, two additional species which are highly endangered are also located on the crater rim. They have not been located in a recent State Parks survey because they are smaller plants that may dieback partially in the dry season, making them hard to locate and identify. These two species are known to grow in a very restricted area and are found nowhere else on earth. Therefore, they are considered to be highly endangered not only from fire, but also from human activities such as hiking. The exact location of these surviving plants probably should not be generally known, but should be protected. A competent botanist knowledgeable of the native and endangered species must conduct a survey to locate these plants. This survey to define the critical habitat of the plants should be done between one and three months after the beginning of the rainy season (December - February). Once the locations of these plants are established, plans to protect the plants may be developed. Final plans should allow for the growth and survival of these plants without endangering their tenuous existence. The greatest threats posed by park development would be an increased danger of fires, trampling of the critical habitat by hikers, and curious people picking or digging up these plants to take home if their location becomes generally known. If a decision is made to maintain a hiking trail to the summit rim, this trail should be as far away from the endangered species habitat as possible.

The following agencies, organizations and individuals requested copies of the EIS and Planning Report and made no follow-up responses prior to the closing of the EIS preparation notice period:

State

University of Hawaii, Sea Grant College

A public hearing was held on June 21, 1979, at 7:00 p.m. at John H. Wilson Elementary School Cafetorium in accordance with Chapter 343, Hawaii Revised Statutes, for the solicitation of formal testimony on the development of Diamond Head State Monument as proposed in this report. No adverse testimony was received.

Organizations

Kahala Community Association

Life of the Land

Neighborhood Board No. 3

Sierra Club, Hawaii Chapter

