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BENJAMIN J. CAYETANO  
GOVERNOR

January 25, 2001

DEPT. OF LAND  
& NATURAL RESOURCES  
STATE OF HAWAII

TO: The Honorable Gilbert Agaran, Director  
Department of Land and Natural Resources

SUBJECT: Acceptance of the Final Environmental Impact Statement for the Diamond Head  
State Monument Master Plan Update

With this memorandum, I accept the Final Environmental Impact Statement for the Diamond Head State Monument Master Plan Update, island of Oahu, as satisfactory fulfillment of the requirements of Chapter 343, Hawaii Revised Statutes. The economic, social and environmental impacts, which will likely occur should this project be implemented, are adequately described in the statement. The analysis, together with the comments made by reviewers, provides useful information to policy makers and the public.

My acceptance of the statement is an affirmation of the adequacy of that statement under the applicable laws but does not constitute an endorsement of the proposed action.

I find that the mitigation measures discussed in the environmental impact statement will minimize the negative impacts of the project. Therefore, if this project is implemented, the Department of Land and Natural Resources and/or its agents should perform these or alternative and at least equally effective mitigation measures at the discretion of the permitting agencies. The mitigation measures identified in the environmental impact statement are listed in the attached document.

  
BENJAMIN J. CAYETANO

Attachment

c: Honorable Bruce S. Anderson, Ph.D., M.P.H.  
Office of Environmental Quality Control

2000 - Oahu - FEIS -  
Diamond Head Park

NOV 8 2000

**FILE COPY**



*Diamond Head State Monument  
Master Plan Update*

**Final Environmental Impact Statement**

Prepared for:  
State Department of  
Land and Natural Resources

Prepared by:  
PBR HAWAII

September 2000

*Diamond Head State Monument  
Master Plan Update*

**Final Environmental Impact Statement**

Prepared for:

State Department of  
Land and Natural Resources

Prepared by:  
PBR HAWAII

September 2000

FINAL  
ENVIRONMENTAL IMPACT  
for  
DIAMOND HEAD STATE MONUMENT  
MASTER PLAN UPDATE

Honolulu, Oahu, Hawaii

Prepared For: The State of Hawaii  
Department of Land and Natural Resources

Responsible Official: This environmental impact statement and all ancillary documents were prepared under my direction or supervision and the information submitted, to the best of my knowledge, fully addresses document content requirements as set forth in Section 11-200-17 and Section 11-200-18, Hawaii Administrative Rules.

  
Timothy E. Johns  
Chair

OCT 23 2000  
Date

Prepared by: PBR Hawaii



DIAMOND HEAD STATE MONUMENT MASTER PLAN UPDATE  
FINAL ENVIRONMENTAL IMPACT STATEMENT

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LIST OF ACRONYMS

ADA	Americans with Disabilities Act
BLNR	Board of Land and Natural Resources
BWS	Board of Water Supply
C&C	City and County of Honolulu
CAC	Citizens Advisory Committee
CERAP	Combined Center/Radar Approach Control
CRMP	Cultural Resource Management Plan
CWRM	Commission on Water Resource Management
CZM	Coastal Zone Management
DHSM	Diamond Head State Monument
DLNR	State Department of Land and Natural Resources
DOCARE	State Division of Conservation and Resource Enforcement
<del>State</del> DOD	<del>State</del> Department of Defense
DOH	Department of Health
DP	Development Plan
EIS	Environmental Impact Statement
EISPN	Environmental Impact Statement Preparation Notice
EOC	Emergency Operations Center
FAA	Federal Aviation Administration
FHWA	Federal Highway Administration
FIRM	Flood Insurance Rate Map
FIT	Free Independent Travel
H-POWER	Honolulu Program of Waste Energy Recovery
HAR	Hawai'i Administrative Rules
HECo.	Hawaiian Electric Company
HRS	Hawai'i Revised Statutes
HTCo.	Hawaiian Telephone Company
JTB	Japan Travel Bureau
KCC	Kapi'olani Community College
LOS	Level of Service
LSB	Land Study Bureau
LUC	Land Use Commission
NPDES	National Pollution Discharge Elimination System
NRHP	National Register of Historic Places
OEQC	Office of Environmental Quality Control
OHA	Office of Hawaiian Affairs
PBQD	Parsons Brinckerhoff Quade & Douglas
PUC	Primary Urban Center
SCORP	State Comprehensive Outdoor Recreation Plan
SLH	Session Laws of Hawai'i
SMA	Special Management Area
TMK	Tax Map Key
TRD	Technical Reference Document
USFWS	U.S. Fish and Wildlife Service

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## Executive Summary

### Purpose

This Draft Environmental Impact Statement (EIS) has been prepared by PBR HAWAII for the State Department of Land and Natural Resources (DLNR) for the update to the 1979 Planning Report (Master Plan) for the Diamond Head State Monument. The proposed action calls for the use of State lands and funds which subjects the proposed action to Chapter 343, Hawai'i Revised Statutes (HRS), and Title 11, Chapter 200, Hawai'i Administrative Rules (HAR) of the Department of Health. The DLNR has determined that the proposed action should be addressed in an EIS.

### Location

Diamond Head, also known as Lē'ahi, lies on the southern coastline of O'ahu, approximately one and a half miles south of the slopes of the Ko'olau range. Diamond Head is a nearly circular crater of approximately two-thirds of a mile in diameter and is bounded by Diamond Head Road and Monsarrat Avenue. To the northwest are residences, Kapi'olani Park, the Honolulu Zoo and Waikīkī. To the north are the Cannon Club, Kapi'olani Community College and the residential areas of Kapahulu and Kaimukī. To the east is the residential area of Kāhala. To the south is Diamond Head Road and Diamond Head Beach Park.

### Description of the Property

The Diamond Head State Monument consists of the following TMKs: TMK: 3-1-42: 6, 8, 10, 14, 17, 21, 23, 24, 25, 36, 37, and 38, and TMK: 3-1-35: 22 and 23. Parcels proposed to be added to the Diamond Head State Monument include: TMK: 3-1-42: 11 (Cannon Club), TMK 3-1-42:15 (FAA), and TMK 3-1-42:16 (FAA), TMK 3-1-42:20 (por.). Today, many structures and facilities house the operations of the ~~State~~ Department of Defense (~~State~~ DOD) and the Federal Aviation Administration (FAA). Scattered around the rim of the crater are bunkers, gun emplacements, tunnels, antennas and other structures which reflect the current and historical governmental uses of the crater.

### Project Objective

The objective of the 1979 plan for Diamond Head State Monument 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 Diamond Head State Monument Plan as developed by the Diamond Head Citizens Advisory Committee (CAC) and adopted by the Board of Land and Natural Resources (BLNR) in 1979, and subsequently enacted into law by the Hawai'i State Legislature in 1992. The objectives and policies were reviewed and portions of the policies were amended and approved by the Diamond Head CAC on November 16, 1995, but were not formally adopted by the Board of Land and Natural Resources.

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### Master Plan Update Process

In 1997, the State Legislature funded an update of the 1979 plan. The update is to include the preparation of plans, and designs for the incremental development of the Monument, including a visitor/interpretive center. The product will be a Master Plan Update and Environmental Impact Statement and related technical appendices, as may be required for the construction of improvements to include a permanent visitor/interpretive center.

As part of State law under Chapter 6E-32, Hawai'i Revised Statutes, amendments to the 1979 document are allowed by the Board of Land and Natural Resources with the review and recommendations of the CAC, organized in October 1977.

Since January 1998, the Division of State Parks and its planning consultant PBR HAWAII has met with the CAC once or twice a month, including field trips, on the update of the 1979 Development Plan and the location and program of the proposed visitor/interpretive center. In the process of these meetings with the CAC, four sites for the visitor/interpretive center were identified within the crater, from which three were identified for further evaluation. These three sites and their accompanying master plans covering the remainder of the DHSM were then presented for public input through the State of Hawai'i Chapter 343 Environmental Impact Statement (EIS) process.

The EIS Preparation Notice (EISPN) was filed with the State Office of Environmental Quality Control (OEQC) on August 25, 1998 for publishing in the September 8, 1998 issue of the Environmental Notice. The 30-day public comment period ended October 8, 1998, during which time there was an opportunity for public input on the desirability of the various alternatives considered.

Public informational meetings were held on November 23 and 24, 1998.

Based on the CAC's recommendations and public comments received on the EISPN and at the public informational meetings, DLNR selected a preferred alternative. This preferred alternative (proposed action) is presented in this Draft EIS which will have a 45-day public comment period.

It is possible that additional refinements to the preferred alternative/proposed action will occur as a result of the 45-day public comment period (on the Draft EIS). These will be presented in the Final EIS. The Master Plan Update will not be finalized until the EIS process has been completed.

Other formal opportunities for public information and input will occur during presentations to various community associations and area Neighborhood Boards. Also, required public hearings will be held in the process of obtaining: 1) Special Management Area (SMA) Use Permit and Diamond Head Special District Major Permit from the City and County of Honolulu (C&C); and 2) Well Permit(s) (Well Construction Permit, Pump Installation Permit, and Water Use Permit), if necessary, from the State Water Commission.

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Key Elements of the Master Plan

In 1998, as part of the Diamond Head Master Plan Update process, a number of alternatives were developed for consideration by the Diamond Head Citizen's Advisory Committee. The CAC narrowed the sites being considered for the visitor/interpretive facility to three locations within the crater and on August 27, 1998 voted unanimously to recommend the siting of the visitor/interpretive facility to the area between the Kāhala Tunnel and Battery Birkhimer. Subsequently, DLNR has concurred with the CAC and has selected the Kāhala Tunnel/Battery Birkhimer site as the location for the proposed visitor/interpretive center. Based on these decisions, the preferred alternative (Alternative Concept 1) was then revised to create the Preliminary Master Plan.

The Preliminary Master Plan is similar to the 1979 Development Plan, as many of the major elements of the 1979 plan have also been incorporated into this proposal. For example, common elements include:

- entry through Kapahulu Tunnel;
- exit through Kāhala Tunnel;
- a permanent visitor/interpretive facility near Battery Birkhimer;
- a caretaker's residence (or DOCARE office);
- removing the FAA CERAP Building;
- removing State DOD Buildings 301, 303 and 304;
- improvements to the wetland;
- proposed trail around the wetland; and
- proposed picnic area.

As such, this proposal should be considered as an update to 1979 plan rather than a completely new master plan. In the face of a significant increase of visitors to the crater since 1979, the following proposal would reinforce these common elements by:

- in the long-term, moving visitor parking to outside of the crater;
- establishing a motorized people mover system, when visitor parking is kept to the exterior;
- utilizing the Cannon Club site for food service and/or visitor orientation and providing restroom facilities;
- opening up Tunnel 407 and Battery Harlow for interpretive purposes and providing restroom facilities;
- keeping the existing comfort station and parking lot and providing additional facilities as necessary;
- accommodating pedestrian access through Kapahulu Tunnel;
- controlling visitor access into sensitive areas (such as the crater rim);
- protecting the *Schidea adamantis* habitat, and the habitat of other native species;
- ~~continuing eco-system restoration work at Battery Harlow;~~
- opening the road/trail from the FAA Link Site to the retractable searchlight on the southeastern edge of the crater rim;
- opening a new trail from the retractable searchlight on the southeastern edge of the crater rim to Tunnel 407;
- utilizing Battery Dodge and the gun emplacements along the eastern edge of the crater as lookouts;
- providing open spaces within the crater for picnicking and community activities;



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- opening a new trail to the flat top reservoir north of the existing trail to the summit;
- adding comfort stations at the exterior parking facility, at secondary interpretive facilities, and picnic areas;
- installing a wastewater lift station; and
- removing the overhead utility lines between Battery Birkhimer and the crater rim and relocating them to the aboveground conduits to the Link Site (once FAA has relocated);

Planting will be coordinated with the State Division of Forestry and Wildlife and the U.S. Fish and Wildlife Service. The areas planted by the State Department of Defense (State DOD) will be evaluated for compatibility with the Diamond Head State Monument Master Plan when areas are turned over to DLNR.

### Summary of Anticipated Impacts

Due to the unique environmental and physical qualities of Diamond Head Crater, potential environmental impacts may occur both before and after project construction. A summary of potential environmental impacts are herein described for the overall project and specific planning considerations for each of the alternative plans considered. The following discussion is not intended to be exhaustive, but is intended to be used in considering the various alternatives.

The potential environmental impacts associated with project construction include air quality impacts from fugitive dust emissions, impacts to the ambient noise quality associated with the interior crater, and temporary visual impacts that may detract from the high value visual experience identified with Diamond Head, as a National Natural Landmark, State Monument, Fort Ruger Historical District, City and County of Honolulu Special Design District, and State Conservation District.

Air quality will likely be impacted by potential fugitive dust emissions and relatively minor vehicular emissions from construction equipment. Over the long-term, the air quality within the crater should actually improve if, in the long term, visitor parking is kept to the exterior (only service vehicles, emergency vehicles, and a proposed motorized people mover would be permitted to operate within the crater). Eventually, all parking for visitors would be located outside of the crater either at the Cannon Club site and/or along Diamond Head Road near the project entry.

Noise quality will also be impacted during the construction period by the operation of construction vehicles, trucks backing up, and localized noise such as hammering, people talking, etc. However, noise quality after construction should be improved since the number of vehicles entering the crater environment will be significantly reduced, if, in the long term, visitor parking is kept to the exterior.

Visual impacts will be of some concern from the perspective of those who object to construction activity and grading within the crater. Views within the crater will change, however, extensive design and landscaping controls will be implemented to ensure that the project goals of a more natural environment are achieved. The impact of a new structure (proposed visitor/interpretive center) must be compared to the positive visual impact of the eventual removal of the existing FAA CERAP Building and State DOD buildings 301, 303, and 304 from the crater floor. For the option of parking other than at the Cannon Club, views outside of the crater will be impacted by the establishment of a new parking area across Diamond

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Head Road from Kapi'olani Community College. However, the optional parking lot location is "above" Diamond Head Road and could be heavily screened by landscaping and topographical buffers.

As indicated above, few potential adverse impacts to the area are expected to result from implementation of the proposed Master Plan Update. Short-term impacts will result in the initial construction phase which will require on-site grading, trenching, and movement of construction vehicles within the project site's unpaved roads. These activities will generate localized noise and dust during construction periods. Mitigation measures to minimize adverse air quality would include frequent watering of unpaved roads and construction areas, dust screens (as applicable), and mulching and planting of ground cover and other vegetation as soon as possible after construction. Construction activities would comply with all applicable regulations of the City and Department of Health.

Long-term impacts from the development are expected to produce minimal impacts to the adjacent residential property owners, Kapi'olani Community College, or Kapi'olani Park. The proposed project is not expected to have any impact on the micro climate of the project area or region. Planned structures would not be tall enough to significantly effect existing wind patterns; and new structures will not significantly effect temperature since some localized cooling can be expected to result from the installation of landscaping.

Social impacts will occur during and after construction through the enhancement of visitors' understanding of Diamond Head's natural, cultural, and military history. Economically, a new visitor/interpretive center is hoped to generate revenue that will help to pay for the enhancement and maintenance of the Diamond Head State Monument. It should be noted that a portion of the revenue generated must be paid to the Office of Hawaiian Affairs.

### Summary of Proposed Mitigation Measures

Recommended mitigation measures include the following:

*Short term:*

- Presence of an archaeologist during any significant grading.
- Frequent watering during construction and demolition activities to maintain dust control.
- Grassing of swales and sodding as soon as practicable once grading has been completed.
- Wind screening as appropriate to limit fugitive dust.
- Restricting use of construction equipment to daylight hours.
- Developing a cultural resource management plan; preparing an inventory level survey; developing management recommendations; and identifying interpretive opportunities.

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*Long term:*

- Establish extensive landscaping to maintain long-term air quality and aesthetically integrate the Master Plan into the natural environment of Diamond Head Crater.
- Use of appropriate engineering, design and construction measures to ensure adequate drainage and irrigation of the site.
- Construction of a multi-user pedestrian bike path along Diamond Head Road between Makapu'u Avenue and 22nd Avenue.
- Traffic and parking control measures will be utilized to minimize noise and maintain the transitional environment of crater exterior and the desired wilderness experience inside the crater.
- All access to the crater by helicopter will be terminated except for emergency purposes.
- 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.
- Manage existing populations of endangered plants species by: reducing the risk of catastrophic fire; assessing the impact of introduced species and developing a means of controlling the introduced species; controlling human activities near the endangered plant species; conducting studies necessary to enhance the endangered plants; expanding current populations; and establishing new populations.

### **Probable Adverse Environmental Effects Which Cannot Be Avoided**

As with any development, there will likely be instances during the construction period where soil erosion from wind and rain will occur and visual impacts will be altered from the current vacant scrub vegetation. Noise levels will also increase above current conditions due to the added traffic levels on the property (during the interim, when visitor vehicles will be allowed in certain areas of the crater), human activity (i.e. children playing), and the addition of mechanical equipment such as air conditioners, service trucks backing up, and vehicular noise (especially during the interim, when visitor vehicles will be allowed in certain areas of the crater). Solid waste, energy consumption, water use levels, and waste water will all increase above current levels.

Each of these impacts, typical of all park uses, will result wherever new park facilities are provided. By providing a master plan where potential impacts can be mitigated through site design and development standards, potential adverse environmental effects which cannot be avoided can be mitigated.

### **Irreversible and Irretrievable Commitments of Resources**

The implementation of the proposed Diamond Head State Monument Master Plan Update would result in the irreversible and irretrievable commitment of the land resource and require use of fiscal resources from the State of Hawai'i. Major resource commitments include the land on which the proposed project is located and the financial commitment for construction materials, manpower and energy required for the project's completion.

In addition to the on-site physical improvements to be provided by the State, development of the subject property will result in the increased use of public infrastructure as the project achieves build out. This commitment to new infrastructure includes transportation improvements, water, and wastewater collection and treatment, and facilities for public services such as police and fire protection. The financial resources required to support these public improvements may be funded by increased user fees and sales within the proposed visitor/interpretive center.

In addition to the physical resources described, labor and materials which are mostly non-renewable and irretrievable will also be necessary during the construction phase. After project completion, occupancy of the caretaker's residence/State Division of Conservation and Resource Enforcement (DOCARE) office, operation of the visitor/interpretive center, and maintenance of the picnic and botanical garden areas will require use of irrigation systems and petroleum-generated electricity which also represents irretrievable commitments of resources.

The impacts reflected by the commitment of these resources, should be weighed against the positive social benefits that could be derived from the project versus the consequences of either taking no action or pursuing another less beneficial use of the property. Consumption of these resources will be replaced by the creation of new recreation and employment facilities. As such, significant enhancement to existing and future lifestyles will result from the project compared to limited benefits derived from a "no-build" alternative.

### **Conformance to Federal, State, and City Planning Policies**

The proposed project generally conforms to: Federal policies; the Hawai'i State Plan; Chapter 205, HRS; Hawai'i State Functional Plans; Coastal Zone Management Program; Special Management Area; City and County of Honolulu General Plan; Primary Urban Center Development Plan; and City and County of Honolulu Zoning. ~~One exception where the plan does not conform with existing land use regulatory controls is that the height limit of the City and County of Honolulu's Diamond Head Special District will be exceeded.~~ The City and County of Honolulu's Diamond Head Special District calls for 0 feet height limit in the area around the DHSM. The proposed visitor/interpretive center, comfort stations, wetland viewing platform, entry guardhouse (at Makapu'u Avenue) and a people mover booth all will exceed this height limit. It should be noted that current (or recently built) projects (not covered by the Master Plan Update), including a interim interpretive kiosk, and toll booth at the entry to Kāhala Tunnel will also exceed this height limit.

~~The following is a preliminary list of major approvals and permits which may be required for the implementation of the proposed plan.~~

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Permit or Approval	Authority
Environmental Impact Statement (EIS)	Chapter 343, HRS, Governor
Department of Army Permit	U.S. Army Corps of Engineers
Diamond Head Special District Major Permit	Department of Planning and Permitting; Design Advisory Committee
Special Management Area Use Permit	City Council
Well Construction Permit, Pump Installation Permit, and Water Use Permit	Commission on Water Resource Management
Stream Channel Alteration Permit	Commission on Water Resource Management
Water Code Permit	Commission on Water Resource Management

In addition to obtaining the above permits and approvals, all facilities will be designed to meet the Americans with Disabilities Act Accessibility guidelines and the requirements of Section 103-50 of the Hawaii Revised Statutes.

All facilities will be designed to meet the Americans with Disabilities Act Accessibility guidelines and the requirements of Section 103-50 Hawaii Revised Statutes (HRS) except: 1) where compliance would cause substantial harm to cultural, historical, religious, or significant natural features and characteristics; 2) where compliance could substantially alter the nature of the setting or the purpose of the facility, or portion of the facility; 3) where compliance would require construction methods or materials that are prohibited by Federal, State, or local regulations or statutes; 4) where compliance would not be feasible due to terrain or prevailing construction practices.

#### Alternatives to the Proposed Action

In compliance with the provisions of Title 11, Department of Health, Chapter 200, Environmental Impact Statement Rules, Section 11-200-10(6) (7), the following section includes identification and summary of alternatives considered, probable impacts and possible mitigation measures. In accordance with the provisions of the Department of Health, Chapter 200, Environmental Impact Statement Rules, Section 11-200-17(f), the "known feasible" alternatives to the proposed project are limited to those "which could attain the objectives of the action." The alternatives described in this section are limited to those that would allow the objective and policies described in Section 2.2 to be met, while minimizing potential adverse environmental impacts. Those environmental impacts that will occur can be mitigated by appropriate site and architectural design, the installation of appropriate infrastructure improvements, and implementation of the best management practices during project construction. Section 8 includes a discussion of the following alternatives:

- alternatives that do not meet project objectives (described in Section 8.1);
- the "no-action" alternative (described in Section 8.2);

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- alternatives that meet project objectives (project objective and policies described in Sections 2.2), including:
  - the 1979 Diamond Head State Monument Development Plan (described in Section 8.3),
  - alternatives related to different designs or details of the 1979 Development Plan which would present different environmental impacts (Alternative Concept 1 as described in Section 8.4),
  - alternative locations for the proposed project, including:
    - Alternative Concept 2 (described in Section 8.5.1),
    - Alternative Concept 3 (described in Section 8.5.2),
  - actions of a significantly different nature which would provide similar benefits with different environmental impacts (described in Section 8.7).

### **Evaluation of Alternatives and Selection of the Preferred Alternative**

Each of the conceptual plans were evaluated based on the following criteria: existing and proposed uses, availability of existing facilities, interpretive and historical value, architecture, and site limitations, including access, transportation, views, aesthetics, development costs, operational costs and interpretive value. Based on the above criteria, DLNR has selected Alternative Concept 1 as the preferred alternative. A visitor/interpretive center located as shown on Alternative Concept 1 would present the following benefits:

- It is the preferred alternative of the Diamond Head Citizens Advisory Committee.
- This alternative provides the most convenient location for visitors to visit the visitor/ interpretive facility because visitors would easily pass the facility twice when taking the people mover around proposed crater interior loop road.
- As the least sloping of the three sites, this alternative will present the least visual impact (building mass) from the front elevation.
- As the least sloping of the three sites, this site should be the most accessible to persons with disabilities, especially in the outdoor areas.
- This site presents a similar, unobstructed, "frontal" view of the summit of Lē'ahi, as experienced when entering through Kāhala Tunnel.
- This site will be the least likely to be seen as one enters the crater from Kapahulu Tunnel.
- This site is the least expensive to build on because of its flatter topography.
- Due to its proximity to Kāhala Tunnel, where service emergency vehicles will be allowed to enter, operational costs for a facility at this site is likely to be the least expensive. Its flatter topography is also likely to present lower operational costs.
- This site is closest to the wetland, which is proposed to be enhanced as a natural resource and an interpretive feature.

### Relationship Between Local Short-Term Uses of Man's Environment and the Maintenance of Long-Term Productivity

As discussed in this Draft EIS, the project area largely consists of vacant land. Long-term impacts from continuing the current use, have been identified as follows:

- the site would not be managed in an appropriate manner with non-essential vehicles continuing to enter the crater;
- the endangered plant habitats would continue to be stressed by hikers, fires and alien species;
- pedestrians would continue to have unsafe access via Kāhala Tunnel due to minimal walkways;
- visitors would have a limited opportunity to experience present closed off areas within the crater including viewpoints, Tunnel 407, and Battery Harlow;
- view opportunities would be limited to the existing trail and the Kāhala Tunnel lookout;
- the quality of visitor experience would deteriorate because visitors would continue to be limited to the already crowded hiking trail to Lē'ahi Summit, and;
- parking for park visitors would continue to be limited.

Clearly, these existing impacts are considered undesirable compared to the potential for long term more productive use of the property. Retaining the property in its present use (the "No Action" alternative), would present a less than optimum use of the land especially because of its semi-wilderness character in the midst of Urban Honolulu and its proximity visitors staying in Waikīkī. Without implementation of the proposed DHSM Master Plan Update, the natural and historical resources of the crater could continue to deteriorate and it will become a less desirable recreational resource for residents and visitors.

### Summary of Unresolved Issues

As noted in Section 2.5, Phasing and Timing of Action, there are a number of major considerations that will affect phasing of the DHSM Master Plan Update. These external factors are the relocation of State DOD to Barbers Point, the securing of a supply of non-potable groundwater for irrigation, and the acquisition of the Cannon Club. Each on their own may affect the ability to implement certain elements of the proposed update of the Master Plan (at various degrees), and in some cases a combination of these factors could result in the inability to implement a particular element of the plan.

For instance, it is assumed that the State DOD will eventually relocate to Barbers Point, but in the interim, the following elements will probably not be implemented because they would be disruptive to the State DOD operations:

- removing State DOD Buildings 301, 303 and 304;
- renovating and opening up Tunnel 407 and Battery Harlow for interpretive purposes and providing restroom facilities;
- opening a new trail from the retractable searchlight on the southeastern edge of the crater rim to Tunnel 407 (allow access only via guided tours); and
- building a new trail from Tunnel 407 to the summit trail.

The inability of securing an adequate source of non-potable groundwater in the vicinity would probably disallow the implementation of the following proposed Master Plan Update proposals:

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- building a pond near the wetland;
- constructing new picnic areas (in front of the visitor/interpretive facility, on the pistol range, in front of Tunnel 407, and between the Crater Road and Diamond Head Road);
- installing the linear park landscaping along Diamond Head Road; and
- creating a new Nā La'au Arboretum between the Crater Access Road and Diamond Head Road.

The inability of securing the Cannon Club would probably mean that the renovation (or replacement) and utilization of the Cannon Club site for parking, food service and/or visitor orientation and providing restroom facilities will not be implemented. As a result, an alternate crater exterior parking lot will have to be developed.



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**1.0**  
**Introduction**

## 1.0 INTRODUCTION

### 1.1 Proposed Action

In June 1979, the Diamond Head State Monument Planning Report was prepared by the Department of Land and Natural Resources Division of State Parks and the Diamond Head Citizens Advisory Committee (CAC). This Plan was accepted by the Board of Land and Natural Resources in 1979, and subsequently adopted by the Legislature as the official document setting forth the future direction of Diamond Head State Monument (Act 313, SLH 1992).

As part of State law under Chapter 6E-32, Hawai'i Revised Statutes, amendments to the document are allowed by the Board of Land and Natural Resources with the review and recommendations of the CAC, organized in October 1977.

During the past 19 years since the Plan was prepared and portions implemented, visitor use of Diamond Head State Monument has increased significantly (from 41,000 visitors in 1980-1981 to 1,000,000 visitors in 1996-1997), impacting natural resources, park improvements, and county facilities (road, water, and sewage treatment). The Federal Aviation Administration (FAA), United States Department of the Army and State Department of Defense (State DOD) lands identified in the 1979 Plan, are being vacated by the respective agencies. The Office of Hawaiian Affairs (OHA) is also now eligible to receive revenues derived from "ceded" lands.

In 1996, the DLNR recognized the need to address this situation and requested funding for an update of the 1979 Plan. The update is to include the preparation of plans, and designs for the incremental development of the Monument, including a visitor/interpretive center. The 1997 State Legislature appropriated the requested funds. The product will be a Master Plan Update and Environmental Impact Statement and related technical appendices, as may be required for the construction of improvements to include a permanent visitor/interpretive center.

### 1.2 Purpose of Document

This Draft Environmental Impact Statement (EIS) has been prepared by PBR HAWAII for the State Department of Land and Natural Resources (DLNR) for the update to the 1979 Planning Report (Master Plan) for the Diamond Head State Monument. The proposed action calls for the use of State lands and funds which subjects the proposed action to Chapter 343, Hawai'i Revised Statutes (HRS), and Title 11, Chapter 200, Hawai'i Administrative Rules (HAR) of the Department of Health. The DLNR has determined that the proposed action should be addressed in an EIS.

### 1.3 Project Summary

The following summary describes the project location (Figure 1), existing entitlements, and proposed actions:

**Project Name:** Diamond Head State Monument Master Plan Update

**Applicant:** State of Hawai'i, Department of Land Natural Resources

**Land Area (Existing):** Diamond Head State Monument: Approximately 498 acres.  
TMK: 3-1-42: 6\* (303.19 acres), TMK: 3-1-42: 8 (.98 acres),  
TMK: 3-1-42: 10 (2.941 acres), TMK: 3-1-42: 14 (145.323 acres),  
TMK: 3-1-42: 17 (6.465 acres), TMK: 3-1-42: 21 (19.250 acres),  
TMK: 3-1-42: 23 (.23 acres), TMK: 3-1-42: 24 (.23 acres),  
TMK: 3-1-42: 25 (.918 acres), TMK: 3-1-42: 37\*,  
TMK: 3-1-42: 38 (14.71 acres), TMK: 3-1-35: 23 (3.475 acres)  
(Figure 2)  
\*TMK: 3-1-42: 6 and 37 overlap DOD E.O. 1997.

**Executive Orders from DLNR:**

E.O. 2000	TMK: 3-1-35 and TMK: 3-1-42: 14
E.O. 3642	TMK: 3-1-42: 8, 10, 17, 21 and 38
E.O. 3688	TMK: 3-1-42: 6
E.O. 3743	TMK: 3-1-35: 22 and 23

**Proposed Additions:** Parcels to be Added to Diamond Head State Monument  
TMK: 3-1-42: 11 (Cannon Club) (7.88 acres)  
TMK: 3-1-42: 20 por. (Board of Water Supply) (6.703 acres)  
TMK: 3-1-42: 15 (FAA) (3.11 acres)  
TMK: 3-1-42: 16 (FAA) (.29 acres)

**Ceded Lands:** According to the State Land Inventory Report dated September 9, 1993, all of the parcels cited above are ceded, except for the following parcels for which there is no information: TMK 3-1-35: 22 and 23; and TMK: 3-1-42: 15, 16, 23, 24, 25, 37 and 38.

**Existing Use:** 1) State Monument, 2) Hawai'i State Department of Defense (State DOD), 3) Federal Aviation Administration (FAA), and 4) Honolulu Board of Water Supply (BWS)

**Proposed Use:** State Monument with Minor State DOD Facilities (Civil Defense)

**State Land Use District:** Conservation and Urban (Figures 3 and 4)

**Primary Urban Center Development Plan Update:** Preservation, Park, Military, Public Facility and Residential

DIAMOND HEAD STATE MONUMENT MASTER PLAN UPDATE  
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**City and County of Honolulu Zoning:** P-1 Restricted Preservation, F-1 Military and Federal Preservation, R-5 and R-10 Residential, P-2 General Preservation (Figure 5)  
Diamond Head Special Design District (Figure 6)

**Action Requested:** Master Plan Update; Special Management Area Use Permit; and Diamond Head Special District Major Permit

**Accepting Authority:** Governor, State of Hawai'i

**Agencies Consulted:** Diamond Head Citizens Advisory Committee, various Federal, State, and City agencies, and area landowners

\*TMK: 3-1-42: 6 and 37 overlap DOD E.O. 1997.

#### **1.4 Identification of Applicant**

The land owner is the State of Hawai'i and the agency preparing the master plan update and acting as applicant for the applicable entitlements is the Department of Land and Natural Resources. The primary approvals from the State will be approval of an updated project master plan and acceptance of the environmental disclosure documents in accordance with Chapter 343, *Hawai'i Revised Statutes* ("HRS"). A Special Management Area Use Permit approval will also be required from the City and County of Honolulu.

To prepare the project master plan and applicable land use entitlement applications, the Department of Land and Natural Resources (the State's lead agency for the project), has contracted PBR HAWAII to prepare an updated master plan and applicable environmental documents in compliance with Chapter 343, HRS. Therefore, in accordance with Chapter 343, HRS, the Department of Land and Natural Resources is the proposing agency for the project whose mailing address and primary contact person is as follows:

Mr. Andrew Monden  
State of Hawai'i  
Department of Land and Natural Resources  
Land Division  
1151 Punchbowl Street, Room 221  
Honolulu, Hawai'i 96813  
Phone: (808) 587-0230

## **1.5 Identification of Accepting Authority**

In accordance with Subchapter 4, Section 11-200-4, Hawai'i Administrative Rules, "the governor, or an authorized representative, whenever an action proposes the use of state lands or the use of state funds, or, whenever a state agency proposes an action within Section 11-200-6(b)" shall be the final authority to accept an environmental impact statement. Consequently, the Governor will act as the Accepting Authority for the Diamond Head State Monument Master Plan Update Environmental Impact Statement.

## **1.6 Identification of Agencies Consulted**

Consulted agencies or agencies which provided information in the preparation of this Draft Environmental Impact Statement (EIS) include the following:

### **STATE AGENCIES/LEGISLATURE:**

Governor's Office  
Office of Environmental Quality Control (OEQC)  
Office of Hawaiian Affairs  
Department of Agriculture  
Department of Accounting and General Services  
Department of Defense Hawai'i Air National Guard  
Department of Education  
Department of Hawaiian Home Lands  
Department of Health (DOH)  
Department of Land and Natural Resources (DLNR), Division of State Parks  
DLNR Water Commission  
DLNR State Historic Preservation Division  
DLNR Land Division  
DLNR Division of Forestry and Wildlife  
Department of Transportation  
Department of Business, Economic Development and Tourism  
DBEDT Energy, Resources and Technology Division  
DBEDT Office of Planning  
State Land Use Commission  
Department of Defense, State Civil Defense  
Department of Defense, Adjutant General  
Department of Budget and Finance, Information and Communication Services Division  
University of Hawai'i, Environmental Center  
University of Hawai'i, Kapi'olani Community College  
University of Hawai'i Sea Grant  
University of Hawai'i, Water Resources Research Center  
Senator Carol Fukunaga  
Senator Les Ihara, Jr.  
Representative Barbara Marumoto  
Senator Matt Matsunaga  
Representative Brian Yamane

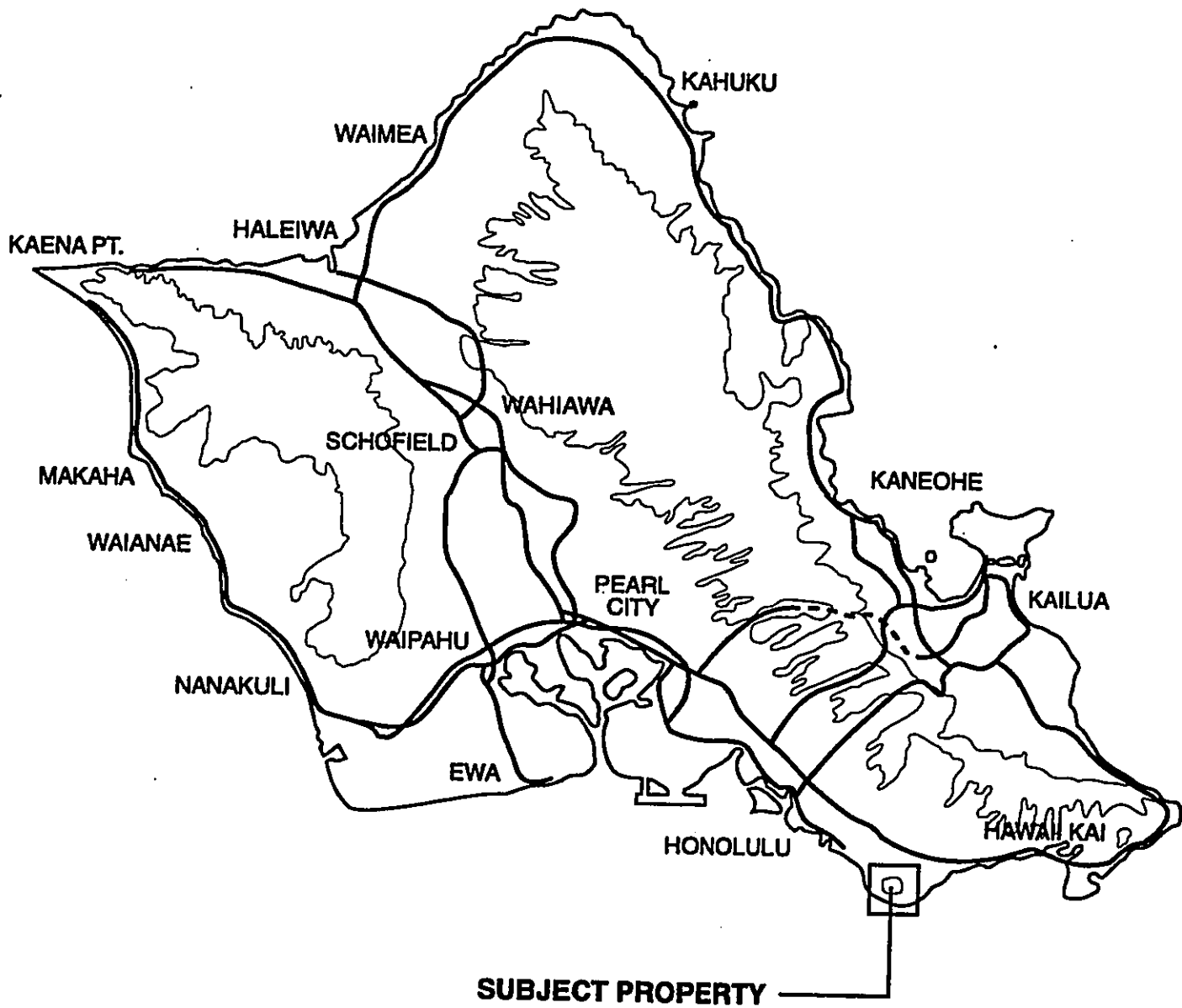


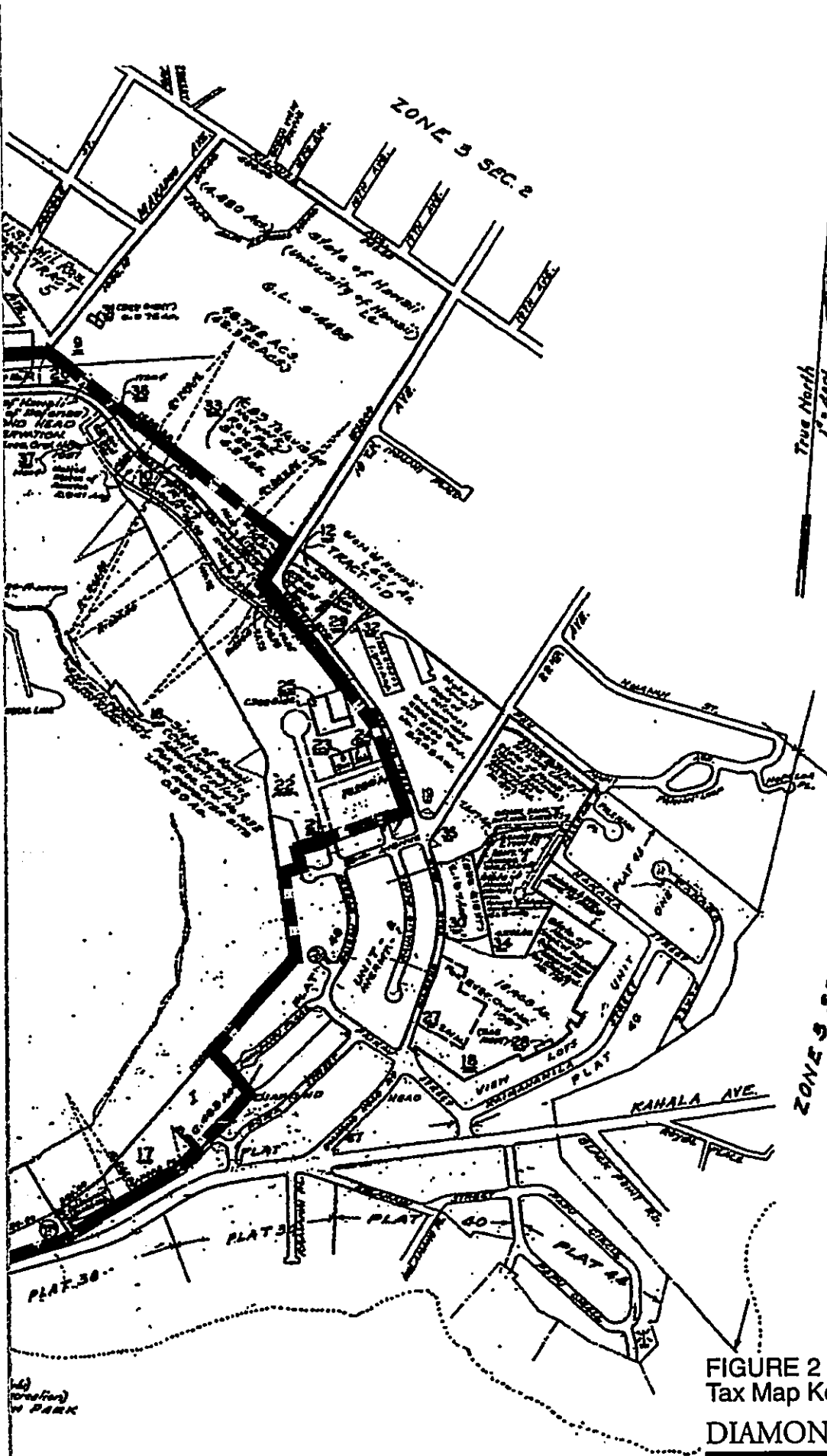
FIGURE 1  
Location Map

**DIAMOND HEAD STATE MONUMENT**



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- 28 State of Hawaii  
(Dept. of Defense)  
DIAMOND HEAD RESERVATION  
Gen. Exec. Ord. No. 1957  
(Veteran Information &  
Referral Service)  
Rev. Plat. 3-3749
- 27 State of Hawaii  
(Dept. of Defense)  
DIAMOND HEAD RESERVATION  
Gen. Exec. Ord. 1957  
(Honolulu Community Theatre)  
Rev. Plat. 3-3753
- 26 State of Hawaii  
(University of Hawaii) Co.  
O.L. 3-4435
- 25 State of Hawaii  
100 AC.
- 23 State of Hawaii  
(Moses Akana Ltd.)  
Rev. Plat. 3-4127  
0.830 Ac.
- 24 State of Hawaii  
(Moses Akana Ltd.)  
Rev. Plat. 3-4128  
0.830 Ac.
- 25 Cash Construction Co.  
1242  
Rev. Plat. 3-4222  
0.910 Ac.
- 28 State of Hawaii  
27074
- 30 State of Hawaii  
Hawaii Association  
for "Retarded Children"  
O.L. 3-4227
- 32 State of Hawaii  
Honolulu Telephone Co. Inc.  
O.L. 3-4224

True North  
1° 45'

ZONE 3 SEC. 3

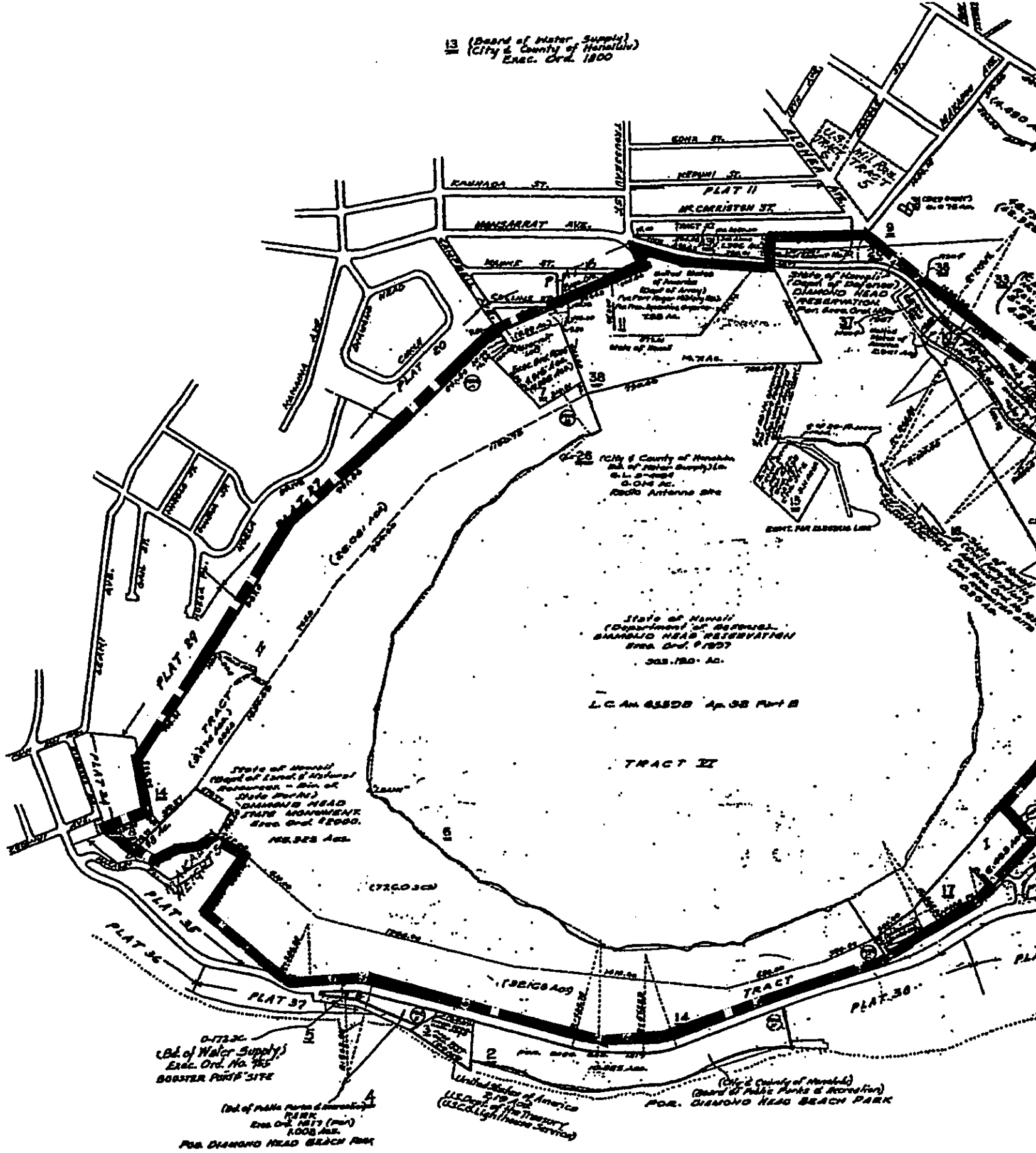
Dropped parcels 1, 22

**FIGURE 2**  
**Tax Map Key 3-1-42**  
**DIAMOND HEAD STATE MONUMENT**

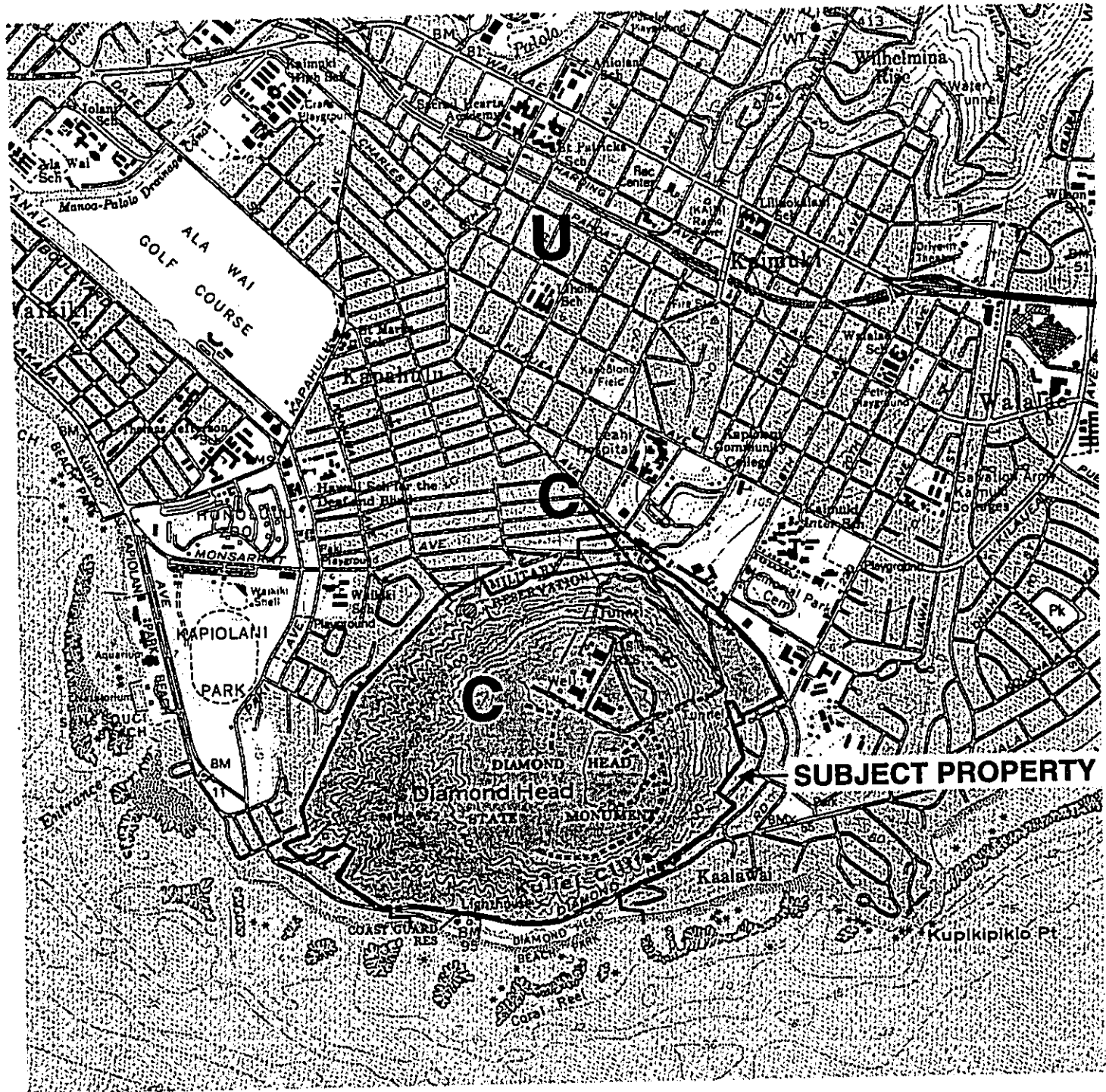




13 (Board of Water Supply)  
(City & County of Honolulu)  
Exec. Ord. 1800



SEA



**LEGEND**

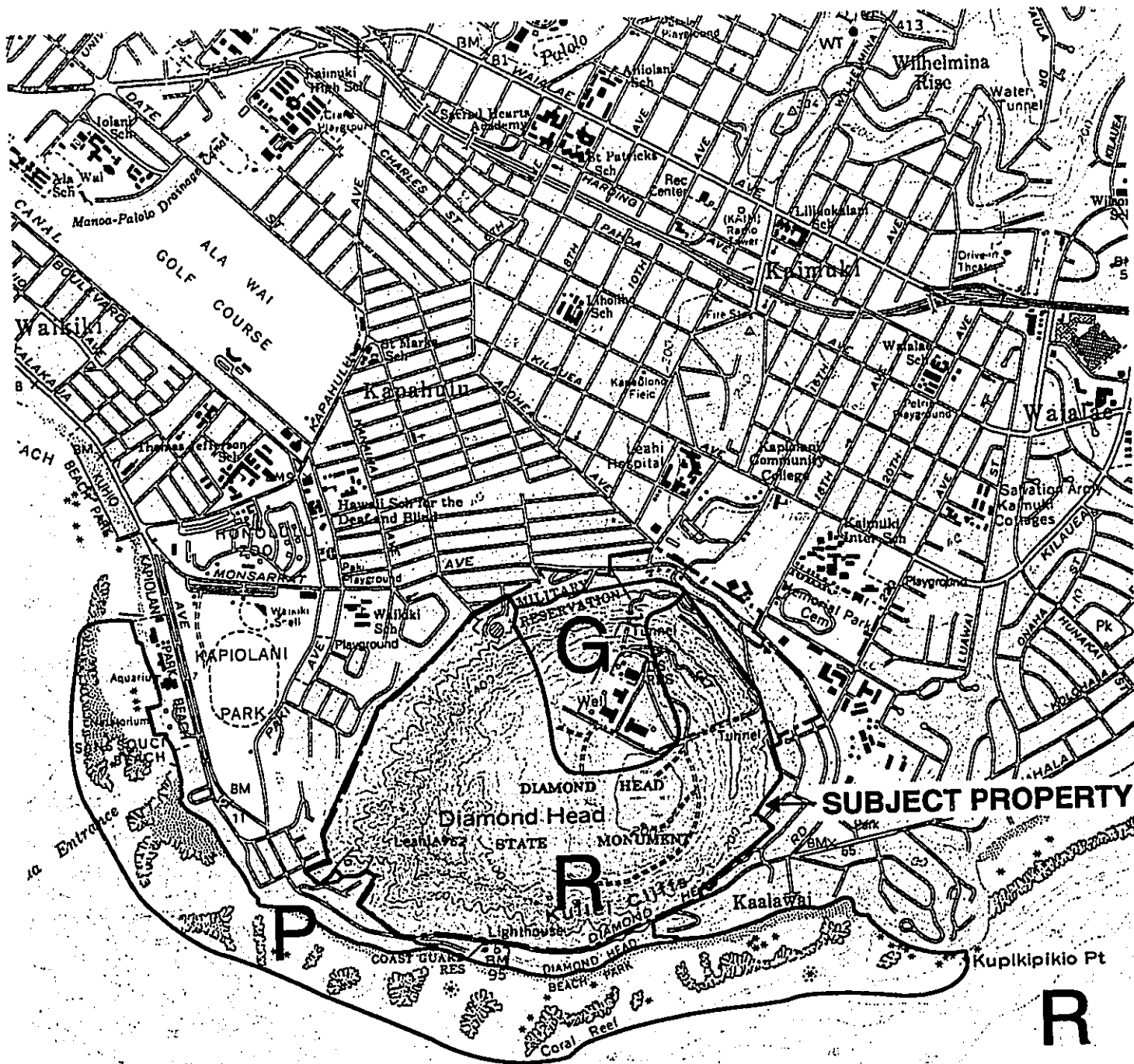
- C CONSERVATION
- U URBAN

**FIGURE 3**  
**State Land Use District Boundary Map**  
**DIAMOND HEAD STATE MONUMENT**



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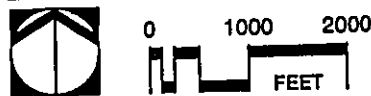




**LEGEND**

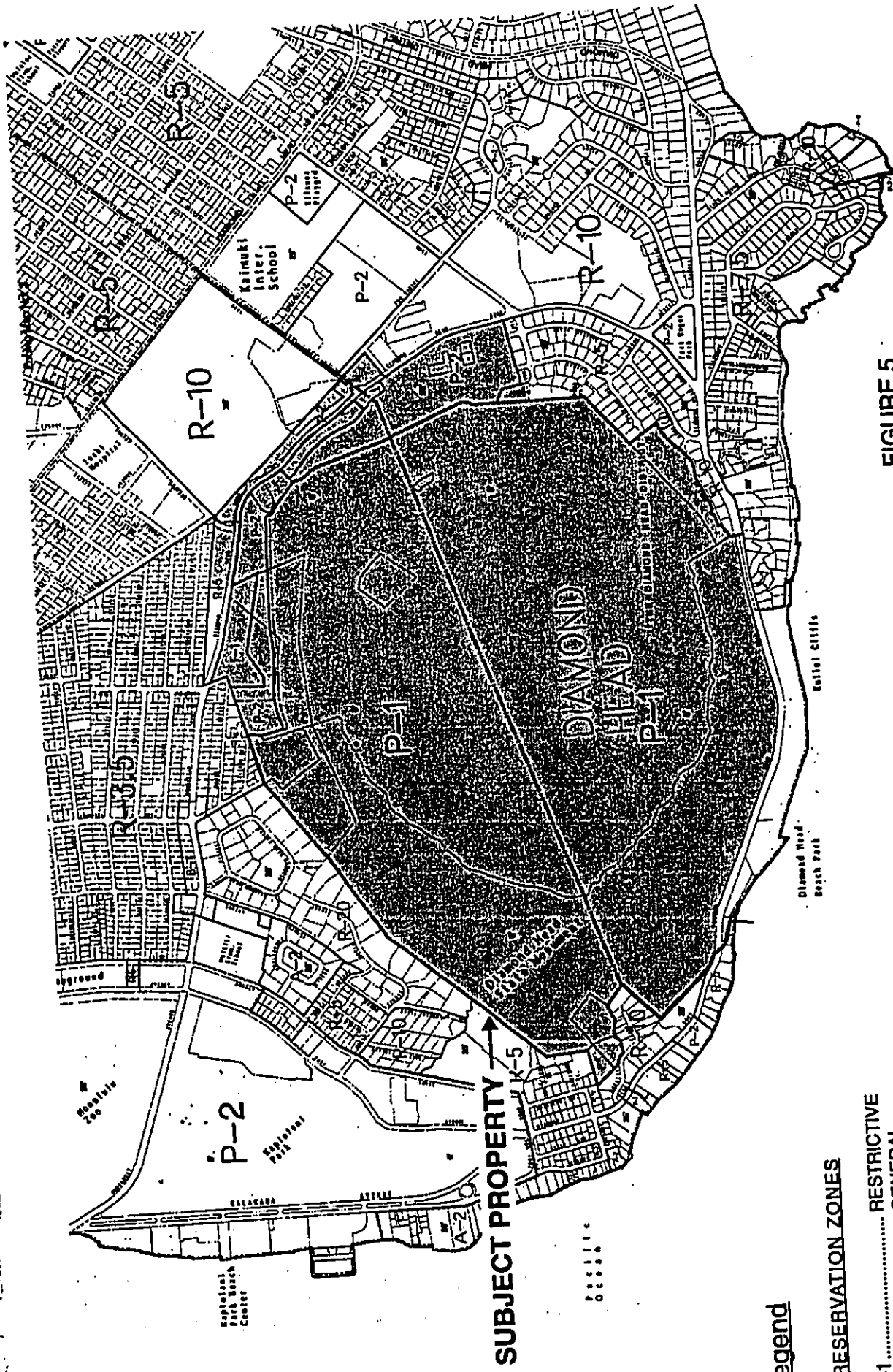
<b>P</b>	PROTECTIVE
<b>R</b>	RESOURCES
<b>L</b>	LIMITED
<b>G</b>	GENERAL

**FIGURE 4**  
**Conservation District Subzones**  
**DIAMOND HEAD STATE MONUMENT**



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**SUBJECT PROPERTY** →

**Legend**

**PRESERVATION ZONES**

- P-1 ..... RESTRICTIVE
- P-2 ..... GENERAL
- F-1 ..... MILITARY AND FEDERAL

**RESIDENTIAL ZONES**

- R-3.5 ..... RESIDENTIAL
- R-7.5 ..... RESIDENTIAL
- R-5 ..... RESIDENTIAL
- R-10 ..... RESIDENTIAL
- R-20 ..... RESIDENTIAL

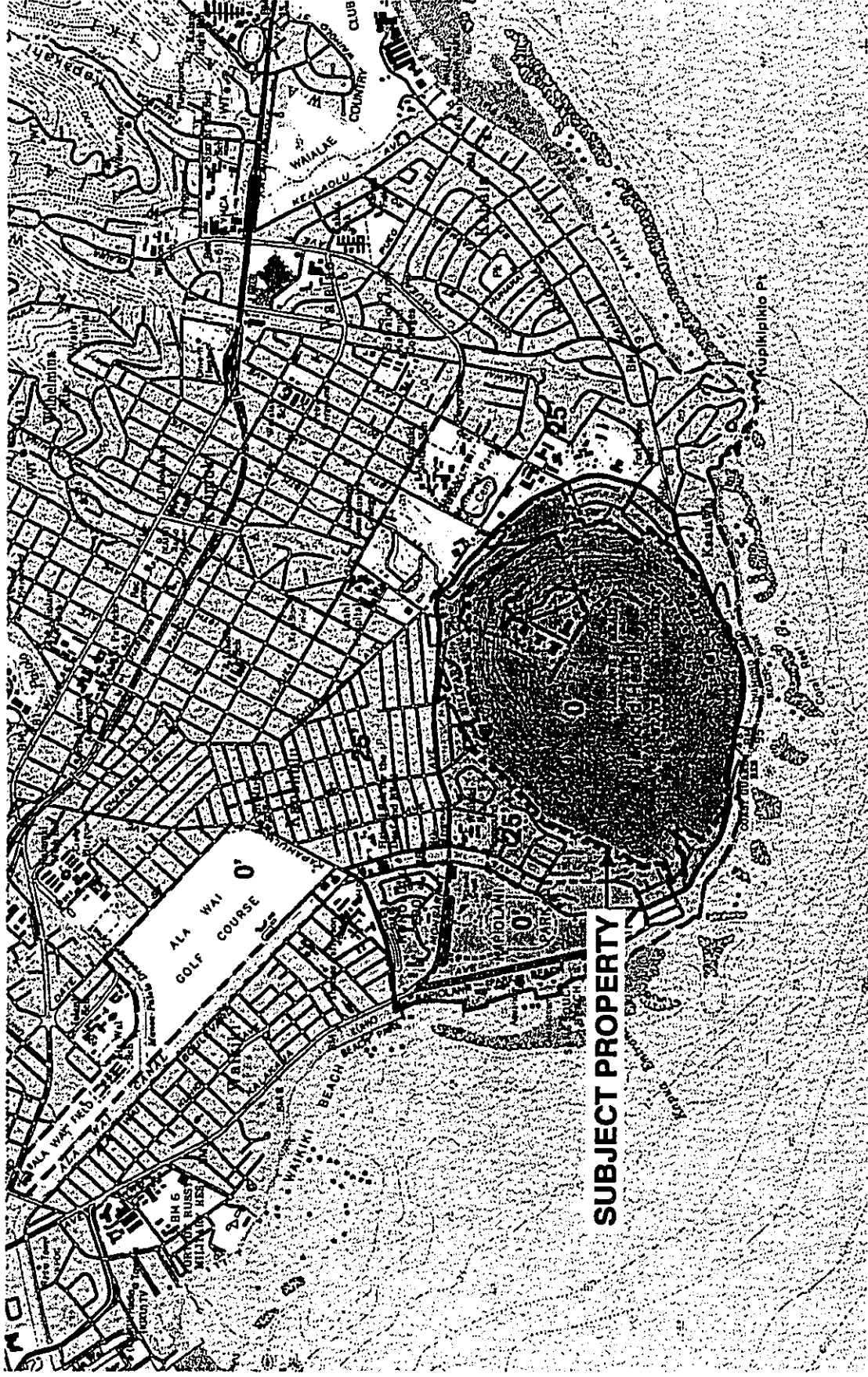
**APARTMENT ZONES**

- A-1 ..... APARTMENT
- A-2 ..... APARTMENT
- A-3 ..... APARTMENT

**FIGURE 5**  
**Zoning Map**  
**DIAMOND HEAD STATE MONUMENT**



October 1988

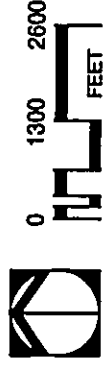


**Legend**

- District Boundary ..... — — —
- Height Limitation ..... : : : 25'
- Core Area ..... [Pattern]

**FIGURE 6**  
Diamond Head Special District

**DIAMOND HEAD STATE MONUMENT**



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**FEDERAL AGENCIES:**

U.S. Department of Agriculture, Natural Resource Conservation Service  
U.S. Army Corps of Engineers  
U.S. Fish and Wildlife Service  
U.S. Geological Survey  
U.S. Department of Transportation, Federal Aviation Administration  
U.S. National Park Service  
U.S. Senator Daniel K. Inouye  
U.S. Senator Daniel K. Akaka  
U.S. Representative Neil Abercrombie

**CITY AND COUNTY OF HONOLULU:**

Board of Water Supply  
Department of Planning and Permitting  
Department of Parks and Recreation Services  
Department of Facility Maintenance  
Department of Transportation Services  
Planning Department  
Police Department  
Honolulu Fire Department  
Department of Design and Construction  
Department of Environmental Services  
Council member Duke Bainum

**NON-GOVERNMENTAL:**

Diamond Head Citizens Advisory Committee  
Wai'alaie-Kāhala Neighborhood Board #3  
Diamond Head/Kapahulu/St. Louis Heights Neighborhood Board #5  
Hawaiian Electric Company, Inc.  
GTE Hawaiian Tel  
Save Diamond Head Association  
Historic Hawai'i Foundation  
The Outdoor Circle  
Kapi'olani Park Preservation Society  
American Institute of Architects  
Sierra Club  
Kāhala Community Association  
Hawai'i's Thousand Friends  
East Diamond Head Community Association  
West Diamond Head Association

**1.7 Location and Background**

Diamond Head, also known as Lē'ahi, lies on the southern coastline of O'ahu, approximately one and a half miles south of the slopes of the Ko'olau range (Figure 1). To the northwest are residences,

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Kapi'olani Park, the Honolulu Zoo and Waikīki (Figure 7). To the north are the Cannon Club, Kapi'olani Community College and the residential areas of Kapahulu and Kaimukī. To the east is the residential area of Kāhala. To the south is Diamond Head Road and Diamond Head Beach Park.

Diamond Head is a prominent feature to Honolulu's landscape, and Hawaiian traditions and historical accounts paint Lē'ahi as a backdrop to numerous social, political, and religious events. One of Kamehameha's main *luakini heiau*, Papa'ena'ena, was situated at the base of the southwest slopes; another *heiau* Pahu-a-Māui stood on the crater's southern cliffs overlooking the ocean (near the site of the present Diamond Head lighthouse).

The earlier Hawaiian use of the crater is not well documented but can be illustrated by the recounting of historical events and legends and references to the historical sites recorded on the outer slopes of the crater. Lē'ahi is the Hawaiian name for the crater and this name has been translated one of two ways:

- The resemblance of the crater profile to the forehead (*lae*) of the tuna (*'ahi*), or
- A "wreath of fire" (*lei ahi*) or "fire headland" (*lae ahi*) referring to the practice of keeping a fire burning on the summit of the crater to guide canoes traveling offshore.

In legends, the fire goddess Pele is associated with Lē'ahi. After being driven off her home island of Hawai'i by her jealous older sister, Pele and her younger sister Hi'iaka traveled from the northern island of Kaua'i to the south. Volcanic eruptions marked their presence on each of the islands. On O'ahu, their presence is noted in Salt Lake and Lē'ahi but when the sea put out the fires at Lē'ahi, they moved on to Moloka'i, then to Haleakalā on Maui, and finally to Mauna Kea, Mauna Loa, and Kīlauea on the island of Hawai'i where they continue to live.

There are few historical accounts relating to the use of the interior crater. But the few descriptions suggest that it was a location for important cultural and strategic uses. In any regard, it is apparent that the interior of the crater was continuously utilized throughout the 19th and 20th centuries.

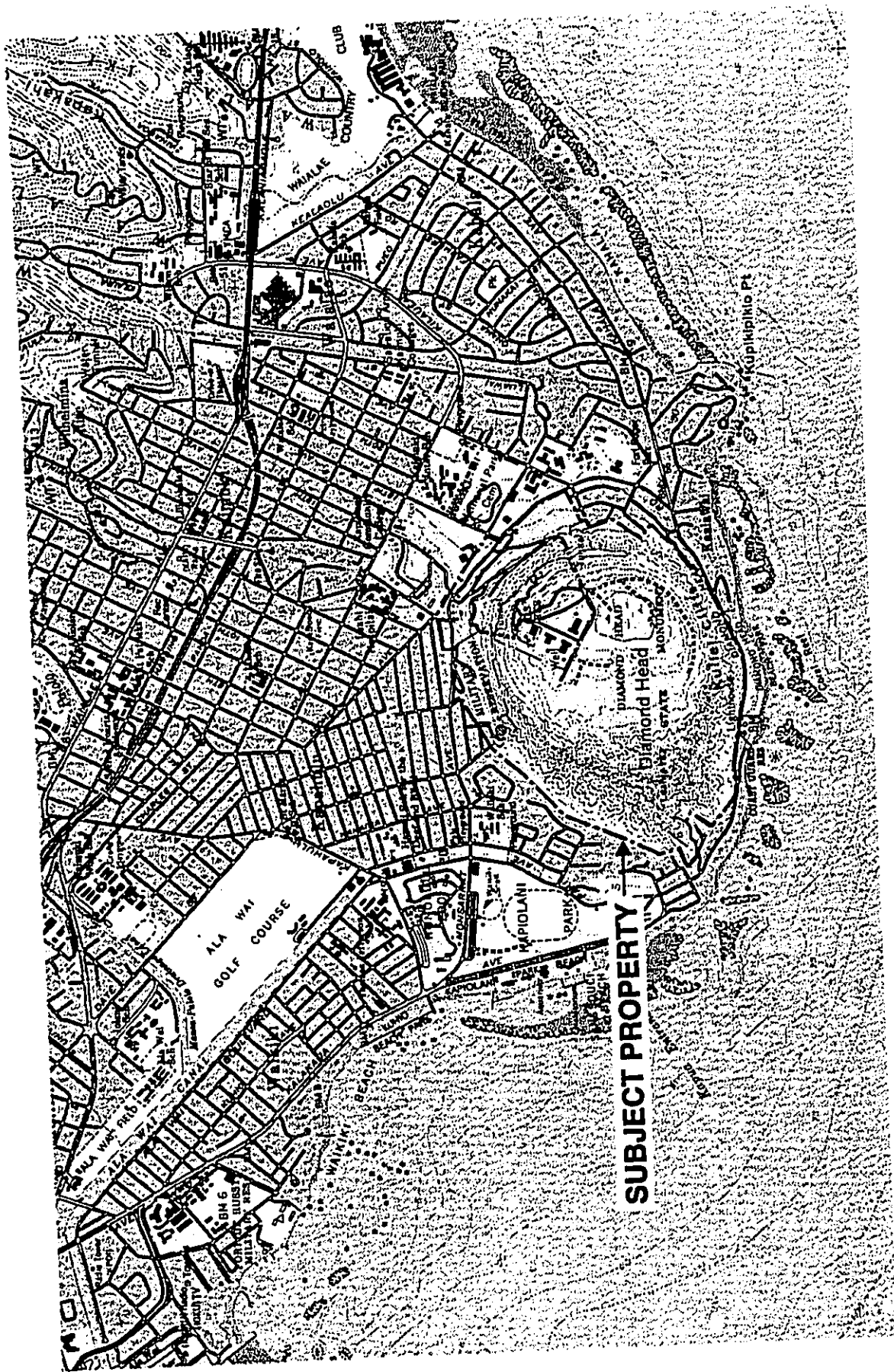
Some reports indicate that cattle, horses, axis deer, goats, and pigs grazed and foraged about the crater, and that people tended gardens in the crater as late as 1822. In 1831, the botanist, Dr. F. J. F. Meyen, noted the crater contained a small pool of water "which was completely covered with plants" (Pultz and Jackson 1981).<sup>1</sup>

Diamond Head was the site of a brief military skirmish in 1895. As part of an effort to restore Queen Lili'uokalani to the throne, Hawaiian rebels hid a cache of weapons inside the crater, but their plot was uncovered and officers of the Republic shelled the area, forcing the surrender of the rebels.

The summit of Lē'ahi, at 761 feet above sea level, affords an excellent and unobstructed view of the ocean from Koko Head in the east, to beyond the 'Ewa Plain to Wai'anae in the west. The quality of

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<sup>1</sup>The Crater pond was filled in by military bulldozing activities, but on rare occasions standing water can be seen there today.



**FIGURE 7**  
 Vicinity Map  
**DIAMOND HEAD STATE MONUMENT**

0 1300 2600  
 FEET  
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this vantage point and its location in proximity to Honolulu Harbor and Pearl Harbor beyond that made Diamond Head the obvious ground from which to observe naval activities and protect O'ahu's shoreline.

The utility of Diamond Head did not go unnoticed by the U.S. Army. In 1905, Secretary of War William Howard Taft visited Honolulu, and then recommended to the National Coast Defense Board that the harbor's defenses be strongly improved. In 1906, the U.S. government acquired 729 acres, including all of Diamond Head and various areas outside the crater, to create Fort Ruger Military Reservation, named after Major General Thomas H. Ruger, who served in the Civil War.

District Engineer of the Army Corps of Engineers, Captain Curtis W. Otwell, saw to the construction of a mortar battery in 1908. Battery Harlow, located on the northern flat outside the crater, was the first structure built at the newly designated fort. Construction was completed in 1910 and Battery Harlow became part of Hawai'i's first coastal defense system, the Artillery District of Honolulu, consisting of additional batteries and gun emplacements at Forts Ruger, Kamehameha, DeRussy, and Armstrong.

Fort Ruger Military Reservation was the only coastal defense structure manned until 1913, and it served as the headquarters for the Coast Defense of O'ahu until 1921.

Completed in 1911, the fire control station at Lē'ahi was the core of O'ahu's coastal defense. The view to the ocean from Battery Harlow was blocked by the protective slopes of Diamond Head and thus, the battery commander could not spot enemy vessels at sea. To solve this problem, Major E. Eveleth Winslow, Otwell's successor as District Engineer of the Army Corps of Engineers, designed a lookout and fire control station to be constructed at the remote location on the summit of Lē'ahi. A tunnel, located near Battery Harlow, was driven through the crater wall to exit just north of the modern FAA parcel. This small tunnel was later widened and is currently called Kapahulu Tunnel. Through this passage, materials for the control station were transported on a mule-powered rail line and then hauled by trail from the tunnel to the base of the escarpment below the peak. A winch and cable system lifted materials and supplies to a mid-way point on a trail to the peak. After a series of switchbacks up a ravine, a 225-foot tunnel equipped with ceiling railings to carry materials, and two staircases, were cut through to the south face of Diamond Head. This became the entrance to the lowest level of the four-leveled fire control station. This design is considered by many to be unique and highly sophisticated for that era.

The first two floors of the fire control station served Batteries Randolph and Dudley at Ft. DeRussy, located on the Waikīkī Plain to the west. The third level was dedicated to fire control for Fort Ruger and the top level was the battle commander's station. The crest of Lē'ahi above the battle commander's station housed an emergency observation post for Battery Harlow. The rest of the command station was excavated within the wall of the crater. The exposed portions of the structure were concealed with boulders embedded into a concrete facade and various other camouflaging methods.

In 1914, construction of inland defenses began, in response to growing American suspicion of its residents of Japanese descent and fears of Japanese aggression like that seen at German-held possessions in the western Pacific; the Alien Land Law passed in California forbidding immigrants to own land was also thought to be a possible provocation of war. On the rim of the crater, Batteries Hulings and Dodge each contained two 4.7-inch guns to protect the Wai'alae and Kāhala regions to the east. An additional six rapid-fire 6-pounder guns pointed in the same direction were emplaced on the crater rim and a road

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connected all components of the complex. Battery Birkhimer, with a 360 degree field of fire with four 12-inch mortars, was situated on the crater floor; the cannons were too large to be taken through the existing tunnel and were carried over the crater wall. Some researchers mention a ramp or possibly a graded road that was constructed to transport these guns; C. Hosokawa of the Division of State Parks suggests some of the grooves in the hillside behind Battery Birkhimer might be evidence of sliding the cannons into place; Thompson simply states that "the mortars had to be hauled over the rim of the crater, the tunnel being too narrow to admit them." Also completed in 1916 were two 5-inch guns on pedestal mounts at Battery S.C. Mills on Black Point. Virtually all fortifications at Fort Ruger were completed by 1916.

On December 7, 1941, the Japanese attacked Pearl Harbor. In the aftermath of the attack, Hawai'i shifted to a state of continuous emergency. Coastal defenses were built up, including Battery 407 on the southern face of Diamond Head; this was one of four permanent batteries for 8-inch guns that were installed in the early years of the war. Troops poured into the islands en route to the western Pacific, and hundreds of soldiers were housed in barracks built on the crater floor.

After the war, in 1950, parts of the crater were turned over to the State DOD, at which time the artillery was dismantled. Also in 1950, George C. Munro began a xerophytic garden on a 9-acre tract on the southwest exterior slopes of the crater. This garden was gradually enlarged to over 100 acres, and by the late 1960's, abandoned and allowed to revert to its natural state.

In 1958, the FAA acquired their current parcel of land and construction of the main FAA building was completed in 1961 (C. Hosokawa 1997). Demolition of obsolete Fort Ruger buildings in the crater occurred throughout the 1950s and 1960s.

In 1965, Legislative Act 249 (SLH 1965) designated Diamond Head State Monument as an historic site and charged the Department of Land and Natural Resources with managing 77 acres.

In 1968, Diamond Head was designated as a National Natural Landmark and the boundaries were extended by the Board of Land and Natural Resources to 415 acres (E.O. 2000). At about the same time (1969), Diamond Head was included in a Preservation District under the City and County of Honolulu Comprehensive Zoning Code.

In 1975, the Diamond Head Historic, Cultural and Scenic District No. 2 was established by the City and County of Honolulu. Shortly thereafter, in 1975, Diamond Head State Monument was included under the State's Historic Preservation Law (Act 182, SLH 1975).

Currently, there are nearly 500 acres of land within Diamond Head State Monument covered under Executive Order No. 2000, dated April 9, 1962, No. 3642, dated February 2, 1995 and No. 3688, dated May 3, 1996. Executive Order No. 3688 overlaps Executive Order No. 1997, which is under the State Department of Defense. Executive Order No. 3743, dated August 13, 1998 added TMK: 3-1-35: 22 and 23. Of lands identified for inclusion into the Monument, the following remain to be incorporated:

1. Approximately 2 acres of land currently used as a State Parks Baseyard along Diamond Head Road as identified as TMK: 3-1-42, portion of parcel 20.

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2. Approximately 3.4 acres of land currently used by the FAA within the Crater identified as TMK: 3-1-42, parcels 15 and 16.
3. Approximately 7.0 acres of land comprising the Cannon Club as used by the U.S. Army and identified as TMK: 3-1-42, parcel 11.

Today, many structures and facilities house the operations of the State DOD and the FAA. Scattered around the rim of the crater are bunkers, gun emplacements, tunnels, antennas and other structures which reflect the current and historical governmental uses of the crater (Figure 8).

### 1.8 Description of the Property

Diamond Head is a nearly circular crater of approximately two-thirds of a mile in diameter and is bounded by Diamond Head Road and Monsarrat Avenue. The Diamond Head State Monument consists of the following TMKs: TMK: 3-1-42: 6, 8, 10, 14, 17, 21, 23, 24, 25, 36, 37, and 38, and TMK: 3-1-35: 22 and 23. Parcels to be added to the Diamond Head State Monument include: TMK: 3-1-42: 11 (Cannon Club) (Figure 2), TMK 3-1-42:15 (FAA), and TMK 3-1-42:16 (FAA), TMK 3-1-42:20 (por.). All of the crater is in government use.

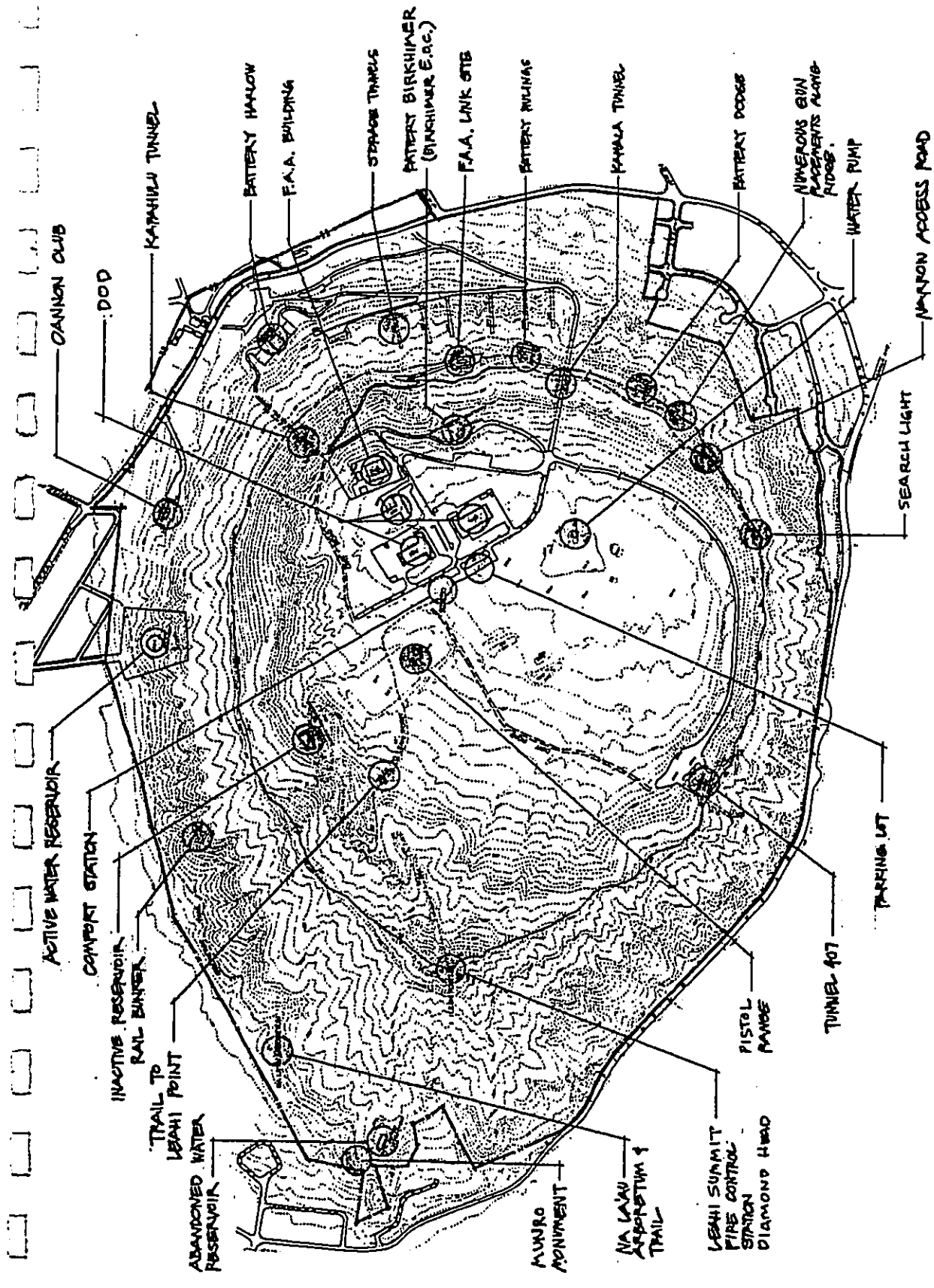
### 1.9 Surrounding Land Uses

The project is located within the Primary Urban Center of Honolulu, surrounded primarily by single family residential land uses. Kapi'olani Park, a major urban regional park, is located just west of Diamond Head Crater. Along the southern edge of the crater, Diamond Head Beach Park and the U.S. Coast Guard Lighthouse lie on the opposite side of Diamond Head Road. Along the northeastern edge of the crater, on the opposite side of Diamond Head Road, is Kapi'olani Community College, Kaimuki Intermediate School, and Diamond Head Memorial Park.

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**FIGURE 8**  
 Physical Conditions  
**DIAMOND HEAD STATE MONUMENT**



NOT TO SCALE

October 1998



**2.0**  
**Description of the Project**

## 2.0 DESCRIPTION OF THE PROJECT

### 2.1 Background

In 1977, in accordance with executive and legislative directives, the Diamond Head State Monument Master Plan was initiated to plan, define, and develop the proposed enlarged Diamond Head State Monument. An interim plan and alternative recreational development proposals were presented for public review in August and September 1977. The conceptual plan alternatives were reviewed by the public at six public meetings and three additional community association presentations. On October 14, 1977, the recommendations were presented to the Board of Land and Natural Resources, which decided that a task force would be established to work out an acceptable long-range plan. This resulted in the formation of the Citizens Advisory Committee in October 1977 to help develop the final plan.

The Citizens Advisory Committee was comprised of a broad range of citizens representing many diverse elements of the community. The 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. The CAC's role was also continued to coordinate all future planning and development of the Monument and environs.

The following Development Plan represents the culmination and consensus of that process which lead to the adoption of the Diamond Head State Monument Plan of 1979.

#### 1979 Plan Objective

The objective of the final plan, as determined by the Diamond Head Citizen's Advisory Committee, was stated as:

*"The establishment of a semi-wild interior park and development of an exterior park for family picnic outings."*

#### 1979 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 State Comprehensive Outdoor Recreation Plan (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 DLNR 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 DLNR 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 DLNR, 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.

#### **1978 Final Conceptual Plan**

After considering a number of conceptual schemes, a Final Conceptual Plan was designed and approved by the CAC in June 1978. The plan restores the interior of the crater to an essentially semi-wild state, with reforested areas, an extensive wildland, and meadowlands. Public access would be through two tunnels, but the short length of the road will do little more than connect them and lead to the interpretive center, restrooms, and parking area all concentrated between the tunnels.

#### **1979 Development Plan Description (Figure 9)**

This development plan unanimously approved by the Diamond Head CAC, reflects a modified "wilderness" area with various uses consonant with the land uses envisioned by the Conceptual Plan. The following summarizes the key elements of the 1979 Development Plan:

##### *Entry*

The main entry would be across the street from Diamond Head Road entry to Kapi'olani Community College. Those entering the crater by vehicles would enter through Kapahulu Tunnel.

##### *Tunnels*

The two major tunnels that access the crater would not be physically altered. Traffic circulation would be one-way with entry into the crater via the Kapahulu Tunnel and exit through the Kāhala Tunnel where a pedestrian walkway was also planned. The existing parking and scenic overlook outside the crater adjacent to the Kāhala Tunnel would be improved to handle the "anticipated influx of visitors to the area."



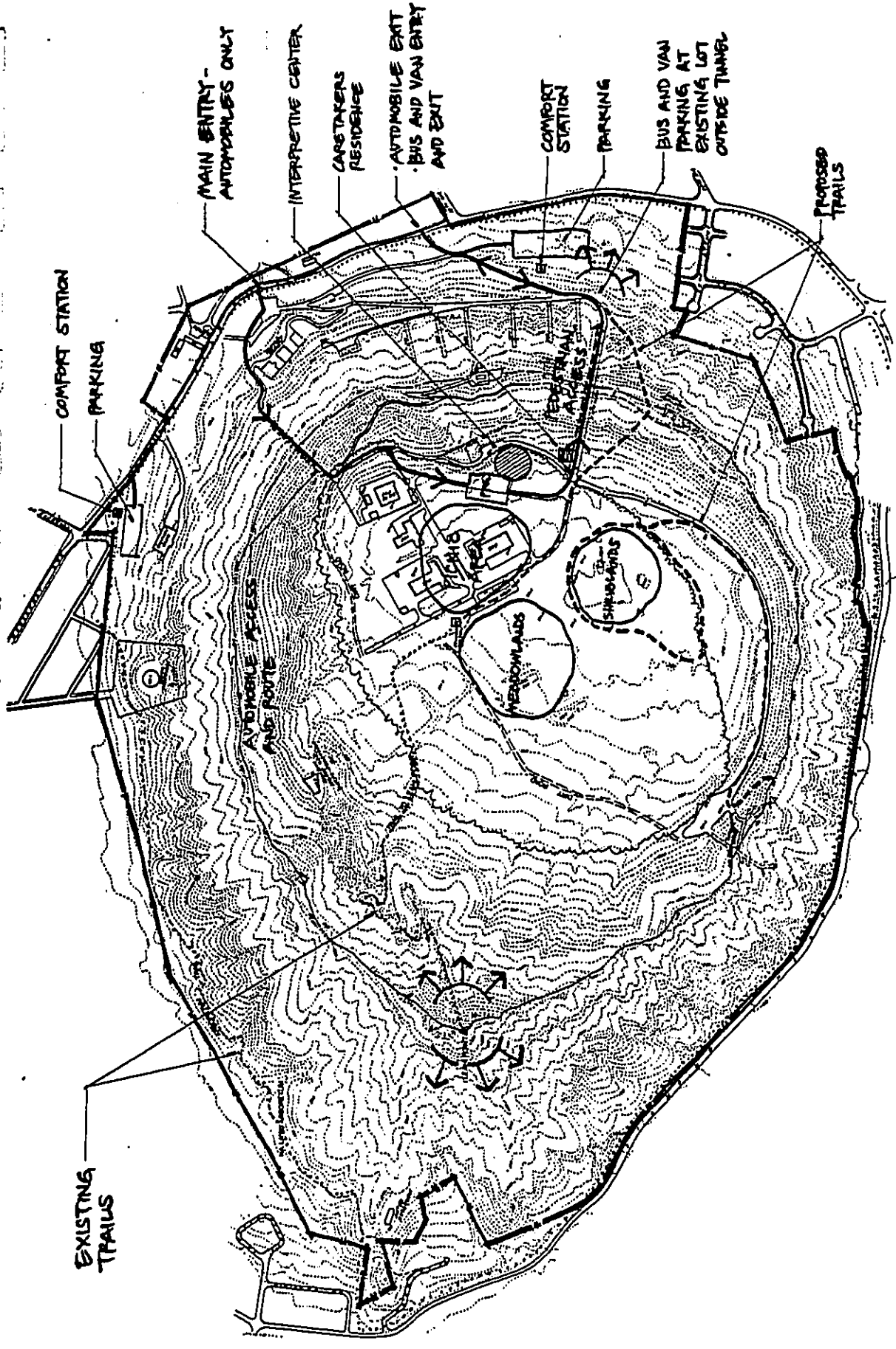


FIGURE 9  
1979 Plan

DIAMOND HEAD STATE MONUMENT



NOT TO SCALE

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### *Interior Roadways and Parking*

The paved roadway network within the Monument would be limited to corridors required for public access and to mostly existing roads through the area currently restricted only to State DOD and FAA personnel. The road from Kapahulu Tunnel would be one-way only to Kāhala Tunnel or vice versa. While the 1979 Development Plan only shows the parking lot below Battery Birkhimer, the text describes parking being limited to a few designated parking lots with planned overflows for events on the landscaped open areas.

### *Interpretive Center*

The proposed interpretive center would be located between the two tunnel entrances inside the crater. Its design would also reflect a rustic character to integrate into the surrounding natural wilderness concept. The structure would also be designed to reveal the panoramic outdoor scene for interpretive and fire watch security purposes. Access to the Center would be provided by the lower parking area (which is the existing parking lot below Battery Birkhimer). The present service road to Birkhimer Emergency Operations Center (EOC) would be used for handicapped access. Although no interpretive program had been developed, the Plan did recommend that any interpretive program stress the geology, historical use, and interesting flora of the crater.

### *Parking*

The 1979 Development Plan showed parking below the site of the proposed interpretive center, with additional parking at the Cannon Club and outside of Kāhala Tunnel. Presumably, the first choice for visitors would be to park near the interpretive center or in a second overflow lot outside of the Kāhala Tunnel (which would require walking in through the tunnel). If these two parking lots were full or otherwise not available, parking at the Cannon Club would be the third alternative.

### *Caretaker Residence*

To facilitate 24-hour security, a caretaker structure was planned to be unobtrusively located proximate to the proposed Interpretive Center.

### *Comfort Stations*

Sanitary facilities would be provided as minimal support for the daily public use of the Monument. Shown on the 1979 Development Plan were facilities located at the Cannon Club, the existing comfort station location and another at the proposed parking lot below the Kāhala Tunnel. Portable chemical lavatories would supplement the permanent facilities for large events and usage requiring additional facilities.

### *Exterior Picnic Area*

Exterior picnic facilities (site undetermined) were also planned to be geared for large gatherings in areas accessible by automobile. According to the 1979 Development Plan, with careful management, picnic areas outside the crater could be utilized 24 hours a day.

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### *Interior Picnic Areas*

As stated in the Plan Objective, family picnics were envisioned as a primary use for the crater. A wooded open space across the road from the Interpretive Center was recommended to serve as a low-density picnic site for visitors and hikers, and as a walk-in site for day users. This area would be designed to integrate facilities into the natural surroundings without introducing a fire hazard. No cooking facilities would be provided and a stone wall would be built as a firebreak.

### *Dryland Habitat*

The proposed dryland habitat element of the Plan, covered essentially the entire interior of the crater. Natural environmental characteristics would establish distinctive zones consisting of the (1) existing *kiawe* forest (to remain intact), (2) dry-lake area (wetland) labeled as "shrubland" on the 1979 Development Plan, (3) meadowlands (existing lawn area), and (4) reforested area. The reforested area would consist of small-tree vegetation reflecting the natural ecosystems for this area. Design of facilities would be just enough to satisfy the basic recreational potential of the area. Service roads, firebreaks, and other fire-control devices would be unobtrusively implemented into the design.

### *Upper Slopes*

This element of the plan addressed primarily Lē'ahi Summit. As a major hiker destination, a closely monitored management program was recommended because of nearby plants and hazardous cliffs. The observation point would need to be refurbished while still maintaining a low profile and rustic character.

### *Trail System*

Two separate trail systems (interior and exterior) were planned to address different needs and purposes. The exterior trail system would have a dual function as a jogging and bicycle path traversing the *mauka* end of the Monument and along the existing trail on the lower 'Ewa-*makai* slopes. Several access points would be required for neighborhood linkages and security. The trail width would be sufficient to accommodate emergency vehicles.

The interior trail system was limited to the existing trail to the summit of Lē'ahi; a new trail around the proposed shrubland (wetland) which would continue on the road to Tunnel 407 and from there to the crater rim; and a new trail starting from outside Kāhala Tunnel over the crater rim to the other side of the tunnel. Only trail access to reach panoramic view sites along the crest and Lē'ahi Summit lookout would be available. The upper slopes with crumbly footing and sparse vegetation, and endangered plants in the area were determined to justify limited access.

### *Landscaping*

- Reforestation and replanting of major areas with hardy, maintenance-free plants to present a rustic natural setting.
- Selected natural areas would be established to ensure the survival of native and endangered plants and their habitats.

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- Areas with high use would be landscaped and maintained as park areas.

*Linear Parkway*

Diamond Head Road would be landscaped with trees, grass, and shrubbery. All overhead utility lines and poles would be eliminated.

*Project Nursery and Maintenance Yard*

This element would be designed to propagate and establish dryland native plants for the Monument. Once the reforestation is completed, the yard would be moved from a temporary facility outside the crater.

## 2.2 Project Objective and Policies

### Objective

The objective of the final plan for Diamond Head State Monument 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 Diamond Head State Monument Plan as developed by the Diamond Head Citizens Advisory Committee and adopted by the Board of Land and Natural Resources in 1979, and subsequently enacted into law by the Hawai'i State Legislature in 1992. The objectives and policies were reviewed and portions of the policies were amended and approved by the Diamond Head CAC on November 16, 1995, but were not formally adopted by the Board of Land and Natural Resources. The amended Plan Policies (November 16, 1995) are stated below.

### Policies

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

1. *That all recreational development be directed toward passive, unstructured activities that require minimal development of the crater site. Such development would be limited to an improved trail system and scenic viewing areas, reforestation and natural landscaping with adequate water supply, picnic areas and meadowlands, and a visitor's interpretive center. Visual impacts and crater view planes are to be given priority consideration in location, design and landscaping.*
2. *That any proposed deviation from the adopted Plan for areas within Diamond Head State monument will require an approved Environmental Assessment and Negative Declaration or a full Environmental Impact Statement in accordance with Chapter 343, HRS.*
3. *That no new permanent buildings or structures be constructed within the Diamond Head State Monument unless required for public health, sanitation, or safety of Park users, or for the maintenance and management support of the Monument in accordance with Section 6E-32, HRS, as amended by Act 313, Session Laws of Hawai'i 1992.*

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4. *That large gatherings and any commercial use not be allowed, and that any use which may detrimentally affect the natural crater environment of Diamond Head State Monument be prohibited, including non-regulated vendors and non-profit activities.*
5. *That DLNR acquire all available, unused and surplus Federal lands adjoining or within the Diamond Head State Monument and secure the phase-out of state and Federal Department of Defense and Federal Aviation Administration operations and demolition of their structures within the Monument.*
6. *That no civilian aircraft be permitted to fly less than 2,000 feet over the Diamond Head State Monument or land anywhere within the Monument, and that no mechanical device create a noise or dust nuisance or endanger people within the Diamond Head State Monument semi-wilderness crater park.*
7. *That all agencies with land fronting Diamond Head Road be urged to coordinate their beautification efforts and that safety features be provided for pedestrian and non-motorized transportation around the crater on Diamond Head Road and within the Monument.*
8. *That landscape design, irrigation, installation and maintenance be implemented in full accordance with the "Recommended Guidelines for Landscape Treatment of the Diamond Head Area" as adopted by DLNR in 1982 per Appendix I attached hereto.*
9. *That minimal and uniform signage graphics be provided on an ongoing basis, and that such graphics be designed and made to the highest standards suitable to natural park conditions to meet the needs of the Monument Park for safety, information, ecology, history and goals of the Park.*

### **2.3 Need for the Project**

Act 287, SLH 1997 appropriated funds for the following purposes "plans and design for the incremental development as determined by existing needs and a Master Plan, development to include a Visitor Center." It should be noted that since 1979, according to DLNR, the estimated visitor population at the crater has grown from 41,000 (1980-1981) to approximately 1,000,000 (1996-1997). In addition, amendments to the plan policies by the CAC in 1995 were never formally adopted by BLNR. For these reasons, an update of the 1979 Plan is being considered.

### **2.4 Key Elements of the Master Plan**

In 1998, as part of the Diamond Head Master Plan Update process, a number of alternatives were developed for consideration by the Diamond Head Citizen's Advisory Committee. The CAC narrowed the sites being considered for the visitor/interpretive facility to three locations within the crater and on August 27, 1998 voted unanimously to recommend the siting of the visitor/interpretive facility to the area between the Kāhala Tunnel and Battery Birkhimer. Subsequently, DLNR has concurred with the CAC and has selected the Kāhala Tunnel/Battery Birkhimer site as the location for the proposed

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visitor/interpretive center. Based on these decisions, the preferred alternative (Alternative Concept 1) was then revised to create the Preliminary Master Plan (Figure 10).

The Preliminary Master Plan (Figure 10) is similar to the 1979 Development Plan, as many of the major elements of the 1979 plan have also been incorporated into this proposal. For example, common elements include:

- entry through Kapahulu Tunnel;
- exit through Kāhala Tunnel;
- a permanent visitor/interpretive facility near Battery Birkhimer;
- a caretaker's residence (or DOCARE office);
- removing the FAA CERAP Building;
- removing ~~State~~ DOD Buildings 301, 303 and 304;
- improvements to the wetland;
- proposed trail around the wetland; and
- proposed picnic area.

As such, this proposal should be considered as an update to 1979 plan rather than a completely new master plan. In the face of a significant increase of visitors to the crater since 1979, the following proposal would reinforce these common elements by:

- in the long-term, moving visitor parking to the outside of the crater;
- establishing a motorized people mover system, when visitor parking is kept to the exterior;
- utilizing the Cannon Club site for food service and/or visitor orientation and providing restroom facilities;
- opening up Tunnel 407 and Battery Harlow for interpretive purposes and providing restroom facilities;
- keeping the existing comfort station and parking lot and providing additional facilities as necessary;
- accommodating pedestrian access through Kapahulu Tunnel;
- controlling visitor access into sensitive areas (such as the crater rim);
- protecting the *Schidea adamantis* habitat, and the habitat of other native species;
- ~~continuing eco-system restoration work at Battery Harlow by the Hawaii Army National Guard;~~
- opening the road/trail from the FAA Link Site to the retractable searchlight on the southeastern edge of the crater rim;
- opening a new trail from the retractable searchlight on the southeastern edge of the crater rim to Tunnel 407;
- utilizing Battery Dodge and the gun emplacements along the eastern edge of the crater as lookouts;
- providing open spaces within the crater for picnicking and community activities;
- opening a new trail to the flat top reservoir north of the existing trail to the summit;
- adding comfort stations at the exterior parking facility, at secondary interpretive facilities, and picnic areas;
- providing an area for outdoor seating at one of the proposed picnic areas;
- installing a wastewater lift station; and

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- removing the overhead utility lines between Battery Birkhimer and the crater rim and relocating them to the aboveground conduits to the Link Site (once FAA has relocated).

The elements of this proposal are shown on the Preliminary Master Plan (Figure 10) and are described below. ~~In general, to minimize criminal activity in the area, during the design phase of future improvements, the District / Community Policing Team of the City and County of Honolulu Police Department should be consulted.~~

#### *Entry*

In the short term, entry would continue through Kāhala Tunnel. Eventually, if the number of vehicles within the crater was determined to be adversely affecting the visual, noise and air quality, visitor parking could be relocated to the exterior of the crater. If the Cannon Club can be acquired, then the existing parking lot at the Cannon Club can be utilized as the visitor parking facility. The main entry to the crater, then, would be at the Cannon Club, with a new road built from the Cannon Club to Battery Harlow. The existing Canon Club building would either be renovated or replaced to provide an orientation center. If the Cannon Club cannot be acquired, then the main entry would be opposite Makapu'u Avenue with parking on the southwest side of the Diamond Head Road/Makapu'u Avenue intersection.

#### *Tunnels*

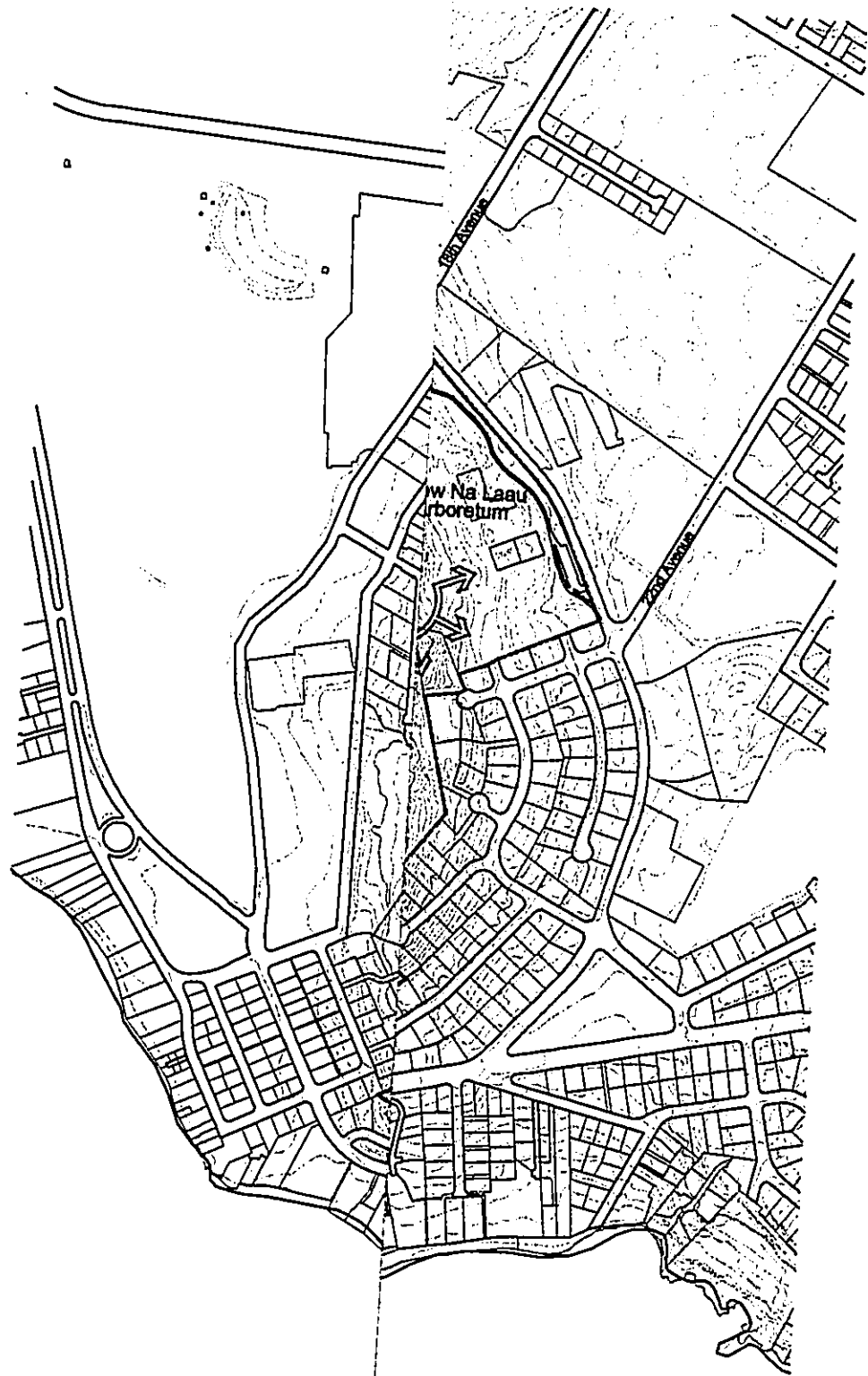
The two major tunnels that access the crater would not be physically altered. Traffic circulation would be one-way with entry into the crater via the Kapahulu Tunnel and exit through the Kāhala Tunnel (except for Birkhimer EOC employees, emergency vehicles and service vehicles). Both tunnels would accommodate pedestrian access. The existing parking and scenic overlook outside the crater adjacent to the Kāhala Tunnel would continue to be used. Specifying one-way traffic through the tunnels will allow the striping of a single lane in the middle of both tunnels for vehicular traffic and narrower "lanes" on either side for pedestrians.

#### *Interior Roadways and Parking*

The paved roadway network within the Monument would be mostly limited to corridors required for public access and to mostly existing roads through the area currently restricted only to State DOD and FAA personnel. Using existing roadways, a loop road would be completed within the crater interior, with new segments built along the west side from Tunnel 407 to Kapahulu Tunnel. A new road will also be built between the existing FAA building to Kāhala Tunnel below Battery Birkhimer. All traffic on this loop road would be one-way in a clock-wise direction allowing for minimal roadway width and pavement.

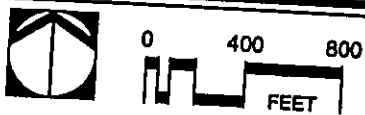
#### *Visitor/Interpretive Center*

The proposed visitor/interpretive center would be located between the two tunnel entrances inside the crater near Battery Birkhimer (Figure 11). The visitor/interpretive center will be approximately 10,000 square feet (SF) with area set aside for a maximum expansion of 5,000 SF. Its design would be designed to be compatible with the site and integrate into the crater surroundings, minimizing the physical and



- Legend**
- Views
  - Major Interpretive Feature
  - Minor Interpretive Feature
  - People Mover Route

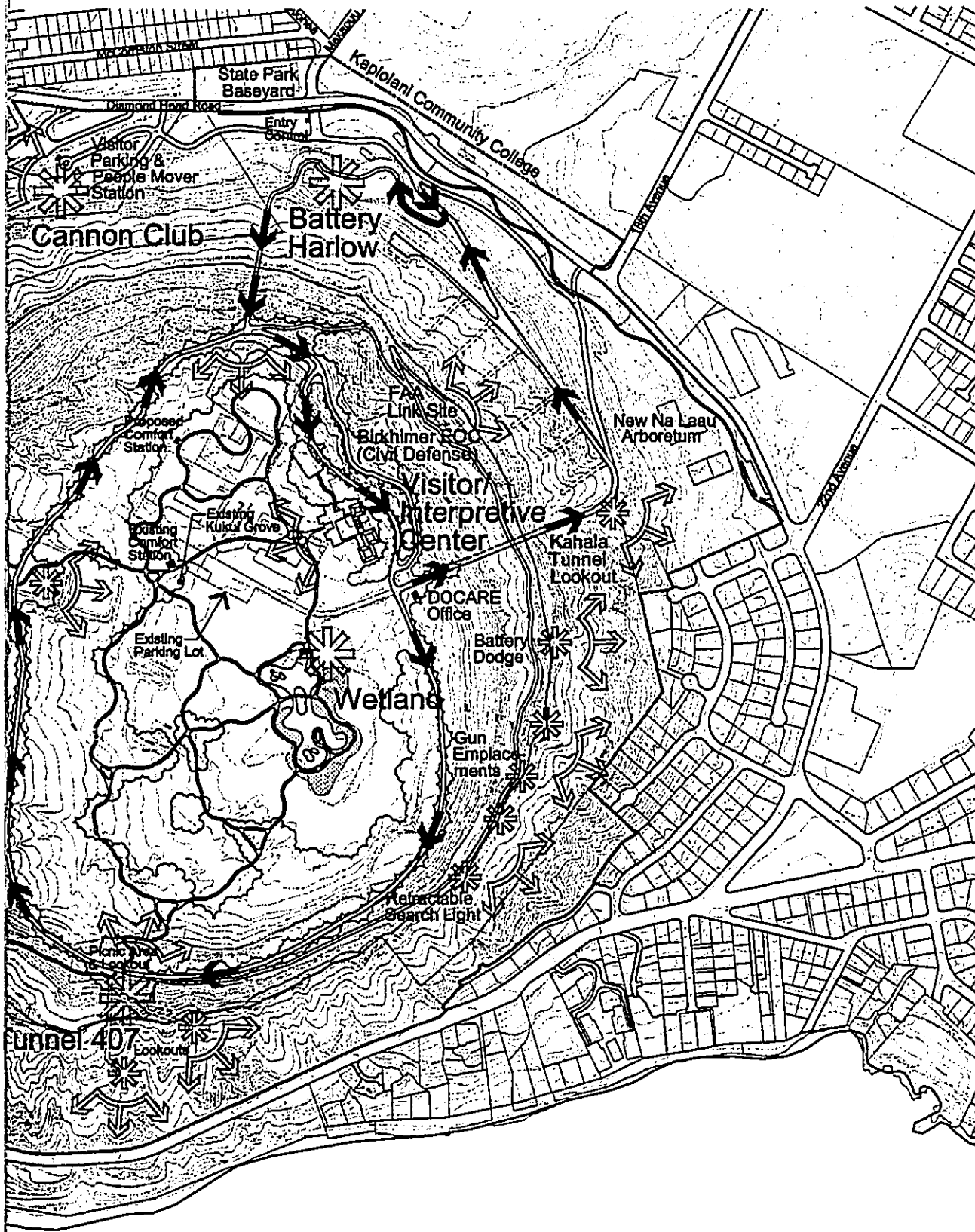
**FIGURE 10**  
**Preliminary Master Plan**  
**DIAMOND HEAD STATE MONUMENT**





# CORRECTION

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



**FIGURE 10**  
**Preliminary Master Plan**  
**DIAMOND HEAD STATE MONUMENT**



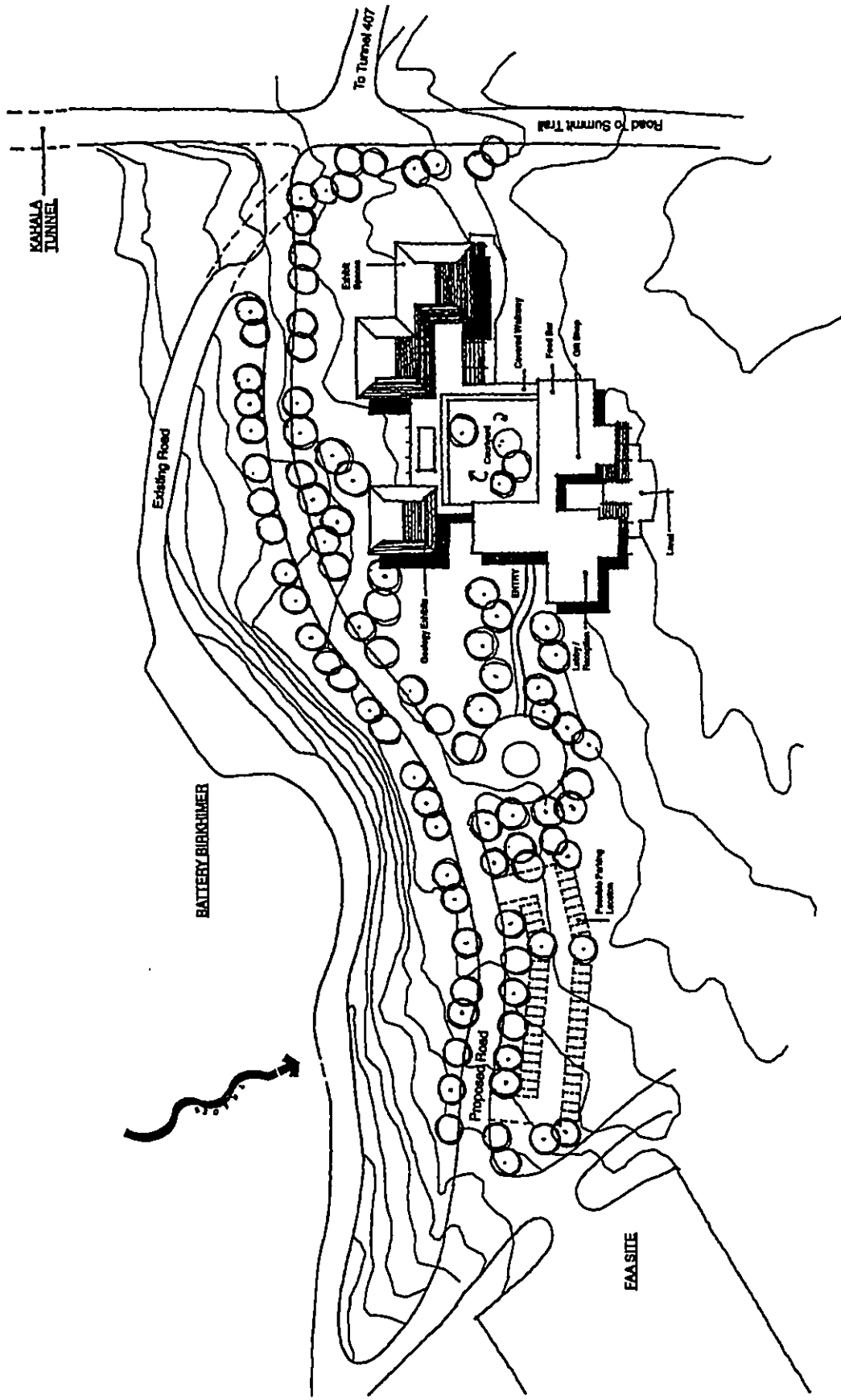
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**Legend**

- |  |                            |  |                       |
|--|----------------------------|--|-----------------------|
|  | Views                      |  | Pedestrian Path/Trail |
|  | Major Interpretive Feature |  | Crater Rim            |
|  | Minor Interpretive Feature |  | Wetland               |
|  | People Mover Route         |  |                       |



**FIGURE 11**  
 Visitor / Interpretive Center  
 Conceptual Site Plan

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visual impact on the crater. The structure would also be designed to reveal the panoramic outdoor scene for interpretive purposes. The center will be one-story above grade except where below grade basements may be required). There will be plentiful outdoor spaces around and between the parts of the facility for gathering, queuing and outdoor interpretive displays. Access to the Center would be from a new road from the FAA CERAP Building. The existing service road to Birkhimer EOC would not be used to access the Center.

*Parking and People Mover*

In the interim, parking would be provided at the existing parking lot near the comfort station and at the various State DOD parking lots as these facilities are phased out. Parking for the visitor/interpretive center would be located near the facility, without obstructing views of Lē'ahi from the Center. As previously mentioned, when it is decided to move visitor parking to the crater exterior, the first choice would be to utilize the existing entry and parking at the Cannon Club. If the Cannon Club cannot be acquired, then a new parking lot could be built near the Makapu'u Avenue/Diamond head Road intersection. When an exterior parking lot is in place, for those who cannot or who do not desire to walk into the crater, a small, motorized "people mover," similar to the one used at Hale Koa Hotel in Waikīkī could be provided. Once a visitor reaches the north side of the crater exterior, he or she has the option of walking into the crater via Kāhala or Kapahulu Tunnels, or to pay a fee to board the people mover. The people mover will start from the parking lot (Cannon Club or near the Makapu'u Avenue/Diamond Head Road intersection) and make a stop at Battery Harlow. The people mover will then enter the crater via Kapahulu Tunnel (which affords a higher vantage point than Kāhala Tunnel) and exit Kāhala Tunnel.

*Caretaker Residence*

To facilitate 24-hour security, a caretaker residence or State Division of Conservation and Resource Enforcement (DOCARE) office is planned to be unobtrusively located inside the crater next to the Kāhala Tunnel.

*Comfort Stations*

Sanitary facilities would include the existing comfort station, restrooms at the proposed permanent visitor/interpretive facility, at the exterior parking facility (either at the Cannon Club or below Battery Harlow), at secondary interpretive facilities (such as Battery Harlow, Tunnel 407 and the Cannon Club), and picnic areas.

*Exterior Picnic Area*

Exterior picnic facilities are proposed in the area between the Kāhala Tunnel Lookout and 22nd Avenue (Figure 12).

*Interior Picnic Areas*

As stated in the Plan Objective, family picnics are envisioned as a primary use for the crater. When the FAA CERAP Building and State DOD Buildings 301, 303 and 304 are removed, an open space across the road from the visitor/interpretive center is recommended to serve as a "low-density" picnic site for

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visitors and hikers (Figure 12). This site would also include an area for outdoor seating. Other new picnic sites are proposed near Tunnel 407, the FAA site, and on the upper Pistol Range (Figure 12). These areas would be designed to integrate facilities into the natural surroundings without introducing a fire hazard. No cooking facilities would be provided. Each picnic area would have either stand-alone comfort stations or nearby restroom facilities. One of the areas would be developed with more open space for community activities.

#### *Crater Floor*

The portion of the crater floor not occupied by the picnic area is proposed for the establishment of a native dryland forest and the enhancement of the existing wetland (Figure 12). Trails, fire roads, firebreaks, and other fire-control devices would be unobtrusively incorporated into the design of the crater floor landscaping.

#### *Upper Slopes*

Generally, the upper slopes would be off-limits to hikers, except for the summit of Lē'ahi, where there is an observation area. The observation point area is in need of renovation and needs to be refurbished while still maintaining a low profile and rustic character. This would be especially true in the area of Making the upper slopes off-limit to hikers except of the refurbished observation area at the summit of Lē'ahi would aid in protecting the *Schidea adamantis* habitat.

#### *Trail System*

Unlike the 1979 Plan, no exterior trail system is proposed from Mākālei Place to the Cannon Club because of security concerns raised by area residents. The master plan update, however, proposes a greater separated multi-purpose bike/pedestrian way along the northwestern edge of the crater along Diamond Head Road (Figure 12).

Other than at Lē'ahi Summit, hikers would not be allowed to hike on the crater rim. Instead, former military facilities along the east rim of the crater will be made more accessible by: opening the road/trail from the FAA Link Site to the retractable searchlight on the southeastern edge of the crater rim; opening a new trail from the retractable searchlight on the southeastern edge of the crater rim to Tunnel 407; and utilizing Battery Dodge and the gun emplacements along the eastern edge of the crater as lookouts. The master plan update also includes opening a new trail to the flat top reservoir north of the existing trail to the summit.

#### *Landscaping (Figure 12)*

The flora of Diamond Head crater consists primarily of alien species representing a coastal dryland plant community. The crater slopes and floor are dominated by *kiawe* trees (*Prosopis pallida*) and *koa haole* shrubs (*Leucaena glauca*) with an understory of lantana (*Lantana camara*), *ilima* (*Sida fallax*) and alien grasses (California grass, buffel grass, sour grass, and fountain grass). The existing vegetation has led to the decline of the native wetland flora, presenting an increased fire hazard within the crater.



FIGURE 12  
 Conceptual Landscape Plan  
 DIAMOND HEAD STATE MONUMENT






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**Legend**

-  Pedestrian Path/Trail
-  Crater Rim
-  Wetland



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Currently an on-going ecosystem restoration is taking place at two sites: 1) Battery Harlow by Hawaii Army National Guard Environmental (HIARN - ENV) personnel, and 2) at the Peace Gardens by Youth for Environmental Service. Thousands of native dryland coastal plants have been planted at these sites over the past three years and are being maintained by staff and volunteer working groups.

The following concept for the landscape of the crater is planned.

It is proposed that a coastal dry mixed community typical of O'ahu's south shore flora in the mid to late 19th century be developed within the crater. Such a landscape would have an important ethnobotanical interpretive value and grant DHSM visitors a picture of O'ahu's landscape of that era. This landscape could be designed to take advantage of and retain desirable existing *kiawe* trees, coupled with the planting of drought tolerant native plant species, i.e. endemic, indigenous and Polynesian introduced plant material.

A series of plant community and maintenance zones will be identified in their relationship to the Visitor/Interpretive Center. It is intended that the areas furthest from the Visitor/Interpretive Center, and within the proposed internal loop road, be kept in a semi-wild, minimally maintained state. Existing *koa haole*, lantana and alien grasses should be eradicated and removed after all native plant species have been identified, marked and protected. For example, it is important to remove alien grass around patches of two native grasslands *'emoloa* (*Eragrostis variabilis*) and *kākonakona* (*Panicum torridum*) and throughout *pili* grass stands, and to eliminate alien *Bidens pilosa* and *cynapifolia* around native *Bidens* locations. Existing *kiawe* trees should be tagged for either demolition or to remain (*kiawe* trees specified to remain would be characterized as having an attractive, shade producing canopy). A semi-permanent, underground drip or flood bubbler irrigation system would be installed to serve the existing and proposed trees and shrubs, while a temporary irrigation system would be used to establish grasses and groundcovers. With an understanding of the level of landscape maintenance involved, the crater floor would be primarily grassland with scattered growths of native trees and shrubs.

More intensely maintained landscape areas would include a demonstration garden picnic areas, shaded seating areas, people mover stops, restroom facilities and trailheads. These would have a permanent, underground irrigation system.

In the immediate vicinity of the Visitor/Interpretive Center, a permanent irrigation system could be installed, with maintained turf areas. This landscape, while drought tolerant, could be more intensively planted for the purpose of educating the visitor. The character of the landscaping at the Visitor/Interpretive Center should be 1) natural (incorporating native, rare and endangered plants endemic to Diamond Head) depending on the review and approval of agencies such as the State Division of Forestry and Wildlife and the U.S. Fish and Wildlife Service; 2) informal; 3) compatible with the surrounding vegetation; 4) respectful of the character of the DHSM; and 5) contain lawn, walkways and shade trees.

The existing and proposed wetlands have the potential of being an exciting botanical study area. Two options are possible. One would include the restoration of the natural hydrology of the existing wetland by eliminating pumping of standing water after heavy rains, controlling alien weeds, replanting with native plant species, and controlling predators (e.g., cats, mongoose) that prey on endangered waterbirds.

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Allowing for the natural expansion of the wetland following heavy rains may require the realignment or elimination of adjacent existing trails and roads that are prone to repeated flooding.

The other option is to delineate the boundaries of the existing wetland and to identify and protect endangered plants. In addition, a lined pond of approximately 2 acres (to double as storage for irrigation water) could be installed, surrounded by a detention basin that will serve as the new drainage feature for the crater interior. This option is contingent on the availability of a source of non-potable groundwater to keep the pond permanently filled. This pond would be very attractive to endangered waterbirds and, if designed with islands, provide protection for the waterbirds from predators. This option may include a surrounding walkway (ADA accessible) and small shelter(s) for viewing and interpretive purposes.

Outside of the crater, in the area between the Kāhala Tunnel and Diamond Head Road is an open area that had previously been proposed for the construction of a private tennis facility. This site is readily accessible to the surrounding community and to Kapi'olani Community College. It is proposed that this area be developed as the new Nā La'au Arboretum. The existing Nā La'au Arboretum, located outside the crater below the Lē'ahi Summit, is inaccessible and has suffered neglect over many years. At a more accessible site, nearby residents and Kapi'olani Community College students could implement and provide maintenance for a master planned ethnobotanical garden, using the "blueprint" of the original Nā La'au Arboretum. A copy of the Munro Monument could be placed in this location.

General concepts for the landscape include: restoration of native flora, fire control in sensitive areas, access and maintenance.

**Restoration of Native Flora.** Actions include agency resources and volunteer groups to replant large areas with appropriate native species that were historically present. While care is taken to reestablish pre-existing native plant communities, near buildings and roads, plants from outside communities, e.g., beach *naupaka*, might be selected. Care should be taken that any native plants (particularly endangered species) brought into the crater from the outside are from as genetically similar stock as possible to the plants already there. In general, this translates into using only plants from nearby areas (or at least from O'ahu) where populations are not likely to have undergone significant genetic divergence from Diamond Head populations.

**Fire Control in Sensitive Areas.** Actions include constructing firebreaks, planting fire resistant (and preferably native) plant species, weed control, and prohibition of smoking in the DHSM. This will also require restricting access to formal trails and roads.

Living fire breaks could be developed with fire-resistant plants. The experimental technology would consist of planting dry-adapted native plants in hedge rows, approximately 1 meter in width by 100 meters in length. Selective drip irrigation would enable rapid native plant growth. In the event of fire, these fire-retardant plants could potentially: 1) slow the path of the burn, or 2) prevent the fire from "leaping" beyond the fire breaks themselves. Areas that contain fire-adapted grasses should be seeded with *Dodonea viscosa* (a. a. lii), which will likely replace the existing grasses.

**Access.** The proposed internal crater loop road will be for people movers and bicycles only. This road will be one-way and should be only wide enough for one-way traffic and to support maintenance and

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emergency vehicles. More paths should be constructed within the crater floor and these should be designed to general hiking trail standards. The paths through picnic areas and around the wetland should be designed to be ADA-accessible. Outside the crater, bicycles should not be allowed on any paths or trails other than the multi-use pedestrian bike path proposed along Diamond Head Road.

**Maintenance.** The majority of the landscape should be designed to be low maintenance, i.e. *pili* with scattered trees. Provisions should also be made to ensure that re-planted areas will be irrigated and maintained, since it is unlikely that the restored habitats will ever be completely self-supporting and maintenance-free.

*Linear Parkway*

Diamond Head Road would be landscaped with trees, grass, and shrubbery (Figure 12). All overhead utility lines and poles would be placed underground.

*Maintenance Yard*

The maintenance yard would continue to be located at its present location.

## 2.5 Phasing and Timing of Action

While the actual schedule for implementation is subject to the availability of funding, there are a number of major considerations that will affect phasing of the DHSM Master Plan Update. These external factors are the relocation of ~~the State~~ DOD to Barbers Point, the securing of a supply of non-potable groundwater for irrigation, and the acquisition of the Cannon Club. Based on these factors, the implementation of the project can be envisioned to occur in five phases, these are:

- Phase One (Continue Existing Operations and Implementation of Currently Funded Projects)
- Phase Two (Projects that Can Be Implemented Within the Next 5 Years)
- Phase Three (Projects that Can Only Be Implemented After the Relocation of ~~the State~~ DOD)
- Phase Four (Projects that Can Only Be Implemented After Securing a Supply of Non-Potable Groundwater)
- Phase Five (Projects that Can Only Be Implemented After Securing the Cannon Club)

The proposed phasing of the various elements of the DHSM Master Plan Update are provided below:

### Phase One

- keeping the existing comfort station and parking lot;
- continuing operation of State Park baseyard at Makapu'u Avenue and Diamond Head Road;
- continuing use of antennas;

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- allowing Battery Birkhimer to remain as a civil defense facility;
- protecting the *Schidea adamantis* habitat, and the habitat of other native species;
- controlling visitor access into sensitive areas (such as the crater rim);

**Phase Two**

- removing the FAA CERAP Building;
- building a permanent visitor/interpretive facility near Battery Birkhimer;
- building the new road behind the visitor/interpretive center (to the new parking lot);
- installing a wastewater lift station;
- removing the overhead utility lines between Battery Birkhimer and the crater rim and relocating them to the aboveground conduits to the Link Site (once FAA has relocated).
- opening new trails to the flat top reservoir and to the adjoining ridge which are north of the existing trail to the summit;
- opening the road between the FAA Link Site and the Retractable Searchlight along the eastern crater rim;
- utilizing Battery Dodge and the gun emplacements along the eastern edge of the crater as lookouts<sup>2</sup>;
- building a multi-use bike pedestrian path along Diamond Head Road;

**Phase Three**

- building a caretaker's residence (or DOCARE office);
- opening a new trail from the retractable searchlight on the southeastern edge of the crater rim to Tunnel 407 (allow access only via guided tours)<sup>3</sup>;
- building a new trail from Tunnel 407 to the summit trail;
- removing State DOD Buildings 301, 303 and 304;
- renovating and opening up Tunnel 407 and Battery Harlow for interpretive purposes and providing restroom facilities;

**Phase Four**

- improving the wetland;
- building a trail around the wetland;
- building new picnic areas near the visitor/interpretive center, Pistol Range site and in front of Tunnel 407;
- installing additional pedestrian trails on the crater floor, especially through picnic areas;
- adding comfort stations at secondary interpretive facilities, and picnic areas;
- installing the linear park along Diamond Head Road;

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<sup>2</sup>The use of Battery Dodge will not occur until the FAA and the Hawaii Army National Guard feel that opening up the existing road to the general public will not impact their facilities or services.

<sup>3</sup>The use of Battery 407 will not occur until the Hawaii Army National Guard no longer requires the use of the tunnel. In the meantime, Battery 407 will be assessed for historic architecture in accordance with the Historic Building Survey (HABS) protocols.

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- installing the new Nā La'au Arboretum between the Crater Road and Diamond Head Road;
- install dryland forest

**Phase Five**

- acquiring and utilizing the Cannon Club for food service and/or visitor orientation (either through renovation or replacement) and providing restroom facilities;
- in the long-term, moving visitor parking to outside of the crater;
- establishing a motorized people mover system, when visitor parking is kept to the exterior;
- building the new intersection across from Makapu'u Avenue;
- allowing entry through Kapahulu Tunnel;
- restricting exits only through Kāhala Tunnel;
- closing the existing Crater Road entry from Diamond Head Road (except for emergency vehicles);
- accommodating pedestrian access through Kapahulu Tunnel;
- continuing the loop road in the crater floor (between Tunnel 407 and Kapahulu Tunnel).
- add comfort station at the exterior parking facility

**2.6 Approximate Project Costs**

The following preliminary cost estimates for the project were prepared by Mitsunaga & Associates, Inc.; CDS International; Hawaii Nature Center; and PBR HAWAII.

**Diamond Head State Monument Master Plan  
Preliminary Phasing Cost Breakdown**

Item No.	Phase One	CIVIL	Building	Elec./Com.	Landscape	Other	Total
1	Keep existing comfort station & parking lot	\$	\$	\$	\$	\$	\$
2	Continue operations of State Park base yard	\$	\$	\$	\$	\$	\$
3	Continue use of antennas	\$	\$	\$	\$	\$	\$
4	Allow Battery Birkhimer to remain as a civil defense facility	\$	\$	\$	\$	\$	\$
5	Protect the Schidea Adamatis habitat and other native species	\$	\$	\$	\$	\$	\$
6	Control visitor access into sensitive areas	\$	\$	\$	\$	\$	\$
	Subtotal	\$	\$	\$	\$	\$	\$

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Phase Two							
7	Remove the FAA CERAP Building	\$0	\$0	\$0	\$0	\$0	\$0
8	Build a permanent Visitor/Interpretive facility near Battery, Birkhimer, and install a wastewater lift station	\$2,871,184	\$8,289,200	\$410,803	\$1,849,594	\$0	\$12,420,781
9	Build a new road behind the visitor/interpretive center	\$518,380	\$0	\$60,950	\$0	\$0	\$579,330
10	Remove overhead utility lines between Battery Birkhimer and the crater rim; relocate them to the aboveground conduits to the Link Site	\$0	\$0	\$138,966	\$0	\$0	\$138,966
11	Open new trails to the flat top reservoir and adjoining ridge north of the existing trail to summit	\$0	\$0	\$0	\$16,091	\$0	\$16,091
12	Open road between the FAA Link Site and the Retractable Searchlight along the eastern crater rim and Utilize Battery Dodge and the gun emplacements along the eastern edge of crater as lookouts	\$2,117,755	\$0	\$0	\$0	\$0	\$2,117,755
13	Build a multi-use path along Diamond Head Road	\$0	\$0	\$650,946	\$112,758	\$0	\$763,704
Subtotal		\$3,507,619	\$8,289,200	\$1,261,665	\$1,978,443	\$0	\$14,036,627
Phase Three							
14	Build a caretaker's residence (or DOCARE office)	\$4,974	\$365,700	\$78,016	\$48,760	\$0	\$497,450
15	Open a new trail from the retractable searchlight on the southeastern edge of the crater rim to Tunnel 407	\$0	\$0	\$0	\$92,156	\$0	\$92,156

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16	Build a new trail from Tunnel 407 to the summit trail	\$153,594	\$153,594	\$153,594	\$153,594	\$153,594	\$153,594
17	Remove DOD buildings 301, 303, and 304	\$649,727	\$649,727	\$51,198	\$649,727	\$649,727	\$700,925
18	Renovate and Open up Tunnel 407 and Battery Harlow for interpretive purposes and providing restroom facilities	\$1,065,016	\$1,359,209	\$240,143	\$1,065,016	\$1,065,016	\$2,664,368
	<b>Subtotal</b>	<b>\$1,069,989</b>	<b>\$1,724,909</b>	<b>\$369,357</b>	<b>\$1,294,510</b>	<b>\$649,727</b>	<b>\$4,108,493</b>
	<b>Phase Four</b>						
19	Improve the wetland	\$2,451,409	\$2,451,409	\$125,183	\$2,451,409	\$2,451,409	\$3,576,592
20	Build a trail around wetland	\$522,951	\$522,951	\$522,951	\$522,951	\$522,951	\$522,951
21	Build new picnic areas near the west shore visitor/interpretive center, Pistol Range site and in front of Tunnel 407	\$651,298	\$651,298	\$651,298	\$651,298	\$651,298	\$651,298
22	Install additional pedestrian trails on the crater floor	\$81,673	\$81,673	\$81,673	\$81,673	\$81,673	\$81,673
23	Add comfort stations at secondary interpretive facilities and picnic areas	\$1,462,800	\$1,462,800	\$1,462,800	\$1,462,800	\$1,462,800	\$1,462,800
24	Install the linear park along Diamond Head Road	\$1,733,479	\$1,733,479	\$1,733,479	\$1,733,479	\$1,733,479	\$1,733,479
25	Install the new Na'au Arboretum between the crater Road and Diamond Head Road	\$3,291,300	\$3,291,300	\$3,291,300	\$3,291,300	\$3,291,300	\$3,291,300
26	Install Dryland Forest	\$2,559,900	\$2,559,900	\$2,559,900	\$2,559,900	\$2,559,900	\$2,559,900
	<b>Subtotal</b>	<b>\$2,451,409</b>	<b>\$1,462,800</b>	<b>\$1,965,784</b>	<b>\$1,965,784</b>	<b>\$1,965,784</b>	<b>\$13,879,993</b>
	<b>Phase Five</b>						
27	Acquire and utilize the Cannon Club for food service and/or visitor orientation and providing restroom facilities	\$8,289,200	\$8,289,200	\$82,892	\$8,289,200	\$8,289,200	\$8,372,092

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28	Establish a motorized people mover system and move visitor parking to outside of the crater.	\$786,185	\$0	\$12,190	\$0	\$0	\$877,375
29	Build the new intersection across from Makapu'u Avenue	\$334,043	\$0	\$173,098	\$0	\$0	\$507,141
30	Allow entry through Kapahu'u tunnel	\$0	\$0	\$0	\$0	\$0	\$0
31	Restrict exits only through Kahala tunnel	\$0	\$0	\$63,388	\$0	\$0	\$63,388
32	Close the existing Crater Road entry from Diamond Head Road	\$0	\$0	\$0	\$0	\$0	\$0
33	Accommodate pedestrian access through Kapahu'u tunnel	\$0	\$0	\$63,388	\$0	\$0	\$63,388
34	Continue the loop road in the crater floor (between tunnel 407 and Kapahu'u tunnel)	\$574,041	\$0	\$135,309	\$0	\$0	\$709,350
35	Add a comfort station at the exterior parking facility	\$0	\$365,700	\$192,644	\$0	\$0	\$558,344
	<b>Subtotal</b>	<b>\$1,770,268</b>	<b>\$28,654,900</b>	<b>\$1,622,909</b>	<b>\$0</b>	<b>\$0</b>	<b>\$11,048,077</b>
	<b>TOTALS</b>	<b>\$18,798,986</b>	<b>\$20,131,809</b>	<b>\$2,253,931</b>	<b>\$11,238,737</b>	<b>\$649,727</b>	<b>\$243,073,190</b>
						<b>SAY</b>	<b>\$243,075,000</b>



3.0  
Required Approvals and Permits

### 3.0 REQUIRED APPROVALS AND PERMITS

All facilities will be designed to meet the Americans with Disabilities Act Accessibility guidelines and the requirements of Section 103-50 Hawaii Revised Statutes (HRS) except: 1) where compliance would cause substantial harm to cultural, historical, religious, or significant natural features and characteristics; 2) where compliance could substantially alter the nature of the setting or the purpose of the facility or portion of the facility; 3) where compliance would require construction methods or materials that are prohibited by federal, State, or local regulations or statutes; 4) where compliance would not be feasible due to terrain or the prevailing construction practices.

#### 3.1 Chapter 343, Hawai'i Revised Statutes

Chapter 343, Hawai'i Revised Statutes, requires that an EA or an EIS be prepared for the proposed development at DHSM. Several factors trigger this: 1) the use of State land and State funds; 2) the existence of historic resources listed on the National Register of Historic Places; 3) development on conservation district land; 4) development within the Special Management Area; and 5) the possible need for a Well Permit from the State Water Commission. An Environmental Impact Statement Preparation Notice (EISPN) was filed with OEQC on August 25, 1998 and was published in the September 8, 1998 issue of the Environmental Notice.

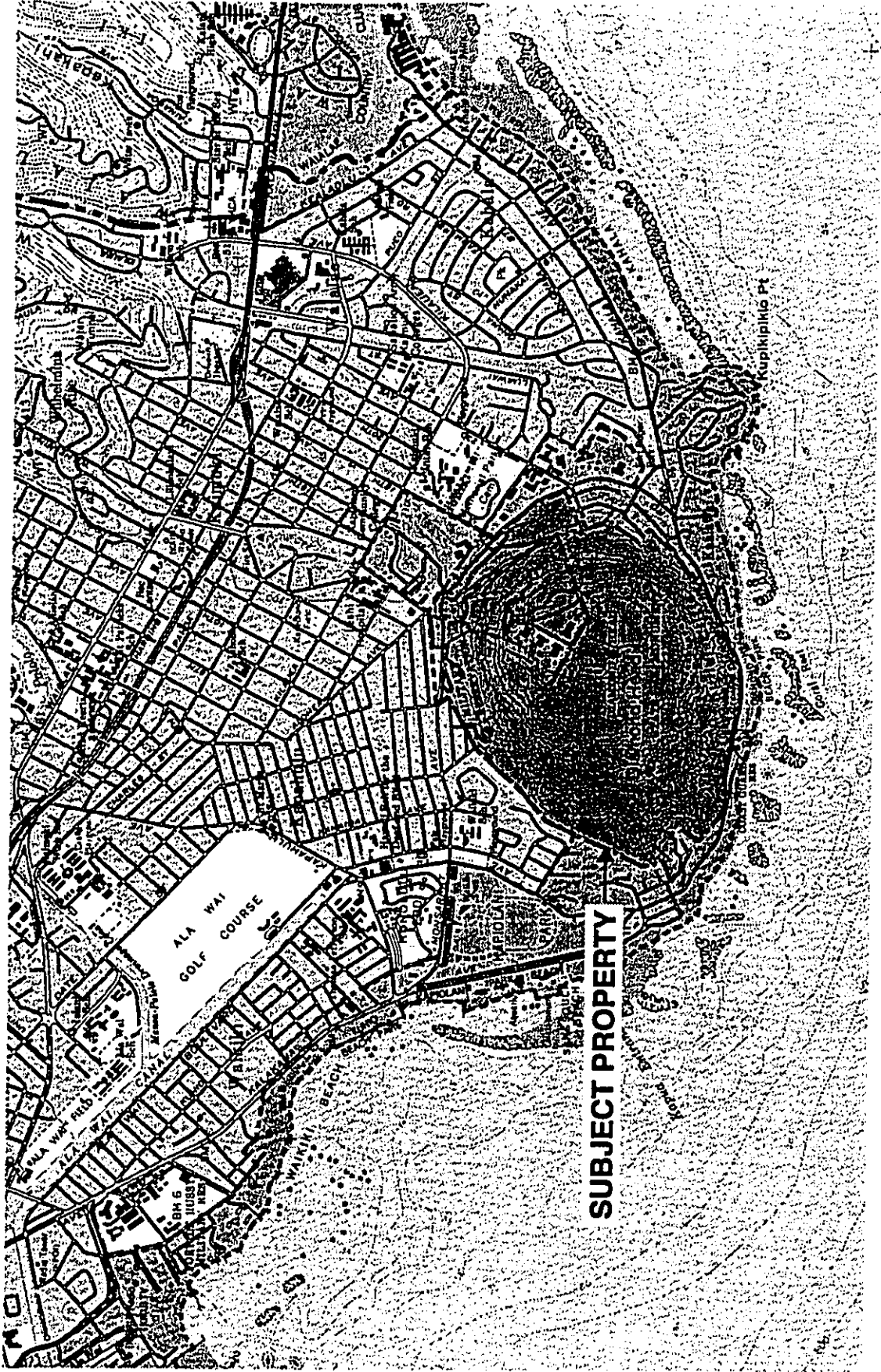
#### 3.2 City and County of Honolulu

##### 3.2.1 Primary Urban Center Development Plan Land Use Map

The General Plan consists of a series of objectives and policy statements. Diamond Head, mostly located within the Preservation District within the Primary Urban Center (PUC) Development Plan (DP), falls under policy statements dealing with preservation. Small portions of the DHSM are located within the Park, Military, Public Facility and Residential Districts. Eventually, these latter designations on portions of the DHSM should be amended on the PUC DP Land Use Map.

##### 3.2.2 Land Use Ordinance Designation - Zoning

The P-1, Restricted Preservation District establishes most of DHSM's underlying zoning, it is "intended that all lands within a state-designated conservation district be zoned P-1 restricted preservation district." As such "within the P-1 restricted preservation district, all uses, structures and development standards shall be governed by the appropriate state agencies." Portions of the Monument are zoned P-2, General Preservation, F-1, Military and Federal Preservation, R-5, Residential District (Figure 5). Eventually, these latter designations on portions of the DHSM should also be rezoned to the proper zoning districts. In their review of the Draft EIS, the City and County of Honolulu Department of Planning and Permitting (DPP) wrote that "the proposed use is considered a public use and is a permitted use within any zoning district regulated by the city."



**Legend**

- Special Management Areas .....
- SMA Boundary Line .....
- DP Boundary Line .....

**FIGURE 13**  
**Special Management Area**  
**DIAMOND HEAD STATE MONUMENT**



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Most of the DHSM is currently designated as an R (Resource) subzone (Figure 4). During the EISPN comment period, the State Land Use Commission noted that TMK: 3-1-42: 10, 21, 23, 24, 25, 36 and 37 were classified as Conservation District but were not subsequently designated within a particular subzone. DLNR will work with the Office of State Planning to ensure that the subject parcels are placed in the proper Conservation District Subzone(s).

The portion of the crater floor where most of the State DOD and FAA facilities are concentrated and the slopes above and over the crater rim are presently designated as G (General) subzone (Figure 4). This is important because most of the proposed visitor/interpretive center will be located in a G (General) subzone.

All structures must be consistent with the purpose of the conservation district. The park's primary structure, the proposed visitor/interpretive center, will probably be located mostly within the General (G) subzone and thus will be subject to those restrictions. The General (G) designation is the least restrictive of the conservation district subzones.

**Well Construction Permit:** Pursuant to Hawai'i Revised Statutes, Chapter 174C, State Water Code, if any wells are proposed within the DHSM, a Well Construction Permit and/or a Pump Installation Permit must be sought from the State Commission of Water Resource Management.

In addition, since the proposed water supply source for the project is located in a designated water management area, a Water Use Permit from the State Commission on Water Resource Management would be required prior to use of this source.

4.0

**Assessment of the  
Existing Natural Environment,  
Potential Impacts, and Mitigative Measures**

## 4.0 ASSESSMENT OF THE EXISTING NATURAL ENVIRONMENT, POTENTIAL IMPACTS, AND MITIGATIVE MEASURES

### 4.1 Climate

#### A. Existing Conditions

Generally, the climate at Diamond Head is characterized by mild and fairly uniform temperatures, generally humid conditions, and a dominance of tradewinds (although the slopes of the crater limit winds at the crater floor). Dry weather prevails except for occasional light tradewind showers which drift over from the Ko'olau Mountains and during periods of major storms.

#### Temperature

Temperatures range from the warmest month in August with an average temperature of 78.4°F to the coldest month of February averaging 71.9°F. Temperatures above 95°F are infrequent.

#### Wind

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 October through April, the trades blow across the entire island chain approximately 50 to 80 percent of the time. Extremely high winds occur only occasionally and then only as a result of a major storm. 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 values generally during the evening frequently between 70 and 80 percent. Afternoon humidity commonly ranges between 50 and 55 percent and seldom below 40 percent. Winter humidity is generally higher than those experienced during summer months.

Heavy masses of clouds frequently cling to the Ko'olau Mountains, but do not generally extend to Diamond Head. Only during extended Kona storms, which occur two or three times a year in the winter, may an overcast persist over Diamond Head for more than a day.

#### Rainfall

The mean annual rainfall for Diamond Head is approximately 25 inches, with a pronounced contrast between the rainy winter season and the drier summer season. 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 areas that do not experience relatively high rainfall. It is not uncommon during intense storms for Diamond Head to receive the mean annual rainfall in only a few hours.

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

The crater floor has slopes running from 2 to 12 percent with approximately 50 percent of the land area with slopes of about 6 percent or less. The lowest point of the crater covers an area of less than 5 percent of the floor and is less than 200 feet above sea level. Slightly more than half the floor area is below 300 feet.

B. Anticipated Impacts

The proposed action is anticipated to have minimal impacts to the topography of the crater as a result of building new trails, roads, picnic areas, comfort stations, parking, the new exterior park and the visitor/interpretive center. Also, DLNR will develop rules for the DHSM that will include restricting access to authorized trails and roads, and restricting access on the crater rim. However, it is anticipated that there will be some visitors who will from time to time disobey these rules and there will be some unavoidable erosion to the crater rim from illegal hiking. It is acknowledged that any disturbance to the rifle ranges may result in remediation of hazardous waste (as reported by the Hawaii Army National Guard).

C. Mitigative Measures

To mitigate the impact of illegal hiking on soil erosion, it is recommended that funding be provided for personnel to enforce park rules and to provide educational materials on the negative impact of hiking off-trail on the environment.

4.3 Drainage

A. Existing Conditions

The source of surface water in the lowest point of the crater floor is precipitation. Though relatively dry, this area may receive heavy rains during intense storms. When this occurs, runoff from the steep crater slopes can be significant because of the shallow soil depths and soil type (Makalapa clay series) in these areas. The intensity of surface water runoff can create 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 generally evaporates or percolates into 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 conditions. Between 1970 and 1980, water from the pond area was pumped out only twice during intense storm periods.

The Federal Emergency Management Agency classifies flood hazard zones as part of the Flood Insurance Program for the City and County of Honolulu (Figure 14). The crater is designated as Zone X on the Flood Insurance Rate Map (FIRM). This zone is determined to be outside the 500-year flood plain. According to U.S. Army Corps of Engineers' review, the flood hazard information provided in the EISPN was correct.

B. Anticipated Impacts and Mitigative Measures

The future development of the subject property will need to include measures such as detention/retention basins to control runoff from hard surface areas. However, the amount of runoff after project development should be reduced due to the demolition of existing structures and parking areas which restrict natural infiltration into the ground.

A complete engineering assessment of drainage system improvements necessary to accommodate the proposed project is provided in Appendix A of the EIS.

4.4 Soils

A. Existing Conditions

The Detailed Land Classification (1965 through 1972) series was produced by the Land Study Bureau (LSB) of the University of Hawai'i for each island. The intent of this series of reports was to develop a land inventory and productivity evaluation based on statewide "standards" of crop yields and levels of management.

The LSB classification system groups lands into homogeneous units called Land Types, describes their condition and environment, delineates the areas on aerial photo base maps, rates the lands on their overall quality (productivity) in relation to other land, and appraises their performance under selected alternative agricultural crops. The productivity evaluations were based on statewide standards of crop yields and levels of management at the time the classification was made.

A five-class productivity rating is applied using the letters "A", "B", "C", "D" and "E", with A representing the class of highest productivity and E the lowest. The soils on the subject property are rated primarily as "D" within the Crater and "E" along the Crater rim and all areas of steep slope (Figure 15).

The Soil Conservation Service Soil Survey (1972) series for each island was prepared by the U.S. Department of Agriculture Soil Conservation Service and the University of Hawai'i Agricultural Experiment Station. These reports are patterned after a soil classification procedure adapted for nationwide, uniform application. Soil types are ranked according to their suitability for most crops. Also provided are listings of crops commonly grown on the soil types and their expected productivity under present management.

The soils of O'ahu, 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.



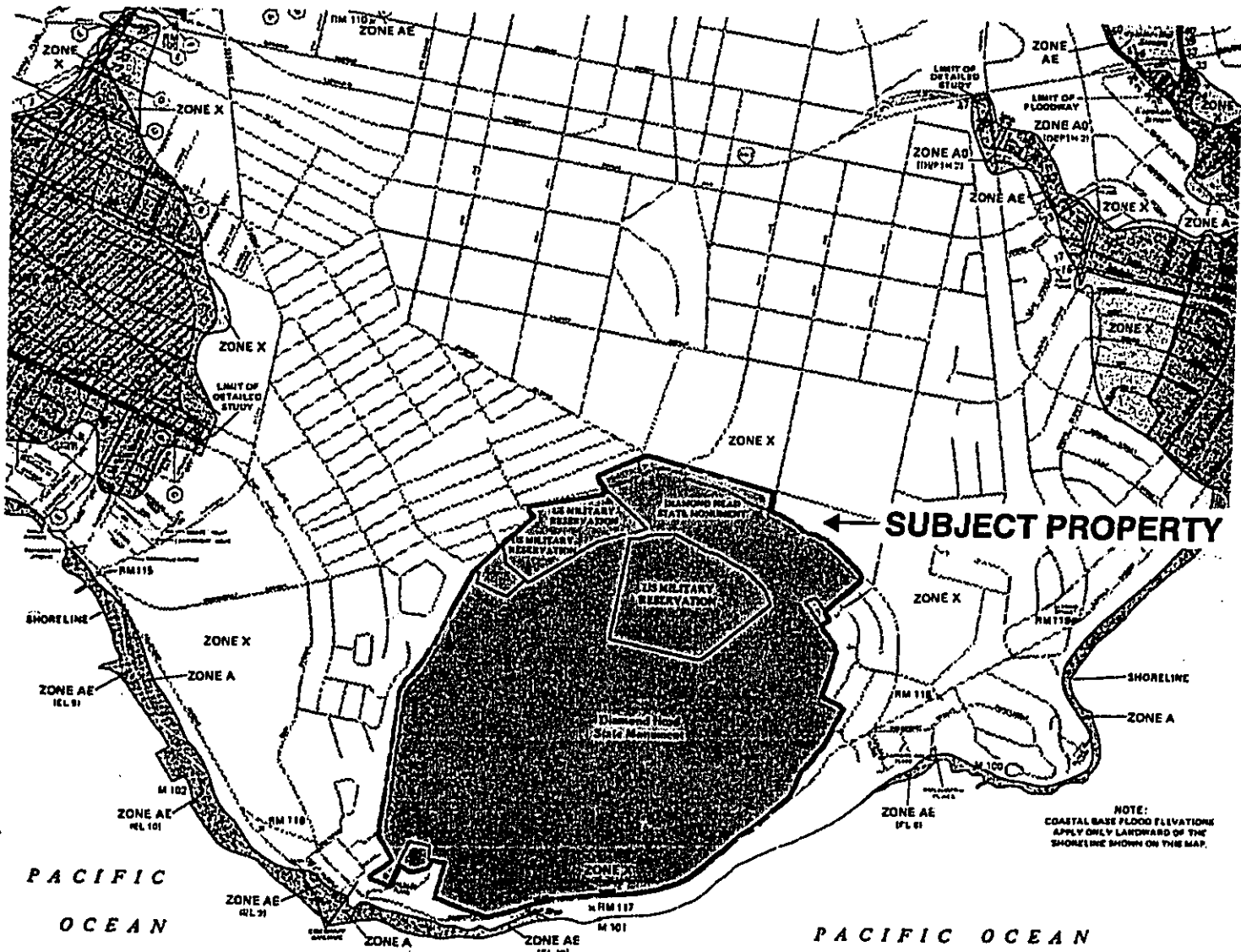
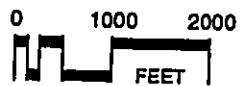
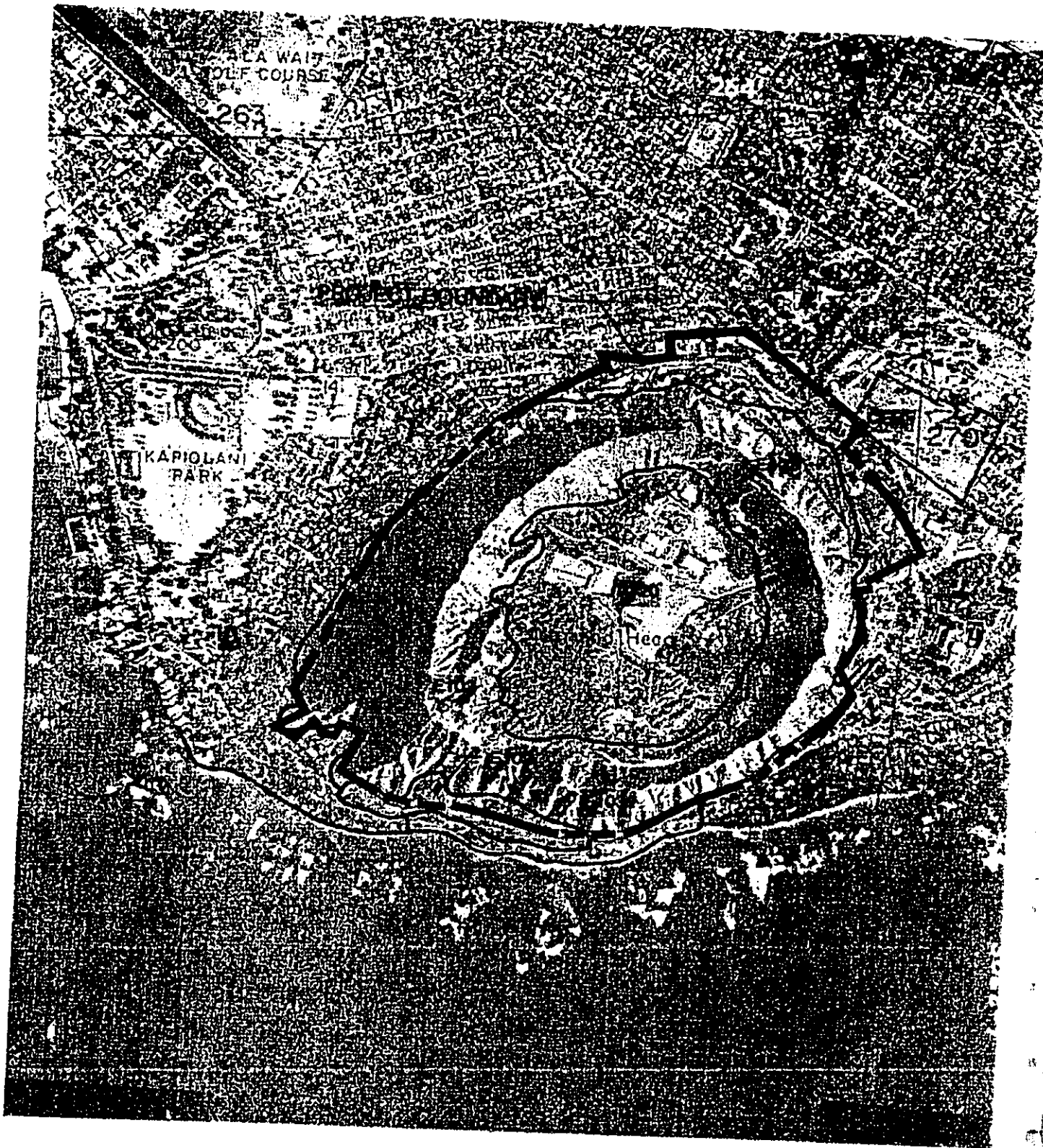


FIGURE 14  
 Flood Insurance Rate Map  
 DIAMOND HEAD STATE MONUMENT



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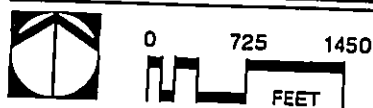




Overall  
Productivity Rating

- A - Lightest
- B
- C
- D
- E - Lowest

FIGURE 15  
Land Study Bureau  
Detailed Land Classification  
DIAMOND HEAD STATE MONUMENT



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HAWAII

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Diamond Head soils consist largely of one-time volcanic ash and lapilli altered to palagonite, and contain magmatic debris and a considerable quantity of talus breccia that formed when the sea level was 40 feet higher than its present level (Figure 16). Occasional blocks of Ko'olau 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. These soils are mildly alkaline in their dry grayish-brown, 8 in. thick surface layer and mildly to moderately alkaline in their 18- to 36-in. lower layer. They are underlaid by light-gray to dark grayish-brown, weathered, volcanic tuff. The Makalapa clay series soils within the project site are described below.

The MdB soils are found in the shallower slopes (2 to 6 percent) of the crater. Their clay components are very sticky and plastic. The shrink-swell potential is high. The permeability and runoff of MdB are slow and the erosion hazard is slight. The available water capacity is about 1.4 inch 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 moderate. MdD is also similar, however, it is located on 12 to 20 percent slopes, runoff is medium and the erosion hazard moderate.

Rockland (rRK) is located on the very steep slopes and is made up of areas where exposed rock covers 25 to 90 percent of the surface. The soil material is generally very sticky and plastic and has a high shrink-swell potential. Buildings on the steep slopes are susceptible to sliding when the soil is saturated.

Beneath the developed area in the crater's interior, fill of miscellaneous composition and various depths has been added.

**B. Anticipated Impacts**

During the construction phases of the project, there is a potential for the generation of dust and for water-borne soil erosion. However, since much of the site consists of bare soil, overall soil loss may be reduced somewhat after development. As portions of the Project Area are bare, there may also be beneficial impacts resulting from the project's landscaping plan.

~~Any disturbance to the rifle ranges within the crater may result in remediation of hazardous waste recorded in the berms (as reported by the Hawaii Army National Guard).~~

**C. Mitigative Measures**

Mitigative measures will be implemented to reduce short-term soil erosion during construction.

(1) **Construction Erosion Control.** Construction activities will follow strict erosion control measures specified by applicable Federal, State, and City regulations. Prior to issuance of a grading permit by the City Department of Planning and Permitting, an erosion control plan and best management practices required for the NPDES permit will be submitted describing the implementation of appropriate erosion control measures. These generally include use of cut-off ditches, temporary ground cover, and use of detention areas.

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(2) **Watering and Landscaping.** A watering program will be implemented to minimize soil loss through fugitive dust emissions during construction. Other control measures include cleaning of construction equipment on the job-site and establishment of ground cover as quickly as possible after grading.

(3) **Landscaping and Long-Term Erosion Control.** Permanent landscaping in selected areas will re-establish the soil retention values throughout the project area. This extensive, continuous, and long-term landscape management program for the property may reduce erosion compared to the existing conditions under wilderness/military use (i.e., low maintenance park use and large truck parking on unpaved surfaces).

~~To minimize the potential erosion impact of removing invasive plants, especially fountain grass in steep areas, invasive plants should be removed incrementally and be replaced with native species. This will curtail significant erosion that might occur if large-scale clearing were involved.~~

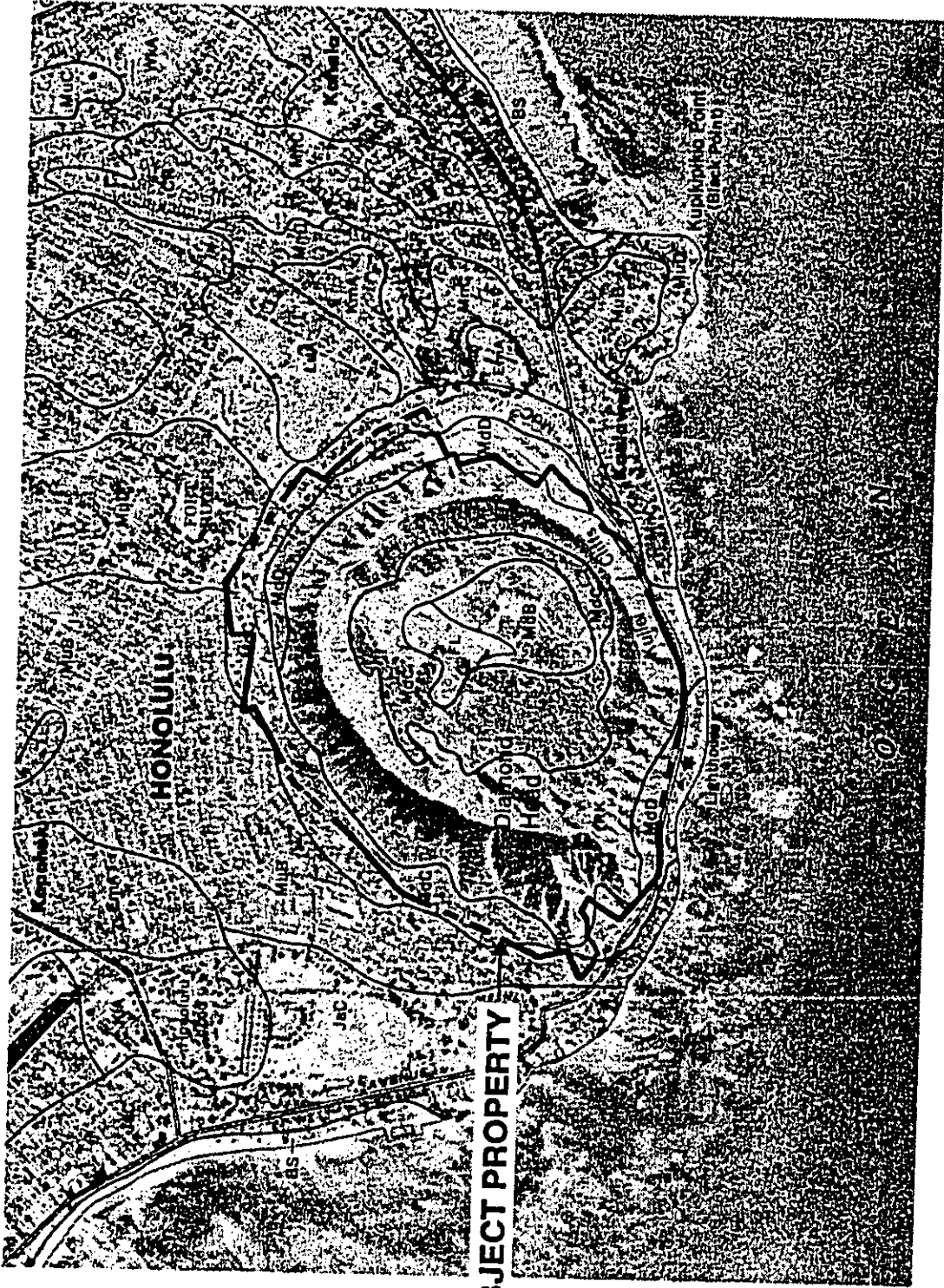
(4) **Other Mitigation.** In addition to those listed above, erosion control measures to further lessen construction impacts include:

- a. Retain existing ground cover until the latest date before construction.
- b. Early construction of drainage control features.
- c. Use temporary sprinklers in non-active construction areas when ground cover is removed.
- d. Station water trucks on-site during the construction period to provide immediate sprinkling as needed, in active construction zones (weekends and holidays included).
- e. Construct temporary sediment basins to trap silt.
- f. Use temporary berms and cut-off ditches where needed, to interrupt and divert flows to the nearest sediment basin.
- g. Construct temporary silt fences or straw bale barriers to trap silt.
- h. Thorough watering of graded areas after construction activity has ceased for the day and on weekends.
- i. Sod or plant all cut and ill slopes immediately after grading work has been completed.

## 4.5 Groundwater Resources/Hydrology

### A. Existing Conditions

In Hawai'i, groundwater 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 freshwater 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.



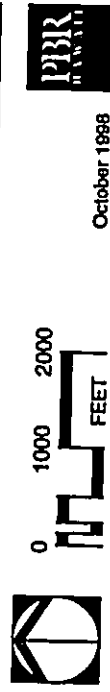
**SUBJECT PROPERTY**

Legend

- |           |  |           |  |
|-----------|--|-----------|--|
| MuB ..... | Molokai Silty Clay Loam, 3 to 7 % slopes | LuA ..... | Lualualei Clay                           |
| MdC ..... | Makalapa Clay, 6 to 12 % slopes          | KmA ..... | Keaau Clay                               |
| MdD ..... | Makalapa Clay, 12 to 20 % slopes         | Jac ..... | Jaucas Sand                              |
| rRK ..... | Rock Land                                | CR .....  | Coral Outcrop                            |
| FL .....  | Fill Land, Mixed                         | MuC ..... | Molokai silty clay loam, 7 to 15 % sipes |
| MnC ..... | Mamala sony silty clay loam              | EmA ..... | Eva silty clay loam, moderately shallow  |

**FIGURE 16**  
**Soils Map**

**DIAMOND HEAD STATE MONUMENT**



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**B. Anticipated Impacts and Mitigative Measures**

Future non-potable groundwater improvements that could be developed to supply irrigation water for the proposed project may include development of water supply wells and construction or improvement of storage and pumping facilities within the crater. Development of groundwater sources is subject to review and approval by the State Commission on Water Resource Management (CWRM). Pursuant to Hawai'i Revised Statutes, Chapter 174C, State Water Code, if any wells are proposed for the DHSM, a Well Construction Permit and/or a Pump Installation Permit must be sought from the CWRM. In addition, since the proposed water supply source for the project is located in a designated water management area, a Water Use Permit from the CWRM would be required prior to use of this source.

Some potable water may be used for limited irrigation at the proposed visitor/interpretive center. The availability of water from municipal sources will be confirmed when the Building Permit application is submitted to the City and County of Honolulu Board of Water Supply for their review and approval.

**4.6 Natural Hazards**

**A. Existing Conditions**

Natural hazards are events such as tsunamis, earthquakes, floods, hurricanes, soil slippage, and volcanic hazards. The project may be subject to hurricanes and minor earthquakes in the future; however, the site is not unique to these potential hazards. Earthquakes in the Hawaiian islands are associated with volcanic eruption or tectonic movement. The Diamond Head Crater is not uniquely susceptible to natural hazards, however, the relatively steep slopes and cliffs can pose a hazard to hikers who do not stay on designated hiking trails.

**B. Anticipated Impacts**

Because the project area is not located within a floodway or a flood fringe area, nor within a designated tsunami inundation area, no part of the project will be impacted by potential flooding hazards. Storm drainage will be controlled by a pond/retention basin which will minimize and control potential flooding within the crater. None of the land uses proposed for the project are susceptible to flooding as described by the FIRM.

The State of Hawai'i has been affected twice since 1982 by devastating hurricanes, 'Iwa in 1982 and 'Iniki in 1992. While it is difficult to predict these natural occurrences it is reasonable to assume that future events could be likely given the record of the past eighteen years. The project area, as the rest of the island, is no more or less vulnerable to the destructive winds and torrential rains associated with hurricanes and cyclones.

**C. Mitigative Measures**

(1) **Protection of Buildings.** The potential impact of destructive winds and torrential rainfall of tropical cyclones/hurricanes on structures within the project will be mitigated by compliance with the Uniform Building Code adopted by the City and County. All structures will be constructed for

protection from earthquakes and tropical cyclones/hurricanes in accordance with the requirements of the City and County.

(2) **Drainage Improvements.** Drainage improvements will include adequate provisions to prevent any localized flooding problems. No other mitigative measures are required to avoid potential flood hazard areas since none exists within the project area.

#### 4.7 Flora

A flora survey was conducted by Winona Char and is summarized below. The complete report on the results of the survey is attached in Appendix B.

##### A. Existing Conditions

The vegetation on the undeveloped portions of the project site is described in detail below (Figure 17). The developed areas are landscaped and maintained; landscaping consists of large expanses of lawn, primarily Bermuda grass (*Cynodon dactylon*), and plantings of various ornamental tree and shrub species. No field studies were made of the developed, maintained areas.

##### *Kiawe/Koa Haole Forest*

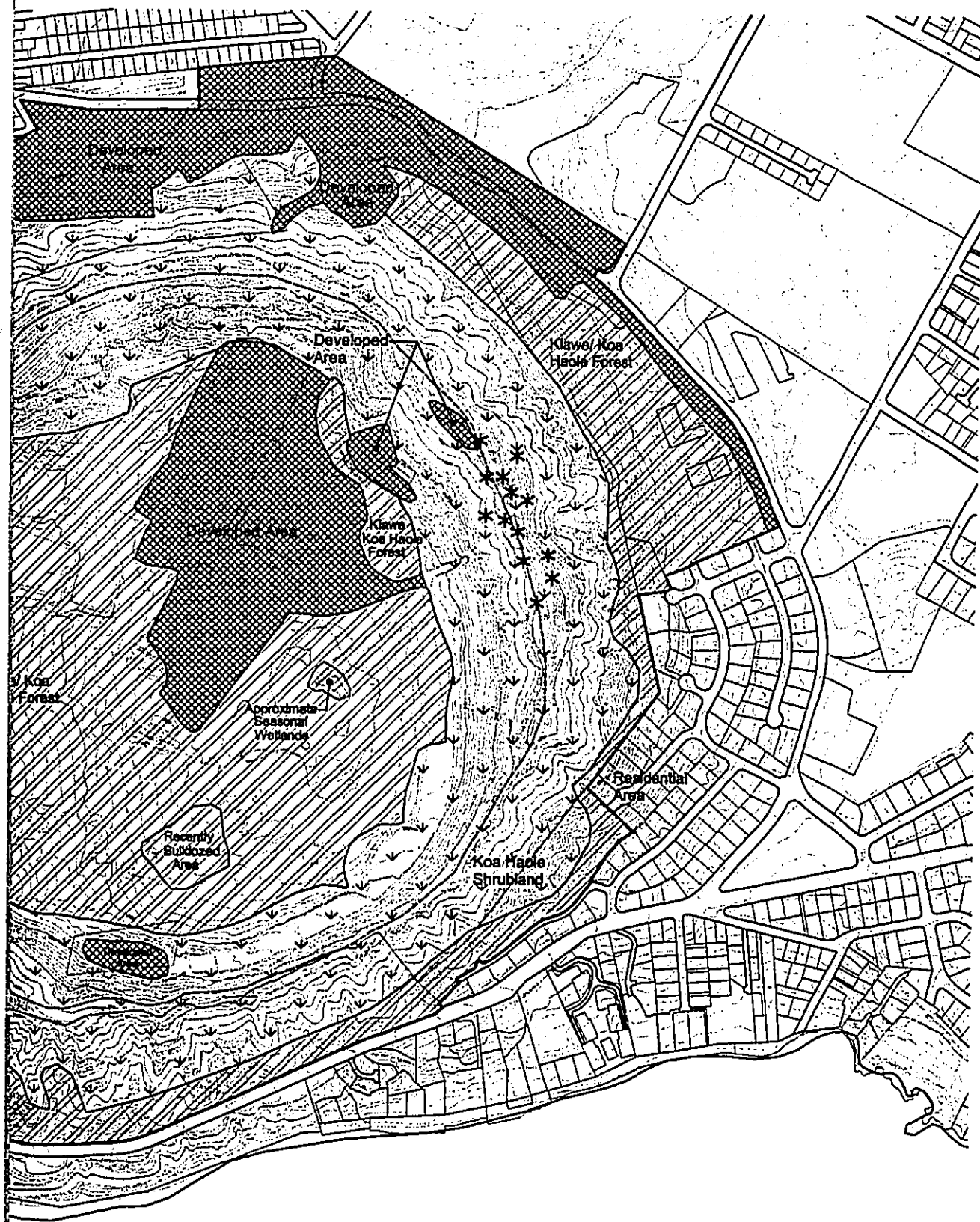
This vegetation type occurs as a band around the outside base of the crater, behind the residential properties and across from Kapi'olani Community College. Within the crater, the *kiawe* (*Prosopis pallida*)/*koa haole* (*Leucaena leucocephala*) forest is found on the undeveloped portions of the crater floor and some of the lower slopes, especially on the western half of the interior. *Kiawe/koa haole* forest occurs on the areas with deeper soil. These are areas with clay soils of the Makalapa series, identified on the soil maps as "MdB," Makalapa clay, 2 to 6 percent slopes; "MdC," Makalapa clay, 6 to 12 percent slopes; and "MdD," Makalapa clay, 12 to 20 percent slopes. These are well-drained, very dark grayish-brown soils formed in volcanic tuff. The soils are very sticky and plastic when wet, and upon drying, form wide cracks.

*Kiawe*, a woody member of the pea family (*Fabaceae*) and native to the Neotropics, forms an open to closed canopy forest, 15 to 30 feet tall. The taller and more closed forests tend to occur in low lying situations or in drainageways where there may be deeper soils and more available soil moisture. Shrubs of *koa haole* form somewhat dense thickets, 6 to 15 feet tall, between the *kiawe* trees. Filling in the matrix between the woody components are dense mats of buffel grass (*Cenchrus ciliaris*), clumps of Guinea grass (*Panicum maximum*), and dense tufts of sourgrass (*Digitaria insularis*). In places, lantana shrubs (*Lantana camara*) may be locally common. During the rainy season, the native 'ilima (*Sida fallax*), a small shrub, is also locally common to abundant, but in the dry summer months only a few live plants remain scattered here and there among the grasses.






##### *Koa Haole Shrubland*

This vegetation type occurs on the slopes and rim of the crater on rockland, identified as "rRK" on the soil maps. It is composed of scrubby *koa haole* plants, 2 to 6 feet tall; the plants are shorter on the

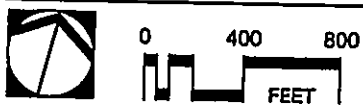




**Legend**

-  Kiawe/Koa Haole Forest
-  Koa Haole Shrubland
-  Native Grassland/Shrubland  
(scattered pockets in koa haole shrubland too small to map; found primarily in the area between the asterisks \*)
-  Seasonal Wetland
-  Developed Areas






**FIGURE 17**  
Vegetation Zones Map  
**DIAMOND HEAD STATE MONUMENT**







**Vegetation Map**  
**DIAMOND HEAD STATE MONUMENT**  
**MASTER PLAN UPDATE**

- Legend**
-  Kawa/Koa Haole F
  -  Koa Haole Shrubla
  -  Native Grassland/Scrubland  
(scattered pockets in Koa forest too small to map; found primarily between the asterisks)
  -  Seasonal Wetland
  -  Developed Areas

exposed upper slopes and rim of the crater. Scattered patches of buffel grass, Guinea grass, and Natal redtop grass (*Melinis repens*) are found in this shrubland. Other introduced or alien species which can be found here include a few shrubs of sourbush (*Pluchea carolinensis*) and Christmas berry (*Schinus terebinthifolius*), the succulent-stemmed carrion flower (*Stapelia gigantea*), *Bidens cynapiifolia*, lion's ear (*Leonotis nepetifolia*), and running pop (*Passiflora foetida*).

Besides the commonly occurring 'ilima and 'uhaloa (*Waltheria indica*), a number of other native species can be found in this shrubland, including the endangered *Schiedea adamantis* and *Spermolepis hawaiiensis*. These include the coast sandalwood or 'iliahialo'e (*Santalum ellipticum*), *nehe* (*Lipochaeta lobata*), *ma'o* (*Gossypium tomentosum*), *alena* (*Boerhavia glabrata*), *kāwelu* or 'emoloa (*Eragrostis variabilis*), *pili* grass (*Heteropogon contortus*), and *kākonakona* (*Panicum torridum*). The *kākonakona* is an annual grass species which is especially abundant during the wetter months.

#### *Native Grassland/Shrubland*

This vegetation type occurs as scattered, remnant pockets among the *koa haole* shrubland and is generally associated with the more exposed, very steep, windward facing, rocky slopes. In these areas *kāwelu* and *pili* grass are the dominant components. Native shrubs found here include 'ilima, 'uhaloa, *nehe*, 'a'ali'i (*Dodonaea viscosa*), and 'akoko (*Chamaesyce degeneri*). *Schiedea adamantis* and *Spermolepis hawaiiensis* also occur in this vegetation type.

#### Fountain Grass

The highly invasive fountain grass community is potentially the most devastating to native dry and mesic ecosystems. This species is one of the worst invaders in the Hawaiian Islands (potentially second behind *Miconia calvescens*) and is targeted for eradication in Diamond Head by the Oahu Fountain Grass Working Group.

#### *Seasonal Wetland*

During the rainy winter months, standing water may form on the crater floor for two to three weeks at a time; however, flooding appears to have been less frequent in recent years. The deepest part or main portion of the seasonal wetland is a sump approximately 100 feet by 50 feet in area and can reach depths greater than 6 feet when flooded. A reinforced pump which allows pumping from a level below the sediment line of the sump is found in this area. A few berms have also been constructed around the sump. Other parts of the wetland have also been greatly modified. Parts of the wetland have been filled in with concrete and metal scrap, lumber, soil, and coral rubble.

At the time of this site visit, the sump was completely dry with the barren soil exhibiting large and deep cracks. A dense mat of dried California grass (*Brachiaria mutica*), 3 to 4 feet tall, and scattered *koa haole* shrubs surround the sump and other low lying areas within the seasonal wetland. Other plants observed in the now dry sump area included a few plants of castor bean (*Ricinus communis*), lion's ear, graceful spurge (*Chamaesyce hypericifolia*), 'ilima, Bermuda grass, cocklebur (*Xanthium strumarium* var. *canadense*), *pōpolo* (*Solanum americanum*), bristly foxtail (*Setaria verticillata*), and *Ammannia auriculata*. Two native sedges occur in and around the sump area. These are the endangered *Cyperus trachysanthos* and *Torulinium odoratum* subspecies *auriculatum*, a species of concern.

### Rare and Endangered Plants

Three endangered species are currently known from Diamond Head Crater. These plants are *Schiedea adamantis* and *Spermolepis hawaiiensis*, known from the crater rim area, and *Cyperus trachysanthos*, which is recorded from the seasonal wetland. One species of concern, *Torulinium odoratum subspecies auriculatum*, also occurs within the seasonal wetland. The *nehe* (*Lipochaeta lobata var. lobata*) is considered rare by The Nature Conservancy's Hawai'i Natural Heritage Program and has been observed on the southwest rim and slopes of the crater. A more complete discussion of these species is presented below.

Two other species were once known from the crater but are believed to have been extirpated from the site. *Ko'oko'olau* (*Bidens molokaiensis* formerly *B. cuneata*), a species of concern, was last observed in 1980 near the summit of Diamond Head. The endangered *Gouania meyenii*, a shrubby member of the buckthorn family (*Rhamnaceae*), was recorded as occurring in the crater bottom in 1831 by F.J. Meyen.

*Schiedea adamantis*: This endangered species is a member of the pink or carnation family (*Caryophyllaceae*), and is known only from the steep, dry slopes on the northwest rim of Diamond Head Crater. It is an erect, glabrous, small shrub, 12 to 24 inches tall. Leaves are opposite, and elliptic to oblanceolate (tapering at the base). Small, green to yellowish green flowers are arranged in a narrow, somewhat congested cluster of flowering branches. The fruit is a capsule, dehiscent upon drying; seeds are small, reddish brown, and kidney-shaped.

The population consists of a main population on the crater rim and two smaller satellite populations on the outer crater slopes nearby. This population is currently part of an intensive research program which will assist in the recovery of the species. The research team which has been monitoring the plants has noted that the population numbers have fluctuated in the recent years. In 1978, 67 plants were seen; in the 1989-1990 flowering season a total population size of 400 was recorded; 364 plants were found in 1994; 87 plants in 1996; and 108 plants in 1997.

The continued existence of this species is threatened by competition from alien plant species, fire, and trampling by humans.

*Spermolepis hawaiiensis*: The endangered *Spermolepis hawaiiensis* is a member of the parsley family (*Apiaceae*). It is a slender annual herb, 2 to 8 inches tall, with finely dissected leaves. Flowers are arranged in a loose, compound umbrella-shaped cluster; petals white. Fruits are oval, laterally compressed, constricted at the line where the two halves of the fruit meet, and covered by curved bristles. At present, a total of 12 populations is known from Kaua'i, O'ahu, Moloka'i, Lāna'i, West Maui, and Hawai'i. The total number of individuals statewide is estimated to be between 2,000 and 6,000 individuals. The O'ahu populations occur on Diamond Head Crater and on the U.S. Army's Makua Military Reservation.

The Diamond Head population is found on the east rim on a buttress ridge above the main entrance tunnel. Like the *Schiedea*, the population numbers fluctuate widely from year to year depending upon the amount and duration of the rainfall received. During the 1988 wet season when the plants were first observed, thousands of plants were seen in an area of several hundred square feet. In 1992, 10 plants

were observed during the dry season. No plants were found during a recent U.S. Fish and Wildlife (USFWS) study.

On the project site, the species is threatened by inadvertent trampling by humans who may use the rim trail, competition from alien plant species, and fire.

*Cyperus trachysanthos*: The Hawaiian name for this endangered species is pu'uka'a. It is a member of the sedge family (*Cyperaceae*), and is a perennial grass-like plant with a short underground stem (*rhizome*). The aerial stems (*culms*) are densely tufted, 8 to 18 inches tall, sticky, and leafy at the base. Leaves are long and narrow with a waxy coating, and somewhat leathery. The flower clusters are 2 to 3.5 inches long and 2 to 5 inches wide. Each flower head contains 10 to 30 pale, yellowish-brown spikelets, each of which contains 8 to 20 flowers. The fruit is a dark-brown, egg-shaped achene. Currently, this species is known from 8 populations with a total of 517 or more individuals on Ni'ihau, Kaua'i, and O'ahu. The plants are found in wet sites (mud flats, wet clay soils, or wet cliff seeps) on coastal cliffs or talus slopes between 10 and 525 feet elevation.

On the project site, *Cyperus trachysanthos* is found in and around the main sump of the seasonal wetland. Estimates of population numbers vary from 38 plants, to 40, and a more recent count of 56 individuals. The total area in which the plants occur within the seasonal wetland is approximately 150 by 70 feet. ~~Their distribution is inherently linked to the formation of the wetland during heavy winter rains. As such, the sedge species may not be present all year round, but rather a significant seed bank may persist from year to year, permitting re-sprouting during the rainy season.~~

The continued existence of this population of *Cyperus trachysanthos* is threatened by competition from alien plant species, fire, pumping of the sump for flood and mosquito control, modifications of the wetland topography, mowing and herbicide application, and runoff from nearby Hawai'i Army National Guard activities which may contain petroleum products or pesticides.

*Torulinium odoratum* ~~subsp.~~ *auriculatum*: The Hawaiian names for this member of the sedge family (*Cyperaceae*) are: pu'uka'a, kili'o'opu, kiolohia, mau'upu'uka'a, pūko'a, and pu'uko'a. This endemic subspecies is listed as a species of concern by the U.S. Fish and Wildlife Service, but is currently being considered for listing as endangered. It is an annual or sometimes short-lived perennial under favorable conditions. The aerial stems (*culms*) are solitary or a few together, 24 to 55 inches tall. Basal leaves are flat, and usually shorter than the aerial stems. The large inflorescences (clusters of flowers) are open, divided several times, and umbrella-shaped. The fruit is an oblong to oblong-ellipsoid, 3-angled achene. In Hawai'i, the plants are apparently rare in low elevation wet sites, such as margins of ponds and vernal pools, taro paddies, and along streams. It has been collected on Kaua'i, O'ahu, Moloka'i, Maui, and Hawai'i. The most recent collections have been from Diamond Head Crater, in 1937 and Ukumehame Gulch, Maui, in 1939.

The plants were rediscovered in and around the main sump of the seasonal wetland during the recent U.S. Fish and Wildlife Service study for the Hawai'i Army National Guard lands. A population of 30 to 50 individuals of this sedge was observed in the main sump during the course of the study.

Threats to the continued existence of this endemic subspecies on the project site are the same as those identified for *Cyperus trachysanthos*.

*Lipochaeta lobata* var. *lobata*: This member of the sunflower family (*Asteraceae*) is not listed by the U.S. Fish and Wildlife Service as threatened or endangered, or a species of concern; however, it is considered rare by The Nature Conservancy's Hawai'i Natural Heritage Program. The Hawaiian name for this *Lipochaeta*, and for most other *Lipochaeta* species, is *nehe*. It is a much-branched, perennial herb with arching-spreading to decumbent stems. Leaves are lanceolate-linear to ovate with a course, sandpapery texture. The daisy-like flower heads are solitary or in clusters of 2 to 3 per node; petals (ray florets) are yellow. The fruit is a tuberculate achene. The variety *lobata* is distinguished from the other variety, var. *leptophylla*, by its ovate to narrowly ovate leaves which are more evenly spaced along the stem. *Lipochaeta lobata* var. *lobata* is found in dry coastal habitats and dry shrublands on Ni'ihau, O'ahu, and West Maui.

On the Diamond Head project site, it has been reported from the south, west, and north portions of the crater along the rim, and inner and outer slopes. It is usually found on rocky substrates with the native grassland/shrubland plant community; common associates include 'ilima, *kāwelu* (*Eragrostis variabilis*), *pili* grass, and 'a'ali'i. The plants can be easily identified during the wet season when they are flowering profusely, but may be more difficult to find during the dry season when they shed their leaves and become dormant.

#### B. Anticipated Impacts and Mitigative Measures

Although the vegetation on the Diamond Head State Monument project site is dominated largely by introduced or alien species, there are still scattered remnant pockets of native vegetation and several rare and endangered species.

Basically, there are four main areas of concern regarding the endangered species, sensitive areas, and the proposed development plans for the crater. These are: (1) alien species such as *koa haole*, buffel grass, and fountain grass which compete for space, nutrients, and moisture; (2) fires which could eliminate the small populations of endangered species and promote the expansion of alien species; (3) low population numbers and limited distribution of endangered species; and (4) trampling by humans who may inadvertently wander onto sensitive areas.

The updated Master Plan includes protection of the endangered *Schiedea adamantis* habitat and the habitat of the other two endangered species, *Spermolepis hawaiiensis* and *Cyperus trachysanthos*, and one species of concern, *Torulinium odoratum* subsp. *auriculatum*. The rim trail and upper slopes in the area of the *Schiedea* and *Spermolepis* habitats will be off-limits to hikers. Other than at Lē'ahi Summit, hikers would not be allowed to hike on the crater rim. The existing seasonal wetland containing the *Cyperus* and *Torulinium* would be enhanced. Fire roads, firebreaks, and other fire-control devices are included in the design plan for the crater floor. A native dryland forest is proposed for the crater floor area.

Recommendations for management of the botanical resources found within the project site have been proposed in the recent U.S. Fish and Wildlife study of the Hawai'i Army National Guard lands and were briefly discussed in an informal report by the Environmental Office, Hawai'i Army National Guard et al. The U.S. Fish and Wildlife Service has prepared a recovery plan for the *Schiedea adamantis* and a draft recovery plan which includes the *Spermolepis hawaiiensis* and *Cyperus trachysanthos* is currently under

review. Detailed recommendations for the stabilizing, and eventual downlisting and delisting of these endangered species are given in the recovery plans.

### Recommendations

The proposed developments for the Diamond Head project have been sited so that they avoid sensitive areas with endangered plants (*Schiedea* and *Spermolepis* habitat) or provide for the enhancement of the habitat (seasonal wetland with *Cyperus* and *Torulinium*). A fire plan will be implemented. However, there is a need for the preparation of a Natural Resources Management Plan (NRMP) which covers the entire project site once the Master Plan and EIS are accepted. As part of the NRMP, a fire protection plan should be developed and implemented. In accordance with the recommendations of the Division of Forestry and Wildlife, this plan should include the installation of fire breaks within and around known colonies of endangered species and the removal of flashy fuels. The NRMP would involve the three agencies currently overseeing the protection of the endangered species-Environmental Office, Hawai'i Army National Guard; Division of Forestry and Wildlife, DLNR; and U.S. Fish and Wildlife Service. The Environmental Office would be the most logical agency to carry out the day to day management of the endangered species as well as areas with remnant native plant communities, as they already are stationed within the project site and nearby Fort Ruger. Funding for the preparation of and implementation of the NRMP can be a joint effort among the three agencies.

The following recommendations are made for the management of the natural resources on the project site.

#### *Endangered Species Habitat and Areas with Remnant Native Vegetation*

1. Removal/control of alien plants: Control methods may involve hand-pulling and/or local herbicide application. Periodic follow-up visits to monitor each site should be made. Long-term field studies conducted for areas with native grassland/shrubland have shown a trend of alien grass species replacing the native *pili* grass, *kāwelu*, and *kākonakona*.

Of particular concern is the recent spread of fountain grass (*Pennisetum setaceum*) onto the slopes of the crater. Recently, the U.S. Fish and Wildlife and the State Department of Land and Natural Resources approved additional personnel to assist the Oahu Fountain Grass Working Group in eradicating fountain grass from Diamond Head Crater. The control methods consist of manual clearing (pulling weeds, clipping of flowering seed heads), chemical application (herbicide Velpar), and incineration of collected material to prevent inadvertent dispersal by field personnel. Focus areas for fountain grass control include Diamond Head trail, where seed can hitchhike onto visitor's clothing, and "fringe" areas where fountain grass has been observed moving into new areas.

An effective alien plant control program must consist of replacing the removed alien plants with native plants. This will decrease the potential for the alien plants re-invading the control areas, thereby facilitating a more permanent solution. Simply removing the alien plants will only result in a continuous cycle of control and invasion.



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2. **Fire control:** Fire-breaks should be constructed around areas with endangered species and the larger native grassland/shrubland communities. Removal of alien plants in and around sensitive sites would also decrease the fire load.
3. **Establish additional populations of endangered and rare species:** The extremely small numbers of individuals and their limited distribution make them especially vulnerable to fire or a natural fluctuation in the number of individuals during prolonged periods of drought. Suitable sites for outplanting should be selected after careful review; those areas with remnant native grassland/shrubland communities would be ideal candidate sites.

Adequate protection of the *Scheidea adamantis* can only be achieved by establishing numerous populations at different locations in and around the crater. Efforts to restore this plant at the current location have met with failure due to the extreme environmental conditions that exist at the rim. Suitable sites should be close to a consistent water source for drip irrigation so plants will survive and reproduce.

*Database Information and Monitoring*

1. **Database collection:** Information on the natural plant communities and an inventory of the species within the project site should be gathered and mapped over several wet seasons. Population numbers of plant species fluctuate widely depending on the amount of rainfall received. Additional, undetected populations of *Schiedea* and *Spermolepis*, and, perhaps, *Bidens molokaiensis* may be found.
2. **Periodic monitoring for alien species:** The vegetation, especially around trails and scenic lookouts, should be monitored periodically for alien species which could be accidentally introduced onto the site. The portion of the project site adjacent to the residential lots, on the outside base of the crater, should also be monitored for landscape species which may have escaped, especially members of the cactus (*Cactaceae*) and spurge (*Euphorbiaceae*) families. Plants should be removed when their numbers are few and still controllable.

*Restoration of Native Dryland Forest*

1. **Long-term maintenance:** The replanted areas need to be weeded and watered on a regular basis. Past efforts with dryland tree plantings on the crater floor survived for just a few years without regular maintenance. It is unlikely that the restored habitats, including the seasonal wetland, will ever be completely self-supporting or maintenance free.

The Hawaii Army National Guard Environmental Staff recommends that drip irrigation systems be used in the absence of a dedicated water source. Permanent systems may be too expensive to install over large areas. Drip emitters would feed a slow water drip (1 gal/day) to the root systems of native plants. Selective watering will enhance root development and promote native seedling survival. The overall result is establishment of native plants to prevent alien species encroachment. With such a system, large plant species can be sustained in high evaporative conditions with only a few ounces of water per day.

2. Selection of stock: Only dryland plant species from the island of O'ahu should be used for the replanting effort. Native plants already occurring on the site should be given first priority, then native dryland plants from southeast O'ahu (i.e. ridges behind Hawai'i Kai, Koko Head, Koko Crater, Makapu'u, etc.), and then plants from other dryland forests/shrublands on O'ahu.

#### 4.8 Fauna

Field surveys were conducted by Tim J. Ohashi on November 8-9, 1998 to assess the wildlife resources found within and around the Diamond Head State Monument. The objective of the survey was to provide a record of wildlife for the area and to determine whether the planned actions would affect wildlife. The following section is a summary of the survey. The complete report on the results of the survey is attached as Appendix C.

##### A. Existing Conditions

##### Mammals

###### Small Indian Mongoose (*Herpestes auropunctatus*)

The small Indian mongoose is a common component of the naturalized *kiawe* forest community throughout the Hawaiian islands. Some tracks were seen on the unpaved trails within the crater on November 8, 1998. A carcass of a mongoose was found on the outside of the crater on November 9, 1998. The mongoose is an aggressive highly adaptable species and has spread to all vegetative zones of each island it has occupied. Its greatest concentrations are in beach and lowland areas. It is omnivorous, feeding on both plant and animal matter.

###### Feral Cat (*Felis catus*)

A black feral house cat was seen in the crater crouched in the middle of a road on the crater floor in the late morning on November 8, 1998. Scats of feral cats were found throughout the crater and along the foot trail on the outside base of the crater. They are an important predator on rodents, but may also be a significant predator on doves and other ground foraging species such as the gray francolin. Three other feral house cats were seen at the abandoned Cannon Club grounds on November 9, 1998. Two were black the other gray and white. It is very likely that these cats are being fed. Feral cats colonies are common throughout O'ahu, and Diamond Head State Monument is no exception.

###### Other Mammals

Four rodents occur in Hawai'i. There are three species of rats, the roof rat (*Rattus rattus*) the Norway rat (*Rattus norvegicus*), the 'iole or Polynesian rat (*Rattus exulans*) and the European house mouse (*Mus domesticus*). No rodent trapping was conducted to determine which species are present within Diamond Head State Monument, however, it is very likely that at least the mouse is present and probably the roof rat. In spite of its name, the house mouse is very well adapted to the field and can subsist entirely in a wild state. If populations are high, the mouse can compete with seed-eating birds for resources. The roof rat is adapted to a wide variety of environments. It is locally common at lower and middle



elevations and may have displaced the 'iole in many parts of O'ahu earlier this century. The roof rat has been noted specifically as a predator on native birds where it is the prominent species in remote forests of Hawai'i. The 'iole is characteristically a lowland rodent. Hawaiian populations are non-commensal in that they do not inhabit human dwellings, but flourish best in agricultural lands and do well in wooded and grassy gulches and waste areas. The 'iole is presumed to have come to Hawai'i over 1,400 years ago, with the first human colonizers.

The native federally listed endangered Hawaiian hoary bat (*Lasiurus cinerius semotus*) was not observed during the survey. The Nature Conservancy of Hawai'i's Hawai'i Natural Heritage Program records reveal no bat sightings within the monument boundaries or adjacent areas such as Kapi'olani Park and Honolulu Zoo. Night observations made by personnel of the U.S. Fish and Wildlife Service on June 19, 1997 did not detect any bats on National Guard property within or outside the crater. Kepler and Scott do not list Diamond Head or any nearby area having had any record of bats between 1964 and 1983. They reported that the few scattered records from O'ahu could be attributed to vagrant individuals from other islands.

## Birds

### Zebra Dove (*Geopelia striata*)

Zebra doves were the second most numerous bird in Diamond Head State Monument. It is also known as the barred dove. It is well adapted to the naturalized *kiawe* woodland where it feeds on seeds of *haole koa*, *kiawe*, *'uhaloa*, and grasses. Zebra doves exist in nearly all types of land-use conditions including urban areas. The zebra doves range is shared with the spotted dove but the larger dove extends its range to higher elevations and tolerates greater rainfall and occurs in more heavily wooded areas. The daily activity pattern is dependent on the availability of suitable sites for feeding, roosting, nesting and watering. Throughout most of their range, these sites are in close proximity and require very little movement by the birds during the day. The project area appears to provide sufficient nesting, roosting and feeding sites for zebra doves. No natural open water sources were identified during the survey. It is very likely that zebra doves rely on artificial sources of water that occur throughout the urbanized areas in and around Diamond Head Crater. The future of the dove population will be dependent on whether planned improvements create or remove such suitable sites.

### Spotted Dove (*Streptopelia chinensis*)

The spotted dove is also known as the lace-necked dove. This is the larger of the two species of doves. It is often less abundant than the zebra dove in the same range. It ranked third in abundance in the bird survey. The zebra dove and spotted dove tend to feed on different plants or use plants at different stages of succession. Spotted doves prefer larger seeded or fruit producing species. It is also suited to all types of land use. Surface water either fresh or brackish or succulent fruit is a prerequisite for good spotted dove range. The health of both dove populations will be dependent of the availability of suitable sites for nesting, roosting, feeding and watering.

### Feral Pigeon (*Columba livia*)

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A total of seven feral pigeons were observed outside the count periods, six flying above the crater rim and one roosting or nesting in crevices on the leeward rocky cliffs facing the zoo and Kapi'olani Park. A large number of white pigeons occur in Waikīkī, and the birds that were encountered on Diamond Head no doubt mix with the birds in the park and beach, but were not all white. The birds observed had mottled plumage of blue gray and reddish. No pigeons were observed feeding on the ground in the crater during the survey.

House Finch (*Carpodacus mexicanus*)

House finches or linnets are an introduced migratory bird from North America. House finches were observed throughout the project site and ranked 5th in abundance during survey counts. House finches are common in open wooded lands and feed on seeds, soft fruit, and insects. About 44 house finches were observed under one fruiting *kiawe* tree feeding among the pods that had dropped to the ground. *Kiawe* seeds, pods and leaves are a very important foods for many species of birds inhabiting the *kiawe* woodland. House finches are highly adaptable to all types of land use, inhabiting cities and towns in the lowlands, but are most abundant in open woodlands, forest edges and pastures. Habitat requirements include open water sources which may be a limiting factor in their distribution.

English Sparrow (*Passer domesticus*)

English Sparrows are also known as house sparrows. English sparrows were not encountered on any count station. They were observed in the irrigated portion of the Crater near the public restrooms, feeding on grass seeds under the kukui in mixed aggregations with house finches, java sparrows, and zebra doves. They are very well adapted to the urban environment and have a commensal relationship with man. They are not well suited to wild environments. English sparrows require man-made structures to nest. The removal of buildings in the crater may cause a decline in English sparrow numbers, however, ample suitable sites occur outside the monument in the surrounding urban area.

Common Myna (*Acridotheres tristis*)

Myna birds were not abundant in the crater. They were encountered on four count stations. Mynas can be common to abundant in lowland areas of the inhabited islands, being most common in residential areas in the vicinity of human habitation in outlying districts. Mynas are expected components of a naturalized *kiawe* woodland. They are omnivorous, feeding on fruits and animal matter and may be in competition with the more recently introduced red-vented bulbul in some portions of their shared ranges. Mynas are cavity nesters and often use buildings to nest. They roost communally and occur in large numbers in banyan trees or other densely foliated tree. Mynas are known to pilfer both spotted dove and zebra dove nests.

Red-vented Bulbul (*Pycnonotus cafer*)

Red-vented bulbuls were the most abundant bird during survey counts and on thirteen of the count stations, in every type of vegetation and terrain. The red-vented bulbul is a relatively recent addition to the avifauna of O'ahu. They are presently restricted to the island of O'ahu, although there have been reports of red-vented bulbul in the Panacea area of Hilo on the Big Island. They inhabit dry lowlands and upper elevation wet forests. They are aggressive, highly adaptable and omnivorous in diet. The red-

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whiskered bulbul (*Pycnonotus jocosus*) which is closely related, is locally common from Hawai'i Kai to Pearl City. Red-whiskered bulbul may prefer wetter areas on the laced, although they have been seen in Kane'ohē and Kailua. No red-whiskered bulbul were encountered within the project site.

Java Sparrow (*Padda oryzivora*)

Four Java sparrows were counted during station counts and could be seen foraging on the lawn grass seeds near the restrooms of Diamond Head State Monument. Like the bulbuls, Java sparrows have become common on O'ahu within the last 20 years. They are often seen in pairs or in flocks. They are primarily seedeaters and can be seen foraging on lawn grasses in urban areas. They roost communally in trees and nest in tree cavities or under the eaves of buildings.

Red crested cardinal (*Paroaria coronata*)

The red-crested cardinal is also known as the Brazilian cardinal. It is a common bird of lowland habitats and is a component of the naturalized the *kiawe* woodland on O'ahu. It is often seen in pairs, where the sexes are similar. It is omnivorous in diet and were seen feeding among the fallen pods of the *kiawe*.

Japanese Bush Warbler (*Cettia diphone*)

A Japanese bush warbler was detected at one count station and later was observed clearly among the sparse dry grasses and shrubs of the crater floor. They are usually secretive and difficult to see in the dense understory. It is primarily insectivorous but will take fruit and nectar.

Japanese White-eye (*Zosterops japonicus*)

The Japanese white-eye was common in the project site. It is a ubiquitous species inhabiting a variety of vegetation zones from sea level to high elevation forests. It feeds on fruit, nectar and insects. Its population will probably be enhanced with the increase in semi-wild areas.

Northern Cardinal (*Cardinalis cardinalis*)

Northern cardinals are also known as the Kentucky cardinal or Virginia cardinal. It was observed on two count stations during the survey. It has a wide range of habitat preferences and does very well in dry lowlands. It feeds on seeds, fruit and insects. Planned improvements to the park will enhance the northern cardinal population since it will increase the semi-wild conditions. Northern cardinals are introduced birds with a legal status of migratory bird, thereby being protected by federal treaty.

Pacific Golden Plover (*Pluvialis dominica*)

Six Pacific golden plovers were seen on feeding territories on the grassfield in the central part of the crater and along the roads. Pacific golden plovers are winter residents and are in Hawai'i from August to May. They are solitary birds and establish daytime feeding territories which they will defend, but may form roosting flocks or roost alone on rooftops at night for safety. A plover will often feed in one location and roost in another. An increase in mowed grass or sparsely vegetated bare ground, plover feeding habitat may increase to support more territorial birds.

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Gray Francolin (*Francolinus pondicerianus*)

Gray francolins were observed during the survey. The gray francolin population in Diamond Head is an isolated population that may be from later releases after their introduction into Hawai'i in 1958. They were not common on O'ahu, being restricted to Lualualei Valley and Diamond Head, until the Division of Forestry and Wildlife began releasing birds about five years ago from Moloka'i. They are omnivorous and may take mice and lizards as well as plant seeds and fruit. The gray francolin population may be limited in Diamond Head due to predation from cats and mongoose.

Nutmeg Mannikin (*Lonchura punctulata*)

Two nutmeg mannikins or rice birds were observed behind residences feeding on fountain grass seeds in a dry drainage channel. No mannikins were encountered during the count periods. There was a noticeable lack of grass seed production throughout the crater, but with the winter rains approaching there will be a flush of production which will benefit mannikins and other seedeaters.

Common Barn Owl (*Tyto alba*)

No owls were seen during the survey during the dusk period, but the skeleton and feathers of a common barn owl were found near the intake box at the wetland. The partially digested exoskeleton of roaches were within the rib cage suggesting that the owl had been feeding on these insects. Owls are very conspicuous, if one was present in the crater, it would have been seen.

Common Waxbill (*Estrilda astrild*)

A pair of waxbills was observed outside the count period within the crater. They are locally common and widespread in lowlands of O'ahu and a relatively recent introduction being first identified in the late 1970's. Diamond Head and Kapi'olani Park were once noted for their interesting array of introduced finches, however, these were not observed during this survey.

White Tern (*Gygis alba*)

White terns were seen outside monument boundaries over the coastal residences south of Diamond Head. White terns are common around Diamond Head, Kapi'olani Park and throughout Honolulu. They will nest on tree branches or ledges without building any nest. Predation is a factor in limiting their numbers. Adults will arrive from sea in February and depart by September, but some pairs remain on O'ahu where they nest year-round.

Parrots (*Psittacidae*)

A flock of thirteen parrots, probably red-crowned amazons (*Amazona viridigenalis*) were seen flying northward on the outside of the crater over the main entrance high above the crater rim on the morning of November 9. They had medium length tails but were not readily identifiable. Judging by their flight, it is unlikely that they originated their flight from within the monument boundaries and they appeared not to be headed anywhere within the project site.

### Other Birds

Recent surveys, conducted by the U.S. Fish and Wildlife Service, reported the federally listed endangered common moorhen (*Gallinula chloropus sandvicensis*) and the Hawaiian coot (*Fulica alai*) being present in the wetland of Diamond Head State Monument during April 1997. The berm around the wetland would suggest that it is being restricted to an area of approximately 4,000 to 8,000 square feet including the ditch that leads under the road to the north of the pump. Dry California grass rimmed the bermed area. In times of rainfall the water that accumulates within the berm is pumped out. Aquatic snail shells were found in low lying depressions south of the berm area suggesting that the *kiawe* forest may also be flooded with heavy rains. Waterbirds are opportunistic and rely on intermittent water for feeding. If water persists, they can be expected to colonize the wetland if feeding, nesting, loafing and cover conditions are favorable.

1998 Hawai'i Natural Heritage Program records show a pueo (*Asio flammeus sandwichensis*) record for Diamond Head Crater on September 19, 1992. Knowledge of pueo distribution and status on O'ahu is poor. Pueo population on O'ahu is listed by the state as endangered. They are definitely rare on O'ahu, and most pueo reports turn out to be the introduced common barn owl. Pueo are active at dawn, dusk and often at midday. They inhabit dry lowlands and rain forests but are more often seen in grasslands where they hunt for rodents. Pueo do take birds which may explain why they have developed a habit of foraging during the day. They build their nests on the ground, and may be highly vulnerable to introduced mammalian predators.

### **Endangered Species**

USFWS records indicate the documented or potential presence of the following rare and/or federally listed, endangered species:

<i>Asio flammeus sandwichensis</i> (Pueo, Hawaiian owl)	native bird protected under State Endangered Species Law
<i>Fulica alai</i> ('Alae ke'oke'o, coot)	endangered waterbird
<i>Gallinula chloropus sandvicensis</i> ('Alae 'ula, moorhen)	endangered waterbird
<i>Anas wyvilliana</i> (Koloa, Hawaiian duck)	endangered waterbird
<i>Pluvialis fulva</i> (Kōlea, Pacific golden plover)	migratory bird protected under the Migratory Bird Treaty Act
<i>Anax junius</i> (dragon fly)	native dragonfly
<i>Pantala flavescens</i> (dragon fly)	native dragonfly

### B. Anticipated Impacts and Mitigative Measures

The Diamond Head State Monument Master Plan calls for the enhancement and expansion of the semi-wild environment within the crater and development of amenities for more recreational park-like qualities on the outside. It also prescribes the improvement of the wetland to allow open water to persist which will provide permanent wetland habitat for endangered Hawaiian waterbirds. A wetland will probably draw other native waterbirds to the crater such as the black-crowned night heron (*Nycticorax nycticorax hoactli*), the Hawaiian stilt (*Himantopus mexicanus knudseni*), the koloa (*Anas wyvilliana*) and migratory waterfowl and shorebirds. The implementation of master plan will not negatively impact

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any of the introduced species described in this report. Wetland enhancement will not only encourage waterbirds to reside within the crater but will provide a ready source of water necessary to enhance the survival of many introduced species. A wetland will require continual maintenance to control vegetation that may choke out the open water. Predator control is recommended and unlike any other state or city park, the deliberate maintenance of a feral cat colony through feeding, will be counter productive to the development of a wetland to sustain native endangered waterbirds.

Ecological Services at the United States Department of the Interior recommends draining the wetland periodically in order to eradicate non-native fish that compete with native waterbirds for food sources such as algae and native invertebrates and in order to make the wetland accessible for weed control. Weed control methods that retain the resting eggs of native crustaceans should be used (i.e. do not bulldoze.) Ecological Services suggests that some fluctuations in water level be maintained because the native sedges may require periodic flooding. Natural hydrology should be modified in order to maintain water in the wetland during dry years. Such a managed fish free wetland may be support native waterbirds year-round and may also be used as a reintroduction site for the proposed endangered orange black damselfly (*Megalagrion xanthomelas*) or the endangered water fern *Marsilea villosa*. Regardless of the chosen method for managing the wetland Ecological Services strongly recommends active trapping for predators such as mongooses, rats, and feral cats as they feed on eggs and birds.

The property may be harboring rodents that could be dispersed to the surrounding areas when buildings are demolished or sites are cleared. Before any demolition or site clearing rodents will be eradicated and the Department of Health Vector Control Branch will be notified as required under Hawaii Administrative Rules Chapter 11-26, Vector Control. To eradicate rodents before any demolition or site clearing rodent traps and rodenticides will be set out on the site for at least a week, or until the rodent activity ceases.

Diamond Head sediments may have never been examined for prehistoric bird bones. During the EISPN public review process, Alan Ziegler suggested that care should be taken in any significant excavation. An archeologist experienced with identifying fossil remains should monitor such excavations and investigate whether Diamond Head sediments contain fossil bird bones as have been found at Mōkapu within Ulupa'u Head.

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**5.0**  
**Assessment of the**  
**Existing Human Environment,**  
**Potential Impacts, and Mitigative Measures**



## 5.0 ASSESSMENT OF THE EXISTING HUMAN ENVIRONMENT, POTENTIAL IMPACTS, AND MITIGATIVE MEASURES

### 5.1 Archaeological and Historic Resources

#### A. Existing Conditions

Diamond Head is a noted representation of the natural forces of island creation. Looming over the Waikīkī plain, it was the backdrop, if not an active setting, for the activities of the Hawaiian chiefs from at least the 15th century until the late 1800s. As the site of Fort Ruger, it was the vanguard installation for the defense of Hawai'i and the mainland in the first half of the 20<sup>th</sup> century. Since the 1950s, it has suffered bulldozing and demolitions, brush fires and brush fire fighting, and even 1960s rock concerts.

Diamond Head is now preserved as a State monument to the natural and cultural history of the region. Plans are currently in process by the Division of State Parks for an improved interpretive program that transmits an understanding and appreciation of the history of the crater to monument visitors (Yent 1998).

Historical research indicates a long history of human activity around the crater, but within the crater itself, it was not until the 20<sup>th</sup> century and the development of coastal defenses that significant, land-form altering events took place. This is reflected in the cultural resources that were identified during the present survey, almost all of which are related to the military occupation of Fort Ruger. The exceptions are the remains of Nā La'au Arboretum that was a recent use of the exterior crater slopes, small arms bullet casings on the interior slopes that might date to the turn-of-the-century, and the wetland area that might hold clues to the paleoenvironment of the crater.

#### Traditional Sites

The archival research, previous archaeological studies, and the present field survey suggest that there is little likelihood for archaeological sites of pre-contact Hawaiian or early post-contact origin. Historical documents note only that possible dryland farming might have taken place in the crater; there are also stories of human burials in the crater walls and human sacrifices on the interior crater slopes. These historically referenced possibilities for cultural remains were checked during field survey, with no evidence for any such remains found. No other cultural remains that pre-date the military period were discovered.

One *heiau* is said to have been located on the summit of the crater, although the information source for this is ambiguous. Of the numerous other religious sites identified in the Waikīkī region, the closest to the State monument were on the lower exterior flanks of the crater, outside of the monument boundaries. The reconstructed distribution of Waikīkī *heiau* indicates a clear focus toward the Waikīkī plain of *heiau* associated with the high chiefs (e.g., Papa'ena'ena Heiau on the prominent overlook below Diamond Head and 'Āpuakēhau Heiau in the middle of the chiefly residential area along the beach); fishing *heiau*, on the other hand, are on the low cliffs overlooking the ocean on the south side of the crater, once noted as a famous fishing grounds (Clark 1977). As in pre-military historic times, Diamond Head seems to have been the background to, rather than the stage upon which, events took place.

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No subsurface testing was carried out during the present project. There is a slight possibility for buried cultural deposits, particularly in areas that have not been extensively graded or excavated (e.g., southwestern slopes and the upper gullies in the northwestern portions of the interior crater).

After consultation with representatives from the Office of Hawaiian Affairs, we asked Dr. George Kanahale to analyze the impact of this project on cultural practices and features (including traditional and customary gathering rights of native Hawaiians, legends, oral histories, heiau and shrines) associated with Diamond Head. Dr. Kanahale wrote the following:

*"It seems clear to me that from a Hawaiian cultural point of view, Diamond Head's importance is mythological, i.e., rooted in Pele. It was kapu. The most kapu place was the crater or pit (or lua as luakini), where Pele resided. Hence, no Hawaiian would think of living, working, or even visiting there, just as no Hawaiian would think of living, working, or visiting a leina a ka uhane (leaping off place). This explains why no evidence of pre-Cook human habitation has been found in the crater. Besides, what thinking Hawaiian would want to live or work in that inaccessible and harsh environment.*

*We can safely conclude that the kapu on Diamond Head and the crater was broken years ago, when Papa'ena'ena heiau lost its mana and when people ceased to worship there (unlike Halema'uma'u where Hawaiian practitioners still worship and conduct ceremonies and rituals).*

*In any case, the crater's importance, then, would be in its geological and botanical environment. In other words, the Hawaiian cultural importance of Diamond Head is to be found on its flanks rather than the crater."*

#### Military Sites

Virtually all sites located during the present survey are related to the development of Fort Ruger as part of the coastal defenses of O'ahu, which clearly stands as the most significant recorded historical event in the history of Diamond Head. The sites range from massive reinforced concrete batteries to reservoirs to soil-bermed firing ranges, and they date from 1909 to the 1950s. The essential components of the coastal defense complex of Fort Ruger are located within the State monument boundaries. The four batteries are Harlow, Hulings, Dodge, and Birkhimer and they represent three main periods of defense development: Battery Harlow was the original coastal defense facility and the other three batteries were built as part of a subsequent land defense network; Battery Birkhimer was remodeled in 1920-21 and reflects the changing orientation in defensive strategy given post-World War I changes in armament technology. The Lē'ahi Fire Control Station was built in support of Battery Harlow (as well as batteries at Fort DeRussy) and is particularly significant as an unusually complex example of fire control buildings. The other sites include other fire control stations, searchlight housings, observation points, magazine tunnels, and gun emplacements.

The National Register of Historic Places (NRHP) nomination form for the Fort Ruger Historic District (Appendix C) states that the fort is "significant in the history of the military in Hawai'i as the first coastal defense fortification established by the United States Army in the Islands" (Hibbard and Nāpōkā 1980). It further specifies that the Lē'ahi Fire Control Station is particularly important as a unique example of such facilities, being the most elaborate construction of this type of facility in the United States.

Since the 1950s when the U.S. Army relinquished control over much of the installation, many facilities have been altered and demolished. However, even if most of the support and administrative facilities of the fort are in alternative uses or are only concrete foundations, the defensive structures remain as testament to this important part of U.S. military presence in Hawai'i. Many are in excellent condition and clearly demonstrate the important function they served in protecting O'ahu's southern coastline.

#### B. Anticipated Impacts

Based on the defined evaluation criteria, the following areas are designated areas of potential cultural resource sensitivity.

**All sites identified during the present survey.** Until such time that an inventory level survey can be carried out, sites identified during the present survey should be considered sensitive areas. This includes the Fort Ruger grounds which includes standing structures, concrete foundations, roads, and retaining walls. Inventory level survey will allow the recording of sufficient site information so as to make evaluations of significance as defined by the NRHP. Although many of the major coastal defense features fall within the Fort Ruger Historic District, inventory level documentation of these features has not been completed. The only site for which there is detailed documentation is Battery Harlow (Allen and Shideler, 1996).

**Wetland.** Although this is technically not a cultural site, the wetland has the potential to produce paleoenvironmental data that could contribute to a better understanding of the crater environment in pre-contact times. The full extent of the wetland, however, is difficult to determine because of modern alterations to the central crater and the boundary is an estimation.

**Relatively undisturbed portions of the crater floor.** The absence of historical or traditional references to use of the crater interior does not discount the possibility that it may have been used in pre-contact or early historical periods. There have been no subsurface archaeological investigations (other than the present wetland coring) to refute or substantiate the presence of buried cultural deposits reflecting human use of the crater before the military occupation. The western portion of the crater (the slopes below and south of the Lē'ahi Fire Control Station and the upper gullies north of the State Parks trail) may have some potential for buried deposits, based on the fact that late 19<sup>th</sup>/early 20<sup>th</sup> century ammunition was found in this area (which suggests that there may be little disturbance in the area). A rough guide to the boundary of this undisturbed area is the graded road that encircles the central portion of the crater (C. Hosokawa 1997).

**Caves and crevices in the steep portions of the crater wall.** Although there are apocryphal stories of burials in the crater, as well as historical but second-hand references to cave burials being rifled, only a full survey of the cliff areas would eliminate the possibility of human remains in caves and crevices of the crater wall. There are portions of the crater rim that would most likely contain burials (if any exist).

#### C. Mitigative Measures

The evaluation of cultural resource sensitivity is a preliminary step in cultural resource documentation. For the purposes of the master plan process, it provides a broad view of archaeological and historical site potential that allows for an informed assessment of future data collection and management requirements for defined areas of the monument. The next step in the documentation process, which can be phased as

development plans become more detailed and concrete, is an inventory survey, as called for in the State of Hawai'i rules governing procedures for historic preservation review (under HRS Chapter 6E).

Table 3 on page 80 of Appendix C summarizes the recommendations by site and sensitive area. These recommendations will be incorporated into the updated master plan for implementation as part of future development projects (as they come on-line).

In addition, the Oahu Burials Council and the State Historic Preservation Division will be contacted if any human burials, artifacts, or other cultural remains or deposits are encountered during the excavation and grading phases of the project. Moreover, if warranted, a consultation process will be initiated for the proposed project and the Office of Hawaiian Affairs will be named a required consultant pursuant to Section 106 of the National Historic Preservation Act.

**Inventory Survey.** An inventory level survey would identify, locate, and record sites in sufficient detail to allow evaluations of site significance based on NRHP and State criteria. An additional purpose of the survey (specifically for management purposes) would be to establish baseline data on site conditions against which future conditions can be monitored. Areas designated as having potential cultural sensitivity should be surveyed at the inventory level prior to any State Parks development.

A detailed architectural study of Lē'ahi Fire Control Station is recommended as a mitigation action as part of the current plans for interpretive development of the monument (Yent 1998). The structure, which is highly significant as a unique and complex example of fire control stations, is presently the destination of many of the visitors to the State Monument. The intensity of public use has a deteriorating effect on the integrity of the structure, which should be documented in detail before it is further adversely impacted. It can only be anticipated that public use will increase with additional development of the State Monument.

If any future development in sensitive areas of the crater entails subsurface excavation (e.g., trenching, grubbing, or grading), it is recommended that an archaeological monitor be present to examine exposed soil profiles or deposits. This will allow an evaluation of the above sensitivity assessment for relatively undisturbed areas of the crater, which can be revised, if necessary, after the first monitoring has been conducted.

**Management Recommendations.** Based on the recommended inventory survey and particularly the significance evaluations, further recommendations can be made as to [1] future data collection requirements such as detailed architectural recording or archaeological data recovery, and [2] long-term preservation requirements for significant sites, particularly those in areas of high public use. It should be noted that, at present, the primary sources of potential damage to historic structures are from vandalism and general deterioration. Vandalism is represented primarily by graffiti and trash and is most evident in the Fort Ruger area, at the retractable searchlight bunker on the southern crater rim, and in the exposed concrete reservoir on the western exterior slopes. All structures are suffering from some degree of deterioration; the Lē'ahi Fire Control Station is particularly vulnerable due to the high public traffic. The present restrictions to public access to most parts of the crater, however, have generally helped to preserve and protect the structures.

**Interpretation.** From the very inception of the monument in the early 1960s, there has been a strong interest in the history of Fort Ruger and the military structures as historic sites. Future interpretive development of the monument should acknowledge this original (and continuing) interest.

An example of integrating interpretation and recreation, as well as disparate interpretive themes, is an eastern crater (below) rim trail that utilizes the existing road cut, Battery Hulings and Dodge and the 6-pound gun emplacements as observation points. A trail that follows segments of the early 20<sup>th</sup> century road that connected the various components of the defensive system, and interpretation can deal with the emplacements themselves (how they were used), as well as how they fit into the overall defensive system. The emplacements and trail offer excellent (and already constructed) vantage points from which to view the interior of the crater (including almost all of the identified sites), east Honolulu, and inland toward the Ko'olau mountain range. Interpretation can be directed into the crater with a focus on the defensive complex and out of the crater addressing any number of interpretive themes (including traditional Hawaiian settlement and activities) that tie the crater to a larger regional and historical context. As early as 1906, the visual assets of a rim trail were recognized (Advertiser 1906:5):

From the rim of Diamond Head crater the wonderfully symmetrical basin strikes one as a beautifully laid out park. ... If the climber were to see nothing more than the floor of the crater and the green sides sloping into it he would feel repaid for his exertions in climbing. Once on the rim he finds that he can walk around two-thirds of the crest on a comparatively good path from every point of which an ever changing panorama presents itself of the beautiful city of Honolulu and its suburbs and the irregular surf-bordered shore of the island.

**Cultural Resource Management Plan.** Ideally, a cultural resource management plan (CRMP) for Diamond Head State Monument should be completed at the earliest opportunity. Such a plan would incorporate the above three recommendations: [1] inventory survey of the monument, including full site documentation and evaluations of significance, [2] management recommendations for identified sites in the context of short-range development plans and long-range maintenance and preservation, and [3] incorporation of historical sites into the monument interpretive program. Although these recommendations could be carried out independently, an integrated CRMP approach is more effective for planning purposes.

## 5.2 Roadways and Traffic

Parsons Brinckerhoff Quade & Douglas (PBQD) prepared a *Traffic Impact Analysis for the Diamond Head State Monument Master Plan*. This report is attached to this EIS as Appendix E and summarized below.

### A. Existing Conditions

Regional and sub-regional access to Diamond Head State Monument is provided primarily by a network of arterial and collector roadways. Access to the H-1 Freeway is provided by a combination of Campbell Avenue and Kapahulu Avenue and a combination of 18<sup>th</sup> Avenue, Kīlauea Avenue, Hunakai Street, and Wai'alae Avenue. Access to Waikīkī is provided primarily by Diamond Head Road/Monsarrat Avenue. Residential collector roadways within the Kaimukī area also provide secondary access.

*Diamond Head Road.* Diamond Head Road provides the primary access to the DHSM. Diamond Head Road also provides access to KCC and other non-residential uses in the area. It is a two-lane, two-way

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major collector that traverses the north, east, and south slopes of Diamond Head crater. It has a posted speed limit of 25 miles per hour (mph). Intersections in the vicinity of the DHSM are located at Makapu'u Avenue, Kapi'olani Community College (KCC) Driveway, DHSM Access, and 18th Avenue. All intersections are unsignalized, T-intersections with stop-sign control on the intersecting street approaches.

*Makapu'u Avenue.* Makapu'u Avenue is a two-lane, undivided major collector that connects Kīlauea Avenue to Diamond Head Road. The posted speed limit is 25 mph. Makapu'u Avenue provides access to Lē'ahi Hospital and to KCC parking lots.

*Kapi'olani Community College Access.* The entrance to KCC provides access to campus parking. The entrance is approximately 825 feet west of the DHSM access. Additional entrances to KCC are provided along Makapu'u Avenue and Kīlauea Avenue.

*Diamond Head State Monument Access.* The DHSM access is a two-lane, undivided roadway. The roadway passes through the wall of the crater via Kāhala Tunnel. The posted speed limit of the access road is 10 mph and 5 mph through Kāhala Tunnel.

*18th Avenue.* 18th Avenue is a two-lane major collector between Diamond Head Road and Kīlauea Avenue. North of Kīlauea Avenue, 18th Avenue is a two-lane residential roadway. The posted speed limit is 25 mph.

Operations of the intersections in the project vicinity were analyzed to identify existing intersection operational characteristics. The intersections were analyzed using the methodologies for unsignalized intersections outlined in the *1994 Highway Capacity Manual*. Operating conditions at an intersection are expressed as a qualitative measure known as Level of Service (LOS) ranging from A to F. LOS A represents free-flow operating conditions, while LOS F represents congested conditions. The overall intersection LOS is a weighted average of the LOS of individual traffic movement groups. In addition to traffic volumes, intersection analyses included data such as peak hour factors, truck percentages, and roadway grades.

According to the *Traffic Impact Analysis for the Diamond Head State Monument Master Plan* report (Appendix D), the existing conditions intersection level of service analysis shows that the intersections in the project vicinity operate acceptably overall. During the peak hours, left turns out of Makapu'u Avenue and 18<sup>th</sup> Avenue experience delay. Because the magnitude of traffic demand for these movements are relatively low, and because the delay occurs only during the peak hours, this situation may be acceptable. Should there be a community desire to provide traffic signal control, both the Makapu'u Avenue and 18<sup>th</sup> Avenue approach volumes satisfy the peak hour traffic volume warrant as defined by the *Manual on Uniform Traffic Control Devices*.

B. Future Traffic Without the Project

The preferred DHSM master plan and various alternatives were evaluated for two future scenarios: Year 2003 representing a 5-year horizon and Year 2008 representing a 10-year horizon.

The Years 2003 and 2008 roadways in the study area are assumed to retain the same configuration as existing conditions. Minor changes are assumed regarding access to the DHSM. In addition to the four intersections analyzed for the existing conditions, the operations of proposed accesses along Diamond Head Road were studied.

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Existing DHSM visitor traffic was established through traffic counts by PBQD and vehicle classification and interview surveys conducted by SMS Research, Inc. Site-generated traffic was defined as DHSM visitor traffic. The level of future visitor activity was provided to this analysis effort after discussions between DLNR and the CAC. For the preferred master plan and for a number of alternatives, the number of visitors was assumed to decrease ten percent from existing conditions. The master plan proposes to shuttle non-walking visitors into the crater with people movers as opposed to allowing them to drive into the crater. It was determined that restricting the ability of visitors to drive into the crater would reduce the number of visitors at DHSM. This effect is desirable, according to reports of DLNR and CAC discussions. The people mover transportation into the crater coupled with the charging of admission fees are expected to either reduce or at most, maintain the amount of visitors to the DHSM at current levels for the foreseeable future.

The visitor traffic generated in Year 2003 and in Year 2008 was directionally distributed, and then the distributed traffic was assigned to the future roadway network according to the preferred plan and various alternatives.

Based on May 14, 1998 observations by SMS Research, Inc., the AM peak hour visitor distribution was judged to be sixty percent to and from the west and forty percent to and from the east of DHSM access. It was assumed that most visitors in the AM peak hour would travel to and from Waikiki/Honolulu. In the PM peak hour, the incoming visitor distribution was assumed to be fifty percent from the east and fifty percent to the west. The outgoing visitor distribution in the PM peak hour was judged to be seventy-five percent could equally arrive at DHSM from any part of the island via Diamond Head Road, but the majority of visitors leaving DHSM would likely head west to return to Waikiki. These distributions were applied to the visitor trips generated.

In the *Traffic Impact Analysis for the Diamond Head State Monument Master Plan* report (Appendix D), the years 2003 and 2008 background traffic volumes represent the projected non-visitor traffic at the intersections evaluated by this study. The background traffic volumes do include traffic from other Diamond Head uses such as the State DOD and EOC.

The background volumes were determined by first applying an annual growth rate of 0.5 percent to existing non-visitor volumes, excluding State DOD and EOC traffic. The 0.5 percent annual growth factor was based on a review of volume growth on selected roadways documented in the City and County of Honolulu *Waikiki Regional Traffic Impact Plan Summary Report* (December 1995). The low growth rate is consistent with development of the area being mature, and significant new development is not expected to occur in the study area. The State DOD and EOC traffic were assumed to remain constant within the future time frame evaluated and were, therefore, not growth factored. (In fact, the State DOD is planning to relocate to Barbers Point, so State DOD traffic is actually expected to decrease significantly in the future). The State DOD and EOC traffic were rerouted, however, to account for the different access schemes proposed by the alternative conceptual plans for the DHSM.

According to the *Traffic Impact Analysis for the Diamond Head State Monument Master Plan* report (Appendix D), the directional distribution of State DOD/EOC trips was derived from the difference between the existing visitor trips and total trips observed. In the AM peak hour, ninety percent of State DOD/EOC trips were assumed to arrive and depart DHSM to the east, and ten percent was assumed to arrive and depart DHSM to the west. In the PM peak hour, approximately eighty percent of State DOD/EOC trips were

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assumed to exit DHSM to the east, and the two State DOD/EOC trips (one hundred percent) entering DHSM during the PM peak hour were assumed to originate from the east. It was assumed that most personnel would originate from the east, equally utilizing 18th Avenue and Diamond Head Road.

C. Future Traffic With the Project

The State DOD/EOC trips were added to the growth-factored components to obtain the total Year 2003 and Year 2008 background traffic.

The site-generated traffic was added to the projected background traffic to obtain the total peak hour traffic volumes for Years 2003 and 2008 for each of the three alternative conceptual plans.

Key intersections were analyzed using the methodologies for unsignalized and signalized intersections outlined in the *1994 Highway Capacity Manual*. In addition to traffic volumes, intersection analyses considered elements such as peak hour factors, truck percentages, and roadway grades. Field observations were performed at selected intersection to verify reasonableness of the analysis results.

D. Anticipated Impacts

According to the *Traffic Impact Analysis for the Diamond Head State Monument Master Plan* report (Appendix D), it is anticipated that all study intersections will operate well overall at LOS A. Most movements will experience minimal delays, and all movements will operate at LOS E or better.

Additionally, there is little difference between the intersection operations in Years 2003 and 2008. Due to the annual growth, the volumes are slightly higher for the ten-year horizon than the five-year horizon, but the delay increases are minimal.

According to the *Traffic Impact Analysis for the Diamond Head State Monument Master Plan* report (Appendix D), there is little difference between the intersection operations of various alternatives. The results suggest that implementation of any of the alternatives studied in the *Traffic Impact Analysis for the Diamond Head State Monument Master Plan* report would result in minimal delay increases for vehicles, and the overall levels of service would not be affected.

In their review of the EISPN, the State Department of Transportation wrote that "The proposed update is not anticipated to have an adverse impact on our State Transportation facilities."

E. Mitigative Measures

From the perspective of intersection operations, all of the alternatives studied in the *Traffic Impact Analysis for the Diamond Head State Monument Master Plan* report (Appendix D) would result in similar intersection levels of service. The traffic volumes produced by the conceptual plans are similar to each other, and they are superimposed on similar patterns and magnitudes of background traffic on Diamond Head Road. Future intersection levels of service are, therefore, similar and are projected to be acceptable.



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The primary traffic-related differences in the conceptual plans pertain to design elements such as the location of DHSM access, visitor access into the crater, and bicycle and pedestrian facilities. From the perspective of transportation issues, all of the alternatives studied in the *Traffic Impact Analysis for the Diamond Head State Monument Master Plan* report (Appendix D) are workable when implemented properly. The following discussion summarizes the recommendations common to all conceptual plans and recommendations that apply specifically to each conceptual plan.

*Pedestrian/Bicycle Paths*

The attached sidewalk on the south (Diamond Head) side of Diamond Head Road is narrow, averaging about three feet in width. Street lighting poles located in the sidewalk area further restrict the sidewalk. Wheelchair ramps are not provided. Most of this sidewalk is constrained from widening by an existing rock retaining wall, varying between 3 and 5 feet in height.

The Master Plan and various alternatives included a grade separated, multi-use pedestrian/bicycle path, located behind the rock wall from near the Cannon Club to 22nd Avenue. This path would provide a safer and more enjoyable walking, jogging, rollerblading, and biking environment than the attached sidewalk that currently exists on the south side of Diamond Head Road. This multi-use path will allow connections to the Kapahulu and Kāhala Tunnels. Moreover, it is proposed that secure bicycle parking be provided at both the Cannon Club and at the entries to the crater. Accommodations will be made for pedestrians to and through both the Kapahulu and Kāhala Tunnels.

It is recommended that Americans with Disabilities Act (ADA)-compliant access be provided from Diamond Head Road to the separated pedestrian path at Makapu'u Avenue, the KCC Access, and 18<sup>th</sup> Avenue. These accesses should be coordinated with the State of Hawai'i Commission on Persons with Disabilities to help ensure compliance with the ADA and ADA Accessibility Guidelines.

This proposed path would not preclude the implementation of bicycle lanes on Diamond Head Road within the DHSM as proposed by the *Draft Honolulu Bicycle Master Plan*. DLNR is coordinating with the City and County of Honolulu Department of Transportation Services in the planning of bicycle facilities within the DHSM. In fact, the creation of a pedestrian/bicycle path as part of the DHSM plan will allow the existing attached sidewalk on the south side of Diamond Head Road within the DHSM to be eliminated. It is, therefore, recommended that the pedestrian/bicycle path be an early implementation item for the DHSM. This would allow the implementers of bicycle lanes on Diamond Head Road within the DHSM to eliminate the existing sidewalk and relocate the street light poles behind the rock wall. In eliminating the sidewalk, it is suggested that the implementers of the bicycle lanes on Diamond Head Road within the DHSM leave one foot of the existing sidewalk to serve as a buffer between Diamond Head Road and the wall, similar to the abutment of a bridge. This would increase roadway width by about two feet, which could then be used as part of the on-street bicycle lanes.

*Bus Stop Modifications*

The Master Plan and various alternatives relocate DHSM access further to the west. It would make sense to relocate the pair of municipal bus stops located near the existing DHSM access to the west as well, since they appear to be utilized primarily by visitors to DHSM. This pair of bus stops could be relocated nearer to Makapu'u Avenue. KCC students appear to utilize the existing pair of bus stops near the existing KCC

Access, and these are recommended to remain. However, it is recommended that the City & County of Honolulu either adjust the location or modify access to the bus stop serving eastbound Diamond Head Road so that ADA compliant access could be provided after elimination of the attached sidewalk on the south side of Diamond Head Road.

#### Intersection Traffic Control

Relocating the bus stops west to the Makapu'u Avenue area would increase pedestrian crossing of Diamond Head Road in this area. Diamond Head Road is curvilinear, both in horizontal and vertical alignment, and it may be prudent to provide additional pedestrian crossing protection.

As presented in the existing conditions analysis, the existing peak hour traffic volumes at the Diamond Head Road/Makapu'u Avenue intersection satisfy the peak hour traffic volume signal warrant as defined by the *Manual on Uniform Traffic Control Devices for Streets and Highways*, Federal Highway Administration, 1988. As a result of annual growth, the future volumes continue to satisfy the peak hour traffic volume signal warrant. Because of the combination of the potential increased pedestrian activity and the existing and future vehicular operations at this intersection, it is recommended that a traffic signal be implemented if a complete engineering analysis and signal design concurs that it is feasible.

As part of the signalization, it is recommended that the crosswalks be provided for pedestrian crossing of Diamond Head Road at the Makapu'u Avenue/Diamond Head intersection.

The Master Plan proposes to relocate DHSM visitor access to the existing Cannon Club driveways. The Cannon Club is located west of Makapu'u Avenue on Diamond Head Road, and it is currently vacant. Because the Master Plan calls for visitors to be shuttled into Diamond Head crater by a people mover, the Cannon Club will function as a transfer point (and visitor center) where visitors will park their cars or tour buses will drop off their passengers.

The proposed Cannon Club entrance/exit is appropriate for visitor and tour bus access given some modifications. The Cannon Club parking lot is configured with two access driveways designed to operate as a one-way entrance and a one-way exit. The flow through the parking lot is counter-clockwise, entering at the west driveway and leaving via the east driveway. The recommended lane configurations for the Master Plan are shown in Figure 23 of the Appendix D. Given the 25 miles per hour (mph) posted speed limit and existing intersection lane configurations along Diamond Head Road, it was judged that a shared through/right-turn lane would be appropriate at the entrance to the Cannon Club. Given the down grade on Diamond Head Road near the Cannon Club, it is recommended to provide a left-turn lane to protect left-turning vehicles from westbound through traffic on Diamond Head Road. This left-turn lane will require some widening of Diamond Head Road. It appears that the widening will have to occur on the south (Diamond Head) side of Diamond Head Road. Exclusive left and right-turn lanes are recommended for the Cannon Club exit approach.

Earlier, the existing DHSM access was proposed to be maintained for use by State DOD/EOC personnel. However, upon further review, it is recommended to close this access and direct State DOD/EOC personnel to a new access located opposite Makapu'u Avenue on Diamond Head Road. It should be noted that the existing DHSM access should be chained, but allowed to be opened by authorized personnel during emergency situations.

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Figures 24 and 25 of the *Traffic Impact Analysis for the Diamond Head State Monument Master Plan* (Appendix D) illustrate the peak hour traffic volumes for the Preferred Alternative with recommended access modifications. The Makapu'u Avenue/Diamond Head Road intersection was assumed to be signalized based on the desire to improve pedestrian access and because existing traffic volumes satisfy the peak hour traffic volume signal warrant defined by the 1998 *Manual on Uniform Traffic Control Devices for Streets and Highways*, Federal Highway Administration. Given these modifications, an intersection analysis showed that the overall intersection would operate well at LOS B and minimal delays to all movements.

Municipal bus access to the Cannon Club requires further analysis. It would appear the exiting pair of bus stops located near the existing DHSM access be relocated closer to the Cannon Club. However, it is unlikely that the Cannon Club driveways will warrant signalization in the future. If the bus stops are located near the Cannon Club, a situation could be created in which the visitors are required to cross Diamond Head Road at an unprotected crossing to reach the westbound bus stop. There is a significant downgrade on Diamond Head Road in this area and pedestrian safety is a concern. Either measures to slow traffic on Diamond Head Road need to be implemented or alternative municipal bus access needs to be provided.

One alternative is to locate the bus stops in the vicinity of Makapu'u Avenue. Then create a people mover stop near this area for people who ride the municipal buses. The people mover has to drive past this area anyway, and an additional stop along its route would probably be acceptable. Additionally, the people mover stop would enable people who walk into the area from the KCC and Kaimukī areas to access the people mover without having to walk down to the Cannon Club.

#### EE Conclusion

Based on the analysis of proposed intersections and accesses of the various alternatives studied in the Traffic Impact Analysis for the Diamond Head State Monument Master Plan, it was concluded that the existing roadway system could accommodate the traffic generated by the proposed improvements to the DHSM. All conceptual plans improve the handling of DHSM traffic on Diamond Head Road, improve pedestrian and recreational mobility on the northern side of Diamond Head Road, and work well with the recommendations of the Honolulu Bicycle Master Plan. ~~In their review of the Draft EIS, the State Department of Transportation wrote that the proposed project is not anticipated to have an adverse impact on our State transportation facilities.~~

Given the recommendations made, the visitor and personnel traffic is projected to be adequately accommodated. The existing DHSM access road was recommended for closure (although available for use in emergencies), and the Makapu'u Avenue/Diamond Head Road intersection was recommended as a DHSM access instead of the previously planned (1979) KCC access, which was judged to have sub-standard stopping sight distance. Intersection analyses showed that the intersections would operate well overall given the recommended access modifications for all of the alternatives studied.

### 5.3 Noise

#### A. Existing Conditions

Noise level measurements were conducted on July 7 and 8, 1998 by D.L. Adams & Associates, Ltd. to assess the existing acoustical environment on and adjacent to the project site. The measurements were obtained at Locations 1 through 5 as shown below and in Figure 6 of Appendix F, using Larson-Davis Laboratories, Models 700, 800, and 820, sound level meters. The following results expressed in terms of equivalent sound levels,  $L_{eq}$ , and in units of A-weighted decibels were obtained.

Measurement Location	Description of Location	Time of Measurement	Duration of Measurement	Sound Pressure Levels (dBA)
1	Cannon Club Parking Lot near Residences	4:00 p.m.	21 min 55 sec	50.7
2	Cannon Club Parking Lot near Diamond Head Road	4:05 p.m.	10 min 00 sec	60.6
3	End of Road between <del>the</del> State DOD and <del>the</del> Existing Comfort Station	4:32 p.m.	14 min 30 sec	47.5
4	McCorriston Street	5:03 p.m.	16 min 30 sec	59.1
5	Backyard of House at the end of Pana Place	3:00 p.m.	60 min 00 sec	42.6

Presently, the dominant noise sources at the above locations include traffic, wind, and occasional distant aircraft flybys. Traffic volumes and vehicle mix were also recorded during measurements at locations 2 and 4.

#### B. Anticipated Impacts

**Project Construction Noise.** Development of Diamond Head State Monument will involve excavation, grading, demolition of existing buildings, and construction of new buildings and infrastructure. The various construction phases of the project may generate noise, which may impact nearby residential areas. The actual noise levels produced will be a function of the methods employed during each stage of the construction process. Typical ranges of construction equipment noise are shown in Figure 7 of Appendix E. Earthmoving equipment, e.g., bulldozers and diesel-powered trucks, will probably be the loudest equipment used during construction, assuming that pile driving will not be required.

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In cases where construction noise exceeds, or is expected to exceed the DOH's "maximum permissible" property line noise levels, a permit must be obtained from DOH to allow the operation of vehicles, construction equipment, power tools, etc., which emit noise levels in excess of "maximum permissible" levels. Specific permit restrictions for construction activities are:

"No permit shall allow any construction activities which emit noise in excess of the maximum permissible sound levels...before 7:00 a.m. and after 6:00 p.m. of the same day, Monday through Friday."

"No permit shall allow any construction activities which emit noise in excess of the maximum permissible sound levels...before 9:00 a.m. and after 6:00 p.m. on Saturday."

"No permit shall allow any construction activities which emit noise in excess of the maximum permissible sound levels on Sundays and on holidays."

In addition, construction equipment and on-site vehicles or devices whose operations involve the exhausting of gas or air, excluding pile hammers and pneumatic hand tools weighing less than 15 pounds, must be equipped with mufflers, and construction vehicles using trafficways must satisfy the DOH's vehicular noise requirements. It should be noted that the crater itself will offer attenuation of noise from construction within the crater.

Any construction vehicles stored at the project site should be located inside the crater and not in the Cannon Club parking area in order to reduce noise impact on the residences in the vicinity of the Cannon Club. Additionally, if demolition inside the crater is to occur while the National Guard buildings are still occupied, then noise mitigation for these buildings should be considered.

**Projected Generated Traffic Noise.** Measured traffic noise levels along with the traffic volume and vehicle mix counts obtained during the measurements were used to calibrate the FHWA's Traffic Noise Prediction Model. The noise model together with the traffic data (Appendix D) was then used to calculate the peak hour traffic noise levels with and without the project. The results are presented in Table 1 of Appendix E.

From the results if Table 1 of Appendix E, traffic noise level increases, with and without the project, were calculated and are presented in Table 2 of Appendix E. As can be seen, the predicted maximum traffic noise level increase along the assessed roadways due to the project is 0.4 dBA, which is below the threshold of change in noise level that is perceptible to most people with normal hearing.

**Parking Areas.** Development and renovation of the Cannon Club parking area will temporarily impact nearby residences. The DOH construction noise regulations discussed above should be adhered to during all phases of construction and renovation.

The Cannon Club parking area, due to automobiles, people movers, and people, could impact nearby residences. Noise from stop-and-go traffic as vehicles enter and exit the proposed Cannon Club parking area may cause annoyance to nearby residences. To avoid this problem, the parking area entrance/exit should be located as far as possible from any residences. Additionally, restricting vehicular traffic to the upper portion of the Cannon Club parking area farthest from Wauke Street would significantly reduce the

probability of noise complaints. Alternately, development of a parking area across from Kapi'olani Community College along Diamond Head Road would significantly reduce the noise impact on local residences but could impact the Chapel, located across from this proposed parking area, if noise sensitive activities are conducted during peak hours. Finally, to eliminate people mover noise, electric people movers could be used.

The increased flow of pedestrians in and around the Cannon Club parking area could impact nearby residences. Construction of an enclosed or semi-enclosed people mover waiting area facing away from the residential area would alleviate much of the impact from pedestrians' voices.

**Long Term Impacts.** Noise sources following the completion of the project will be vehicular and pedestrian traffic entering and exiting the proposed parking areas to the west of DHSM. The noise emanating from these parking areas could impact nearby residential areas.

Noise created in the crater during park usage is expected to be equal to or less than current levels and should not impact local residences.

## 5.4 Air Quality

### A. Existing Conditions

The regional and local climates together with the type and quantity of human activity generally dictates the air quality of a given location. Outside the crater, winds are predominantly trade winds from an easterly direction. Wind speeds typically vary between about 5 and 20 miles per hour and provide good ventilation much of the time.

Temperatures in the Diamond Head area are generally very moderate with the average daily minimum and maximum ranging from about 70°F to 85°F. The average annual rainfall measured at nearby Black Point approximates 21 inches with most of the rainfall generally occurring during the winter months. Wind, temperature and precipitation conditions at the project site, however, may be somewhat different from nearby areas outside of the crater due to the micro climatic effects caused by the crater's terrain.

Along the crater rim turbulent winds are created by the merging updrafts from the crater floor and crater exterior. Occasional strong winds also sweep the valley floor, kicking up small dust storms during the dry months.

The present air quality in the crater is primarily affected by the emissions from motor vehicles and to a lesser extent by distant agricultural, industrial, and natural sources. The State Department of Health operates a network of air quality monitoring stations located at various locations on O'ahu. According to the *Air Quality Study for the Proposed Diamond Head State Monument Master Plan Update* (Appendix G), ambient air quality data from nearby monitoring stations indicate it is likely that all national ambient air quality standards are currently being met in the project area. However, occasional exceedences of the more stringent state standard for ozone may presently occur at many locations around Honolulu. Occasional exceedences of the state carbon monoxide standards within small "hot-spot" areas near some traffic-congested intersections may also occur.

B. Anticipated Impacts and Mitigative Measures

The major potential short-term air quality impact of the project will likely occur from the emission of fugitive dust during construction phases of the project, particularly because of the relatively dry climate of the project area. Adjacent populated areas outside the crater may be the biggest concern. Uncontrolled fugitive dust emissions from construction activities are estimated to amount to about 1.2 tons per acre per month, depending on rainfall. At a minimum, active work areas and any temporary unpaved work roads should be watered at least twice daily on days without rainfall to control dust emissions. Other dust control measures such as installing wind screens, limiting disturbed areas, soil stabilizing, covering dirt-hauling trucks, cleaning paved roadways, and scheduling the early paving of parking and roadways will also be considered. Monitoring dust at the project boundary during the period of construction will be considered as a means to evaluate the effectiveness of the project dust control program and to adjust the program if necessary.

~~Before any demolition activities, all affected areas will be inspected to determine whether asbestos is present, as required by federal rules (40 Certified Federal Rules Part 61, National Emission Standard for Hazardous Air Pollutants, Asbestos, NESHAP, Revision, Final Rule, November 20, 1990). Under this NESHAP regulation, the project is required to file with the Noise, Radiation and Indoor Air Quality Branch of the Department of Health an Asbestos Demolition/Renovation notification ten working days before demolition of each building or the disturbance of regulated asbestos-containing materials. All regulated quantities and types of asbestos-containing materials are subject to emission control, proper collection, containerizing, and disposal at a permitted landfill.~~

During construction phases, emissions from engine exhausts (primarily consisting of carbon monoxide and nitrogen oxides) will also occur both from on-site construction equipment and from vehicles used by construction workers and from trucks traveling to and from the project. Increased vehicular emissions due to disruption of traffic by construction equipment and/or commuting construction workers can be alleviated by moving equipment and personnel to the site during off-peak traffic hours.

After construction of the various phases of the Master Plan are complete, emissions from motor vehicle traffic attracted to the DHSM will occur on a long-term basis. Motor vehicle related emissions of carbon monoxide are the greatest concern. Based on the projected peak-hour traffic volumes and the roadway configurations and lanes given for the roadway intersections affected by the project, air quality model projections for the year 2008 indicate that air quality conditions at nearby locations outside the crater will be in compliance with state and national standards. The recommendation of the traffic consultant to relocate the access point to the Makapu'u Avenue intersection with Diamond Head Road and to signalize this intersection would cause some air quality degradation in the immediate area, but worst-case concentrations should remain within the standards.

Even if traffic is continued to be allowed inside the crater, it is unlikely that air pollution levels would reach anywhere near the standards. Compliance with both state and national standards will likely be achieved both inside and outside the crater, and air quality levels comparable to existing conditions will likely be maintained. Thus, according to the *Air Quality Study for the Proposed Diamond Head State Monument Master Plan Update* (Appendix F) measures to mitigate any long-term air quality impacts of the project appear to be either unnecessary or unwarranted. To mitigate long-term impacts, tour buses will be prohibited from idling for long periods of time in the visitor parking areas.

## 5.5 Visual Resources and Open Space

### A. Existing Conditions

Diamond Head is a prominent national natural landmark, state monument, and scenic district that can be viewed from the sea, from the air, and from much of urban Honolulu (Figures 18, 18a-18g). The crater is also known as Lē'ahi, its Hawaiian name. The most familiar profile of Diamond Head is known worldwide. Views from the east, north, and south provide different, but no less distinctive profiles, recognized by residents and even by many visitors.

The exterior of the Crater appears as a massive circular form elongated at the southwest rim, which forms the highest point. The eroded exterior is characterized by numerous deep, narrow ravines, which extend from the base of the Crater to the rim.

The interior of the Crater encloses an area of approximately 175 acres and is 3,520 feet in length. The floor is nearly level with its greatest slope at approximately 12 percent. The interior walls are much softer and rolling in appearance than the exterior walls. The slope is more gradual and less dissected in appearance. The Crater floor is mixed with trees and variety of grasses and smaller shrubs.

There is an upper, middle, and lower story of vegetation. This pattern is more noticeable on the north facing slopes because they are considerably denser in vegetation than the south facing slopes which consist mostly of small shrubs and grasses. A hiking trail cuts through the most densely vegetated area of the Crater. This area is composed of a thick canopy of trees and an understory of mixed shrubs and grasses. During the rainy season, this becomes more green and foliated. However, during most of the year the interior Crater often appears brown and dry. This is especially apparent on the southern exposure facing slopes.

Upon entering the Crater through Kāhala Tunnel, one can see various buildings to the north of the entrance road. The buildings house the facilities of the State DOD and the FAA. The buildings are block-like concrete structures with no distinguishing architectural value. The proposed Master Plan calls for the removal of the FAA CERAP building, the three largest State DOD buildings and the State DOD vehicles from the crater floor. The appearance of this portion of the crater floor should change from one of a military-type installation to a park-like and/or semi-wilderness character.

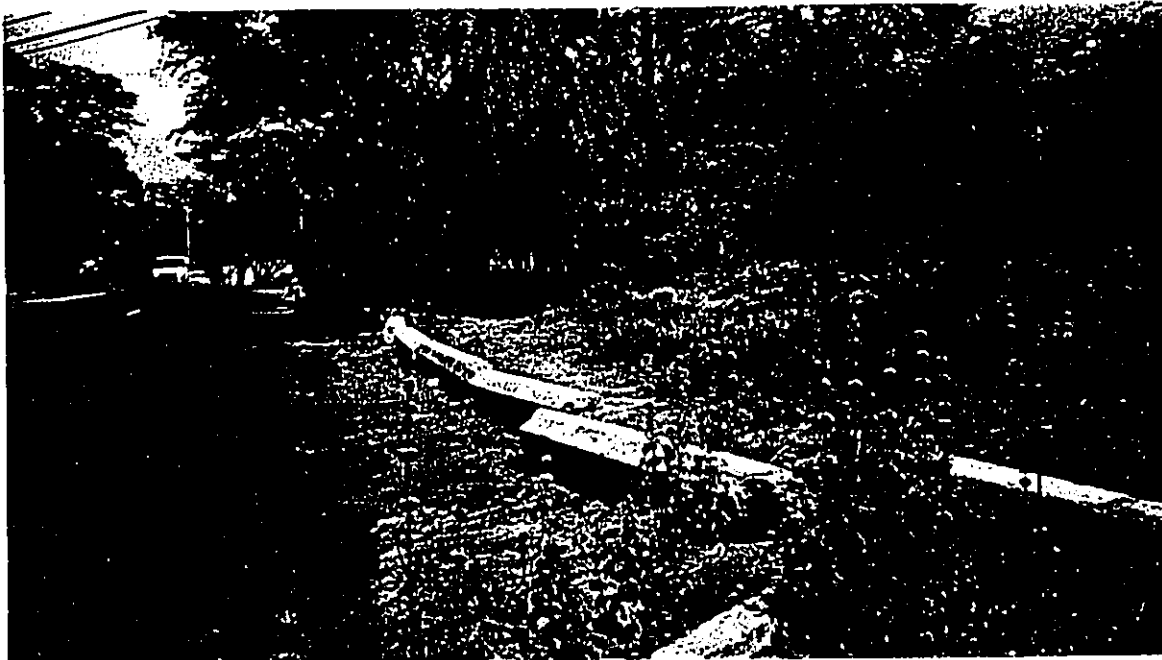
From outside the Crater, the City and County of Honolulu Coastal View Study, 1987 designates Diamond Head within the "South Shore Viewshed" and as an "Important Coastal Land Form".

### B. Anticipated Impacts

The visual impact of the Monument as a Natural Landmark has remained important to many as urban Honolulu has developed around the Crater. The public and the CAC have fought many battles to keep the gaze of developers and government in check.

The landform, Diamond Head Crater, is a pyroclastic cinder cone generally comprising of a friable tuff-type soil structure which is easily scarified and subject to accelerated erosion. Uncontrolled access, however, along the slopes have brought about visible scarring as the soil breaks away. The exterior visual impact of





1. View along Diamond Head Road.



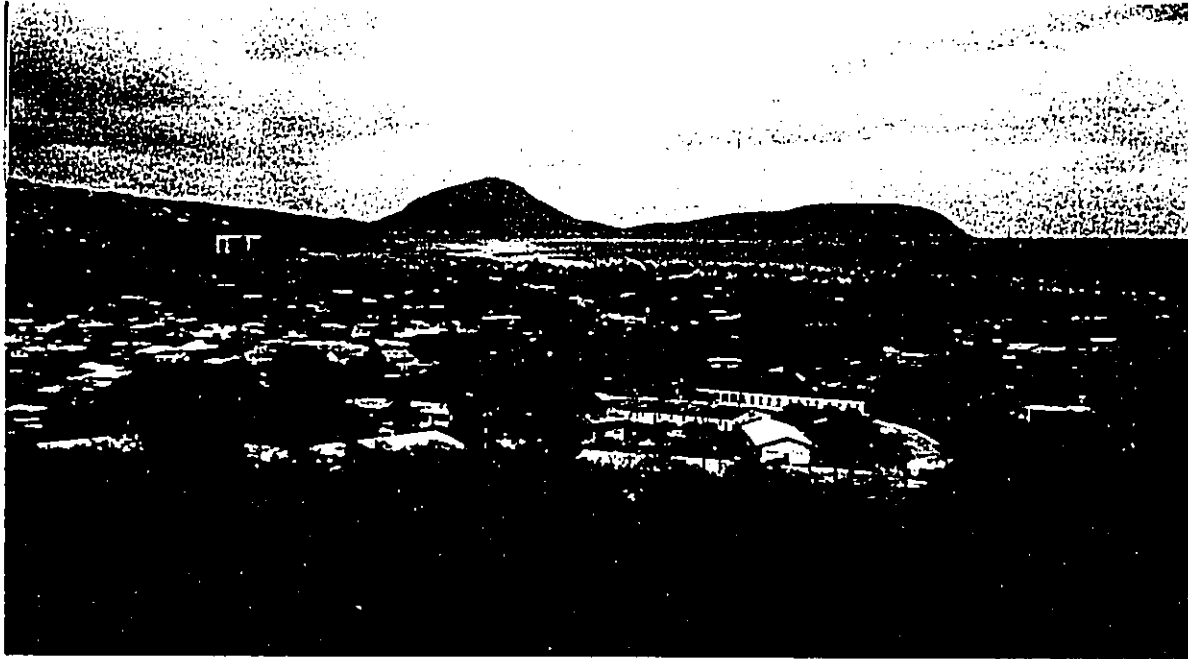
2. View point mauka of Diamond Head Kapiolani Community College.

FIGURE 18a  
Visual Analysis

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3. View looking east toward Koko Crater and Kahala from the existing Crater Road scenic overlook just prior to entering Kahala Tunnel.



4. View of seasonal wetland.

FIGURE 18b  
Visual Analysis  
DIAMOND HEAD STATE MONUMENT

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5. Kapahulu  
Tunnel entry  
from within  
Diamond Head  
Crater.



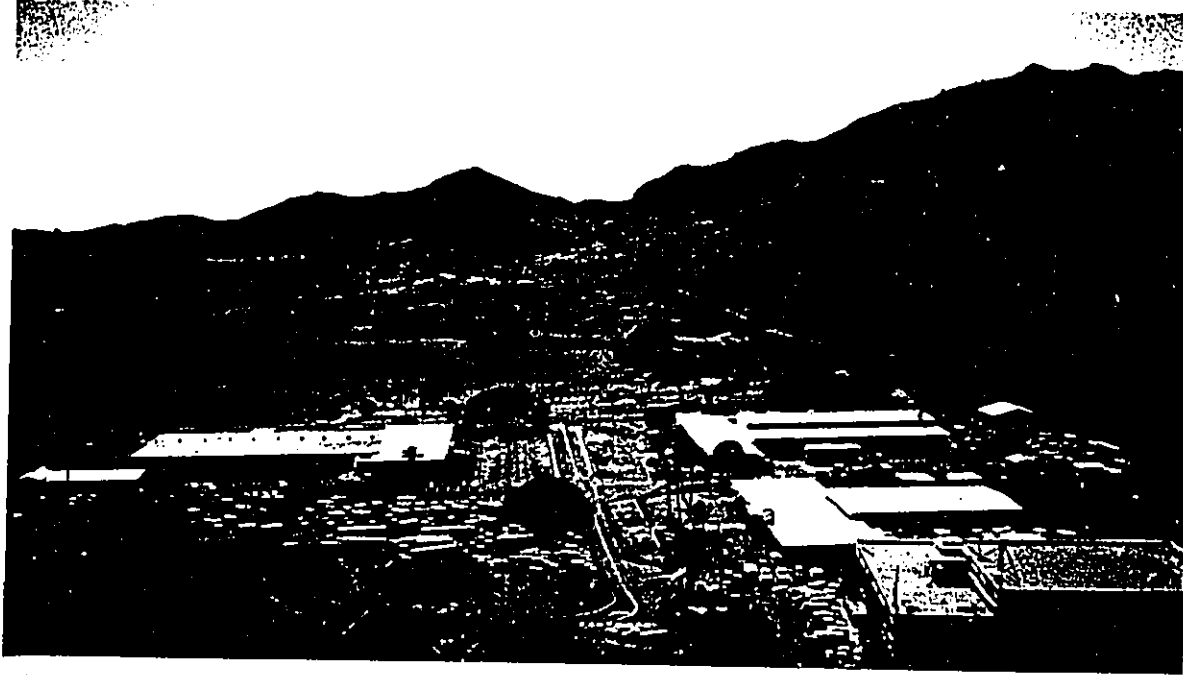
6. View of Cannon Club from crater rim. Note the existing parking area, proximity to residential neighborhoods, and steep slopes of Diamond Head Crater.

FIGURE 18c  
Visual Analysis

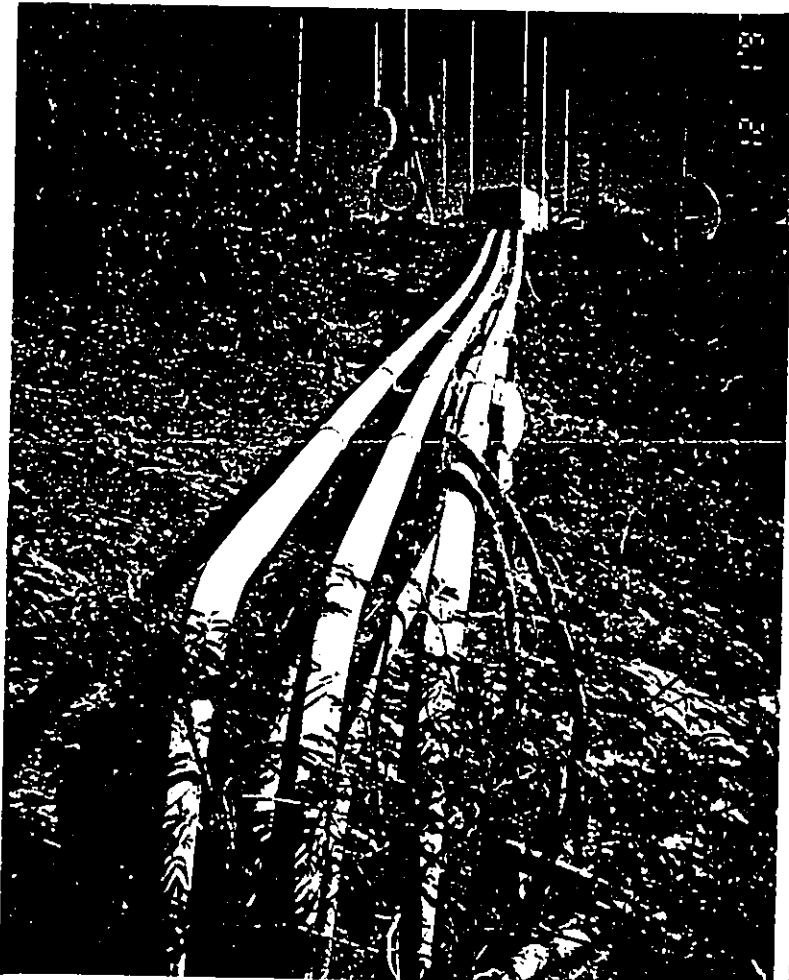
**DIAMOND HEAD STATE MONUMENT**

October 1998





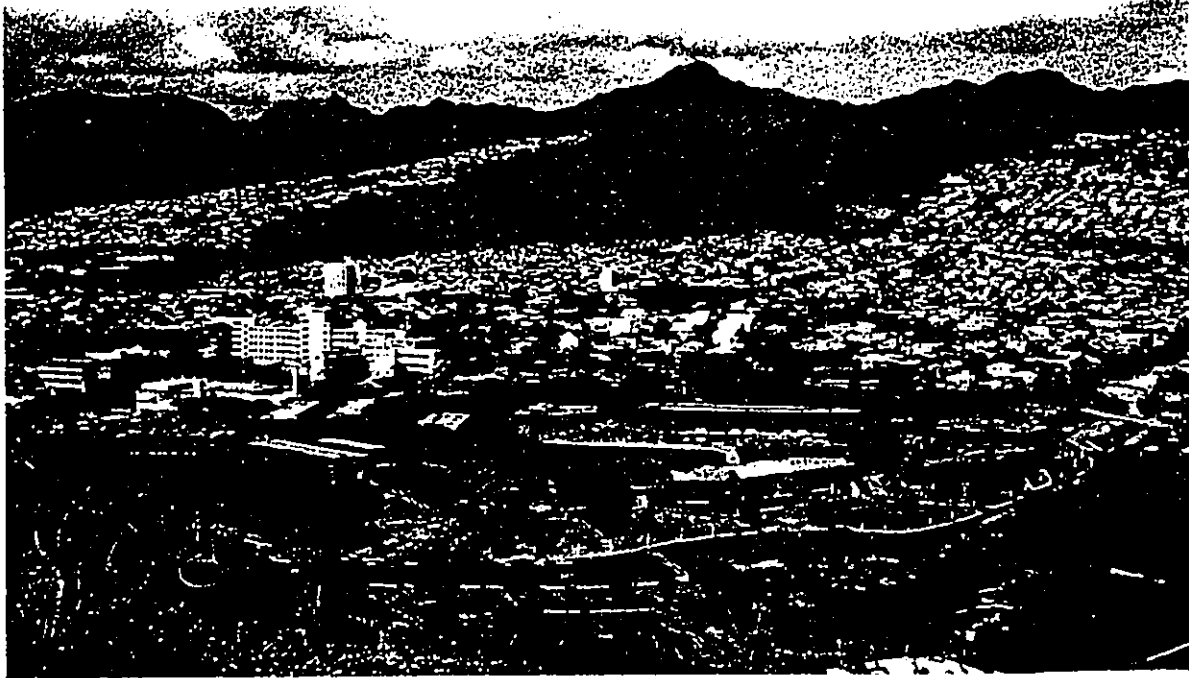
7. View of existing structures, parking, old rifle range, and open space areas.



8. Existing electrical lines and communications dishes located up to and at the FAA Link Site area of Diamond Head.

FIGURE 18d  
Visual Analysis

**DIAMOND HEAD STATE MONUMENT**



9. View of Kapiolani Community College looking mauka from the crater rim between Kahala and Kapahulu tunnels.

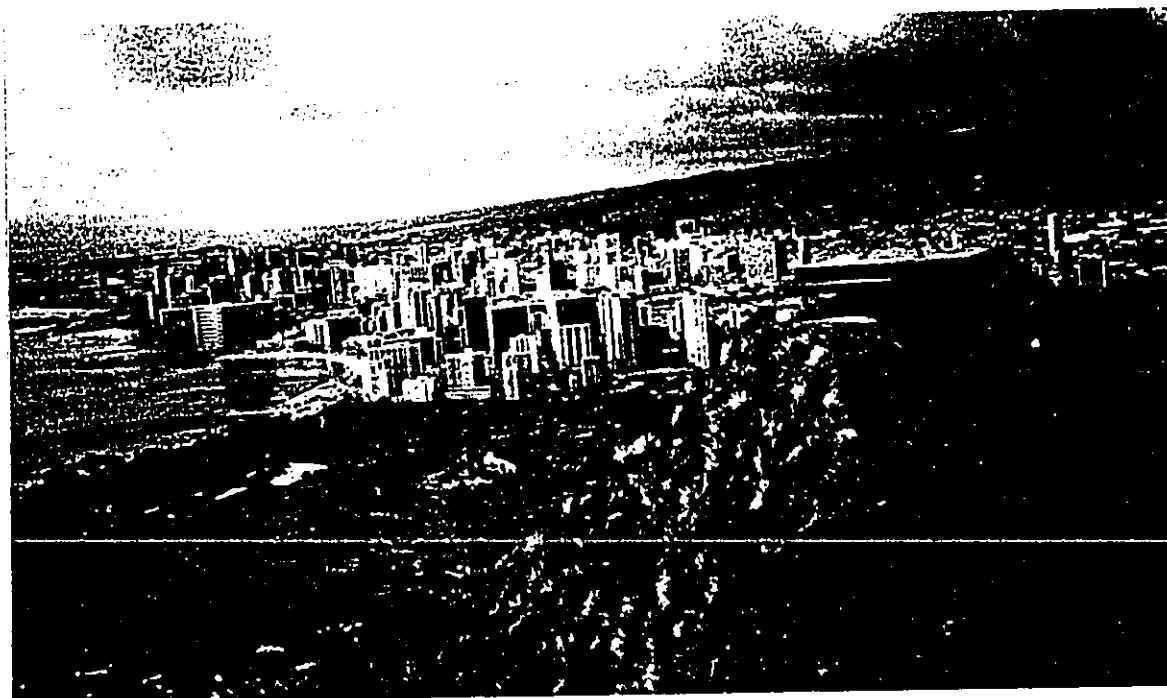


10. Visitor parking area and beginning of trail to Leahi Summit.

FIGURE 18e  
Visual Analysis  
DIAMOND HEAD STATE MONUMENT



11. Paved portion of Leahi Summit Trail. Note Leahi Summit in the distance and dominance of dryland vegetation in this area.



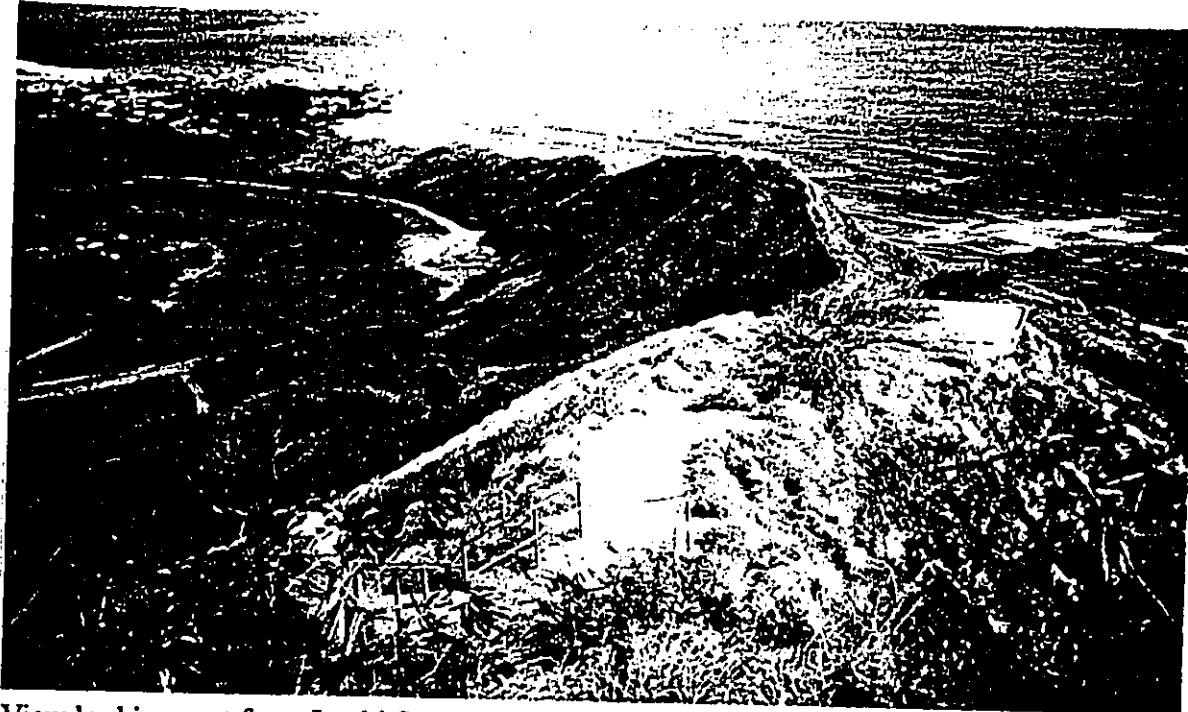
12. View of Kapiolani Park and Waikiki looking west from Leahi Summit. Unauthorized trail along crater rim connects to adjoining military lookout.

FIGURE 18f  
Visual Analysis

**DIAMOND HEAD STATE MONUMENT**

October 1998





13. View looking east from Leahi Summit toward Blackpoint and Kahala. Unauthorized trail is evident on rim.



14. View looking east from Tunnel 407 exterior portal. Portlock and Blackpoint are visible in the distance.

FIGURE 18g  
Visual Analysis  
**DIAMOND HEAD STATE MONUMENT**

October 1998



Diamond Head as a "Registered Natural Landmark" (Department of the Interior, 1968) has been kept intact through City and County Ordinances and the Department's (DLNR) efforts to preserve the natural beauty of this world renown cinder cone. Past proposals on the development of the Crater would have altered this natural landscape.

There are numerous natural and man-made areas in and around the crater which offer unobstructed vistas, whether the views are of the inside and/or the outside of the crater. Some of these lookout locations are presently in use, but there are many more that are currently restricted to visitors. While clearly the best views are along the crater rim, concerns about the destruction of the *Schidea adamantis* habitat, erosion from foot traffic, and hiker safety, disallow unimpeded access along the rim of Diamond Head. Many of the lookout locations identified above could mitigate the adverse impacts from rim access, while providing many more viewing opportunities than are currently provided.

## 5.6 Infrastructure

### 5.6.1 Water Supply Facilities

#### A. Existing Conditions

Potable water is provided by the Board of Water Supply (BWS). Storage of potable water is provided by BWS's reservoirs, Wilhelmina (2,000,000 million gallon) and Pālolo (two 500,000 gallon). The reservoirs have spillway elevations of 405 feet above mean sea level. Water is transmitted to DHSM via a BWS 12-inch main in Diamond Head Road. An existing 12-inch transmission line connected to the BWS main provides water to DHSM. The transmission main enters the crater through Kapahulu Tunnel, runs behind the FAA building, and ends at Battery Birkhimer. Within the crater, existing 8-inch, 6-inch, 4-inch, and 2-inch lines distribute water to various buildings and to Tunnel 407. Water is provided to the Cannon Club by two inch water line. The average consumption in DHSM from July to September 1998, according to State DOD records, was 39,400 gallons per day (gpd). Currently non-potable water for irrigation is not available, landscaped areas are irrigated with potable water.

#### B. Anticipated Impacts and Mitigative Measures

To provide fire and domestic flow, proposed water system improvements in the crater include extending the transmission main from Battery Birkhimer to the visitor/interpretive center and Tunnel 407, adding fire hydrants, and waterlines to the comfort stations. The estimated average potable water demand is 21,500 gpd. In their review of the EISPN, the BWS wrote that "The existing off-site water system is presently adequate to accommodate the proposed improvements to Diamond Head State Monument. The water service limit for the area is the 305-foot elevation." If the landscaped area around the visitor/interpretive center will be irrigated with potable water, the estimated average demand will be 6,700 gpd. Total potable water demand, domestic consumption plus irrigation of the landscaping (at the visitor/interpretive center only), is approximately 28,200 gpd. The availability of additional water will be confirmed when the building permit application is submitted to BWS for their review and approval. To that end, DLNR will coordinate with the City and County of Honolulu to incorporate the proposed project into the County's Water Use and Development Plan. According to the BWS, when water is made available, DLNR will be required to pay BWS's Water System Facilities Charges for transmission and daily storage. The on-site fire



protection requirements will be coordinated with the Fire Prevention Bureau of the Honolulu Fire Department. During their review of the Draft EIS, the Fire Department requested that a private water system where all appurtenances, hydrant spacing, and fire-flow requirements meet Board of Water Supply standards be provided. If a three-inch or larger meter is required, the construction drawings showing the installation of the meter should be submitted to BWS for review and approval. The proposed project is subject to Board of Water Supply cross-connection control requirements prior to the issuance of the building permit application.

The Conceptual Master Plan includes approximately 41 acres of park-like intensity of landscaped area. The landscaped area, except for approximately one acre around the visitor/interpretive center, is proposed to be irrigated with non-potable water. Non-potable water wells located outside the crater are being considered as potential sources. Well water will be pumped into the crater through a waterline in Kāhala Tunnel. From the tunnel, non-potable water will be piped to the proposed water feature. The pond, lined with a waterproof membrane, will store irrigation water. From the pond, water will be pumped to irrigated areas inside the crater. Estimated non-potable irrigation demand is 270,000 gpd. The BWS also noted during its review of the EISPN that a water allocation will be required from the Commission on Water Resource Management (CWRM). The proposed project will be incorporated into the State Water Projects Plan.

If the nonpotable system is implemented, the potable and nonpotable water systems will be carefully designed and operated to prevent cross-connections and backflow conditions. The two systems will be clearly labeled and physically separated by air gaps or reduced pressure principle backflow preventers to avoid contaminating the potable water supply. All nonpotable spigots and irrigated areas will be clearly labeled with warning signs to prevent the inadvertent consumption of nonpotable water. In addition, nonpotable spigots will be installed in secured, below-grade enclosures.

A complete engineering report describing water system requirements and infrastructure improvements necessary for development of the proposed master plan is provided in Appendix A.

## 5.6.2 Wastewater Facilities

### A. Existing Conditions

The interior of the crater has an existing sanitary sewage system that collects sewage from all of the buildings and pipes to a lift station located south of Building 303. The lift station pumps sewage through a 4-inch force main to a manhole located in Kāhala Tunnel. From this manhole, sewage flows in a gravity sewer line to a City and County of Honolulu (C&C) manhole located at the intersection of Paiku Street and 22<sup>nd</sup> Avenue. The C&C system transports sewage through a series of gravity lines, lift stations and force mains to the Sand Island Wastewater Treatment Plant for treatment and disposal. Sewage from Tunnel 407 is disposed in an existing cesspool located near the tunnel entrance.

Sewage from the Cannon Club flows in a gravity pipeline to the existing C&C sewer line in Wauke Street. No change to the sewage system for Cannon Club is proposed.

B. Anticipated Impacts and Mitigative Measures

Proposed sewage system improvements include new collection system, and to transport sewage out of the crater, to a new lift station, force main and gravity main. The sewage will be collected and piped from the visitor/interpretive center, Tunnel 407, Battery Birkhimer, the caretaker's residence (or DOCARE office), and comfort stations to the sewage to a new lift station. The new lift station, proposed to be located south of the visitor/interpretive center, will pump sewage through a new force main to a new manhole in Kāhala Tunnel. From this manhole, sewage will flow in a new gravity sewer line to a C&C manhole located at the intersection of Paiku Street and 22<sup>nd</sup> Avenue. Estimated sewage generated by the visitor/interpretive center, Tunnel 407, caretaker's residence, and comfort stations is approximately 15,400 gpd.

Construction of on-site collection system, lift station, and force and gravity mains are anticipated to accommodate the proposed master plan. The gravity collection system is proposed to be constructed from Tunnel 407, comfort station on the floor of the crater and the proposed visitor/interpretive center, to a new lift station located in the vicinity of the existing lift station. The lift station will pump sewage out of the crater through Kāhala Tunnel in a new force main, then flow in a new gravity line, both along the same route of the existing force main and gravity line, into the City and County of Honolulu system at Paiku Street and 22<sup>nd</sup> Avenue.

A complete engineering report describing wastewater system requirements and infrastructure improvements necessary for development of the proposed master plan is provided in Appendix A.

5.6.3 Drainage Facilities

A. Existing Conditions

The existing drainage system consists of natural drainage ways, culverts, lift stations, and drain lines. Culverts convey runoff under paved surfaces, which prevents flooding of roadways and build-up of debris on the roadways. Storm water runoff collects at the low point in the crater. When water levels rise to a level that threatens roads and buildings, a diesel powered lift station is activated. The lift station pumps water through a force main. The force main ends at the interior opening of Kahala Tunnel. From this point, water drains through a gravity line to a City and County of Honolulu drainage manhole at Paikau Street and 22<sup>nd</sup> Avenue.

B. Anticipated Impacts and Mitigative Measures

It is proposed that all existing culverts be left in place, new culverts be added, and, to convey storm water out of the crater, a new lift station, force main, and gravity drain line be constructed. The proposed irrigation improvements include a pond at the low point in the crater near the proposed visitor/interpretive center. This pond will be used as a storage basin for irrigation water. It will also serve as a holding basin for storm water that will be pumped out by the lift station.

Estimated peak storm water flow from a 100 year storm is 1,500 cfs which represents no change from existing conditions. The proposed drainage system for the new crater interior perimeter road includes swales on the uphill side of the roadways to direct storm water flowing off of the steep crater walls to culverts, which will convey water under the proposed perimeter roadway. Culverts under the remaining roadways

are also proposed. As in the existing conditions, storm water within the crater will collect at the low point in the crater. Storm water retained on the crater floor will be disposed by evaporation, transpiration, percolation, or when necessary, pumped out of the crater. The retained storm water may also be used for landscape irrigation. The new lift station, 12-inch force main, and 18-inch gravity line to pump water out of the crater is proposed adjacent to the proposed pond. The lift station would pump storm water through a 12-inch force main, to a manhole in Kahala Tunnel. From this manhole, an 18-inch gravity drain connects to the City and County of Honolulu manhole at Paikau Street and 22<sup>nd</sup> Avenue.

All drainage improvements are examined in more detail in Appendix A of the EIS.

#### 5.6.4 Solid Waste Disposal Facilities

##### A. Existing Conditions

On O'ahu, residential and commercial wastes are hauled to landfills, the incinerator, or transfer stations. A waste-to-energy combustor, H-POWER (Honolulu Program of Waste Energy Recovery) located at the Campbell Industrial Park, began full commercial operation on May 21, 1990. The facility is designed to process about 2,000 tons per day, and its gross generating capacity is 57 megawatts of electricity. About 1,800 tons per day of waste is incinerated, producing ash and non-processibles that are transported to Waimānalo Gulch Landfill and buried. Currently, the H-POWER facility receives all the residential and commercial packer truck wastes on the island. Waimānalo Gulch Landfill accepts residential, commercial, non-hazardous industrial solid waste, demolition debris, and ash and residue from the H-POWER waste-to-energy facility.

##### B. Anticipated Impacts and Mitigative Measures

All existing and future solid waste generated within Diamond Head Crater will be disposed of using these facilities. No significant increase in the quantity of solid waste above the current level is anticipated with the implementation of the proposed master plan, assuming similar or less visitor counts than existing (due to the charging of fees and the proposal of limiting visitor parking to the exterior of the crater). It is assumed that the change in composition of solid waste from military uses to those associated with park like uses will not be significant.

#### 5.6.5 Electrical/Telephone/Communication

##### A. Existing Conditions

Electric power to Diamond Head is provided by Hawaiian Electric Company (HECo) and telephone service is provided by Hawaiian Telephone Company (HTCo). The HECo main power lines are along Makapuu and Alohea Avenues. The electrical system for the crater, maintained by HECo, is brought via overhead lines to the tunnel next to Battery Harlow. The lines then go underground through the tunnel and then again overhead within the crater. An overhead line also climbs the makai outer slope of the crater to serve Tunnel

407. Light standards abound along roadways with overhead lines. ~~Not all of the existing power lines are owned by HECO.~~ HECO will analyze their system when exact loads are known.

Hawaiian Telephone Company lines follow the HECO overhead and underground lines along Makapuu and Alohea Avenues and within the crater. HECO will also analyze their system when exact requirements are known.

The ~~State~~ Department of Defense (~~State~~ DOD) and the Federal Aviation Administration (FAA) also maintain underground and overhead lines and antennas within the crater.

#### B. Anticipated Impacts and Mitigative Measures

Because the net level of use within the crater will not be significantly altered compared to current levels, existing electrical and telephone infrastructure will be modified to accommodate the master plan requirements. Based on availability of present service capabilities and planned improvements in the existing electrical facilities, significant impacts are not expected to result from the proposed action. Similarly, the proposed action should produce no significant impacts to telephone service. However, the proposed Interpretive/Visitor Center will have large electrical/communications loads and HECO and HECO services will need to be extended to this facility.

The HECO and HECO services may be modified by relocating the existing overhead lines to underground, for aesthetics, then reconnecting the existing facilities to remain. ~~The cost to underground lines for aesthetics will not be borne by HECO.~~ After the FAA relocates to Honolulu International Airport, Birkhimer EOC desires to realign existing overhead electrical and communications lines into the above ground utility conduits along the road to the FAA Link Site. According to HECO, ~~the point of contact at HECO for this project is Francis Hirakami (549-7536) senior customer engineer. HECO suggests that during further work on the project Mr. Hirakami coordinate HECO's continuing input.~~ the overhead lines can then be removed which ~~placing lines underground~~ would help to implement the DHSM objective of restoring the crater to a semi-wilderness condition.

### 5.7 Public Services

#### 5.7.1 Civil Defense

##### A. Existing Conditions

The State of Hawaii Department of Civil Defense currently uses several Diamond Head sites for communication and storage facilities. These sites include specific Battery locations and the "M" tunnels. Communication sites include Vault III (below the FAA link site), Battery Hulings and Battery Dodge for radio transmitter and receiver facilities. The area above and around Birkhimer Tunnel is also being used for radio antennas and above ground utility lines.

State Civil Defense also holds permits granting other public safety/emergency response agencies access to specific areas for radio/antenna sites. Antennas associated with radio equipment are located on or near the East Side rim of the crater. Tunnel M0 is currently used by the Federal Department of Defense as a cable

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and radio support facility that is key to their communication support in the Koko Head, Diamond Head, Waikiki, and downtown areas. Antennas above Tunnel M0 are part of this installation.

State Civil Defense storage facilities include Battery Harlow and the M1-M6 tunnels that line the exterior face on the East Side of Diamond Head. Tunnels M4-M6 are required for contingency storage of disaster response materials, including medical supplies, emergency sheltering supplies, emergency rations, and items required to sustain disaster application center operations during disasters.

State Civil Defense also maintains minor storage facilities in Battery Harlow. The Civil Air Patrol, which supports State Civil Defense during disaster situations, maintains an emergency operations center in Battery Harlow.

**B. Anticipated Impacts and Mitigative Measures**

Civil defense operations will continue at Diamond Head, however State Civil Defense has indicated a willingness to work toward the objective in the Diamond Head State Monument Master Plan Update of returning Diamond Head to a semi-wilderness condition. Antennas associated with the radio equipment need to remain on or near the East Side rim of Diamond Head. State Civil Defense will work to limit the number and visual impact of antennas to the extent possible based on funding, operational, and technological constraints. Because changes in technology are inevitable, and given that the State Civil Defense operations change with time, changes to the configuration of antennas and support towers or poles will continue to be required.

State Civil Defense is willing to vacate its storage facilities in Battery Harlow and relocate to tunnels M4-M6. They have also stated that Tunnels M1-M3 are excess to their requirements. In addition, the Civil Air Patrol has been informed of the proposed use of Battery Harlow for interpretive viewing and has indicated that they are willing to relinquish their use of this area as an emergency operations center.

The Diamond Head State Monument Master Plan Update proposes to increase access to various areas that are currently restricted. This includes improving the existing road from Battery Hulings and Battery Dodge to various gun placements along the eastern rim of the crater. Public access to Battery Hulings and Battery Dodge is currently not feasible due to existing radio equipment placed in both tunnels with antennas on or near the crater rim at these locations. State Civil Defense will seek approval and funding for reconfiguration and consolidation of the radio equipment in these tunnels to allow access while still allowing use as radio sites. This will entail technological changes to the antenna systems to allow for use of transmitter and receiver combiners. This will also provide visual enhancement, since fewer radiating antennas will be required and remaining antennas will be consolidated onto a support structure.

**5.7.2 Police Protection**

**A. Existing Conditions**

The subject property falls within the Police Department's District #7 which encompasses the area from Makapu'u to Punahou. There are about 5 field officers assigned to the entire district, including the beach taskforce and bicycle patrol. Response time fluctuates depending on the location of available field officers at the time of the call. Diamond Head Crater is presently patrolled by both HPD field officers and the bicycle patrol, and by DOCARE personnel.

B. Anticipated Impacts and Mitigative Measures

There will be an occasional demand for police services, however, personal security could be improved if revenues generated within the crater could support park ranger-type personnel and/or private security guard services. If and when the State DOD leaves the crater, there will be no security at night. To mitigate this impact, the proposed action could include a live-in caretaker's residence or a DOCARE office. To minimize criminal activity in the area, the District 7 Community Policing team will be contacted during the design phase of future improvements at Diamond Head. During the comment period for the EISPN, the City and County of Honolulu Police Department wrote that "This project should have no additional impact on the operations of the Honolulu Police Department." In their review of the Draft EIS, the Police Department wrote, "In spite of mitigation measures, we anticipate an increase in calls for service to the area during the construction phase of the project because of dust, noise and traffic complications. Then when it becomes operational, we expect that noise and traffic-related problems will generate calls for police service to the area."

5.7.3 Fire Protection

A. Existing Conditions

There are two fire stations servicing the Diamond Head Crater. For fires within the crater, the Waikiki Station (with approximately twelve firefighters) has a response time for one Engine company of approximately 2-3 minutes. The Kaimuki station would respond with one engine company and one ladder truck for larger structural fires.

B. Anticipated Impacts and Mitigative Measures

There will be an occasional demand for firefighting services. Availability of fire protection capability is critical for both structural fires and brushfires which could threaten the endangered plant species located on the property. Structural fires could be addressed by the incorporation of the latest fire safety system in the design of any new structures.

In addition, the Fire Department requested the following:

1. Provide a private water system where all appurtenances, hydrant spacing, and fire flow requirements meet Board of Water Supply standards.

2. Provide a fire department access road to within 150 feet of the first floor of the most remote structure. Such access shall have a minimum vertical clearance of 13 feet 6 inches, be constructed on an all-weather driving surface complying with Department of Transportation Services standards, capable of supporting the minimum 60,000 pound weight of out fire apparatus, and with a gradient not to exceed 20%. The unobstructed width of the fire apparatus access road shall meet the requirements of the appropriate county jurisdiction. All dead-end fire apparatus access roads in excess of 150 feet in length shall be provided with an approved turn-around having a radius complying with DTS standards.

3. Submit construction plans to the HFD and the Department of Planning and Permitting.

Brush fires could be mitigated by the preparation and implementation of fire control measures such as reducing fuel load, the construction of fire breaks and roads, the installation of landscaping, planting fire-resistant plants, and education of visitors to Diamond Head.

In addition, there will be an occasional demand for emergency rescue services. The Fire Department frequently provides emergency rescue service to stranded and injured hikers. According to Fire Department statistics, from 1996 to present, there were 52 rescues made in the Diamond Head Trail area, or approximately 2.5 rescues per month. The Fire Department concurs that providing a ranger to educate hikers on preparedness prior to starting their hikes should assist in preventing most of the rescue calls for this area.

#### 5.7.4 Health Care/Hospitals

##### A. Existing Conditions

Health care facilities within the area include Lē'ahi Hospital, Kaiser Moanalua Medical Center, Kapi'olani Medical Center, Kuakini Medical Center, Queen's Medical Center, St. Francis Medical Center, Straub Clinic & Hospital. Most of the aforementioned facilities are within a 15 minute drive by car from the project site. In addition, there are numerous private physician offices in the surrounding area.

##### B. Anticipated Impacts

At buildout, the project can be expected to have minimal impact on area medical facilities.

#### 5.7.5 Schools

##### A. Existing Conditions

Public schools in the vicinity of the subject property are Kaimukī Intermediate School, Wai'alaie Elementary School, Kāhala Elementary School, Jefferson Elementary School, and Waikīkī Elementary School. Kapi'olani Community College is also located immediately north of Diamond Head Road.

##### B. Anticipated Impacts and Mitigative Measures

Because no residential development is planned for the project, no increases in school enrollments will occur in the surrounding neighborhoods. However, the educational interpretive programs and facilities afforded by the proposed project will expand the students' understanding of Hawai'i's natural history, Hawaiian culture, and military history. School groups will be able to visit the proposed visitor/interpretive center and also experience examples of Hawai'i's natural and cultural history through the proposed system of trails, enhanced wetland, a native dryland forest and possibly a botanical garden.

#### 5.7.6 Recreation Facilities

##### A. Existing Conditions

Recreational facilities in the area are designated as regional parks, community parks, neighborhood parks, and beach/shoreline parks. Regional parks, such as Kapi'olani Park, are large recreational complexes.

Community parks serve an approximate population of 10,000 people and normally include playfields, courts, and a recreation building. Neighborhood parks serve an approximate population of 5,000 people and normally include playfields, courts, and a comfort station. Beach/shoreline parks, such as Diamond Head Beach Park, are day use parks primarily for sunbathing, and picnicking.

#### B. Anticipated Impacts

Although none of the alternatives proposed contain any facilities for active recreation, family oriented passive recreation improvements are planned. These include hiking trails and picnic areas. An enhanced wetland area, a botanical garden, and a native dryland forest, would also provide opportunities for bird watching, nature talks, and facilities for self-guided educational/interpretive programs. It is also proposed that biking be restricted to roads to avoid conflicts with slower moving pedestrians.

### 5.7.7 Public Transportation

#### A. Existing Conditions

The Bus routes 3 (Kaimukī/Pearl Harbor), 58 (Hawai'i Kai/Sea Life Park), and 22 ("Beach Bus" – Waikīkī/Sea Life Park) traverse Diamond Head Road fronting the proposed project. There are four bus stops in the project area, two in the eastbound direction and two in the westbound direction. One east bound and one west bound entry is located just west of the existing entry to Diamond Head Crater. The other east bound entry is located opposite the Diamond Head Chapel (or east of the Diamond Head Road entry to Kapi'olani Community College). One west bound entry is located between the Diamond Head Road entry to Kapi'olani Community College and Makapu'u Street.

#### B. Anticipated Impacts and Mitigative Measures

If that portion of Diamond Head Road fronting the project is widened to accommodate bike lanes, existing bus stops along Diamond Head Road may need to be relocated. According to the *Traffic Impact Analysis Report for the Diamond Head State Monument* (Appendix D), some bus stops should be moved from their current location. Any new and/or refurbished bus stop must meet the requirements of the Americans with Disabilities Act. At the appropriate stage in design of the widening of Diamond Head Road, the Facilities and Equipment Branch of the Department of Transportation Services will be consulted for design specifications.

### 5.8 Social

A social impact assessment and revenue analysis was prepared by John M. Knox & Associates, Inc. in August 1998 and their study is summarized below and attached to this EIS as Appendix H. The social impacts are organized according to various potentially affected "communities:"

- Community of Nearby Residents
- Community of On-Site Diamond Head Entrepreneurs
- Community of Tour Operators and Associated Agencies



- Community of Diamond Head Crater Recreational Users
- Community of Diamond Head "Stewards"
- Community of Hawai'i Taxpayers

### 5.8.1 Community of Nearby Residents

#### A. Existing Conditions

Diamond Head is visible and important to many neighborhoods throughout urban Honolulu, but activities inside the Crater would be of most concern to nearby neighborhoods. Exhibit 2-A of Appendix G shows the location of five U.S. census tracts closest to the project site (including Census Tract 6, which actually contains all of the Diamond Head State Monument). Exhibit 2-B of Appendix G shows selected 1990 Census data which indicate important ways these areas differ from one another and from the overall O'ahu population.

The combined 1990 population for these five census tracts was about 14,600 people. All five areas had a population that was, on average, older than the islandwide population and more likely to have been settled in their homes for many years. Four of the five tracts are marked by a high proportion of single-family rather than apartment units. Some ways in which they differed from one another:

- "West Diamond Head/Waikiki" (C.T. 17) is clearly an "apartment" area, with three-fourths of all housing units located within multiple-unit structures and a very low average household size. It is also the most "Caucasian" area (76% Caucasian, with a majority of people born on the Mainland). Few children under 18 live in this neighborhood, and there is a high proportion of senior citizens. Many employed people are in the professional category, but household incomes are only a little above the islandwide norm (probably due in part to the number of senior citizens, in part to fewer workers per household).
- Kapahulu and Lower Kaimuki (C.T. 16, 8, and 7), the three tracts north of Diamond Head, are roughly similar to one another in being very "local" (particularly Japanese) communities with long-time homeowners living mostly in single-family properties. Kapahulu has a few apartments and an income profile slightly lower than the islandwide norm. As one moves from west to east in these three areas, the profiles switch progressively from slightly lower-middle-class to middle- or slightly upper-middle-class.
- East Diamond Head/Black Point (C.T. 6) — which actually contains the Diamond Head State Monument, though its housing is located only to the east and along a small southern coastal strip — is one of the most affluent areas on O'ahu. It is ethnically cosmopolitan, with a high percentage of college graduates and professional workers. Its small and aging population lives overwhelmingly in single-family households (with a low average household size and few children), in homes they have owned or held for many years. In terms of place of birth, though, it is no more nor less "local" (Hawai'i-born) than O'ahu as a whole.

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**Probable Issues and Concerns:**

- (1) Because of previous public use of the Crater for concerts in the 1960s and early 1970s, nearby residents may be expected to express concern about noise and litter if Crater attendance increases and/or the visitor/interpretive center is used for any sort of live performances.
- (2) Traffic/parking concerns are also a probable issue, both because of past memories and because of the example of Hanauma Bay.
- (3) A review of Neighborhood Board minutes for the surrounding communities (through early July 1998) indicates that the size of the potential visitor/interpretive center has been the only major topic of discussion yet to emanate from discussions over possible changes to the Diamond Head Master Plan. This may be in part related to the foregoing issues, in part to concerns about the aesthetics in the Crater.
- (4) DLNR staff and survey interviewers (Appendix G, Chapter 4) noted that a small but regular group of neighbors use the Crater for purposes such as jogging, bicycling, and occasional picnics. Effects of fee structures on neighborhood access are therefore a likely concern.
- (5) During the interviews with tour companies and travel desk representatives (Appendix G, Chapter 5), it was noted that property owners in the City's "Diamond Head Special District" (roughly equivalent to the census tracts of Exhibit 2-A of Appendix G, but excluding the upper parts of tracts 7 and 8 and including a few parts of tracts 15 and 21) are subject to height limitations, and those closest to the slopes of Diamond Head itself have other design restrictions affecting ability to expand or remodel homes. It is possible there may be perceived inequities if government is permitted to erect large structures in the Crater while nearby residents cannot enlarge the size of their own structures.

**B. Anticipated Impacts and Mitigative Measures**

The most important likely actual impact of project development would involve *traffic and parking* consequences, rather than conventional "social" consequences such as crime or community disruption. Should outside parking be located at the old Cannon Club site as desired by the CAC, immediate neighbors would face a resumption and perhaps magnification of the sort of noise, traffic, and evening lights previously experienced when the Club was in operation—although landscaping and other site improvements are expected to minimize much of this impact. The combination of outside parking and parking fees could well result in more people trying to park in the Kapi'olani Community College lot (or, if daily rates at the Diamond Head lot are cheaper than student rates at KCC, the reverse problem might occur). It is also possible that parking fees could encourage spillover parking onto neighborhood streets.

From a strictly "social" perspective, the project is likely to have an overall *neutral impact on surrounding communities*. There may be some loss of access to the Crater for purposes such as jogging if fees are imposed. Based on the Hanauma Bay experience (Appendix G H, Chapter 3), it is reasonable to expect residents will be charged limited or even no entry fees. For the interim period until the exterior toll booth is completed fees of \$1.00 per entry/\$10.00 per year are proposed for pedestrians. Once the toll booth is completed, the following fees are proposed:

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Non-commercial

- Pedestrians: \$1.00 per entry or \$10.00 per year
- Cars: \$5.00 per entry or \$30.00 per year

Commercial

- The commercial fee will depend on capacity

**5.8.2 Community of On-Site Diamond Head “Unauthorized” Entrepreneurs**

**A. Existing Conditions**

At the present time, such on-site “unauthorized” entrepreneurs consist primarily of a handful of t-shirt vendors, as well as a few purveyors of trail guides and beverages.

**B. Anticipated Impacts**

Most of the entrepreneurs are allowed to operate under current DLNR rules pursuant to First Amendment activities. These rules are independent of the Master Plan, and thus the Master Plan would have no direct effect on such activities. However, it is possible that sales from authorized concessions would compete with the entrepreneurs and that most Crater visitors would shop there rather than on the trail.

**5.8.3 Community of Tour Operators and Associated Agencies**

**A. Existing Conditions**

**Types of Tour Groups:** Diamond Head also provides some degree of economic return to organizers of tour groups which come to Diamond Head. These are of two<sup>4</sup> overall types:

- Sightseeing tours, in which Diamond Head is visited only very briefly, usually as the first stop on a “circle-island” tour from Waikiki. In many cases, these tour vehicles simply drive through the Crater, stopping only long enough for tourists to snap a few pictures. Sometimes — as when arriving Japanese tourists are waiting to check into their hotel rooms — people get out of the vehicles to stretch their legs and use the restroom, but almost never hike to the rim of the Crater.
- “Destination” tours, in which Diamond Head is the principal destination (or one of a very few destinations) of the tour. In these cases, the principal activity is hiking up to the spectacular viewpoints on the Crater rim. These tours may include guides or may simply involve transportation to and from the Crater, at appointed times.

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<sup>4</sup>There is a third variant, though arguably not a “tour” — the Japan Travel Bureau’s charter trolley, which charges tourists a fee for riding the trolley and gives them some limited comments about each of the possible sites, including Diamond Head. Japanese tourists may choose to stay on the trolley or get off at Diamond Head and then catch a later trolley. If outside vehicles are no longer permitted in the Crater, the trolley would presumably just drop customers outside.

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**Probable Issues and Concerns:**

- (1) Because of previous public use of the Crater for concerts in the 1960s and early 1970s, nearby residents may be expected to express concern about noise and litter if Crater attendance increases and/or the visitor/interpretive center is used for any sort of live performances.
- (2) Traffic/parking concerns are also a probable issue, both because of past memories and because of the example of Hanauma Bay.
- (3) A review of Neighborhood Board minutes for the surrounding communities (through early July 1998) indicates that the size of the potential visitor/interpretive center has been the only major topic of discussion yet to emanate from discussions over possible changes to the Diamond Head Master Plan. This may be in part related to the foregoing issues, in part to concerns about the aesthetics in the Crater.
- (4) DLNR staff and survey interviewers (Appendix G, Chapter 4) noted that a small but regular group of neighbors use the Crater for purposes such as jogging, bicycling, and occasional picnics. Effects of fee structures on neighborhood access are therefore a likely concern.
- (5) During the interviews with tour companies and travel desk representatives (Appendix G, Chapter 5), it was noted that property owners in the City's "Diamond Head Special District" (roughly equivalent to the census tracts of Exhibit 2-A of Appendix G, but excluding the upper parts of tracts 7 and 8 and including a few parts of tracts 15 and 21) are subject to height limitations, and those closest to the slopes of Diamond Head itself have other design restrictions affecting ability to expand or remodel homes. It is possible there may be perceived inequities if government is permitted to erect large structures in the Crater while nearby residents cannot enlarge the size of their own structures.

**B. Anticipated Impacts and Mitigative Measures**

The most important likely actual impact of project development would involve *traffic and parking* consequences, rather than conventional "social" consequences such as crime or community disruption. Should outside parking be located at the old Cannon Club site as desired by the CAC, immediate neighbors would face a resumption and perhaps magnification of the sort of noise, traffic, and evening lights previously experienced when the Club was in operation—although landscaping and other site improvements are expected to minimize much of this impact. The combination of outside parking and parking fees could well result in more people trying to park in the Kapi'olani Community College lot (or, if daily rates at the Diamond Head lot are cheaper than student rates at KCC, the reverse problem might occur). It is also possible that parking fees could encourage spillover parking onto neighborhood streets.

From a strictly "social" perspective, the project is likely to have an overall *neutral impact on surrounding communities*. There may be some loss of access to the Crater for purposes such as jogging if fees are imposed. Based on the Hanauma Bay experience (Appendix G H, Chapter 3), it is reasonable to expect residents will be charged limited or even no entry fees. For the interim period until the exterior toll booth is completed fees of \$1.00 per entry/\$10.00 per year are proposed for pedestrians. Once the toll booth is completed, the following fees are proposed:

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Because of the focus in this report on potential revenues and market feasibility, interviews were conducted with representatives of these groups, as well as tour wholesalers and travel desks who may help to place tourists with such companies. Chapter 5 of Appendix G provides a detailed account of these interviews. However, a brief synopsis of some points is given here.

Based on these interviews, *the great majority of group tourists entering Diamond Head Crater arrive on sightseeing-only tours.* Only a very few small companies have recently been offering "destination tours" to Diamond Head, although the New Otani Kaimana Beach Hotel (located at the Diamond Head end of Waikiki) encourages its guests to visit Diamond Head and sometimes organizes tours led by the hotel general manager.

**Probable Issues and Concerns:** The large tour companies which bring people to Diamond Head strictly for sightseeing view the Crater as a very incidental part of their business. However, the idea that the State may restrict vehicle access and institute significant entry fees raised some issues for them, to some extent left over from past debates on Hanauma Bay:

- (1) **Image of Hawai'i** — The visitor economy is poor now, and tourists to O'ahu in particular have become very budget-conscious. There have been other places which were once free and now have entry charges (e.g., Hanauma, the Honolulu Zoo), and some industry officials are anxious about yet another apparent attempt to, in their view, "hit up" or "gouge" visitors who have expressed clear irritation with the trend.
- (2) **Equity** — Based on past experience, industry officials assume that residents will be given discounted or free entry while tourists must pay. They believe this is inequitable and is also detrimental to Hawai'i's long-term economic best interests. Another perceived "equity" issue involves the appropriateness of possibly charging entry fees for sightseeing only. If the rationale for fees at Diamond Head is to pay for resource protection in the Crater alone (although this is not clear to them), then the argument is that sightseers in the parking lot cause far less impact than do actual hikers.
- (3) **Government Assumption of "Private-Sector" Role** — A few industry interviewees questioned whether local government should appropriately "get in the business of running tourist attractions."

These people assumed the rationale for fees was to make a profit for other State activities, not just pay for Diamond Head. While some voices in the business sector have urged local government to earn revenues in new and imaginative ways in order to avoid raising taxes, people in the tour and transportation industry (or at least some of them) are currently alarmed by the City's attempt to woo tourists onto City buses with discounted passes. They view the move to create a significant attraction at Diamond Head — which would most likely result in people going there on a FIT (free and independent traveler) basis, rather than on tours — in the context of that sort of government competition.

The few organizations which provide some form of "destination tour" to Diamond Head would, of course, be primarily concerned with the impacts on their activities — would such tours continue to attract customers if costs are higher? Would Diamond Head still be a symbol of "aloha" that helps attract guests to hotels near it? There may also be some concerns over equity if a nonprofit operating any new visitor/interpretive center

offers guided tours. Some small businessmen who operate what might be called "ecotour" operations feel that their respect for, and impact on, the environment matches those of nonprofit groups, and they resent the special discounts or advantages which government sometimes offers to nonprofits in use of trails or other natural resources.

B. Anticipated Impacts

If all parking is moved outside the Crater and/or commercial vehicle assessment fees are implemented, it seems probable that sightseeing tours will simply skip the Diamond Head Crater. This is due not only to cost considerations, but also to logistics — the time it takes to see the Crater, difficulties in keeping groups together, and, for Japanese or other foreign-language groups, the probability that signage and commentary would be in English only.

The impact on smaller groups spending more time in the Crater is less certain. It would be a matter of the level of additional cost vs. the average disposable income levels of the tourist market at that point in time. However, the overall effect would probably be to make even small group tours more problematic, such that tourists really interested in Diamond Head would be even more likely to go on an FIT basis (and tourists who are only somewhat interested would be less likely to go).

5.8.4 Community of Diamond Head Crater Recreational Users

A. Existing Conditions

(For purposes of this sub-section, FAA and State DOD employees will not be considered, since their relocation is expected with or without Master Plan revisions. The word "user" here is intended in a neutral sense, without any connotation of "exploiter." A synonym could be "visitor.")

Exhibit 2-C of Appendix G gives official State DLNR visitation estimates from 1980 to 1998, according to the July 1998 draft *Interim Interpretive Plan* for the Diamond Head State Monument.

The apparent sudden dramatic increases in 1994 and 1998 are, of course, highly doubtful. It seems likely that visitations were underestimated prior to 1994 and may well be overestimated for 1998. As DLNR notes, "Unfortunately, annual visitor counts have not been done systematically and in most cases, the counts are extrapolated by visitor counts taken for a couple of hours during one day of the year." (*Ibid.*, p. 54)

Perhaps more important, studies to date have not attempted to estimate visitor count by *degree of impact on park resources*. Possible levels would be:

- People driving through without stopping at all — i.e., sightseers only.<sup>5</sup>

<sup>5</sup>Arguably, some "drive-throughs" could be intended park users unable to find parking space. In market research terminology, these people would represent "pent-up demand" for use of the Crater's current recreational resources. However, it is difficult at this point to estimate whether many of the drive-through vehicles counted in traffic surveys at Diamond Head were deliberately not stopping or might have stopped had space been available.

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- Sightseeing groups making only brief stops, but no real use of the park facilities (except perhaps the restrooms).
- Active park users — mostly hikers, but perhaps a few picnickers, etc.<sup>6</sup>

A May 1998 visitor and traffic count commissioned by PBR HAWAII for the Master Plan revision effort (SMS Research, 1998)<sup>7</sup> resulted in figures which suggest about 700,000 visitations per year in the *last two of the above categories only* — i.e., people arriving in vehicles which actually stopped, as well as some pedestrians. Some further analysis of that data in Chapter 4 of Appendix G suggests the number of active park users (the third category alone) in 1998 may be roughly 600,000 people. However, the main point here is that visitation estimates to date are extremely rough and unreliable, and it is important in future efforts to distinguish different types of users according to their level of impact on facilities and/or their demand for different types of experiences in the Crater.

As will be discussed in Appendix G, Chapter 4, the May count produced an estimate that 12% of the people actually stopping in the Crater were Hawai'i residents, while a July 1998 survey conducted for this report found 17% were residents. The great majority of users thus are tourists. Differing methodologies produce different estimates of the breakdown of tourists by origin, but it is clear that a substantial and perhaps growing portion is of Asian origin.

**Probable Issues and Concerns:** Some non-systematic comments taken in 1998 by DLNR staff and/or survey interviewers (pp. 4-5 and 4-17 of Appendix G) suggest that some Crater users will be concerned about paying fees if there is no assurance the revenues will be used for actual improvements in the Crater. Resident users were also concerned about the possible precedent for user fees in other State parks.

While some people want more information and interpretation, there is probably an equal or greater demand for snack and gift concessions which are orderly and contained, as opposed to being provided by a sort of "gauntlet" of vendors.

Improved restroom facilities and improved safety were also mentioned — i.e., better lighting of tunnels and emergency phones for people who may be hurt or become ill at the top of the trail.

#### B. Anticipated Impacts

These are of both positive and negative (or at least uncertain) types.

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<sup>6</sup> The JTB tourist trolley represents a unique problem in this categorization scheme. People getting off the trolley are probably active users, but other passengers are "drive-throughs."

<sup>7</sup> The SMS count was carried out in a way that deliberately excluded FAA and National Guard personnel. These people represent another category which must be explicitly addressed (either excluded or separately counted) in future visitation estimates based on traffic counts.

### Positive Outcomes

- The central experience for active users — trail and viewpoint — will be protected and improved.
- Opportunities for information and interpretation will be greatly enhanced.
- The proposed people mover system will make all parts of the Crater more accessible, even to older or less physically fit visitors.
- If the ~~State~~ DOD's Tunnel 407 is returned, even disabled people will have access to a stunning view.
- Removal of large buildings, new picnic areas, elimination of parking, and reforestation combined will make the Crater's interior much more aesthetically pleasing for users.

### Negative/Uncertain Outcomes

- A substantial portion of current users — those coming on group tours for sightseeing only — will probably be eliminated. Some of these people may choose to come anyway on an FIT basis, especially if the visitor/interpretive center is effectively marketed as a major attraction in itself. However, the sort of person who prefers to travel in a group (perhaps for cultural/language reasons), and whose principal interest in Diamond Head was simply to see the interior of a volcanic crater, is only marginally likely to pay to come on an individual basis.
- At the present time, it is uncertain whether the tunnel stairs will be lighted, and such a lack of safety improvements could produce dissatisfied visitors if fees are charged. The present experience of struggling through a darkened area and emerging into the light is almost mystical in nature, and keeping this experience will be greatly valued by many people. But it does come at the expense of occasional accidents, and these may be less tolerated by users if they have paid a fee and hence might expect more safety. ~~When considering whether or not to light the tunnel stairs, visitor safety should be a high priority.~~
- Similarly, it is uncertain whether emergency communications will be installed on the Crater rim for people who may happen to fall ill, and this may also be more expected if fees are charged.

## 5.8.5 Community of Diamond Head "Stewards"

### A. Existing Conditions

The term "stewards" is intended to refer to people who have established a special sense of emotional connection with the Crater environment, and who feel a responsibility to the place and to the people who go there.



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Officially recognized stewards would include State Parks personnel and the Diamond Head CAC, which includes representatives of many neighborhood and environmental groups with a longstanding interest in preserving both the exterior and interior of Diamond Head. For the most part, this sub-section will be concerned with these people, or people much like them. But it should again be noted that others also feel a sense of voluntary care and responsibility for Diamond Head — including some people who have a commercial connection to the Crater and some area residents not represented on the CAC.

**Issues and Concerns:** State Parks staff, the CAC, and associated groups have worked on Diamond Head planning for decades. They have produced numerous reports, extending to hundreds of pages. Their issues and concerns are far more extensive and complex than can possibly be summarized here. However, some topics have been particularly relevant in recent months:

- **Preservation of environmental resources:** Key issues for Diamond Head stewards of a strictly objective, environmental nature have included the hiking trail itself (its quality) and the protection of endangered plant species growing mostly near the Crater Rim.
- **Preservation of nature-oriented human experience:** On the subjective, experiential side, the CAC has been concerned with limiting overt commercialism, restoring original natural features, and maintaining a natural visual quality in the Crater. This had led to concerns about the size of the possible visitor/interpretive center.
- **Desire for limitation of human use of the Crater:** Although it has not always been clear whether those who discuss the Crater's "carrying capacity" are referring to the objective or to the subjective aspects, there has been definite concern that too many people may now be coming, and many more should not be encouraged.
- **Use of revenues generated from entry fees:** As also mentioned by some Diamond Head users during surveys, various Diamond Head "stewards" have expressed concern that entry fees — both the preliminary fees which may be implemented in 1998 and the more substantial fees which could be collected later if the Master Plan is revised — would probably just go into the General Fund rather than come back for needed improvements in the Crater. However, it should be noted that all revenues generated within State parks already go into a special fund for the interpretive parks program, 'Aina Ho'omalua Special Fund. There has been a call to establish a special fund for any entry fees that could only be used for the DHSM.

**B. Anticipated Impacts**

Consequences for Diamond Head "stewards" will depend on the exact alternatives selected and the exact form of governance adopted for the new attraction. These include:

- **Satisfaction of many goals** — a Crater which is visually much more "natural," reforestation, protection of species, etc. Assuming elimination or great reduction in the number of sightseeing tours, this would also include the goal of reducing numbers of people to the Crater — although the reduction would be more meaningful for the subjective

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goal of reducing "commercialism" (i.e., elimination of large buses and/or obvious paid tours) than for the objective goal of resource preservation, since the group being eliminated would include few if any hikers.

- **Potential for increased liability:** As noted previously, imposition of fees without significant safety improvements could result in unhappy users.
- **Shift to a more economic perspective in stewardship —** It is not clear at this time to what extent the present "stewards" would retain their current level of responsibility for Diamond Head under any system which involves collection of entry fee and/or other revenues which are, in fact, clearly earmarked for Crater maintenance and improvements. As is discussed in Chapter 3 of Appendix G, gift shop profits in other State parks and in the National Parks are major potential sources of revenues for those parks.

Thus, the operator of the visitor/interpretive center (or at least of the profit centers within that facility) could become an important funder and possible "steward" as well. This could be a new agency, or the present CAC might form a "Friends of Diamond Head" organization to fulfill that function.

At any rate, if Diamond Head becomes a significant revenue-generating attraction, it will be necessary to attend to the business and economic aspects, just as is now done in National Parks.

A. Existing Conditions

This "larger community" would primarily be affected by implementation of fees (although that may well occur independently of any Master Plan considerations) and consequent revenue for the State.

**Probable Issues and Concerns:** The State of Hawai'i has been hearing several conflicting messages from different segments of taxpayers:

- (1) "Find new revenue sources to help balance the budget without raising taxes!" One consequence of this has been to examine additional possible revenue sources, including more user fees at recreational facilities.
- (2) "I am already being taxed to pay for public parks — why should I have to pay entry fees there?"

Any proposal to make Diamond Head a revenue-producing attraction would be reflective of both changes, although obviously in different ways.

As noted in Chapters 4 and 5 of Appendix G, a common reaction of residents both in business and at the Diamond Head Crater was, "Next they'll be charging us to go to the beaches!" Nonetheless, user fees have helped to produce significant improvements at places like the Honolulu Zoo and Hanauma Bay, and in some cases have helped generate revenue to meet taxpayer needs elsewhere.

B. Anticipated Impacts

The actual outcomes for Hawai'i taxpayers will depend on the likely revenues generated vs. the level of costs involved for implemented proposed changes to the Master Plan.

5.8.7 Summary Social Impacts

Exhibit 1-A, on page 97, summarizes the contents of Appendix G- Chapter 2, the social impact analysis. It considers probable issues and concerns and likely actual social impacts for various "communities of interest."

The most obvious "community" consists of nearby neighbors. Because of the Crater's previous history for rock concerts in the 1960s and early 1970s, it is expected that neighbors will have a great sensitivity to possible effects of new operations there. However, the factor which will most seriously affect the surrounding neighborhoods will be traffic and parking — whether the proposed move to outside parking will result in Crater visitors' cars or other vehicles overflowing onto residential streets or other parking lots in the area. If these concerns can be effectively addressed, it is expected that developments inside the Crater will have little effect on area residents.

One of the most important conclusions in Exhibit 1-A is that "Tour groups coming for sightseeing only (especially in large buses) will be effectively eliminated, for both economic and logistical causes." This conclusion is based on discussions with representatives of various tour companies, wholesalers, and travel desks. At the present time, most organized commercial tours to Diamond Head involve brief stops — often the first stop on a multi-destination circle-island tour — for sightseeing, picture-taking, and use of the restroom. Often, tour buses do not even stop to let people out, and the major tour companies do not consider this Crater stop to be an important aspect of their business.

Because the average O'ahu group tourist is increasingly budget-conscious, the major companies feel they will almost certainly just skip the Crater interior (although they may go to one of the exterior lookouts) if any fees are imposed. And because they are on a tight schedule, there are logistical considerations as well — there is simply no time to unload passengers at an outside parking lot, worry about keeping them together as they transfer to a proposed people mover system, wait for them to hike or go to the visitor/interpretive center, and then reassemble to go to the next location. The new center *might* be a draw for some smaller tour groups which actually spend time in the Crater, but this will depend on cost, commissions, etc. The overall effect will be to discourage group tourists and restrict the Crater mostly to residents and tourists arriving independently.

Another noteworthy comment in Exhibit 1-A of Appendix G involves the possibility that longtime Diamond Head "stewards" (champions of its preservation) could become involved in generating revenues for its improvement through giftshop sales, as occurs in National Parks. If so, this would increase their decision-making clout, but would require them to take more of an economic perspective.

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**5.9 Revenues**

**5.9.1 Background Market Research**

In preparation for the final cost and revenue analysis, a number of market research<sup>8</sup> efforts were carried out to gather information about the feasibility of:

- Overall development of the Crater park, with entry fees to help pay for resource management;
- The visitor/interpretive center in particular — i.e., the market appeal of a major facility which might add to Diamond Head's "draw" and/or be self-sustaining.

<b>EXHIBIT 1-A: SUMMARY OF SOCIAL IMPACT ASSESSMENT</b>		
<u>Affected Community</u>	<u>Probable Issues &amp; Concerns</u>	<u>Probable Actual Impacts</u>
<u>Community of Nearby Residents</u> (especially those living in neighborhoods very close to Diamond Head)	<ul style="list-style-type: none"> <li>- Noise and litter; repetition of nuisances from early use of Crater for concerts, etc.</li> <li>- Traffic/Parking concerns</li> <li>- Size of interpretive center</li> <li>- Effects of fees on neighborhood access (jogging, etc.)</li> <li>- Perceived inequities if State erects structures when nearby residents limited by DH Special Design District</li> </ul>	<ul style="list-style-type: none"> <li>- Fees may actually reduce number of visitors to area</li> <li>- Traffic/Parking is key to real level of impact. Potential for conflicts over use of Kapi'olani Community College parking lot, vehicles spilling over into residential streets.</li> <li>- If this can be well handled through good planning, then actual impacts likely neutral as most changes will be inside, not outside, Crater.</li> </ul>
<u>Community of On-Site Diamond Head Entrepreneurs</u>	Unknown - probably continuation of activities	Master Plan does not affect "First Amendment rights"
<u>Community of Tour Operators</u>	<ul style="list-style-type: none"> <li>- Image of Hawai'i for visitors: "squeezing" money again</li> <li>- Equity/Fairness if tourists must pay more than residents</li> <li>- Govt. assumption of private role in operating "tourist attraction"</li> </ul>	<ul style="list-style-type: none"> <li>- Tour groups coming for sightseeing only (especially in large buses) will be effectively eliminated, for both economic and logistical causes</li> <li>- Effect on the few operations spending real time in DH is uncertain, but likely negative</li> </ul>

<sup>8</sup>Because of the focus on market feasibility and revenues, most of the remainder of this chapter will use the language of business and commerce, which is in some part appropriate if the major underlying question is, "Will this make money (or at least not lose much)?" However, as noted at the end of the chapter, other values are also involved in planning for Diamond Head.

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<p><u>Community of Diamond Head Recreational Users</u> (both residents and visitors)</p>	<ul style="list-style-type: none"> <li>- Fees never welcome; questions about actual use for DH improvements and if this is precedent for other parks</li> <li>- Concerns about safety, lighting of tunnels, better restrooms, phone at top, etc.</li> <li>- Probable tourist demand for food gifts in well-organized shops, not from vendors</li> </ul>	<ul style="list-style-type: none"> <li>- Fees probably minimal for residents</li> <li>- Better maintenance of trail and viewpoint</li> <li>- More interpretive information</li> <li>- Viewpoints more accessible to older, more frail visitors</li> <li>- Interior more natural, pretty</li> <li>- People wanting only to sightsee probably screened out</li> <li>- Uncertainty about safety, emergency phone at top</li> </ul>
<p><u>Community of Diamond Head "Stewards"</u> (people who have come to feel a special aloha and responsibility - especially Parks staff, CAC, but also many other people)</p>	<ul style="list-style-type: none"> <li>- Preserving objective environmental resources (trail quality, endangered plants)</li> <li>- Preserving nature-oriented subjective experience (limits to commercialism, human structures in Crater)</li> <li>- Limiting number of people</li> <li>- Use of revenues for DH</li> <li>- Size of visitor/interpretive center</li> </ul>	<ul style="list-style-type: none"> <li>- Satisfaction of many long-standing goals, especially related to natural appearance and limiting "commercialism" associated with tour activities</li> <li>- Possibly more concerns about liability for State</li> <li>- if some "stewards" help raise \$ for DH through gift sales, they would be empowered on the one hand, but also now must take more of an economic perspective on operations</li> </ul>
<p><u>Community of Hawai'i Taxpayers</u></p>	<p>Conflicting voices: "Govt. should cut taxes, go to user fees instead!" vs. "Don't charge me; my taxes pay for this!"</p>	<p>Outcomes will depend on actual level of revenues vs. costs of project. Rest of analysis thus is market research.</p>

**5.9.1.1 Methods**

- (1) Case studies of Hawai'i "comparables" (or quasi-comparables) for:
  - The overall Crater park development — with particular attention to Hanauma Bay (an example of a recently "free" recreational attraction which began charging fees);
  - The potential visitor/interpretive center — with particular attention to the Hawai'i Nature Center located at 'Īao Valley, Maui (a stand-alone education-based attraction originally intended to capture FIT visitors to the adjacent State park in Maui's 'Īao Valley), and with secondary attention to the Kōke'e Natural History Museum and a few other museums or aquatic facilities.
- (2) Additional analysis of a Diamond Head visitor and vehicle count recently conducted within the Crater (SMS Consulting, 1998). This took place on one weekend day and one weekday during May 1998.

- (3) An intercept survey of 446 active Diamond Head users<sup>9</sup> to determine both their characteristics and their "willingness to pay," at various likely price points, for the sort of development contemplated for the Crater in various alternative versions of the updated Master Plan. This survey was conducted July 11 – 17, 1998 at various times of each day.
- (4) Interviews with about a dozen representatives of Hawai'i's largest organized tour companies and/or tour wholesalers and travel desks. (Included were a few small companies specializing in organized tours with Diamond Head as an occasional specific focus, though we could not find many such companies.)

Full information about these methods is provided in Chapters 3 through 5 of Appendix G. The following few pages provide a summary overview of selected key results.

#### 5.9.1.2 Numbers and Types of People Now Coming to Diamond Head

Available estimates of the numbers of people coming into the Crater are rough and approximate, based on counts made just one or two days out of a year. Hence, "official" State estimates summarized in DLNR's July 1998 draft *Interim Interpretive Plan for the Diamond Head State Monument* show some unlikely abrupt increases — e.g., the leap from about 60,000 people in fiscal 1993-94 to about 1,000,000 visitors the next year, or the leap from about 1,000,000 in 1996-97 to about 1.7 million for 1997-98.

Another problem is that past estimates have not adequately distinguished among types of visitors who have very different levels of impact on the Crater and its resources:

- People driving through without stopping at all — i.e., sightseers only (and maybe some intended users who could not find parking);
- Sightseeing groups making only brief stops, for picture taking or bathroom breaks;
- Active park users — mostly hikers, but perhaps a few picnickers, too.

The May 1998 visitor traffic count suggested an annual total of about 690,000 people *in the last two categories only*. Additional analysis of the May dataset for this report yields a very rough estimate of 600,000 visitors per year for the *last category only* — i.e., the principal likely "customer base" if sightseeing tour groups are effectively screened out of the Crater.

(These figures leave considerable doubt about the numbers "just driving through." If both the DLNR and SMS figures are true, the implication is that 1 million people drove through the Crater without stopping in the past year — a figure which is of course theoretically possible but highly doubtful. For purposes of this

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<sup>9</sup>The survey necessarily excluded people on sightseeing buses who did not emerge from buses or whose buses just drove through without stopping. The original sample included an additional 38 people who said they were on group tours and/or had arrived in tour vehicles, but these were eliminated from the final sample because in some cases we were talking to atypical tourists — those enthusiastic enough to get off the bus while others remained on it. The final sample thus consisted strictly of residents and "free independent travel" (FIT) tourists, as well as a few Japanese tourists who freely got on and off the Japan Travel Bureau charter trolley.

analysis, however, the number of "drive-throughs" is largely irrelevant, because the updated Master Plan is clearly designed to serve active park users only — the "drive-throughs" are not part of the base for revenue purposes.)

The July 1998 survey gives a sense of the characteristics of the roughly 600,000 active users of the Crater:

- Resident, 17%; Asian visitor, 40%; North American visitor, 37%; other visitors (including European), 7%.
- About half came by private car; a quarter by City bus; 14% by trolley; with the remainder by various other methods (taxi, foot, bicycle, etc.). Residents and North Americans came overwhelmingly by private car, while Asians were much more likely to come by bus or the JTB charter trolley.
- 92% had hiked or intended to hike to the top of the Crater. Thus, when drive-through sightseers are excluded, the principal "draw" of the Diamond Head Crater at this time is clearly the hike and the spectacular view from the top of the rim.

#### 5.9.1.3 Market Appeal of Overall Development Under Updated Master Plan

(Both survey respondents and tourism industry interviewees were told that eventual plans may include outside parking, people movers, elimination of the current larger interior buildings, possible return of the "Tunnel 407" with its Kāhala coast lookout, reforestation, new picnic areas, and a fairly large new visitor/interpretive center.)

Evidence from Hanauma Bay: Data suggest that attendance at the Hanauma Bay Nature Preserve (exclusive of sightseeing only) was sharply affected by the initial \$5 entry fee imposed on tourists in 1995. That fee (along with commercial vehicle fees) was later dropped, but a \$3 non-resident entry fee and \$1 parking fee for all private cars was later re-imposed in 1997. The \$3 fee had little or no apparent effect on attendance, indicating that \$3 was seen as a fair price point but that \$5 was a significant deterrent. In viewing this evidence, it should be kept in mind that Hanauma Bay is a fairly unique O'ahu attraction which had been — and still is — heavily promoted in tourist literature. Diamond Head is less unique (Punchbowl Crater offers much the same urban view for free), and it has been much less heavily promoted. Therefore, even a \$3 fee at Diamond Head might have a deterrent effect on attendance.

Diamond Head Survey — Willingness to Pay Outside Parking Fee: The great majority (about 80%) of those coming by car were willing to pay \$1, but only about half were willing to pay \$2.

Diamond Head Survey — Willingness to Pay Additional Fee to Cover Overall Entry and People Mover (not Covering Visitor/interpretive center): About half of Hawai'i residents would not pay even the minimal suggested \$3 fee. Among tourists, however, roughly three-quarters overall were willing to pay \$3 (with North Americans more likely to be deterred by this level of fee and foreign tourists more likely to accept it). Resistance increased sharply at the \$5 level, and only about 10% would pay \$7 or more. This suggests that tourists could not be charged more than \$3 (1998 dollars) without steep losses in attendance.

**Tour Company Acceptance:** As previously noted, the great majority of interviewees agreed the major tour companies will simply skip Diamond Head if: (1) any commercial vehicle fee or other cost is imposed (unless a major change has occurred in the current budget-conscious O'ahu market); and/or (2) outside parking makes it impossible to see Diamond Head *quickly* as part of a multi-destination tour. There was more uncertainty about effects on smaller tour group operations spending some time in the Crater, but there was little feeling that the new arrangement, especially the fee structure, would encourage more tour groups — it was more a question of whether or not present tour activities could survive, and that would depend on cost vs. market demand at the time.

#### 5.9.1.4 Market Appeal of New Visitor/Interpretive Center

**Relevant Information from Case Studies:** In its first year of operations (1997-98), the 'Āao Nature Center — charging adults \$6 for entry to a 4,000 square-foot facility — managed to break even on Maui. In that time, the Nature Center captured just 10% of the estimated attendance at the adjacent 'Āao Valley State Park. To augment business and generate revenues for its educational programs, the Nature Center now is establishing ties with Maui group tour companies, and hopes to double business in 1999. However, as previously indicated, the option of connecting with tour companies may not be available at Diamond Head. Thus, the 'Āao Nature Center's experience is "good news" in the sense that imminent profitability (at least at a small facility) seems possible, but the low capture rate is worrisome. Other conclusions from the examination of case studies:

- There is no Hawai'i market "comparable" for a larger interpretive center based on the natural history of a unique landmark. All existing facilities are much smaller and (except for the 'Āao project) essentially free.
- Revenues for such operations (and, to an extent, for paid facilities like Maui Ocean Center) come heavily from book/giftshop sales, not fees. The mark-up from these sales typically go to nonprofits running the shops, who by law must limit their stock to material relevant to their educational mission. State parks currently benefit little from these profits, but National Parks have standardized arrangements with nonprofit groups which might be a good model for the State.

**Diamond Head Survey — Willingness to Pay Separate Entry Fee for Visitor/Interpretive Center (Over and Above Parking and Overall Park Entry/Shuttle Fees):** Nearly two-thirds of the survey respondents were unwilling to pay the minimal suggested separate entry fee of \$5. Hawai'i residents were particularly disinclined to pay a separate fee for the center. (Management at the 'Āao Nature Center and the Hanauma Bay Nature Preserve both express reservations about the idea of a separate fee for the center, although the revenue analysis reported below suggests some reason to reconsider that view.)

**Diamond Head Survey — Willingness to Pay Combined Entry Fee for Admission to Overall Park, Visitor/Interpretive Center, and People Mover:** About 50% of the respondents said they would be deterred by the minimal suggested combined fee of \$7. (Again, residents were particularly resistant.) The survey process effectively "marketed" the center by oral description and a visual rendering; thus, it seems probable that in reality more than 50% would be deterred, especially since the initial payment question found 90% were deterred by the \$7 level.



**Tour Company Interest:** Interviewees were generally pessimistic about the market potential of the center. Few could think of any type of interpretive center which could, at the suggested range of fees, draw additional people to Diamond Head, whether on group tours or on an FIT basis. The consensus view was that tourist demand is typically less for "educational" than for "entertaining" experiences. And from the group tour perspective, there are other logistical and economic considerations:

- Keeping tour groups together and moving quickly;
- Fears that State facilities historically have not met the language needs of foreign visitors;
- Commissions for tour operators are significantly greater at competing, higher-fee attractions (e.g., Waimea Valley, Sea Life Park).

#### **5.9.1.5 General Advice of Tour Company Interviewees**

Interviews closed with a request for general strategies that would help to pay for Diamond Head improvements. Several people recommended making money from food or gifts, as opposed to a visitor center. Most stressed the need to be clear on the goal of fees. If it is to pay for maintenance and conservation, they thought few people would begrudge a dollar or two. But to generate truly significant revenue, they said the State must develop a major attraction ("with real pizzazz!") and be prepared to heavily market and promote it.

All recognized the need to maintain and upgrade the Crater, but only a few were enthusiastic about the potential for a major tourist attraction with more "pizzazz" than is currently being planned — most thought such a course would be risky for the State and could blur the line between public and private enterprise. The majority recommended that the State focus on the Crater's current assets ("a hike and a view") rather than trying to create something that is not already there now.

#### **5.9.2 Projected Costs vs. Revenues**

The following few pages summarize the complete analysis contained in Chapter 6 of Appendix G.

##### **5.9.2.1 Critical Conceptual Assumptions**

The analysis is based on a variety of assumptions, but it is important to point out three basic assumptions of a conceptual nature:

- (1) Large tour groups now coming to Diamond Head only for sightseeing (and remaining there for just a few minutes) would not be part of the market base for this project — they would no longer come into the Crater.
- (2) The implementation of entry fees would deter some current Diamond Head users from going into the Crater (and/or into the visitor/interpretive center). It is not a matter of assuming the State can get X dollars from everybody going into the Crater, because not everybody would go if they had to pay X dollars.

- (3) The assumed economics of the visitor/interpretive center will be based on existing Hawai'i models (particularly those at Hawai'i's National Parks). At present, other consultants are working on approaches to the center that could be far different than existing models. However, based on the resources and "comparables" available for this study, it is difficult accurately to estimate the economics of such alternative approaches.

#### 5.9.2.2 Cost Factors

Based on information provided by PBR HAWAII and its subcontractors:

- Construction costs for the project will total about \$25 million in 1998 dollars.
- Annual operating and amortization costs would total about \$2.3 million, which becomes the estimated yearly "break even" point.

#### 5.9.2.3 Estimated Revenues

Revenues were estimated for both a "Separate Entry Fee Scenario" (in which visitors would have to pay one fee to enter the Crater and a separate fee for admission to the visitor/interpretive center) and also a "Combined Entry Fee Scenario" (in which a single, higher combined fee would cover admission both to the overall park and to the center). In the first scenario, more people would pay a lower fee (assumed to be \$3 for adult tourists, nothing for residents) to enter the overall Crater, and only a small proportion would likely pay a separate fee for the center (\$5 for tourists, \$4 for residents). In the second scenario, fewer people would pay the combined entry fee (assumed to be \$7 for tourists, \$3 for residents), but a higher proportion would go into the center thereafter. Exhibit 1-B, on the next page, summarizes results of the analysis.

The analysis suggests neither entry fee scenario would meet projected annual costs, but the Separate Entry Fee approach would come closer.

In fact, given the rough and preliminary nature of these numbers, the best interpretation would be that the Separate Fee approach would be "close to break-even, but a little on the negative side of the mark."

The complete analysis in Chapter 6 of Appendix G also provides further numbers indicating that the Combined Entry Fee approach *could* reach the level of profitability if fewer people are deterred than we assume ... and/or if it is very effectively marketed and promoted. However, the approach is riskier, because the analysis also shows that if numbers are lower than assumed, the shortfall increases more rapidly than under the Separate Entry Fee Scenario.

This analysis in many ways reinforces the comments offered by tourism company interviewees. To be seriously profitable, the visitor/interpretive center must have far more intrinsic market appeal than anything yet developed in Hawai'i, and/or it must be marketed and promoted in a way that local government has not previously attempted for any public park or visitor facility. That would mean a commitment to Diamond Head as a tourist attraction, possibly in competition with other O'ahu attractions. Such a commitment does not necessarily imply the "commercialization" of Diamond Head, if — as is the case with National Parks — good planning principles are followed; giftshops are operated by nonprofits; and revenues are used for

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maintenance and improvements in the area. It does, however, imply a commitment to an economic perspective, to adopting many of the values of good business operations.

Alternatively, the main purpose of the visitor/interpretive center could be viewed as something other than profit. It could be viewed as an appropriate adjunct to a natural resource — as having intrinsic educational value, for both residents and tourists, the sort of value which merits a moderate level of State subsidy. And/or it could be viewed as the sort of traditional government addition to the visitor plant (again, like National Parks) which helps to re-invigorate our “tourism product” by providing facilities which appeal to some if not all segments of the visitor market. This might also argue for a moderate level of State subsidy.

Ideally, the Diamond Head Crater and its visitor/interpretive facility would fulfill all these purposes—it could educate, contribute to the tourism economy, *and* generate surplus revenues for the State which could be used to improve the Crater environment. Our analysis suggests this ideal will probably not be met, and so a decision needs to be made as to which purpose has priority.

<b>EXHIBIT 1-B: SUMMARY OF PROJECTED ANNUAL ATTENDANCE, REVENUES, AND TOTAL COST</b>		
	<b>I. Separate Entry Fee Scenario</b>	<b>II. Combined Entry Fee Scenario</b>
<b>Attendance Levels</b>		
- Overall Crater	517,500	207,000
- Interpretive Center	182,200	144,300
<b>Revenue Levels</b>		
- Crater Entry Fee	\$1,214,100	\$1,246,300
- Parking Fee	\$119,000	\$47,600
- Shuttle Concession	\$64,500	\$25,800
(Subtotal from Outside Center)	\$1,397,600	\$1,319,700
Center Entry Fee	\$843,100	\$471,800
Gift Shop Profits	\$51,000	\$40,400
Food Concession	\$178,300	\$71,300
(Subtotal from Interpretive Center)	\$1,072,400	\$583,500
<b>TOTAL REVENUES</b>	<b>\$2,470,000</b>	<b>\$1,903,200</b>
<b>State Portion (80%)</b>	<b>\$1,976,000</b>	<b>\$1,522,560</b>
	vs.	vs.
<b>Projected Annual Cost</b>	<b>\$2,309,800</b>	<b>\$2,309,800</b>

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**6.0**  
**Irreversible and**  
**Irretrievable Commitments of Resources**

## 6.0 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

The implementation of the proposed Diamond Head State Monument Master Plan Update would result in the irreversible and irretrievable commitment of the land resource and require use of fiscal resources from the State of Hawai'i. Major resource commitments include the land on which the proposed project is located and the financial commitment for construction materials, manpower and energy required for the project's completion.

The primary resource of concern is the use of Diamond Head Crater, which is currently used for by the FAA, ~~the State~~ DOD (Hawai'i National Guard and EOC), the Board of Water Supply and the State Division of State Parks. Currently the FAA and the Hawai'i National Guard are housed in four large buildings on the crater floor, which have a significant visual impact. There are current plans for the FAA and the Hawai'i National Guard to move out of the crater. The proposed Master Plan Update includes the eventual removal of the four buildings and the inclusion of the EOC at Battery Birkhimer and the BWS reservoir in its current location. Although there are existing State Parks facilities within the crater, these do not adequately service existing visitor counts, and the proposed Master Plan Update includes recommended improvements. Due to resource itself (Diamond Head Crater), there are no alternatives to siting the proposed plan elsewhere on O'ahu or anywhere else in the State.

In addition to the on-site physical improvements to be provided by the State, development of the subject property will result in the increased use of public infrastructure as the project achieves build out. This commitment to new infrastructure includes transportation improvements, water, and wastewater collection and treatment, and facilities for public services such as police and fire protection. The financial resources required to support these public improvements may be funded by increased user fees and sales within the proposed visitor/interpretive center.

In addition to the physical resources described, labor and materials which are mostly non-renewable and irretrievable will also be necessary during the construction phase. After project completion, occupancy of the caretaker's residence/DOCARE office, operation of the visitor/interpretive center, and maintenance of the picnic and botanical garden areas will require use of irrigation systems and petroleum-generated electricity which also represents irretrievable commitments of resources.

The impacts reflected by the commitment of these resources, should be weighed against the positive social benefits that could be derived from the project versus the consequences of either taking no action or pursuing another less beneficial use of the property. Consumption of these resources will be replaced by the creation of new recreation and employment facilities. As such, significant enhancement to existing and future lifestyles will result from the project compared to limited benefits derived from a "no-build" alternative.

### 6.1 Probable Adverse Environmental Effects Which Cannot Be Avoided

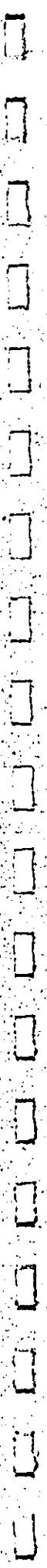
As with any development, there will likely be instances during the construction period where soil erosion from wind and rain will occur and visual impacts will be altered from the current vacant scrub vegetation. Noise levels will also increase above current conditions due to the added traffic levels on the property (during the interim, when visitor vehicles will be allowed in certain areas of the crater), human activity (i.e.

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children playing), and the addition of mechanical equipment such as air conditioners, service trucks backing up, and vehicular noise (especially during the interim, when visitor vehicles will be allowed in certain areas of the crater). Solid waste, energy consumption, water use levels, and waste water will all increase above current levels.

Each of these impacts, typical of all park uses, will result wherever new park facilities are provided. By providing a master plan where potential impacts can be mitigated through site design and development standards, potential adverse environmental effects which cannot be avoided can be mitigated.



**7.0**

**Conformance to Federal,  
State, and City Planning Policies**



## 7.0 CONFORMANCE TO FEDERAL, STATE, AND CITY PLANNING POLICIES

Land use regulatory restrictions are applicable to the Park from the State, County, and federal government jurisdictions. Certain restrictions may also apply when funding for Park improvements are derived from governmental sources. However, the following plans, programs, and regulations apply from a land use perspective.

### 7.1 Federal

According to comments received during their review of the EISPN, the U.S. Army Corps of Engineers indicated that a Department of Army Permit may be required for any work done in the wetland. A wetland boundary delineation is currently being conducted by PBR HAWAII, Botanist Winona Char, and Biologist Tim Ohashi, with the assistance of Ecologist Melissa Dumaran of the Hawai'i National Guard. All applicable Corps permits will be obtained by DLNR in accordance with pertinent regulations prior to any alteration to the wetland.

At least three endangered species are found inside and on the slopes of Diamond Head: 1) *Spemolepis hawaiiensis*, 2) *Cyperus trachysanthos* in the wetland area, and 3) *Schidea adamantis* on the crater rim.

According to the *Endangered and Rare Species Survey and Management Recommendations for Hawai'i Army National Guard Lands* prepared by the U.S. Fish and Wildlife Service, June, 1998, management plans are necessary to ensure that endangered species within the crater areas are appropriately protected from harmful activities. While such management plans have been, at least in part, implemented for the endangered *Schidea adamantis*, the other endangered and rare species inhabiting the crater have only recently be found and/or, only recently received listed status (e.g., *Spemolepis hawaiiensis* and *Cyperus trachysanthos*). As a consequence, management for these species are only in the early planning phase. Management efforts should promote the preservation and recovery of rare and endangered species and includes the removal/control of alien species and fire control, among other measures. Federal permits are required for the possession and handling of listed plant and animal species.

The ADA Americans with Disabilities Act (ADA) of 1990 sets guidelines for accessibility to buildings and facilities by individuals with disabilities. All facilities will be designed to meet the Americans with Disabilities Act Accessibility guidelines and the requirements of Section 103-50 of the Hawaii Revised Statutes. These guidelines will be applied during the design and construction of new facilities covered by the ADA to the extent required by regulations issued by federal agencies including the Department of Transportation.

All facilities will be designed to meet the Americans with Disabilities Act Accessibility guidelines and the requirements of Section 103-50 Hawaii Revised Statutes (HRS) except: 1) where compliance would cause substantial harm to cultural, historical, religious, or significant natural features and characteristics; 2) where compliance could substantially alter the nature of the setting or the purpose of the facility, or portion of the facility; 3) where compliance would require construction methods or materials that are prohibited by Federal, State, or local regulations or statutes; 4) where compliance would not be feasible due to terrain or prevailing construction practices.

Other than the National Pollution Discharge Elimination System Permit, which is administered by the State Department of Health, there are no other known federal plans or programs applicable to the project.

## 7.2 State of Hawai'i - Hawai'i State Plan

The Hawai'i State Plan (Chapter 226, Hawai'i Revised Statutes), was developed to "serve as a guide for the future long-range development of the State; identify the goals, objectives; policies, and priorities for the State; provide a basis for determining priorities and allocating limited resources, such as public funds, services, human resources, land energy, water, and other resources; improve coordination of federal, state, and county plans, policies, programs, projects, and regulatory activities; and to establish a system for plan formulation and program coordination to provide for an integration of all major state and county activities."

The Plan is divided into three parts. Part I (Overall Theme, Goals, Objectives and Policies); Part II (Planning, Coordination and Implementation); and Part III (Priority Guidelines). Part II elements of the State Plan pertain primarily to the administrative structure and implementation process of the State Planning process. As such, project specific comments regarding the applicability of Part II (Section 226-52(a) and 226-52(b) - statewide planning system) do not directly pertain to the proposed project.

As stated in Section 226-4 (2) State Goals, it shall be the goal of the State to achieve:

"A desired physical environment, characterized by beauty, cleanliness, quiet, stable natural systems, and uniqueness, that enhances the mental and physical well-being of people."

The applicability of specific sections of the Hawai'i State Plan relative to the development of the Diamond Head State Monument Master Plan is discussed below. The cumulative impact of the proposed project is also considered in terms of Hawai'i State Plan implementation and the attainment of statewide planning goals and aspirations.

Section 226-8 Objective and policies for the economy — visitor industry.

Section 226-8(b) (1) Support and assist in the promotion of Hawai'i's visitor attractions and facilities.

Section 226-8(b) (2) Ensure that visitor industry activities are in keeping with the social, economic, and physical needs and aspirations of Hawai'i's people.

**Discussion:** As described in Section 2.4, facility improvements are proposed to expand the Park's interpretive program. While these improvements will provide residents with more recreational opportunities and improve interpretive facilities in the DHSM, they will also expand the types of resources which currently attract FIT visitors to Hawai'i. It is recognized that charging user fees and implementing the long-term plan to move visitor parking to the exterior of the crater may dissuade tour groups from entering the crater, however, the overall experience inside the crater is likely to improve as a result. In that regard, a resource with better visitor and interpretive facilities and less visitors is anticipated to be more attractive to visitors, especially to FIT's which is the growing portion of the visitor market. In the long-term, the loss

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of group visitors will be offset by a more enjoyable experience for residents and a more desirable "attraction" for FITs.

Section 226-11 (a) (2) Effective protection of Hawai'i's unique and fragile environmental resources.

Section 226-11 (b) (2) Ensure compatibility between land-based and water-based activities and natural resources and ecological systems.

Section 226-11 (b) (3) take into account the physical attributes of areas when planning and designing activities and facilities.

Section 226-11 (b) (6) Encourage the protection of rare and endangered plant and animal species and habitats native to Hawai'i.

Section 226-11 (b) (8) Pursue compatible relationships among activities, facilities, and natural resources.

**Discussion:** Physical, environmental, and cultural attributes of the property were surveyed prior to preparation of the proposed the DHSM Master Plan Update. Site features such as slope, drainage characteristics, presence of important archaeological sites, and provisions for the protection of important flora and fauna were incorporated into the design as applicable. Provisions for existing services and infrastructure are also considered by the project master plan to assure more efficient use of existing facilities.

Section 226-12 Objective and policies for the physical environment — scenic, natural beauty, and historic resources.

226-12(b) (1) Promote the preservation and restoration of significant natural and historic resources.

226-12(b) (2) Provide incentives to maintain and enhance historic, cultural, and scenic amenities.

226-12(b) (3) Promote the preservation of views and vistas to enhance the visual and aesthetic enjoyment of mountains, ocean, scenic landscapes, and other natural features.

**Discussion:** The proposed improvements described in Section 2.4 are intended to enhance the "semi-wilderness character of the DHSM. Improvements include: more lookouts than currently available, less buildings, more landscaping, and more access to historic (military) resources.

Section 226-13 Objectives and policies for the physical environment — land, air and water quality.

226-13(a) (2) Greater public awareness and appreciation of Hawai'i's environmental resources.

226-13(b) (1) Foster educational activities that promote a better understanding of Hawai'i's limited environmental resources.

**Discussion:** The interpretive program in the DHSM will be enhanced by the development of the visitor/interpretive center and the use of existing structures such as the Tunnel 407, Battery Harlow and the

Cannon Club (renovated or replaced) for interpretive facilities. These structures, additional signage and brochures will improve both residents' and visitors' understanding of the DHSM's limited resources.

### 7.3 Hawai'i State Land Use Districts (Chapter 205)

The State LUC places all lands in the State of Hawai'i in one of four land use districts: urban, agriculture, conservation, or rural. As illustrated in Figure 3, the DHSM consists primarily of conservation district land. Only a very small portion of the DHSM lies in the urban district and is subject to City and County of Honolulu zoning regulations.

Conservation District land is subject to the administrative rules of the Hawai'i State DLNR, Title 13, Chapter 5. These rules define four subzones of conservation district land, two of which apply to the DHSM.

**Resource (R) subzone:** The objective of this subzone is "to develop, with proper management, areas to ensure sustained use of the natural resources of those areas." The resource subzone encompasses lands used for parks or for outdoor recreational uses.

**General (G) subzone:** The objective of this subzone is "to designate open space where specific conservation uses may not be defined, but where urban use would be premature."

Most of the DHSM appears to be currently designated as an R (Resource) subzone, although it was noted during the EISPN comment period, the State Land Use Commission noted that TMK: 3-1-42: 10, 21, 23, 24, 25, 36 and 37 were classified as Conservation District, but were not subsequently designated within a particular subzone. DLNR will work with the Office of State Planning to ensure that the subject parcels are placed in the proper Conservation District Subzone(s). The portion of the crater floor where most of the State DOD and FAA facilities are concentrated and the slopes above and over the crater rim presently are designated as G (General) subzone. This is important because most of the proposed visitor/interpretive center will be located in a G (General) subzone.

All structures must be consistent with the purpose of the Conservation District. The park's primary structure, the proposed visitor/interpretive center, will probably be located mostly within the General (G) subzone. The General (G) designation is the least restrictive of the conservation district subzones.

### 7.4 Hawai'i State Functional Plans

The Hawai'i State Plan directs the appropriate State agencies to prepare functional plans for their respective program areas. As such, these functional plans serve as the primary implementing vehicle for the goals, objectives and policies of the Hawai'i State Plan. An important component of the Hawai'i State Plan are the various functional plans which provide long-range direction for Hawai'i's future and guide programs, actions, and resource allocation decisions. The following sections of the listed State Functional Plans are directly applicable to the proposed project.

#### 7.4.1 State Historic Preservation Functional Plan

The objectives, policies and implementing actions of the State Historic Preservation Functional Plan are directed toward State agencies, primarily the Department of Land and Natural Resources, Historic Preservation Division. The historical and archaeological resources of the project site have been surveyed and the survey report is being evaluated by the State Historic Preservation Division (SHPD). If archaeological sites or other cultural resources become known in the future, the DLNR Historic Preservation Division will be advised and appropriate actions will be implemented to ensure proper treatment. A site for interment of remains will be established on accordance with recommendations from the O'ahu Burial Council. The review of projects within the Diamond Head State Monument by SHPD is also triggered by the listing of the Fort Ruger Historic District on the National and Hawaii Registers of Historic Places (Site #50-80-14-1350).

#### 7.4.2 State Recreation Functional Plan

The functional plan most applicable to the proposed Diamond Head State Monument Master Plan is the "Recreation Functional Plan." This Functional Plan focuses on various planning issues relating to shoreline recreation, inland recreation, shoreline access issues, resource conservation and management, recreation programs, and wetlands protection and management.

According to the "State Recreation Functional Plan Technical Reference Document (TRD) December 1990, the population of Hawai'i is growing at a proportionally higher rate than the nation as a whole. Between 1980 and 1988, the United States population increased 8.5 percent, compared with 13.8 percent for Hawai'i. The de facto population of O'ahu is projected to increase at 9.11 percent for the period between 1990 and 2000. During this same period, the median age of the resident population will rise from 31.9 in 1990 to 34.1 in 2000. The number of persons 65 years and older is projected to rise from 11.0 percent to 12.5 percent.

This "greying" of the population will impact the amount and type of recreation demanded by the overall population. The Recreational Functional Plan anticipated increased demand for golf, and increase in leisure time spent on relaxing, home-based, non-physical types of activities, and continuation of the popularity of walking as identified by the Recreational Functional Plan TRD statewide resident inventory.

As such, a growing demand for less active forms of recreation appears evident. This trend was also reflected by the State Recreation Functional Plan Advisory Committee which has identified the development of interpretive programs for areas of historic and cultural significance as a critical need. The State Tourism Functional Plan recognized historic/cultural sites as assets which can enrich both residents and visitors. In addition, resort developers who have significant historic and archaeological resources on their properties are encouraged to preserve, maintain, and interpret them.

Generally, the needs related to the development of recreational resources were identified as follows:

#### Threats to Health and Safety or Valued Resources

- Capacity limitations of beach Parks
- User conflicts

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- 
- Limited availability of activities and facilities
  - Restrictions to public access
  - Environmental degradation
  - Enforcement of rules
  - Inadequate maintenance of existing facilities
  - Demand for wetlands protection

#### Recreational Demand

- Shortage of mauka recreational opportunities
- Overburdened or insufficient urban and community recreation

#### Recreation Resources Management

- Need for more cooperation between agencies
- Inadequate funding mechanisms to acquire, develop, and manage recreation resources

In addition to identifying the recreational needs listed above, the Recreation Functional plan also addresses actions designed to mitigate these existing and potential problems. The mitigation actions applicable to and incorporated into the proposed Diamond Head State Monument Master Plan Update (Section 2.4) include:

- Plan and develop Parks featuring historic, cultural, scenic, and natural resources; implement interpretive programs.
- Proceed with planning, acquisition, and development of hiking trails.
- Assure the provision of adequate improvements and maintenance of public access ways.
- Develop and implement information, education, and interpretive programs regarding environmental degradation.
- Identify existing wetlands that have the potential for recreational use without adversely affecting wetland resources.
- Develop a coordinated approach to wetlands protection, acquisition, and management.

### 7.5 Coastal Zone Management Program

The objectives of the Hawai'i Coastal Zone Management (CZM) Act as set forth in Chapter 205A, Hawai'i Revised Statutes, applies to the protection and maintenance of valuable coastal resources and the establishment of Special Management Areas. The SMA boundary applicable to Diamond Head State Monument is shown in Figure 13 and encompasses the entire Monument.

Inasmuch as the proposed Diamond Head State Monument Master Plan is consistent with the already approved Urban State Land Use District and City and County of Honolulu P-2 zoning designation, in general the proposed project does not conflict with existing land use regulatory controls. One exception were the plan does not conform with existing land use regulatory controls is that the height limit of the City and County of Honolulu's Diamond Head Special District will be exceeded.

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The SMA is defined by ordinance of the City and County of Honolulu to establish additional development controls along O'ahu's shoreline areas. Specifically, development is generally defined as grading, removing, dredging mining, or the extraction of any materials; and the construction, reconstruction, demolition, or alteration of the size of any structure. Consequently, the proposed improvements will be subject to approval under provisions set forth by the City and County of Honolulu's SMA ordinance.

A discussion of the CZM Program objectives applicable to the Diamond Head State Monument Master Plan is presented below:

1. Recreational Resources

*Objective:*

Provide coastal recreational opportunities accessible to the public.

*Policies:*

- 1.b. Provide adequate, accessible and diverse recreational opportunities in the coastal zone management area by:
  - i. Protecting coastal resources uniquely suited for recreational activities that cannot be provided in other areas;
  - iii. Providing and managing adequate public access, consistent with conservation of natural resources, to and along shorelines with recreational value;
  - iv. Providing an adequate supply of shoreline parks and other recreational facilities suitable for public recreation;
  - vii. Developing new shoreline recreational opportunities, where appropriate, such as artificial lagoons, artificial beaches, artificial reefs for surfing and fishing.
  - viii. Encouraging reasonable dedication of shoreline areas with recreational value for public use as part of discretionary approvals or permits by the Land Use Commission, Board of Land and Natural resources, county planning commissions and crediting such dedication against the requirements of 46-6.

**Discussion:** The DHSM Master Plan Update addresses improvements to the recreational resources of the Monument (hiking trails, lookouts, picnic areas, botanical garden, wetland) and to access to those facilities, while protecting: 1) the "wilderness character" of the crater in this mostly urban setting; 2) the eroding crater rim; 3) the endangered species habitats.

## 2. HISTORIC RESOURCES

### *Objective:*

Protect, preserve, and where desirable, restore those natural and man-made historic and pre-historic resources in the coastal zone management area that are significant in Hawaiian and American history and culture.

### *Policies:*

- 2.a. Identify and analyze significant archaeological resources;
- 2.b. Maximize information retention through preservation of remains and artifacts or salvage operations; and
- 2.c. Support state goals for protection, restoration, interpretation and display of historic resources.

**Discussion:** The DHSM Master Plan Update includes preservation of all existing structures (other than the FAA building and State DOD buildings 301, 303 and 304). The Plan also includes recommendations for: the development of a cultural resource management plan; the preparation of an archaeological inventory level survey; the development of management recommendations; and the identification of interpretive opportunities.

## 3. SCENIC AND OPEN SPACE RESOURCES

### *Objective*

Protect, preserve, and where desirable, restore or improve the quality of coastal scenic and open space resources.

### *Policies*

Insure that new developments are compatible with their visual environment by designing and locating such developments to minimize the alteration of natural landforms and existing public views to and along the shoreline.

Preserve, maintain, and where desirable, improve and restore shoreline open space and scenic resources.

**Discussion:** The DHSM Master Plan Update includes the following elements which should serve to improve scenic and open space resources: 1) removal of the FAA building and State DOD buildings 301, 303 and 304; 2) the realignment of overhead electrical and communication lines to Birkhimer EOC to the aboveground conduits to the FAA Link Site and then the removal of the overhead lines and supporting structures; and 3) opening more lookouts and providing access to these sites by constructing more trails.



#### 4. COASTAL ECOSYSTEMS

##### *Objective*

Protect valuable coastal ecosystems from disruption and minimize adverse impacts on all coastal ecosystems.

##### *Policies*

- 4.a. Improve the technical basis for natural resource management;
- 4.b. Preserve valuable coastal ecosystems of significant biological or economic importance.

**Discussion:** The DHSM Master Plan identifies valuable habitats and resources and proposes their protection through: 1) the identification of key habitats and proposes restrictions to accessing these habitats; 2) restricting access to the crater rim; 3) recognizing the importance of wildfire control and proposing possible mitigative measures such as a fire control plan, removal of non-native brush (fire material), and planting fire resistant species; and 4) proposing enhancements to the wetland.

#### 5. ECONOMIC USES

##### *Objective*

Provide public and private facilities and improvements important to the State's economy in suitable locations.

##### *Policies*

- 5.b. Insure that coastal dependent development such as harbors and ports, visitor industry facilities and energy generating facilities are located, designed and constructed to minimize adverse social, visual and environmental impacts in the coastal zone management area.
- 5.c. Direct the location and expansion of coastal dependent developments to areas presently designated and used for such developments and permit reasonable long-term growth at such areas, and permit coastal dependent development outside presently designated areas when:
  - ii. Adverse environmental effects are minimized.

**Discussion:** An important resource to residents, the attraction of the DHSM to visitors cannot be discounted. Charging user fees and implementing the long-term plan to move visitor parking to the exterior of the crater may dissuade tour groups from entering the crater, however, the overall experience inside the crater is likely to improve as a result. In that regard, a resource with better visitor and interpretive facilities and less visitors is anticipated to be more attractive to visitors, especially to FIT's which is the growing portion of the visitor market. In the long-term, the loss of group visitors will be offset by a more enjoyable experience for residents and a more desirable "attraction" for FITs.

## 6. COASTAL HAZARDS

### *Objective*

Reduce hazard to life and property from tsunami, storm waves, stream flooding, erosion and subsidence.

### *Policies*

- 6.b. Control development in areas subject to storm wave, tsunami, flood, erosion and subsidence.
- 6.c. Ensure that developments comply with the requirements of the Federal Flood Insurance Program.

**Discussion:** There do not appear to be any known coastal hazards to the DHSM.

## 7. MANAGING DEVELOPMENT

### *Objective*

Improve the development review process, communication and public participation in the management of coastal resources and hazards.

### *Policies*

- 7.a. Effectively utilize and implement existing law to the maximum extent possible in managing present and future coastal zone development.
- 7.b. Facilitate timely processing of application for development permits and resolve overlapping or conflicting permit requirements.
- 7.c. Communicate the potential short- and long-term impacts of proposed significant coastal developments early in their life-cycle and in terms understandable to the general public to facilitate public participation in the planning and review process.

**Discussion:** This EIS is an integral component of the development review process, communicating information regarding the project and providing opportunities for public participation in the reviews of the EISPN and of the DEIS.

### 7.6 City and County of Honolulu General Plan

As required by the City Charter, the General Plan for the City and County of Honolulu serves two purposes. The first is a statement of the long-range social, economic, environmental, and design objectives for the welfare and prosperity of the people of Oahu. Second, the General Plan is a statement of broad policies that facilitate the attainment of the objectives of the plan. The General Plan consists of a series of objectives and policy statements. Diamond Head, mostly located within the Preservation District within the Primary Urban

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~~Center (PUC) Development Plan (DP), falls under policy statements dealing with preservation. Small portions of the DHSM are located within the Park, Military, Public Facility and Residential Districts. Eventually, these latter designations on portions of the DHSM should be amended on the PUC DP Land Use Map~~

*Objective*

To preserve and enhance the natural monuments and scenic views of O'ahu for the benefit of both residents and visitors.

*Policies*

1. Protect the Island's well-known resources: its mountains and craters; forests and watershed areas; marshes, rivers, and streams; shoreline, fishponds, and bays; and reefs and offshore islands.
2. Protect O'ahu's scenic views, especially those seen from highly developed and heavily traveled areas.
3. Provide opportunities for recreational and educational use and physical contact with O'ahu's natural environment.

**Discussion:** Diamond Head is a natural monument and none of the elements of the Master Plan Update are likely to affect long views of the crater except for those from mauka areas (St. Louis Heights, Wilhelmina Rise, etc.). In the long term, from those views, the FAA CERAP Building and State DOD Buildings 301, 303 and 304 will no longer be visible (after being removed) and the proposed visitor/interpretive center may be viewable. When visitor parking is moved to the exterior of the crater, there may be little alteration of current views if parking is available at the Cannon Club (which is already paved for parking) and if there is no significant change in building elevation if the building needs to be replaced. If the Cannon Club cannot be acquired, then parking could be developed near Makapu'u Avenue. With landscaping, this parking could be effectively screened. In either case, the DHSM Master Plan calls for an approximately 100-foot wide linear park of landscaping along Diamond Head Road between 22nd Avenue and the Cannon Club. This landscaping is anticipated to have a positive impact on views of Diamond Head from Diamond Head Road.

The DHSM Master Plan Update provides more opportunities for recreational and educational use and physical contact with Diamond Head by providing: 1) more lookouts and trails; 2) more picnic areas; 3) an enhanced wetland; 4) a new, more accessible Nā La'au Arboretum; 5) a visitor/interpretive center; and 6) opening up Tunnel 407, Battery Harlow and the Cannon Club.

*Objective*

To protect O'ahu's cultural, historic, architectural, and archaeological resources.

*Policies*

1. Identify, and to the extent possible, preserve and restore buildings, sites, and areas of social, cultural, historic, architectural, and archaeological significance.

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2. Promote the interpretive and educational use of cultural, historic, architectural, and archaeological sites, buildings, and artifacts.

**Discussion:** The DHSM Master Plan Update calls for the preservation of all buildings except for the FAA CERAP Building and State DOD Buildings 301, 303 and 304. The Plan also calls for the renovation of Tunnel 407, Battery Harlow and the Cannon Club (if structurally sound, otherwise it may have to be replaced) and their use as interpretive and/or visitor facilities. Also, it is proposed that access be made available to the exterior of other facilities, such as the Flat Top Reservoir, Battery Dodge, various gun emplacements along the east rim of the crater and the Retractable Searchlight. All of the facilities have both historic and scenic values. The visitor/interpretive center is intended to provide interpretive information on other historical, cultural, archaeological, architectural and geological features of the DHSM.

*Objective*

To provide a wide range of recreational facilities and services that are readily available to all residents of O'ahu.

*Policies*

1. Encourage public and private botanic and zoological parks on O'ahu to foster an awareness and appreciation of the natural environment.
2. Encourage the State to develop and maintain a system of natural resource-based parks, such as beach, shoreline, and mountain parks.
3. Provide convenient access to all beaches and inland recreation areas.
4. Provide for recreation programs which serve a broad spectrum of the population.
5. Provide for safe and secure use of public parks, beaches, and recreation facilities.

**Discussion:** The DHSM Master Plan Update proposes the development of a new Nā La'au Arboretum on the exterior slopes of the crater between the Crater Access Road and Diamond Head Road. The Plan addresses the improvement of access to and inside the crater, while trying to limit visitor parking inside the crater. The DHSM Master Plan Update provides recreation programs which serve a broad range of the population by providing: 1) more lookouts and trails; 2) more picnic areas; 3) an enhanced wetland; 4) a new, more accessible Nā La'au Arboretum; 5) a visitor/interpretive center; and 6) opening up Tunnel 407, Battery Harlow and the Cannon Club.

## 7.7 City and County of Honolulu Primary Urban Center Development Plan

Diamond Head, mostly located within the Preservation District within the Primary Urban Center (PUC) Development Plan (DP), falls under policy statements dealing with preservation. Small portions of the DHSM are located within the Park, Military, Public Facility and Residential Districts. Eventually, these latter designations on portions of the DHSM should be amended on the PUC DP Land Use Map.

### 7.7.1 Common Provisions

Preservation areas as defined in Section 24-1.3(k) encompass elements of O'ahu's natural environment that give the island its essential character while also performing invaluable functions for its residents at no cost. These functions include buffering the island from storm winds and flood tides, stabilizing the shorelines, purifying water and maintaining a fresh water system that supports unique wildlife and lush vegetation. Preservation areas and their related functions support the health, safety and welfare of every resident of O'ahu and shall be preserved and protected from incompatible development.

**Discussion:** Diamond Head is designated as a Preservation Area and while it helps to "give the island its essential character", as also a park, it does not perform "invaluable functions for its residents at no cost." Even at its current level of maintenance and operations, funds must be expended for watering, upkeep, interpretation, etc., while serving anywhere from 700,000 to 1,000,000 visitors a year.

### 7.7.2 Special Provisions

Diamond Head is the area generally bounded by Kapahulu Avenue, Mo'ohau Avenue, Maunaloa Avenue, Kilauea Avenue, and 'Elepaio Street. It also includes the Ala Wai Golf Course.

The purpose of the following principles and controls is to preserve and protect Diamond Head as a scenic resource and to enhance the historic, cultural, and scenic qualities of the surrounding areas.

- (A) The natural appearance and public views of Diamond Head, especially as seen from heavily traveled and highly developed areas, shall be identified and protected.

**Discussion:** Diamond Head is a natural monument and none of the elements of the Master Plan Update are likely to affect long views of the crater except for those from mauka areas (St. Louis Heights, Wilhelmina Rise, etc.). In the long term, from those views, the FAA CERAP Building and State DOD Buildings 301, 303 and 304 will no longer be visible (after being removed) and the proposed visitor/interpretive center may be viewable. When visitor parking is moved to the exterior of the crater, there may be little alteration of current views if parking is available at the Cannon Club (which is already paved for parking) and if there is no significant change in building elevation if the building needs to be replaced. If the Cannon Club cannot be acquired, then parking could be developed near Makapu'u Avenue. With landscaping, this parking could be effectively screened. In either case, the DHSM Master Plan calls for an approximately 100-foot wide linear park of landscaping along Diamond Head Road between 22nd Avenue and the Cannon Club. This landscaping is anticipated to have a positive impact on views of Diamond Head from Diamond Head Road.

- (B) Cultural and historic sites shall be preserved and enhanced.

**Discussion:** The DHSM Master Plan Update calls for the preservation of all buildings except for the FAA CERAP Building and State DOD Buildings 301, 303 and 304. The Plan also calls for the renovation of Tunnel 407, Battery Harlow and the Cannon Club (if structurally sound, otherwise it may have to be replaced) and their use as interpretive and/or visitor facilities. Also, it is proposed that access be made available to the exterior of other facilities, such as the Flat Top Reservoir, Battery Dodge, various gun

emplacements along the east rim of the crater and the Retractable Searchlight. All of the facilities have both historic and scenic values. The visitor/interpretive center is intended to provide interpretive information on other historical, cultural, archaeological, architectural and geological features of the DHSM.

- (C) The general height limits for the area shall be as provided in the Diamond Head Historic, Cultural and Scenic District.

**Discussion:** The City and County of Honolulu's Diamond Head Special District calls for 0 feet height limit in the area around the DHSM. The proposed visitor/interpretive center, comfort stations, wetland viewing platform, entry guardhouse (at Makapu'u Avenue) and a people mover booth all will exceed this height limit. It should be noted that current projects (not covered by the Master Plan Update), including a interim interpretive kiosk and toll booth at the entry to Kāhala Tunnel will also exceed this height limit.

## 7.8 City and County of Honolulu Zoning

**Land Use Ordinance:** The P-1, Restricted Preservation District establishes most of DHSM's underlying zoning, it is "intended that all lands within a state-designated conservation district be zoned P-1 restricted preservation district." As such "within the P-1 restricted preservation district, all uses, structures and development standards shall be governed by the appropriate state agencies." Portions of the Monument are zoned P-2, General Preservation, F-1, Military and Federal Preservation, and R-5, Residential District.

**Diamond Head Special District (Ord. #77-123):** The Special District designation are for "Areas wherein natural and man-made objects of beauty and historic, cultural, architectural and scenic significance may be preserved, enhanced and perpetuated."

Every development in a special district is classified into one of three categories: major, minor, or exempt. Major and minor projects require a special district permit. Major permits are required for projects that may significantly change the intended character of special district. Major permits require review by the neighborhood board before submission of the application, a public hearing by the Director of the Department of Planning and Permitting (formally Department of Land Utilization), and review by the Design Advisory Committee. Minor permits are required for projects which will have limited impact. The Director of the Department of Planning and Permitting has the right to review and modify such projects. Exempt projects have negligible or no impact. They include projects which require emergency repairs, interior work and in some cases, do not change the exterior appearance of a structure. It is anticipated that implementation of the Master Plan Update will may require a Major Permit.

**8.0**

**Alternatives to the Proposed Action**

## 8.0 ALTERNATIVES TO THE PROPOSED ACTION

In compliance with the provisions of Title 11, Department of Health, Chapter 200, Environmental Impact Statement Rules, Section 11-200-10(6) (7), the following section includes identification and summary of alternatives considered, probable impacts and possible mitigation measures. In accordance with the provisions of the Department of Health, Chapter 200, Environmental Impact Statement Rules, Section 11-200-17(f), the "known feasible" alternatives to the proposed project are limited to those "which could attain the objectives of the action." The alternatives described in this section are limited to those that would allow the objective and policies described in Section 2.2 to be met, while minimizing potential adverse environmental impacts. Those environmental impacts that will occur can be mitigated by appropriate site and architectural design, the installation of appropriate infrastructure improvements, and implementation of the best management practices during project construction.

This section includes a discussion of the following alternatives:

- alternatives that do not meet project objectives (described in Section 8.1);
- the "no-action" alternative (described in Section 8.2);
- alternatives that meet project objectives (project objective and policies described in Sections 2.2), including:
  - the 1979 Diamond Head State Monument Development Plan (described in Section 8.3),
  - alternatives related to different designs or details of the 1979 Development Plan which would present different environmental impacts (Alternative Concept 1 as described in Section 8.4),
  - alternative locations for the proposed project, including:
    - Alternative Concept 2 (described in Section 8.5.1),
    - Alternative Concept 3 (described in Section 8.5.2),
  - actions of a significantly different nature which would provide similar benefits with different environmental impacts (described in Section 8.7).

Where appropriate, probable environmental impacts and possible mitigation measures are also identified in this section.

### 8.1 Alternatives That Do Not Meet Project Objectives

Over the years, numerous alternative uses for the crater have been proposed. Examples of these potential use alternatives considered have included a zoo, golf course, theme park, active recreation (ballfields/tennis, etc.), camping, and facilities for festivals and other large events. However, introduction of artificial or man-made elements into the crater that would detract from a "semi-wild" interior park were rejected as being inconsistent with the objective and policies established for the crater (1979, and amended in 1995). As described in Sections 2.2.1 and 2.2.2, establishment of passive recreational opportunities with interpretive facilities depicting the natural and cultural history of Diamond Head would not be achieved if these uses were implemented.



The alternative of locating the permanent visitor/interpretive center outside of the crater was brought before the CAC in 1998, but was discounted for lack of support. This alternative is significantly different from the location of the visitor/interpretive center shown on the 1979 Development Plan (which is inside the crater).

In addition, the permanent reuse of existing buildings (State DOD Buildings 301, 303, and 304) for a visitor/interpretive facility was also rejected as being inconsistent with the following policy statement: "...secure the phase-out of State and Federal Department of Defense and Federal Aviation Administration operations and demolition of their structures within the monument."

## 8.2 "No-Action Alternative"

The "no-action" alternative would not be consistent with the objective and policies stated in Section 2.2. This alternative would maintain the site in its present condition with the following negative impacts:

- the site would not be managed in an appropriate manner with non-essential vehicles continuing to enter the crater;
- the endangered plant habitats would continue to be stressed by hikers, fires and alien species;
- State DOD Buildings 301, 303 and 304 facilities would continue to have a detrimental visual impact on the crater floor in their present conditions;
- pedestrians would continue to have unsafe access via Kāhala Tunnel due to mixed traffic;
- visitors would have a limited opportunity to experience present closed off areas within the crater including viewpoints, Tunnel 407, and Battery Harlow;
- view opportunities would be limited to the existing trail and the Kāhala Tunnel lookout;
- the quality of visitor experience would deteriorate because visitors would continue to be limited to the already crowded hiking trail to Lē'ahi Summit, and;
- limited parking for park visitors.

## 8.3 1979 Diamond Head State Monument Master Plan

This alternative, which is the 1979 Development Plan, would meet the objective and policies described in Section 2.2. The Diamond Head State Monument Master Plan of 1979 would restore the interior of the crater to an essentially semi-wild state, with reforested areas, an extensive wildland, and meadowlands. This wilderness area would be accessed by the public through a one-way vehicular circulation system which would involve entering from the Kapahulu Tunnel and exiting through the Kāhala Tunnel. An interpretive center, restrooms, and parking area concentrated between the tunnels were also planned (refer to Section 8.3 for a detailed description of this alternative).

## 8.4 Alternatives Related to Different Designs or Details of the 1979 Development Plan Which Would Present Different Environmental Impacts

### Alternative Concept 1

In 1998, as part of the Diamond Head Master Plan Update process, a number of alternatives were developed for consideration by the Diamond Head Citizen's Advisory Committee. The CAC narrowed the sites being considered for the visitor/interpretive facility to three locations within the crater. The following alternative,

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Alternative Concept 1 (Figure 19), is similar to the 1979 Development Plan, as many of the major elements of the 1979 plan have also been incorporated into this alternative. For example, common elements include:

- entry through Kapahulu Tunnel;
- exit through Kāhala Tunnel;
- a permanent visitor/interpretive facility near Battery Birkhimer;
- a caretaker's resident or DOCARE office;
- removing the FAA CERAP Building;
- removing State DOD Buildings 301, 303 and 304;
- improvements to the wetland;
- proposed trail around the wetland; and
- proposed picnic area.

As such, this alternative should be considered as an update to 1979 plan rather than a completely new master plan. In the face of a significant increase of visitors to the crater since 1979, the following alternative would reinforce these common elements by:

- in the long-term, moving visitor parking to outside of the crater;
- establishing a motorized people mover system, when visitor parking is kept to the exterior;
- utilizing the Cannon Club site for food service and/or visitor orientation and providing restroom facilities;
- opening up Tunnel 407 and Battery Harlow for interpretive purposes and providing restroom facilities;
- keeping the existing comfort station and parking lot;
- allowing pedestrian access through Kapahulu Tunnel;
- controlling visitor access into sensitive areas (such as the crater rim);
- protecting the *Schidea adamantis* habitat, and the habitat of other native species;
- opening the road/trail from the FAA Link Site to the retractable searchlight on the southeastern edge of the crater rim;
- comfort stations at the picnic areas;
- wastewater lift station;
- opening a new trail from the retractable searchlight on the southeastern edge of the crater rim to Tunnel 407;
- utilizing Batteries Dodge and Hulings and the gun emplacements along the eastern edge of the crater as lookouts;
- opening a new trail to the flat top reservoir north of the existing trail to the summit;
- adding comfort stations at the exterior parking facility, at secondary interpretive facilities, picnic areas, and possibly at the summit; and
- installing a wastewater lift station.

The elements of this alternative are shown on Alternative Concept 1 - visitor/interpretive center at Kāhala Tunnel with two-way road (Figure 19) and are described below.

### *Entry*

In the short term, entry would continue through Kāhala Tunnel. Eventually, if the number of vehicles within the crater was determined to be adversely affecting the visual, noise and air quality, visitor parking could be relocated to the exterior of the crater. If the Cannon Club can be acquired, then the existing parking lot at the Cannon Club can be utilized as the visitor parking facility. The main entry to the crater, then, would be at the Cannon Club, with a new road built from the Cannon Club to Battery Harlow. If the Cannon Club cannot be acquired, then the main entry would be across the street from the Diamond Head Road entry to Kapi'olani Community College.

### *Tunnels*

The two major tunnels that access the crater would not be physically altered. Traffic circulation would be one-way with entry into the crater via the Kapahulu Tunnel and exit through the Kāhala Tunnel. Both tunnels would allow pedestrian access. The existing parking and scenic overlook outside the crater adjacent to the Kāhala Tunnel would continue to be used. Specifying one-way traffic through the tunnels will allow the striping of a single lane in the middle of both tunnels for vehicular traffic and narrower "lanes" on either side for pedestrians.

### *Interior Roadways and Parking*

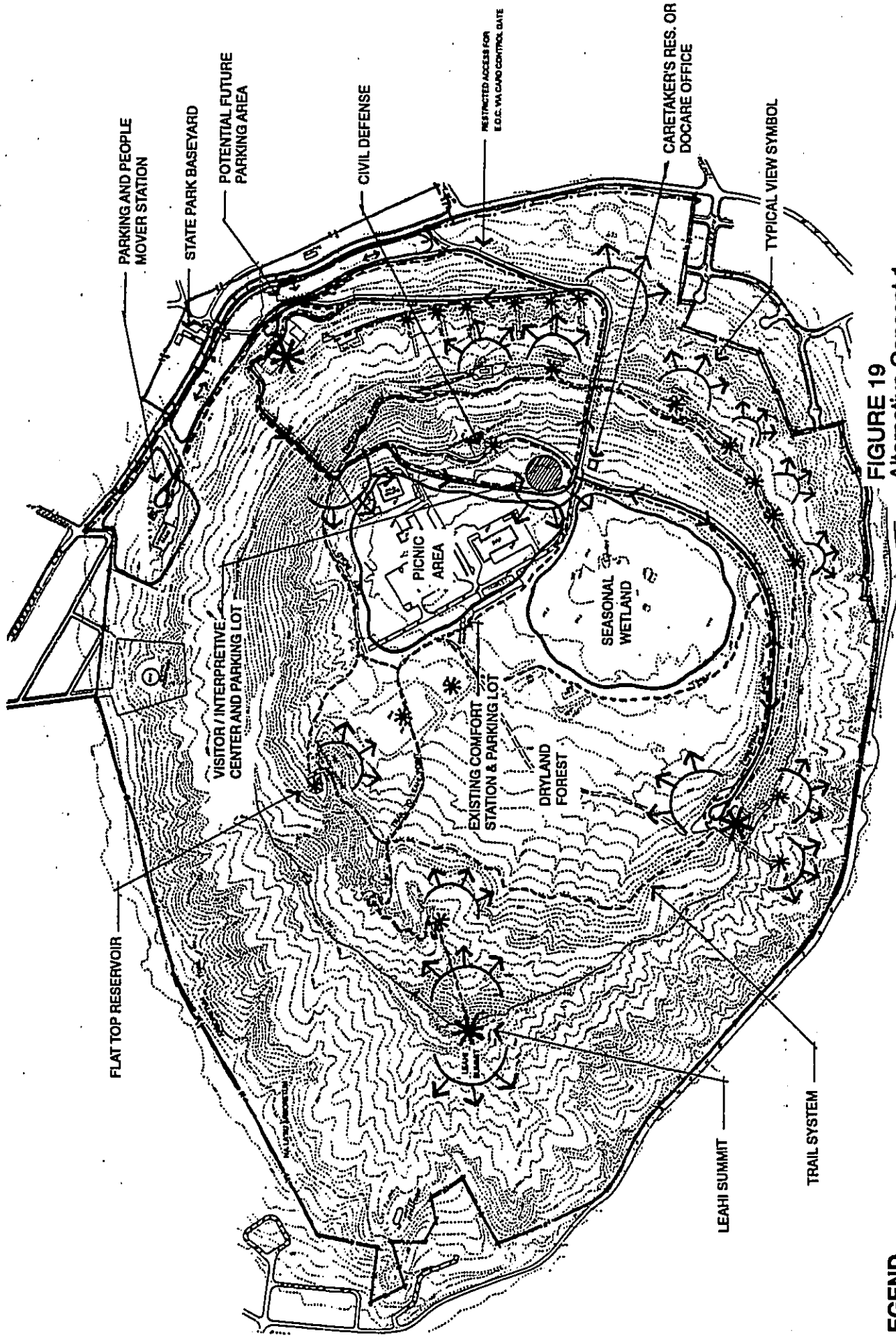
The paved roadway network within the Monument would be limited to corridors required for public access and to mostly existing roads through the area currently restricted only to State DOD and FAA personnel (except if a loop road were added to this alternative). The road from Kapahulu Tunnel would be one-way only to Kāhala Tunnel.

### *Visitor/Interpretive Center*

The proposed visitor/interpretive center would be located between the two tunnel entrances inside the crater. Its design would be designed to integrate into the crater surroundings. The structure would also be designed to reveal the panoramic outdoor scene for interpretive purposes. Access to the Center would be from the existing road to the FAA CERAP Building. The existing service road to Birkhimer EOC would not be used.




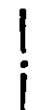


### *Parking and People Mover*

In the interim, parking would be provided at the existing parking lot near the comfort station and at the various State DOD parking lots as these facilities are phased out. Parking for the visitor/interpretive center would be located below the facility, without obstructing views of Lē'ahi from the facility. As previously mentioned, when it is decided to move visitor parking to the crater exterior, the first choice would be to utilize the existing entry and parking at the Cannon Club. If the Cannon Club cannot be acquired, then a new parking lot could be built below Battery Harlow (across from Kapi'olani Community College). When an exterior parking lot is in place, for those who cannot or who do not desire to walk into the crater, this alternative includes the provision of a small, motorized "people mover", similar to those used at Hale Koa Hotel in Waikīkī. Once a visitor reaches the north side of the crater exterior, he or she has the option of walking into the crater via Kāhala or Kapahulu Tunnels, or to pay a fee to board the people mover. The people mover will start from the parking lot (Cannon Club and/or across from Kapi'olani Community



**FIGURE 19**  
Alternative Concept 1  
**DIAMOND HEAD STATE MONUMENT**

**LEGEND**

-  VIEW SYMBOL
-  PEOPLE MOVER ROUTE
-  PEDESTRIAN ROUTES / HIKING TRAILS
-  PEDESTRIAN / BIKE PATH
-  MAJOR MILITARY INTERPRETIVE FEATURE WITH COMFORT STATION
-  MINOR MILITARY INTERPRETIVE FEATURE



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College) and make a stop at Battery Harlow. The people mover will then enter the crater via Kapahulu Tunnel (which affords a higher vantage point than Kāhala Tunnel) and exit Kāhala Tunnel.

*Caretaker Residence*

To facilitate 24-hour security, a caretaker residence or DOCARE office is planned to be unobtrusively located inside the crater next to the Kāhala Tunnel.

*Comfort Stations*

Sanitary facilities would include the existing comfort station, restrooms at the proposed permanent visitor/interpretive facility, at the exterior parking facility (either at the Cannon Club or below Battery Harlow), at secondary interpretive facilities (such as Battery Harlow, Tunnel 407 and the Cannon Club), picnic areas and possibly on the summit trail.

*Exterior Picnic Area*

No exterior picnic facilities are proposed in this alternative.

*Interior Picnic Areas*

As stated in the Plan Objective, family picnics were envisioned as a primary use for the crater. When the State DOD Buildings 301, 303 and 304 are removed, an open space across the road from the visitor/interpretive center is recommended to serve as a "low-density" picnic site for visitors and hikers. This area would be designed to integrate facilities into the natural surroundings without introducing a fire hazard. No cooking facilities would be provided.

*Crater Floor*

The portion of the crater floor not occupied by the picnic area is proposed for the establishment of a native dryland forest and the enhancement of the existing wetland. Trails, fire roads, firebreaks, and other fire-control devices would be unobtrusively implemented into the design.

*Upper Slopes*

Generally, the upper slopes would be off-limits to hikers, except for the summit of Lē'ahi. This would be especially true in the area of the *Schideea adamantis* habitat. The observation area at the summit of Lē'ahi would be renovated and restored to a good condition.

*Trail System*

Unlike the 1979 Plan, no exterior trail system is proposed from Mākālei Place to the Cannon Club because of security concerns raised by area residents. This alternative, however, proposes the enhancement of the walkway along the northwestern edge of the crater along Diamond Head Road for walking and bicycling.

Other than at Lē'ahi Summit, hikers would not be allowed to hike on the crater rim. Instead, former military facilities along the east rim of the crater will be made more accessible by: opening the road/trail from the FAA Link Site to the retractable searchlight on the southeastern edge of the crater rim; opening a new trail from the retractable searchlight on the southeastern edge of the crater rim to Tunnel 407; and utilizing Batteries Dodge and Hulings and the gun emplacements along the eastern edge of the crater as lookouts. This alternative also includes opening a new trail to the flat top reservoir north of the existing trail to the summit.

#### *Landscaping*

- The crater floor would be reforested and replanted with hardy, drought-resistant, maintenance-free, and in some cases, fire-resistant plants.
- Selected natural areas would be established to ensure the survival of endangered plants and their habitats.
- Areas with high use would be landscaped and maintained as park areas.

#### *Linear Parkway*

Diamond Head Road would be landscaped with trees, grass, and shrubbery. All overhead utility lines and poles would be eliminated.

#### *Maintenance Yard*

The maintenance yard would continue to be located at its present location.

## **8.5 Alternative Locations for the Proposed Project**

### **8.5.1 Alternative Concept 2**

Another alternative was developed for consideration by the Diamond Head Citizen's Advisory Committee in 1998. This alternative is similar to the 1979 Development Plan as many of the major elements of the 1979 plan have also been incorporated into this alternative. For example, common elements include:

- entry through Kapahulu Tunnel;
- exit through Kāhala Tunnel;
- a caretaker's resident or DOCARE office;
- removing the FAA CERAP Building;
- removing State DOD Buildings 301, 303 and 304;
- improvements to the wetland;
- proposed trail around the wetland; and
- proposed picnic area.

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As such, this alternative should be considered as an update to 1979 plan rather than a completely new master plan. In the face of a significant increase of visitors to the crater since 1979, the following alternative would reinforce these common elements by:

- constructing a permanent visitor/interpretive facility near the Kapahulu Tunnel;
- in the long-term, moving visitor parking to outside of the crater;
- establishing a motorized people mover system, when visitor parking is kept to the exterior;
- providing a road which would circle the interior of the crater to allow those with disabilities to experience more of the crater;
- utilizing the Cannon Club site for food service and/or visitor orientation and providing restroom facilities;
- opening up Tunnel 407 and Battery Harlow for interpretive purposes and providing restroom facilities;
- keeping the existing comfort station and parking lot;
- allowing pedestrian access through Kapahulu Tunnel;
- controlling visitor access into sensitive areas (such as the crater rim);
- protecting the *Schidea adamantis* habitat, and the habitat of other native species;
- opening the road/trail from the FAA Link Site to the retractable searchlight on the southeastern edge of the crater rim;
- opening a new trail from the retractable searchlight on the southeastern edge of the crater rim to Tunnel 407;
- utilizing Batteries Dodge and Hulings and the gun emplacements along the eastern edge of the crater as lookouts;
- opening a new trail to the flat top reservoir north of the existing trail to the summit;
- adding comfort stations at the exterior parking facility, at secondary interpretive facilities, picnic areas, and possibly at the summit; and
- installing a wastewater lift station.

The elements of this alternative are shown on Alternative Concept 2 - visitor/interpretive center at Kapahulu Tunnel with a loop road (Figure 20) and are described below.

#### *Entry*

In the short term, entry would continue through Kāhala Tunnel. Eventually, if the number of vehicles within the crater was determined to be adversely affecting the visual, noise and air quality, visitor parking could be relocated to the exterior of the crater. If the Cannon Club can be acquired, then the existing parking lot at the Cannon Club can be utilized as the visitor parking facility. The main entry to the crater, then, would be at the Cannon Club, with a new road built from the Cannon Club to Battery Harlow. If the Cannon Club cannot be acquired, then the main entry would be across the street from the Diamond Head Road entry to Kapi'olani Community College.

#### *Tunnels*

The two major tunnels that access the crater would not be physically altered. Traffic circulation would be one-way with entry into the crater via the Kapahulu Tunnel and exit through the Kāhala Tunnel. Both tunnels would allow pedestrian access. The existing parking and scenic overlook outside the crater adjacent to the Kāhala Tunnel would continue to be used. Specifying one-way traffic through the tunnels will allow

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the striping of a single lane in the middle of both tunnels for vehicular traffic and narrower "lanes" on either side for pedestrians.

*Interior Roadways and Parking*

On this alternative, the existing paved roadway network within the Monument would be supplemented by additional roadway so that a loop road would be available within the crater. The road from Kapahulu Tunnel would be one-way towards Kāhala Tunnel.

*Visitor/Interpretive Center*

The proposed visitor/interpretive center would be located near the Kapahulu Tunnel entrance inside the crater. Its design would be designed to integrate into the crater surroundings. The structure would also be designed to reveal the panoramic outdoor scene for interpretive purposes. Access to the Center would be from the proposed loop road.

*Parking and People Mover*

In the interim, parking would be provided at the existing parking lot near the comfort station and at the various ~~State~~ DOD parking lots as these facilities are phased out. Visitor parking for the visitor/interpretive facility would be very limited due to the topography of the site and the surrounding area. As previously mentioned, when it is decided to move visitor parking to the crater exterior, the first choice would be to utilize the existing entry and parking at the Cannon Club. If the Cannon Club cannot be acquired, then a new parking lot could be built below Battery Harlow (across from Kapi'olani Community College). When an exterior parking lot is in place, for those who cannot or who do not desire to walk into the crater, this alternative includes the provision of a small, motorized "people mover", similar to those used at Hale Koa Hotel in Waikīkī. Once a visitor reaches the north side of the crater exterior, he or she has the option of walking into the crater via Kāhala or Kapahulu Tunnels, or to pay a fee to board the people mover. The people mover will start from the parking lot (Cannon Club and/or across from Kapi'olani Community College) and make a stop at Battery Harlow. The people mover will then enter the crater via Kapahulu Tunnel (which affords a higher vantage point than Kāhala Tunnel) and exit Kāhala Tunnel.

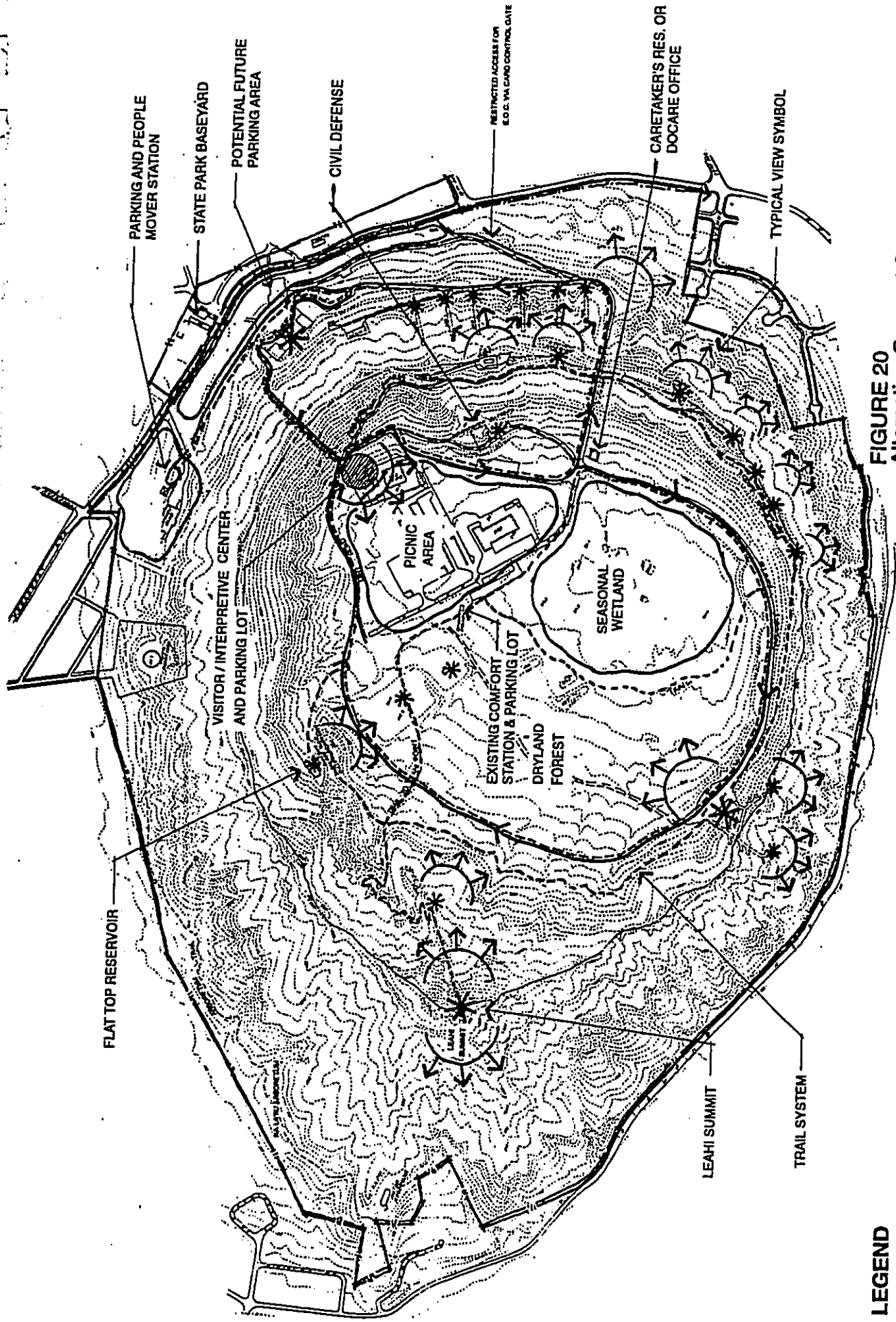
*Caretaker Residence*

To facilitate 24-hour security, a caretaker residence or DOCARE office is planned to be unobtrusively located inside the crater next to the Kāhala Tunnel.


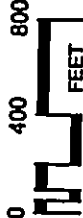
*Comfort Stations*

Sanitary facilities would include the existing comfort station, restrooms at the proposed permanent visitor/interpretive facility, at the exterior parking facility (either at the Cannon Club or below Battery Harlow), at secondary interpretive facilities (such as Battery Harlow, Tunnel 407 and the Cannon Club), picnic areas and possibly on the summit trail.












**FIGURE 20**  
 Alternative Concept 2  
**DIAMOND HEAD STATE MONUMENT**

0 400 800  
 FEET



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- LEGEND**
-  VIEW SYMBOL
  -  PEOPLE MOVER ROUTE
  -  PEDESTRIAN ROUTES / HIKING TRAILS
  -  PEDESTRIAN / BIKE PATH
  -  MAJOR MILITARY INTERPRETIVE FEATURE WITH COMFORT STATION
  -  MINOR MILITARY INTERPRETIVE FEATURE

### *Exterior Picnic Area*

No exterior picnic facilities are proposed in this alternative.

### *Interior Picnic Areas*

As stated in the Plan Objective, family picnics were envisioned as a primary use for the crater. When State DOD Buildings 301, 303 and 304 are removed, an open space across the road from the visitor/interpretive center is recommended to serve as a "low-density" picnic site for visitors and hikers. This area would be designed to integrate facilities into the natural surroundings without introducing a fire hazard. No cooking facilities would be provided.

### *Crater Floor*

The portion of the crater floor not occupied by the picnic area is proposed for the establishment of a native dryland forest and the enhancement of the existing wetland. Trails, fire roads, firebreaks, and other fire-control devices would be unobtrusively implemented into the design.

### *Upper Slopes*

Generally, the upper slopes would be off-limits to hikers, except for the summit of Lē'ahi. This would be especially true in the area of the *Schidea adamantis* habitat.

### *Trail System*

Unlike the 1979 Plan, no exterior trail system improvements are planned from Mākālei Place to the Cannon Club because of security concerns raised by area residents. This alternative, however, proposes the enhancement of the walkway along the northwestern edge of the crater along Diamond Head Road for walking and bicycling.

Other than at Lē'ahi Summit, hikers would not be allowed to hike on the crater rim. Instead, former military facilities along the east rim of the crater will be made more accessible by: opening the road/trail from the FAA Link Site to the retractable searchlight on the southeastern edge of the crater rim; opening a new trail from the retractable searchlight on the southeastern edge of the crater rim to Tunnel 407; and utilizing Batteries Dodge and Hulings and the gun emplacements along the eastern edge of the crater as lookouts. This alternative also includes opening a new trail to the flat top reservoir north of the existing trail to the summit.

### *Landscaping*

- The crater floor would be reforested and replanted with hardy, drought-resistant, maintenance-free, and in some cases, fire-resistant plants.
- Selected natural areas would be established to ensure the survival of endangered plants and their habitats.
- Areas with high use would be landscaped and maintained as park areas.

### *Linear Parkway*

Diamond Head Road would be landscaped with trees, grass, and shrubbery. All overhead utility lines and poles would be eliminated.

### *Maintenance Yard*

The maintenance yard would continue to be located at its present location.

### **8.5.2 Alternative Concept 3**

A third alternative was developed for consideration by the Diamond Head Citizen's Advisory Committee in 1998. This alternative is similar to the 1979 Development Plan as many of the major elements of the 1979 plan have also been incorporated into this alternative. For example, common elements include:

- entry through Kapahulu Tunnel;
- exit through Kāhala Tunnel;
- a caretaker's resident or DOCARE office;
- removing the FAA CERAP Building;
- removing ~~State~~ DOD Buildings 301, 303 and 304;
- improvements to the wetland;
- proposed trail around the wetland; and
- proposed picnic area.

As such, this alternative should be considered as an update to 1979 plan, rather than a completely new master plan. In the face of a significant increase of visitors to the crater since 1979, the following alternative would reinforce these common elements by:

- constructing a permanent visitor/interpretive facility near the Tunnel 407;
- in the long-term, moving visitor parking to outside of the crater;
- establishing a motorized people mover system, when visitor parking is kept to the exterior;
- providing a road which would circle the interior of the crater to allow those with disabilities to experience more of the crater;
- utilizing the Cannon Club site for food service and/or visitor orientation and providing restroom facilities;
- opening up Tunnel 407 and Battery Harlow for interpretive purposes and providing restroom facilities;
- keeping the existing comfort station and parking lot;
- allowing pedestrian access through Kapahulu Tunnel;
- controlling visitor access into sensitive areas (such as the crater rim);
- protecting the *Schidea adamantis* habitat, and the habitat of other native species;
- opening the road/trail from the FAA Link Site to the retractable searchlight on the southeastern edge of the crater rim;
- utilizing Batteries Dodge and Hulings and the gun emplacements along the eastern edge of the crater as lookouts;
- opening a new trail to the flat top reservoir north of the existing trail to the summit;

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- adding comfort stations at the exterior parking facility, at secondary interpretive facilities, picnic areas, and possibly at the summit; and
- installing a wastewater lift station.

The elements of this alternative are shown on Alternative Concept 3 - visitor/interpretive center at Tunnel 407 with two-way road (Figure 21) and are described below:

*Entry*

In the short term, entry would continue through Kāhala Tunnel. Eventually, if the number of vehicles within the crater was determined to be adversely affecting the visual, noise and air quality, visitor parking could be relocated to the exterior of the crater. If the Cannon Club can be acquired, then the existing parking lot at the Cannon Club can be utilized as the visitor parking facility. The main entry to the crater, then, would be at the Cannon Club, with a new road built from the Cannon Club to the existing road below Battery Harlow. If the Cannon Club cannot be acquired, then the main entry would be across the street from the Diamond Head Road entry to Kapi'olani Community College.

*Tunnels*

The two major tunnels that access the crater would not be physically altered. Traffic circulation would be two-way with entry and exit into the crater via the Kāhala Tunnel. Both tunnels would allow pedestrian access. The existing parking and scenic overlook outside the crater adjacent to the Kāhala Tunnel would continue to be used. Traffic through Kāhala Tunnel could be made one-way through the use of signal lights at the tunnel openings. One-way traffic through Kāhala Tunnel will allow the striping of a single lane in the middle of the tunnel for vehicular traffic and narrower "lanes" on either side for pedestrians. Kapahulu Tunnel would be used for emergency vehicles.

*Interior Roadways and Parking*

The paved roadway network within the Monument would be limited to corridors required for public access and to mostly existing roads through the area currently restricted only to State DOD and FAA personnel (except if a loop road were added to this alternative).

*Visitor/Interpretive Center*

The proposed visitor/interpretive center would be located opposite the entry to Tunnel 407 inside the crater. Its design would be designed to integrate into the crater surroundings. The structure would also be designed to reveal the panoramic outdoor scene for interpretive purposes. Access to the center would be from the existing road to the Tunnel 407 (and from a loop road, if desired).

*Parking and People Mover*

In the interim, parking would be provided at the existing parking lot near the comfort station and at the various State DOD parking lots as these facilities are phased out. Visitor parking would be available for the visitor/interpretive facility in the large flat area fronting Tunnel 407. As previously mentioned, when it is decided to move visitor parking to the crater exterior, the first choice would be to utilize the existing entry

and parking at the Cannon Club. If the Cannon Club cannot be acquired, then a new parking lot could be built below Battery Harlow (across from Kapi'olani Community College). When an exterior parking lot is in place, for those who cannot or who do not desire to walk into the crater, this alternative includes the provision of a small, motorized "people mover", similar to those used at Hale Koa Hotel in Waikiki. Once a visitor reaches the north side of the crater exterior, he or she has the option of walking into the crater via Kāhala or Kapahulu Tunnels, or to pay a fee to board the people mover. The people mover will start from the parking lot (Cannon Club and/or across from Kapi'olani Community College) and make a stop at Battery Harlow. The people mover will then enter and exit the crater via Kāhala Tunnel.

#### *Caretaker Residence*

To facilitate 24-hour security, a caretaker residence or DOCARE office is planned to be unobtrusively located inside the crater next to the Kāhala Tunnel.

#### *Comfort Stations*

Sanitary facilities would include the existing comfort station, the proposed permanent visitor/interpretive facility, at the exterior parking facility (either at the Cannon Club or below Battery Harlow), at secondary interpretive facilities (such as Battery Harlow, Tunnel 407 and the Cannon Club), picnic areas and possibly on the summit trail.

#### *Exterior Picnic Area*

No exterior picnic facilities are proposed in this alternative.

#### *Interior Picnic Areas*

As stated in the Plan Objective, family picnics were envisioned as a primary use for the crater. When State DOD Buildings 301, 303 and 304 are removed, an open space across the road from the visitor/interpretive center is recommended to serve as a "low-density" picnic site for visitors and hikers. This area would be designed to integrate facilities into the natural surroundings without introducing a fire hazard. No cooking facilities would be provided.

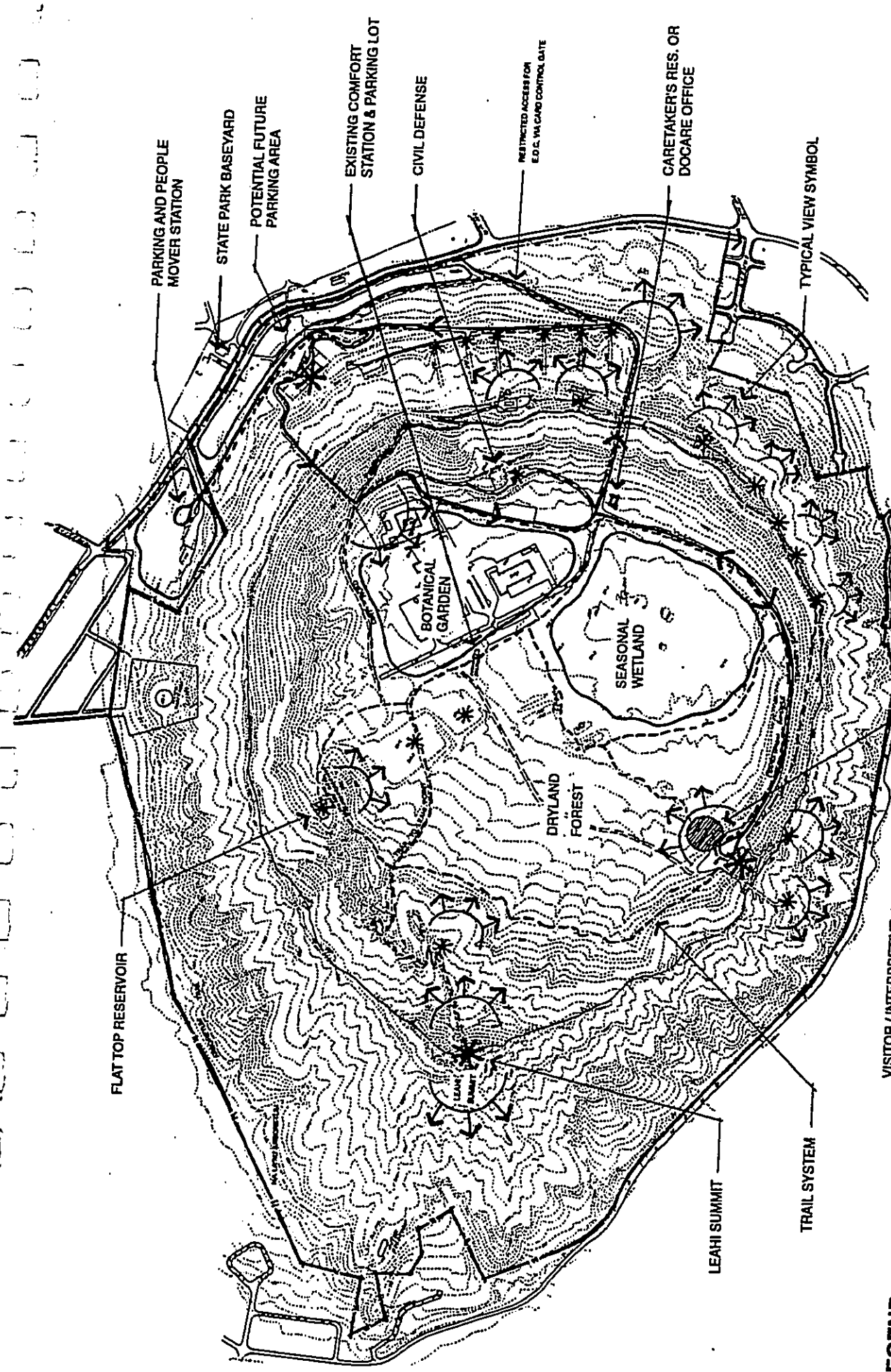
#### *Crater Floor*

The portion of the crater floor not occupied by the picnic area is proposed for the establishment of a native dryland forest and the enhancement of the existing wetland. Trails, fire roads, firebreaks, and other fire-control devices would be unobtrusively implemented into the design.

#### *Upper Slopes*

Generally, the upper slopes would be off-limits to hikers, except for the summit of Lē'ahi. This would be especially true in the area of the *Schideea adamantis* habitat.

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100



**FIGURE 21**  
Alternative Concept 3  
**DIAMOND HEAD STATE MONUMENT**

- LEGEND**
- VIEW SYMBOL
  - PEOPLE MOVER ROUTE
  - PEDESTRIAN ROUTES / HIKING TRAILS
  - VISITOR / INTERPRETIVE CENTER AND PARKING LOT
  - PEDESTRIAN / BIKE PATH
  - MAJOR MILITARY INTERPRETIVE FEATURE WITH COMFORT STATION
  - MINOR MILITARY INTERPRETIVE FEATURE

0 400 800 FEET

October 1988

### *Trail System*

Unlike the 1979 Plan, no exterior trail system improvements are planned from Mākālei Place to the Cannon Club because of security concerns raised by area residents. This alternative, however, proposes the enhancement of the walkway along the northwestern edge of the crater along Diamond Head Road for walking and bicycling.

Other than at Lē'ahi Summit, hikers would not be allowed to hike on the crater rim. Instead, former military facilities along the east rim of the crater will be made more accessible by: opening the road/trail from the FAA Link Site to the retractable searchlight on the southeastern edge of the crater rim; opening a new trail from the retractable searchlight on the southeastern edge of the crater rim to Tunnel 407; and utilizing Batteries Dodge and Hulings and the gun emplacements along the eastern edge of the crater as lookouts. This alternative also includes opening a new trail to the flat top reservoir north of the existing trail to the summit.

### *Landscaping*

- The crater floor would be reforested and replanted with hardy, drought-resistant, maintenance-free and in some cases fire-resistant plants.
- Selected natural areas would be established to ensure the survival of endangered plants and their habitats.
- Areas with high use would be landscaped and maintained as park areas.

### *Linear Parkway*

Diamond Head Road would be landscaped with trees, grass, and shrubbery. All overhead utility lines and poles would be eliminated.

### *Maintenance Yard*

The maintenance yard would continue to be located at its present location.

## **8.6 Summary of Common Elements of Alternative Concepts 1, 2 and 3**

The common elements of Alternative Concepts 1, 2 and 3 are summarized below:

### **a. Natural Resources**

- Preserve the natural and visual feature of the crater itself.
- Preserve and enhance the flora and fauna of the crater landscape.
- Restore wetland and native dryland forest.

**b. Visitors**

- Provide additional pedestrian access within the Monument without ruining the natural resources of the crater.
- Improve access to persons with disabilities within the crater.
- Short term: allow visitor parking within the crater.
- Long term: limit vehicular access into crater to service and emergency vehicles.

**c. Existing Man-Made Structures**

- Remove the FAA CERAP Building and Link Site structures, and restore the site.
- Remove State Department of Defense Buildings 301, 303 and 304 and restore the sites when facilities are vacated.
- Preserve structures of military historical value for their interpretive and scenic use.
- Continue operation of State Park baseyard at Makapu'u Avenue and Diamond Head Road.
- Continue use of antennas.
- Develop, operate, and maintain Battery Harlow as a museum to interpret the military history of Diamond Head/Fort Ruger Military Reservation (but does not duplicate the information exhibited at the U.S. Army Museum at Fort DeRussy).
- Renovate Tunnel 407 as a secondary interpretive facility, if made available by ~~the State~~ DOD.
- Acquire and utilize Cannon Club facility for parking and a visitor facility (which may require renovation and/or replacement).
- Allow Battery Birkhimer to remain as civil defense facility.
- Continue use of the FAA Link site for antenna.

**d. View Opportunities**

- Provide a variety of vantage and scenic viewpoints for the visitor to appreciate the crater and the surrounding landscape.

**e. Access**

- Provide controlled pedestrian access through Kapahulu and/or Kāhala Tunnels.
- Build additional pedestrian trails on the crater floor, especially around an enhanced wetland and through a new native dryland forest (as long as it doesn't threaten these ecosystems).
- Build a new hiking trail on the small ridge next to the abandoned water reservoir inside the crater.
- Allow pedestrian access to the FAA Link Site via guided tours.
- Improve the existing road from Battery Hulings and Battery Dodge to various gun emplacements along the eastern rim of the crater (allow access only via guided tours).
- Build a new trail from the end of the existing road at Battery Dodge to Tunnel 407 (allow access only via guided tours).
- Gradually eliminate visitor vehicular access into the crater with all visitor parking to be eventually accommodated outside. Bus and van access will be the first to be restricted and replaced with a people mover system for the movement of visitors into and out of the crater.



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- 
- Move visitor parking to the exterior of the crater (ideally to the Cannon Club and/or to the area opposite Kapi'olani Community College).

**f. Recreation and Park Programs**

- Construct picnic areas.
- Reconstruct sites or features of cultural significance (if present).
- Build visitor/interpretive facility.
- Construct trails and scenic viewpoints.
- Improve walking/running/biking facilities along the east side of the Monument along Diamond Head Road.

**8.7 Actions of a Significantly Different Nature Which Would Provide Similar Benefits with Different Environmental Impacts**

There are improvements that are proposed or underway which are in keeping with the objective and policies described in Section 2.2, but are significantly less in scope than the 1979 Development Plan (described in Section 2.1). These are:

- Construct trail improvements to minimize erosion.
- Construct a new trail at the summit.
- Install signs along trail and at Kāhala Tunnel Lookout.
- Construct interim interpretive kiosk.
- Construct toll/information booth with landscaping.
- Collect park entry fees

While these actions provide some benefits by: reducing project costs (from the alternatives described in Sections 8.4 and 8.5), reducing erosion, improving accessibility, providing information and first aid supplies, and generating revenues, these actions will share many of the negative impacts associated with the "no action alternative" (described in Section 8.2):

- the site would not be managed in an appropriate manner with non-essential vehicles continuing to enter the crater;
- the endangered plant habitats would continue to be stressed by hikers, fires and alien species;
- pedestrians would continue to have unsafe access via Kāhala Tunnel due to minimal walkways;
- visitors would have a limited opportunity to experience present closed off areas within the crater including viewpoints, Tunnel 407, and Battery Harlow;
- view opportunities would be limited to the existing trail and the Kāhala Tunnel lookout;
- the quality of visitor experience would deteriorate because visitors would continue to be limited to the already crowded hiking trail to Lē'ahi Summit, and;
- parking for park visitors would continue to be limited.

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## 8.8 Evaluation of Alternatives

Each of the conceptual plans were evaluated based on the following criteria: existing and proposed uses, availability of existing facilities, interpretive and historical value, architecture, and site limitations, including access, transportation, views, aesthetics, development costs, operational costs and interpretive value.

### Existing and Proposed Uses

This criteria refers to how each alternative relates to surrounding existing and proposed uses.

### Architecture

Architecture refers to how the design of the proposed visitor/interpretive center fits the site in which it is located and its overall setting within the crater interior.

### Access

In determining the access ratings of the three concepts, three major factors were considered: 1) pedestrian friendliness, 2) access for people with disabilities (in accordance with ADA standards), and 3) transportation requirements.

- Pedestrian Friendliness relates to how well a plan accommodates the walking visitor or contributes to the ease of walking around the crater without having to hike solely on trails.
- For ADA Compliance, each plan will be evaluated for how it would allow individuals with disabilities to experience the natural features and utilize facilities within the monument.
- Transportation relates to vehicle access considerations within and outside the crater for the movement of visitors.

### Views

Views refer to how well a given plan utilizes the interior and exterior views afforded at various locations within the crater, as well as views from outside the crater.

### Aesthetics

In determining ratings for Aesthetics, each plan was evaluated based on how well it is in keeping with the desired "semi-wilderness" natural character of the monument.

### Development Costs

Development Costs account for all costs associated with the design and construction of all improvements with associated initial provisioning and equipment.

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**Operational Costs**

Operational Costs include labor, contract, utilities, repairs and maintenance, and other related costs needed on a continuing or recurring basis. Operational costs also include payments to OHA from revenues.

**Interpretive and Historical Values**

Interpretive Value refers to how well a plan lends itself to the interpretation of the natural, cultural and military "story" of the crater.

The following table summarizes the evaluation of the three alternatives.

Selection Criteria	Alternative Concept 1 (Visitor/Interpretive Facility near Kāhala Tunnel)	Alternative Concept 2 (Visitor/Interpretive Facility near Kapahulu Tunnel)	Alternative Concept 3 (Visitor/Interpretive Facility near Tunnel 407)
<i>Public Input</i>	On August 27, the Diamond Head Citizens Advisory Committee voted unanimously to recommend the siting of the visitor/interpretive facility between Battery Birkhimer and Kāhala Tunnel. No input favoring this site was received during the EISPN public comment period.	No input favoring this site was received during the EISPN public comment period.	No input favoring this site was received during the EISPN public comment period.
<i>Existing and Proposed Uses</i>	Based on the proposed circulation system (i.e. entry through Kapahulu Tunnel, exit through Kāhala Tunnel), this alternative provides the most convenient location for visitors to visit the visitor/interpretive facility because visitors would easily pass the facility twice when taking the people mover around proposed crater interior loop road. In the short term, its proximity to State DOD facilities will cause a negative visual impact on the visitor/interpretive facility.	Based on entry through Kapahulu Tunnel, this site is ideally located to "capture" visitors immediately upon entry to the crater, however, a circulation pattern in the counter-clockwise direction would less likely to capture visitors before departing the crater. In the short term, its proximity to State DOD facilities will cause a negative visual impact on the visitor/interpretive facility.	In the short-term, this site is the least impacted by the view of the State DOD facilities, since it is located the furthest away. This locational advantage is negated by its less desirability in terms of being readily accessible by visitors, especially by those on foot, since it is the furthest away from Kapahulu and Kāhala Tunnels.

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<i>Architecture</i>	As the least sloping of the three sites, this alternative will present the least visual impact (building mass) from the front elevation.	This site is steep and is further constrained by its narrow width.	While this site is steep, the site could be moved to the wide parking lot fronting Tunnel 407 and will not require the construction of roads like the other two alternatives.
<i>Access – Pedestrian Friendliness</i>	This site is close to Kāhala Tunnel, where many of the pedestrians will enter the crater.	This site is close to Kapahulu Tunnel, where presumably most of the pedestrians will enter the crater.	As previously noted, since this site is the furthest away from Kapahulu and Kāhala Tunnels, it is the least accessible for pedestrians.
<b>Selection Criteria</b>	<b>Alternative Concept 1 (Visitor/Interpretive Facility near Kāhala Tunnel)</b>	<b>Alternative Concept 2 (Visitor/Interpretive Facility near Kapahulu Tunnel)</b>	<b>Alternative Concept 3 (Visitor/Interpretive Facility near Tunnel 407)</b>
<i>Access – ADA</i>	As the least sloping of the three sites, this site should be the most accessible to persons with disabilities, especially in the outdoor areas.	The sloping nature of the site will probably require elevators, adding to the cost of construction.	The sloping nature of the site will probably require elevators, adding to the cost of construction.
<i>Access – Transportation</i>	In all three concepts, access to the facility is aligned on the rim-side, so that views towards the interior of the crater is not impacted by roads or people movers. This site will require the construction of a road below the road to Battery Birkhimer (to avoid conflicting traffic during emergencies), across a sloped bank.	Since this site is narrow, a road on the rim-side of the facility will need to be built across very steep slopes and mini-ridges. The construction of the road will be expensive and will present a negative visual impact.	This site already contains a road on the rim-side so it is both very accessible by motorized vehicle and will be the least expensive to implement at least based on this particular criteria.
<i>Views</i>	This site presents a similar, unobstructed, “frontal” view of the summit of Lē’ahi, as experienced when entering through Kāhala Tunnel.	While this site is located at a higher elevation than Kāhala Tunnel, it does not present a “frontal” view of the summit of Lē’ahi.	This site provides a “close-up” view of the summit of Lē’ahi and a very interesting view of the Ko’olau Mountain Range, beyond the northern rim of the crater.

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<i>Aesthetics</i>	This site will be the least likely to be seen as one enters the crater from Kapahulu Tunnel.	This site would probably be the most visible site as one enters the crater from Kapahulu Tunnel. Its high elevation would also make it more visible from many areas inside the crater.	This site would appear to be most visible site as one enters the crater from Kapahulu Tunnel, however, its distance from the tunnel will mitigate the impact significantly. Its location and elevation would also make it more visible from many areas inside the crater. Of the three sites, this site would probably be the most visible to residents living on the Ko'olau Mountain Range ridges (St. Louis Heights, Wilhelmina Rise).
<b>Selection Criteria</b>	<b>Alternative Concept 1 (Visitor/Interpretive Facility near Kāhala Tunnel)</b>	<b>Alternative Concept 2 (Visitor/Interpretive Facility near Kapahulu Tunnel)</b>	<b>Alternative Concept 3 (Visitor/Interpretive Facility near Tunnel 407)</b>
<i>Development Costs</i>	This site is the least expensive to build on because of its flatter topography.	Due to the highly sloping nature of the site, and the narrowness of the site which would force the construction of an access road into and along the steep interior crater walls, this site is likely to be the most expensive of the three sites. This is especially the case since most of this area has not been significantly altered and will require grading into original crater soils and rock.	Although this site already includes an access road, this site is sloping and will also be expensive to build, although less expensive than Alternative Concept 2, because most of the slope is presumed to consist of fill material (probably excavated material from Tunnel 407).
<i>Operational Costs</i>	Due to its proximity to Kāhala Tunnel, where service emergency vehicles will be allowed to enter, operational costs for a facility at this site is likely to be the least expensive. Its flatter topography is also likely to present lower operational costs.	While this site is located relatively close to the Kāhala Tunnel, the sloping nature and narrowness of the site will add to the cost of operations.	Since this site is located furthest from Kāhala Tunnel, it is most likely to present the highest operational costs.

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<i>Interpretive and Historical Values</i>	This site's main interpretive and historical values include: 1) the "frontal" view of the summit of Lē'ahi; 2) its proximity to the summit trail; and 3) its proximity to the wetland.	This site's main value is the higher elevation as entry to the crater interior. The site is also located near the road to the FAA Link Site, which is proposed to be an interpretive trail along and below the east crater rim to Tunnel 407.	This site probably presents the best interpretive location due to: 1) its proximity to Tunnel 407 (a feature of historical and scenic value); 2) its proximity to the summit of Lē'ahi; 3) its proximity to proposed trails (connecting to the summit trail and to the road below the east crater rim); 4) the views presented of the Ko'olau Mountain Range; 5) the views of the wetland.
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Based on the above evaluation, DLNR has selected Alternative Concept 1 as the preferred alternative. In summary, a visitor/interpretive center located as shown on Alternative Concept 1 would present the following benefits:

- It is the preferred alternative of the Diamond Head Citizens Advisory Committee.
- This alternative provides the most convenient location for visitors to visit the visitor/ interpretive facility because visitors would easily pass the facility twice when taking the people mover around proposed crater interior loop road.
- As the least sloping of the three sites, this alternative will present the least visual impact (building mass) from the front elevation.
- As the least sloping of the three sites, this site should be the most accessible to persons with disabilities, especially in the outdoor areas.
- This site presents a similar, unobstructed, "frontal" view of the summit of Lē'ahi, as experienced when entering through Kāhala Tunnel.
- This site will be the least likely to be seen as one enters the crater from Kapahulu Tunnel.
- This site is the least expensive to build on because of its flatter topography.
- Due to its proximity to Kāhala Tunnel, where service emergency vehicles will be allowed to enter, operational costs for a facility at this site is likely to be the least expensive. Its flatter topography is also likely to present lower operational costs.
- This site is closest to the wetland, which is proposed to be enhanced as a natural resource and an interpretive feature.

## 8.9 Summary of Probable Impacts and Proposed Mitigation Measures

Due to the unique environmental and physical qualities of Diamond Head Crater, potential environmental impacts may occur both before and after project construction. A summary of potential environmental impacts are herein described for the overall project and specific planning considerations for each of the alternative plans considered. The following discussion is not intended to be exhaustive, but is intended to be used in considering the various alternatives.

### *Potential Environmental Impacts*

The potential environmental impacts associated with project construction include air quality impacts from fugitive dust emissions, impacts to the ambient noise quality associated with the interior crater, and temporary visual impacts that may detract from the high value visual experience identified with Diamond Head, as a National Natural Landmark, State Monument, Fort Ruger Historical District, City and County of Honolulu Special Design District, and State Conservation District.

Air quality will likely be impacted by potential fugitive dust emissions and relatively minor vehicular emissions from construction equipment. Over the long-term, the air quality within the crater should actually improve if, in the long term, visitor parking is kept to the exterior, since service vehicles, emergency vehicles, and a proposed motorized people mover would be permitted to operate within the crater. Eventually, all parking for visitors would be located outside of the crater either at the Cannon Club or along Diamond Head Road near the project entry.

Noise quality will also be impacted during the construction period by the operation of construction vehicles, trucks backing up, and localized noise such as hammering, people talking, etc. However, noise quality after construction should be improved since the number of vehicles entering the crater environment will be significantly reduced, if, in the long term, visitor parking is kept to the exterior.

Visual impacts will be of some concern from the perspective of those who object to construction activity and grading within the crater. For the option of parking other than at the Cannon Club, views outside of the crater will be impacted by the establishment of a new parking area across Diamond Head Road from Kapi'olani Community College. However, the optional parking lot location is "above" Diamond Head Road and could be heavily screened by landscaping and topographical buffers. Views within the crater will change, however, extensive design and landscaping controls will be implemented to ensure that the project goals of a more natural environment is achieved.

As indicated above, few potential adverse impacts to the area are expected to result from implementation of the proposed Master Plan Update. Short-term impacts will result in the initial construction phase which will require on-site grading, trenching, and movement of construction vehicles within the project site's unpaved roads. These activities will generate localized noise and dust during construction periods. Mitigation measures to minimize adverse air quality would include frequent watering of unpaved roads and construction areas, dust screens (as applicable), and mulching and planting of ground cover and other vegetation as soon as possible after construction. Construction activities would comply with all applicable regulations of the City and Department of Health.

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Long-term impacts from the development are expected to produce minimal impacts to the adjacent residential property owners, Kapi'olani Community College, or Kapi'olani Park. The proposed project is not expected to have any impact on the micro climate of the project area or region. Planned structures would not be tall enough to significantly effect existing wind patterns; and new structures will not significantly effect temperature since some localized cooling can be expected to result from the installation of landscaping.

Social impacts will occur during and after construction through the enhancement of visitors' understanding of Diamond Head's natural, cultural, and military history. Economically, a new visitor/interpretive center is hoped to generate revenue that will help to pay for the enhancement and maintenance of the Diamond Head State Monument. It should be noted that a portion of the revenue generated must be paid to the Office of Hawaiian Affairs.

Recommended mitigation measures include the following:

*Short term:*

- Frequent watering during construction and demolition activities to maintain dust control.
- Grassing of swales and sodding as soon as practicable once grading has been completed.
- Wind screening as appropriate to limit fugitive dust.
- Restricting use of construction equipment to daylight hours.

*Long term:*

- Establish extensive landscaping to maintain long-term air quality and aesthetically integrate the Master Plan into the natural environment of Diamond Head Crater.
- Use of appropriate engineering, design and construction measures to ensure adequate drainage and irrigation of the site.
- Construct transportation improvements to mitigate traffic generated by the Master Plan Update.
- Traffic and parking control measures will be utilized to minimize noise and maintain the transitional environment of crater exterior and the desired wilderness experience inside the crater.
- All access to the crater by helicopter will be terminated except for emergency purposes.
- 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.
- Manage existing populations of endangered plants species by: reducing the risk of catastrophic fire; assessing the impact of introduced species and developing a means of controlling the



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introduced species; controlling human activities near the endangered plant species; conducting studies necessary to enhance the endangered plants; expanding current populations; and establishing new populations.

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9.0

**Relationship Between  
Local Short-Term Uses of Man's Environment  
and the Maintenance of Long-Term Productivity**

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## 9.0 RELATIONSHIP BETWEEN LOCAL SHORT-TERM USES OF MAN'S ENVIRONMENT AND THE MAINTENANCE OF LONG-TERM PRODUCTIVITY

As discussed in the previous sections of this Draft EIS, the project area largely consists of vacant land. Long-term impacts from continuing the current use, have been identified as follows:

- the site would not be managed in an appropriate manner with non-essential vehicles continuing to enter the crater;
- the endangered plant habitats would continue to be stressed by hikers, fires and alien species;
- pedestrians would continue to have unsafe access via Kāhala Tunnel due to minimal walkways;
- visitors would have a limited opportunity to experience present closed off areas within the crater including viewpoints, Tunnel 407, and Battery Harlow;
- view opportunities would be limited to the existing trail and the Kāhala Tunnel lookout;
- the quality of visitor experience would deteriorate because visitors would continue to be limited to the already crowded hiking trail to Lē'ahi Summit, and;
- parking for park visitors would continue to be limited.

Clearly, these existing impacts are considered undesirable compared to the value of this important natural resource. Retaining the property in its present use (the "No Action" alternative), would present a less than optimum use of the land especially because of its value as a major recreational and natural resource in the midst of Urban Honolulu. Without implementation of the proposed DHSM Master Plan Update, the natural and historical resources of the crater could continue to deteriorate and it will become a less desirable recreational resource for residents and visitors.

Short term uses and long term productivity respectively consists of the project's construction phases and enhancement of the Monument after it achieves buildout. Short-term construction related impacts can be mitigated while they occur. The proposed long-term land uses of the DHSM would generate significant social benefits to residents, and possibly, indirectly, long-term benefits to the ecotourism and FIT markets (not necessarily exclusive). These benefits consist of better recreational opportunities, improvements to the visual and noise quality of the crater interior, less intrusion into the crater by large vehicles, provisions for new public facilities, increased job opportunities, and increased tax revenues to the State government. Public revenues in the form of the collection of user fees and sales at the proposed visitor/interpretive center are expected to offset much of the expenses associated with the implementation of the DHSM Master Plan Update. However, it should be noted that what is being compared is only estimated direct revenues vs. the estimated costs of the project, for there are probably some indirect benefits of having a more attractive, semi-wilderness park so close to Waikīkī.

Long-term impacts to the environment will, on balance, be positive if the proposed mitigation measures are implemented. The physical attributes of the subject property are clearly appropriate for the land uses proposed. Existing transportation infrastructure is available, and improvements to existing infrastructure and recreational resources will benefit the entire community. Through careful site planning, the project area will be used in a manner that would enhance this natural place in such an urban setting.

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- the endangered plant habitats would continue to be stressed by hikers, fires and alien species;
- pedestrians would continue to have unsafe access via Kāhala Tunnel due to minimal walkways;
- visitors would have a limited opportunity to experience present closed off areas within the crater including viewpoints, Tunnel 407, and Battery Harlow;
- view opportunities would be limited to the existing trail and the Kāhala Tunnel lookout;
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Long-term impacts to the environment will, on balance, be positive if the proposed mitigation measures are implemented. The physical attributes of the subject property are clearly appropriate for the land uses proposed. Existing transportation infrastructure is available, and improvements to existing infrastructure and recreational resources will benefit the entire community. Through careful site planning, the project area will be used in a manner that would enhance this natural place in such an urban setting.

10.0

**Cumulative and Secondary Impacts**



## 10.0 CUMULATIVE AND SECONDARY IMPACTS

### 10.1 Cumulative and Secondary Environmental Impacts

As noted in Section 9.0, without the implementation of the proposed DHSM Master Plan Update, the natural and historical resources of the crater could continue to deteriorate and it will become a less desirable recreational resource for residents and visitors. The proposed Master Plan Update includes: 1) improving the habitat of endangered species found within the crater; 2) replanting with native plants; 3) improving the existing wetland; 4) increasing access to more of the historical structures and lookouts throughout the crater; 5) increasing the number of trails; and, 6) improving the appearance of the crater, all without increasing traffic. The latter is possible because it is anticipated that the collection of user fees and the long-term plan to limit visitor parking to the exterior of the crater may have a negative impact on visitors who visit the crater by tour vehicles. The reduced number of visitors could result in less revenues, but it should result in less traffic on area streets, and less visitors inside the crater, which could be considered a positive impact.

The improvement of the DHSM and other features such as Haunama Bay, Koko Crater and Koko Head will have a positive, cumulative impact on residents' recreational opportunities and on the FIT and ecotourism markets, which may have a long-term, secondary impact on O'ahu's economy.

Therefore, the consideration of potential negative environmental and socio-economic effects of the unplanned or "no action" alternative should receive commensurate consideration during the planning and land use approval process compared to the preferred alternative..

### 10.2 Cumulative and Secondary Impacts on Public Services and Facilities

As the projected population of Honolulu grows in the future, cumulative and secondary impacts on public services and facilities will occur with or without development of the proposed project in response to the needs of the growing population. More solid waste will be created, there will be increased demand for electrical generation, traffic levels will increase, and facilities to provide additional public services will be necessary. However, these cumulative impacts will result from growth in the island-wide population, not from the approval and development of the DHSM project. This project will actually serve to mitigate or meet the demand for recreational facilities as a result of population growth.

The following is an analysis of potential cumulative impacts on public services and facilities that will result from the proposed project.

**Land Use Character.** While O'ahu's population is expected to grow, major new development will take place in those areas planned for new growth. This demand for new development will be redirected into areas most suitable for urban development. On O'ahu, major new development and investment in public infrastructure is planned by both the City and State for the 'Ewa plain. In comparison, the region in which the DHSM is located could be considered nearly fully built out and although highly urbanized, there are significant zoning designations in place which would significantly alter the land use character of the area. In fact, the designation of the crater as a State Monument, its inclusion in the State Conservation District, its designation as a City and County of Honolulu Special District, all serve to ensure that this property will be difficult to develop (for residential, commercial or other urban uses).

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**Traffic.** Based on the analysis of proposed intersections and accesses of the various alternatives studied in the *Traffic Impact Analysis for the Diamond Head State Monument Master Plan* (Appendix D), it was concluded that the existing roadway system could accommodate the traffic generated by the proposed improvements to the DHSM. The proposed master plan would improve the handling of DHSM traffic on Diamond Head Road, improve pedestrian and recreational mobility on the northern side of Diamond Head Road, and work well with the recommendations of the *Draft Honolulu Bicycle Master Plan*. Given the recommendations made, the visitor and personnel traffic is projected to be adequately accommodated.

**Potable Water.** Once the State DOD relocates out of the DHSM, potable water demand is expected to decrease from current usage. The average consumption in DHSM from July to September 1998, according to State DOD records, was 39,400 gallons per day (gpd). To provide fire and domestic flow, proposed water system improvements in the crater include extending the transmission main from Battery Birkhimer to the visitor/interpretive center and Tunnel 407, adding fire hydrants, and waterlines to the comfort stations. The average potable water demand is expected to be 21,500 gpd. The water service limit for the area is the 305-foot elevation." If the landscaped area around the visitor/interpretive center will be irrigated with potable water, the estimated average demand will be 6,700 gpd. Total potable water demand, domestic consumption plus irrigation of the landscaping (at the visitor/interpretive center only), is approximately 28,200 gpd. The availability of additional water will be confirmed when the building permit application is submitted to BWS for their review and approval. In their review of the EISPN, the BWS wrote that "The existing off-site water system is presently adequate to accommodate the proposed improvements to Diamond Head State Monument.

**Other Public Services and Facilities.** The cumulative impact of the project on other public services and facilities (i.e. fire, police protection, and health care) is expected to be minimal and have been addressed in Section 5.7.

**Economic Impact.** Based on *Social Impact Assessment and Revenue Analysis* (Appendix G), revenues from entry fees, food and beverage sales and gift shop sales are estimated at between \$1,522,560.00 to \$1,976,000.00 per year, depending on how entry fees charged.

**Fiscal Impact.** The *Social Impact Assessment and Revenue Analysis* (Appendix G) estimated that the cost of implementing the DHSM Master Plan Update would be approximately \$2,309,800.00 a year. This results in a "loss" of between \$333,800.00 to \$787,240 a year based on the estimated revenues described in the previous paragraph. This does not include the amount that is currently spent on the DHSM, which may offset this loss somewhat. Nor does it include the indirect, positive impact the implementation of the DHSM Master Plan Update may have on the FIT or ecotourism markets.

**11.0**  
**Summary of Unresolved Issues**

## 11.0 SUMMARY OF UNRESOLVED ISSUES

As noted in Section 2.5, Phasing and Timing of Action, there are a number of major considerations that will affect phasing of the DHSM Master Plan Update. These external factors are the relocation of the State DOD to Barbers Point, the securing of a supply of non-potable groundwater for irrigation, and the acquisition of the Cannon Club. Each on their own may affect the ability to implement certain elements of the proposed update of the Master Plan (at various degrees), and in some cases a combination of these factors could result in the inability to implement a particular element of the plan.

For instance, it is assumed that the State DOD will eventually relocate to Barbers Point, but in the interim, the following elements will probably not be implemented because they would be disruptive to State DOD operations:

- removing State DOD Buildings 301, 303 and 304;
- renovating and opening up Tunnel 407 and Battery Harlow for interpretive purposes and providing restroom facilities;
- opening a new trail from the retractable searchlight on the southeastern edge of the crater rim to Tunnel 407 (allow access only via guided tours); and
- building a new trail from Tunnel 407 to the summit trail.

The inability of securing an adequate source of non-potable groundwater in the vicinity would probably disallow the implementation of the following proposed Master Plan Update proposals:

- building a pond near the wetland;
- constructing new picnic areas (in front of the visitor/interpretive facility, on the pistol range, in front of Tunnel 407, and between the Crater Road and Diamond Head Road);
- installing the linear park landscaping along Diamond Head Road; and
- creating a new Nā La'au Arboretum between the Crater Access Road and Diamond Head Road.

The inability of securing the Cannon Club would probably mean that the renovation and utilization of the Cannon Club for parking, food service and/or visitor orientation and providing restroom facilities will not be implemented. As a result, an alternate crater exterior parking lot will have to be developed.

As more information becomes available about these issues, they will be incorporated prior to the printing of the Final Report on the DHSM Master Plan Update which is currently scheduled to be completed November 2000.

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12.0

References and List of Preparers

## 12.0 REFERENCES AND LIST OF PREPARERS

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Hosokawa, Clyde. (1997, May-June). Personal Communication. Department of Land and Natural Resources, Division of State Parks.

Macrae, J. (1972). *With Lord Byron at the Sandwich Islands in 1825. Being Extracts from the MS Diary of James Macrae, Scottish Botanist.* Honolulu: Petroglyph Press [originally printed in 1922].

McMahon, N. (1988, February). *Archaeological Reconnaissance Survey of the Proposed Diamond Head Tennis Court, Honolulu, O'ahu Island, Hawai'i (TMK 3-1-42:21).* Prepared for Environmental Communications, Inc. Public Archaeological Section, Applied Research Group, B.P. Bishop Museum, Honolulu.

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National Register of Historic Places. (1984). "Nomination Form for the Fort Ruger Historic District". Form on file at the State Historic Preservation Division.

Nishimura, Charles H. (April 1988). *Public Use and Access in Diamond Head Crater.* Report prepared for Legislative Reference Bureau.

Pacific Planners Corporation. (1968). *Diamond Head Study.* Report prepared for the Department of Land and Natural Resources.

Parsons Brinckerhoff Quade & Douglas. (1998). *Preliminary Traffic Impact Assessment Report.*

PBR HAWAII. (1998) *Diamond Head State Monument, Master Plan Update. Environmental Impact Statement Preparation Notice.* Prepared for State Department of Land and Natural Resources. August 1998.

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~~R. M. Powell Corporation. (2000) Final Restoration Feasibility Evaluation for Battery Harlow. Report Prepared for State of Hawaii Department of Defense Hawaii Army National Guard. May 2000.~~

SMS Consulting. (1998). *Letter Report on Diamond Head Traffic Count, May 14 and 16, 1998.* Survey and report prepared for PBR HAWAII, Inc. On file at State Parks Office, Honolulu.

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## 12.2 Preparers of the Environmental Impact Statement

The Draft Environmental Impact Statement was prepared by PBR HAWAII, Pacific Tower, Suite 650, 1001 Bishop Street, Honolulu, Hawai'i 96813. The staff involved in the preparation of this document included:

W. Frank Brandt, FASLA	President
Vincent Shigekuni	Senior Associate
Chris Kimura	Planner/Geographer
Tom Schnell, AICP	Planner
Kip Aoki	Graphic Artist/Designer
Dionne Self	Production

Several key technical consultants were employed to provide specific assessments of environmental factors for this project. These consultants, their company affiliation, and their specialty are listed below:

Ed Iida, P.E. R.M.	Mitsunaga and Associates	Civil Engineering
Wayne Yoshioka	Parsons Brinckerhoff	Traffic
Winona P. Char	Char and Associates	Botanical Assessment
Tim Ohashi	Tim J Ohashi, Wildlife Consultant	Biological Assessment
Myra Tuggle	International Archaeological Research Institute, Inc.	Archaeology
John Knox	Knox & Associates	Socio-Economic Assessment
David Adams	Darby and Associates	Noise Assessment
Barry Neal	Barry Neal and Associates	Air Quality Impact Analysis
Roslyn Van Zyle	Hawai'i Nature Center	Interpretive Exhibits
Pravin Desai	CDS International	Architecture

DIAMOND HEAD STATE MONUMENT MASTER PLAN UPDATE  
FINAL ENVIRONMENTAL IMPACT STATEMENT

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**13.0**

**Government Agencies, Organizations and  
Individuals Consulted in the Preparation of the EIS**

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**13.0 AGENCIES, ORGANIZATIONS AND INDIVIDUALS CONSULTED IN THE  
PREPARATION OF THE EIS**

**13.1 Government Agencies Consulted in the Preparation of the EIS**

**STATE AGENCIES/LEGISLATURE:**

Governor's Office  
Office of Environmental Quality Control  
Office of Hawaiian Affairs  
Department of Agriculture  
Department of Accounting and General Services  
Department of Defense Hawai'i Air National Guard  
Department of Education  
Department of Hawaiian Home Lands  
Department of Health (DOH)  
Department of Land and Natural Resources (DLNR), Division of State Parks  
DLNR Water Commission  
DLNR State Historic Preservation Division  
DLNR Land Division  
DLNR Division of Forestry and Wildlife  
Department of Transportation  
Department of Business, Economic Development and Tourism  
DBEDT Energy, Resources and Technology Division  
DBEDT Office of Planning  
State Land Use Commission  
Department of Defense, State Civil Defense  
Department of Defense, Adjutant General  
Department of Budget and Finance, Information and Communication Services Division  
University of Hawai'i, Environmental Center  
University of Hawai'i, Kapi'olani Community College  
University of Hawai'i Sea Grant  
University of Hawai'i, Water Resources Research Center  
Senator Carol Fukunaga  
Senator Les Ihara, Jr.  
Representative Barbara Marumoto  
Senator Matt Matsunaga  
Representative Brian Yamane

**FEDERAL AGENCIES:**

U.S. Department of Agriculture, Natural Resource Conservation Service  
U.S. Army Corps of Engineers  
U.S. Fish and Wildlife Service  
U.S. Geological Survey  
U.S. Department of Transportation, Federal Aviation Administration

DIAMOND HEAD STATE MONUMENT MASTER PLAN UPDATE  
FINAL ENVIRONMENTAL IMPACT STATEMENT

U.S. National Park Service  
U.S. Senator Daniel K. Inouye  
U.S. Senator Daniel K. Akaka  
U.S. Representative Neil Abercrombie

**CITY AND COUNTY OF HONOLULU:**

Board of Water Supply  
Department of Planning and Permitting  
Department of Parks and Recreation Services  
Department of Facility Maintenance  
Department of Transportation Services  
Planning Department  
Police Department  
Honolulu Fire Department  
Department of Design and Construction  
Department of Environmental Services  
Councilmember Duke Bainum

**13.2 Individuals/Organizations Consulted During the EIS Preparation Process**

Diamond Head Citizens Advisory Committee  
Wai'alaie-Kāhala Neighborhood Board #3  
Diamond Head/Kapahulu/St. Louis Heights Neighborhood Board #5  
Hawaiian Electric Company, Inc.  
GTE Hawaiian Tel  
Save Diamond Head Association  
Historic Hawai'i Foundation  
The Outdoor Circle  
Kapi'olani Park Preservation Society  
American Institute of Architects  
Sierra Club  
Kāhala Community Association  
Hawai'i's Thousand Friends  
East Diamond Head Community Association  
West Diamond Head Association  
Juli Walters  
Luci Pfaltzgraff  
Cynthia Marnie

**13.3 Individuals/Organizations Contacted During the Master Plan Preparation Process**

During the preparation of the Master Plan Update, presentations were made to representatives of various community groups, boards, community associations, businesses and government agencies as described below:



DIAMOND HEAD STATE MONUMENT MASTER PLAN UPDATE  
FINAL ENVIRONMENTAL IMPACT STATEMENT

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- Diamond Head Citizens Advisory Committee
- George Kanahele
- Division of State Parks
- Water Commission
- Hawai'i National Guard
- Federal Aviation Administration
- Wai'alaie-Kāhala Neighborhood Board #3
- Diamond Head/Kapahulu/St. Louis Heights Neighborhood Board #5
- Save Diamond Head Association
- East Diamond Head Community Association
- Kapi'olani Park Preservation Society
- Kāhala Community Association
- Hawai'i's Thousand Friends
- Historic Hawai'i Foundation
- Outdoor Circle
- Sierra Club Hawai'i Chapter
- Hawaiian Trail and Mountain Club
- American Society of Landscape Architects
- West Diamond Head Association
- Representative Barbara Marumoto
- Senator Les Ihara
- Councilmember Duke Bainum
- UH Sea Grant
- Hawai'i Nature Center
- Waikīkī Improvement Association
- Hawai'i Visitor Convention Bureau
- Outrigger Hotels
- Hawai'i Hotel Association
- Starwood Sheraton
- O'ahu Visitors Bureau
- Polynesian Adventure Tours
- Seahorse Tours, Inc.
- E Noa Corporation
- Trans Hawaiian Services, Inc.
- Roberts Hawai'i
- O'ahu Nature Tours
- New Otani Kaimana Beach Hotel
- Pleasant Hawaiian Holidays
- Outrigger Activities Center
- Connoisseur Holidays Unlimited
- Aloha V.I.P. Tours, Inc.

Based on the responses to these presentations and the comments received, the Diamond Head Master Plan Update was revised to reflect community and business concerns.

DIAMOND HEAD STATE MONUMENT MASTER PLAN UPDATE  
FINAL ENVIRONMENTAL IMPACT STATEMENT

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14.0

Comments and Responses to the EISPN

DIAMOND HEAD STATE MONUMENT MASTER PLAN UPDATE  
FINAL ENVIRONMENTAL IMPACT STATEMENT

**14.0 COMMENTS AND RESPONSES TO THE EISPN**

**14.1 Agencies that Responded to the EISPN**

	AGENCY	PREP NOTICE MAIL DATE	DATE OF COMMENTS
	<b>STATE</b>		
1	Governor's Office	9/4/98	
2	Office of Environmental Quality Control	9/4/98	10/7/98
3	Office of Hawaiian Affairs	9/4/98	
4	Department of Agriculture	9/4/98	10/8/98
5	Department of Accounting and General Services.	9/4/98	
6	Department of Defense Hawai'i National Guard	9/4/98	9/15/98
7	Department of Education	9/4/98	9/25/98
8	Department of Hawaiian Home Lands	9/4/98	
9	Department of Health (DOH)	9/4/98	
10	Department of Land & Natural Resources (DLNR), Division of State Parks	9/4/98	9/2/98
11	DLNR Water Commission	9/4/98	
12	DLNR State Historic Preservation District	9/4/98	
13	DLNR Land Division	9/4/98	
14	DLNR Division of Forestry and Wildlife	9/4/98	9/14/98
15	Department of Transportation	9/4/98	
16	Department of Business, Economic Development & Tourism	9/4/98	
17	DBEDT Energy, Resources and Technology Division	9/4/98	10/12/98
18	DBEDT Office of Planning	9/4/98	9/8/98
19	State Land Use Commission	9/4/98	11/27/98
20	Department of Defense, State Civil Defense	9/4/98	
21	Department of Defense, Adjutant General	9/4/98	
22	Department of Budget and Finance, Information and Communication Services Division	9/4/98	
23	University of Hawai'i, Environmental Center	9/4/98	
24	University of Hawai'i, Kapi'olani Community College	9/4/98	
25	University of Hawai'i, Sea Grant	9/4/98	
26	University of Hawai'i, Water Resources Research Center	9/4/98	
27	Senator Carol Fukunaga	9/4/98	
28	Senator Les Ihara, Jr.	9/4/98	
29	Representative Barbara Marumoto	9/4/98	
30	Senator Matt Matsunaga	9/4/98	
31	Representative Brian Yamane		
	<b>FEDERAL</b>		
32	U.S. Department of Agriculture, Natural Resource Conservation Service	9/4/98	
33	U.S. Army Corps of Engineers	9/4/98	10/5/98
34	U.S. Fish and Wildlife Service	9/4/98	10/8/98
35	U.S. Geological Survey	9/4/98	9/4/98
36	U. S. Department of Transportation, Federal Aviation Administration	9/4/98	
37	U.S. National Park Service	9/4/98	
38	U.S. Senator Daniel K. Inouye	9/4/98	
39	U.S. Senator Daniel K. Akaka	9/4/98	
40	U.S. Representative Neil Abernethy	9/4/98	

DIAMOND HEAD STATE MONUMENT MASTER PLAN UPDATE  
FINAL ENVIRONMENTAL IMPACT STATEMENT

	AGENCY	PREP NOTICE MAIL DATE	DATE OF COMMENTS
	<b>NON-GOVERNMENTAL AGENCIES/INDIVIDUALS</b>		
41	Diamond Head Citizens Advisory Committee	9/4/98	
42	Wai'alaie-Kūhala Neighborhood Board #3	9/4/98	
43	Diamond Head/Kapahulu/St. Louis Heights Neighborhood Board #5	9/4/98	
44	Hawaiian Electric Company, Inc.	9/4/98	9/23/98
45	GTE Hawaiian Tel	9/4/98	
46	Save Diamond Head Association	9/4/98	
47	Historic Hawai'i Foundation	9/4/98	
48	The Outdoor Circle	9/4/98	10/7/98
49	Kapi'olani Park Preservation Society	9/4/98	
50	American Institute of Architects	9/4/98	
51	Sierra Club	9/4/98	
52	Kāhala Community Association	9/4/98	
53	Hawai'i's Thousand Friends	9/4/98	
54	East Diamond Head Community Association	9/4/98	
55	West Diamond Head Association	9/4/98	
56	Juli Walters	9/4/98	
57	Luci Pfaltzgraff	9/4/98	
58	Cynthia Marnie	9/4/98	
59	Ruth Gay		10/8/98
60	Alan Ziegler	9/22/98	10/13/98
61	Hawai'i Bicycling League	9/29/98	10/8/98
	<b>CITY AND COUNTY OF HONOLULU</b>		
62	Board of Water Supply	9/4/98	9/25/98
63	Department of Planning and Permitting	9/4/98	
64	Department of Parks and Recreation Services	9/4/98	10/5/98
65	Department of Facility Maintenance	9/4/98	9/3/98
66	Department of Transportation Services	9/4/98	10/14/98
67	Planning Department	9/4/98	9/21/98
68	Police Department	9/4/98	10/1/98
69	Honolulu Fire Department	9/4/98	9/18/98
70	Department of Design and Construction	9/4/98	9/24/98
71	Department of Environmental Services	9/4/98	9/21/98
72	Councilmember Duke Bainum	9/4/98	

## 14.2 EISPN Comment Letters and the Applicant's Responses

The following are the EISPN comment letters received and applicable responses.


MONAIE B. HENRIK, CHAIRPERSON  
BOARD OF LAND AND NATURAL RESOURCES  
CULTURE COLLABORATION  
STATE OF HAWAII  
LOCAL USE DEVELOPMENT PROGRAM  
AGRICULTURE AND RURAL DEVELOPMENT  
COASTAL AND OCEAN RESOURCES  
COUNTRYSIDE  
FORESTRY AND WILDLIFE  
LAND AND NATURAL RESOURCES  
PLANNING DIVISION  
TECHNICAL SUPPORT BRANCH  
STATE PALACE  
HONOLULU, HAWAII 96809  
TELEPHONE: 587-4185  
FACSIMILE: 587-4186

BENJAMIN L. CAVETANO  
GOVERNOR OF HAWAII



STATE OF HAWAII  
DEPARTMENT OF LAND AND NATURAL RESOURCES  
P. O. BOX 621  
HONOLULU, HAWAII 96809  
REF:LD/WL-EK  
OCT 15 1998

BENJAMIN L. CAVETANO  
GOVERNOR OF HAWAII



STATE OF HAWAII  
OFFICE OF ENVIRONMENTAL QUALITY CONTROL  
238 SOUTH SERTANAKA STREET  
SUITE 703  
HONOLULU, HAWAII 96813  
TELEPHONE: 586-4185  
FACSIMILE: 586-4186

GARY GILL  
DIRECTOR

OCT 9 1998

October 7, 1998

Mr. Michael Wilson, Chair  
Department of Land and Natural Resources  
P.O. Box 621  
Honolulu, Hawaii 96809

Dear Mr. Wilson:

Subject: Comments on EISPN for the Diamond Head State Monument  
Master Plan Update, Oahu

This is in response to the request for comments on the subject project. We have the following comments.

1. Please describe, with as much detail as possible, the nature, size and scope of the proposed visitor/interpretive center.
2. Please analyze the impact of this project on cultural practices and features (including traditional and customary gathering rights of native Hawaiians, legends, oral histories, heiau and shrines) associated with the Diamond Head. Please refer to the attached guidelines for assessing cultural impacts.
3. Diamond Head played an important role in the 1895 rebellion against American rule. A "battle" took place outside the crater and the rebels hid for a time inside. Appropriate historical markers or interpretive displays would be a fine addition to the project.

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

Sincerely,

  
Gary Gill  
Director

c: JBBR

TO: Mr. Gary Gill, Director  
Office of Environmental Quality Control

FROM: Michael D. Wilson, Chairperson 

SUBJECT: Diamond Head State Monument Master Plan Update  
Environmental Impact Statement Preparation Notice (EISPN)

Thank you for your letter of October 7, 1998, regarding the EISPN for the proposed project. We appreciate the time spent by your staff reviewing the document. All your comments are noted and will be taken into consideration in the preparation of the draft EIS.

You will be sent a copy of the draft EIS for review and comment as soon as it is completed. In the meantime, if you have any further questions, please contact Mr. Andrew Monden, Chief Engineer, at 587-0230.

REGULATORY SERVICES DIVISION

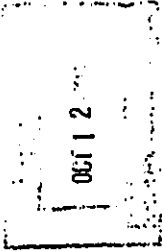


STATE OF HAWAII  
DEPARTMENT OF LAND AND NATURAL RESOURCES

P. O. BOX 611  
HONOLULU, HAWAII 96809

MICHAEL D. WILSON, CHAIRPERSON  
BOARD OF LAND AND NATURAL RESOURCES  
GILBERT OLOPEA-AOJAWAN  
ADVISORY BOARD  
LAND AND NATURAL RESOURCES  
COMMISSIONER OF LAND AND NATURAL RESOURCES  
COMMITTEES  
PLANNING AND POLICY  
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(P) 1642.8



OCT 8 1998

REF:LD/WL-EK

OCT 15 1998

TO: Mr. Andrew Monden, Section Head  
Project Planning Section  
Department of Land and Natural Resources

SUBJECT: Environmental Impact Statement Preparation Notice  
(EISP/N) for the Diamond Head State Monument  
Master Plan Update

Thank you for the opportunity to review the subject document which we received as an attachment to your memorandum on September 3, 1998.

We do not foresee the project impacting any of our existing or proposed facilities. Therefore, we have no comments to offer at this time. However, we welcome the opportunity to review and comment on the project's draft EIS and final EIS.

If you should have any questions, please contact Mr. Ronald Ching of the Planning Branch at 586-0490.

*Gordon Matsuoka*

GORDON MATSUOKA  
Public Works Administrator

RC/ET:jj  
c: OEQC  
PBR Hawaii

TO: Mr. Gordon Matsuoka  
Public Works Administrator  
Department of Accounting and General Services

FROM: Michael D. Wilson, Chairperson

SUBJECT: Diamond Head State Monument Master Plan Update  
Environmental Impact Statement Preparation Notice (EISP/N)

Thank you for your letter of October 8, 1998, commenting on the subject project. We appreciate your taking the time to review the EISP/N.

You will be sent a copy of the draft EIS for review and comment as soon as it is completed. In the meantime, if you have further questions, please contact Mr. Andrew Monden, Chief Engineer, at 587-0230.



WV

3404

BOULANGER J. CADETIANO  
SCHOOL OF LAND AND NATURAL RESOURCES



STATE OF HAWAII  
DEPARTMENT OF EDUCATION  
P.O. BOX 2348  
HONOLULU, HAWAII 96808

OFFICE OF THE SUPERINTENDENT

BOULANGER J. CADETIANO  
SCHOOL OF LAND



STATE OF HAWAII  
DEPARTMENT OF LAND AND NATURAL RESOURCES  
P.O. BOX 621  
HONOLULU, HAWAII 96808

REF:LD/WL-EK

OCT 13 1998

RECEIVED

98 SEP 22 8:03

DEPT. OF LAND  
& NATURAL RESOURCES  
STATE OF HAWAII

September 15, 1998

MEMO TO: Mr. Michael Wilson, Chairperson  
Department of Land and Natural Resources

A T T N: Mr. Andy Monden

F R O M: Paul G. LeMahieu, Ph.D., Superintendent  
Department of Education

*Paul G. LeMahieu*

SUBJECT: Diamond Head State Monument  
Master Plan Update EISPN

The Department of Education has no comment on the subject environmental impact statement preparation notice.

Thank you for the opportunity to respond.

PLeM:hy

cc: OBS  
M. Shishido, HDO  
OEQC  
D. Hulse, PBR Hawaii

AN AFFIRMATIVE ACTION AND EQUAL OPPORTUNITY EMPLOYER

TO: Mr. Paul G. LeMahieu, Ph.D., Superintendent  
Department of Education

FROM: Michael D. Wilson, Chairperson *M.D. Wilson*

SUBJECT: Diamond Head State Monument Master Plan Update  
Environmental Impact Statement Preparation Notice (EISPN)

Thank you for your letter of September 15, 1998, commenting on the subject project. We appreciate your taking the time to review the EISPN.

Should you have any questions or comments, please contact Mr. Andrew Monden, Chief Engineer, at 587-0230.

MICHAEL D. WILSON, CHAIRPERSON  
SCHOOL OF LAND AND NATURAL RESOURCES  
DEPT. OF LAND AND NATURAL RESOURCES  
OLBERT COLLEGE BUILDING  
HONOLULU, HAWAII 96808  
ADULT EDUCATION PROGRAM  
PLANNING & DEVELOPMENT  
COMMUNITY SERVICES  
PLANNING & SUPPORT BRANCH  
PLANNING & SUPPORT BRANCH  
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PLANNING & SUPPORT BRANCH



BENJAMIN J. CAVETANO  
GOVERNOR  
STATE OF HAWAII



STATE OF HAWAII  
DEPARTMENT OF HAWAIIAN HOME LANDS  
P. O. BOX 1878  
HONOLULU, HAWAII 96818

KALI WATSON  
CHAIRMAN  
HAWAIIAN HOMES COMMISSION  
JOSEPH K. AIYAMA  
DEPUTY TO THE CHAIRMAN

BENJAMIN J. CAVETANO  
GOVERNOR



STATE OF HAWAII  
DEPARTMENT OF LAND AND NATURAL RESOURCES  
P. O. BOX 671  
HONOLULU, HAWAII 96809

MICHAEL D. WILSON, CHAIRPERSON  
BOARD OF LAND AND NATURAL RESOURCES  
DEPUTY  
OSBERT COLOMA-AQUINO  
ALLOKAI BARR DEVELOPMENT PROGRAM  
ADJUNCT ASSISTANT  
COMMISSIONER OF LAND AND NATURAL RESOURCES  
SPECIAL ASSISTANT  
COMMISSIONER OF LAND AND NATURAL RESOURCES  
PLANNING AND DEVELOPMENT  
LAND USE DIVISION  
PLANNING BRANCH  
PLANNING BRANCH  
PLANNING & SUPPORT BRANCH  
WATER RESOURCES MANAGEMENT

September 25, 1998

OCT 13 1998

To: Mr. Andy Monden  
Department of Land and Natural Resources

From: Kali Watson, Chairman  
Hawaiian Homes Commission *Darrell Grogan*

Subject: Diamond Head State Monument Master Plan Update,  
TMK 3-1-42: 06, 08, 10, 11, 14 -17, 20, 21, 23, 24,  
25, 36 - 38; 3-1-35:22 & 23, Honolulu, Oahu,  
Dated August, 1998

Thank you for the opportunity to review the subject application.  
The Department of Hawaiian Home Lands has no comment to offer.

If you have any questions, please call Daniel Ornellas at  
586-3837.

TO: Honorable Kali Watson, Chairman  
Hawaiian Homes Commission

FROM: *Dr* Michael D. Wilson, Chairperson *OSBERT COLOMA-AQUINO*

SUBJECT: Diamond Head State Monument Master Plan Update  
Environmental Impact Statement Preparation Notice (EISPN)

Thank you for your letter of September 25, 1998, commenting on the subject project. We  
appreciate your taking the time to review the EISPN.

Should you have any questions or comments, please contact Mr. Andrew Monden, Chief  
Engineer, at 587-0230.

COPY



MICHAEL D. WILSON, CHAIRPERSON  
 BOARD OF LAND AND NATURAL RESOURCES

DEPUTY  
 OLBERT COLOMBO-AGANAH

AGRICULTURE DEVELOPMENT PROGRAMS  
 AQUATIC RESOURCES  
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 TRUST FUNDS  
 WATER RESOURCES

STATE OF HAWAII  
 DEPARTMENT OF LAND AND NATURAL RESOURCES  
 P. O. BOX 671  
 HONOLULU, HAWAII 96809

OCT 13 1998

BEAUMUNTI CAYTELANO  
 GOVERNOR OF HAWAII

REF:LD/WL-EK

TO: Mr. Timothy E. Johns, Deputy Director  
 Commission on Water Resource Management

FROM: Michael Wilson, Chairperson

SUBJECT: Diamond Head State Monument Master Plan Update  
 Environmental Impact Statement Preparation Notice (EISP/N)

Thank you for your memorandum dated September 21, 1998, regarding the EISP/N for the proposed project. We appreciate the time spent by your staff reviewing the document. All your comments are noted and will be taken into consideration in the preparation of the draft EIS.

You will be sent a copy of the draft EIS for review and comment as soon as it is completed. In the meantime, if you have any further questions, please contact Mr. Andrew Monden, Chief Engineer, at 587-0230.

MICHAEL D. WILSON  
 CHAIRPERSON

ROBERT G. ORLANDO  
 DEPUTY CHAIRPERSON

DAVID A. MARIOLA  
 LAND DIVISION

JOHN W. HARRIS  
 ENGINEERING BRANCH

HERBERT M. RICHMOND, JR.  
 WATER RESOURCES

TIMOTHY E. JOHNS  
 DEPUTY DIRECTOR

STATE OF HAWAII  
 DEPARTMENT OF LAND AND NATURAL RESOURCES  
 COMMISSION ON WATER RESOURCE MANAGEMENT  
 P. O. BOX 671  
 HONOLULU, HAWAII 96809

September 21, 1998

SEP 28 1998

TO: Mr. Andy Monden, Branch Chief  
 Engineering Branch  
 Land Division

FROM: Timothy E. Johns, Deputy Director  
 Commission on Water Resource Management (CWRM)

SUBJECT: Environmental Impact Statement Preparation Notice  
 Diamond Head State Monument Master Plan Update

Thank you for the opportunity to review the subject document. Our comments related to water resources are marked below.

In general, the CWRM strongly promotes the efficient use of our water resources through conservation measures and use of alternative non-potable water resources whenever available. feasible, and there are no harmful effects to the ecosystem. Also, the CWRM encourages the protection of water recharge areas which are important for the maintenance of streams and the replenishment of aquifers.

- [ X ] We recommend coordination with the county government to incorporate this project into the county's 20-year Water Use and Development Plan, which is subject to regular updates.
- [ X ] We recommend coordination with the Land Division of the State Department of Land and Natural Resources to incorporate this project into the 20-year State Water Projects Plan, which is subject to regular updates.
- [ ] We are concerned about the potential for ground or surface water degradation/contamination and recommend that approvals for this project be conditioned upon a review by the State Department of Health and the developer's acceptance of any resulting requirements related to water quality.
- [ X ] A Well Construction Permit and/or a Pump Installation Permit from the CWRM would be required before ground water is developed as a source of supply for the project.
- [ X ] The proposed water supply source for the project is located in a designated water management area, and a Water Use Permit from the CWRM would be required prior to use of this source.
- [ ] Groundwater withdrawals from this project may affect streamflows. This may require an instream flow standard amendment.
- [ ] If the proposed project diverts additional water from streams or if new or modified stream diversions are planned, the project may need to obtain a stream diversion works permit and petition to amend the Instream Flow Standard for the affected stream(s).
- [ ] If the proposed project performs any work within the bed and banks of a stream channel, the project may need to obtain a stream channel alteration permit and a petition to amend the Instream Flow Standard for the affected stream(s).

[ X ] OTHER:  
 The report indicates that well permits will be required in order to meet increased water demand. We recommend that the DEIS and FEIS disclose the projected potable and non-potable water demand and indicate the aquifer system for which new wells are proposed to meet the increased demand.

If there are any questions, please contact Lenore Nakama at 587-0218.  
 c: David Hulse, PBR Hawaii





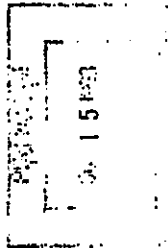
**DEPARTMENT OF BUSINESS,  
ECONOMIC DEVELOPMENT & TOURISM**

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

Ref. No. P-7726

**BENJAMIN J. CATELANO**  
GOVERNOR  
SHEILA MATA  
BRADLEY J. MOSSMAN  
DEPUTY DIRECTOR  
IN CHARGE  
DIRECTOR, OFFICE OF PLANNING

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



October 12, 1998

**MEMORANDUM**

**TO:** Michael D. Wilson, Chairperson  
Department of Land and Natural Resources

**ATTN:** Andy Monden  
Land Division

**FROM:** Bradley J. Mossman  
Director, Office of Planning

**SUBJECT:** Environmental Impact Statement Preparation Notice (EISPN) for the  
Diamond Head State Monument Master Plan Updated, Oahu

A portion of the project appears to be situated in the City's Special Management Area (SMA). A map of the project site relative to the SMA should be provided to clarify this. In addition, we suggest that an assessment of the project's compliance with the Coastal Zone Management (CZM) objectives and policies, Chapter 205A, Hawaii Revised Statutes, be incorporated into the draft EIS document.

If there are any questions, please contact Charles Carole of our CZM Program at 587-2804.

cc: OEOC  
✓ David Hulse, PBR Hawaii

**BENJAMIN J. CATELANO**  
GOVERNOR OF HAWAII



**STATE OF HAWAII**  
**DEPARTMENT OF LAND AND NATURAL RESOURCES**  
P. O. BOX 611  
HONOLULU, HAWAII 96808

REF:LD/WL-EK

OCT 19 1998

**TO:** Mr. Bradley J. Mossman, Director  
Office of Planning  
Department of Business Economic Development & Tourism

**FROM:** ✓ Michael D. Wilson, Chairperson

**SUBJECT:** Diamond Head State Monument Master Plan Update  
Environmental Impact Statement Preparation Notice (EISPN)

Thank you for your letter of October 12, 1998, regarding the EISPN for the proposed project. We appreciate the time spent by your staff reviewing the document. All your comments are noted and will be taken into consideration in the preparation of the draft EIS.

You will be sent a copy of the draft EIS for review and comment as soon as it is completed. In the meantime, if you have any further questions, please contact Mr. Andrew Monden, Chief Engineer, at 587-0230.

**MICHAEL D. WILSON, CHAIRPERSON**  
BOARD OF LAND AND NATURAL RESOURCES

**REPORT**  
**CELEST COCOMA-KOAHAM**  
AGRICULTURE DEVELOPMENT PROGRAM  
AGRICULTURE RESOURCES  
CONSERVATION AND RESTORATION  
COMMITTEES  
FORESTRY AND WILDLIFE  
HISTORIC PRESERVATION  
LAND MANAGEMENT  
PLANNING & SUPPORT SERVICES  
PUBLIC RELATIONS DIVISION



DEPARTMENT OF BUSINESS, ECONOMIC DEVELOPMENT & TOURISM  
LAND USE COMMISSION

P.O. Box 2359  
Honolulu, HI 96804-2359  
Telephone: 808-587-3922  
FAC: 808-587-3327

September 8, 1998

(9) - 9 1998

ESTHER UEDA  
EXECUTIVE OFFICER

Mr. Andy Monden  
September 8, 1998  
Page 2

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

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

Mr. Andy Monden  
Department of Land and  
Natural Resources  
P. O. Box 621  
Honolulu, Hawaii 96809

Dear Mr. Monden:

Subject: Diamond Head State Monument Master Plan Update;  
Environmental Impact Statement Preparation Notice  
(EISPN), TMS 3-1-42: 6, 8, 10, 14, 17, 21, 23,  
24, 25, 36, 37 and 38; 3-1-35: 22 and 23 (Makalei  
Place); 3-1-42: 11 (Cannon Club); 3-1-42: por. 20;  
3-1-42: 15 and 16 (FAA)

We have reviewed the EISPN for the subject Master Plan update and find that the subject property, as represented on Figure 2, is designated within both the State Land Use Conservation and Urban Districts.

For your information, a portion of the subject property, consisting of approximately 23.642 acres and identified as TMS 3-1-42: 10, 21, 23, 24, 25, 36, and 37, was reclassified from the Urban District to the Conservation District for the protection of Diamond Head Crater's significant scenic resources, pursuant to the Commission's Order Adopting Hearing Officer's Proposed Findings of Fact, Conclusions of Law, and Decision and Order dated June 28, 1994 (LUC Docket No. BR93-692/Office of State Planning). The reclassification was subject to the following condition:

1. Petitioner shall ensure that the Property is placed into the proper Conservation District Subzone by working with the Department of Land and Natural Resources in their determination of the proposed subzone.

Based on our review of Figure 3, it is not clear whether the reclassified area has been designated within a subzone. Clarification should be provided on this matter.

Sincerely,

ESTHER UEDA  
Executive Officer

EU:th

cc: OEQC  
-David Hulse, PBR Hawaii



MOHAMMAD CADETANO  
Specialist IV



STATE OF HAWAII  
DEPARTMENT OF LAND AND NATURAL RESOURCES  
P. O. BOX 621  
HONOLULU, HAWAII 96809

REF:LD/WL-EK

OCT 13 1998

MICHAEL D. WILSON, CHAIRPERSON  
BOARD OF LAND AND NATURAL RESOURCES  
SECRETARY  
CELESTY COLOMBAJAHAN  
AGRICULTURE DEVELOPMENT PROGRAM  
ADULTS SERVICES  
COMMUNITY DEVELOPMENT  
COMMUNITY SERVICES  
CONSUMER SERVICES  
COURTESY AND WELFARE  
DEPARTMENT OF LAND AND NATURAL RESOURCES  
HONOLULU, HAWAII  
STATE WASTE & SOLID WASTE  
WATER RESOURCES MANAGEMENT

TO: Ms. Esther Ueda, Executive Officer  
Land Use Commission  
Department of Business, Economic Development & Tourism

FROM: *Michael D. Wilson*, Chairperson

SUBJECT: Diamond Head State Monument Master Plan Update  
Environmental Impact Statement Preparation Notice (EISP/N)

Thank you for your letter dated September 8, 1998, regarding the EISP/N for the proposed project. We appreciate the time spent by your staff reviewing the document. All your comments are noted and will be taken into consideration in the preparation of the draft EIS.

You will be sent a copy of the draft EIS for review and comment as soon as it is completed. In the meantime, if you have any further questions, please contact Mr. Andrew Monden, Chief Engineer, at 587-0230.

BRUCE J. CAVITT  
DIRECTOR



RECEIVED

EDWARD V. RICHARDSON  
MAJOR GENERAL  
ADJUTANT GENERAL

30 DEC 1 10:40 AM '98

DELLA L. PETERSON, JR.  
DIRECTOR

STATE OF HAWAII  
DEPARTMENT OF DEFENSE  
OFFICE OF THE ADJUTANT GENERAL  
3411 DIAMOND HEAD ROAD, HONOLULU, HAWAII 96819-4111

IN THE OFFICE OF THE ADJUTANT GENERAL  
LAND DEPARTMENT

November 27, 1998

TO: Department of Land and Natural Resources  
P.O. Box 621  
Honolulu, Hawaii 96809

ATTN: Mr. Andy Monden  
FROM: Major General Edward V. Richardson  
Director of Civil Defense

SUBJECT: ENVIRONMENTAL IMPACT STATEMENT (EIS) PREPARATION NOTICE,  
DIAMOND HEAD STATE MONUMENT MASTER PLAN UPDATE, HONOLULU, OAHU,  
HAWAII

We appreciate the opportunity to comment on subject document, Tax Map Keys: 3-1-42: 6, 8, 10, 14, 17, 21, 23, 24, 25, 36, 37 AND 38; 3-1-35: 22 AND 23; 3-1-42: 11; 3-1-42: 20 (POR); 3-1-42: 15 AND 16.

STATE CIVIL DEFENSE COMMENTS:

Page 2 of the Environmental Impact Statement Preparation Notice (EISPN) for the update to the 1979 Planning Report (Master Plan) recognizes "Minor DOD Facilities (Civil Defense)" within the monument area, but existing civil defense facility use is incomplete. Page 36 currently identifies Battery Birkhimer remaining as a civil defense facility, with continued use of antennas and continued use of the FAA Link site for antenna. There are several locations not discussed that are part of civil defense's existing use in Diamond Head Crater.

Specifically, this includes existing use of Vault III (below FAA link site), Battery Huling, and Battery Dodge as radio transmitter and receiver facilities. State Civil Defense also holds permits granting other public safety/emergency response agencies access to these 3 sites for radio repeater/antenna siting. Vault III is not shown in figure 4 of the EISPN but is depicted on enclosure 1.

Antennas associated with the radio equipment need to remain on or near the East Side rim of Diamond Head. Civil Defense will work to limit the number and visual impact of antennas to the extent possible based upon funding, operational, and technological constraints. Because changes in technology are inevitable, and given that the Civil Defense operations do change with

time, changes to the configuration of antennas and support towers or poles will continue to be required.

The "M" (storage) tunnels, which line the exterior face on the East Side of Diamond Head, are also not addressed. Tunnel M0 is currently used by the Federal Department of Defense as a cable and radio support facility which is key to their communication support in Koko Head/Diamond Head/Waikiki and downtown area. However, the poles for antennas above M0 are included.

Tunnels M1-M3 are excess to Civil Defense requirements, while M4-M6 are required for retention for contingency storage of disaster response materials which include medical supplies, emergency sheltering supplies, emergency rations, and items required to sustain disaster application center operations during disasters.

State of Hawaii, Department of Defense, Civil Defense Division (SCD) currently maintains minor storage facilities in Battery Harlow. However, SCD is willing to vacate Battery Harlow and relocate to M4-M6 Tunnels. The Civil Air Patrol (CAP) which supports State Civil Defense during disaster situations currently maintains an emergency operations center (EOC) in Battery Harlow. CAP has been advised of the Monument Plan use of Harlow for interpretive viewing, and has indicated that due to its limited access, they are willing to relinquish their use of Harlow as an EOC and operate as staffing personnel for SCD EOC Telecommunications during emergencies. They will be advised when DOD is scheduled to vacate Harlow, and will be asked to comply with this schedule.

The area above and around Birkhimer tunnel is being used by SCD for placement of radio antennas, and above ground utility lines.

On page 37 Paragraph e. Access, Bullet 4 - "Improve existing road from Battery Huling and Dodge to various gun emplacements along the..." was not mentioned in the 1979 plan. Public access into Battery Huling and Dodge is currently not feasible due to existing radio equipment emplaced in both tunnels with antennas on or about the crater rim at these locations.

State Civil Defense will seek approval and funding for reconfiguration and consolidation of the radio equipment in these tunnels, to allow for public access to and viewing from these tunnels, while allowing for continued use of these areas as radio sites. This will entail technological changes to the antenna systems to allow for use of transmitter and receiver combiners. This will also provide visual enhancements, since fewer radiating antennas will be required, but will also entail consolidation of antennas onto a support structure that will provide for long-term emplacement. SCD will inform and seek approval for these future changes when they occur.

SCD agrees with the recommendation that the electrical services and other utilities be placed underground and that these should be done as soon as possible. Those poles above and around Birkhimer Tunnel which are used to support electrical service and cabling are still required, but could be removed as part of an overall utility improvement to Diamond Head crater, with electrical and communications facilities being laid underground. Such an effort, if undertaken,



should be comprehensive and all continued electrical and communications users need to be consulted to insure that the result allows for maximum effectiveness throughout the Monument Area

"Cellular and Personal Communication Services" vendors for all wireless companies should be asked to provide repeaters where possible to insure that wireless coverage exists inside Diamond Head crater, since wireless coverage is very poor due to radio signals being blocked by the natural terrain effects of the crater. With very high visitor counts inside Diamond Head, cellular phones will greatly increase the safety factor to tourists.

HAWAII NATIONAL GUARD COMMENTS:

Page 16, Item 3 - "No new permanent buildings or structures be constructed..." ADD: for public safety for the State of Hawaii.

Page 17, Item 6 - ADD: no civilian aircraft (except for government aircraft)...and no mechanical devices (except for State Civil Defense emergency generators...)

Page 17, Paragraph 2.5.3, Near Term Bullet 3 - "WHO? is to closely work with the U.S. Fish and Wildlife Service, Department of Land and Natural Resources and the Department of Defense Environmental Section..."

Page 36, Paragraph 2.6.6, Item C, Bullet 6 - "Hawaii Army National Guard will not be a resource to develop, operate and maintain Battery Harlow as a museum. Hawaii Army National Guard is programmed to relocate to Barbers Point." Recommend: DELETE SECTION.

We appreciate your consideration and expression of interest on this matter.

c: Office of the Governor  
c/o Office of Environmental Quality Control  
235 S. Beretania Street, Suite 702  
Honolulu, Hawaii 96813-2437

FBR Hawaii  
Pacific Tower, Suite 650  
1001 Bishop Street  
Honolulu, HI 96813

REGINA J. CAVETANO  
CHIEF OF BUREAU



REF:LD/WL-EK  
DEPARTMENT OF LAND AND NATURAL RESOURCES  
STATE OF HAWAII  
P. O. BOX 471  
HONOLULU, HAWAII 96809

NR 20 200

TIMOTHY E. JOHNS, CHAIRPERSON  
BOARD OF LAND AND NATURAL RESOURCES  
DEPUTY  
JAMES E. HAWKES  
ADJUTANT GENERAL  
DEPARTMENT OF LAND AND NATURAL RESOURCES  
EMPLOYMENT  
COMMUNITY DEVELOPMENT  
HISTORIC PRESERVATION  
PLANNING BRANCH  
STATE PLANNING SUPPORT BRANCH

TO: Honorable Major General Edward L. Correa Jr.  
Adjutant General and Director of Civil Defense

FROM: Timothy E. Johns, Chairperson *Tim E Johns*

SUBJECT: Diamond Head State Monument Master Plan Update  
Environmental Impact Statement Preparation Notice (EISPN)

Thank you for your memorandum regarding the EISPN for the proposed project. We appreciate the time you spent reviewing the document. All your comments are noted and will be taken into consideration in the preparation of the Draft Environmental Impact Statement (DEIS).

A copy of the DEIS will be sent for your review and comment as soon as it is completed. If you have any further questions, please contact Mr. Andrew Monden, Chief Engineer, at extension 70230.



NOV 17 '98 18:25PM STATE/DLNR/ENGINEERING BRANCH

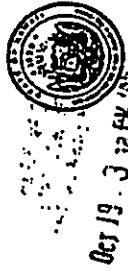
P.1

NOV 17 '98 09:38AM STATE/DLNR/ENGINEERING BRANCH

531-8851

P.2

BRUNNEN & CAYLAND  
GOVERNOR OF HAWAII



Oct 19 3 32 PM '98

STATE OF HAWAII

DEPARTMENT OF LAND AND NATURAL RESOURCES

STATE HISTORIC PRESERVATION DIVISION  
53 SOUTH KING STREET, 4TH FLOOR  
HONOLULU, HAWAII 96813

October 12, 1998

Memorandum

LOG NO: 22363  
DOC NO: 98100008  
Architecture

To: Andy Monden  
Land Division

From: Don Hibbard, Administrator  
Historic Preservation Division

Subject: Environmental Impact Statement Preparation Notice  
Diamond Head Monument Master Plan Update  
TMK 3-1 various; Honolulu, Oahu

We received the Environmental Impact Statement Preparation Notice for Diamond Head State Monument Master Plan Update from PBR Hawaii. We look forward to the field survey documenting existing conditions to identify any potentially significant archaeological areas on the property and the report describing the findings in the Draft and Final Environmental Impact Statements. As the plans are further developed should projects which may have an effect on any of the historic resources or their settings proposed, we request the opportunity to review and concur with the project.

Thank you for the opportunity to comment.

CO:jk

MICHAEL B. WALSH, CHIEF ENGINEER  
BOARD OF LAND AND NATURAL RESOURCES

BRUNNEN & CAYLAND  
GOVERNOR OF HAWAII



STATE OF HAWAII  
DEPARTMENT OF LAND AND NATURAL RESOURCES

LAND DIVISION  
ENGINEERING BRANCH  
P.O. BOX 272  
HONOLULU, HAWAII 96808

NOV - 6 1998

TO: Dr. Don Hibbard, Administrator  
Historic Preservation Division

FROM: Andrew Monden, Chief Engineer

SUBJECT: Diamond Head State Monument Master Plan Update  
Environmental Impact Statement Preparation Notice (EISP/N)

Thank you for your memorandum dated October 12, 1998, regarding the EISP/N for the proposed project. We appreciate the time you spent reviewing the document. All your comments are noted and will be taken into consideration in the preparation of the draft EIS.

A copy of the draft EIS will be sent for your review and comment as soon as it is completed. If you have any further questions, please contact Mr. Eric Yuasa of the Project Planning Section at extension 70729.

SA:ck

MICHAEL B. WALSH, CHIEF ENGINEER  
BOARD OF LAND AND NATURAL RESOURCES  
MARTY  
CULTURE COLLEGE-HAWAII  
ARCHITECTURE DEVELOPMENT PROGRAM  
ARCHITECTURAL SERVICES  
DESIGN AND CONSTRUCTION SERVICES  
ENVIRONMENTAL SERVICES  
CONSTRUCTION SERVICES  
CONSTRUCTION MANAGEMENT  
LAND DIVISION  
ENGINEERING BRANCH  
P.O. BOX 272  
HONOLULU, HAWAII 96808  
STATE HISTORIC PRESERVATION DIVISION  
53 SOUTH KING STREET, 4TH FLOOR  
HONOLULU, HAWAII 96813

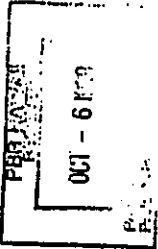




DEPARTMENT OF THE ARMY  
U.S. ARMY ENGINEER DISTRICT, HONOLULU  
FT. SHAFTER, HAWAII 96834-5440

REPLY TO  
ATTENTION OF

October 5, 1998



EDUARDO J. CAYetano  
ENGINEER IN CHARGE



STATE OF HAWAII  
DEPARTMENT OF LAND AND NATURAL RESOURCES

P.O. BOX 671  
HONOLULU, HAWAII 96809

REF:LD/WL-EK

OCT 13 1998

MICHAEL D. WILSON, CHIEF ENGINEER  
DIVISION OF LAND AND NATURAL RESOURCES  
STATE OF HAWAII  
COURTNEY COLONIA-AGUIAR  
DEVELOPMENT PROGRAM  
PLANNING AND DESIGN  
CONSULTATION AND RESOURCES  
DIVISION  
PLANNING AND DESIGN  
UNIT DIVISION  
PLANNING AND DESIGN  
UNIT DIVISION  
PLANNING AND DESIGN  
UNIT DIVISION  
PLANNING AND DESIGN  
UNIT DIVISION

Civil Works Branch

Mr. Andy Monden  
State of Hawaii  
Department of Land  
and Natural Resources  
PO Box 621  
Honolulu, Hawaii 96809

Dear Mr. Monden:

Thank you for the opportunity to review and comment on the Environmental Impact Statement Preparation Notice (EISP) for the Diamond Head State Monument Master Plan Update, Honolulu, Oahu (TMs 3-1-35: 22, 23; 3-1-42: 6, 8, 10-11, 14-17, 20, 23-25, and, 36-39). The following comments are provided in accordance with U.S. Army Corps of Engineers authorities to provide flood hazard information and to issue Department of the Army (DA) permits.

- a. Based on the information provided, a DA permit may be required for any work done in the "seasonal" wetland. For further information, please contact Mr. William Lennan of our Regulatory Section at 438-9258 (extension 13) and refer to file number 980000321.
  - b. The flood hazard information provided on page 58 of the EISP is correct.
- Due to the recent 1998 reorganization of the local Corps of Engineers office, all correspondence concerning comments to environmental and planning documents should be sent to the Honolulu Engineer District, attention: CEPOH-ED-C. Thank you for your attention to this matter.

Sincerely,

Paul Mizue, P.E.  
Chief, Civil Works Branch

Mr. Paul Mizue, P.E.  
Chief, Civil Works Branch  
Department of the Army  
U.S. Army Engineer District, Honolulu  
Ft. Shafter, Hawaii 96858-5440

Dear Mr. Mizue:

Diamond Head State Monument Master Plan Update  
Environmental Impact Statement Preparation Notice (EISP)

Thank you for your letter of October 5, 1998, commenting on the EISP for the proposed project. We appreciate the time spent by your staff reviewing the document. The information you provided will be useful in the preparation of the draft EIS. Also, all correspondence concerning comments to environmental and planning documents will be sent to the Honolulu Engineer District, Attention: CEPOH-ED-C.

You will be sent a copy of the draft EIS for review and comment as soon as it is completed. In the meantime, if you have any further questions, please contact Mr. Andrew Monden, Chief Engineer, at 587-0230.

Aloha,

MICHAEL D. WILSON



United States Department of the Interior

OCT - 9 1998

FISH AND WILDLIFE SERVICE  
Pacific Islands Ecoregion  
300 Ala Moana Boulevard, Room 3-122  
Box 50088  
Honolulu, Hawaii 96850

In Reply Refer to: CS

OCT - 8 1998

Mr. Andy Monden  
Department of Land and Natural Resources  
P.O. Box 621  
Honolulu, Hawaii 96809

Re: *Diamond Head State Monument Master Plan Update - Environmental Impact Statement Preparation Notice*

Dear Mr. Monden:

The U.S. Fish and Wildlife Service (Service) has reviewed the *Diamond Head State Monument Master Plan (Plan) Update - Environmental Impact Statement Preparation Notice (EISPN)*. The proposed action entails updating the Plan, which has not been updated since its publication in 1979. The Plan will take into account significant increases in visitor use since 1979, changing land use by various State and Federal agencies, and the incorporation of adjacent parcels of land into the Monument. It will also include designs for the construction of various improvements, including a permanent visitor/interpretive center. Other potential improvements include road and trail construction, the addition of restrooms and a picnic area, construction of a caretaker's residence, building demolition, and protection and restoration of wetland habitat and native plants and birds.

The Service recommends that the Draft Environmental Impact Statement (DEIS) describe project-related impacts to wildlife resources and habitats within the project area. The DEIS should include current maps detailing the distribution of native flora, fauna, and habitat types in and around the project area. In particular, the DEIS should address impacts on rare, threatened, and endangered species of plants and birds. Our records indicate the documented or potential presence of the following rare and/or federally listed, endangered species:

<i>Spermolepis hawaiiensis</i> (no common name (NCN))	endangered plant
<i>Cyperus trachysanthos</i> (Pu'uka'a)	endangered plant
<i>Schiedea adamanis</i> (NCN)	endangered plant
<i>Lipochea lobata</i> var. <i>lobata</i> (Nehe)	rare native plant
<i>Bidens molokaitensis</i> (Ko'oko'olau)	rare native plant (a Service Species of Concern (SOC))
<i>Torulinium odoratum auriculatum</i> (NCN)	rare native plant (SOC)

*Asio flammeus sandwicensis* (Pueo, Hawaiian owl)

native bird protected under State

Endangered Species Law

endangered waterbird

endangered waterbird

endangered waterbird

migratory bird protected under the

Migratory Bird Treaty Act

native dragonfly

native dragonfly

*Fulica alai* ('Alae ke'oke'o, Coot)

*Gallinula chloropus sandwicensis* ('Alae 'ula, moorhen)

*Anas wyvilliana* (Koloa, Hawaiian duck)

*Ploveralis fulva* (Kolea, Pacific golden plover)

*Anax junius* (dragonfly)

*Pantala flavescens* (dragonfly)

The DEIS should describe potential environmental impacts caused by construction activity, habitat loss due to new buildings or infrastructure, and increased human use. It also should describe measures to avoid unnecessary impacts, minimize unavoidable impacts, or compensate for significant unavoidable impacts to rare, threatened, and endangered species and sensitive habitats.

Descriptions of natural resources and proposed mitigation should be based on current biological surveys conducted by qualified botanists and ornithologists. The surveys should be conducted this winter during the rainy season to maximize the chances of finding native plants and waterbirds whose presence is often dependent on increased rainfall.

The Service supports the proposal to improve wetland habitat and protect and restore native plants, as mentioned in the EISPN. We request that the Master Plan Update and DEIS include and analyze the following management actions as part of the overall strategy for the protection and restoration of Diamond Head's natural resources:

- 1. Wetland restoration:** Actions include restoring the natural hydrology of the existing wetland by stopping pumping of water after rains, controlling alien weeds, replanting with native plant species, and controlling predators (e.g., cats, mongoose) that prey on endangered waterbirds. Allowing for the natural expansion of the wetland following heavy rains may require the re-alignment or elimination of adjacent trails and roads that are prone to repeated flooding.
- 2. Fire control in sensitive habitats:** Actions include constructing firebreaks, planting fire resistant (and preferably native) plant species, weed control, and prohibition of smoking in fire-prone areas. This may require precluding visitors from areas with a particularly high risk of fire.
- 3. Restoration of native flora:** Actions include using agency resources and volunteer groups to replant large areas with appropriate native species that were historically present. Care should be taken that any native plants (particularly endangered species) brought into the crater from the outside are from as genetically similar stock as possible to the plants already there. In general, this translates into using only plants from nearby areas (or at least from Oahu) where populations are not likely to have undergone significant genetic divergence from Diamond Head populations. Provisions should also

be made in the Plan to insure that re-planted areas will be appropriately cared for and maintained (e.g., weeded, watered, etc.) over time, since it is unlikely that the restored habitats will ever be completely self-supporting and maintenance-free. The DEIS should also note that State and Federal permits are required for the possession and handling of listed plant and animal species.

The Service appreciates the opportunity to provide comments on the EISPN, and we look forward to reviewing the DEIS. If you have questions regarding these comments, please contact Fish and Wildlife Biologist Chris Swenson at 541-3441.

Sincerely,



Robert P. Smith  
Pacific Islands Manager

cc: Mr. Gary Gill (OEQC, Honolulu)  
Mr. David Hulse (PBR Hawaii, Honolulu)

BERNARD J. CAVEZANO  
COMMISSIONER OF HAWAII



STATE OF HAWAII  
DEPARTMENT OF LAND AND NATURAL RESOURCES

P. O. BOX 821  
HONOLULU, HAWAII 96809

OCT 15 1998

REF:LD/WL-EK

MOHAI, D. WILSON, CHAIRPERSON  
BOARD OF LAND AND NATURAL RESOURCES

DEPT.  
CELESTINE COLMAN-AGADAM  
ADULT CARE DEVELOPMENT PROGRAM  
ADULT RESOURCES  
ADULT SERVICES  
COMMUNITY AND RESOURCES  
DEPARTMENT  
HONOLULU, HAWAII  
POLICIES AND REGULATIONS  
PLANNING AND DEVELOPMENT  
PLANNING BRANCH  
PLANNING SUPPORT BRANCH  
STATE PLANS  
WATER RESOURCE MANAGEMENT

Mr. Robert P. Smith  
Pacific Islands Manager  
U.S. Fish and Wildlife  
300 Ala Moana Boulevard, Room 3-122  
Honolulu, Hawaii 96850

Dear Mr. Smith:

Diamond Head State Monument Master Plan Update  
Environmental Impact Statement Preparation Notice (EISPN)

Thank you for your letter of October 8, 1998, regarding the EISPN for the proposed project. We appreciate the time spent by your staff reviewing the document. All your comments are noted and will be taken into consideration in the preparation of the draft EIS.

You will be sent a copy of the draft EIS for review and comment as soon as it is completed. In the meantime, if you have any further questions, please contact Mr. Andrew Monden, Chief Engineer, at 587-0230.

Aloha,

  
MICHAEL D. WILSON



United States Department of the Interior

SEP 9 1998

U.S. GEOLOGICAL SURVEY  
WATER RESOURCES DIVISION  
677 Ala Moana Boulevard, Suite 415  
Honolulu, Hawaii 96813

September 4, 1998

Mr. Andy Monden  
State of Hawaii  
Department of Land and Natural Resources  
P.O. Box 621  
Honolulu, Hawaii 96809

Dear Mr. Monden:

Subject: Environmental Impact Statement Preparation Notice (EISPN)  
Diamond Head State Monument Master Plan Update

The staff of the U.S. Geological Survey, Water Resources Division, Hawaii District, has reviewed the EISPN, and we have no comments to offer at this time.

Thank you for allowing us to review the report. We are returning it for your future use.

Sincerely,

*William Meyer*  
William Meyer  
District Chief

Enc.

cc: Office of the Governor, c/o Office of Environmental Quality Control  
Mr. David Hulse, PBR Hawaii

EDUARDO CAVENTANO  
GOVERNOR OF HAWAII



STATE OF HAWAII  
DEPARTMENT OF LAND AND NATURAL RESOURCES

P. O. BOX 621  
HONOLULU, HAWAII 96809

REF:LD/WL-EK

007 13 1998

MICHAEL D. WILSON, CHIEF ENGINEER  
BOARD OF LAND AND NATURAL RESOURCES  
HONOLULU, HAWAII  
OLBERT COLLETT AQUARIUM  
AQUACULTURE DEVELOPMENT PROGRAM  
WATER RESOURCES DIVISION  
HONOLULU, HAWAII  
CONTRACTS  
PROPERTY AND IMPLUVE  
LAND DIVISION  
PLANNING DIVISION  
TECHNICAL & SUPPORT BRANCH  
WATER RESOURCES DIVISION

Mr. William Meyer, District Chief  
U.S. Department of the Interior  
U.S. Geological Survey  
Water Resources Division  
677 Ala Moana Boulevard, Suite 415  
Honolulu, Hawaii 96813

Dear Mr. Meyer:

Diamond Head State Monument Master Plan Update  
Environmental Impact Statement Preparation Notice (EISPN)

Thank you for your letter of September 4, 1998, commenting on the subject project. We appreciate your taking the time to review the EISPN.

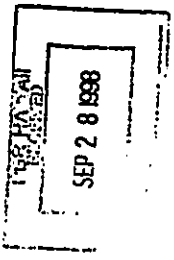
Should you have any questions or comments, please contact Mr. Andrew Monden, Chief Engineer, at 587-0230.

Aloha,

*Michael D. Wilson*  
MICHAEL D. WILSON



Hawaiian Electric Company, Inc. • PO Box 2750 • Honolulu, HI 96840-0001



RECEIVED  
OFFICE OF THE  
GOVERNOR



STATE OF HAWAII  
DEPARTMENT OF LAND AND NATURAL RESOURCES

P. O. BOX 621  
HONOLULU, HAWAII 96809  
OCT 13 1998

MICHAEL D. WILSON, CHAIRPERSON  
BOARD OF LAND AND NATURAL RESOURCES  
DEPUTY  
GILBERT COLEMAN-AGUIAR  
ACTING LAND DEVELOPMENT PROGRAM  
MANAGER  
PLANNING AND DESIGN  
CONSULTATION AND RESEARCH  
CONSULTANTS  
QUALITY AND HEALTH  
AND DESIGN  
PROGRAMS  
TECHNICAL & SUPPORT BRANCH  
STATE PLANS  
OFFICE OF LAND MANAGEMENT

REF:LD/WL-EK

September 23, 1998



Scott W.H. Seu, P.E.  
Manager  
Environmental Department

Mr. Andy Monden  
Department of Land and Natural Resources  
P.O. Box 621  
Honolulu, HI 96809

Dear: Mr. Monden

Subject: Diamond Head State Monument Master Plan

Thank you for the opportunity to comment on your August 1998 EIS Preparation Notice for the Diamond Head State Monument Master Plan, as proposed by the Department of Land and Natural Resources, State of Hawaii. We have reviewed the subject document and have no comments at this time.

HECO shall reserve further comments pertaining to the protection of existing powerlines bordering the project area until construction plans are finalized. Again, thank you for the opportunity to comment on this notice.

Sincerely,

cc: OEQC

PBR Hawaii  
Pacific Tower, Suite 650  
1001 Bishop Street  
Honolulu, Hawaii 96813  
for: David Hulse



WINNER OF THE EDISON AWARD  
FOR DISTINGUISHED INDUSTRY LEADERSHIP

Mr. Scott W.H. Seu, P.E., Manager  
Environmental Department  
Hawaiian Electric Company, Inc.  
P.O. Box 2750  
Honolulu, Hawaii 96840-0001

Dear Mr. Seu:

Diamond Head State Monument Master Plan Update  
Environmental Impact Statement Preparation Notice (EISPN)

Thank you for your letter of September 23, 1998, commenting on the subject project. We appreciate your taking the time to review the EISPN.

You will be sent a copy of the draft EIS for review and comment as soon as it is completed. In the meantime, if you have any further questions, please contact Mr. Andrew Monden, Chief Engineer, at 587-0230.

Aloha,

MICHAEL D. WILSON



**THE OUTDOOR CIRCLE**  
 1314 South King St., Suite 308 • Honolulu, HI 96814  
 Phone: 808-593-0300 Fax: 808-593-0323

OCT - 9 1998  
 10:00 AM

Established 1912  
 A Non-profit Organization

**BRANCHES**

**OAHU**

Kaunohi  
 Lele-Kaliua  
 North Shore  
 Waialeale-Kahala

**HAWAII**

Iliha  
 Kāʻa  
 Kona  
 Puna  
 Waimea

**KAUAI**

**MAUI**

**MOLOKAI**

**GARDEN CIRCLE**

Lele-Kai

October 7, 1998

Mr. Andrew Monden

State of Hawaii

Department of Land and Natural

1151 Punchbowl Street, Room 221

Honolulu, HI 96813

RE: Diamond Head State Monument

Master Plan Update

Environmental Impact Statement Preparation Notice

Dear Mr. Monden:

We have reviewed the above referenced EISPN and offer the following comments:

The document appears to contradict itself regarding the utilization of exterior picnic areas. The 1979 Developmental Plan Description (pg. 14) seems to be in direct opposition to the stated position on page 25. Please be sure the Environmental Impact Statement (DEIS) clarifies this issue.

Page 15 refers to a Project Nursery. We are unable to locate where this is designated, either in writing or in a figured drawing. Please indicate where the temporary project nursery will be located in the EIS.

We are confused by the wastewater lift station referred to on page 23. Will one be installed or does one already exist?

We agree that cooking within the crater should be expressly forbidden and stated so with the appropriate signage.

Regarding landscaping. The Outdoor Circle encourages landscaping both in the interior and exterior of the crater. We feel it is very important that on-going landscape maintenance be addressed in the EIS. In fact, landscape maintenance should be included in every phase of the planning and execution of this Master Plan. In addition, we heartily endorse undergirding the utility lines.

Various methods of possible funding for the crater are stated on page 48. However, no where is a special Kamā'āina rate for admission discussed. Was this an oversight or for a reason?

Diamond Head State Monument  
 Master Plan Update  
 Environmental Impact Statement Preparation Notice  
 Page 2

Thank you for the opportunity to respond to the Diamond Head State Monument Master Plan Environmental Impact Statement Preparation Notice. We look forward to receiving your response.

Sincerely,

*Susan Bright Spangler (MS)*

Susan Bright Spangler  
 Member, Board of Directors

cc: Governor Benjamin J. Cayetano  
 David Hulse, FBR



BERNARD J. CAVEZANO  
DIRECTOR OF PLANNING



STATE OF HAWAII  
DEPARTMENT OF LAND AND NATURAL RESOURCES  
P. O. BOX 671  
HONOLULU, HAWAII 96808

REF:LD/WL-EK

OCT 15 1998

*File*

MICHAEL D. WILSON, CHAIRPERSON  
BOARD OF LAND AND NATURAL RESOURCES  
DEPUTY  
OLBERT COLEMAN, HONORARY  
ADVISORY DEVELOPMENT PROGRAM  
ADVISORY BOARD  
ADVISORY BOARD  
CONSERVATION AND RESOURCES  
COMMISSION  
PLANNING AND DESIGN  
COMMISSION  
PLANNING AND DESIGN  
COMMISSION  
PLANNING AND DESIGN  
COMMISSION  
PLANNING AND DESIGN  
COMMISSION  
PLANNING AND DESIGN  
COMMISSION

Ms. Susan Bright Spangler  
Member, Board of Directors  
The Outdoor Circle  
1314 South King Street, Suite 306  
Honolulu, Hawaii 96814

Dear Ms. Spangler:

**Diamond Head State Monument Master Plan Update  
Environmental Impact Statement Preparation Notice (EISPN)**

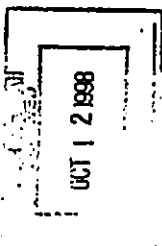
Thank you for your letter of October 7, 1998, regarding the EISPN for the proposed project. We appreciate the time you spent reviewing the document. All your comments are noted and will be taken into consideration in the preparation of the draft EIS.

You will be sent a copy of the draft EIS for review and comment as soon as it is completed. In the meantime, if you have any further questions, please contact Mr. Andrew Monden, Chief Engineer, at 587-0230.

Aloha,

*Michael D. Wilson*  
MICHAEL D. WILSON





1626 Ruth Place  
Honolulu, HI 96816  
October 8, 1998

Andrew Monden, DLNR  
1151 Punchbowl St., Rm 221  
Honolulu, HI 96813

I appreciate the opportunity to review the Diamond Head State Monument Master Plan Update EIS Preparation Notice. I am a plant ecologist and educator who has observed aspects and conducted field classes at Diamond Head since the 60's and 70's.

**ECOLOGICAL DESCRIPTIONS**

As this notice defines the scope of affected environmental features, I recommend the inclusion of a section on ecological zones, either under FLORA (as in the 1979 Plan) or separately. As part of this section, survey results of proposed new trails could be included.

**CRATER FLOOR PLANTINGS**

I think choosing appropriate tree species for a dryland forest and keeping the tree specimens alive long-term will be challenging under semi-wild conditions in this climatic-soil regime. Past efforts with dryland tree plantings on the floor required more maintenance than expected and survived for just a few years.

However, as an educator I would look forward to opportunities for hands-on student activities, perhaps at the edge of wetlands and certainly in potential patches of native 'ilima scrub on rocky sites. 'Ilima and an associated species on these sites were the first plants to reemerge with appreciable cover after the '94 brush fire.

In preparation for planting, a climate analysis to determine the frequency or other patterns of very low and very high rainfall years might be useful. I've noticed that existing native plants (and some aliens) are surprisingly numerous and vigorous during years of high rainfall.

As plans are made and carried out, I hope that care is taken to reestablish preexisting native plant communities except near buildings and roads where creative gardens of plants from many crater habitats and species from outside communities, e.g. beach naupaka, might be selected.

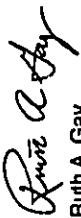
**PRESERVING AND ENHANCING THE FLORA OF SLOPES AND RIDGES**

I strongly support high priority for the maintenance of native plant communities through the reduction of the widespread alien koa haole. This action would significantly reduce fuel for potential fires as smaller native shrubs and herbs regained dominance.

Other important needs for alien plant control are to  
(1) remove alien grass around patches of the two native grasslands 'emoloa (*Eragrostis variabilis*) and kakonakona (*Panicum torridum*) and throughout pill grass stands  
(2) eliminate alien *Bidens pilosa* and *cynapiifolia* around native *Bidens* locations.

**GRAPHICS**  
Maps in this document are more difficult to comprehend than in the '79 plan because  
(1) the many additional contour lines obscure orientation landmarks such as tunnels, roads, the summit and rim, and  
(2) some features are not discernibly labeled, e.g. service road to Birkhimer EOC and DOD 301, 303, 304.

I hope that these comments are helpful to your preparation of the plan update. I wish to be a consulted party and want to receive a copy of the draft EIS.

Sincerely yours,  
  
Ruth A. Gay  
Retired Faculty Member, Botany Dept.  
University of Hawaii at Manoa





STATE OF HAWAII  
DEPARTMENT OF LAND AND NATURAL RESOURCES  
P. O. BOX 611  
HONOLULU, HAWAII 96808  
OCT 15 1988

MICHAEL D. WILSON CHAIRPERSON  
Board of Land and Natural Resources  
AGENT  
CELESTY COLYER-JAGARAN  
AGRICULTURE, RECREATION, FORESTRY  
ADULTS, RECREATION  
ADMINISTRATIVE SERVICES  
COMMUNITY DEVELOPMENT  
CONSERVATION  
COUNCIL ON THE ENVIRONMENT  
CULTURAL AFFAIRS  
ELECTRICITY AND UTILITIES  
LAND AND NATURAL RESOURCES  
PLANNING AND DEVELOPMENT  
POLLUTION CONTROL  
TECHNICAL & SUPPORT SERVICES  
TOTAL PARKS  
WATER RESOURCES MANAGEMENT

REF:LD/WLEK

Ms. Ruth A. Gay  
1626 Ruth Place  
Honolulu, Hawaii 96813  
Dear Ms. Gay:

Diamond Head State Monument Master Plan Update  
Environmental Impact Statement Preparation Notice (EIS/SPN)

Thank you for your letter of October 8, 1988, regarding the EIS/SPN for the proposed project. We appreciate the time you spent reviewing the document. All your comments are noted and will be taken into consideration in the preparation of the draft EIS. As requested, you will be a consulted party during the preparation of the draft EIS.

You will be sent a copy of the draft EIS for review and comment as soon as it is completed. In the meantime, if you have any further questions, please contact Mr. Andrew Monden, Chief Engineer, at 587-0230.

Aloha,

*Michael D. Wilson*  
MICHAEL D. WILSON

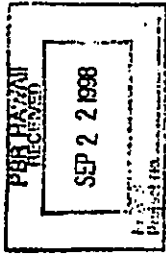
ALAN C. ZIEGLER, Ph.D.  
Zoological Consultant

45-636 Iiua Place  
Kilaheo, Hawaii 96744

20 September 1988

David Hulme  
PBR Hawaii  
1001 Bishop Street  
Pacific Tower, Suite 650  
Honolulu, Hawaii 96813

Telephone:  
(808) 247-5318



Dear David Hulme,

I am writing in regard to the Diamond Head State Monument Master Plan Update. I would like to be considered a consulted party in this PBR Hawaii's undertaking.

My primary concern is that for bones of prehistorically extinct Hawaiian birds that possibly--indeed, probably--lie in the soil now partially filling Diamond Head Crater after originally eroding from the inner slopes of the cone.

As you undoubtedly know, Diamond Head is among a number of O'ahu volcanic tuff cones formed during the Posterosional Eruption Series on this island. Uluapa'u Head, on the Windward Moku Peninsula is of similar origin, and its crater sediments have been found to contain a wealth of fossil bird remains. I have enclosed here for your possible interest the Abstract and Discussion sections of a 1987 paper by Helen F. James giving details of this scientifically and educationally important Windward site.

To my knowledge, Diamond Head sediments have never been examined for such prehistoric bird bones, but it seems quite reasonable to expect that these occur there. Thus, if the Diamond Head Master Plan development entails any significant excavations within the crater (such as for water or sewer lines, building foundations, and the like), I hope provision will be made to have such work monitored by a local archaeological consultant firm to document any fossil items encountered.

May I thank you very much for your attention in this matter, and for consideration of my request to be a consulted party. Please just telephone me (afternoon) at the number on this letterhead if it seems there is any more information I might provide at this time. Continued best of everything in all of your work !!

Sincerely,  
*Alan C. Ziegler*  
Alan C. Ziegler

encl.

L'EVOLUTION DES OISEAUX D'APRES LE TEMOIGNAGE DES FOSSILES

Table Ronde internationale du CNRS  
Lyon-Villeurbanne, 18-21 Septembre 1988

C. Mouret-Charrin (Coordonnateur)

A LATE PLEISTOCENE AVIFAUNA  
FROM THE ISLAND OF OAHU, HAWAIIAN ISLANDS

Helen F. JAMES

Docum. Lab. Géol. Lyon, n° 99, 1987, p. 221-230, 1 fig., 1 tabl.

# A LATE PLEISTOCENE AVIFAUNA FROM THE ISLAND OF OAHU, HAWAIIAN ISLANDS

## UNE AVIFAUNE DU PLEISTOCENE SUPERIEUR DE L'ILE D'OAHU (HAWAII)

Helen F. JAMES\*

### Abstract

Fossils from an eroding sea cliff on the Mokapu Peninsula of the island of Oahu constitute the oldest vertebrate fauna known from the Hawaiian Islands. These bones, apparently accumulated in a lake that once occupied the crater of the Ulupepe Head ruff cone, probably during the Illinoian Glacial. The fossil avifauna from this locality comprises an ecologically diverse assemblage of birds, including seabirds, shorebirds, waterfowl, and large and small land birds. At least two species of seabirds from Ulupepe Head are not known historically or in Holocene fossil deposits from the Hawaiian Archipelago. The presence of migratory shorebirds and waterbirds is evidence that migratory routes of these species over the Pacific Ocean have endured for more than 120,000 years. Preliminary morphological comparison of the land and fresh water birds from Ulupepe Head with a Holocene fossil avifauna from Barber's Point, Oahu, suggest that many, if not all, of the major adaptations found in the endemic Hawaiian species had already evolved at the time the Ulupepe Head fossils were deposited.

KEY-WORDS: Fossil birds, Hawaiian Islands, Late Pleistocene, migration, evolution.

### Résumé

Les fossiles provenant d'une falaise érodée par la mer de la presqu'île de Mokapu, dans l'île d'Oahu, représentent la plus ancienne faune de Vertébrés connue dans l'archipel des Hawaii. Ces ossements se sont accumulés dans un lac qui occupait le cratère du volcan Ulupepe Head, probablement au cours de la glaciation d'Ilinoï. L'avifaune fossile de ce gisement comprend des formes appartenant à des biotopes variés, incluant des oiseaux de mer, de rivage, d'eau douce et des formes terrestres de grande et de petite taille. Parmi les oiseaux de mer, deux espèces au moins n'ont pas été connues durant les périodes historiques ni dans les faunes fossiles d'âge holocène de l'Archipel des Hawaii. La présence de formes migratrices dans les oiseaux d'eau ou de rivage indique que les voies de migration de ces espèces à travers l'Océan Pacifique étaient déjà établies il y a plus de 120,000 ans. Les premières comparaisons morphologiques entre les formes terrestres et d'eau douce et l'avifaune fossile holocène de Barber's Point, Oahu, suggèrent que la plupart sinon toutes les adaptations majeures trouvées dans les espèces endémiques des Hawaii (dont déjà apparues au moment de la formation du gisement d'Ulupepe Head).

MOTS-CLES: Oiseaux fossiles, Îles Hawaii, Pléistocène supérieur, Migration, Evolution.

\* Dept. of Vertebrate Zoology, National Museum of Natural History, Smithsonian Institution, Washington, D.C. 20560, U.S.A.

### DISCUSSION

The fossils from Ulupepe Head include remains of at least 28 species of birds, although some of them could not be positively identified at the specific level. This total includes representatives from all major habitats exploited by birds in the Hawaiian Islands, with 6 seabirds, 2 shorebirds, 4 waterbirds, 2 predatory species, 3 terrestrial flightless species, and 11 to 12 passerine species. The size of the current fossil collection from Ulupepe Head is small compared to other major Hawaiian collecting localities (Olson and James, 1982b), and there can be little doubt that more species will be found as collecting at the site continues. Future collecting should also fill in morphological details for many taxa in the fauna that are at present known from only one or a few skeletal elements. With sufficient fossils from Ulupepe Head, it should be possible to study turnover and morphological evolution in the endemic avifauna of Oahu over a period of more than 120,000 years.

Even this preliminary study has yielded much useful information about the history of Hawaiian birdlife. Relatively few seabird bones have been collected from Ulupepe Head so far, yet these include *Neodyfipetes fuliginosa* and at least one other species of seabird that has not been recorded in the Hawaiian Islands during History. Pleistocene turnover in breeding seabirds of oceanic islands has already been observed on St. Helena (Olson, 1975) and Bermuda (S. L. Olson, pers. com.), and fossils from Ulupepe Head may eventually show that the phenomenon was not restricted to the Atlantic. The fossils of *Micromerus fuliginosa*, *Phaethon dorsalis*, and migratory geese in the deposit constitute the oldest available evidence for the antiquity of the migratory routes of these species over the Pacific Ocean. As for the endemic land birds of Oahu, which are well represented in this preliminary fossil collection, no striking examples of morphological evolution were found in comparing the Pleistocene and Holocene avifaunas. Although *Ardea herodias* has possibly become larger, and the species of skua-like gapers may not be the same in the Ulupepe Head and Barber's Point deposits, these apparent changes are minor and perhaps illusory, since they could also be explained as artifacts of sampling or of recent human-caused extinctions. The weight of the evidence here indicates that remarkably little morphological evolution or turnover in species composition has occurred in the endemic avifauna of Oahu during the Late Pleistocene and Holocene.

Most vertebrate fossil sites that have been found on volcanic, oceanic islands date to the Wisconsin Glacial or the Holocene (e.g. Olson and James, 1982b; Stedman and Olson, 1986; Stedman, 1986). In fact, I do not know of another fossil vertebrate site on a volcanic, oceanic island that would compare with Ulupepe Head as a well-documented older deposit containing remains of birds from all major habitats found on the island. In view of the important role islands have played in the development of modern evolutionary and ecological principles, more effort should be spent in locating and studying ancient fossil sites on these and other oceanic islands.

### ACKNOWLEDGEMENTS

Permission to collect fossils at Ulupepe Head was kindly granted by the Commander of the United States Marine Corps Air Station at Kaneohe Bay. I am particularly grateful to Diane Drigot for helping scientists gain access to the site. Gustav Pauly discovered the vertebrate fossils at Ulupepe Head, and originated the reinterpretation of the colder alluvium as a late-stage sediment. I thank Carl Kikkawa, Alan Ziegler, and Alan Allison of the Bishop Museum for collecting and loaning many of the specimens used in this study. My research at Ulupepe Head is part of an ongoing research project under the direction of Storrs L. Olson at the Smithsonian Institution. Jonathan Becker, Gustav Pauly, Storrs L. Olson, and David Stedman provided helpful criticisms of a previous draft of the manuscript.

### LITERATURE

- BERGER A.J. (1981). - Hawaiian Birdlife. Second edition. *Univ. Press Hawaii*, Honolulu, XV + 260 P., 137 fig.
- GRAMLICH J.W., LEWIS V.A. & NAUGHTON J.J. (1971). - Pleistocene-Age Dating of Holocene Basalts of the Honolulu Volcanic Series. *Geol. Soc. America Bull.*, Boulder, Colorado, vol. 82, p. 1399-1404, 1 fig.
- JOHANN C. & MOUGER J.-L. (1979). - Order Procellariiformes. In Mayr E. & Collar C.W., eds.: *Checklist of Birds of the World*, vol. 1, second edition, *Museum Comparative Zoology*, Cambridge, Massachusetts.
- KING W.B. & GOULD P.J. (1967). - The Status of Newell's race of the Manx Shearwater. *Living Bird*.



STATE OF HAWAII  
DEPARTMENT OF LAND AND NATURAL RESOURCES  
P. O. BOX 621  
HONOLULU, HAWAII 96808

REF:LD/WL-EK

MICHAEL D. WILSON, CHAIRPERSON  
BOARD OF LAND AND NATURAL RESOURCES  
DEPUTY  
CLERK: COLLEEN AGARON  
AGRICULTURE DEVELOPMENT PROGRAM  
CIVIL ENGINEERING  
CONSERVATION AND RESTORATION  
DIVISIONS  
FORESTRY AND WILDLIFE  
LAND AND NATURAL RESOURCES  
LAND CONSERVATION  
MARKETING BRANCH  
PLANNING BRANCH  
TECHNICAL SUPPORT BRANCH  
STATE PARKS  
WATER RESOURCE MANAGEMENT

OCT 13 1998

Dr. Alan C. Ziegler, Ph.D.  
Zoological Consultant  
45-636 Luluia Place  
Kaneohe, Hawaii 96744

Dear Dr. Ziegler:

Diamond Head State Monument Master Plan Update  
Environmental Impact Statement Preparation Notice (EISP/N)

Thank you for your letter of September 20, 1998, regarding the EISP/N for the proposed project. We appreciate the time spent by your staff reviewing the document. All your comments are noted and will be taken into consideration in the preparation of the draft EIS. Also, you will be a consulted party in the preparation of the draft EIS.

You will be sent a copy of the draft EIS for review and comment as soon as it is completed. In the meantime, if you have any further questions, please contact Mr. Andrew Monden, Chief Engineer, at 587-0230.

Aloha,

*Michael D. Wilson*  
MICHAEL D. WILSON



OCT 23 '98 08:49PM STATE/DJR/ENGINEERING BRANCH

MOHAMED B. WILSON, CHAIRMAN  
BOARD OF LAND AND NATURAL RESOURCES  
GILBERT COLLIAS, ADJUTANT  
SECRETARY  
AGRICULTURE, FORESTRY, FISHERIES  
AND MARINE RESOURCES  
CIVIL ENGINEERING  
CONSERVATION AND RESOURCES  
DEPARTMENT OF LAND AND NATURAL RESOURCES  
HONOLULU, HAWAII 96816  
TELEPHONE: 521-2300  
FAX: 521-2300



STATE OF HAWAII  
DEPARTMENT OF LAND AND NATURAL RESOURCES

P. O. BOX 621  
HONOLULU, HAWAII 96809  
OCT 15 1998

REF:LD/WL-EK

Ms. Eve J. DeCoursey  
Executive Director  
Hawaii Bicycling League  
3442 Wai'alea Avenue, Suite 1  
Honolulu, Hawaii 96816

Dear Ms. DeCoursey:

**Diamond Head State Monument Master Plan Update  
Environmental Impact Statement Preparation Notice (EISP/N)**

Thank you for your letter of October 8, 1998, regarding the EISP/N for the proposed project. We appreciate the time spent by your staff reviewing the document. All your comments are noted and will be taken into consideration in the preparation of the draft EIS.

You will be sent a copy of the draft EIS for review and comment as soon as it is completed. In the meantime, if you have any further questions, please contact Mr. Andrew Monden, Chief Engineer, at 587-0230.

Aloha,

*Michael D. Wilson*  
MICHAEL D. WILSON

OCT. 08 1998 08:34PM P1

PHONE NO. : 638 735756



3442 Wai'alea Ave., Suite 1, Honolulu, Hawaii 96816 • (808) 735-5756 • Email: bicycling@hnl.com

October 8, 1998

Mr. Andrew Monden  
Dept. of Land and Natural Resources  
1151 Punchbowl Street, Room 221  
Honolulu, Hawaii 96813

RE: Diamond Head State Monument Master Plan Update

Dear Mr. Monden:

The Hawaii Bicycling League applauds the overall direction that the State has presented in the Master Plan for Diamond Head. We feel very strongly that the aim of eventually limiting automobile access to the Crater will greatly enhance the beauty of this natural monument.

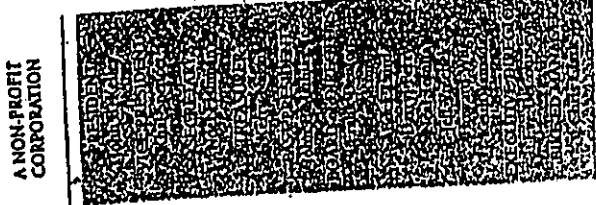
We find, however, that what the Master Plan neither recognizes nor addresses the great surge in eco-tourism, and the numbers of tourists who will be walking or bicycling to Diamond Head from Waikiki. The Plan also does not address the residents who live in the nearby area who would use the land, particularly outside the Crater, once it is developed. To accommodate both of these potential user groups we recommend that the following be added to all three Alternative Concepts:

- landscaped multi-use paths that run from the Cannon Club area to both the Kapahulu and the Kohala tunnels;
- accommodation of pedestrians and bicyclists through both tunnels;
- (The three concepts do mention "allowing" pedestrian access, but we feel that there is a very important distinction between allowing and accommodating);
- secure bicycle parking both at the Cannon Club and at the trailhead inside Diamond Head;

Thank you very much for this opportunity to comment. We would be very happy to be of any assistance, and can be reached at 735-5756.

Sincerely yours,  
*Eve J. DeCoursey*  
Eve J. DeCoursey  
Executive Director  
Hawaii Bicycling League

cc: State Office of Environmental Quality Control  
PBR Hawaii



**BOARD OF WATER SUPPLY**

CITY AND COUNTY OF HONOLULU  
800 SOUTH BERTANNA STREET  
HONOLULU, HAWAII 96843  
PHONE (808) 527-6180  
FAX (808) 533-2714



RECEIVED

SEP 25 11:26 AM '98

SEPTEMBER 25, 1998

DEPARTMENT OF LAND AND NATURAL RESOURCES

JEREMY HARRIS, Mayor  
BOBIE FLORES, R.L. Chairman  
ROBERT C. MURPHY, Vice Chairman  
KAZUHI YAMASHITA  
JAN MALLY, A.M.  
JONATHAN K. BEHARAD, P.D.  
BARBARA KOKI BEHARAD  
CHARLES A. STEB  
CLIFFORD S. JAMBLE  
Manager and Chief Engineer

Mr. Andy Monden  
Department of Land and Natural Resources  
State of Hawaii  
P. O. Box 621  
Honolulu, Hawaii 96809

Dear Mr. Monden:

Subject: Environmental Impact Statement Preparation Notice  
for the Diamond Head State Monument Master Plan

Thank you for the opportunity to review and comment on the Environmental Impact Statement Preparation Notice (EISP/N) for the Diamond Head State Monument Master Plan.

We provide the following comments to the EISP/N:

1. There are two active water services serving TMK: 3-1-42: 06 and 20. Two other services, Prem IDs #1104587 and #1104588 were ordered off on June 10, 1997 and August 13, 1985, respectively.
2. The existing off-site water system is presently adequate to accommodate the proposed improvements to Diamond Head State Monument. The water service limit for the area is the 305-foot elevation.
3. A water allocation will be required from the Department of Land and Natural Resources.
4. The availability of additional water will be confirmed when the building permit application is submitted for our review and approval. When water is made available, the applicant will be required to pay our Water System Facilities Charges for transmission and daily storage.
5. The on-site fire protection requirements should be coordinated with the Fire Prevention Bureau of the Honolulu Fire Department.
6. If a three-inch or larger meter is required, the construction drawings showing the installation of the meter should be submitted for our review and approval.

Mr. Andy Monden  
Page 2  
September 25, 1998

7. The proposed project is subject to Board of Water Supply cross-connection control requirements prior to the issuance of the building permit application.
8. We reserve further comment until we review the Draft Environmental Impact Statement.

If there are any questions, please contact Barry Usagawa at 527-5235.

Very truly yours,

CLIFFORD S. JAMBLE  
Manager and Chief Engineer



BERNARD J. CAULFIELD  
GOVERNOR OF HAWAII



STATE OF HAWAII  
DEPARTMENT OF LAND AND NATURAL RESOURCES  
P. O. BOX 101  
HONOLULU, HAWAII 96809

REF:LDWL-EK

OCT 13 1998

MICHAEL D. WILSON, CHAIRPERSON  
BOARD OF LAND AND NATURAL RESOURCES  
DEPT.  
OLBERT COLLEGE, HAWAII  
AGRICULTURE DEVELOPMENT PROGRAM  
AGRICULTURE RESOURCES  
AGRICULTURE ADMINISTRATION  
CONSTRUCTION AND REPAIRS  
CROPPING  
FORESTRY AND WILDLIFE  
LAND AND NATURAL RESOURCES  
MANAGEMENT SERVICES  
TECHNICAL SUPPORT BRANCH  
STATE PRINT  
WATER RESOURCES BRANCH

Mr. Clifford S. Jamile, Manager and Chief Engineer  
Board of Water Supply  
City and County of Honolulu  
630 South Beretania Street  
Honolulu, Hawaii 96843

Dear Mr. Jamile:

**Diamond Head State Monument Master Plan Update  
Environmental Impact Statement Preparation Notice (EISPN)**

Thank you for your letter of September 25, 1998, regarding the EISPN for the proposed project. We appreciate the time spent by your staff reviewing the document. All your comments are noted and will be taken into consideration in the preparation of the draft EIS.

You will be sent a copy of the draft EIS for review and comment as soon as it is completed. In the meantime, if you have any further questions, please contact Mr. Andrew Monden, Chief Engineer, at 587-47230.

Aloha,

  
MICHAEL D. WILSON



DEPARTMENT OF PARKS AND RECREATION  
**CITY AND COUNTY OF HONOLULU**

630 SOUTH KING STREET, 10TH FLOOR • HONOLULU, HAWAII 96813  
PHONE: (808) 923-4182 • FAX: (808) 923-4081



SEPERT HARRIS  
MAYOR

BOJUAN J. CANTANO  
DIRECTOR OF PARKS



STATE OF HAWAII  
**DEPARTMENT OF LAND AND NATURAL RESOURCES**

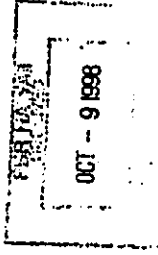
P. O. BOX 671  
HONOLULU, HAWAII 96809

REF:LD/WL-EK

MICHAEL D. WILSON, CHAIRPERSON  
BOARD OF LAND AND NATURAL RESOURCES  
CLUBBET COLOMA-AQUARIUM  
SERVANT  
MANAGEMENT AND RECREATION PROGRAMS  
ADULTS, YOUTH, SENIORS  
CULTURE AND CULTURAL EDUCATION  
COUNSELING AND RECREATION  
DEPARTMENT OF RECREATION  
CONSERVATION  
COURTNEY W. HARRIS  
NATIONAL PARKS SERVICE  
HONOLULU FIELD OFFICE  
RECREATION DIVISION  
PARKS BRANCH  
STATE PARKS SUPPORT BRANCH  
WATER RESOURCE MANAGEMENT

WILLIAM D. BALFOUR, JR.  
DIRECTOR  
MICHAEL T. AMB  
DEPUTY DIRECTOR

October 5, 1998



Mr. Andy Monden  
Department of Land and Natural Resources  
State of Hawaii  
P. O. Box 621  
Honolulu, Hawaii 96809

Dear Mr. Monden:

Re: Environmental Impact Statement (EIS) Preparation Notice  
Diamond Head State Monument Master Plan Update

We have reviewed the document referenced above. The proposed scope of the Environmental Impact Statement (EIS) appears to be adequate. We look forward to reviewing the draft EIS.

If you have any questions, please contact Mr. John Eveland, Executive Assistant, at 527-6038.

Sincerely

*W.D. Balfour, Jr.*

WILLIAM D. BALFOUR, JR.  
Director

WDB:CU  
(88-269707)

cc: Office of Environmental Quality Control  
/ PBR Hawaii

Mr. William D. Balfour, Jr., Director  
Department of Parks and Recreation  
City and County of Honolulu  
650 South King Street, 10th Floor  
Honolulu, Hawaii 96813

Dear Mr. Balfour:

Diamond Head State Monument Master Plan Update  
Environmental Impact Statement Preparation Notice (EISPN)

Thank you for your letter of October 5, 1998, commenting on the subject project. We appreciate your taking the time to review the EISPN.

You will be sent a copy of the draft EIS for review and comment as soon as it is completed. In the meantime, if you have further questions, please contact Mr. Andrew Monden, Chief Engineer, at 587-0230.

Aloha,

*Michael D. Wilson*  
MICHAEL D. WILSON



DEPARTMENT OF FACILITY MAINTENANCE  
**CITY AND COUNTY OF HONOLULU**  
650 SOUTH KING STREET, 11TH FLOOR • HONOLULU, HAWAII 96813  
Phone: (808) 523-4341 • Fax: (808) 527-8827



JEREMY HARRIS  
MAYOR

BENJAMIN J. CAVETANO  
DIRECTOR OF FACILITY MAINTENANCE



STATE OF HAWAII  
DEPARTMENT OF LAND AND NATURAL RESOURCES  
P. O. BOX 621  
HONOLULU, HAWAII 96808

REF:LD/WL-EK

OCT 13 1998

MICHAEL D. WILSON, CHAIRPERSON  
BOARD OF LAND AND NATURAL RESOURCES  
OLBERT COLEMAN-JOHNAN  
AGRICULTURE DEVELOPMENT PROGRAM  
AGRICULTURE RESOURCES  
COMMUNITY DEVELOPMENT  
COMMUNICATIONS AND RESOURCES  
CONSERVATION  
FORESTRY AND WILDLIFE  
HISTORIC PRESERVATION  
PLANNING AND DESIGN  
RECREATION BRANCH  
TECHNICAL SUPPORT BRANCH  
TRUST FUNDS  
WATER RESOURCES MANAGEMENT

September 3, 1998

Mr. Andy Monden  
Department of Land and Natural Resources  
State of Hawaii  
P.O. Box 621  
Honolulu, Hawaii 96809

Dear Mr. Monden:

Subject: Diamond Head State Monument - Master Plan Update

We have no comments. If you have any questions, please call Laverne Higa at 527-6246.

Very Truly Yours,

Jonathan K. Shimada, PhD  
Director and Chief Engineer

LH  
cc: OEOC  
VPBR Hawaii

Dr. Jonathan K. Shimada  
Director and Chief Engineer  
Department of Facility Maintenance  
City and County of Honolulu  
650 South King Street, 11th Floor  
Honolulu, Hawaii 96813

Dear Dr. Shimada:

Diamond Head State Monument Master Plan Update  
Environmental Impact Statement Preparation Notice (EISPN)

Thank you for your letter of September 3, 1998, commenting on the subject project. We appreciate your taking the time to review the EISPN.

Should you have any questions or comments, please contact Mr. Andrew Monden, Chief Engineer, at 587-0230.

Aloha,

MICHAEL D. WILSON

DEPARTMENT OF TRANSPORTATION SERVICES  
**CITY AND COUNTY OF HONOLULU**  
PACIFIC PARK PLAZA • 711 KAPOLANI BOULEVARD, SUITE 1200 • HONOLULU, HAWAII 96813  
PHONE: (808) 533-4929 • FAX: (808) 522-4720



JEREMY HARRIS  
MAYOR

CHERYL D. SOON  
DIRECTOR  
JOSEPH M. MAGALOK, JR.  
DEPUTY DIRECTOR

October 14, 1998

TPD9/98-05262R

Mr. Andy Monden  
Department of Land and Natural Resources  
State of Hawaii  
P.O. Box 621  
Honolulu, Hawaii 96809

Dear Mr. Monden:

Subject: Diamond Head State Monument Master Plan Update

In response to the letter from PBR Hawaii, the environmental impact statement (EIS) preparation notice for the subject project was reviewed. The following comments are the result of this review:

1. Bicycling facilities should be part of the subject project. This department is interested in discussing this matter with you.
2. It is recommended that the project be coordinated with the State of Hawaii Commission on Persons with Disabilities to help ensure compliance with the Americans with Disabilities Act (ADA) and ADA Accessibility Guidelines.

We look forward to reviewing the draft EIS. In order to facilitate this review, please provide us with two copies of the document.

Should you have any questions regarding this matter, please contact Faith Miyamoto of the Transportation Planning Division at 527-6976.

Sincerely,

*Cheryl D. Soon*  
CHERYL D. SOON  
Director

cc: Mr. Gary Gill, Office of  
Environmental Quality Control  
Mr. Davis Hulse, PBR Hawaii

BENJAMIN J. CAYETANO  
SUCCESSION OF HONOR



STATE OF HAWAII  
DEPARTMENT OF LAND AND NATURAL RESOURCES  
P. O. BOX 621  
HONOLULU, HAWAII 96809

REF:LD/WL-EK

OCT 13 1998

Mr. Patrick T. Onishi, Chief Planning Officer  
Planning Department  
City and County of Honolulu  
650 South King Street, 8th Floor  
Honolulu, Hawaii 96813-3017

Dear Mr. Onishi:

**Diamond Head State Monument Master Plan Update  
Environmental Impact Statement Preparation Notice (EISPN)**

Thank you for your letter of September 21, 1998, regarding the EISPN for the proposed project. We appreciate the time spent by your staff reviewing the document. All your comments are noted and will be taken into consideration in the preparation of the draft EIS.

You will be sent a copy of the draft EIS for review and comment as soon as it is completed. In the meantime, if you have any further questions, please contact Mr. Andrew Monden, Chief Engineer, at 587-0230.

Aloha,

*Michael D. Wilson*  
MICHAEL D. WILSON

MICHAEL D. WILSON, CHAIRPERSON  
BOARD OF LAND AND NATURAL RESOURCES

DEPARTMENT OF LAND AND NATURAL RESOURCES  
OFFICE OF THE CHAIRPERSON  
1505 KALANIANA'OLANI AVENUE, SUITE 200  
HONOLULU, HAWAII 96813  
PHONE: (808) 533-4929  
FAX: (808) 522-4720

PLANNING DEPARTMENT  
**CITY AND COUNTY OF HONOLULU**

650 SOUTH KING STREET, 8TH FLOOR • HONOLULU, HAWAII 96813-3017  
PHONE: (808) 522-4332 • FAX: (808) 522-4950



JEREMY HARRIS  
MAYOR

Mr. Andy Monden  
Department of Land and Natural Resources  
September 21, 1998  
Page 2

PATRICK S. ONISHI  
CHIEF PLANNING OFFICER

DONAL L. HAWAHE  
DEPUTY CHIEF PLANNING OFFICER

JH 9/98-1726

September 21, 1998

Mr. Andy Monden  
Department of Land and Natural Resources  
State of Hawaii  
P.O. Box 621  
Honolulu, Hawaii 96809

Dear Mr. Monden:

**Environmental Impact Statement Preparation Notice  
for Diamond Head State Monument Master Plan Update**

Thank you for the opportunity to comment on the Environmental Impact Statement Preparation Notice for the Diamond Head State Monument Master Plan Update.

The Draft Environmental Impact Statement (DEIS) should address how the proposed alternatives conform with the General Plan of the City and County of Honolulu and particularly with the objective of preserving and enhancing the natural monuments and scenic views of Oahu for the benefit of both residents and visitors.

The DEIS should also address how the proposed alternatives will conform to the Development Plan Common Provisions and the Special Provisions for the Primary Urban Center. The proposed project should protect the views of Diamond Head and provide appropriate development for this important preservation area. Mitigation of visual impacts and of impacts on traffic and parking in and around the crater will be critical.

We have no further comments at this time. Should there be any questions regarding our comments, please contact Jeanne Hamilton of our staff at 523-4431.

Yours very truly,

PATRICK S. ONISHI  
Chief Planning Officer

PTO:ft

c: OEQC  
/PBR Hawaii

BEQUAIN J. CAVITANO  
DIRECTOR OF HONOLULU



**STATE OF HAWAII**  
**DEPARTMENT OF LAND AND NATURAL RESOURCES**  
P. O. BOX 471  
HONOLULU, HAWAII 96809

REF:LD/WL-EK

OCT 13 1998

MICHAEL D. WILSON, CHAIRPERSON  
BOARD OF LAND AND NATURAL RESOURCES  
OFFICE OF THE CHAIRPERSON  
1001 KALANIANA'OHU DRIVE  
HONOLULU, HAWAII 96813-3017  
TELEPHONE: (808) 551-5500  
FAX: (808) 551-5501  
E-MAIL: MICHAEL.WILSON@DLNR.HAWAII.GOV

Mr. Patrick T. Onishi, Chief Planning Officer  
Planning Department  
City and County of Honolulu  
650 South King Street, 8th Floor  
Honolulu, Hawaii 96813-3017

Dear Mr. Onishi:

**Diamond Head State Monument Master Plan Update  
Environmental Impact Statement Preparation Notice (EISP/N)**

Thank you for your letter of September 21, 1998, regarding the EISP/N for the proposed project. We appreciate the time spent by your staff reviewing the document. All your comments are noted and will be taken into consideration in the preparation of the draft EIS.

You will be sent a copy of the draft EIS for review and comment as soon as it is completed. In the meantime, if you have any further questions, please contact Mr. Andrew Monden, Chief Engineer, at 587-0230.

Aloha,

  
MICHAEL D. WILSON



POLICE DEPARTMENT  
CITY AND COUNTY OF HONOLULU  
801 SOUTH BERETANIA STREET  
HONOLULU, HAWAII 96813 - AREA CODE (808) 828-3111

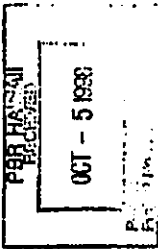


JEREMY HARRIS  
MAYOR

LEE D. DONOHUE  
CHIEF  
WILLIAM B. CLARE  
MICHAEL CARVALLO  
DEPUTY CHIEFS

OUR REFERENCE CS-DL

October 1, 1998



Mr. Andy Monden  
Department of Land and  
Natural Resources  
P.O. Box 621  
Honolulu, Hawaii 96809

Dear Mr. Monden:

Thank you for the opportunity to review and respond to the EIS Preparation Notice for the Diamond Head State Monument Master Plan Update.

This project should have no additional impact on the operations of the Honolulu Police Department.

Sincerely,

LEE D. DONOHUE  
Chief of Police

By *James Femia*  
JAMES FEMIA  
Assistant Chief  
Administrative Bureau

CC: Ofc. of Environmental Quality Control  
Mr. David Hulse, PBR Hawaii  
Major Henry Robinson, District 7

HONOLULU CITY AND COUNTY  
OFFICE OF THE MAYOR



STATE OF HAWAII  
DEPARTMENT OF LAND AND NATURAL RESOURCES

P. O. BOX 651  
HONOLULU, HAWAII 96809

OCT 13 1998

REF:LD/WL-EK

MICHAEL D. WILSON, CHIEF ENGINEER  
OFFICE OF LAND AND NATURAL RESOURCES

OLBERT COLMAN, AGRI-CULTURE  
ADVISORY BOARD  
ADMINISTRATIVE AND COORDINATION  
OFFICER  
CONSERVATION AND RESOURCES  
COMMISSIONER  
LAND DIVISION  
LAND MANAGEMENT  
PLANNING & SUPPORT DIVISION  
NATURAL RESOURCES MANAGEMENT

Mr. James Femia, Assistant Chief  
Police Department, Administrative Bureau  
City and County of Honolulu  
801 South Beretania Street  
Honolulu, Hawaii 96813

Dear Mr. Femia:

Diamond Head State Monument Master Plan Update  
Environmental Impact Statement Preparation Notice (EISPN)

Thank you for your letter of October 1, 1998, commenting on the subject project. We appreciate your taking the time to review the EISPN.

Should you have any questions or comments, please contact Mr. Andrew Monden, Chief Engineer, at 587-0230.

Aloha,

*Michael D. Wilson*  
MICHAEL D. WILSON

**CITY AND COUNTY OF HONOLULU**  
FIRE DEPARTMENT  
3376 KOA'APAKA STREET, SUITE 1422  
HONOLULU, HAWAII 96819-1869

RECEIVED



September 18, 1998

18 SEP 24 10:43 AM '98

JOHN CLARA DEPUTY FIRE CHIEF  
DIV. OF WATER & LAND DEVELOPMENT

Mr. Andy Monden  
State of Hawaii  
Department of Land and Natural Resources  
P. O. Box 621  
Honolulu, Hawaii 96809

Dear Mr. Monden:

Subject: Diamond Head State Monument Master Plan Update  
Environmental Impact Statement Preparation Notice  
HFD Internal No. OL 98-323

We received the Environmental Impact Statement Preparation Notice for the Diamond Head State Monument Master Plan Update, and we have no objections or additional comments to make at this time.

Should you have any questions, please call Battalion Chief Charles Wassman of our Fire Prevention Bureau at 831-7778.

Sincerely,

*Attilio K. Leonard*  
ATTILIO K. LEONARDI  
Fire Chief

AKJCW:bb

KEUMUKEI CAVEIANO  
CHIEF OF POLICE



STATE OF HAWAII  
DEPARTMENT OF LAND AND NATURAL RESOURCES  
P. O. BOX 621  
HONOLULU, HAWAII 96809

REF:LD/VL-EK

OCT 13 1998

MICHAEL D. WILSON, CHAIRPERSON  
BOARD OF LAND AND NATURAL RESOURCES  
DEPUTY  
OLBERT COLEMAN-JACQUES  
ADULTER DEVELOPMENT PROGRAM  
ATLANTIC TECHNOLOGIES  
CITIES AND COUNTY INITIATION  
COMMUNITY DEVELOPMENT  
CONSTRUCTION  
ECONOMY AND REVENUE  
ENVIRONMENTAL  
HONOLULU AND MAUI  
HONOLULU AND MAUI  
HONOLULU AND MAUI  
HONOLULU AND MAUI  
PLANNING BRANCH  
PLANNING BRANCH  
STATE PLANNING & SUPPORT BRANCH  
WATER RESOURCES MANAGEMENT

Mr. Attilio K. Leonard, Fire Chief  
Fire Department  
City and County of Honolulu  
3375 Koaapaka Street, Suite H425  
Honolulu, Hawaii 96819-1869

Dear Mr. Leonard:

**Diamond Head State Monument Master Plan Update  
Environmental Impact Statement Preparation Notice (EISPN)**

Thank you for your letter dated September 18, 1998, commenting on the subject project. We appreciate your taking the time to review the EISPN.

Should you have any comments or questions, please contact Mr. Andrew Monden, Chief Engineer, at 587-0230.

Aloha,

*Michael D. Wilson*  
MICHAEL D. WILSON



PBR PROJECT RECORDS  
SEP 28 1998  
Project  
Project No.

HELEMANIAI CANTAWO  
DIRECTOR OF PBR



STATE OF HAWAII  
DEPARTMENT OF LAND AND NATURAL RESOURCES  
P. O. BOX 671  
HONOLULU, HAWAII 96808

REF:LD/WL-EK

DC-166

OCT 13 1998

MICHAEL D. WILSON, CHAIRPERSON  
BOARD OF LAND AND NATURAL RESOURCES  
GILBERT COLSON, AGAWAH  
ADULTS  
AGRICULTURE, CONSERVATION PROGRAMS  
ARCHITECTURE, DESIGN, PLANNING  
CIVIL ENGINEERING, PLANNING  
CONSTRUCTION, PLANNING  
COURTESY AND LOCAL RECREATION  
CULTURAL RESOURCES  
ENVIRONMENTAL  
HISTORIC PRESERVATION  
LAND USE, PLANNING  
LAND USE, PLANNING  
PLANNING, DESIGN  
PLANNING, DESIGN  
TECHNICAL SUPPORT BRANCH  
WATER RESOURCES MANAGEMENT

Mr. Andy Monden  
Department of Land and Natural Resources  
State of Hawaii  
P. O. Box 621  
Honolulu, Hawaii 96809

Dear Mr. Monden:

Subject: Diamond Head State Monument Master Plan Update  
Environmental Impact Statement Preparation Notice

This is in response to your request of August 1998 to review and comment on the subject matter.

We have no comments to offer but appreciate the opportunity to review the document.

Should there be any questions, please contact Douglas Collinson at 527-6375.

Very truly yours,

*Randall K. Fujiki*  
FOR RANDALL K. FUJIKI  
Director

RKF:jo  
cc: Office of Environmental Quality Control  
Office of the Governor, c/o OEQC  
PBR Hawaii

Mr. Randall K. Fujiki, Director  
Department of Design and Construction  
City and County of Honolulu  
650 South King Street  
Honolulu, Hawaii 96813

Dear Mr. Fujiki:

Diamond Head State Monument Master Plan Update  
Environmental Impact Statement Preparation Notice (EISPN)

Thank you for your letter dated September 24, 1998, commenting on the subject project. We appreciate your taking the time to review the EISPN.

Should you have any questions or comments, please contact Mr. Andrew Monden, Chief Engineer, at 587-0230.

Aloha,

*Michael D. Wilson*  
MICHAEL D. WILSON



DEPARTMENT OF ENVIRONMENTAL SERVICES  
CITY AND COUNTY OF HONOLULU  
650 SOUTH KING STREET  
HONOLULU HI 96813



JEREMY HARRIS  
Mayor

RECEIVED

30 SEP 21 AM 11:29

Mr. Kenneth E. Sprague  
Director  
Department of Environmental Services  
City and County of Honolulu  
650 South King Street  
Honolulu, Hawaii 96813  
ENV 98-181

September 21, 1998

Mr. Andy Monden  
Department of Land and Natural Resources  
State of Hawaii  
P.O. Box 621  
Honolulu, Hawaii 96809

Dear Mr. Monden:

Subject: Environmental Impact Statement Preparation Notice (EISP/N)  
Diamond Head State Monument Master Plan Update  
IMK-Various

We have reviewed the subject EISP/N and have no comments to offer at this time.  
Should you have any questions, please contact Alex Ho, Environmental Engineer, at  
523-4150.

Sincerely,

*Kenneth E. Sprague*  
KENNETH E. SPRAGUE  
Director

RECEIVED  
DEPARTMENT OF LAND AND NATURAL RESOURCES



STATE OF HAWAII  
DEPARTMENT OF LAND AND NATURAL RESOURCES  
P. O. BOX 631  
HONOLULU, HAWAII 96809

REF:LD/WL-EK

OCT 13 1998

MICHAEL D. WILSON, CHIEF ENGINEER  
DEPARTMENT OF LAND AND NATURAL RESOURCES  
CLIENT: COLONY-AKASHAN  
PROJECT: DIAMOND HEAD STATE MONUMENT MASTER PLAN UPDATE  
SUBJECT: ENVIRONMENTAL IMPACT STATEMENT PREPARATION NOTICE (EISP/N)  
ACTION: REVIEW AND COMMENT  
DATE: 10/13/98  
APPROVED: MICHAEL D. WILSON  
TITLE: CHIEF ENGINEER

Mr. Kenneth E. Sprague, Director  
Department of Environmental Services  
City and County of Honolulu  
650 South King Street  
Honolulu, Hawaii 96813

Dear Mr. Sprague:

Diamond Head State Monument Master Plan Update  
Environmental Impact Statement Preparation Notice (EISP/N)

Thank you for your letter dated September 21, 1998, commenting on the subject project. We appreciate your taking the time to review the EISP/N.

Should you have any comments or questions, please contact Mr. Andrew Monden, Chief Engineer at 587-0230.

Aloha,

*Michael D. Wilson*  
MICHAEL D. WILSON



15.0

Comments and Responses to the Draft EIS

DIAMOND HEAD STATE MONUMENT MASTER PLAN UPDATE  
FINAL ENVIRONMENTAL IMPACT STATEMENT

**15.0 COMMENTS AND RESPONSES TO THE DRAFT EIS**

**15.1 Agencies that Responded to the Draft EIS**

	AGENCY	DEIS MAIL DATE	DATE OF COMMENTS
	<b>FEDERAL</b>		
1	U.S. Department of Agriculture, Natural Resource Conservation Service	4/8/00	5/25/00
2	U.S. Army Corps of Engineers	4/8/00	4/19/00
3	U.S. Fish and Wildlife Service	4/8/00	6/23/00
4	U.S. Geological Survey	4/8/00	
5	U.S. Department of Transportation, Federal Aviation Administration	4/8/00	
6	U.S. National Park Service	4/8/00	
7	U.S. Senator Daniel K. Inouye	4/8/00	
8	U.S. Senator Daniel K. Akaka	4/8/00	
9	U.S. Representative Neil Abercrombie	4/8/00	
	<b>STATE</b>		
10	Governor's Office	4/8/00	
11	Office of Environmental Quality Control	4/8/00	5/23/00
12	Office of Hawaiian Affairs	4/8/00	5/22/00
13	Department of Agriculture	4/8/00	
14	Department of Accounting and General Services	4/8/00	6/6/00
15	Department of Defense, Hawaii National Guard	4/8/00	
16	Department of Hawaiian Home Lands	4/8/00	4/14/00
17	Department of Health (DOH)	4/8/00	5/8/00
18	Disability and Communication Access Board	4/8/00	5/22/00
19	Department of Land & Natural Resources (DLNR), Division of State Parks	4/8/00	
20	DLNR Water Commission	4/8/00	4/25/00
21	DLNR State Historic Preservation Division	4/8/00	
22	DLNR Land Division	4/8/00	4/14/00
23	DLNR Division of Forestry and Wildlife	4/8/00	4/27/00
24	DLNR Division of Forestry and Wildlife, Oahu Branch	4/8/00	5/20/00
25	Department of Transportation	4/8/00	4/13/00
26	Department of Business, Economic Development & Tourism	4/8/00	
27	DBED, Energy, Resources and Technology Division	4/8/00	
28	DBED, Office of Planning	4/8/00	
29	Department of Defense, State Civil Defense	4/8/00	5/23/00
30	University of Hawaii, Environmental Center	4/8/00	5/26/00
31	University of Hawaii, Kapiolani Community College	4/8/00	5/19/00
32	University of Hawaii, Water Resources Research Center	4/8/00	
33	Senator Carol Fukunaga	4/8/00	
34	Senator Deshaara, Jr.	4/8/00	
35	Representative Barbara Marumoto	4/8/00	
36	Senator Matt Matsunaga	4/8/00	
37	Representative Brian Yamane	4/8/00	

**DIAMOND HEAD STATE MONUMENT MASTER PLAN UPDATE  
FINAL ENVIRONMENTAL IMPACT STATEMENT**

	<b>AGENCY</b>	<b>DEIS NOTICE MAIL DATE</b>	<b>DATE OF COMMENTS</b>
	<b>CITY AND COUNTY OF HONOLULU</b>		
38	Board of Water Supply	4/8/00	5/18/00
39	Department of Planning and Permitting	4/8/00	5/16/00
40	Department of Parks and Recreation Services	4/8/00	6/1/00
41	Department of Facility Maintenance	4/8/00	
42	Department of Transportation Services	4/8/00	5/19/00
43	Police Department	4/8/00	4/20/00
44	Honolulu Fire Department	4/8/00	
45	Department of Design and Construction	4/8/00	4/20/00
46	Department of Environmental Services	4/8/00	5/15/00
47	Department of Environmental Services Refuse Division	4/8/00	
48	Council member Duke Bañum		
	<b>NON-GOVERNMENTAL AGENCIES/INDIVIDUALS</b>		
49	Diamond Head Citizens Advisory Committee	4/8/00	
50	Waialae-Kāhala Neighborhood Board #3	4/8/00	
51	Diamond Head/Kapahulu/St. Louis Heights Neighborhood Board #5	4/8/00	5/17/00
52	Hawaiian Electric Company, Inc.	4/8/00	
53	GTE Hawaii, Inc.	4/8/00	
54	Save Diamond Head Association	4/8/00	
55	Historic Hawaii Foundation	4/8/00	5/22/00
56	The Outdoor Circle	4/8/00	
57	Kapiolani Park Preservation Society	4/8/00	
58	American Institute of Architects	4/8/00	
59	Sierra Club	4/8/00	
60	Kāhala Community Association	4/8/00	
61	Hawaii's Thousand Friends	4/8/00	
62	East Diamond Head Community Association	4/8/00	
63	West Diamond Head Association	4/8/00	5/22/00
64	Townscape, Inc.	4/8/00	
65	Helber, Hastert & Fee Planners	4/8/00	
66	Julie Walters	4/8/00	
67	Don Paltzeroff	4/8/00	
68	Cynthia Marnie	4/8/00	
69	Suzanne Marinelli	4/8/00	
70	Ruth Gay	4/8/00	
71	Alan Ziegler	4/8/00	5/23/00
72	Hawaii Bicycling League	4/8/00	5/23/00
73	On the Mountain Grass Working Group		

**15.2 Draft EIS Comment Letters and the Applicant's Responses**

The following are the Draft EIS comment letters received and applicable responses:

1762.01\EIS\DEIS\prefinal



United States  
Department of  
Agriculture  
Natural  
Resource  
Conservation  
Service  
P.O. Box 50004  
Honolulu, HI  
96850

*Our People... Our Islands... In Harmony*

May 25, 2000

JUN - 6 2000

Mr. Andrew Monden  
Department of Land and Natural Resources  
P.O. Box 373  
Honolulu, Hawaii 96809


Dear Mr. Monden:

Subject: Draft Environmental Impact Statement (DEIS) - Diamond Head State Monument Master Plan Update, Honolulu, Oahu, Hawaii

We have reviewed the above mentioned document and have no comments to offer at this time.

Thank you for the opportunity to review this document.

Sincerely,

  
KENNETH M. KANESHIRO  
State Conservationist

Cc: Office of the Governor c/o Office of Environmental Quality Control, 235 S. Beretania Street, Suite 702, Honolulu, Hawaii 96813  
Mr. Vincent Shigekuni, PBR Hawaii, Pacific Tower, Suite 650, 1001 Bishop Street, Honolulu, Hawaii 96813

The Natural Resources Conservation Service works hand-in-hand with the American people to conserve natural resources on private lands.

AN EQUAL OPPORTUNITY EMPLOYER

DEPARTMENT OF LAND AND NATURAL RESOURCES



STATE OF HAWAII  
DEPARTMENT OF LAND AND NATURAL RESOURCES

P.O. BOX 151  
HONOLULU, HAWAII 96850

REF:LD/WL-EK

AUG 15 2000

TIMOTHY E. JOHNS, CHAIRPERSON  
BOARD OF LAND AND NATURAL RESOURCES  
NEW YORK  
JANET E. HARVELD  
AGRICULTURE  
CONSERVATION  
DEPARTMENT  
PROPERTY AND RIGHTS  
LAND MANAGEMENT  
PLANNING  
POLICY AND SUPPORT  
ECONOMIC DEVELOPMENT  
NATURAL RESOURCES  
NATURAL RESOURCE  
NATURAL RESOURCE  
STATE PLANNING


Mr. Kenneth M. Kaneshiro  
State Conservationist  
United States Department of Agriculture  
P.O. Box 50004  
Honolulu, HI 96850

Dear Mr. Kaneshiro:

Diamond Head State Monument Master Plan Update  
Draft Environmental Impact Statement (DEIS)

Thank you for your letter of May 25, 2000, on the Diamond Head State Monument Master Plan Update DEIS. We acknowledge that you have no comments.

Should you have any questions, please contact Mr. Andrew Monden, Chief Engineer, at 587-0730.

Aloha,  
  
TIMOTHY E. JOHNS



DEPARTMENT OF THE ARMY  
U.S. ARMY ENGINEER DISTRICT, HONOLULU  
FT. SHAFTER, HAWAII 96854-5400

REPLY TO  
ATTENTION OF

April 17, 2000

10 APR 15 8 11: 48

Civil Works Technical Branch

Mr. Andrew Monden  
State of Hawaii  
Department of Land and Natural Resources  
P.O. Box 373  
Honolulu, Hawaii 96809

Dear Mr. Monden:

Thank you for the opportunity to review and comment on the Draft Environmental Impact Statement for the Diamond Head State Monument Master Plan, Honolulu, Oahu. We do not have any additional comments to offer beyond those previously provided in our letter dated October 5, 1998.

If you require additional information, please feel free to contact Ms. Jessie Dobinchick of my Civil Works Technical Branch staff at 438-8876.

Sincerely,

*James Pennaz*  
James Pennaz, P.E.  
Chief, Civil Works  
Technical Branch

BERNARD J. CAETANO  
GOVERNOR OF HAWAII



STATE OF HAWAII  
DEPARTMENT OF LAND AND NATURAL RESOURCES  
P. O. BOX 521  
HONOLULU, HAWAII 96809

REF:LD/WL-EK

AUG 15 2000

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

DEPUTY  
JANET E. KAMELO  
LAND RESOURCES  
PLANNING AND OCEAN POLLUTION  
CONSERVATION AND RESOURCES  
DEPARTMENT  
POLICY AND ANALYSIS  
PLANNING AND RESTORATION  
LAND DIVISION  
TECHNICAL SUPPORT BRANCH  
STATE PARKS

Mr. James Pennaz, P.E., Chief,  
Civil Works Technical Branch  
Department of the Army  
U.S. Army Engineer District, Honolulu  
Fort Shafter, Hawaii 96868-5440

Dear Mr. Pennaz:

Diamond Head State Monument Master Plan Update  
Draft Environmental Impact Statement (DEIS)

Thank you for your letter of April 17, 2000 on the Diamond Head State Monument Master Plan Update DEIS. We acknowledge that you have no comments.

Should you have any questions, please contact Mr. Andrew Monden, Chief Engineer, at 587-0230.

Aloha,  
*Timothy E. Johns*  
TIMOTHY E. JOHNS





United States Department of the Interior

FISH AND WILDLIFE SERVICE

Pacific Islands Ecoregion  
300 Ala Moana Blvd, Rm 3-122  
Box 50088  
Honolulu, HI 96850

JAN 29 1999

JUN 23 2000

State of Hawaii  
Department of Land and Natural Resources  
P.O. Box 373  
Honolulu, Hawaii 96809

Re: *Draft Environmental Impact Statement for Diamond Head State Monument, Oahu, Hawaii*

Dear Mr. Monden:

The U.S. Fish and Wildlife Service (Service) has reviewed the Draft Environmental Impact Statement (DEIS) for Diamond Head State Monument, Hawaii. The accepting authority for the project is the State Department of Land and Natural Resources. The proposed action involves updating the 1979 Planning Report (Master Plan) for the Diamond Head State Monument. The objective of the 1979 plan was to establish a semi-wild interior park and develop an exterior park for family picnic outings. The update retains many features of the original plan, but also plans to move visitor parking to the outside of the crater, establish a motorized people mover, use the Cannon Club, Battery Harlow, and tunnel 407 for interpretive purposes; accommodate pedestrian access through the Kapahulu tunnel; control visitor access to sensitive areas; protect the habitat of native and endangered species; open new trails; install a wastewater lift station; and remove and relocate utility lines. The Service offers the following comments for your consideration.

We appreciate the incorporation of our October 8, 1998, comments in regard to project impacts on the rare and/or federally listed species.

We are concerned about the State designated noxious weed *Pennisetum setaceum* (Fountain Grass) that occurs throughout Diamond Head Crater. Fountain grass disperses rapidly via wind in dry environments. This species is a serious fire threat because its copious dead leaves provide excellent fuel for frequent fires. Fountain Grass is in its early stages of establishment on Oahu and we believe it should be eradicated before it spreads to other areas. Diamond Head State Monument is home to the largest population of Fountain Grass on Oahu. Because Diamond Head State Monument receives high visitation, the risk of spread to other areas via seeds on hikers' boots and clothes is especially high. On the Big Island, Fountain grass has invaded thousands of acres in North Kona and South Kohala districts, promoting range fires approximately once every five years. These fires threaten multiple interests including endangered species and their habitats, hunting, ranching, and development.

For information on controlling Fountain Grass, please contact the Fountain Grass Working Group at (808) 677-1674. The group is dedicated to controlling Fountain Grass and other invasive species on Oahu and has already begun Fountain Grass control within Diamond Head Crater. The Fountain Grass Working Group consists of representatives from the Service, the State Department of Agriculture, the State Department of Land and Natural Resources Division of Forestry and Wildlife, the U.S. Army, the U.S. Navy, the City and County of Honolulu Board of Water Supply, The University of Hawaii, the

Hawaii Army National Guard, The Nature Conservancy of Hawaii and other concerned organizations.

Diamond Head National Monument is also home to the last remaining wild population of the endangered plant *Schiedea adamanis* in the world. The Service is working with researchers from the University of California at Irvine and has invested resources in protecting and restoring this population. However, additional work is critical to the survival of the species and the population continues to decline, largely due to drought. We recommend installing a watering system to assist these plants. We also recommend establishing additional populations in areas that can be managed (watered, weeded, and protected from fire). Please contact us for additional information and assistance on managing this species.

We support the DEIS' emphasis on preservation of native wetland flora and fauna. We recommend draining the wetland periodically in order to eradicate non-native fish that compete with native waterbirds for food sources such as algae and native invertebrates, and in order to make the wetland accessible for weed control. Weed control methods that retain the resting eggs of native crustaceans should be used (i.e., do not bulldoze). We suggest that some fluctuations in water level be maintained because the native sedges may require periodic flooding. We also recommend that the natural hydrology be modified in order to maintain water in the wetland during dry years. Such a managed, fish free, wetland may support native waterbirds year-round and may also be used as a reintroduction site for the proposed endangered orange black damselfly (*Megalagrion xanthomelas*) or the endangered water fern *Marsilea villosa*. Regardless of the chosen method for managing the wetland, we strongly recommend active trapping for predators such as mongooses, rats, and feral cats because they feed on eggs and birds.

We fully concur with your plans to restore the crater with native plants. We caution against leaving *Proxypis pallida* (Kiawe) trees in the vicinity of the wetland because they are known to require large amounts of water and may negatively impact the hydrology of the wetland. Other shade trees may be planted in their place.

The Service appreciates the opportunity to provide comments on the DEIS and we look forward to working with you on future projects. If you have questions regarding these comments, please contact Fish and Wildlife Biologist Christina Crooker at (808) 541-3441.

Sincerely,

Paul Henson  
Field Supervisor  
Ecological Services

cc: Office of the Governor  
PBR Hawaii



STATE OF HAWAII  
DEPARTMENT OF LAND AND NATURAL RESOURCES  
P. O. BOX 421  
HONOLULU, HAWAII 96809

REF:LD/WL-EK

AUG 15 2000

Mr. Paul Henson, Field Supervisor  
Ecological Services  
United States Department of the Interior  
Fish and Wildlife Service  
Pacific Islands Ecoregion  
300 Ala Moana Blvd., Room 3-122  
Honolulu, Hawaii 96813

Dear Mr. Henson:

Diamond Head State Monument Master Plan Update  
Draft Environmental Impact Statement (DEIS)

Thank you for your letter of June 23, 2000, commenting on the Diamond Head State Monument Master Plan Update DEIS. We appreciate your comments regarding the need to control Fountain Grass throughout Diamond Head Crater. For your information, we received similar comments from the Hawaii Army National Guard Environmental Staff and the Fountain Grass Working Group. Please note that the removal of Fountain Grass is mentioned in Section 4.7 of the Draft EIS.

Similarly, the establishment of additional populations of *Schideea adamantis* is also mentioned in Section 4.7 of the DEIS. The Final EIS will be revised to include the recommendation that a watering system be installed to assist the existing population of *Schideea adamantis* and your agency's recommendations regarding the wetland.

Should you have any questions, please contact Mr. Andrew Monden, Chief Engineer, at 587-0230.

Aloha,

TIMOTHY E. JOHNS

TIMOTHY E. JOHNS, CHIEF ENGINEER  
DIVISION OF LAND AND NATURAL RESOURCES  
HONOLULU, HAWAII 96809  
JANETTE HANFIELD  
OFFICE OF THE CHIEF ENGINEER  
DIVISION OF LAND AND NATURAL RESOURCES  
HONOLULU, HAWAII 96809  
TELEPHONE: 587-0230  
FAX: 587-0230  
E-MAIL: timothy.johns@hawaii.gov



BENJAMIN J. CAYETANO  
DIRECTOR

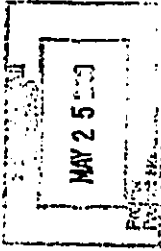


STATE OF HAWAII  
OFFICE OF ENVIRONMENTAL QUALITY CONTROL

226 SOUTH BERTANNA STREET  
HONOLULU, HAWAII 96813  
TELEPHONE (808) 586-4185  
FACSIMILE (808) 586-4186

May 23, 2000

GENEVIÈVE SALMONSON  
DIRECTOR



BENJAMIN J. CAYETANO  
DIRECTOR



STATE OF HAWAII  
DEPARTMENT OF LAND AND NATURAL RESOURCES

P. O. BOX 671  
HONOLULU, HAWAII 96808

MAY 15 2000

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

DEPUTY  
JANET E. LAWRENCE  
AGRICULTURE  
BOATING AND COASTAL RECREATION  
CIVIL ENGINEERING  
ENVIRONMENTAL  
CONSERVATION  
NATURAL PRESERVATION  
LAND USE  
PLANNING BRANCH  
STATEWIDE SUPPORT BRANCH  
STATE PARKS

Mr. Tim Johns, Chair  
Department of Land and Natural Resources  
P.O. Box 621  
Honolulu, Hawaii 96803

Dear Mr. Johns:

Subject: Draft Environmental Impact Statement for the Diamond  
Head State Monument Master Plan Update

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

1. We would like to take this opportunity to thank your staff  
members Clyde Hosokawa and Norman Shiroma for taking us to  
visit Diamond Head, giving us an excellent overview of the  
project and answering all our questions regarding the  
proposed plan.
2. Please also include the table listing of permits and  
approvals (see section 3.4) in the executive summary.
3. Please sign the EIS in accordance with section 11-200-20(d),  
Hawaii Administrative Rules.

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

Sincerely,

*Genevieve Salmonson*  
Genevieve Salmonson  
Director

C: PER

REF:LD/WL-EK

TO: Genevieve Salmonson, Director  
Office of Environmental Quality Control

FROM: Timothy Johns, Chairperson *Tim Johns*  
Department of Land and Natural Resources

SUBJECT: Diamond Head State Monument Master Plan Update  
Draft Environmental Impact Statement (DEIS)

Thank you for your letter of May 23, 2000, commenting on the Diamond Head State Monument  
Master Plan Update DEIS. We offer the following responses:

1. A table listing required permits and approvals will be included in the Executive  
Summary.
2. The EIS will be signed in accordance with Section 11-200-20(d), Hawaii  
Administrative Rules.

Should you have any questions, please contact Mr. Andrew Monden, Chief Engineer at  
587-0230.

PHONE (808) 594-1888

FAX (808) 594-1885



STATE OF HAWAII  
OFFICE OF HAWAIIAN AFFAIRS  
711 KAPOLANI BOULEVARD, SUITE 500  
HONOLULU, HAWAII 96813

COPY

MAY 23 1999

May 22, 2000

Mr. Andrew Monden  
Department of Land and Natural Resources  
P.O. Box 373  
Honolulu, HI 96809

(EIS #375)

Subject: Diamond Head Monument State Park  
Master Plan Update Draft Environmental Impact Statement

Dear Mr. Monden:

Thank you for the opportunity to comment on the above referenced project. The Draft Environmental Impact Statement (Draft EIS) has been prepared by PBR Hawaii for the State Department of Land and Natural Resources (DLNR) for the update to the 1979 Planning Report (Master Plan) for the Diamond Head State Monument. Stated below are concerns by the Office of Hawaiian Affairs (OHA).

Ceded Land Revenues

20% of the pro rata share of the project's proceeds should be reserved for the Public Land Trust. OHA assumes that any revenues generated from this project will be subject to OHA's revenue requirements, pursuant to Chapter 10, Hawaii Revised Statutes (HRS) §10-13.5. In addition, OHA requests clarification as to whether the Canon Club, TMK 3-1-42:11, is situated on ceded land.

Traditional Sites

According to OHA's Master Plan, OHA is mandated, "To assist and encourage the conservation and culturally responsive management of historic and culturally significant Hawaiian sites and natural resources to prevent further destruction." The proposed project will require on-site grading, trenching, and movement of construction vehicles. Also, no subsurface testing was carried out during the present project. According to the Draft EIS, there is a slight possibility for buried cultural deposits, particularly in areas that have not been extensively graded or excavated.

Mr. Andrew Monden  
Department of Land and Natural Resources  
May 22, 2000  
Page two

The O'ahu Island Burials Council and SHPD should be contacted if any human burials, artifacts, or other cultural remains or deposits are encountered during the excavation and grading phases of the project. Finally, a consultation process should be initiated for the proposed project and OHA be named as a required consultant, pursuant to Section 106 of the National Historic Preservation Act.

If you have any questions, please contact Mark A. Mararagan, Policy Analyst at 594-1945.

Sincerely,

Colin C. Kippen, Jr.  
Deputy Administrator

cc: OHA Board of Trustees  
Office of Environmental Quality Control  
Mr. Vincent Shigetani, PBR Hawaii



RONALD J. CARSTEN  
DIRECTOR OF LAND



STATE OF HAWAII  
DEPARTMENT OF LAND AND NATURAL RESOURCES

P. O. BOX 671  
HONOLULU, HAWAII 96809

REF:LDWL-EK

TIMOTHY E. JOHNS, CHAIRPERSON  
BOARD OF LAND AND NATURAL RESOURCES  
SPICY  
JANET E. HARREL  
ADULTIC RESOURCE  
BOATING AND OCEAN RECREATION  
CONSERVATION AND RESOURCES  
COURTNEY  
COURTNEY  
HAWAIIAN AND ISLAND  
LAND DAMAGE  
NATURAL AND CULTURAL  
PLANNED IMPROVEMENT  
TECHNICAL SUPPORT BRANCH  
STATE PHASE

AUG 15 2000

TO: Mr. Colin C. Kippen Jr., Deputy Administrator  
Office of Hawaiian Affairs

FROM: *Timothy E. Johns*  
Timothy E. Johns, Chairperson  
Department of Land and Natural Resources

SUBJECT: Diamond Head State Monument Master Plan Update  
Draft Environmental Impact Statement (DEIS)

We have reviewed your letter dated May 22, 2000, regarding the DEIS for the Diamond Head State Monument Master Plan Update. We offer the following responses:

- 1) The Draft EIS notes that any revenues generated from ceded lands will be subject to OHA's revenue requirements: (last sentence of the third paragraph of Section 1.1; page 139, paragraph after "Operational Costs"; and Exhibit 1-B which assumes 20 percent of the revenue collected at the crater would go to OHA, and the State Portion" is 80% of the total revenues. Our understanding is that the Cannon Club (TMK 3-1-42: 11) is located on ceded lands.
- 2) An inventory-level survey would be conducted in undisturbed areas and/or areas designated as having potential cultural sensitivity prior to the construction of new park facilities.
- 3) The Oahu Burials Council and the State Historic Preservation Division will be contacted if any human burials, artifacts, or other cultural remains or deposits are encountered during the excavation and grading phases of the project. Moreover, if warranted, a consultation process will be initiated for the proposed project and OHA will be named a required consultant, pursuant to Section 106 of the National Historic Preservation Act. This information will be included in Section 5.1 of the Final EIS.

Should you have any questions, please contact Mr. Andrew Monden, Chief Engineer, at 587-0230.

BERNARD J. CAULFIELD  
COMMISSIONER



STATE OF HAWAII  
DEPARTMENT OF ACCOUNTING AND GENERAL SERVICES  
P.O. BOX 118, HONOLULU, HAWAII 96818

200 JUN 6 4 44 PM '00 (P) 1270.0

BERNARD J. CAULFIELD  
COMMISSIONER



STATE OF HAWAII  
DEPARTMENT OF LAND AND NATURAL RESOURCES  
P.O. BOX 121  
HONOLULU, HAWAII 96818

REF:LD/WL-EK

AUG 15 2000

TIMOTHY E. JOHNS, CHAIRPERSON  
BOARD OF LAND AND NATURAL RESOURCES  
JANETE MARLEO  
SECRETARY  
ADMINISTRATIVE SERVICES  
COMMUNITY AND ECONOMIC DEVELOPMENT  
CONSERVATION AND RESOURCES  
COURTESY AND COMPLIANCE  
PLANNING AND DEVELOPMENT  
LAND AND NATURAL RESOURCES  
PLANNING DIVISION  
PLANNING BRANCH  
PLANNING & SUPPORT BRANCH

JUN - 6 2000

TO: Mr. Andrew Monden, Chief Engineer  
Engineering Branch  
Land Division  
Department of Land and Natural Resources

FROM: Mr. Gordon Matsuoka, Administrator  
Division of Public Works  
Department of Accounting and General Services  
Timothy E. Johns, Chairperson  
Department of Land and Natural Resources

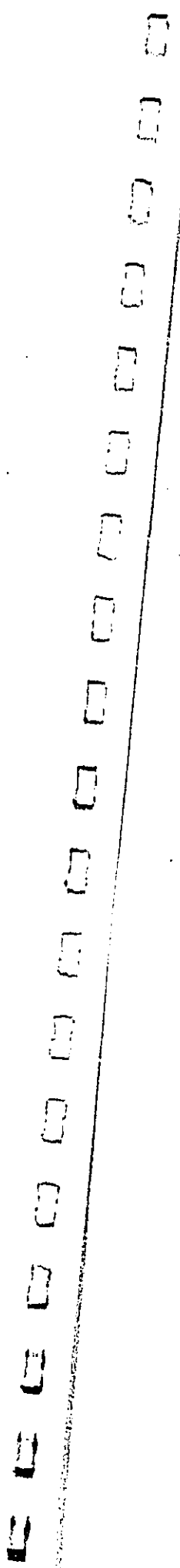
SUBJECT: Diamond Head State Monument Master Plan Update  
Master Plan Update  
Draft Environmental Impact Statement

We have reviewed the subject document and determined that it will have no impact on any of our facilities. Therefore, we have no comments.  
Thank you for the opportunity to comment on the project.

*Gordon Matsuoka*  
GORDON MATSUOKA  
Public Works Administrator

RY:mo  
c: OEQC  
FBR Hawaii

Thank you for your memorandum of June 6, 2000, commenting on the Diamond Head State Monument Master Plan Update DEIS. We acknowledge that you have no comments.  
Should you have any questions, please contact Mr. Andrew Monden, Chief Engineer, at 587-0230.



ROYALTY J. CATTING  
GOVERNOR  
STATE OF HAWAII



STATE OF HAWAII  
DEPARTMENT OF HAWAIIAN HOMELANDS  
P.O. BOX 1879  
HONOLULU, HAWAII 96803

RAYNARD C. SOON  
CHAIRMAN  
HAWAIIAN HOMES COMMISSION  
PLEASE MAIL ENVELOPES TO THE CHAIRMAN

ROYALTY J. CATTING  
GOVERNOR OF HAWAII



STATE OF HAWAII  
DEPARTMENT OF LAND AND NATURAL RESOURCES  
P.O. BOX 671  
HONOLULU, HAWAII 96809

TIMOTHY E. JOHNS, CHAIRPERSON  
BOARD OF LAND AND NATURAL RESOURCES  
DEPUTY  
JANET E. LANGELO  
AGRICULTURE  
CONSERVATION AND RECREATION  
ENVIRONMENT  
FORESTRY AND WILDLIFE  
HISTORIC PRESERVATION  
INDUSTRIAL DEVELOPMENT  
PLANNING  
TECHNICAL BRANCH  
TRADITIONAL ARTS  
STATE PLANNING

April 14, 2000

To: The Honorable Timothy E. Johns, Chairperson  
Board of Land and Natural Resources

Attn: Andrew Monden

From: Raynard C. Soon, Chairman  
Hawaiian Homes Commission

*David Gagnier*

Subject: Diamond Head State Monument Master Plan Update, Draft  
Environmental Impact Statement, TMK 3-1-42, Kapahulu  
to Waialae, Oahu, Dated March 2000

Thank you for the opportunity to review the subject application.  
The Department of Hawaiian Home Lands has no comment to offer.

If you have any questions, please call Daniel Ornellas of our  
Planning Office at 586-3836.

AG 15 2000

REF:LD/WL-EK

TO: Mr. Raynard C. Soon, Chairman,  
Hawaiian Homes Commission

FROM: Timothy E. Johns, Chairperson  
Department of Land and Natural Resources

*Janet E. Langeolo*

SUBJECT: Diamond Head State Monument Master Plan Update  
Draft Environmental Impact Statement (DEIS)

Thank you for your memorandum of April 14, 2000, on the Diamond Head State Monument  
Master Plan Update DEIS. We acknowledge that you have no comments.

Should you have any questions, please contact Mr. Andrew Monden, Chief Engineer, at  
587-0230.

BERNARD J. CATTI  
GOVERNOR OF HAWAII



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

BRUCE L. ANDERSON, M.D., M.P.H.  
DIRECTOR OF PHS/PH

In reply, please refer to  
FILE

MAY 15 1980

May 8, 2000

00-064/epo

Mr. Andrew Monden  
State Department of Land  
& Natural Resources  
P.O. Box 373  
Honolulu, Hawaii 96809

Dear Mr. Monden:

Subject: Draft Environmental Impact Statement (DEIS)  
Diamond Head State Monument Master Plan Update  
TMK: 3-1-42: 6 and various others

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

Drinking Water

The Diamond Head State Monument Master Plan Update Draft Environmental Impact Statement indicates that the proposed development will have a dual water system. The potable and nonpotable water systems must be carefully designed and operated to prevent cross-connections and backflow conditions. The two systems must be clearly labeled and physically separated by air gaps or reduced pressure principle backflow preventers to avoid contaminating the potable water supply. All nonpotable spigots and irrigated areas should be clearly labeled with warning signs to prevent the inadvertent consumption of nonpotable water. In addition, nonpotable spigots should be installed in secured, below-grade enclosures.

If you have any questions concerning these comments, please contact Mr. William Wong, Chief, Safe Drinking Water Branch.

Asbestos

Prior to any demolition activities, federal rules (40 CFR Part 61, National Emission Standard for Hazardous Air Pollutants, Asbestos NESHAP Revision; Final Rule, November 20, 1990), require.

Mr. Andrew Monden  
May 8, 2000  
Page 2

00-064

an inspection of all affected areas to determine whether asbestos is present.

Under the NESHAP regulation, the project would be required to file with the Noise, Radiation and Indoor Air Quality Branch of the Department of Health an Asbestos Demolition/Renovations notification ten working days prior to demolition of each building or the disturbance of regulated asbestos-containing materials. All regulated quantities and types of asbestos-containing materials would be subject to emission control, proper collection, containerizing, and disposal at a permitted landfill.

Questions concerning asbestos requirements should be directed to Mr. Robert H. Lopes at 586-5800. Should there be additional concerns, please contact Mr. Russell Takata, Environmental Health Program Manager of the Noise, Radiation and Indoor Air Quality Branch at 586-4701.

VECTOR CONTROL

The property may be harboring rodents which will be dispersed to the surrounding areas when any buildings are demolished or the site is cleared. The applicant is required by Hawaii Administrative Rules, Chapter 11-26, "Vector Control" to eradicate any rodents prior to demolition or site clearing activities and to notify the Department of Health by submitting Form VC-12 to the local Vector Control Branch when such action is taken. Rodent traps and/or rodenticides should be set out on the project site for at least a week or until the rodent activity ceases.

The Vector Control Branch phone numbers are as follows:  
Oahu: 831-6767

Kauai: 241-3306

Hawaii--Hilo: 974-4238, Kona: 322-7011  
Maui (includes Molokai and Lanai): 873-3560

Sincerely,

Gary Gill  
Deputy Director  
for Environmental Health

C: SDWB OEQC  
NR&IAQB PDR Hawaii ✓  
VCB



BERNARD J. CAVEZANO  
GOVERNOR OF HAWAII




STATE OF HAWAII  
DEPARTMENT OF LAND AND NATURAL RESOURCES  
P. O. BOX 671  
HONOLULU, HAWAII 96808

REF:LD/WL-EK

AUG 15 2000

TIMOTHY E. JOHNS, CHAIRPERSON  
BOARD OF LAND AND NATURAL RESOURCES  
DEPUTY  
JANET E. TUMBLEO  
ADULTIC RESOURCES  
CIVIL AND OCCUPATIONAL RESOURCES  
CONSERVATION  
ENVIRONMENT  
HAWAIIAN CULTURE  
NATIVE AFFAIRS  
NATIVE PARTICIPATION  
PLANNING BRANCH  
STATE PLANNING SUPPORT BRANCH

TO: Gary Gill, Deputy Director  
Department of Health

FROM:  Timothy E. Johns, Chairperson  
Department of Land and Natural Resources

SUBJECT: Diamond Head State Monument Master Plan Update  
Draft Environmental Impact Statement (DEIS)

Thank you for your letter of May 8, 2000, commenting on the Diamond Head State Monument Master Plan Update DEIS. We offer the following responses:

1. Thank you for the information provided on the dual water systems. This information will be included in Section 5.6.1 of the Final EIS.
2. We will comply with all requirements and regulations pertaining to asbestos removal and disposal. This information will be included in Section 5.4 of the Final EIS.
3. We will comply with Hawaii Administrative Rules, Chapter 11-26 "Vector Control" to eradicate any rodents prior to demolishing buildings or site clearing. This information will be included in Section 4.8 of the Final EIS. ✓

Should you have any questions, please contact Mr. Andrew Mondten, Chief Engineer, at 587-0230.

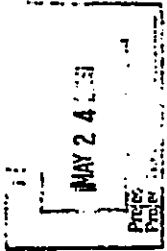


**DISABILITY AND COMMUNICATION ACCESS BOARD**

919 Ala Moana Boulevard, Room 101 • Honolulu, Hawaii 96814  
Ph. (808) 586-8121 (V/TDD) • Fax (808) 586-8129

May 22, 2000

Mr. Vincent Shigekuni  
PBR Hawaii  
1001 Bishop Street  
Suite 650  
Honolulu, HI 96813



Subject: Diamond Head State Monument - Master Plan Update  
Draft Environmental Impact Statement  
TMKS: TMK: 3-1-42: 6, 8, 10, 14, 17, 21, 23, 24, 25, 36, 37, and 38  
TMK: 3-1-35: 22 and 23  
Parcels Proposed to be added: TMK: 3-1-42: 11(Cannon Club),  
TMK: 3-1-42:15 (FAA), TMK: 3-1-42:16(FAA), TMK: 3-1-42:20 (por.)

Dear Mr. Shigekuni,

The Draft Environmental Impact Statement for the Diamond Head State Monument has been submitted to our office for comment. The purpose of our review is to ensure that the planning and design development phases of this proposed project take into account accessibility for persons with disabilities. The following common elements for the planned Diamond Head State Monument improvements are listed below. This proposal is considered as update to the 1979 plan:

- Entry through the Kapahulu Tunnel;
- Exit through the Kabala Tunnel;
- A permanent visitor/interpretive facility near Battery Birdthinner;
- A caretaker's residence (or DOCARE office);
- Removing the FAA CERAP Building;
- Removing the DOD Buildings 301, 303, and 304;
- Improvements to the wetland;
- Proposed trail around wetland; and proposed picnic area.

The proposed facility as presented will include, but not be limited to, a visitor's interpretive center, various outdoor recreational areas and resources, picnic areas, outdoor recreational access routes to the wetlands and botanical gardens, and a trail system to other features such as scenic viewpoints, military bunkers, and tunnels. The proposal also includes the upgrade and addition of comfort stations and a caretaker's residence. The plan should ensure that all features and routes incorporate appropriate walking surfaces and people moving concepts starting not only from accessible parking from the exterior of the monument site facilities to the interior monument site interior facilities, but also to applicable outdoor features of interest. For your reference, the U.S. Access Board's Regulatory Negotiation Committee has published the "Final Report on Accessibility Guidelines for Outdoor Developed Areas" in September 1999. It will provide this project with information that may be helpful in the overall planning of the site.

We offer the following comments:

This project falls within the scope of the Americans with Disabilities Act (ADA) Title II, covering state and local governments, and Hawaii Revised Statutes (HRS) §103-50. Although the technical requirements are nearly identical, there may be areas of difference. Also, HRS 103-50 contains a requirement for a document review process by the Disability and Communication Access Board.

We recommend that you include the following statement on accessibility requirements under HRS 103-50 to read:

*"All facilities will be designed to meet the Americans with Disabilities Act Accessibility guidelines and the requirements of §103-50 Hawaii Revised Statutes (HRS)."*

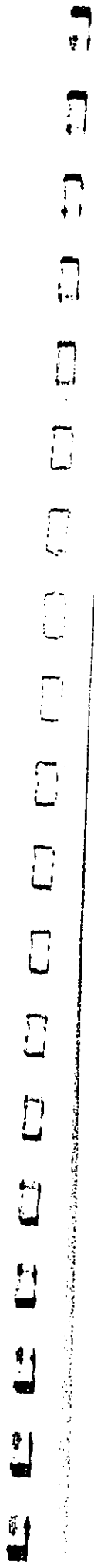
The statement should be restated in Chapter 3.0 "Required Approvals and Permits," in Chapter 3.4 "Summary of Required Permits and Approvals," and in Chapter 7.0 "Conformance to Federal, State, and City Planning Policies."

The above reflects staff's comments. They do not reflect our Board's approval or disapproval of the plan. Thank you for giving us the opportunity to provide comment.

If you have questions or concerns, please feel free to contact Mr. Gary L. Batcheller, Facility Access Specialist at 586-8121.

Sincerely,

CHARLOTTE L. TOWNSEND  
Acting Executive Director





DEPARTMENT OF LAND AND NATURAL RESOURCES



STATE OF HAWAII  
DEPARTMENT OF LAND AND NATURAL RESOURCES  
P. O. BOX 611  
HONOLULU, HAWAII 96814

REF:LDWL-EK

15 AUG 2000

Charlotte L. Townsend  
Acting Executive Director  
Disability and Communication Access Board  
919 Ala Moana Blvd, Room 101  
Honolulu, Hawaii 96814

Dear Ms. Townsend:

**Diamond Head State Monument Master Plan Update  
Draft Environmental Impact Statement (DEIS)**

Thank you for your letter of May 22, 2000, commenting on the Diamond Head State Monument Master Plan Update DEIS and the U.S. Access Board's "Final Report on Accessibility Guidelines for Outdoor Developed Areas." We offer the following responses:

The following statement shall be included in the EIS in sections 3.0, 3.4, and in 7.0:

*All facilities will be designed to meet the Americans with Disabilities Act Accessibility guidelines and the requirements of §103-50 Hawaii Revised Statutes (HRS), except: 1) where compliance would cause substantial harm to cultural, historical, religious, or significant natural features and characteristics; 2) where compliance could substantially alter the nature of the setting or the purpose of the facility, or portion of the facility; 3) where compliance would require construction methods or materials that are prohibited by Federal, State, or local regulations or statutes; 4) where compliance would not be feasible due to terrain or the prevailing construction practices.*

Should you have any questions, please contact Mr. Andrew Monden, Chief Engineer, at 587-0230.

Aloha,  
  
TIMOTHY E. JOHNS

TIMOTHY E. JOHNS, CHAIRPERSON  
BOARD OF LAND AND NATURAL RESOURCES  
DEPARTMENT OF LAND AND NATURAL RESOURCES  
P. O. BOX 611  
HONOLULU, HAWAII 96814  
TEL: 587-0230  
FAX: 587-0230



STATE OF HAWAII  
DEPARTMENT OF LAND AND NATURAL RESOURCES  
COMMISSION ON WATER RESOURCE MANAGEMENT  
HONOLULU, HAWAII 96822

April 25, 2000

TO: Mr. Dean Uchida, Administrator  
Land Division

FROM: Linnel T. Nishioka, Deputy Director  
Commission on Water Resource Management (CWRM)

SUBJECT: Job No. 87-OP-02, Diamond Head Visitor Center, Honolulu, Oahu  
Draft Environmental Impact Statement

Thank you for the opportunity to review the subject document. Our comments related to water resources are marked below.

In general, the CWRM strongly promotes the efficient use of our water resources through conservation measures and use of alternative non-potable water resources whenever available, feasible, and there are no harmful effects to the ecosystem. Also, the CWRM encourages the protection of water recharge areas which are important for the maintenance of streams and the replenishment of aquifers.

- We recommend coordination with the county government to incorporate this project into the county's Water Use and Development Plan.
- We recommend coordination with the Land Division of the State Department of Land and Natural Resources to incorporate this project into the State Water Projects Plan.
- We are concerned about the potential for ground or surface water degradation/contamination and recommend that of any resulting requirements related to water quality.
- A Well Construction Permit and/or a Pump Installation Permit from the Commission would be required before ground water is developed as a source of supply for the project.
- The proposed water supply source for the project is located in a designated water management area, and a Water Use Permit from the Commission would be required prior to use of this source.
- Groundwater withdrawals from this project may affect streamflows which may require an instream flow standard amendment.
- We recommend that no development take place affecting highly erodible slopes which drain into streams within or adjacent to the project.
- If the proposed project includes construction of a stream diversion, the project may require a stream diversion works permit and amend the instream flow standard for the affected stream(s).
- If the proposed project alters the bed and banks of a stream channel, the project may require a stream channel alteration permit.
- OTHER:

If there are any questions, please contact the Commission staff at 587-0218.

DEPARTMENT OF LAND AND NATURAL RESOURCES  
LAND DIVISION  
ENGINEERING BRANCH

AUG - 9 2000

TO: Ms. Linnel T. Nishioka, Deputy Director  
Commission on Water Resource Management

FROM: Andrew Monden, Chief Engineer *Andrew Monden*

SUBJECT: Diamond Head State Monument Master Plan Update  
Draft Environmental Impact Statement

Thank you for your memorandum of April 25, 2000, commenting on the Diamond Head State Monument Master Plan Update DEIS. We offer the following responses:

1. We will coordinate with the City and County of Honolulu to incorporate this project into the County's Water Use and Development Plan.
2. We will incorporate this project into the State Water Projects Plan.
3. We will obtain a Well Construction Permit and/or a Pump Installation Permit before ground water is developed as a source of supply for the project.
4. We acknowledge that the source is in a designated water management area and will apply for a Water Use Permit.

Should you have any questions, please call Mr. Eric Yuasa of the Project Planning Section at extension 7-0229.

SA:ck

APR 25 2000  
ENGINEERING BRANCH  
LAND DIVISION  
DEPARTMENT OF LAND AND NATURAL RESOURCES  
HONOLULU, HAWAII 96822

APR 25 2000  
ENGINEERING BRANCH  
LAND DIVISION  
DEPARTMENT OF LAND AND NATURAL RESOURCES  
HONOLULU, HAWAII 96822



DEPARTMENT OF LAND AND NATURAL RESOURCES  
Land Division  
Engineering Branch

April 14, 2000

TO: Dean Uchida, Administrator  
FROM: Andrew Monden, Chief Engineer

SUBJECT: Job No. 87-OP-D2, Diamond Head Visitor Center, Honolulu, Oahu  
Draft Environmental Impact Statement (DEIS)

Attached for your review and comments is a copy of the DEIS for the subject project. Please submit your comments by April 28, 2000. If we do not receive your comments by this date, we will assume that you do not have any comments.

Should you have any questions, please contact Mr. Eric Yuasa of the Project Planning Section at extension 7-0229.

SA:ck  
Attachment

4/19/2000

no comments  
Chadron

APR 17 10 36 AM '00

DEPARTMENT OF LAND AND NATURAL RESOURCES  
LAND DIVISION  
ENGINEERING BRANCH

ALB -9 2000

TO: Mr. Dean Uchida, Administrator  
Land Division

FROM: Andrew Monden, Chief Engineer

SUBJECT: Diamond Head State Monument Master Plan Update  
Draft Environmental Impact Statement (DEIS)

Thank you for your memorandum of April 14, 2000, on the Diamond Head State Master Plan Update DEIS. We acknowledge that you have no comments.

Should you have any questions, please contact Mr. Eric Yuasa of the Project Planning Section at extension 7-0229.

SA:ck

# Division of Forestry & Wildlife

1151 Punchbowl Street, Rm. 315 • Honolulu, HI 96813 • (808) 587-0166 • Fax: (808) 587-0160

April 27, 2000

## MEMORANDUM

**TO:** Eric Yuasa, Planning Section Head  
Engineering Branch, Land Division

**THRU:** Dean Uchida, Administrator  
Land Division

**FROM:** Michael G. Buck, Administrator  
Forestry and Wildlife

**SUBJECT:** Job No. 87-OP-D2, Diamond Head State Monument Master Plan, Honolulu,  
Oahu Draft Environmental Impact Statement.

Post-It Fax Note	7671	Date	5/1/00
To	VIC-LNC	From	ERIC YUASA
Copy	PER HI	On	DNR
Phone	523-1602	Phone	587-0277
Fax	521-5031	Fax	587-0763



There is an urgent need for a long-term maintenance program for these endangered plants. Replanted areas require weeding and watering to assure their survival. It is unlikely that the restored areas will ever be completely self-supporting or maintenance free.

4. The non-native vegetation, especially around construction sites, trails, and scenic outlooks should be monitored periodically and contained within that area or removed. Of particular interest is fountain grass which has been seen on the upper slopes of the crater. This area was once a thriving dryland native forest. Today, the vegetation includes invasive non-native plants.

Thank you for the opportunity to comment on this project. Given the planning and effort required to protect these endangered plants, people visiting this historic landmark will appreciate DLNR's effort to restore and protect this area that is near Waikiki Resorts.

C: Oahu DOFAW Branch  
Vickie Caraway, State Botanist

We have reviewed the draft EA for Diamond Head State Monument Master Plan and provide the following comments to your request.

1. Fire is a major threat to public safety and to the endangered plants growing in the area. Because of the predominance of flashy fuels i.e. dry grass in the crater, coupled with the expected increase of tourist visiting the area, the potential for a wildland fire is greatly enhanced. The Division of Forestry and Wildlife recommends that a fire plan for the crater be developed and implemented to include fire breaks within and around known colonies of endangered plant species. The plan will detail and include fire prevention, suppression and suppression measures.
2. Locating natural plant communities and conducting an inventory of the species within the project site should be collected and mapped over several wet seasons. The Char and Associates 1998 botanical survey was primarily a literature review with limited field information due to the extremely dry conditions of the crater. Locating known plant populations is difficult during the dry season. Therefore, the likelihood of discovering additional plant populations of *Schizaea*, *Spermolipsis*, and possibly, *Bidens molokaiensis* maybe greater during the wet season.
3. With community input, the need to increase populations of endangered and rare plant species in the crater is critical to their survival. Because of the extremely low number of individuals and their limited distribution in the crater, make them especially vulnerable to fire, drought or other disasters. Suitable sites for out-planting should be considered after careful review for those areas in the crater that can sustain its population and survival.



DEPARTMENT OF LAND AND NATURAL RESOURCES  
LAND DIVISION  
ENGINEERING BRANCH

AUG - 9 2000

TO: Michael Buck, Administrator  
Division of Forestry and Wildlife

FROM: Andrew Monden, Chief Engineer *Andrew Monden*

SUBJECT: Diamond Head State Monument Master Plan Update  
Draft Environmental Impact Statement (DEIS)

Thank you for your memorandum of April 27, 2000, commenting on the Diamond Head State Monument Master Plan Update DEIS. Please note that many of your comments have been addressed on pages 52 through 54 of the Draft EIS. In addition, we offer the following responses:

1. We acknowledge that fire is a major threat to public safety and to the endangered plants growing in the area. We will include recommendations to install fire breaks within and around known colonies of endangered plant species and remove of flammable fuels in the Final EIS. Also, the Final EIS will be revised to indicate that a fire protection plan will be developed as part of the Natural Resource Management Plan.
2. We acknowledge that the likelihood of discovering additional plant populations may be greater during the wet season. The Draft EIS states on the bottom of page 53 that database information on the natural plant communities and an inventory of species should be gathered and mapped over several wet seasons.
3. We acknowledge the need to increase populations of endangered and rare plant species in the crater. The Draft EIS states on page 53 that there is a need to establish additional populations of endangered and rare species. The Draft EIS also states on page 54 that there is a need for long-term maintenance.
4. The non-native vegetation will be monitored and contained or removed. Page 54 of Draft EIS addresses periodic monitoring for alien species and page 53 discusses removal and control of alien species.

Should you have any questions, please contact Mr. Eric Yuasa of the Project Planning Section at extension 7-0230.

# Memo

We are assuming that the Natural Resource Management Plan (NRMP) will detail the vegetative and fire protection schemes for Diamond Head. In that regard, the recommendations on Page 53 should be expounded upon to reflect comments above.

Should you have any questions, please feel free to contact my office. Mahalo!

To: Vincent R. Shigetani, PBR Hawaii--Associate  
Ralston Nagata, State Parks--Administrator  
From: Patrick G. Costales, DOFAW--Oahu Branch Manager *Pat Costales*  
Date: May 20, 2000  
Subject: Draft HHS--Diamond Head State Monument Master Plan Update

cc DOFAW Admin Office Staff  
Brent Liesenmeyer

We're in general agreement with the concepts proposed in the DHS for subject master plan regarding the landscape scheme and fire protection.

The first paragraph on Page 31 captures the meaning for the State's stewardship of native flora which are unique to specific ecosystems, in this case--"a coastal dry mixed community typical of Oahu's south shore flora..." We view this as a grand opportunity to restore a piece of Hawaii that have changed over the ages because of the intrusion of human activities, i.e. Diamond Head offers a suitable venue for effecting the State's threatened and endangered plant program. Page 32, third paragraph suggests that localized plants should be species of first consideration because of their existence at the State monument. We support that position because it is biologically sound and provides for their survival in perpetuity. We especially like the idea of including other Oahu plants from different locale(s). Particularly those species that may not be of the immediate area but are in jeopardy and live in a similar eczone, e.g. *Abutilon menziesii*. In other words, we feel that Diamond Head can serve as a safe haven for many plants from the coastal, dry mixed community.

DLNR has a key role in the care of threatened/endangered plants and must use all of its management options to preserve and protect them particularly if they are at risk because of changing land uses. In many cases, off-site mitigation is essential to continued existence of these unique plants in perpetuity. Diamond Head offers the perfect setting for many coastal plant types and therefore should include provisions for augmentation planting and improved biological diversity.

In reference to fire protection, the draft has provisions for implementation of a fire plan but we could find no evidence that a fire management plan will be developed. Before you can implement something, there must be a plan for something... However, the draft mentions a few protective measures but does not articulate specifics for basic wildland fire protection, i.e. prevention-presuppression-suppression.

DEPARTMENT OF LAND AND NATURAL RESOURCES  
LAND DIVISION  
ENGINEERING BRANCH

AUG -9 2000

TO: Patrick G. Costales, Oahu Branch Manager  
Division of Forestry and Wildlife

FROM: Andrew Monden, Chief Engineer *Andrew Monden*

SUBJECT: Diamond Head State Monument Master Plan Update  
Draft Environmental Impact Statement (DEIS)

Thank you for your memorandum of May 20, 2000, commenting on the Diamond Head State Monument Master Plan Update DEIS. We offer the following response:

1. We acknowledge that you are in general agreement with the concepts proposed in the DEIS regarding fire protection and the landscape concept.
2. The Final Environmental Impact Statement will be revised to indicate that a fire protection plan will be developed as part of the Natural Resources Management Plan.

Should you have any questions, please contact Eric Yuasa of the Project Planning Section at extension 7-0229.

SA:ek

TIMOTHY E. JOHNS, CHAIRPERSON  
BOARD OF LAND AND NATURAL RESOURCES  
DEPUTY  
JANET E. MARFIELD  
AGRICULTURE  
CONSERVATION AND RESOURCES  
DEPARTMENT  
PLANNING AND DEVELOPMENT  
POLICY AND ADMINISTRATION  
REGISTRATION AND RECORDS  
PLANNING BRANCH  
REGISTRATION BRANCH  
STATE PLANNING REPORT BRANCH  
STATE PLANNING



STATE OF HAWAII  
DEPARTMENT OF LAND AND NATURAL RESOURCES  
P. O. BOX 631  
HONOLULU, HAWAII 96809

APR 15 2000

37457

KAZU HAYASHIDA  
DIRECTOR  
DEPUTY DIRECTORS  
BRIAN K. URUJAI  
GLENN H. OKAMOTO



RECEIVED  
APR 25 2:07 PM '00  
STATE OF HAWAII  
DEPARTMENT OF TRANSPORTATION  
885 PUNCHBOWL STREET  
HONOLULU, HAWAII 96813-5097  
April 13, 2000

STATE OF HAWAII  
DEPARTMENT OF TRANSPORTATION  
885 PUNCHBOWL STREET  
HONOLULU, HAWAII 96813-5097  
April 13, 2000

APR 20 2 13 PM '00

RECEIVED  
DEPARTMENT OF LAND AND NATURAL RESOURCES  
STATE OF HAWAII

TO: THE HONORABLE TIMOTHY E. JOHNS, CHAIR  
BOARD OF LAND AND NATURAL RESOURCES  
DEPARTMENT OF LAND AND NATURAL RESOURCES

ATTN: ANDREW MONDEN

FROM: KAZU HAYASHIDA  
DIRECTOR OF TRANSPORTATION

SUBJECT: DIAMOND HEAD STATE MONUMENT MASTER PLAN UPDATE  
DRAFT ENVIRONMENTAL IMPACT STATEMENT (DEIS)

TO: Honorable Kazu Hayashida, Director  
Department of Transportation

FROM: Timothy E. Johns, Chairperson  
Department of Land and Natural Resources

SUBJECT: Diamond Head State Monument Master Plan Update  
Environmental Impact Statement (DEIS)

Thank you for your letter of April 13, 2000, commenting on the Diamond Head State Monument Master Plan Update DEIS. We do not anticipate that the proposed update will have an adverse impact on State transportation facilities.

Should you have any questions, please contact Mr. Andrew Monden, Chief Engineer, at extension 7-0230.

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

The proposed update is not anticipated to have an adverse impact on our State transportation facilities.

We appreciate the opportunity to provide comments.

c: Ms. Genevieve Salmonson, Office of Environmental Quality Control

RECEIVED  
60 APR 20 P 2: 06  
DEPARTMENT OF LAND AND NATURAL RESOURCES  
STATE OF HAWAII





EDWARD J. CAFFEY/SGO  
COMMISSIONER

MAJOR GENERAL EDUARDO L. CORREA, JR.  
DIRECTOR OF CIVIL DEFENSE



STATE OF HAWAII  
DEPARTMENT OF DEFENSE  
OFFICE OF THE DIRECTOR OF CIVIL DEFENSE  
3445 DIAMOND HEAD ROAD  
HONOLULU, HAWAII 96814-8485

May 25, 2000



PHONE: (808) 725-4300  
FAX: (808) 725-4307

MAY 26 2000

**REVIEW COMMENTS:**  
*Diamond Head State Monument Master Plan Update*  
*Draft Environmental Impact Statement*  
Hawaii Army National Guard - Environmental Staff  
5 May 00  
p. 1  
Legend indicating author's comments:  
blue text = Melissa Demers, red text = Tim Messard, green text = Wendy Tolleson.

**TO:** Mr. Andrew Monden  
Department of Land and Natural Resources  
P. O. Box 373  
Honolulu, Hawaii 96809

**FROM:** Mr. Edward T. Teixeira  
Vice Director of Civil Defense

**SUBJECT:** DRAFT ENVIRONMENTAL IMPACT STATEMENT, DIAMOND  
HEAD STATE MASTER PLAN

We appreciate the opportunity to review and comment on the Draft Environmental Assessment (DEIS) on the Diamond Head State Master Plan.

State Civil Defense (SCD) does not have any comments or recommendations with regard to this project. Our SCD planners and technicians are in the process of consolidating radio equipment in tunnels as noted in our letter dated November 27, 1998. SCD's consultant will contact PBR Hawaii for conformation with the Diamond Head State Monument Master Plan.

Enclosed are Hawaii Army National Guard comments.

If you have any questions, please contact Mr. Norman Ogasawara of SCD at 733-4300, ext 531.

Enc.

c: Office of the Governor  
c/o Office of Environmental Quality Control  
235 S. Beretania Street, Suite 702  
Honolulu, Hawaii 96813

✓ PBR Hawaii  
Pacific Tower, Suite 650  
1001 Bishop Street  
Honolulu, Hawaii 96813

Page No.	Item/ Selection No.	Reviewer's Comments
33	Section on updates to 1979 plan	Under this list, there is no mention of the large scale ecosystem restoration that would take place; i.e., dryland forest restoration in large sections of Diamond Head Crater; the proposed new Na La 'au Arhwaum; or the on-going ecosystem restoration work at Banyan Hollow.
30	Landscaping	Delete the reference to the native 'ilima ( <i>Platanus foliosa</i> ), which is included under your list of non-native species that have led to the decline of the native flora and increased fire hazard.
31	31 paragraph, 5th line down	"Native" need not be capitalized.
33	Paragraph on landscaping	Will there be interpretive signs at the new Na La 'au Arboretum, or anywhere else in Diamond Head Crater that help identify native areas and shrubs? Interpretive signs and identification tags would be helpful to ensure that visitors understand the ecosystems they are enjoying and viewing.
31	Paragraph on landscaping	Need to mention the fact that on-going ecosystem restoration is currently taking place at two sites: (1) historic Banyan Hollow, by HIARN-ENV personnel, and (2) at the Peace Garden, by Youth for Environmental Service. Thousands of native dryland, coastal plants have been planted at these restoration sites over the past three years, and are being maintained by staff and volunteer working groups. Both these areas should be incorporated into the larger, proposed dry land interpretive trail outside of Diamond Head Crater.
32	32 paragraph	Native, rare, and endangered plants endemic to Diamond Head, such as <i>Scheuchzeria palustris</i> should be incorporated into landscaping plan around visitor/interpretive area. Other appropriate plants include <i>Abutilon menziesii</i> , <i>Achyrocline satureioides</i> , <i>Chamaecyparis degenetii</i> , <i>Gnaphalium sandwicense</i> , <i>Lipocheris lobata</i> , and <i>Bidens molokainensis</i> . For more information regarding these and other plants, contact Trace Messard, Field Ecologist for Army National Guard Environmental at 733-4267.
33	33 paragraph	Recommended more details about fire resistant plants and "living fire breaks" be included here: the experimental technology would consist of planting dry-adapted native plants in hedge rows, approximately 1 m in width by 100 m in length. Selective drip irrigation will enable rapid native plant growth. In the event of fire, these fire-resistant plants could potentially 1) slow the path of the burn, or 2) prevent the fire from "leaping" beyond the fire breaks themselves.
33	33 paragraph	Areas that contain fire-adapted grasses should be seeded with <i>Dactyloctenium aegyptium</i> (s.a. IT) which will likely replace the existing grasses.
33	Landscaping & Long-term Restoration Considerations	Need to disclose the potential erosion impacts of removing invasive plants, especially fountain grass in steep areas. We envision that invasive plants will be removed incrementally, and be replaced with native species (as you've mentioned) thereby curtailing significant erosion that might occur if large-scale clearing were involved.

Any discussion about community types at Diamond Head needs to include the highly invasive fountain grass community, the largest population on Oahu, and potentially the most devastating to native dry and mesic ecosystems. This species is one of the worst invaders in the Hawaiian Islands (potentially second behind *Miconia caldasana*) and the target for eradication by the U.S. Army-sponsored Oahu Fountain Grass Working Group (FGWG). FGWG has targeted the Diamond Head population for eradication.

**REVIEW COMMENTS:**  
**Diamond Head State Monument Master Plan Update**  
**Draft Environmental Impact Statement**  
**Hawaii Army National Guard - Environmental Staff**  
**5 May 00**  
**p. 2**

Legend indicating author's comment:  
blue text = Melissa Dunsen, red text = Tom McLeod, green text = Wendy Tolleson

Page No.	Item/Section No.	Reviewer's Comments
51	5th paragraph, 1st line	Under your discussion of the wetland sedges, mention that their distribution is inherently linked to the formation of the wetland during heavy winter rains. As such, the sedge species may not be present all year around, but rather a significant seed bank may persist from year to year, permitting re-sprouting during the rainy season.
51	6th paragraph, 1st line	No need to italicize "subsp." within the scientific name.
53	Removal/control of alien plants	Recommend more details regarding control of fountain grass. Recently, the U.S. Fish and Wildlife and the Department of Land and Natural Resources approved additional personnel to assist the Oahu Fountain Grass Working Group in eradicating fountain grass from Diamond Head Crater. The control methods consist of: manual clearing (pulling weeds, clipping of flowering seed heads), chemical application (using herbicide Velpar), and incineration of collected material to prevent inadvertent dispersal by field personnel. Focus areas for fountain grass control include the Diamond Head trail, where seeds can "hitchhike" onto visitor's clothing, and "fringe" areas where fountain grass has been observed as moving into new areas. An effective alien plant control program must consist of replacing the removed alien plants with native plants. This will decrease the potential for the alien plants re-invading the control areas, thereby facilitating a more permanent solution. Simply removing the alien plants will only result in a continuous cycle of control and invasion. Adequate protection for the <i>Schizoides adenanthi</i> can only be achieved by establishing numerous populations at different locations in and around the crater. Efforts to restore this plant at the current location have not with failure due to the extreme environmental conditions that exist at the rim. Suitable sites should be close to a consistent water source for drip irrigation so orphaned plants will survive and reproduce. Recommend more detail regarding ecosystem restoration. Specifically, we recommend that drip irrigation systems be used in the absence of a dedicated water source. Permanent systems may be too expensive to install over large areas. Drip emitters would feed a slow water drip (1 gal/day) to the root systems of native plants. Selective watering will enhance root development and promote native seedling survival. The overall result is establishment of native plants to prevent alien species encroachment. With such a system, large plant species can be sustained in high evaporative conditions with only a few ounces of water per day.
	Restoration of alien Dryland Forest	A new road proposed to be built from the Camooe Club to Battery Harlow will significantly impact the fragile resources associated with Battery Harlow, including the structure and surroundings of the Battery itself, as well as erosion and damage to the grounds. Recommend further study of these impacts and cost of mitigation be included. IAW guidance from State Parks and SHPD. Adverse impacts to Battery Dodge include excessive wear and tear on a resource that has had little protection over the past 75 years. Recommend more thorough assessment of impacts, both short and long term, IAW guidance from State
	General Comments/ Cultural Resources	
	Plants	

10	Part 3	Parts and SHPD. Battery 407 has not been assessed for the ICRMP not been assessed for historic architecture IAW with the Historic Building Survey (HABS) protocols. The Battery is an historic structure, however, until assessment has been completed, the nature and extent of impacts (if used for interpretive purposes) is extensive but unknown. Recommend this issue be addressed in the EIS. Restroom facilities in Battery 407 are limited, and would have to be upgraded and expanded before these could be used by the public. Recommend that Battery 407 not be included as an interpretive site or a restroom location.
11	Part 4	Hazardous waste issues for the rifle ranges within the crater will add to the overall cost of the interior improvements, as listed on the table on page 35. Review of the following reports that address this issue and is suggested: Phase I Environmental Baseline Study No. 34-EH-7842-94 Hawaii Army National Guard Fort Rucker, Honolulu, Hawaii, 9-13 February and 14-23 July 1993 prepared by the U.S. Army Center for Health Promotion and Preventive Medicine, and Restoration Feasibility Evaluation for Battery Harlow, Ft. Rucker, Honolulu, Hawaii prepared by R.M. Towill Corp for the State of Hawaii Department of Defense. Cost estimates should be upgraded based on assessment of the hazardous waste issues.
12	Part 5	Any disturbance to the rifle ranges within the crater may result in remediation of hazardous waste recorded in the forms.
13	Part 6	The construction of the bicycle path will impact the exterior of the crater. Though the starting point of the path is clear, the layout of the rest of the route is unclear, and construction aspects not addressed. Recommend that this be clarified in the Final Draft.
14	Part 7	The following report should be referenced: An Archaeological and Historic Assessment of the Federal Aviation Administration CERAP in Diamond Head Crater prepared by International Archaeological Research Institute, Inc. for Sverdrup Environmental Inc. July 1997. Recommend that this report be used to guide mitigation and further inventory activities, with reference to said report.
15	Part 8	The impacts to batteries Dodge, 407, and Battery Harlow have not been adequately addressed to satisfy the requirement of the Environmental Impact Statement process. These impacts should be assessed to determine short term and long-term impacts. In particular, the impacts to the very fragile Battery Harlow, and costs to mitigate this.
16	Part 9	The impacts to batteries Dodge, 407, and Battery Harlow have not been adequately addressed to satisfy the requirement of the Environmental Impact Statement process. These impacts should be assessed to determine short term and long-term impacts. In particular, the impacts to the very fragile Battery Harlow, and costs to mitigate this.
17	Part 10	The impacts to batteries Dodge, 407, and Battery Harlow have not been adequately addressed to satisfy the requirement of the Environmental Impact Statement process. These impacts should be assessed to determine short term and long-term impacts. In particular, the impacts to the very fragile Battery Harlow, and costs to mitigate this.
18	Part 11	Need to ensure protection of HIARNO's native plant restoration project at Battery Harlow. Any alteration to the existing roads, such as widening, would impact the native ecosystem in this area.



STATE OF HAWAII  
DEPARTMENT OF LAND AND NATURAL RESOURCES  
P. O. BOX 611  
HONOLULU, HAWAII 96809  
MS 15 200

TIMOTHY E. JOHNS, CHAIRPERSON  
DEPARTMENT OF LAND AND NATURAL RESOURCES  
JAMES T. HENNING  
GENERAL MANAGER  
DEPARTMENT OF LAND AND NATURAL RESOURCES  
TIMOTHY E. JOHNS, CHAIRPERSON  
DEPARTMENT OF LAND AND NATURAL RESOURCES  
TIMOTHY E. JOHNS, CHAIRPERSON  
DEPARTMENT OF LAND AND NATURAL RESOURCES

TO: Edward T. Teixeira, Vice Director  
Department of Defense

FROM: Timothy E. Johns, Chairperson  
Department of Land and Natural Resources

SUBJECT: Diamond Head State Monument Master Plan Update  
Draft Environmental Impact Statement (DEIS)

Thank you for your memorandum of May 25, 2000, commenting on the Diamond Head State Monument Master Plan Update DEIS. We acknowledge that State Civil Defense does not have any comments.

In response to comments from the Hawaii Army National Guard (HARNG), we offer the following responses. For ease in comparison with the comments, we have listed our responses by page number, as in the first column of the comment form used by the HARNG.

Reference Page Number	Response
Page 3	No large scale ecosystem restoration projects are planned. Instead, planting of endemic to Hawaii plants in various disturbed areas for coverage and landscaping at facilities will be undertaken. The planting will be coordinated with the State Division of Forestry and Wildlife and the U.S. Fish and Wildlife Service. The areas planted by the State Department of Defense (DOD) will be evaluated for compatibility with the Diamond Head State Monument Master Plan when areas are turned over to DLNR. Should DOD desire to continue it's environmental restoration efforts and fire suppression measures after the areas are turned over to DLNR, these activities would be welcomed and appreciated. The EIS will be revised accordingly.
Page 30	As recommended reference to Ilima will be deleted in this paragraph.
Page 31	The word "native" will not be capitalized in this paragraph of the Final EIS.

Pages 31-33 It is highly likely that there will be interpretive signs at the new Na La'au Arboretum or anywhere else in Diamond Head Crater which have been identified as being accessible to the general public.

Page 31 The final EIS will mention that on-going ecosystem restoration is currently taking place at Battery Harlow by HARNG-ENV personnel and at the Peace Garden by Youth for Environmental Service. We acknowledge the desire to have both of these areas incorporated in an interpretive trail outside of Diamond Head Crater.

We acknowledge the recommendation to incorporate native, rare, and endangered plants endemic to Diamond Head into landscaping around the visitor/interpretive area. Implementation of the recommendation would depend on the review and approval of agencies such as the State Division of Forestry and Wildlife and the U.S. Fish and Wildlife Service.

Page 32 The information provided about fire resistant plants and "living fire breaks" will be included in the Final EIS.

Page 46 The information provided about the removal of invasive plants from steep areas and erosion will be included in the Final EIS.

Page 48 In the Final EIS, the section about existing flora conditions will include fountain grass.

Page 51 The comment regarding wetland sedges will be included in the Final EIS.

Page 51 The Final EIS will be revised to un-italicize "subsp."

Page 53 We appreciate the information provided on the control of fountain grass and will incorporate it into the Final EIS.

The information provided on the *Scheidea adamantis* will be included in the Final EIS.

Page 54 The information provided will be included in the Final EIS in describing the planting of endemic plants.

General Comments:

In regards to the proposed roads from the Cannon Club to Battery Harlow, whenever possible the existing roads will be used. However, should modifications and/or realignment of the existing roads be required, further studies will be conducted to determine impacts and identify mitigative measures.

Page 34 Please note that the reuse of Battery Dodge was addressed on page 65 of the Draft EIS. Also, in Appendix D of the Draft EIS, the consulting archaeologist

recommended that Battery Dodge undergo inventory-level survey and (in terms of final treatment) be incorporated into rim trail interpretation. The use of Battery Dodge will not occur until the FAA and the HIARNG feel that opening up the existing road to the general public will not impact either their facilities or services. This information will be included in the Final EIS.

Page 34

Please note that the reuse of Battery 407 was addressed in Appendix D of the Draft EIS, where the consulting archaeologist recommended that Battery 407 undergo inventory-level survey and (in terms of final treatment) be incorporated into interior crater interpretation. The use of Battery 407 will not occur until the HIARNG no longer requires the use of the tunnel. In the meantime, Battery 407 will be assessed for historic architecture in accordance with the Historic American Building Survey (HABS) protocols. This information will be included in the Final EIS. If Battery 407 is available for reuse, it was anticipated that restroom facilities would need to be expanded to accommodate the general public (the infrastructure cost estimate included connecting Battery 407 to the municipal wastewater collection and treatment system).

It is unfortunate that the HIARNG is now recommending that Battery 407 not be included as an interpretive site, when various representatives from the HIARNG have attended the monthly Diamond Head Citizens Advisory Committee meetings since the onset of Master Plan Update process (over two (2) years). We believe that there was an adequate "scoping" process and opportunity for input to discuss this important component of the Master Plan Update proposal. This is especially true since the crater is a natural feature which is not entirely accessible, and Battery 407 provides an opportunity for persons with disabilities to be able to access the outside upper slopes of the southern portion of the crater.

Page 34 We will review the reports you suggest and include relevant information in the Final EIS.

Page 45 We acknowledge that any disturbance to the rifle ranges may result in remediation of hazardous waste. This will be noted in the Final EIS.

Page 69 The bicycle path will occur within 100 feet of Diamond Head Road. This is shown on Figure 12 (Conceptual Landscape Plan) of the EIS.

Page 111 Please note that the reference cited was listed as a reference in Section 12.1 of the EIS. Also, the consulting archaeologists for the EIS, M.J. Toimonari-Tuggle and R. Blankfein were selected because of their prior work on the FAA CERAP project, so they were intimately familiar with previous recommendations to guide mitigation and further inventory activities.

Page 125 The impacts to Batteries Dodge, 407 and Harlow were addressed in Table 3 of Appendix D of the Draft EIS (Historical Research and Archaeological Assessment). In the cases of Batteries Dodge and 407, the consulting archaeologists recommended that each facility undergo inventory-level survey and (in terms of

final treatment) be incorporated into either rim trail or interior crater interpretation. In the case of Battery Harlow, the archaeologist determined that documentation was already completed and Harlow could be the primary focus of Fort Ruger interpretation. The use of all three (3) former batteries will not occur until the Hawaii Army National Guard no longer requires the use of these facilities.

Page 129

The impacts to Batteries Dodge, 407 and Harlow were addressed in Table 3 of Appendix D of the Draft EIS (Historical Research and Archaeological Assessment). In the cases of Batteries Dodge and 407, the consulting archaeologists recommended that each facility undergo inventory-level survey and (in terms of final treatment) be incorporated into either rim trail or interior crater interpretation. In the case of Battery Harlow, the archaeologist determined that documentation was already completed and Harlow could be the primary focus of Fort Ruger interpretation. The use of all three (3) former batteries will not occur until the Hawaii Army National Guard no longer requires the use of these facilities.

Page 133

The impacts to Batteries Dodge, 407 and Harlow were addressed in Table 3 of Appendix D of the Draft EIS (Historical Research and Archaeological Assessment). In the cases of Batteries Dodge and 407, the consulting archaeologists recommended that each facility undergo inventory-level survey and (in terms of final treatment) be incorporated into either rim trail or interior crater interpretation. In the case of Battery Harlow, the archaeologist determined that documentation was already completed and Harlow could be the primary focus of Fort Ruger interpretation. The use of all three (3) former batteries will not occur until the Hawaii Army National Guard (HIARNG) no longer requires the use of these facilities.

Pages 27-28 Please provide DLNR with maps showing the exact locations of HIARNG's native plant restoration projects. As previously mentioned, there are no plans to construct new roads near Battery Harlow or to widen them, thus no impacts are expected to native ecosystems near Battery Harlow.

Should you have any questions, please contact Mr. Andrew Monden, Chief Engineer at 587-0230.



# University of Hawaii at Mānoa

Environmental Center  
A Unit of Water Resources Research Center  
2150 Campus Road - Cavendish 317 • Honolulu, Hawaii 96812  
Telephone: (808) 958-7301 • Telex: (808) 958-2980

May 26, 2000  
RE: 0702

State of Hawaii  
Department of Land and Natural Resources  
P.O. Box 373  
Honolulu, Hawaii 96809  
Attn: Andrew Monden

Dear Mr. Monden:

Diamond Head State Monument Master Plan Update  
Draft Environmental Impact Statement  
Honolulu, Oahu

The State Department of Land and Natural Resources proposes an update of the 1979 Diamond Head State Monument (DIISM) Master Plan to manage a significant increase in visitors since 1979. The current objective, as well as several key elements of the 1979 Master Plan, remain the same, therefore warranting an update rather than a completely new plan. Elements of the current proposed Master Plan include: reorganization of entry points, addition of roads within the crater, construction of a visitor/interpretation center, implementation of exterior parking and a people mover system, creation of a caretaker's residence, increasing the number of comfort stations, addition of interior and exterior picnic areas, reevaluation of visitor accessible trails and lookouts to protect natural resources, and landscaping.

This review was completed with the assistance of Charles Lamoureux, Lyon Arboretum; and Sherri Hiraoaka, Environmental Center.

### General Comments

This Environmental Impact Statement (EIS) covers project impacts comprehensively. However, there were some areas where our reviewers requested further clarification. One area that was mentioned but not thoroughly discussed is carrying capacity. The notion that there exists an ideal number of visitors to any attraction may be problematic to demonstrate. However, this EIS could have benefited from discussion about how many people DHSM should accommodate. Scenarios discussing an "all-conservation" point of view or a "full speed ahead" tourism perspective could generate potential numbers of users.

We would also note that the high cost of developing the Master Plan, \$23 million, could be lowered if existing buildings are utilized for some interim period. A warehouse located in the crater, for example, could be modified for use as a visitors center.

Mr. Monden  
May 26, 2000  
Page 2

As noted in the section on social impacts, it may be difficult to institute a separate fee for residents and visitors. However, requiring a fee for residents will be difficult to promote to the public and will negatively impact the numbers of residents who will go to the DHSM.

Other specific issues are listed below.

### Visitor/Interpretive Center

A visitor's center can be a beneficial tool in educating visitors about DHSM and the resources available to them there but it was not clear from the (EIS) if this was the true intent of the building. The discussion on the market appeal of the new visitor/interpretive center (page 100) suggest that one of the goals of the center is to provide revenue for the upkeep of DHSM. If the purpose of the center is strictly educational and to promote responsible use of the area, then the assessment of a fee to enter the center seems like it will deter visitors. The result may be that most visitors will not enter the center, and thus will not have the benefit of the educational opportunity offered by it.

### Project Objectives and Policies

The landscape plans were said in policy number 8 on page 26 to be in accordance with the "Recommended Guidelines for Landscape Treatment of the Diamond Head Area" in Appendix I. No Appendix I was found. Was this a reference to another document? If so, please cite that document.

### Upper Slopes

What is meant by the term "refurbished" when referring to observation points on page 307? How do these activities apply to *Schlotheimia* habitat?

### Landscape

Choice of Plants Our reviewers suggest that the selection of landscape vegetation be restricted specifically to those that were already present in Hawaii at the time of Captain Cook's arrival in 1778.

Wetlands It seems as if one of the goals of restoring the wetlands is to enhance native plant and waterbird habitat (page 31). If this is true, then the presence of walkways and visitors through the wetland could be harmful to these plants and birds. Has there been consideration of eliminating walkways that run through the wetland while maintaining those surrounding it?

Na I'a'au Arboretum The arboretum is proposed to be moved to a more accessible location. If this move occurs, what will happen to the existing facility? The original arboretum location still contains some plantings. If they can be restored, this may be developed into another area for visitor recreation.

MAY-26-00 FRI 16:20

UH ENVIRONMENTAL CENTER

FAX NO. 8089563980

P. 04

Mr. Monden  
May 26, 2000  
Page 3

Community of Nearby Residents

Parking was cited as a issue (page 88) since the assessment of parking fees for DHSM may lead to parking congestion at KCC and/or neighborhood streets. What can be done to prevent motorists from parking at KCC? How does the community feel about the potential for their street parking to be taken by DHSM visitors?

Discussion comparing the "Hanauma Bay experience" on page 88 refers to Appendix G. This section should indicate reference to Appendix H, Social Impact Assessment and Revenue Analysis, instead of Appendix G, Air Quality Study.

The proposed non-commercial fee (page 88) indicates that cars will be charged \$5.00 per entry or \$30.00, but does not state what the \$30.00 is for.

Community of Diamond Head Crater Recreational Users

Implementation of tunnel stair lighting and emergency communications were listed as uncertain on pages 92 and 93. While these additions may lead some visitors to believe that "mystical" nature of the Park is being lost, the real issue is one of safety. Visitor safety should be the first priority when considering these types of issues.

Community of Diamond Head "Stewards"

The discussion on the "use of revenues generated from entry fees" (page 94) states that "all revenues generated within State parks already go into a special fund for the interpretive parks program, 'Aina Ho'omaluu Special Fund.'" The 2000 legislature proposed dissolving this fund. Does the 'Aina Ho'omaluu Special Fund still exist?

Conclusion

This Draft EIS was well done and complete in discussing anticipated impacts. However, there were a few points that our reviewers felt were incomplete. Of particular concern was the lack of data on the carrying capacity of the Park. This information would be helpful in evaluating certain elements of the DHMS Plan. Other than this, the implementation of the Master Plan would have a positive effect on the current conditions of the Park. We hope that our comments will be useful in developing the final document. Thank you for the opportunity to comment on this Draft EIS.

Sincerely,

*Peter Rappa*  
Peter Rappa  
Assistant Environmental Coordinator

cc: Vincent Shigekuni, PDR Hawaii  
OEQC  
James Moncur, WRRRC  
Charles Lamoureux, Lyon Arboretum  
Sherri Hironaka, Environmental Center

REGULATORY & COMPLIANCE  
DIVISION OF LAND AND NATURAL RESOURCES



STATE OF HAWAII  
DEPARTMENT OF LAND AND NATURAL RESOURCES

P. O. BOX 671  
HONOLULU, HAWAII 96809

REF:LD/WL-EK

AUG 15 2000

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

DAVID E. WATKINS  
ADJUTANT GENERAL  
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TO: Mr. Peter Rappa,  
Assistant Environmental Coordinator  
Environmental Center, University of Hawaii

FROM: Timothy E. Johns, Chairperson  
Department of Land and Natural Resources

SUBJECT: Diamond Head State Monument Master Plan Update  
Draft Environmental Impact Statement (DEIS)

Thank you for your letter of May 26, 2000, commenting on the Diamond Head State Monument Master Plan Update DEIS. We offer the following responses:

General Comments:

We agree that there exists an ideal number of visitors to any attraction, which is problematic to demonstrate. For this reason, the concept of "carrying capacity" has not been thoroughly discussed in the Draft EIS. We feel that it would be inappropriate to speculate on either an "all conservation" point of view or a "full speed ahead" tourism perspective in regard to carrying capacity because the reality of expected use is somewhere in between.

In regards to using existing buildings, the buildings vacated by the State Department of Defense may be utilized on an interim basis for Diamond Head State Monument use. However, long-term use of the existing buildings are inconsistent with the CAC's policies adopted in 1995.

In regard to instituting a different entrance fee for residents and visitors, please note that such a fee structure has been in effect at Hanauma Bay for several years. For Diamond Head, a fee system recently has been implemented since May 1, 2000. Fees are \$1.00 per visit or \$10.00 for an annual pass. While before and after comparison counts have not been tabulated, the fee system has received relatively little opposition.

#### Visitor/Interpretive Center

The visitor/interpretive center will provide information on the fragile eco-system within the crater, the history of the crater, and how to safely enjoy the crater. Scenarios for a combined or separate entrance fee for the visitor/interpretive center are summarized in Exhibit 1-B, page 104, visitor/interpretive center. This fee will be determined based on public input.

#### Project Objectives and Policies

The reference to Appendix I refers to a single page with some recommended landscape treatments. We have attached a copy for your use, however it will not be included in the Final EIS, as we understand that the CAC acknowledges that the recommended landscape treatment is "dated" and does not represent the more current interest in using native plants for landscape materials.

#### Upper Slopes

The term "refurbish" means to renovate, or to restore to good condition. The summit of Le'ahi currently contains an observation area. This area would be refurbished. Making the upper slopes off-limit to hikers except for the refurbished observation area at the summit of Le'ahi would aid in protecting the *Schidea adamanis* habitat. These points will be clarified in the Final EIS.

#### Landscaping

**Choice of Plants.** We acknowledge your suggestion to restrict the selection of vegetation to plants that were present in Hawaii at the time of Captain Cook's arrival in 1778 and will take this recommendation into consideration when selecting the landscaping for the crater floor.

**Wetlands.** Your suggestion that walkways should not be allowed to run through the proposed enhanced wetland will be taken into consideration when designing the wetland.

**Na La'au Arboretum.** The use of the Na La'au Arboretum was considered, however, it was not pursued because residents who live on the outward edge of the crater, are concerned with the numerous illegal trails, squatters and security issues. Also, not many of the Arboretum plantings are left, except for the willow trees.

#### Community of Nearby Residents

Strict enforcement of parking regulations can be implemented to prevent Diamond Head visitors from parking at Kapiolani Community College (KCC). The community was not surveyed in regard to the potential for "their" street parking to be taken by DHSM visitors. However, it

should be noted that parking fees will be kept to a reasonable amount to encourage DHSM visitors to park within the monument.

The incorrect reference to Appendix G on page 88, will be corrected to Appendix H in the Final EIS.

The \$30 fee mentioned on page 88 of the Draft EIS is the annual entry fee for cars. The Final EIS will be revised to state: "Cars: \$5 per entry or \$30 per year".

#### Community of Diamond Head Recreational Users

We agree that visitor safety should be high priority when considering whether or not to light the tunnel stairs. This section of the EIS will be revised accordingly.

#### Community of Diamond Head "Stewards"

The 'Aina Ho'omalu Special Fund still exists within the State Parks Special Fund that was approved by the 2000 legislature.

Should you have any questions, please contact Mr. Andrew Monden, Chief Engineer at 587-0230.



**MAY 15 2000**  
**LETTER OF TRANSMITTAL**  
**UNIVERSITY OF HAWAII**  
**OFFICE OF THE SENIOR VICE PRESIDENT,**  
**UNIVERSITY OF HAWAII AND CHANCELLOR FOR COMMUNITY COLLEGES**  
**PHYSICAL FACILITIES, PLANNING AND CONSTRUCTION**  
 4303 Diamond Head Road  
 Maeda Building, Room 103  
 Honolulu, Hawaii 96816

**DEPARTMENT OF LAND AND NATURAL RESOURCES**  
**STATE OF HAWAII**  
 P. O. BOX 621  
 HONOLULU, HAWAII 96809  
**AUG 15 2000**

TIMOTHY E. JOHNS, CHAIRPERSON  
 BOARD OF LAND AND NATURAL RESOURCES  
 BOBMY  
 JANET E. KAMELO  
 AQUATIC RESOURCES  
 BOATING AND OCEAN RECREATION  
 COASTAL AND WATERSHED RESOURCES  
 ENVIRONMENTAL  
 CONSERVATION  
 LAND AND NATURAL RESOURCES  
 PLANNING AND CONSTRUCTION  
 PLANNING AND CONSTRUCTION  
 PLANNING BRANCH  
 PLANNING SUPPORT BRANCH  
 STATE PLANNING

**TO:** PBR Hawaii  
 Pacific Tower, Suite 650  
 1001 Bishop Street  
 Honolulu, HI 96813

**DATE:** May 11, 2000

**SUBJECT:** Diamond Head State Monument Master Plan

**ATTN:** Vincent Shigekuni **JOB NO.**

**WE ARE SENDING YOU:**  Attached  Under separate cover  
 Copy of Letter  Plans  Specifications  
 Cost Estimate  Submittals

**TO:** Mr. Maynard Young, Senior Vice President  
 University of Hawaii

**FROM:** *Timothy E. Johns*  
 Timothy E. Johns, Chairperson  
 Department of Land and Natural Resources

**SUBJECT:** Diamond Head State Monument Master Plan Update  
 Draft Environmental Impact Statement (DEIS)

COPIES	DATE	NO.	DESCRIPTION
1	March 2000		Diamond Head State Monument Master Plan Update Draft Environmental Impact Statement

Thank you for your letter of transmittal of May 11, 2000, on the Diamond Head State Monument Master Plan Update DEIS. We acknowledge that you have no comments.

Should you have any questions, please contact Mr. Andrew Monden, Chief Engineer at 587-0230.

THESE ARE BEING TRANSMITTED AS CHECKED BELOW:

For your information and files  Appropriate attention  
 As requested  For review and comments  For your signature and return

REMARKS: No Comment

Copy to: \_\_\_\_\_  
 Signed: *Maynard Young*  
 Maynard Young, Director

BOARD OF WATER SUPPLY  
CITY AND COUNTY OF HONOLULU  
830 SOUTH BERETANIA STREET  
HONOLULU, HAWAII 96843



May 18, 2000

Mr. Andrew Monden  
Department of Land and Natural Resources  
State of Hawaii  
P. O. Box 373  
Honolulu, Hawaii 96809

Dear Mr. Monden:

Subject: Your Letter Dated April 8, 2000 Regarding the  
Draft Environmental Impact Statement for the  
Diamond Head State Monument Master Plan

Thank you for the opportunity to review and comment on the Draft  
Environmental Impact Statement (EIS) for the Diamond Head State  
Monument Master Plan.

We have the following comments:

1. Our comments on the EIS Preparation Notice dated September 25,  
1998 are still applicable and enclosed for your use.
2. There are no services to TMKs: 3-1-42: 6, 8, 10, 11, 15, 16,  
17, 21, 23, 24, 25, 36, 37, 38, and TMK: 3-1-35: 23.

There are existing water services to the following TMKs:

TMK	Prem ID Number	Status
3-1-42: 14	1025209	active
	1025212	active
	1025215	active
3-1-42: 20	1001476	active
	1001477	active
	1001478	active
	1001479	active
3-1-35: 22	1104587	ordered-off 5/97
	1104588	ordered-off 8/85

If you have any questions, please contact Kathryn Kami at 527-5221.

Very truly yours,

CLIFFORD S. SPITTLE  
Manager and Chief Engineer

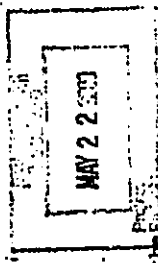
Enclosure

cc: Vincent Shigekuni, PBR Hawaii

Pure Water... our greatest need - use it wisely

JEREMY HARRIS, Mayor  
EDDIE FLORES, Councilmember  
CHARLES A. STEEL, Vice Mayor  
JAN MULLY, AMM  
HERBERT S.K. SAOPUKA, SR.  
BARBARA KIM STANTON

KAZU HAYASHIDA, E-Office  
ROSS E. BAQUEDA, E-Office  
CLIFFORD E. JAMES  
Manager and Chief Engineer





STATE OF HAWAII  
DEPARTMENT OF LAND AND NATURAL RESOURCES

P. O. BOX 631  
HONOLULU, HAWAII 96843

REF:LD/WL-EK

AUG 15 2000

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

JANEY E. FANELO  
ADULTIC RESOURCES  
COUNTY AND OCEAN RECREATION  
MANAGEMENT  
COASTAL ZONING AND  
PLANNING  
POLICY AND REGULATORY  
PLANNING DIVISION  
PLANNING BRANCH  
ENGINEERING BRANCH  
STATE PLANNING  
STATE PLANNING

- 5. The on-site fire protection requirements will be coordinated with the Fire Prevention Bureau of the Honolulu Fire Department. This is noted in Section 5.6 of the Draft EIS.
- 6. Construction drawings will be submitted if a three-inch or larger meter is required. This is noted in Section 5.6 of the Draft EIS.
- 7. We acknowledge that the project is subject to Board of Water Supply cross-connection control requirements before the issuance of the building permit application. This is noted in Section 5.6 of the Draft EIS.

Should you have any questions, please contact Mr. Andrew Monden, Chief Engineer, at 587-0230.

Clifford S. Jamile, Manager and Chief Engineer  
Board of Water Supply  
City and County of Honolulu  
630 South Beretania Street  
Honolulu, Hawaii 96843

Aloha,

TIMOTHY E. JOHNS

Diamond Head State Monument Master Plan Update  
Draft Environmental Impact Statement (DEIS)

Thank you for your letter of April 25, 2000, commenting on the Diamond Head Statement Monument Master Plan Update DEIS. We offer the following responses:

- 1. We acknowledge the availability of services as specified by TMK numbers in both of your letters. However, we are not clear about the availability of services for TMK 3-1-42: 6. In your letter of September 25, 1998, it stated that there are active water services serving this TMK, but in your letter of May 18, 2000, it was stated that there are no services to this TMK.
- 2. We acknowledge that the existing off-site water system is adequate to accommodate the proposed improvements. This is noted in Section 5.6 of the DEIS.
- 3. We will obtain a water allocation from the Department of Land and Natural Resources, Land Division, Engineering Branch. This is noted in Section 5.6 of the DEIS.
- 4. We acknowledge the need to pay Water System Facilities Charges fee for transmission and daily storage. This is noted in Section 5.6 of the DEIS.

DEPARTMENT OF PLANNING AND PERMITTING  
CITY AND COUNTY OF HONOLULU

150 SOUTH KING STREET - HONOLULU, HAWAII 96813  
TELEPHONE: (808) 525-2414 • FAX: (808) 527-5743 • INTERNET: www.ci.honolulu.hi.us/planning

MAY 17 10:01



RANDALL K. DUNN, MA  
DIRECTOR

POSTAL FAX NOTE 7871

TO	From: 5/17/00	Page: 2
TO	From: 5/17/00	Page: 2
TO	From: 5/17/00	Page: 2
TO	From: 5/17/00	Page: 2
TO	From: 5/17/00	Page: 2

Mr. Andrew Monden  
Department of Land and Natural Resources  
State of Hawaii  
P.O. Box 373  
Honolulu, Hawaii 96809

Dear Mr. Monden:

Diamond Head State Monument Master Plan Update  
Draft Environmental Impact Statement (EIS)

We have reviewed the above document and offer the following comments:

Throughout the document, reference is made to the Department of Defense (DOD). The Final EIS should clarify if this is a state or federal agency.

Land Use Ordinance

1. The proposed use is considered a public use and is a permitted use within any zoning district regulated by the City.
2. Section 3.2.3 of the Draft EIS discusses approvals required under the Diamond Head Special District, and states "It is anticipated that implementation of the Master Plan Update will require a Major Permit." The same statement is made in Section 7.8.

Since most, if not all of the project area, is within the State Conservation District, the Department of Land and Natural Resources could choose to exempt the project from compliance with the City Land Use and zoning requirements, including the Special District provisions.

Mr. Andrew Monden  
Page 2  
May 16, 2000

However, should the state wish to pursue a Diamond Head Special District Permit, it is more appropriate that each of the project's five phases be reviewed separately under the Land Use Ordinance's Special District provisions rather than under one omnibus major permit. This is due to the Master Plan's broad overall scope of work and the uncertainty of the phasing and timing for full implementation. The nature of the Special District (SD) Provisions requires fairly detailed plans in the review of permit applications, and it is unlikely that such plans would be available until construction of each phase is imminent.

According to the general description of work provided in the Draft EIS, it does not appear that a major SD permit would be required for every phase. Except for the construction of major facilities (indicated for Phase IV, and possibly for Phases II and V), it appears that the work would either require a SD minor permit or be exempt. The final determinations would depend upon review of detailed plans as they become available.

3. Pages 7 and 113 of the Draft EIS indicate that the proposal is consistent with applicable zoning established by the City and County of Honolulu. Elsewhere (e.g. page 7), the Draft EIS notes that the proposal will exceed the height limit for the Diamond Head Special District. The Final EIS should resolve or clarify this apparent conflict.

General Plan

Page 117, Section 7.6, City and County of Honolulu General Plan states that the General Plan serves two purposes, but nowhere are those two purposes cited. The Final EIS should identify the "two purposes" of the General Plan. The remainder of this paragraph addresses conformity with the Primary Urban Center Development Plan. This discussion should be moved to Section 7.7.

Special Management Area

As noted in the Draft EIS, the project is within the Special Management Area and a major Special Management Area Use Permit will be required. It would be appropriate for the project's Master Plan to be comprehensively reviewed during the processing of this permit.

Mr. Andrew Monden  
Page 3  
May 16, 2000

If you have any questions, please contact Ardis Shaw-Kim of our staff at 527-5349.

Sincerely yours,

*Randall K. Fujiki*

RANDALL K. FUJIKI, AIA  
Director of Planning and  
Permitting

RKF:lg  
DM 3803



STATE OF HAWAII  
DEPARTMENT OF LAND AND NATURAL RESOURCES  
P. O. BOX 51  
HONOLULU, HAWAII 96809

REF:LD/WL-EK

AUG 15 2000

Mr. Randall K. Fujiki, AIA, Director  
Department of Planning and Permitting  
City and County of Honolulu  
650 South King Street  
Honolulu, Hawaii 96813

Dear Mr. Fujiki:

**Diamond Head State Monument Master Plan Update  
Draft Environmental Impact Statement (DEIS)**

Thank you for your letter of May 16, 2000, commenting on the Diamond Head State Monument Master Plan Update DEIS. We offer the following responses:

- 1) As recommended, all references to "Department of Defense" or "DOD" will be changed to "State Department of Defense" or "State DOD" in the Final EIS.
- 2) We acknowledge that the proposed use is considered a public use and is a permitted use within any zoning district regulated by the City.
- 3) We acknowledge that most of the proposed improvements are within the State Conservation District and that DLNR could choose to exempt the project from compliance with City Land Use and zoning requirements, including the Special District provisions.
- 4) It is stated on page 7 of the DEIS, that this project "generally conforms" to the City and County of Honolulu General Plan, along with several other plans. This is then followed with a statement that the project's height limit will be deviated from the plan. This is also the intent of statements on page 113 will be further clarified in the Final EIS.
- 5) The Final EIS will briefly address the purposes of the General Plan. As recommended, the remainder of the first paragraph of Section 7.6 will be moved to Section 7.7 of the Final EIS.

TIMOTHY E. JOHNS, CHAIRPERSON  
BOARD OF LAND AND NATURAL RESOURCES  
DEPUTY  
JANET E. YANWEL  
AGRICULTURE  
BOILING AND OCEAN RECREATION  
COUNTRYSIDE AND RECREATION  
DEPARTMENT  
CONSERVATION  
COURTNEY W. HARRIS  
HISTORIC PRESERVATION  
LAND USE  
PLANNING BRANCH  
STATE PLANNING SUPPORT BRANCH

6) While we appreciate your statement that the Master Plan be comprehensively reviewed during the processing of the Special Management Area Use Permit, please note that the project has undergone an extensive community planning and public review process, including:

- Over two (2) years of public meetings and site visits with an established citizens advisory committee (20+ years old);
- Four (4) public informational meetings;
- One (1) Board of Land and Natural Resources Meeting;
- The current EIS public review process (2 public review periods);
- Coordination with the city's Visioning project for Diamond Head Road;
- Coordination with the City's Honolulu Bicycle Master Plan; and
- Coordination with all the agencies listed on pages 14, 15, 159, 160, and 161 of the Draft EIS.

Should you have any questions, please contact Mr. Andrew Monden, Chief Engineer at 587-0230.

Aloha,

*Timothy E. Johns*  
de  
TIMOTHY E. JOHNS

DEPARTMENT OF PARKS AND RECREATION  
CITY AND COUNTY OF HONOLULU

850 SOUTH KING STREET, 10TH FLOOR • HONOLULU, HAWAII 96813  
PHONE: (808) 523-4182 • FAX: 523-4064



JEREMY HARRIS  
MAYOR

WILLIAM D. BALFOUR, JR.  
DIRECTOR

MICHAEL T. AMI  
DEPUTY DIRECTOR

June 1, 2000

Department of Land and  
Natural Resources  
State of Hawaii  
P. O. Box 373  
Honolulu, Hawaii 96809

Attention: Mr. Andrew Monden

Gentlemen:

Subject: TMKs 3-1-42: 6, 8, 10, 14, 17, 21, 23, 24, 25, 37,  
and 38; TMK 3-1-35:23; TMK 3-1-42:11 (Cannon Club);  
TMK 3-1-42:20 por. (Board of Water Supply);  
TMKs 3-1-42: 15 and 16 (FAA)

Thank you for the opportunity to review and comment on the Draft  
Environmental Impact Statement relating to the Diamond Head State  
Monument Master Plan Update.

The Department of Parks and Recreation supports the Master Plan  
Update.

Should you have any questions, please contact Mr. John Reid,  
Planner, at 547-7396.

Sincerely,

*W.D. Balfour, Jr.*  
WILLIAM D. BALFOUR, JR.  
Director

WDB:cu

cc: Office of the Governor  
✓ PBR Hawaii  
Mr. Don Griffin, Department of Design and Construction

DELUANNE J. CAVITANO  
COMMISSIONER OF HAWAII



STATE OF HAWAII  
DEPARTMENT OF LAND AND NATURAL RESOURCES

P. O. BOX 431  
HONOLULU, HAWAII 96809

REF:LD/WL-EK

AUG 15 2000

Mr. William D. Balfour, Jr., Director  
Department of Parks and Recreation  
City and County of Honolulu  
650 South King Street, 10<sup>th</sup> Floor  
Honolulu, HI 96813

Dear Mr. Balfour:

Diamond Head State Monument Master Plan Update  
Draft Environmental Impact Statement (DEIS)

Thank you for your letter of June 1, 2000, regarding the Diamond Head State Monument Master  
Plan Update DEIS. We acknowledge that you support the Master Plan Update and have no  
further comments.

Should you have any questions, please contact Mr. Andrew Monden, Chief Engineer, at  
587-0230.

Aloha,

*Timothy E. Johns*  
TIMOTHY E. JOHNS

TIMOTHY E. JOHNS, CHIEF ENGINEER  
DIVISION OF LAND AND NATURAL RESOURCES

DEPUTY

LAND AND NATURAL RESOURCES  
DEPARTMENT OF LAND AND NATURAL RESOURCES  
CONSERVATION AND RESTORATION  
COMMISSIONER  
PLANNING AND DEVELOPMENT  
LAND AND NATURAL RESOURCES  
DEPARTMENT OF LAND AND NATURAL RESOURCES  
TECHNICAL & SUPPORT BRANCH  
STATE HALL



LAND PLANNING  
LANDSCAPE ARCHITECTURE  
ENVIRONMENTAL STUDIOS

RECEIVED  
DEPARTMENT OF  
FACILITY MAINTENANCE

APR 10 7 24 AM '00

April 8, 2000

Dear Participant:

Attached for your review is a Draft Environmental Impact Statement (DEIS) which was prepared pursuant to the EIS Law (Hawaii Revised Statutes, Chapter 343) and the EIS rules (Administrative Rules, Title 11, Chapter 200).

Title of Project: Diamond Head State Monument Master Plan Update Draft Environmental Impact Statement

Location: Island: Oahu District: Primary Urban Center

Tax Map Keys: TMKs 3-1-42: 6, 8, 10, 14, 17, 21, 23, 24, 25, 37, and 38; TMK 3-1-35: 23; TMK 3-1-42: 11 (Cannon Club); TMK 3-1-42: 20 por. (Board of Water Supply); TMKs 3-1-42: 15 and 16 (FAA)

Agency Action: X Applicant Action: —

Your comments must be received or postmarked by May 23, 2000.

Please address your comments to the:

Applicant: State of Hawaii, Department of Land and Natural Resources  
P.O. Box 373  
Honolulu, Hawaii 96809

Contact: Mr. Andrew Monden Phone: 587-0230

Copies of your comments should also be sent to the following:

Accepting Authority: Office of the Governor  
c/o Office of Environmental Quality Control  
235 S. Beretania Street, Suite 702  
Honolulu, Hawaii 96813

Phone: 586-4185 City & County of Honolulu

Consultant: PBR Hawaii  
Pacific Tower, Suite 650  
1001 Bishop Street  
Honolulu, Hawaii 96813

Contact: Mr. Vincent Shigekuni Phone: 521-5631 Fax: 523-1402

If you no longer need this Environmental Impact Statement Please return it to PBR Hawaii. Thank you for participating in the Environmental Impact Statement process.

W. Frank Brack • Thomas S. Wilson • R. Sun Deacon • Russell Y.I. Cheng  
HONOLULU OFFICE  
1001 BISHOP STREET, PACIFIC TOWER, SUITE 650, HONOLULU, HAWAII 96813  
TELEPHONE: (808) 521-5631 FAX: (808) 523-1402

WAILUKU OFFICE  
3112 KAHOA STREET, WAILUKU, HAWAII 96793-2304  
TELEPHONE: (808) 933-3378 FAX: (808) 942-2392

HALO OFFICE  
111 ALUPA STREET, HALO LAKE, HONOLULU, HAWAII 96813  
TELEPHONE: (808) 941-0101 FAX: (808) 941-0077

BRUNNEN & CAVALLO  
Department of Hawaii



STATE OF HAWAII  
DEPARTMENT OF LAND AND NATURAL RESOURCES  
P. O. BOX 521  
HONOLULU, HAWAII 96809

AUG 15 2000

TIMOTHY E. JOHNS, CHAIRPERSON  
BOARD OF LAND AND NATURAL RESOURCES  
DEPUTY  
JANET Y. DUNFELD  
ADJUTANT GENERAL  
DEPARTMENT OF LAND AND NATURAL RESOURCES  
ADMINISTRATIVE SERVICES  
CONSTRUCTION AND MAINTENANCE  
PLANNING AND DEVELOPMENT  
LAND AND NATURAL RESOURCES  
CONSERVATION  
TECHNICAL SUPPORT BRANCH  
PLANNING

Mr. Ross S. Sasamura  
Director and Chief Engineer  
Department of Facility Maintenance  
City and County of Honolulu  
650 South King Street, 11<sup>th</sup> Floor  
Honolulu, Hawaii 96813

Dear Mr. Sasamura:

Diamond Head State Monument Master Plan Update  
Draft Environmental Impact Statement (DEIS)

Thank you for your transmittal of April 10, 2000, on the Diamond Head State Monument Master Plan Update (DEIS). We acknowledge that you have no comments.

Should you have any questions, please contact Mr. Andrew Monden, Chief Engineer, at 587-0230.

Aloha,  
*Timothy E. Johns*  
TIMOTHY E. JOHNS



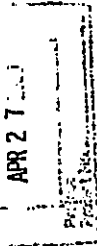


FIRE DEPARTMENT  
CITY AND COUNTY OF HONOLULU  
3378 KOAULA STREET, SUITE 4415 • HONOLULU, HAWAII 96819-1841  
TELEPHONE: (808) 831-7761 • FAX: (808) 831-7750 • INTERNET: www.ci.honolulu.hi.us



JEREMY HARRIS  
SAFETY

Mr. Andrew Monden  
Page 2  
April 20, 2000



ATTILIO K. LEONARDI  
FIRE CHIEF  
JOHN CLARK  
SUPPORT FIRE CHIEF

Should you have any questions, please call Battalion Chief Kenneth Silva of our Fire Prevention Bureau at 831-7778.

April 20, 2000

Mr. Andrew Monden  
State of Hawaii  
Department of Land and Natural Resources  
P. O. Box 373  
Honolulu, Hawaii 96809

Dear Mr. Monden:

We received a letter from PBR Hawaii dated April 8, 2000, regarding the Draft Environmental Impact Statement for the Diamond Head State Monument Master Plan Update.

The Honolulu Fire Department (HFD) requests that the following be compiled with for the visitor interpretive facility and the DOCARE office:

1. Provide a private water system where all appurtenances, hydrant spacing, and fire flow requirements meet Board of Water Supply standards.
2. Provide a fire department access road to within 150 feet of the first floor of the most remote structure. Such access shall have a minimum vertical clearance of 13 feet 6 inches, be constructed of an all-weather driving surface complying with Department of Transportation Services (DTS) standards, capable of supporting the minimum 60,000 pound weight of our fire apparatus, and with a gradient not to exceed 20%. The unobstructed width of the fire apparatus access road shall meet the requirements of the appropriate county jurisdiction. All dead-end fire apparatus access roads in excess of 150 feet in length shall be provided with an approved turnaround having a radius complying with DTS standards.
3. Submit construction plans to the HFD and the Department of Planning and Permitting.

Sincerely,

ATTILIO K. LEONARDI  
Fire Chief

AKL/KS:jo

cc: Office of Environmental Quality Control  
Vincent Shigekuni, PBR Hawaii



BRUCE M. J. CANTLAND  
GOVERNOR OF HAWAII



STATE OF HAWAII  
DEPARTMENT OF LAND AND NATURAL RESOURCES

P. O. BOX 151  
HONOLULU, HAWAII 96810

REF:LD/WL-EK

AUG 15 2000

TIMOTHY E. JOHNS, CHAIRPERSON  
BOARD OF LAND AND NATURAL RESOURCES  
JANET E. KAMELO  
ADVISOR  
SOILS, WATER, AND OCEAN RESOURCES  
CONSERVATION AND RESTORATION  
COMMISSION  
LAND USE AND PLANNING  
DIVISION  
1505 KALANANAKU AVENUE  
HONOLULU, HAWAII 96813  
TELEPHONE: 521-8300  
FAX: 521-8300

Attilio K. Leonard, Chief  
Fire Department  
City and County of Honolulu  
3375 Koapaka Street, Suite H425  
Honolulu, Hawaii 96819-1869

Dear Chief Leonard:

**Diamond Head State Monument Master Plan Update  
Draft Environmental Impact Statement (DEIS)**

Thank you for your letter of April 20, 2000, commenting on the Diamond Head State Monument Master Plan Update DEIS. We offer the following responses:

1. The water system, including all appurtenances, hydrant spacing, and fire flow requirements will be designed to meet Board of Water Supply standards.
2. The project will provide a Fire Department access road that meets the requirements specified in your letter.
3. Construction plans will be submitted to the Honolulu Fire Department and the Department of Planning and Permitting.

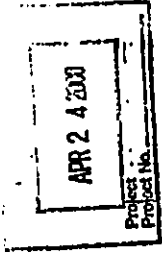
Should you have any questions, please contact Mr. Andrew Monden, Chief Engineer, at 587-0230.

Aloha,  
  
TIMOTHY E. JOHNS

DEPARTMENT OF ENVIRONMENTAL SERVICES  
CITY AND COUNTY OF HONOLULU  
650 SOUTH KING STREET, 3RD FLOOR • HONOLULU, HAWAII 96813  
PHONE: (808) 537-4663 • FAX: (808) 537-4675 • Website: www.cc.hawaii.gov



JERRY HARRIS  
Mayor



KENNETH E. SPRAGUE, P.E., P.A.B.  
Director  
QUALITY PROGRAMS  
Deputy Director

APR 20 2000

ENV 00-34

BOULANGER & CAVERANO  
CONSULTANTS



STATE OF HAWAII  
DEPARTMENT OF LAND AND NATURAL RESOURCES  
P.O. BOX 621  
HONOLULU, HAWAII 96809

REF:LD/WL-EK

AUG 15 2000

TIMOTHY E. JOHNS, CHAIRPERSON  
BOARD OF LAND AND NATURAL RESOURCES  
JANET E. FANALELO  
SECRETARY  
LAND USE RESOURCES  
PLANNING AND COORDINATION  
CONSERVATION AND RESOURCES  
DEPARTMENT  
COUNTY OF HONOLULU  
FORESTRY AND WILDLIFE  
LAND DIVISION  
PLANNING AND COORDINATION  
TECHNICAL SUPPORT BRANCH  
STATE PARKS

Mr. Andrew Monden  
Department of Land and Natural Resources  
State of Hawaii  
P.O. Box 373  
Honolulu, HI 96809

Dear Mr. Monden:

Subject: Draft Environmental Impact Statement (DEIS)  
Diamond Head State Monument Master Plan Update  
IMK: Various

We have reviewed the subject DEIS and have no comments to offer at this time.  
Should you have any questions, please contact Alex Ho at 523-4150.

Sincerely,  
  
KENNETH E. SPRAGUE  
Director

cc: Office of Environmental Quality Control  
PBR Hawaii - Mr. Vincent Shigekumi ✓

Mr. Kenneth E. Sprague, Director  
Department of Environmental Services  
City and County of Honolulu  
650 S. King Street, 3<sup>rd</sup> Floor  
Honolulu, Hawaii 96813

Dear Mr. Sprague:

Diamond Head State Monument Master Plan Update  
Draft Environmental Impact Statement (DEIS)

Thank you for your letter of April 20, 2000, on the Diamond Head State Monument Master Plan Update DEIS. We acknowledge that you have no comments.

Should you have any questions, please contact Mr. Andrew Monden, Chief Engineer, at 587-0230.

Aloha,  
  
TIMOTHY E. JOHNS



TIMOTHY E. JOHNS, CHAIRPERSON  
BOARD OF LAND AND NATURAL RESOURCES  
COUNTY  
JAMES E. JAMESLO  
AGRICULTURAL RESOURCES  
PLANNING AND OCEAN MANAGEMENT  
COMMITTEE ON LAND AND NATURAL RESOURCES  
COMMITTEE ON ENVIRONMENTAL  
CONSERVATION  
COMMITTEE ON PUBLIC UTILITIES  
LAND DIVISION  
PLANNING DIVISION  
RECREATION DIVISION  
WATER RESOURCES DIVISION  
ZONING & SUPPORT DIVISION  
3111 FIVE

REGINALD C. CAVIARO  
GOVERNOR OF HAWAII

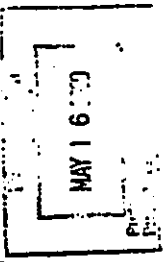


STATE OF HAWAII  
DEPARTMENT OF LAND AND NATURAL RESOURCES

P. O. BOX 671  
HONOLULU, HAWAII 96809

REF:LD/WL-EK

AUG 15 2000



May 15, 2000

LETTER OF TRANSMITTAL

To: Mr. Vincent Sotiropoulos  
PBR Hawaii  
Pacific Tower, Suite 650  
1001 Bishop Street  
Honolulu, Hawaii 96813

From: James Louis  
ENV. Services- Refuse Division  
PH. 577-5832

Subject: Draft Environmental Impact Statement  
Diamond Head State Monument, Master Plan Update

Enclosed is the copy of the Draft EA requested by our office. Thank you providing our office with the copy.

Mr. James Louis  
Department of Environmental Services  
Refuse Division  
City and County of Honolulu  
650 South King Street, 6<sup>th</sup> Floor  
Honolulu, Hawaii 96813

Dear Mr. Louis:

Diamond Head State Monument Master Plan Update  
Draft Environmental Impact Statement (DEIS)

Thank you for your letter of transmittal of May 15, 2000, on the Diamond Head State Monument Master Plan Update DEIS. We acknowledge that you have no comments.

Should you have any questions, please contact Mr. Andrew Monden, Chief Engineer, at 587-0230.

Aloha,  
  
TIMOTHY E. JOHNS

Hawaiian Electric Company, Inc. • PO Box 2750 • Honolulu, HI 96840-0001

REGULATORY DIVISION  
DEPARTMENT OF LAND AND NATURAL RESOURCES



STATE OF HAWAII  
DEPARTMENT OF LAND AND NATURAL RESOURCES  
P. O. BOX 611  
HONOLULU, HAWAII 96809

REF:LD/WL-EK

AUG 15 2000

TIMOTHY E. JOHNS, CHIEF ENGINEER  
MANAGER OF LAND AND NATURAL RESOURCES  
DIVISION  
JANET E. MAWELI  
MANAGER  
PLANNING AND SOCIAL CONSULTATION  
CONSERVATION AND RESTORATION  
PROJECTS  
CONSTRUCTION  
PERMITTING  
PROPERTY AND WILDLIFE  
MANAGEMENT  
LAND DIVISION  
CONSULTANTS  
TECHNICAL SUPPORT BRANCH  
STATE PARKS



Scott W.H. Sou, P.E.  
Manager  
Environmental Department

PBR Hawaii  
Pacific Tower, Suite 650  
1001 Bishop Street  
Honolulu, Hawaii 96813

Attention: Mr. Vincent Shigekuni

Subject: Diamond Head State Monument Master Plan Update

Thank you for the opportunity to comment on your April 2000 Draft EIS for the Diamond Head State Monument Master Plan Update, proposed by the State Department of Land and Natural Resources. We have reviewed the subject document and have the following comments:

Pg. 81, Section 5.6.5 - B (Electrical/Telephone/Communication - Anticipated Impacts and Mitigative Measures)

1. The cost to underground existing HECO overhead lines for aesthetics shall be borne by the party requesting the undergrounding.
2. Not all the existing powerlines are owned by HECO.
3. Realigning the existing overhead power lines into the existing above ground utility conduits along the road to the FAA Link Site is not allowed by the Public Utilities Commission's General Order No. 10 (Rules for Construction of Underground Electrical and Communications Systems in the State of Hawaii).

Our point of contact for this project, and the originator of these comments, is Francis Hirakami (543-7536) senior customer engineer. I suggest your staff and consultants deal directly with Francis to coordinate HECO's continuing input on this project.

Sincerely,

cc: F. Hirakami  
OEOC



WINNER OF THE EDISON AWARD  
FOR DISTINGUISHED INDUSTRY LEADERSHIP

Mr. Scott W.H. Seglu, PE  
Manager, Environmental Department  
Hawaiian Electric Company, Inc.  
P.O. Box 2750  
Honolulu, Hawaii 96840-0001

Dear Mr. Seau:

Diamond Head State Monument Master Plan Update  
Draft Environmental Impact Statement (DEIS)

Thank you for your letter of May 17, 2000, commenting on the Diamond Head State Monument Master Plan Update DEIS. We offer the following responses:

1. We acknowledge that the cost of burying existing HECO lines for aesthetic reasons will be borne by the party requesting the undergrounding.
2. We acknowledge that not all the existing power lines are owned by HECO.
3. We acknowledge the Public Utilities Commission's General Order No. 10 does not allow for the realigning of existing overhead power lines into the existing above ground utility conduits along the road to the FAA Link Site.

The above information will be incorporated in Section 5.6.5 of the Final EIS. A copy of this letter will be forwarded to the Civil Defense (the agency interested in undergrounding the power lines).

Should you have any questions, please contact Mr. Andrew Monden, Chief Engineer, at 587-0230.

Aloha,

TIMOTHY E. JOHNS





**THE OUTDOOR CIRCLE**  
 1314 South King St., Suite 306 • Honolulu, HI 96814  
 Phone: 808-593-0100 Fax: 808-593-0535

MAY 24 2000  
 RECEIVED  
 OFFICE OF THE DIRECTOR  
 DEPARTMENT OF LAND AND NATURAL RESOURCES

Diamond Head State Monument Master Plan Update DEIS  
 May 22, 2000  
 Page 2

Established 1912  
 A Non-profit Organization  
**BRANCHES**  
 OAHU

Kaneohe  
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**HAWAII**

Hilo  
 Kilauea  
 Kona  
 Puna  
 Waianae

**KAUAI**  
**MAUI**

**MOLOKAI**  
**GARDEN CIRCLE**  
 Lanikai

May 22, 2000

Mr. Andrew Monden  
 State of Hawaii, Department of Land and Natural Resources  
 P.O. Box 373  
 Honolulu, HI 96809

RE: Diamond Head State Monument Master Plan Update Draft Environmental Impact Statement

Dear Mr. Monden:

For more than 88 years The Outdoor Circle has worked to keep Diamond Head Crater free from development and over-use. We think of ourselves as longtime stewards of the Crater and have participated on the Diamond Head Citizen's Advisory Committee (CAC) since its inception. We have reviewed the above referenced Draft Environmental Impact Statement (DEIS) and offer the following comments:

The primary objective of the Diamond Head State Monument Master Plan, developed in 1979, was the establishment of a semi-wild interior park and development of an exterior park for family picnic outings. As we see it, now the challenge begins. It is essential that the Master Plan strike a balance between the natural environment and development. Although the updated DEIS claims to maintain the same objectives as declared in 1979, we feel it comes up short in many ways.

**Construction Impacts:**

We are concerned that the anticipated impacts during construction are only touched on in the DEIS, but not developed in detail. Temporary construction activities could have long-term severe negative impacts on the crater and its flora if the construction is not carefully planned and executed. In the discussion on construction erosion control mitigation measures, soil compaction is never discussed. This sort of negative impact will not just be temporary during construction but will have long lasting impacts on the flora, some of which is endangered even now. In the Final EIS, please elaborate on plans to protect the land during construction.

**Forest Restoration:**

The document states that for a successful restoration of the native dryland forest it is imperative that the areas be weeded and watered on a regular basis. The DEIS also correctly points out that all previous attempts at restoration have failed due to a lack of follow-up maintenance and water. However, there is no discussion regarding long term maintenance plans for the area. The FEIS should address how the forest reforestation will be maintained as well as how maintenance in the other landscaped areas in the Crater will be maintained.

**Cultural Resources:**

The Outdoor Circle believes that prior to construction, it is imperative that a Cultural Resource Management Plan be completed for Diamond Head State Monument. An integrated approach is more effective in long term planning for the monument. Additionally, the legislature and Governor passed a bill this year that makes cultural impact assessments an integral part of the environmental impact assessment process. This new bill requires disclosure of the effects of a proposed action on the cultural practices of community and state and amends the definition of "significant impact" to include adverse effects on cultural practices. The Diamond Head Monument Master Plan Update FEIS should be expanded to cover this information.

**Visual Impacts:**

A review of the visual analysis, Figure 18d #8, is of the "existing electrical and communications improvements." We do not understand what this photo shows nor do we understand the caption. Please explain.

A visual impact study should be provided for the road which is planned to go to the top of the crater rim. This road must not be visible from outside of the crater. An accurate computer simulation of the road should be provided in the FEIS.

**Soil:**

The discussion in the DEIS focuses on crop yields which seems irrelevant. We are concerned with the soil's ability to hold a road at the rim of the crater. The document states that the soil, when saturated, might slip. What will keep this road from failing? Please address this in the document. Failure of the road or the trail could mean major devastation of existing and proposed flora.

Additionally, it is unclear from the figures if a road or a trail is planned for the crater rim. Please be clear in the FEIS which it is.

**Interpretive Center:**

We are concerned with the lack of information in the DEIS regarding the Interpretive Center. Please provide detailed information regarding its size, height, location, landscaping, and what

Diamond Head State Monument Master Plan Update DEIS  
May 22, 2000  
Page 3

activities will be held there. In addition, renderings which show the impact of the building on the rest of the landscape should also be provided.

In addition, the 1979 Plan Policies state, "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." Plans for a 10,000 square foot Interpretive Center (with area set aside for a maximum expansion of 5,000 SF) seems contradictory and not in keeping with the statement made in the document that the updated Master Plan is commensurate with the previous one. Please address this contradiction in the FEIS.

**Other:**


Regarding the relocation of telephone and electric lines within the crater, will a separate EIS be prepared when the lines are placed underground? It is unclear from the section on anticipated impacts and mitigative measures what will happen. If not, please provide more information now.

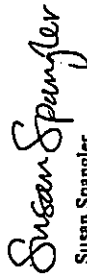
We wonder what "large events" are anticipated in the crater which would require additional comfort stations. Please address this in the FEIS.

Please note that Figure 2, Tax Map Key 3-1-42 is illegible. In the final document, please ensure that all figures are clear. Confirm that this figure will be redrawn.

Thank you for the opportunity to comment.

Sincerely,

  
Mary Steiner  
CEO

  
Susan Spangler  
Vice President &  
DH CAC Representative

cc: Office of the Governor  
FBR, Hawai'i

BERNARD J. CARTWRIGHT  
GOVERNOR OF HAWAII



STATE OF HAWAII  
DEPARTMENT OF LAND AND NATURAL RESOURCES

P. O. BOX 631  
HONOLULU, HAWAII 96808

SEP - 6 2000

REF:LD/WL-EK

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

DEPUTY  
JANET E. KAWILO  
AGRICULTURE  
BOATING AND BOAT REPAIR  
CONSTRUCTION  
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HISTORIC PRESERVATION  
LAND DIVISION  
PLANNING  
RECREATION  
TECHNICAL SUPPORT BRANCH  
TITLES

Ms. Mary Steiner, CEO  
Ms. Susan Spangler, Vice President  
The Outdoor Circle  
1314 South King Street, Suite 306  
Honolulu, Hawaii 96814

Dear Meses. Steiner and Spangler:

**Diamond Head State Monument Master Plan Update  
Draft Environmental Impact Statement (DEIS)**

Thank you for your letter of May 22, 2000, commenting on the Diamond Head State Monument Master Plan Update DEIS. We concur that it is important to strike a balance between the natural environment and development of public improvements. We offer the following responses:

**Construction Impacts:**

We understand that "construction activities could have long-term severe negative impacts on the crater and its flora," in this fragile environment with scarring and damage to the ecosystem. Measures to minimize construction impacts include monitoring and directing activity away from sensitive and undisturbed areas.

Construction plans for Diamond Head State Monument will contain specifications under sections such as "Pollution Control", "Site Preparation and Earthwork", and "Archaeological Protection" to provide guidance and control measures on soil, erosion, compaction, etc..

**Forest Restoration:**

In the same section referred to in your letter, the following is recommended: removal/control of alien plants, fire control, establishment of additional populations of endangered and rare species, collection of data (on natural plant communities), periodic monitoring for alien species, long-term maintenance, and selection of stock. Please note that a key element of the plan is to develop a non-potable water source. Without this source it is unlikely that large-scale plantings of native vegetation will occur.

In addition, page 31 of the DEIS describes the maintenance of other landscaped areas.



#### Cultural Resources:

We are aware of the recently enacted law that makes cultural impacts an integral part of the environmental impact assessment process. Archaeological and historic resources are discussed extensively in the DEIS on pages 61-65. This section is based on an archaeological assessment that was conducted specifically for this study and is contained in its entirety as Appendix D of the DEIS. Please note that page 65 of the DEIS stated that a "Cultural Resource Management Plan (CRMP) for Diamond Head State Monument should be completed at the earliest opportunity".

#### Visual Impacts:

Figure 18d #8 is a photograph of electrical lines and communication dishes located up to and at the FAA Link Site area of Diamond Head. A more detailed caption will be included in the Final EIS. These facilities are discussed in Section 5.6.5 Electrical/Telephone/Communication.

There are no new road improvements planned to go to the top of the crater rim, accordingly, no visual impact study will be provided. In addition, on page 30 of the Draft EIS, it is stated that "Other than at Le'ahi Summit, hikers would not be allowed to hike on the crater rim". There is an existing roadway to the FAA link site on the North rim area and an old service road within the crest from the link site area to an abandoned retractable search light station on the southeast rim, which appears on the Master Plan.

#### Soil:

We agree that the issue of crop yields at Diamond Head is irrelevant. However, the principle focus of soil suitability studies prepared for lands in Hawaii has been to describe the physical attributes of land and the relative productivity of different land types for agricultural production. The sources cited in the Draft EIS (the University of Hawaii Land Study Bureau Detailed Land Classification and the U.S. Department of Agriculture Soil Conservation Services Soil Survey) are the acknowledged authoritative sources for information on soils in Hawaii. As stated above, there is no road (and no trail) improvements planned for the crater rim, except for the Le'ahi Summit trail.

#### Interpretive Center:

Information regarding the interpretive center can be found on pages 28-29 of the DEIS. In addition, Figure 11 contains a conceptual site plan of the center. No further plans or renderings are available at this time.

In 1998, the Diamond Head Citizens Advisory Committee (CAC) discussed alternative sites for the center and narrowed the selection to three (3) sites within the crater. On August 27, 1998, the CAC voted *unanimously* to recommend the siting of the interpretive center to the area inside the crater between the Kahala Tunnel and Battery Blirikiimer. The site (for the interpretive center) agreed upon in 1998 is very close to the site shown on the 1979 plan. The only difference is that the current site is located on a flatter portion of the crater, requiring less grading of the interior slope of the crater, and should result in a smaller front elevation (smaller looking building) when viewed from the Le'ahi Summit trail.

The interpretive center will provide information on the fragile eco-system within the crater, the history of the crater, and how to safely enjoy the crater. For convenience, each picnic area mentioned on page 20 of the DEIS would have a comfort station or easy access to a nearby restroom facility. One (1) of these picnic areas would have room for outdoor seating for community activities.

#### Other:

The purpose of this EIS is to include actions such as the possible realignment and/or under grounding of electrical and/or communication lines. A separate EIS will not be prepared regarding the relocation of communication and electric lines within the crater.

The comfort stations planned on page 29 are part of the interior picnic areas on pages 29-30 and figure 12. One of the picnic areas may accommodate "Community Activities". No "Large Events" are envisioned contrary to Plan Policy Number 4, page 26. The other picnic area with comfort station is to serve "Low-Density" use, page 20.

Figure 2 will be enlarged to 11" by 17" so that it is more legible.

Should you have any questions, please call Mr. Andrew Monden, Chief Engineer at 587-0230.

Aloha,

*Timothy E. Johns*

TIMOTHY E. JOHNS

COPY

**TOWNSCAPE, INC.**

Planned Communities, Master Plans, Land Use Permits

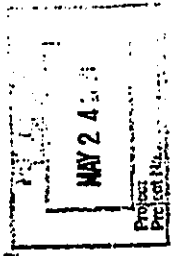
900 Fort Street Mall, Suite 800, Honolulu, HI 96813  
Telephone (808) 536-6999 Facsimile (808) 574-4998  
email address: townscape@panworld.net

May 22, 2000

Department of Land and Natural Resources  
State of Hawaii  
P.O. Box 621  
Honolulu, HI 96809

ATTN: Mr. Andrew Monden

RE: Diamond Head State Monument Master Plan Update  
Draft Environmental Impact Statement (March 2000)



Townscape, Inc. is contracted with the City & County of Honolulu as part of the City's Vision Process to prepare a *Diamond Head Road Recreation Master Plan*. The objective of our project is to identify how the roads, sidewalks and planting strips (and other elements within the streets' right-of-way) encircling the Diamond Head State Monument (Pali Avenue, Diamond Head Road, Moanani Avenue) can be enhanced for greater recreational enjoyment, and better relate to existing recreational amenities such as the State Monument and area City parks.

At the time of this writing, approximately one-third of the Diamond Head Road Recreation Master Plan process has been completed. Alternative plans and improvements are being developed and discussed. We appreciate the on-going involvement of DLNR staff and members of the Diamond Head Citizens Advisory Committee, along with members of our Community Advisory Committee, in this City project whose "boundary" literally encircles the State Monument. Continued coordination between the City and the State will be critical to the success of both projects.

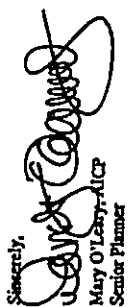
Particular elements of the Diamond Head State Monument Master Plan are potentially links to the City's Diamond Head Road Recreation Master Plan. Below is a listing of those portions of the Draft EIS Section 2.4 Key Elements of the Master Plan that are particularly applicable:

- Exterior Picnic Area (page 29)
  - Exterior picnic facilities are proposed in the area between Kahala Tunnel Lookout and 22<sup>nd</sup> Avenue"
- Landscaping (page 32)
  - Proposed development of a new Na La'u Arboretum.
- Linear Parkway (page 33)
  - "Diamond Head Road would be landscaped with trees, grass and shrubbery. All overhead utility lines and poles would be placed underground."

Diamond Head State Monument Master Plan Update  
Draft Environmental Impact Statement (March 2000)  
Page 2 of 2

It is recommended that the City and the State continue to coordinate with each other on the planning and implementation of these two inter-related projects to ensure that they are appropriately integrated and offer a cohesive recreational opportunity for all.

Thank you for the opportunity to comment.

Sincerely,  
  
Mary O'Leary-Alcega  
Senior Planner

cc: Office of Environmental Quality Control  
EP/ER Hawaii  
City Department of Design & Construction

12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32

SEKUNUKEI CAVALANO  
GOVERNOR OF HAWAII



STATE OF HAWAII  
DEPARTMENT OF LAND AND NATURAL RESOURCES  
P. O. BOX 521  
HONOLULU, HAWAII 96807

REF:LD/WL-EK

AUG 15 2000

Mary O'Leary, AICP  
Senior Planner  
Townscaps, Inc.  
900 Fort Street Mall, Suite 800  
Honolulu, Hawaii, 96813

Dear Ms. O'Leary:

**Diamond Head State Monument Master Plan Update  
Draft Environmental Impact Statement (DEIS)**

Thank you for your letter of May 22, 2000, commenting on Diamond Head State Monument Master Plan Update DEIS.

We agree that the processes of preparing the Diamond Head State Monument Master Plan Update and the Diamond Head Road Recreation Master plan are interrelated. We also agree that continued coordination between the City and the State will be critical to the success of both projects.

Should you have any questions, please call Mr. Andrew Monden, Chief Engineer, at 587-0230.

Aloha,  
*Timothy E. Johns*  
TIMOTHY E. JOHNS

TIMOTHY E. JOHNS, CHAIRPERSON  
BOARD OF LAND AND NATURAL RESOURCES  
DEPT. OF LAND AND NATURAL RESOURCES  
STATE OF HAWAII  
1515 KANELOA DRIVE  
HONOLULU, HAWAII 96813  
TEL: 521-1200  
FAX: 521-1200



3442 Waialeale Ave. #1, Honolulu, Hawaii 96816 • Voice/fax: (808) 735-5756 • Email: bicycle@hbl.com  
May 23, 2000

A NON-PROFIT CORPORATION

Andrew Monden  
State of Hawaii, Department of Land and Natural Resources  
P.O. Box 373  
Honolulu, HI 96809

Dear Mr. Monden,

The Hawaii Bicycling League supports efforts to improve Diamond Head through making environmentally friendly changes. We at HBL feel very strongly, however, that the area between 22nd Avenue and the Cannon Club area should be utilized more effectively. We propose extensive biking and hiking trails throughout this area, instead of the single path running along Diamond Head Road. Building a path that follows the road would be noisy and, with fast traffic whizzing by at all times, the ability to enjoy nature would prove impossible.

The area is very dense and lush, making it prime land for these purposes. The Peace Garden is a perfect example of what this area could potentially become. By expanding the garden to the rest of the proposed area, Diamond Head could exceed its reputation as an island attraction. The exterior monument area could be vastly improved and enjoyed by both residents and visitors alike. This is especially possible in conjunction with the phase five proposal allowing pedestrian and exit-only access through the Kahala Tunnel.

HBL also recognizes the need to conserve the native grassland/ shrubland within this area. This could be accomplished through careful trail placement and the use of these conservation lands as part of the attraction.

We at HBL are certain that support and cooperation is the key to any successful venture. Our community is willing to help. Corporate sponsorship and other resources should also be considered, since everyone wants to encourage and enjoy our natural aesthetic resources. HBL is eager to work with the planning department for this area in order to accomplish a better trail and bicycle system for our island residents and visitors.

If you have any questions regarding this proposal, please feel free to call us at 735-5756.

Sincerely,

*Eve DeCoursey*  
Eve DeCoursey  
Executive Director

PRESIDENT  
Amy Spence  
VICE PRESIDENT  
Howard Wigg  
SECRETARY  
Norma Lani  
TREASURER  
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EXECUTIVE DIRECTOR  
Eve DeCoursey  
BIKE ED MANAGER  
Chris Clark

MAY 30 2000

REGINA J. CANTIANO  
Executive Director



STATE OF HAWAII  
DEPARTMENT OF LAND AND NATURAL RESOURCES  
P. O. BOX 521  
HONOLULU, HAWAII 96809

REF:LD/WL/EK

AUG 15 2000

Ms. Eve DeCoursey  
Executive Director  
Hawaii Bicycling League  
3440 Waialeale Ave., #1  
Honolulu, Hawaii 96816

Dear Ms. DeCoursey:

**Diamond Head State Monument Master Plan Update  
Environmental Impact Statement (DEIS)**

Thank you for your letter of May 23, 2000, commenting on the Diamond Head State Monument Master Plan Update DEIS. We offer the following responses:

We agree that the plan should provide for an attractive area for bikers and hikers to travel outside of the crater. We acknowledge that building a single path that follows Diamond Head road would be impacted by traffic noise. To minimize such impacts, the path whenever possible will be elevated and located away from Diamond Head road.

We also acknowledge your desire to see a more extensive trail system along this area of the monument. As you may know, Townscape, Inc. is preparing a Diamond Head Road Recreation Master Plan for the City and County of Honolulu, which might address some of these issues as well.

Should you have any questions, please contact Mr. Andrew Monden, Chief Engineer at 587-0230.

Aloha,

*Timothy E. Johns*  
TIMOTHY E. JOHNS

TIMOTHY E. JOHNS, CHAIRPERSON  
BOARD OF LAND AND NATURAL RESOURCES  
8577  
JANET E. DUNFELD  
ADJUTANT GENERAL  
DEPARTMENT OF LAND AND NATURAL RESOURCES  
ENVIRONMENTAL  
PROTECTION  
DIVISION  
1505 EAST WILHELM  
AVENUE, SUITE 200  
HONOLULU, HAWAII 96819  
TELEPHONE: 521-2100  
FAX: 521-2101



STATE OF HAWAII  
DEPARTMENT OF LAND AND NATURAL RESOURCES

P. O. BOX 521  
HONOLULU, HAWAII 96809

AUG 15 2000

REF:LD/WL-EK

VOLUNTEER CENTER  
DEPARTMENT OF LAND AND NATURAL RESOURCES

OAHU FOUNTAIN GRASS WORKING GROUP  
P.O. Box 971665, Waipahu, Hawaii 96797; Phone: (808) 677-1674; email: [jyoshioka@dnr.hawaii.gov](mailto:jyoshioka@dnr.hawaii.gov)

June 23, 2000

Mr. Andrew Monden  
State of Hawaii  
Department of Land and Natural Resources  
P.O. Box 373  
Honolulu, Hawaii 96809

Dear Mr. Monden:

The Oahu Fountain Grass Working Group appreciates the opportunity to comment on the Draft Environmental Impact Statement for Diamond Head State Monument, Hawaii. The working group is dedicated to controlling the State-designated noxious weed, Fountain Grass (*Pennisetum setaceum*), and other invasive species on Oahu. The Oahu Fountain Grass Working Group consists of representatives from the U.S. Fish and Wildlife Service, State Department of Agriculture, State Department of Land and Natural Resources' Division of Forestry and Wildlife, U.S. Army, U.S. Navy, U.S.G.S. Biological Resources Division, City and County of Honolulu's Board of Water Supply, University of Hawaii, Hawaii Army National Guard, The Nature Conservancy of Hawaii and other concerned organizations.

We are very concerned about Fountain Grass that occurs throughout Diamond Head Crater. The population there represents the largest known infestation of this grass on Oahu. Fountain grass is a serious threat because its copious dead leaves provide excellent fuel for fire and, because it is fire-adapted, is one of the first plants to rejuvenate after a fire. Fountain grass has invaded thousands of acres on the Kona side of the Big Island and contributed to several very large fires that burned through the dry forests of Kaupulehu, Puuwaawaa and surrounding areas, including critically endangered plant populations. This grass is perhaps the most serious threat to native dry forests due to its fire-promoting qualities. On Oahu, Fountain Grass is in its early stages of establishment and we believe it should be eradicated before it spreads to other areas. Because Diamond Head State Monument receives high visitation, the risk of spread to other areas via seeds on hiker's boots and clothes or by wind is especially high. We want to ensure that Fountain Grass on Oahu is eradicated before it poses a similar threat to Oahu.

The group is already working with the Army National Guard to control Fountain Grass within Diamond Head Crater and would like to offer our continued assistance to help control and eventually eradicate Fountain Grass. Please contact me on behalf of the Oahu Fountain Grass Working Group at 677-1674 if you have questions or for additional information.

CC: Office of the Governor  
PBR Hawaii

Ms. Joan Yoshioka, Chairperson  
Oahu Fountain Grass Working Group  
P.O. Box 971665  
Waipahu, Hawaii 96797

Dear Ms. Yoshioka:

Diamond Head State Monument Master Plan Update  
Draft Environmental Impact Statement (DEIS)

Thank you for your letter of June 23, 2000, commenting on the Diamond Head State Monument Master Plan DEIS Update. We appreciate your comments regarding the need to control Fountain Grass throughout Diamond Head Crater. For your information, we received similar comments from the Hawaii Army National Guard Environmental Staff and the U.S. Fish and Wildlife Service. Please note that the removal of Fountain Grass is mentioned in Section 4.7 of the Draft EIS.

Should you have any questions, please contact Mr. Andrew Monden, Chief Engineer, at 587-0230.

Aloha,  
*Timothy E. Johns*  
for  
TIMOTHY E. JOHNS

*Appendix A*  
Civil Engineering Master Plan

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**Design Development**

Of

**Diamond Head State Monument  
Master Plan**

October 1998

Prepared By  
**Mitsunaga & Associates, Inc.**

## INTRODUCTION

The Diamond Head State Monument Master Plan consists of improvements to the interior and exterior of Diamond Head Crater. These improvements include a visitor center, trolley system, parking lot, improved hiking trails, and various infrastructure improvements.

This report describes the civil engineering design criteria and possible solutions to various improvements.

## **POTABLE WATER SYSTEM**

### **I BACKGROUND**

Potable water servicing the Diamond Head State Monument is provided by the municipal water system of the Board of Water Supply (BWS).

The BWS storage reservoirs at Wilhemina (2.0 MG) and Palolo (two 0.5 MG), spillway of 405 feet mean sea level, provides service to the Kaimuki, Kahala, and Diamond Head areas. The BWS system consists of transmission lines and grids of 8" water lines in the Kaimuki/Kahala area that distributes water from the reservoirs to a 12" main in Diamond Head Road. The elevation of the water main at the current connection point for Diamond Head State Monument is approximately 150 feet. The service pressure is approximately 100 psi.

### **II EXISTING DEMAND**

Domestic water is currently supplied to the Department of Defense Buildings 301, 303, 304, Battery Harlow, Tunnel 407, Cannon Club, FAA, and Civil Defense (Battery Birkhimer). Water is also supplied to the Diamond Head State Park, which uses potable water for both domestic and irrigation purposes. According to the Department of Defense records from the months of July to September 1998, the average demand was 40,000 gallons per day (gpd).

### **III EXISTING SYSTEM**

In the early 1990's, a potable water system providing service to the crater interior was designed and constructed by the Department of Land and Natural Resources (DLNR). Improvements include a new 12" transmission line and various distribution lines servicing the crater facilities.

A 12" transmission line connects to the 12" BWS water main at Diamond Head Road, near Kapiolani Community College (KCC). This transmission line runs from the BWS water main to the top of Kapahulu Tunnel, where it continues in the direction of the firing range. Water lines up to 8" serve the various facilities within the crater.

### **IV PROPOSED DEMAND**

The water demands were based on the Board of Water Supply System Standards, Volume 1, per estimated visitor counts provided by PBR Hawaii. The total peak domestic water demand for the visitor center, comfort stations, interpretive centers, Civil Defense, and caretaker's residence is 127 gallons per minute (gpm). Average daily demand is:

Visitor	21,000 gpd
Employees	500 gpd
Battery Birkhimer	3,800 gpd
Irrigation (1 acre around visitor center)	6,900 gpd
Total	32,200 gpd



Fire flow requirement is 2,000 gallons per minute. See Appendix B for calculations. The most critical area for fire flow is at Tunnel 407, because of its elevation and remote location.

#### V PROPOSED SYSTEM IMPROVEMENTS

Potable water is provided at the Visitor Center, comfort stations, Civil Defense, caretaker's residence, and Tunnel 407. Fire hydrants are proposed near the Visitor Center, caretaker's residence, and at Tunnel 407.

It is proposed that all irrigation needs be met with non-potable water sources, except for 1 acre around visitor center. These sources are discussed in a later section.

The proposed water system improvements include the reuse of existing 12" transmission line, new 12" transmission line, and new 8", 6", 4", and 2" distribution lines to service new facilities. A new 16" transmission line is proposed to connect the 12" line to Tunnel 407 to provide domestic and fire flow. See figure 2 for proposed water system alignment.

The proposed water system improvements have an estimated cost of \$600,000. See Appendix A for an itemized cost estimate.

### SANITARY SEWER SYSTEM

#### I BACKGROUND

Wastewater treatment and disposal services of the Diamond Head State Monument will be provided by the City and County of Honolulu municipal system.

The Diamond Head State Monument sewer system connects to an 8" City and County sewer line at the corner of Paikau Street and 22<sup>nd</sup> Avenue. Sewer is transmitted through a series of pump stations, force mains, and gravity lines to the Sand Island Wastewater Treatment Plant, for treatment and disposal.

#### II EXISTING DEMAND

No existing sewer demand flows are available. From current water consumption, sewer flows can be estimated by assuming 80% of water consumption is wastewater. Given this assumption, the current wastewater flow is about 32,000 gallons per day (gpd).

#### III EXISTING SYSTEM

The sanitary sewer system for the crater interior provides service for Department of Defense (DOD), Federal Aviation Administration (FAA), Civil Defense (Batter Birkheimer), and the Diamond Head State Park comfort station. Sewage from Tunnel 407 is disposed in a septic tank/cesspool system located at the tunnel interior entrance.

Sewage drains from the various facilities to a sewage lift station located south of building 303. The lift station pumps the sewage through a 4" force main to a manhole in Kahala Tunnel. From this manhole, sewage flows in a gravity sewer line to a City and County manhole at the intersection of Paikau Street and 22<sup>nd</sup> Avenue.

#### IV PROPOSED DEMAND

Design sewer flows were based on design criteria established by the City and County of Honolulu Design Standards of the Department of Wastewater Management and estimated visitor counts provided by PBR Hawaii. The design peak sewer flow is 324 gallons per minute (gpm). Average daily domestic flow is 20,000 gpd. See Appendix B for calculations.

#### V PROPOSED SYSTEM IMPROVEMENTS

A new sanitary sewer system servicing all facilities within the crater is proposed. This new system provides service to the Visitor Center, Civil Defense, comfort stations, caretaker's residence, and Tunnel 407.

All facilities within the crater drain through 6" or 8" pipes to a new sewage lift station located south of the visitor center. See figure 4 for proposed sewer system alignment. A new lift station pumps sewage through a 6" force main to a manhole located at the

interior opening of Kahala Tunnel. An 8" gravity line then drains to the City and County sewer system at Paikau Street.

The proposed sanitary sewer system improvements have an estimated cost of \$550,000. See Appendix A for an itemized cost estimate.

## DRAINAGE SYSTEM

### I BACKGROUND

The Diamond Head Crater has no natural drainage outlet to the ocean for surface runoff. Rain water flows down the steep crater walls to the low point in the crater. Without proper disposal of this water, flooding may occur.

### II EXISTING RUNOFF

The quantities for storm water runoff were estimated using the Storm Drainage Standards of the Department of Public Works, City and County of Honolulu. Existing topographic maps were used to determine the tributary areas for each drainage area.

Design of culverts is based on a 10 year storm. Design of pump station, force main, and drain line is based on 100 year storm. The total drainage area is 250 acres. For a 100 year storm, peak discharge is estimated at 1500 cubic feet per second (cfs).

### III EXISTING SYSTEM

The existing system consist of natural drainage ways, culverts, lift station, and drain lines that allow the runoff to flow down the crater walls and eventually discharged out of the crater. Culverts allow runoff to flow under paved surfaces, which prevent flooding of roadways and the build-up of debris on the roadways. Once the runoff reaches the low point in the crater, a diesel powered lift station pumps the water through a force main. The force main ends at the interior opening of Kahala Tunnel, where the water drains through gravity lines to the City and County of Honolulu drainage manhole at Paikau Street.

### IV PROPOSED DEMAND

For this Master Plan, there will be no change in storm water runoff.

### V PROPOSED SYSTEM IMPROVEMENTS

It is proposed that all existing culverts are left in place, new culverts added, and to convey storm water out of the crater a new lift station, force main, and gravity drain line be constructed.

The new trolley roadways are proposed to circle the crater interior. Culverts are proposed along this road to carry storm water under the roadway. See figure 6 for proposed drainage improvements.

A new lift station, force main, and gravity line is to pump water out of the crater is proposed. The lift station would pump storm water through a force main, to a manhole in Kahala Tunnel. From this manhole, a gravity drain connects to the City and County of Honolulu manhole at Paikau Street.

The proposed drainage system improvements have an estimated cost of \$350,000. See Appendix A for an itemized cost estimate.

## IRRIGATION SYSTEM

### **I BACKGROUND**

Source of non-potable irrigation water may be available from wells drilled outside the crater. Although non-potable water sources has yet to be confirmed, it is assumed for this report that non-potable water is available.

### **II EXISTING DEMAND**

The irrigation demand is unknown.

### **III EXISTING SYSTEM**

Currently, all irrigation needs are met by the existing potable water system. The existing irrigation system is unknown.

### **IV PROPOSED DEMAND**

Irrigation demand is provided by PBR Hawaii and is approximately 277,000 gallons per day (gpd) to irrigate 40 acres of landscaped area.

### **V PROPOSED SYSTEM IMPROVEMENTS**

An irrigation system, which includes non-potable wells, pumps, transmission lines, and a storage reservoir, is proposed.

Approximately four wells located on the exterior of the crater, spaced approximately 1000 feet apart are proposed. These wells may vary in depth, from 150 to 175 feet. The wells are to be outfitted with pumps to pump water into the crater through Kapahu Tunnel. From Kapahu Tunnel, the non-potable water flows to a created wetland at the crater floor. The wetland will be used to store irrigation water. It includes a pond, which will be used as a reservoir for irrigation water. The wetland will be lined with a waterproof membrane. From the wetland, a pump will distribute the irrigation water to various locations in the on Diamond Head State Monument. See figure 7 for proposed irrigation system alignment and well locations.

Pumps, irrigation lines, and appurtenances required to distribute irrigation water from the wetland to various locations on Diamond Head State Monument is not covered in this report.

The proposed irrigation system, including artificial pond, is estimated at \$2,000,000. See Appendix A for an itemized cost estimate

## ROADWAY SYSTEM

### **I BACKGROUND**

The proposed roadway improvements are based on conceptual plans provided by PBR Hawaii and recommendations stated in a traffic study prepared by Parsons Brinckerhoff, Inc. in October 1998.

The proposed roadways will conform to applicable engineering design guidelines and recommendations provided by Parsons Brinckerhoff, Inc. The proposed trolley roadways also consider trolley limitations and pedestrian traffic.

### **II EXISTING ROADWAYS**

Access to the crater is along Diamond Head Road, near 18<sup>th</sup> Avenue. Crater Road starts at Diamond Head Road and continues through Kahala Tunnel. After entering the crater, Crater Road leads to the visitor parking, located near the Department of Defense (DOD) buildings.

A series of roads service various facilities in the crater. All roads are asphalt concrete paved, with exception to the road leading to Tunnel 407, and vary in width and grade. The road to Tunnel 407 is unpaved.

Visitors enter the crater by bus, car, or walking. Vehicles drive from Diamond Head Road to the crater interior and park in the parking lot or on the roadside. Since no sidewalks or dedicated pedestrian paths are present, pedestrians entering the crater must walk on the roadways.

Employees of DOD, Federal Aviation Administration (FAA), and Civil Defense utilize roadways that service their respective facilities. Access to the crater interior for employees are also through Kahala Tunnel.

### **IV PROPOSED SYSTEM IMPROVEMENTS**

Improvements include a new trolley roadway, emergency access, parking at Cannon Club, and a multi-user pedestrian/bicycle pathway is along Diamond Head Road. Improvements to various sections of Diamond Head Road are recommended by Diamond Head State Monument Master Plan Traffic Impact Analysis prepared by Parsons Brinckerhoff in October 1998.

The trolley roadway design is based on roadway alignment provided by PBR Hawaii. A typical trolley roadway is proposed to have 12 foot pavement and 4 foot shoulders on each side to accommodate emergency vehicles. Grades have a minimum of 1% and a maximum of 8%. Guardrails are provided where needed.

Temporary visitor parking is proposed next to the visitor center.

Permanent visitor parking is proposed at the Cannon Club parking lot. Improvements to the Cannon Club involve re-paving.

The multi-user pedestrian/bicycle path is proposed to run along Diamond Head Road, from the Cannon Club to 22nd Avenue. The path is proposed to be 10 feet wide and paved with asphalt concrete.

The proposed improvements to the trolley roads, parking lots, and pedestrian/bicycle paths have an estimated cost of \$1,000,000. See Appendix A for an itemized cost estimate.

The Parsons Brinckerhoff report had recommended traffic signalization at the intersection of Diamond Head Road and Makapuu Avenue. Proposed improvements include widening of the intersection and adding traffic signals. The proposed intersection improvements have an estimated cost of \$300,000. See Appendix A for an itemized cost estimate.

## SITE WORK AND HIKING TRAILS

### **I BACKGROUND**

The Visitor Center is proposed to be located near Kahala Tunnel, below Civil Defense. This area is gradually sloped and is partially covered with plants and vegetation and partially covered with asphalt concrete roads.

Site preparation includes clearing and grubbing, excavation and embankment, hauling and disposal, and removal of existing roadways and parking lots.

A hiking trail currently in use leads to the Leahi summit, located on the ocean side of the crater rim. New hiking trails are proposed to traverse the crater floor and crater rim.

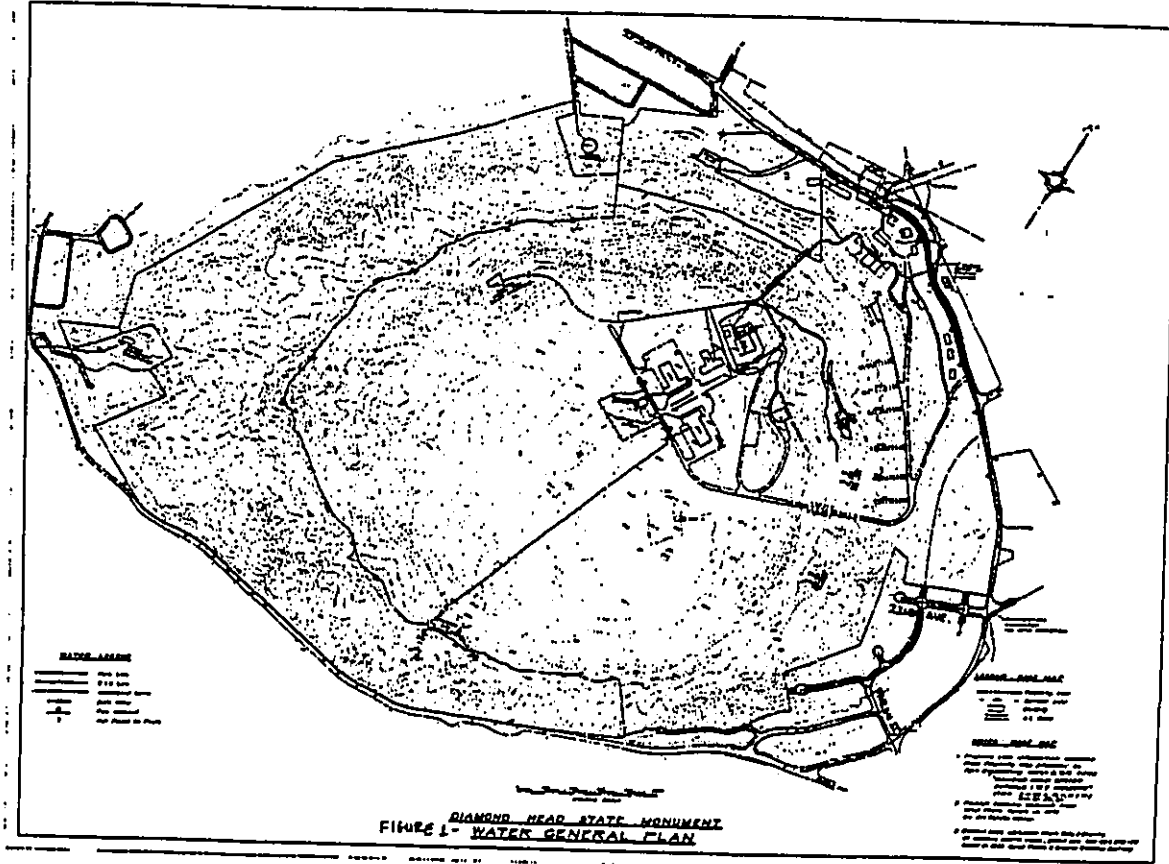
### **II PROPOSED IMPROVEMENTS**

At this time, site work is only estimated using preliminary Visitor Center plans provided by PBR Hawaii. Approximately 2 acres are cleared for the Visitor Center. Extent of demolition work to existing pavement is based on topographic maps and conceptual plans provided by PBR Hawaii.

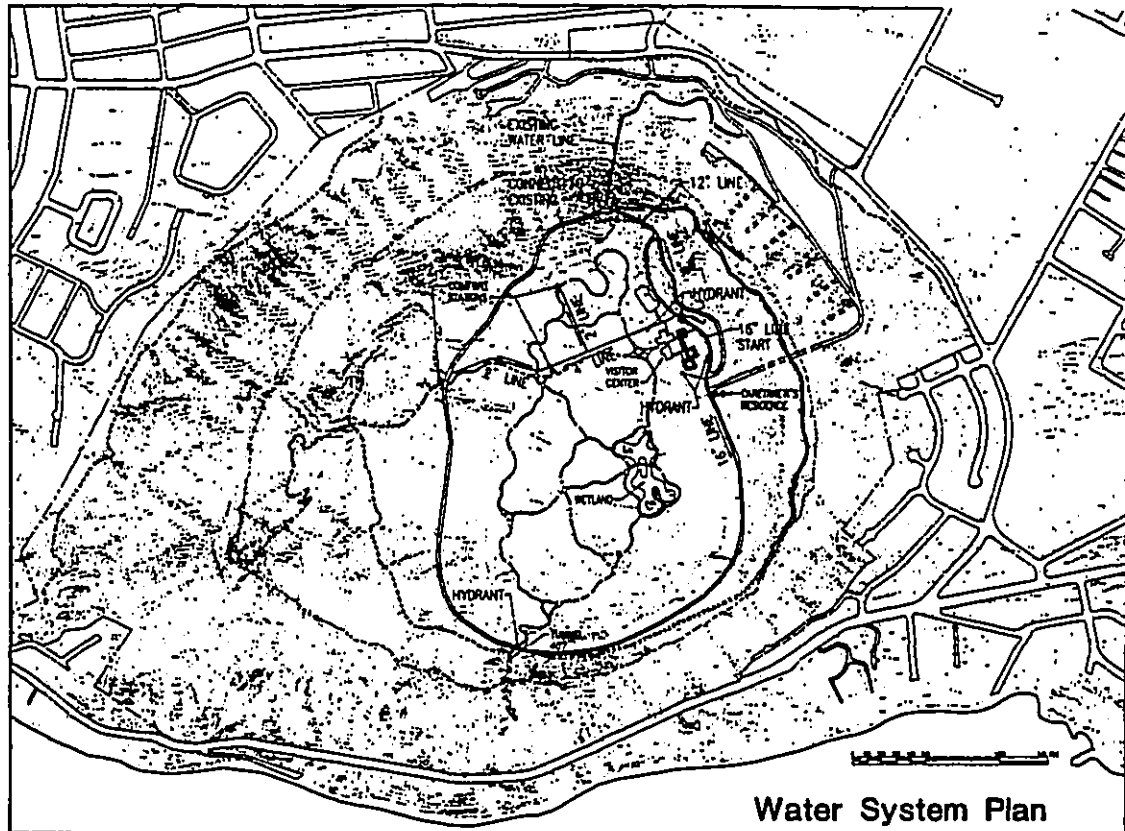
The proposed site improvements have an estimated cost of \$1,550,000. See Appendix A for an itemized cost estimate.

Hiking trails are proposed on the crater floor and around the crater rim. Concrete walkways which are ADA compliant are proposed in the vicinity of the Visitor Center and around the wetland area. 7800 lineal feet of 6 foot wide concrete paths are proposed. Approximately 15,000 lineal feet of non-ADA compliant hiking trails are proposed to navigate the crater rim and various scenic points in the crater.

The proposed hiking trail improvements have an estimated cost of \$350,000. See Appendix A for an itemized cost estimate.



DIAMOND HEAD STATE MONUMENT  
FIGURE 1 - WATER GENERAL PLAN



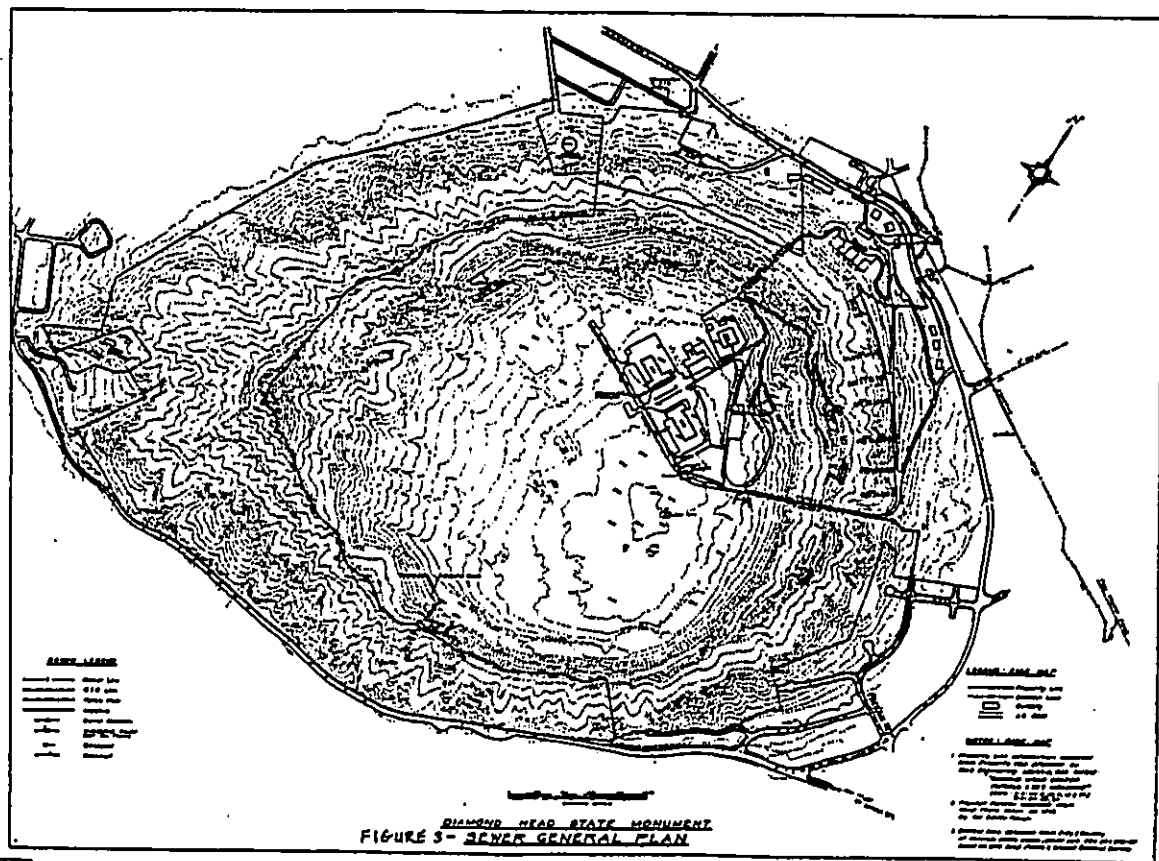
Water System Plan

Figure 2



Wilmarra & Associates, Inc.

DIAMOND HEAD STATE MONUMENT VISITOR CENTER



DIAMOND HEAD STATE MONUMENT  
FIGURE 3 - SEWER GENERAL PLAN

**SEWER LINES**

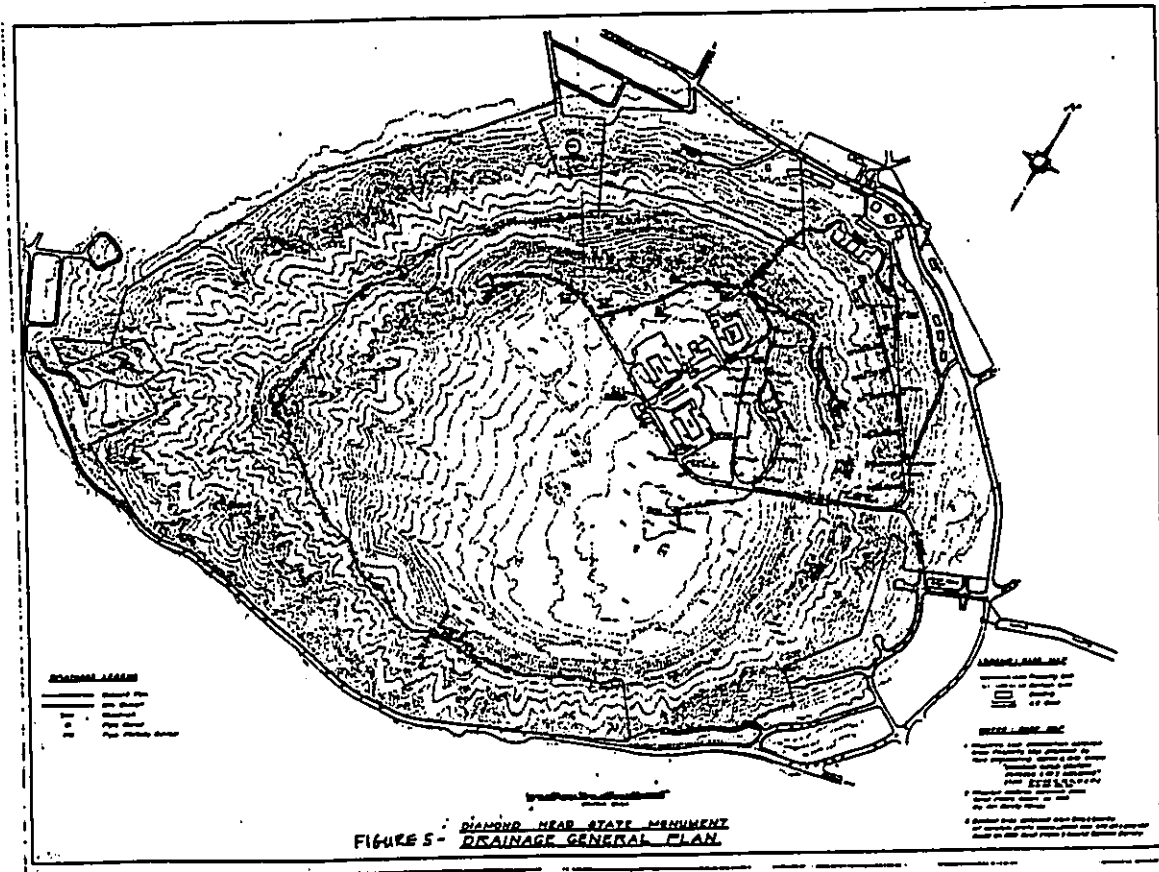
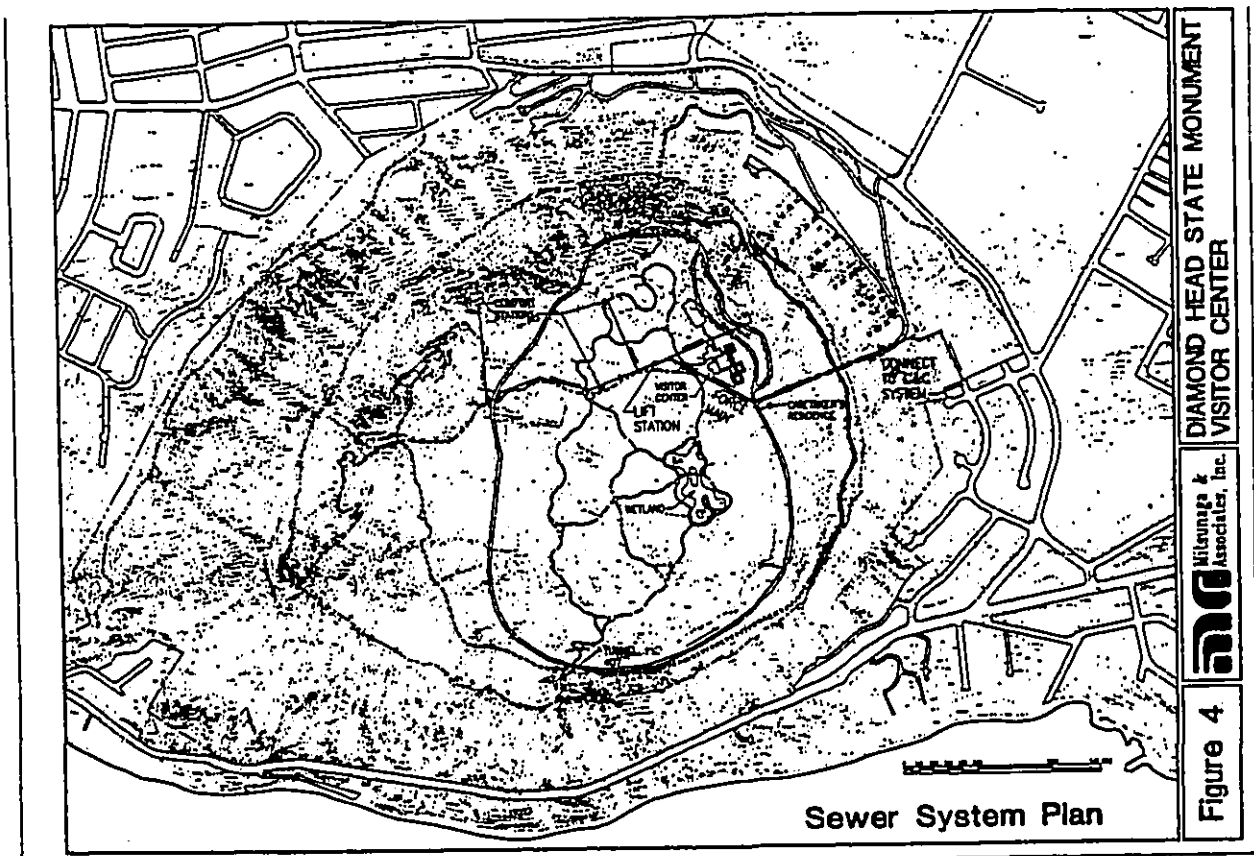
[Symbol]	12" Sewer
[Symbol]	15" Sewer
[Symbol]	18" Sewer
[Symbol]	24" Sewer
[Symbol]	30" Sewer
[Symbol]	36" Sewer
[Symbol]	42" Sewer
[Symbol]	48" Sewer
[Symbol]	54" Sewer
[Symbol]	60" Sewer
[Symbol]	66" Sewer
[Symbol]	72" Sewer
[Symbol]	78" Sewer
[Symbol]	84" Sewer
[Symbol]	90" Sewer
[Symbol]	96" Sewer
[Symbol]	102" Sewer
[Symbol]	108" Sewer
[Symbol]	114" Sewer
[Symbol]	120" Sewer

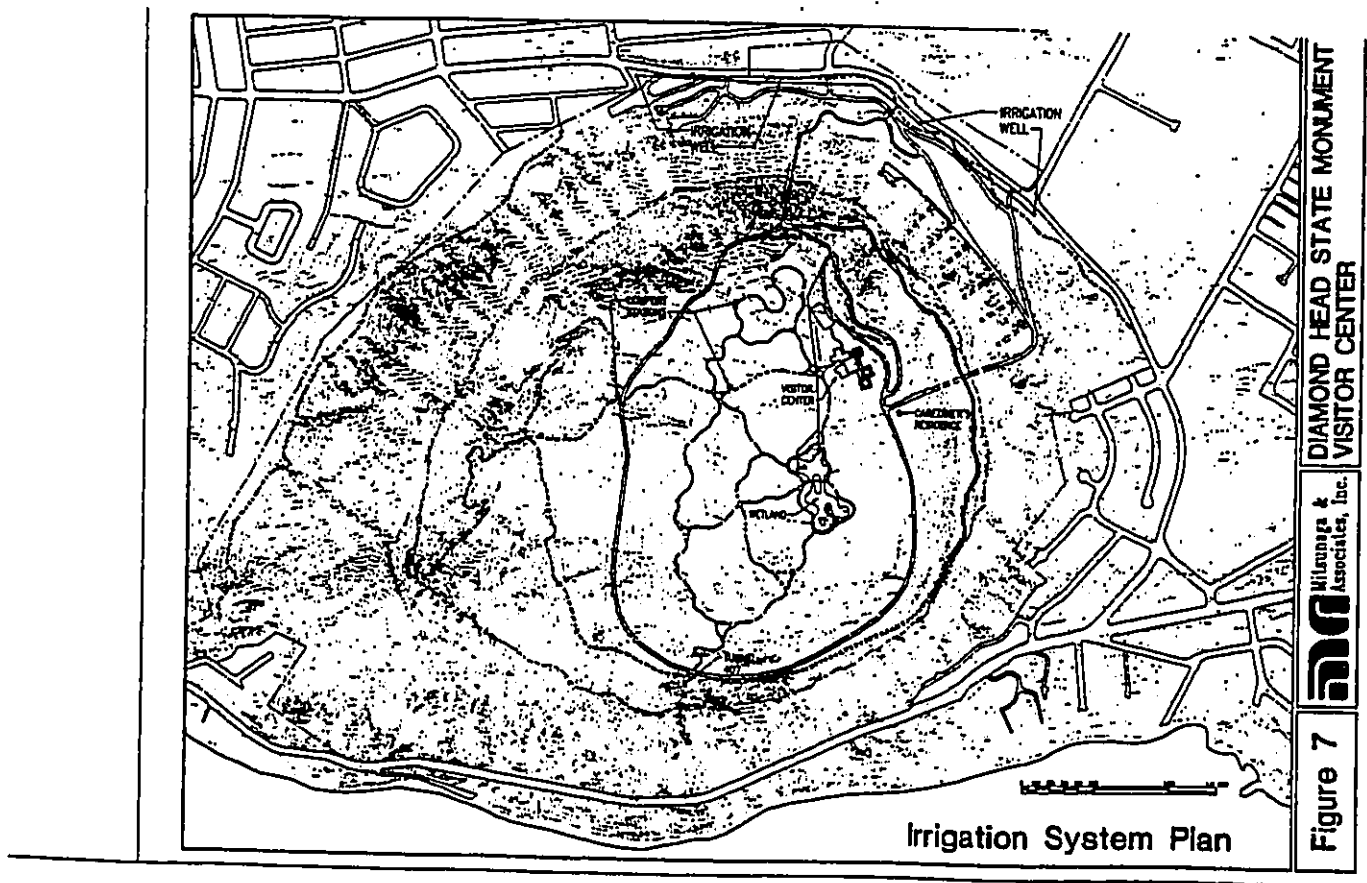
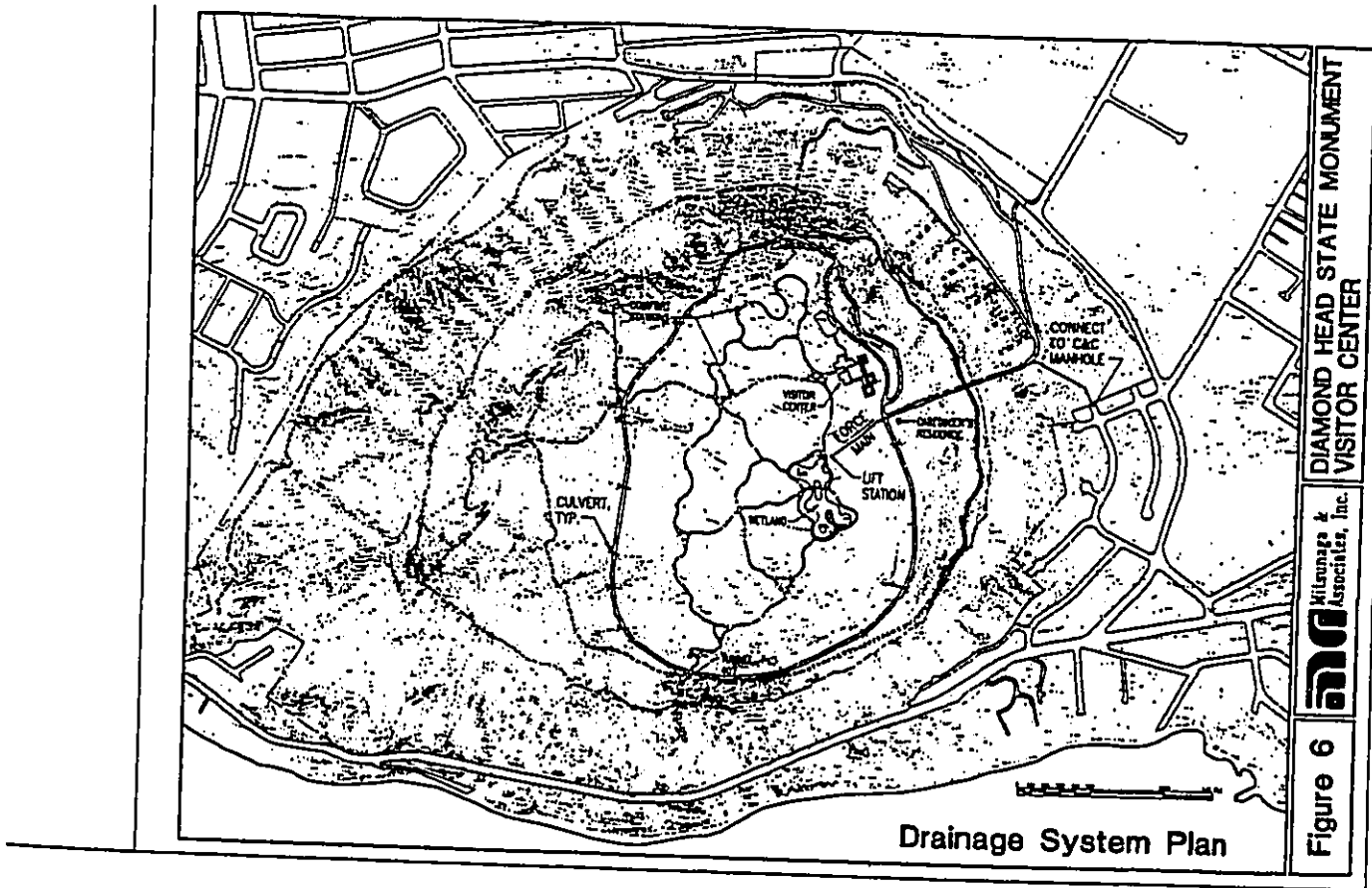
**MANHOLES**

[Symbol]	12" Manhole
[Symbol]	15" Manhole
[Symbol]	18" Manhole
[Symbol]	24" Manhole
[Symbol]	30" Manhole
[Symbol]	36" Manhole
[Symbol]	42" Manhole
[Symbol]	48" Manhole
[Symbol]	54" Manhole
[Symbol]	60" Manhole
[Symbol]	66" Manhole
[Symbol]	72" Manhole
[Symbol]	78" Manhole
[Symbol]	84" Manhole
[Symbol]	90" Manhole
[Symbol]	96" Manhole
[Symbol]	102" Manhole
[Symbol]	108" Manhole
[Symbol]	114" Manhole
[Symbol]	120" Manhole

**NOTES:**

- All sewer lines shall be installed in accordance with the latest edition of the International Plumbing Code.
- All manholes shall be installed in accordance with the latest edition of the International Plumbing Code.
- All sewer lines shall be installed in accordance with the latest edition of the International Plumbing Code.
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STATE OF HAWAII  
DEPARTMENT OF LAND AND NATURAL RESOURCES

PROJECT Diamond Head State Monument  
Cost Summary

PREPARED BY: MITSUNAGA AND ASSOCIATES, INC  
DATE: JUNE 1998

SUBMITTAL: SCHEMATIC

PROJECT NO.:

ITEM NO.	ITEM	AMOUNT
1	Crater Exterior Improvements	\$1,000,000
2	Crater Interior Improvements	\$8,500,000
3	Trolley Road In Crater	\$2,100,000
4	Intersection Improvements	\$300,000
<b>TOTAL ESTIMATED COST</b>		<b>\$10,000,000</b>

**APPENDIX A**  
**COST ESTIMATE**

STATE OF HAWAII  
DEPARTMENT OF LAND AND NATURAL RESOURCES

PROJECT Diamond Head State Monument  
Crater Interior Improvements

PREPARED BY: MITSUNAGA AND ASSOCIATES, INC  
DATE: October 1998

PROJECT NO.:

SUBMITTAL: SCHEMATIC

ITEM NO.	ITEM	APPROX. QUANTITY	UNIT	UNIT PRICE	AMOUNT
<b>DRAINAGE SYSTEM</b>					
17	Furnishing and Installing 24-inch culvert drain pipe, in place complete	510	LIN FT	\$90	\$45,900
18	Furnishing and Installing 12-inch drain force main, in place complete	800	LIN FT	\$60	\$48,000
19	Furnishing and Installing 18-inch drain pipe, in place complete	1,350	LIN FT	\$75	\$101,250
20	Culvert Headwall	22	EACH	\$2,000	\$44,000
21	Manhole	4	EACH	\$5,000	\$20,000
22	Lift station	1	EACH	\$100,000	\$100,000
SUBTOTAL					\$359,150
<b>TRAIL IMPROVEMENTS</b>					
23	4" Thick Conc. Walkway (ADA Comp.) w/ agg. base course - 6'-0" wide	7,800	LIN FT	\$55	\$429,000
24	Hiking Trails (non-ADA Comp.) - 5'-0" wide	14,900	LIN FT	\$10	\$149,000
25	Trail Hand Railings	7,100	LIN FT	\$30	\$213,000
SUBTOTAL					\$362,000
<b>WETLAND IMPROVEMENTS</b>					
26	Wetland Pond Clearing and Grubbing	5	ACRE	\$2,500	\$11,500
27	Wetland Pond Excavation	21,000	CU YD	\$40	\$840,000
28	Pond Liner	80,000	SQ FT	\$3	\$240,000
29	Embankment Over Rubber Liner - 12" thick	3,000	CU YD	\$10	\$30,000
30	Furnish and install 12" irrigation pipe from pond to pump	50	LIN FT	\$75	\$3,750
31	Irrigation Well and pump	4	EACH	\$150,000	\$600,000
32	Furnish and install 4" irrigation pipe from wells to wetland	6,700	LIN FT	\$35	\$234,500
33	1 1/2" Asphalt Concrete Overlay on exist. roads in crater	5,100	SQ YD	\$10	\$51,000
SUBTOTAL					\$2,010,750
34	Temporary Project Water Pollution Control	1	FA	\$10,000	\$10,000
35	Mobilization (not to exceed 6 percent of the sum of all items excluding this item)	1	LS	\$325,647	\$325,647
Subtotal					\$5,753,097
Contingency (15%)					\$862,965
<b>TOTAL ESTIMATED COST</b>					<b>\$6,600,000</b>

STATE OF HAWAII  
DEPARTMENT OF LAND AND NATURAL RESOURCES

PROJECT Diamond Head State Monument  
Crater Interior Improvements

PREPARED BY: MITSUNAGA AND ASSOCIATES, INC  
DATE: October 1998

PROJECT NO.:

SUBMITTAL: SCHEMATIC

ITEM NO.	ITEM	APPROX. QUANTITY	UNIT	UNIT PRICE	AMOUNT
<b>SITE IMPROVEMENTS FOR VISITOR CENTER</b>					
1	Clearing and Grubbing	1.80	ACRE	\$2,500	\$4,750
2	Excavation	16,120	CU YD	\$40	\$644,800
3	Haul and Disposal	16,120	CU YD	\$10	\$161,200
4	Demolish and Remove Existing A/C Pavment	37,500	SQ YD	\$20	\$750,000
SUBTOTAL					\$1,560,750
<b>WATER SYSTEM</b>					
5	Furnishing and Installing 18-inch Pipe, Valves and all Appurtenances,	3,400	LIN FT	\$100	\$340,000
6	Furnishing and Installing 12-inch Pipe, Valves and all Appurtenances,	1,200	LIN FT	\$75	\$90,000
7	Furnishing and Installing 8-inch Pipe, Valves and all Appurtenances,	1,100	LIN FT	\$50	\$55,000
8	Furnishing and Installing 6-inch Pipe, Valves and all Appurtenances,	250	LIN FT	\$40	\$10,000
9	Furnishing and Installing 4-inch Pipe, Valves and all Appurtenances,	700	LIN FT	\$35	\$24,500
10	Furnishing and Installing 2-inch Pipe, Valves and all Appurtenances,	2,200	LIN FT	\$25	\$55,000
11	Install 6" Water Meter, in place complete	1	EACH	\$7,000	\$7,000
	Chlorination and Testing	1	LS	\$5,000	\$5,000
SUBTOTAL					\$586,500
<b>SEWER SYSTEM</b>					
12	Furnishing and Installing 8-inch sewer pipe, in place complete	5,580	LIN FT	\$35	\$195,300
13	Furnishing and Installing 8-inch sewer pipe, in place complete	2,250	LIN FT	\$40	\$90,000
14	Furnishing and Installing 6-inch sewer force main, in place complete	1,200	LIN FT	\$40	\$48,000
15	Sewer Manhole	33	EACH	\$5,000	\$165,000
16	Package Sewer Lift Station	1	EACH	\$40,000	\$40,000
SUBTOTAL					\$538,300

STATE OF HAWAII  
DEPARTMENT OF LAND AND NATURAL RESOURCES

PROJECT Diamond Head State Monument  
Trolley Roadway With In Crater

PREPARED BY: MITSUNAGA AND ASSOCIATES, INC  
DATE: JUNE 1988

PROJECT NO.:

SUBMITTAL: SCHEMATIC

ITEM NO.	ITEM	APPROX. QUANTITY	UNIT	UNIT PRICE	AMOUNT
	<b>TROLLEY ROADWAY WITH CRATER SITE IMPROVEMENTS</b>				
1	Clearing and Grubbing	20	ACRE	\$2,500.00	\$50,000
2	Excavation	1,750	CU YD	\$40.00	\$70,000
3	Embankment	19,600	CU YD	\$35.00	\$686,000
4	6" Aggregate Base Course	1,950	CU YD	\$42.00	\$81,900
5	2" Asphalt Concrete Pavement Mix No. IV	11,500	SQ YD	\$13.00	\$149,500
6	Grassing	215,000	SQ FT	\$2.00	\$430,000
7	Guardrail	8,000	LIN FT	\$32.00	\$256,000
	<b>SUBTOTAL</b>				\$1,723,400
7	Mobilization (not to exceed 8 percent of the sum of all items excluding this item)	1	LS	\$103,404.00	\$103,404
	Subtotal				\$1,826,804
	Contingency (15%)				\$274,021
	<b>TOTAL ESTIMATED COST</b>				\$2,100,000

STATE OF HAWAII  
DEPARTMENT OF LAND AND NATURAL RESOURCES

PROJECT Diamond Head State Monument  
Trolley Roadway/Parking/Bikeway/Emergency Access Outside of Crater

PREPARED BY: MITSUNAGA AND ASSOCIATES, INC  
DATE: JUNE 1988

PROJECT NO.:

SUBMITTAL: SCHEMATIC

ITEM NO.	ITEM	APPROX. QUANTITY	UNIT	UNIT PRICE	AMOUNT
	<b>SITE IMPROVEMENTS</b>				
1	Clearing and Grubbing	3.00	ACRE	\$2,500.00	\$7,500
2	Rock Excavation (Trolley Turn Around)	450	CU YD	\$100.00	\$45,000
3	Embankment	2,800	CU YD	\$35.00	\$98,000
4	6" Aggregate Base Course	2,200	CU YD	\$42.00	\$92,400
5	2" Asphalt Concrete Pavement Mix No. IV	42,000	SQ YD	\$13.00	\$546,000
6	Curb and Gutter	200	LF	\$30.00	\$6,000
	<b>SUBTOTAL</b>				\$794,900
7	Mobilization (not to exceed 6 percent of the sum of all items excluding this item)	1	LS	\$47,694.00	\$47,694
	Subtotal				\$842,594
	Contingency (15%)				\$126,389
	<b>TOTAL ESTIMATED COST</b>				\$1,000,000

**APPENDIX B**  
**CALCULATIONS AND**  
**QUANTITIES**

STATE OF HAWAII  
DEPARTMENT OF LAND AND NATURAL RESOURCES

PROJECT Diamond Head State Monument  
Intersection Improvements at Diamond Head Road and Makapuu Ave.

PREPARED BY: MITSUNAGA AND ASSOCIATES, INC  
DATE: JUNE 1998

PROJECT NO.:

SUBMITTAL: SCHEMATIC

ITEM NO.	ITEM	APPROX. QUANTITY	UNIT	UNIT PRICE	AMOUNT
<b>SITE IMPROVEMENTS</b>					
1	Clearing and Grubbing	0.50	ACRE	\$2,500.00	\$1,250
2	6" Aggregate Base Course	50	CU YD	\$42.00	\$2,100
3	2" Asphalt Concrete Pavement Mix No. IV	160	SQ YD	\$13.00	\$2,080
4	Curb and Gutter	220	LF	\$30.00	\$6,600
5	Concrete Pad For Bus Lane	1,200	SQ FT	\$10.00	\$12,000
6	Traffic Signals For Four Way Intersection	1	LS	\$250,000.00	\$250,000
	<b>SUBTOTAL</b>				\$274,030
7	Mobilization (not to exceed 6 percent of the sum of all items excluding this item)	1	LS	\$16,441.80	\$16,442
	Subtotal				\$290,472
	Contingency (15%)				\$43,571
	<b>TOTAL ESTIMATED COST</b>				\$300,000

WATER SUPPLY

- 1000,000 VISITORS/YEAR, USE 3000 VISITORS/DAY
- 25 EMPLOYEES/DAY (ASSUMED)
- 7 GALL/VISITOR/DAY
- 20 GALL/EMPLOYEE/DAY
- NO POTABLE WATER IRRIGATION

AVERAGE DAILY DEMAND =  $(7 \times 3,000) + (20 \times 25) + 3000 + 6900$   
 $= 32,200 \text{ GPD}$   
 $= 22.2 \text{ GPM}$

MAX. DAILY DEMAND =  $(22.2 \text{ GPM})(1.5)$   
 $= 33.3 \text{ GPM}$

PEAK FLOW =  $(22.2 \text{ GPM})(3.0) = 67 \text{ GPM}$  (40 PSI RESIDUAL)

FIRE FLOW = 2,000 GPM

DESIGN FLOW = MAX. DAILY DEMAND + FIRE FLOW

$= 33 + 2000$

$= 2033 \text{ GPM}$  (20 PSI RESIDUAL)

WASTE WATER SYSTEM

- 5 GALL/VISITOR/DAY
- 15 GALL/EMPLOYEE/DAY

AVERAGE FLOW =  $(5 \times 3,000) + (15 \times 25)$   
 $= 15,375 \text{ GPD}$   
 $= 10.6 \text{ GPM}$

MAX. FLOW =  $10.6 \times 5.0 = 53 \text{ GPM}$

DRY WEATHER  $\frac{1}{3} = 5 \text{ GPD} \times 3,025 = 15,125 \text{ GPD} = 10.5 \text{ GPM}$

DESIGN AVE. FLOW =  $10.6 \text{ GPM} + 0.5 \text{ GPM} = 11.1 \text{ GPM}$

DESIGN MAX. FLOW =  $53 \text{ GPM} + 10.5 \text{ GPM} = 63.5 \text{ GPM}$

WET WEATHER  $\frac{1}{3} = 1250 \text{ GALL/DAY} \times 300 \text{ AC} = 375,000 \text{ GPD} = 260 \text{ GPM}$

DESIGN PEAK FLOW =  $63.5 \text{ GPM} + 260 \text{ GPM} = 324 \text{ GPM}$

- HIGHLY AVERAGE DAILY FLOW = 80% OF DAILY DEMAND
- AVE FLOW = 20,240 GPD

WATER SYSTEM QUANTITIES

- 12" WATER LINE  
 - FROM BATTERY BIRKUMER TO TOP OF KAPAHULU TUNNEL  
 - 200 LF. FROM KAPAHULU TUNNEL TO VISITOR CENTER

- 16" WATER LINE  
 - 340 LF. FROM VISITOR CENTER TO TUNNEL 407

- 8" WATER LINE  
 - 1000 LF. FROM 12" LINE NEAR V.C. TO HYDRANT IN FRONT OF V.C.

- 10" WATER LINE  
 - 100 LF. FROM 12" LINE TO VISITOR CENTER

- 6" WATER LINE  
 - 50 LF. FROM 8" LINE TO HYDRANT #1 IN FRONT OF V.C.

- 12" LF  
 - FROM 12" LINE TO HYDRANT #2 IN BACK OF V.C.

- 12" LF  
 - FROM 16" LINE TO HYDRANT #3 IN BACK OF V.C.

- 150 LF  
 - FROM 16" LINE TO HYDRANT #4 ADJACENT TO V.C.

- 12" LF  
 - FROM 16" LINE TO HYDRANT #5 NEAR CARETAKER'S RESIDENCE

- 12" LF  
 - FROM 16" LINE TO HYDRANT #6 AT TUNNEL 407

7 1/2" LF

- 8" WATER LINE  
 - 700 LF. FROM 8" LINE TO EXIST. COMFORT STATION

2" WATER LINE

- 600 LF. FROM 12" LINE TO BIRKUMER
- 500 LF. FROM 4" LINE TO COMFORT STATION NEAREST KAPAHULU TUNNEL
- 20 LF. FROM 4" LINE TO EXIST. COMFORT STATION
- 900 LF. FROM 4" LINE TO COMFORT STATION AT CREEPY RANGE
- 60 LF. FROM 16" LINE TO CARETAKER'S RESIDENCE
- 120 LF. FROM 16" LINE TO TUNNEL 407

3" DOLF

DESCRIPTION	BY	CHECKED
	Mitsunaga & Associates, Inc.	
PROJECT	JOB NO.	SHEET
		OF
	DATE	

DESCRIPTION	BY	CHECKED
	Mitsunaga & Associates, Inc.	
PROJECT	JOB NO.	SHEET
	Project: Pinedale Head State Monument	OF
	DATE	

SEWER SYSTEM QUANTITIES

- 8" SEWER GRAVITY LINE
- 650 LF - FROM VISITOR CENTER TO LIFT STATION
  - 1600 LF - FROM TOP OF KANSLA TUNNEL TO CFC SYSTEM
- 2580 LF
- 6" SEWER FORCE MAIN
- 1200 LF - FROM LIFT STATION TO TOP OF KANSLA TUNNEL
- 6" SEWER GRAVITY LINE
- 3500 LF - FROM TUNNEL 407 TO 8" LINE IN FRONT OF 1/4 15 M.H.
  - 300 LF - FROM BIRKHAMER TO V.C. 2 M.H.
  - 1200 LF - FROM COMFORT STATION AT FIRING RANG TO LIFT STATION 6 M.H.
  - 20 LF - FROM EXIST. COMFORT STATION TO 6" LINE
  - 500 LF - FROM COMFORT STATION NEAREST KAPPAHOLD TUNNEL 1 M.H.
  - 60 LF - FROM CARETAKER'S RESIDENCE TO 6" LINE
- 5580 LF

DESIGNS

CULVERT 31-TUNNELS 477 ACRES 20. MEASURES TO CR 101 RD

TRIBUTARY AREA: 265,000 SQ. FT.

AREA: 6.1 ACRES.

CURVEFF 10% EFFICIENT: 0.07

RAINFALL INTENSITY:

$$I = \sqrt{\frac{A}{T}} \cdot \sqrt{\frac{I_p}{I_s}} = 2.2$$

TIME TO DRINK: 5 MIN.

REGRESSION FACTOR: 2.8

PER. TIME: 12. I = 2.0

$$I_c = (2.8)(12.0)(2.0) = 134.4$$

Q = CA (0.56)(134.4)

Q = 30.1 CFS

USE 16" PIPE

VELOCITY = 2.5 FPS

VELOCITY = 2.5 FPS

VELOCITY = 2.5 FPS

VELOCITY = 2.5 FPS

VELOCITY = 2.5 FPS

VELOCITY = 2.5 FPS

VELOCITY = 2.5 FPS

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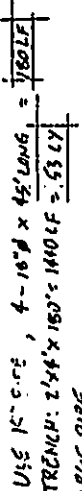
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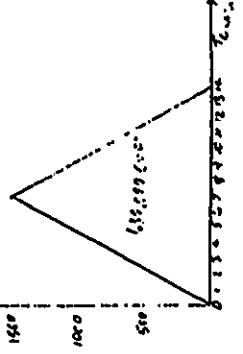
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USE 16" PIPE, 4'-10" x 45' LONG = 180 LF  
 TRENCH: 2 1/4" x 160' = 140 LF = 53 LF  
 DISCHARGE PIPE  
 CATCH AREA: 250 ACRES  
 PEAK DISCHARGE: 1500 CFS (PLATES)  
 TIME TO DRINK: 5.5 HOURS



FOR 18" PIPE, S = 0.1, FULL FLOW  
 Q = 32 CFS  
 TIME TO DRINK = 5.5 HOURS  
 USE 16" PIPE  
 FOR 16" PIPE, S = 0.1, FULL FLOW  
 Q = 25 CFS  
 TIME TO DRINK = 5.5 HOURS  
 TRENCH: 2 1/4" x 160' = 140 LF  
 DISCHARGE PIPE

DESCRIPTION: Mitsunaga & Associates, Inc.

PROJECT: Damned Head State Management

BY: \_\_\_\_\_

JOB NO. \_\_\_\_\_

DATE \_\_\_\_\_

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OF \_\_\_\_\_

DESCRIPTION: Mitsunaga & Associates, Inc.

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OF \_\_\_\_\_

DRAINAGE SYSTEM

- 12" RCP FORCE MAIN
- 800 LF - FROM LIFT STATION TO TOP OF KAHALA TUNNEL
- 18" RCP GRAVITY DRAIN LINE
- 1950 LF - FROM TOP OF KAHALA TUNNEL TO 4" STORM DRAIN
- 24" RCP CULVERTS
- 10LF (9EA) ALONG TROLLEY ROAD, INCL. HEADWALL FOR EACH
- 75LF (2EA) ALONG TROLLEY ROAD, BETWEEN FIRING RANGE AND KAPAHULU TUNNEL
- 510 LF
- MANHOLES
- 4EA - ALONG 18" GRAVITY LINE

DESCRIPTION

Mitsunaga & Associates, Inc.

BY:

CHECKED

JOB NO.

SHEET

DATE

OF

PROJECT: Diamond Head State Monument

IRRIGATION SYSTEM

- IRRIGATION DEMAND
- 401 ACRES (FE<sup>2</sup>) = 1,790,000 SQ. FT. (1 ACRE IRRIGATED W/ 570 GPD)
- DEMAND = 6900 GPD/ACRE
- AVERAGE DAILY DEMAND = (401)(6900) = 2,762,900 GPD
- ASSUME WELL CAPACITY = 100,000 GPD (24 HRS)
- PUMP FOR 18 HRS/DAY
- EFFECTIVE WELL CAPACITY = 1,800,000 GPD (18/24) = 75,000 GPD
- NO. OF WELLS = 2,762,900 / 75,000 = 3.7, USE 4 WELLS SIZED AT 1,000,000
- IRRIGATION WELLS
- WELL #1 (ACROSS 18TH AVE) - ELEV. = 135
- WELL #2 (ACROSS LAHAPEL) - ELEV. = 160
- WELL #3 (AT BLD. 49 SITE) - ELEV. = 155
- WELL #4 (BELOW CANNON CLUB PARKING) - ELEV. = 110
- 4 PUMPS

IRRIGATION SYSTEM

4" IRRIGATION LINES

- 3000 LF - CONNECTING WELLS
- 1500 LF - FROM WELLS TO TOP OF KAPAHULU TUNNEL
- 2300 LF - FROM TOP OF KAPAHULU TUNNEL TO WETLAND
- 6700 LF

DESCRIPTION

Mitsunaga & Associates, Inc.

BY:

CHECKED

JOB NO.

SHEET

DATE

OF

PROJECT: Diamond Head State Monument

WALKWAY PATHS

CONC. WALKWAY - ADA COMPLIANT - MIN. WIDTH = 6'-0"

- 2900 LF - FROM 1/2 TO WETLAND
  - 3000 LF - PUMP AREA
  - 1700 LF - V.C. TO PHYSICAL CHANGE
  - 200 LF - INTERIM VISITOR PARKING TO V.C.
- WALKWAY TOTALS - 9800 LF - WIDTH = 6'-0"
- 6700 LF - CENTER FLOOR
  - 4100 LF - BATTERY BUILDINGS TO TUNNEL DOT (ORIGINALLY 6700 LF)
  - 1100 LF - FILING RANGE TO FLAT TOP RESERVOIR
  - 3000 LF - TUNNEL DOT TO SUMMIT TRAIL (FROM RAILINGS)
- 14,900 LF

7600 LF TOTAL

WETLAND IMPROVEMENTS

- AREA = 80,000 SQ. FT.
- DEPTH = 6 FEET AVE w/ 5:1 SLOPE SIDES (EXTRA 1 FT. EXTRA FOR LINER)
- ELEV. = 198.0
- AREA GRADED AROUND POND 120,000 SQ. FT.
- TOTAL EXCAVATION = 2,100 CU. YD.

RUBBER LINER

- AREA = 80,000 SQ. FT.

SOIL OVER RUBBER LINER

- DEPTH = 12 IN.

IRRIGATION DRAIN

- 4800 LF CENTER FROM WETLAND
- 50 LF - 4" IRRIGATION LINE FROM POND TO PUMP

DEMOLITION

A/C PAVEMENT

- 37,500 SQ. YD. - CENTER INTERIOR

BUILDING FOUNDATION AND SLAB

- 9,800 SQ. YD. - FAA, HING (30,303,304), MISC. BLDGS IN VICINITY

DESCRIPTION	BY: Mitsunaga & Associates, Inc.		CHECKED
	PROJECT: Diamond Head State Monument	JOB NO.	SHEET OF
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EXISTING ROADWAY IMPROVEMENTS

- 1/2" A/C OVERLAY - INTERIOR OF CENTER
- 1600 LF X 12 FT WIDE - FROM KAPAHULU TUNNEL TO 4th LINK SITE (2133 SQ YDS)
- 600 LF X 10 FT WIDE - ROAD TO BATTERY BUILDINGS (607 SQ YDS)
- 1300 LF X 12 FT WIDE - ROAD TO BATTERY BARRACKS (2311 SQ YDS)

DESCRIPTION	BY:	CHECKED
	Mitsumaga & Associates, Inc.	
PROJECT:	JOB NO.	SHEET OF
	DATE	

*Appendix B*

Flora Survey Report

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APPENDICES

BOTANICAL STUDY  
DIAMOND HEAD STATE MONUMENT  
MASTER PLAN UPDATE  
EAST HONOLULU, O'AHU

by

Winona P. Char  
CHAR & ASSOCIATES  
Botanical Consultants  
Honolulu, Hawaii

Prepared for: PBR HAWAII

November 1998

BOTANICAL STUDY  
DIAMOND HEAD STATE MONUMENT  
MASTER PLAN UPDATE  
EAST HONOLULU, O'AHU

INTRODUCTION

In June 1979, the Diamond Head State Monument Planning Report was prepared by the Department of Land and Natural Resources Division of State Parks and the Diamond Head Citizens Advisory Committee. During the past 19 years since the Plan was prepared and portions implemented, visitor use has increased significantly from 41,000 visitors in 1980-1981 to approximately 1,000,000 visitors in 1996-1997. This has impacted the natural resources, park improvements, and county facilities (road, water, and sewage treatment). Some of the Federal and State agencies which have facilities within the Monument are also being vacated (PBR Hawaii 1998).

In 1997, the State Legislature recognized the need to address these changes and funded an update of the 1979 Plan. The update is to include the preparation of plans, and designs for the incremental development of the Monument, including a permanent Visitor/Interpretive Center. Other proposed developments/improvements include additional parking, a caretaker's residence, comfort stations, picnic areas, road and trail system, restoration of a seasonal wetland habitat, and establishment of a dryland forest.

The project site is a nearly circular crater roughly two-thirds of a mile in diameter and is bounded by Diamond Head Road and Monsarrat Road. The Diamond Head State Monument currently consists of nearly 500 acres of land. Another ±22 acres of land have also

been identified for inclusion into the Monument and Master Plan Update.

A review of the botanical resources found within the project site is being made for the Master Plan Update and Environmental Impact Statement, and is presented in this report. The study focuses primarily on a review of the literature, especially for the rare and endangered species. Only limited field studies were conducted since the environmental conditions were extremely dry. The field studies were made on 28 October and 10 November 1998. No inventory of the species was prepared as many of the plants were in poor condition, many leafless, and identification was difficult. Many of the annual species, which come up after the rains, were absent. The Hawaii Army National Guard biologists stationed at the crater noted that the *Schiedea adamantis* and *Spermolepis hawaiiensis*, two endangered species, had long gone dormant or died back.

PREVIOUS STUDIES

A limited study of the flora of Diamond Head Crater with a short species checklist is presented in the 1979 Diamond Head State Monument Planning Report. It lists plants found within four "zones": (1) steep rockland slopes; (2) soil-covered upper slopes and ridges; (3) lower slopes and crater floor; and (4) seasonal wetlands.

A very recent study of the Hawaii Army National Guard lands at Diamond Head Crater and Fort Ruger was made by the U.S. Fish and Wildlife Service, Pacific Islands Office (1998a). Rare and endangered plants which occur within the crater were discussed in detail. Recommendations for the management of these plants as well as for the seasonal wetland on the crater floor were made.

In addition, the faculty and students at the University of Hawai'i, Manoa, Botany Department have conducted field classes and studies at Diamond Head Crater since the 1960's up to the present (R. Gay, pers. comm.). The results from these studies have been used in class papers.

A few plants were collected from or are known only from Diamond Head. In the most recent treatment of the Hawaiian flora (Wagner *et al.* 1990), for example, it is noted that the lesser snapdragon (*Antirrhinum orontium*) is naturalized on the dry ridges of Diamond Head Crater where it was first collected in 1950; and littleseed muhly (*Muhlenbergia microsperma*), an annual grass, is known from only Diamond Head, O'ahu, and the sand dunes at Wai'ale Reservoir, Maui. Plant specimens from Diamond Head can be found in the herbarium collections at Bishop Museum (BISH) and the University of Hawai'i, Botany Department (HAW).

#### DESCRIPTION OF THE VEGETATION

The plant names used in this report follow Wagner *et al.* (1990), and Evenhuis and Miller (1995-1998) for the most recent name changes.

The vegetation on the undeveloped portions of the project site is described in detail below. The developed areas are landscaped and maintained; landscaping consists of large expanses of lawn, primarily Bermuda grass (*Cynodon dactylon*), and plantings of various ornamental tree and shrub species. No field studies were made of the developed, maintained areas.

#### Kiawe/Koa Haole Forest

This vegetation type occurs as a band around the outside base of

the crater, behind the residential properties and across from Kapi'olani Community College. Within the crater, the kiawe (*Prosopis pallida*)/koa haole (*Leucaena leucocephala*) forest is found on the undeveloped portions of the crater floor and some of the lower slopes, especially on the western half of the interior. Kiawe/koa haole forest occurs on the areas with deeper soil. These are areas with clay soils of the Makalapa series, identified on the soil maps (Foote *et al.* 1972) as "MdB", Makalapa clay, 2 to 6 percent slopes; "Mdc", Makalapa clay, 6 to 12 percent slopes; and "Mdd", Makalapa clay, 12 to 20 percent slopes. These are well-drained, very dark grayish-brown soils formed in volcanic tuff. The soils are very sticky and plastic when wet, and upon drying, form wide cracks.

Kiawe, a woody member of the pea family (Fabaceae) and native to the Neotropics, forms an open to closed canopy forest, 15 to 30 ft. tall. The taller and more closed forests tend to occur in low lying situations or in drainageways where there may be deeper soils and more available soil moisture. Shrubs of koa haole form somewhat dense thickets, 6 to 15 ft. tall, between the kiawe trees. Filling in the matrix between the woody components are dense mats of buffel grass (*Cenchrus ciliaris*), clumps of Guinea Grass (*Panicum maximum*), and dense tufts of sourgrass (*Digitaria insularis*). In places, lantana shrubs (*Lantana camara*) may be locally common. During the rainy season, the native 'ilima (*Sida fallax*), a small shrub, is also locally common to abundant, but in the dry summer months only a few live plants remain scattered here and there among the grasses.

#### Koa Haole Shrubland

This vegetation type occurs on the slopes and rim of the crater on rockland, identified as "rRK" on the soil maps (Foote *et al.* 1972). It is composed of scrubby koa haole plants, 2 to 6 ft.

tall; the plants are shorter on the exposed upper slopes and rim of the crater. Scattered patches of buffel grass, Guinea grass, and Natal reed grass (Melinis repens) are found in this shrubland. Other introduced or alien species which can be found here include a few shrubs of sourbush (Pluchea carolinensis) and Christmas berry (Schinus terebinthifolius), the succulent-stemmed carrion flower (Stapelia gigantea), Bidens cynapiifolia, lion's ear (Leonotis nepetifolia), and running pop (Passiflora foetida).

Besides the commonly occurring 'ilima and 'uhaloa (Malthesia indica), a number of other native species can be found in this shrubland, including the endangered Schiedea adamantis and Spermolepis hawaiiensis. These include the coast sandalwood or 'iliahialo'e (Santalum ellipticum), nehe (Lipochaeta lobata), ma'o (Gossypium tomentosum), alena (Boerhavia glabrata), kawelu or 'emolua (Eragrostis variabilis), pili grass (Heteropogon contortus), and kakonakona (Panicum torridum). The kakonakona is an annual grass species which is especially abundant during the wetter months.

#### Native Grassland/Shrubland

This vegetation type occurs as scattered, remnant pockets among the koa haole shrubland and is generally associated with the more exposed, very steep, windward facing, rocky slopes. In these areas kawelu and pili grass are the dominant components. Native shrubs found here include 'ilima, 'uhaloa, nehe, 'a'ali'i (Donoaea viscosa), and 'akoko (Chamaesyce degeneri). Schiedea adamantis and Spermolepis hawaiiensis also occur in this vegetation type.

#### Seasonal Wetland

During the rainy winter months, standing water may form on the crater floor for two to three weeks at a time, however, flooding appears

to have been less frequent in recent years (PBR Hawaii 1998). The deepest part or main portion of the seasonal wetland is a sump approximately 100 by 50 ft. in area and can reach depths greater than 6 ft. when flooded. A reinforced pump which allows pumping from a level below the sediment line of the sump is found in this area (U.S. Fish and Wildlife Service 1998a). A few berms have also been constructed around the sump. Other parts of the wetland have also been greatly modified. Parts of the wetland have been filled in with concrete and metal scrap, lumber, soil, and coral rubble.

At the time of this site visit, the sump was completely dry with the barren soil exhibiting large and deep cracks. A dense mat of dried California grass (Brachiaria mutica), 3 to 4 ft. tall, and scattered koa haole shrubs surround the sump and other low lying areas within the seasonal wetland. Other plants observed in the now dry sump area included a few plants of castor bean (Ricinus communis), lion's ear, graceful spurge (Chamaesyce hypericifolia), 'ilima, Bermuda grass, cocklebur (Xanthium strumarium var. canadense), popolo (Solanum americanum), bristly foxtail (Setaria verticillata), and Ammannia auriculata. Two native sedges occur in and around the sump area. These are the endangered Cyperus trachysanthos and Torulinum odoratum subspecies auriculatum, a species of concern (U.S. Fish and Wildlife Service 1997).

#### RARE AND ENDANGERED PLANTS

Three endangered species are currently known from Diamond Head Crater. These plants are Schiedea adamantis and Spermolepis hawaiiensis, known from the crater rim area, and Cyperus trachysanthos, which is recorded from the seasonal wetland. One species of concern, Torulinum odoratum subspecies auriculatum, also occurs within the seasonal wetland. The nehe (Lipochaeta lobata var. lobata) is considered rare by The Nature Conservancy's Hawai'i Natural Heritage Program (HNHP) and has been observed on

the southwest rim and slopes of the crater. A more complete discussion of these species is presented below.

Two other species were once known from the crater but are believed to have been extirpated from the site. Ko'oko'olau (Bidens molokaiensis formerly B. cuneata), a species of concern, was last observed in 1980 near the summit of Diamond Head (HNHP database; U.S. Fish and Wildlife Service 1997). The endangered Gouania meyenii, a shrubby member of the buckthorn family (Rhamnaceae), was recorded as occurring in the crater bottom in 1831 by F.J. Meyen (HNHP database; U.S. Fish and Wildlife Service 1998a, 1998b).

Schiedea adamantis: This endangered species is a member of the pink or carnation family (Caryophyllaceae), and is known only from the steep, dry slopes on the northwest rim of Diamond Head Crater. It is an erect, glabrous, small shrub, 12 to 24 inches tall. Leaves are opposite, and elliptic to oblanceolate (tapering at the base). Small, green to yellowish green flowers are arranged in a narrow, somewhat congested cluster of flowering branches. The fruit is a capsule, dehiscent upon drying; seeds are small, reddish brown, kidney-shaped (Wagner et al. 1990).

The population consists of a main population on the crater rim and two smaller satellite populations on the outer crater slopes nearby. This population is currently part of an intensive research program which will assist in the recovery of the species (U.S. Fish and Wildlife Service 1994a). The research team which has been monitoring the plants has noted that the population numbers have fluctuated in the recent years. In 1978, 67 plants were seen; in the 1989-1990 flowering season a total population size of 400 was recorded; 364 plants were found in 1994; 87 plants in 1996; and 108 plants in 1997 (HNHP database; U.S. Fish and Wildlife Service 1998a).

The continued existence of this species is threatened by competition from alien plant species, fire, and trampling by humans (U.S. Fish and Wildlife Service 1982, 1994a).

Spermolepis hawaiiensis: The endangered Spermolepis hawaiiensis is a member of the parsley family (Apiaceae). It is a slender annual herb, 2 to 8 inches tall, with finely dissected leaves. Flowers are arranged in a loose, compound umbrella-shaped cluster; petals white. Fruits are oval, laterally compressed, constricted at the line where the two halves of the fruit meet, and covered by curved bristles. At present, a total of 12 populations is known from Kaula'i, O'ahu, Moloka'i, Lana'i, West Maui, and Hawai'i. The total number of individuals statewide is estimated to be between 2,000 and 6,000 individuals (U.S. Fish and Wildlife Service 1998c). The O'ahu populations occur on Diamond Head Crater and on the U.S. Army's Makua Military Reservation.

The Diamond Head population is found on the east rim on a buttress ridge above the main entrance tunnel (HNHP database). Like the Schiedea, the population numbers fluctuate widely from year to year depending upon the amount and duration of the rainfall received. During the 1988 wet season when the plants were first observed, thousands of plants were seen in an area of several hundred square feet. In 1992, 10 plants were observed during the dry season. No plants were found during a recent U.S. Fish and Wildlife study (1998a).

On the project site, the species is threatened by inadvertent trampling by humans who may use the rim trail, competition from alien plant species, and fire (U.S. Fish and Wildlife Service 1994, 1998c).

Cyperus trachysanthos: The Hawaiian name for this endangered species is pu'uka'a (Wagner et al. 1990). It is a member of the sedge family (Cyperaceae), and is a perennial grass-like plant with a short underground stem (rhizome). The aerial stems (culms) are densely tufted, 8 to 18 inches tall, sticky, and leafy at the base. Leaves are long and narrow with a waxy coating, and somewhat leathery. The flower clusters are 2 to 3.5 inches long and 2 to 5 inches wide. Each flower head contains 10 to 30 pale, yellowish-brown spikelets, each of which contains 8 to 20 flowers. The fruit is a dark-brown, egg-shaped achene. Currently, this species is known from 8 populations with a total of 517 or more individuals on Ni'ihau, Kaua'i, and O'ahu. The plants are found in wet sites (mud flats, wet clay soils, or wet cliff seeps) on coastal cliffs or talus slopes between 10 and 525 ft. elevation (Wagner et al. 1990; U.S. Fish and Wildlife Service 1996, 1998c).

On the project site, Cyperus trachysanthos is found in and around the main sump of the seasonal wetland. Estimates of population numbers vary from 38 plants (U.S. Fish and Wildlife Service 1998c), to 40 (HNHP database), and a more recent count of 56 individuals (U.S. Fish and Wildlife Service 1998a). The total area in which the plants occur within the seasonal wetland is approximately 150 X 70 ft. (U.S. Fish and Wildlife Service 1998a).

The continued existence of this population of Cyperus trachysanthos is threatened by competition from alien plant species, fire, pumping of the sump for flood and mosquito control, modifications of the wetland topography, mowing and herbicide application, and runoff from nearby Hawaii Army National Guard activities which may contain petroleum products or pesticides (U.S. Fish and Wildlife Service 1998a, 1998c).

Torulinum odoratum subsp. auriculatum: The Hawaiian names for this member of the sedge family (Cyperaceae) are: pu'uka'a, killi'opu, kiolohia, mau'u pu'uka'a, puko'a, and pu'uko'a (Wagner et al. 1990). This endemic subspecies is listed as a species of concern by the U.S. Fish and Wildlife Service (1997), but is currently being considered for listing as endangered (U.S. Fish and Wildlife Service 1998a). It is an annual or sometimes short-lived perennial under favorable conditions. The aerial stems (culms) are solitary or a few together, 24 to 55 inches tall. Basal leaves are flat, and usually shorter than the aerial stems. The large inflorescences (clusters of flowers) are open, divided several times, and umbrella-shaped. The fruit is an oblong to oblong-ellipsoid, 3-angled achene. In Hawai'i, the plants are apparently rare in low elevation wet sites, such as margins of ponds and vernal pools, taro paddies, and along streams. It has been collected on Kaua'i, O'ahu, Moloka'i, Maui, and Hawai'i. The most recent collections have been from Diamond Head Crater, in 1937 and Ukumehame Gulch, Maui, in 1939 (Wagner et al. 1990).

The plants were rediscovered in and around the main sump of the seasonal wetland during the recent U.S. Fish and Wildlife Service study (1998a) for the Hawaii Army National Guard lands. A population of 30 to 50 individuals of this sedge was observed in the main sump during the course of the study (April 1996 to June 1997).

Threats to the continued existence of this endemic subspecies on the project site are the same as those identified for Cyperus trachysanthos.

Lipochaeta lobata var. lobata: This member of the sunflower family (Asteraceae) is not listed by the U.S. Fish and Wildlife Service (1997) as threatened or endangered, or a species of concern, however, it is considered rare by The Nature Conservancy's



Hawai'i Natural Heritage Program (HNHP). The Hawaiian name for this Lipochaeta, and for most other Lipochaeta species, is nehe. It is a much-branched, perennial herb with arching-spreading to decumbent stems. Leaves are lanceolate-linear to ovate with a course, sandpapery texture. The daisy-like flower heads are solitary or in clusters of 2 to 3 per node; petals (ray florets) are yellow. The fruit is a tuberculate achene. The variety lobata is distinguished from the other variety, var. leptophylla, by its ovate to narrowly ovate leaves which are more evenly spaced along the stem. Lipochaeta lobata var. lobata is found in dry coastal habitats and dry shrublands on Ni'ihau, O'ahu, and West Maui.

On the Diamond Head project site, it has been reported from the south, west, and north portions of the crater along the rim, and inner and outer slopes (HNHP database). It is usually found on rocky substrates with the native grassland/shrubland plant community; common associates include 'ilima, kawelu (Eragrostis variabilis), pili grass, and 'a'ali'i. The plants can be easily identified during the wet season when they are flowering profusely, but may be more difficult to find during the dry season when they shed their leaves and become dormant.

#### DISCUSSION AND RECOMMENDATIONS

Although the vegetation on the Diamond Head State Monument project site is dominated largely by introduced or alien species, there are still scattered remnant pockets of native vegetation and several rare and endangered species.

Basically, there are four main areas of concern regarding the endangered species, sensitive areas, and the proposed development plans for the crater. These are: (1) alien species such as koa haole, buffel grass, and fountain grass which compete for space,

nutrients, and moisture; (2) fires which could eliminate the small populations of endangered species and promote the expansion of alien species; (3) low population numbers and limited distribution of endangered species; and (4) trampling by humans who may inadvertently wander onto sensitive areas.

The updated Master Plan includes protection of the endangered Schiedea adamantis habitat and the habitat of the other two endangered species, Spermolepis hawaiiensis and Cyperus trachysanthos, and one species of concern, Torulinium odoratum subsp. auriculatum. The rim trail and upper slopes in the area of the Schiedea and Spermolepis habitats will be off-limits to hikers. Other than at Le'ahi Summit, hikers would not be allowed to hike on the crater rim. The existing seasonal wetland containing the Cyperus and Torulinium would be enhanced. Fire roads, firebreaks, and other fire-control devices are included in the design plan for the crater floor. A native dryland forest is proposed for the crater floor area.

Recommendations for management of the botanical resources found within the project site have been proposed in the recent U.S. Fish and Wildlife study (1998a) of the Hawaii Army National Guard lands and were briefly discussed in an informal report by the Environmental Office, Hawaii Army National Guard et al. (1997). The U.S. Fish and Wildlife Service has prepared a recovery plan for the Schiedea adamantis (1994a) and a draft recovery plan which includes the Spermolepis hawaiiensis and Cyperus trachysanthos (1998c) is currently under review. Detailed recommendations for the stabilizing, and eventual downlisting and delisting of these endangered species are given in the recovery plans.

#### Recommendations

The proposed developments for the Diamond Head project have been

sited so that they avoid sensitive areas with endangered plants (Schidea and Spermolepis habitat) or provide for the enhancement of the habitat (seasonal wetland with Cyperus and Torulinum). A fire plan will be implemented. However, there is a need for the preparation of a Natural Resources Management Plan (NRMP) which covers the entire project site once the Master Plan and EIS are accepted. The NRMP would involve the three agencies currently overseeing the protection of the endangered species -- Environmental Office, Hawaii Army National Guard; Division of Forestry and Wildlife, DLNR; and U.S. Fish and Wildlife Service. The Environmental Office, would be the most logical agency to carry out the day to-day management of the endangered species as well as areas with remnant native plant communities as they already are stationed within the project site and nearby Fort Ruger. Funding for the preparation of and implementation of the NRMP can be a joint effort among the three agencies.

The following recommendations are made for the management of the natural resources on the project site.

Endangered species habitat and areas with remnant native vegetation

1. Removal/control of alien plants: Control methods may involve hand-pulling and/or local herbicide application. Periodic follow-up visits to monitor each site should be made. Long-term field studies conducted for areas with native grassland/shrubland have shown a trend of alien grass species replacing the native pilli grass, kawelu, and kakonakona (R. Gay, pers. comm.). Of particular concern is the recent spread of fountain grass (Pennisetum setaceum) onto the slopes of the crater.

2. Fire control: Fire-breaks should be constructed around areas with endangered species and the larger native grassland/shrubland communities. Removal of alien plants in and around

sensitive areas would also decrease the fire load.

3. Establish additional populations of endangered and rare species: The extremely small numbers of individuals and their limited distribution make them especially vulnerable to fire or a natural fluctuation in the number of individuals during prolonged periods of drought. Suitable sites for outplanting should be selected after careful review; those areas with remnant native grassland/shrubland communities would be ideal candidate sites.

Database information and monitoring

1. Database collection: Information on the natural plant communities and an inventory of the species within the project site should be gathered and mapped over several wet seasons. Population numbers of plant species fluctuate widely depending on the amount of rainfall received. Additional, undetected populations of Schidea and Spermolepis, and, perhaps, Bidens molokaiensis may be found.

2. Periodic monitoring for alien species: The vegetation, especially around trails and scenic lookouts, should be monitored periodically for alien species which could be accidentally introduced onto the site. The portion of the project site adjacent to the residential lots, on the outside base of the crater, should also be monitored for landscape species which may have escaped, especially members of the cactus (Cactaceae) and spurge (Euphorbiaceae) families. Plants should be removed when their numbers are few and still controllable.

Restoration of native dryland forest

1. Long-term maintenance: The replanted areas need to be weeded

and watered on a regular basis. Past efforts with dryland tree plantings on the crater floor survived for just a few years without regular maintenance (R. Gay, pers. comm.). It is unlikely that the restored habitats, including the seasonal wetland, will ever be completely self-supporting or maintenance free (R. Smith, U.S. Fish and Wildlife Service, Oct. 8, 1998 letter).

3. Selection of stock: Only dryland plant species from the island of O'ahu should be used for the replanting effort. Native plants already occurring on the site should be given first priority, then native dryland plants from southeast O'ahu (i.e. ridges behind Hawai'i Kai, Koko Head, Koko Crater, Makapu'u, etc.), and then plants from other dryland forests/shrublands on O'ahu.

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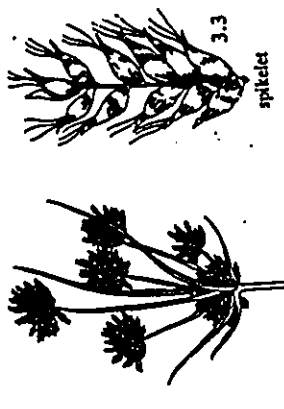
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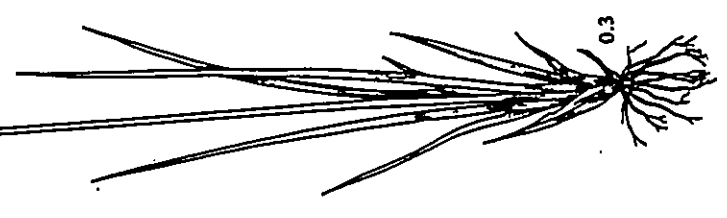
#### APPENDIX A

Line drawings of rare and endangered plants.



*Cyperus trachysanthos*

From Wagner et al. (1990).

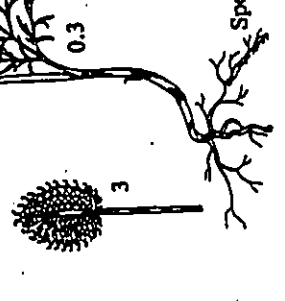


*Spermolepis hawaiiensis*

From Wagner et al. (1990).



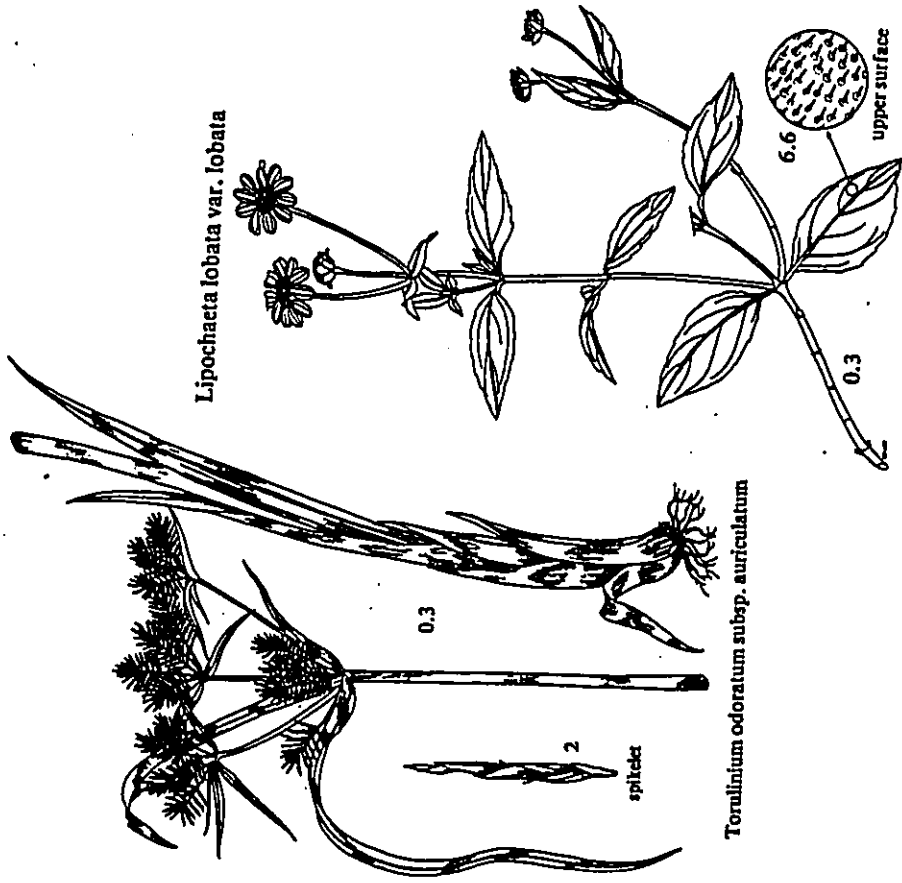
*Schiedea adamantis*



0.3

APPENDIX B

List of native plant species found during the survey of the Hawaii Army National Guard lands at Diamond Head Crater, O'ahu (from U.S. Fish and Wildlife 1998a). See column under "Ft. Ruger".



From Wagner et al. (1990).

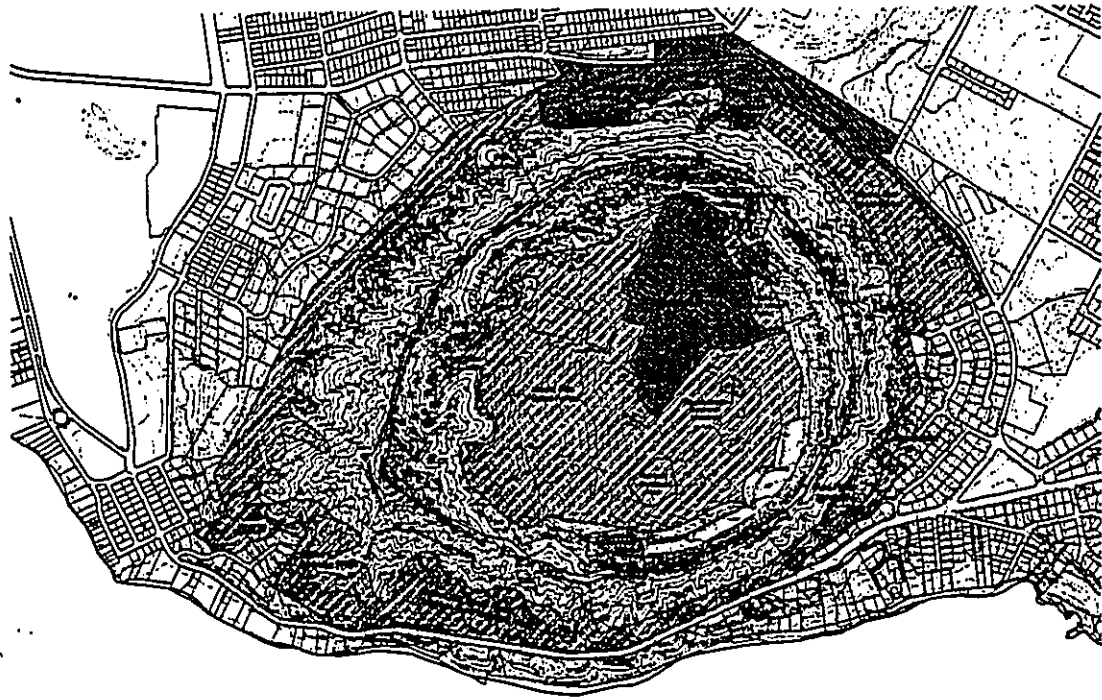
Table 1. Native and Polynesian plants found on the HAWAII facilities on Oahu. Most of the native trees and shrubs appear to be planted as ornamentals. The data for Diamond Head/Veteran Roger is lumped for all four sites in those areas. Consult the text for occurrence of native plants in each of the areas.

Genus species (Common name)	LOCATIONS				
	Haliwa	Whicker	Wahikua	Wahua/Gulich	E. Ruess
<i>Carex neclera</i> (coconut palm) Pol.	A	A	A	P	A
<i>Calocallis ovalata</i> (taro) Pol.	A	A	A	P	A
<i>Cordyline frutescens</i> (ti) Pol.	P	P	P	P	P
<i>Cyperus tuckermansii</i> (sedge) E*	A	A	A	A	P
<i>Heteropogon contortus</i> (tall grass) IT	A	A	A	A	P
<i>Musa x paradisiaca</i> (banana) Pol.	A	A	P	P	P
<i>Pandanus tectorius</i> (tule) I	A	A	A	A	P
<i>Panicum terribile</i> (kukurukana) E	A	A	A	A	P
<i>Pyrosia polystachya</i> (sedge) I	A	P	A	P	A
<i>Taraxacum officinale</i> (sedge) E*	A	A	A	A	P
<i>Trapa striata</i> and <i>Trapa</i>	A	A	A	A	A
<i>Abutilon incanum</i> (ma'o) IT	A	A	A	A	P
<i>Aleurites mollecula</i> (tutu) Pol.	A	A	A	P	P
<i>Argemone glauca</i> (pau kaha) E	A	A	A	A	P
<i>Barbarea repens</i> (lele) I	A	A	A	A	P
<i>Barbarea glabra</i> (lele) I	A	A	A	A	P
<i>Dioscorea villosa</i> ('a'ali) I	A	A	A	A	P
<i>Erythronium sandwicense</i> (willow) IT	A	A	A	A	P
<i>Geoplinium tomentosum</i> (ma'o) IT	A	A	A	A	P
<i>Lycopersicon tomentosum</i> (poho) IT	A	A	A	A	P
<i>Merrisida coccinea</i> (koali kua haka) IT	A	A	A	A	P
<i>Oxalis corniculata</i> (yellow wood sorrel) Pol.	P	P	P	P	P
<i>Sambucus ellipticus</i> (coast sandalwood) E	A	A	A	A	P

Table 1 continued

Genus species (Common name)	LOCATIONS				
	Haliwa	Whicker	Wahikua	Wahua/Gulich	E. Ruess
<i>Schlotheimia adhaerens</i> E**	A	A	A	A	P
<i>Sida fallax</i> (lilua) I	A	A	A	A	P
<i>Solenanthe australis</i> (popoio) IT	P	P	P	P	P
<i>Spermatocarpus hawaiiensis</i> E**	A	A	A	A	P
<i>Waltheria indica</i> (tuhalo) I	A	P	A	A	P

Abbreviations: I=Indigenous, native to the Hawaiian Islands and elsewhere; E=endemic, known only from the Hawaiian Islands; Pol=reestablished by early Polynesian colonists; A=abundant; P=present; \*\*=reintroduced; \*=-rare or species of concern.



Vegetation Map  
 DIAMOND HEAD STATE MONUMENT  
 MASTER PLAN UPDATE

- Diamond Head State Monument
- Park Property Boundary
- Road
- Contour Interval
- Elevation
- Contour Interval





*Appendix C*

Wildlife Survey Report

**Wildlife Survey  
Diamond Head State Monument  
Island of Oahu**

**1.0 Introduction**

Field surveys were conducted on November 8-9, 1998 to assess the wildlife resources found within and around Diamond Head or Leahi Crater on property referred to as Diamond Head State Monument (PBR Hawaii 1998). The State Department of Land and Natural Resources is updating a Master Plan prepared in 1979 with the objective of establishing a semi-wild park in the interior of the crater, and recreational amenities for family outings on the outside. The objective of the survey was to provide a record of wildlife for the area and to determine whether the planned actions would affect wildlife.

**2.0 Site and Habitat Description**

The project site is within the boundaries of Diamond Head State Monument and includes the interior and exterior walls of Leahi Crater. The crater interior is semi-wild, with facilities occupied by the Department of Defense and the Federal Aviation Administration. Surrounding Diamond Head crater are the urban communities of Kaimuki, Kahala, and Kapaehulu, a cemetery, National Guard facilities and a community college. A more complete description can be found in the Diamond Head State Monument Master Plan Update EIS Preparation Notice (PBR Hawaii 1998).

The area is representative of vegetation Zone A according to Ripperton and Hosaka 1942 (in Schwartz and Schwartz 1949) and is used as a game-range type. Zone A is generally described as coastal flats and adjacent sloping lands, from sea level to 500 feet on lee sides of islands with less than 20 inches of annual precipitation. Temperatures range from 75°F at sea level with maximum temperatures exceeding 90°F. Ground cover is sparse and conditions are semi-desert. Where soils are more developed, there is a naturalized kiawe (*Prosopis pallida*) woodland community with haole koa (*Lachne leucocephala*), kiu (*Acacia farnesiana*), uhaloa (*Waltheria americana*), and ilima (*Sida fallax*). The project site also supports sour grass (*Tricachne insularis*), buffle grass (*Cenchrus ciliaris*), and fountain grass (*Pennisetum setaceum*). On more rocky ground, sparse haole koa and grasses are present with remnants of native shrub community such as ilima, uhaloa and aalii (*Dodonea* sp.). At the time of the survey the project site was very dry with not much greenery except where irrigated. The kiawe were sprouting leaves and seed pod production was well underway. A few kukui trees (*Alseurites moluccana*) were planted near the public restrooms and are sustained by irrigation. Ornamental trees

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and shrubs were present within the FAA and DOD compounds and scattered around rim of the crater on the outside. A grove of wiliwili trees (*Erythrina sandwicensis*), planted by George C. Munro (Paul Breese pers. comm.), were present on the outside of the crater on the southwest side behind La Pietra. Apiaries were present both within and on the outside of the crater.

The wetland was dry. Dried California grass (*Brachiaria mutica*) was present throughout the wetland area. A native cyperus was present in the bare substrate of the wetland.

### 3.0 Method

A survey was made on November 8 and 9, 1998 to assess birds and other wildlife within the proposed site. Fourteen count stations were established on the project site, 7 inside the crater and 6 on the outside (Figure 1). Eight minutes were spent at each station, recording all birds seen and heard, and noting conditions. The survey counts were made between 0600 and 1000 hrs. Cursory observations were made for other wildlife between stations. Observations for bats and owls were made on the evening of November 8.

### 4.0 Results and Discussion

#### Mammals

##### Small Indian Mongoose (*Herpestes auropunctatus*)

The small Indian mongoose is a common component of the naturalized kiawe forest community throughout the Hawaiian islands. Some tracks were seen on the unpaved trails within the crater on November 8, 1998. A carcass of a mongoose was found on the outside of the crater on November 9, 1998. The mongoose is an aggressive highly adaptable species and has spread to all vegetative zones of each island it has occupied (Tomich 1986). Its greatest concentrations are in beach and lowland areas. It was introduced to Hawaii on September 30, 1883 and released along the Hamakua coast of the island of Hawaii. They were subsequently introduced to Oahu and the islands of Maui and Molokai. It is omnivorous, feeding on both plant and animal matter. Its importance as a predator on birds is

indisputable, but local control of the mongoose can be achieved using recently registered diaphacinone in fish flavored bait blocks or through a consistent trapping program.

#### Feral Cat (*Felis catus*)

A black feral house cat was seen in the crater crouched in the middle of a road on the crater floor in the late morning on November 8, 1998. Scats of feral cats were found throughout the crater and along the foot trail on the outside base of the crater. They are an important predator on rodents, but may also be a significant predator on doves and other ground foraging species such as the gray francolin. Three other feral house cats were seen at the abandoned Cannon Club grounds on November 9, 1998. Two were black the other gray and white. It is very likely that these cats are being fed. Feral cats colonies are common throughout Oahu, and Diamond Head State Monument is no exception.

#### Other Mammals

Four rodents occur in Hawaii. There are three species of rats, the roof rat (*Rattus rattus*) the Norway rat (*Rattus norvegicus*), the 'iole or Polynesian rat (*Rattus exulans*) and the European house mouse (*Mus domesticus*). No rodent trapping was conducted to determine which species are present within Diamond Head State Monument, however, it is very likely that at least the mouse is present and probably the roof rat. In spite of its name, the house mouse is very well adapted to the field and can subsist entirely in a wild state. If populations are high, the mouse can compete with seed-eating birds for resources (Schwartz and Schwartz 1949). The roof rat is adapted to a wide variety of environments. It is locally common at lower and middle elevations (Tomich 1986) and may have displaced the 'iole in many parts of Oahu earlier this century. The roof rat has been noted specifically as a predator on native birds where it is the prominent species in remote forests of Hawaii (Tomich 1986). The 'iole is characteristically a lowland rodent. Hawaiian populations are noncommensal in that they do not inhabit human dwellings, but flourish best in agricultural lands and do well in wooded and grassy gulches and waste areas. The 'iole is presumed to have come to Hawaii over 1,400 years ago, with the first human colonizers (Tomich 1986).

The native federally listed endangered Hawaiian hoary bat (*Lasiurus cinereus semotus*) was not observed during the survey. Heritage (1998) records reveal no bat sightings within the monument boundaries or adjacent areas such as Kapiolani Park and Honolulu Zoo. Night observations made by personnel of the U.S. Fish and Wildlife Service (FWS 1998) on June 19, 1997 did not detect any bats on National Guard property within or outside the crater. Kepler and Scott (1990) do not list Diamond Head or any nearby area having had any record of bats between 1964 and 1983. They reported that the few scattered records from Oahu could be attributed to vagrant individuals from other islands. If bats were once common on Oahu, only one record made by von Kotzebue (von Kotzebue 1821 in Tomich 1986), gave evidence to a former more common occurrence. On December 8, 1816 near what was judged to be Moanalua Valley, von Kotzebue noted that "the air was filled with a small species of bats." There were no subsequent records to suggest any such abundance of the hoary bat on Oahu (Tomich 1986).

According to Kepler and Scott (1990) bats are most conspicuous from August to December when they are seen early in the evening in aggregations over coastal waters. During intensive field operations from 1963 to 1965 Tomich (1986) collected bat specimens on the island of Hawaii in all months. Tomich (1986) stated that the "rarity" of the bat is a myth which stems from a lack of understanding by the casual observer of how a nonsocial and scattered population should appear. He also states that the bats were never abundant. Kepler and Scott (1990) state that foraging patterns suggest that bats concentrate in the fall and may hibernate. Tomich (1986) stated that winter torpor has yet to be demonstrated. Tomich (1986) stated that the hoary bat is highly unselective in the kind of tree it chooses to roost. The depletion of native forest cover in agricultural development of lands and its replacement with introduced trees in urban areas may not be a significant hazard to the bat population. Kepler and Scott (1990) report that the hoary bat are more often associated with exotic (64%) than with native (19%) vegetation. It may also use rock structures for shelter more than is realized (Tomich 1986).

## Birds

### Zebra Dove (*Geopelia striata*)

Zebra doves were the second most numerous bird in Diamond Head State Monument. It is also known as the barred dove. It is well adapted to the naturalized kiawe woodland where it feeds on seeds of h ole koa, kiawe, uhaloa, and grasses. Zebra doves exist in nearly all types of land-use conditions including urban areas. The zebra doves range is shared with the spotted dove but the larger dove extends its range to higher elevations and tolerates greater rainfall and occurs in more heavily wooded areas. The daily activity pattern is dependent on the availability of suitable sites for feeding, roosting, nesting and watering (Schwartz and Schwartz 1949). Throughout most of their range, these sites are in close proximity and require very little movement by the birds during the day. The project area appears to provide sufficient nesting, roosting and feeding sites for zebra doves. No natural open water sources were identified during the survey. It is very likely that zebra doves rely on artificial sources of water that occur throughout the urbanized areas in and around Diamond Head Crater. The future of the dove population will be dependent on whether planned improvements create or remove such suitable sites.

### Spotted Dove (*Streptopelia chinensis*)

The spotted dove is also known as the lace-necked dove. This is the larger of the two species of doves. It is often less abundant than the zebra dove in the same range. It ranked third in abundance in the bird survey. The zebra dove and spotted dove tend to feed on different plants or use plants at different stages of succession. Spotted doves prefer larger seeded or fruit producing species. It is also suited to all types of land use. Surface water either fresh or brackish or succulent fruit is a prerequisite for good spotted dove range (Schwartz and Schwartz 1949). The health of both dove populations will be dependent of the availability of suitable sites for nesting, roosting, feeding and watering.

**Feral Pigeon (*Columba livia*)**

A total of seven feral pigeons were observed outside the count periods, six flying above the crater rim and one roosting or nesting in crevices on the leeward rocky cliffs facing the zoo and Kapiolani Park. A large number of white pigeons occur in Waikiki, and the birds that were encountered on Diamond Head no doubt mix with the birds in the park and beach, but were not all white. The birds observed had mottled plumage of blue gray and reddish. No pigeons were observed feeding on the ground in the crater during the survey.

**House Finch (*Carpodacus mexicanus*)**

House finches or linnets are an introduced migratory bird from North America (Caum 1933 in Berger 1972). House finches were observed throughout the project site and ranked 5th in abundance during survey counts. House finches are common in open wooded lands and feed on seeds, soft fruit, and insects. About 44 house finches were observed under one fruiting kiawe tree feeding among the pods that had dropped to the ground. Kiawe seeds, pods and leaves are a very important foods for many species of birds inhabiting the kiawe woodland. House finches are highly adaptable to all types of land use, inhabiting cities and towns in the lowlands, but are most abundant in open woodlands, forest edges and pastures. Habitat requirements include open water sources which may be a limiting factor in their distribution (Scott et.al. 1986).

**English Sparrow (*Passer domesticus*)**

English Sparrows are also known as house sparrows. English sparrows were not encountered on any count station. They were observed in the irrigated portion of the Crater near the public restrooms, feeding on grass seeds under the kukui in mixed aggregations with house finches, java sparrows, and zebra doves. They are very well adapted to the urban environment and have a commensal relationship with man. They are not well suited to wild environments. English sparrows require man-made structures to nest. The removal of buildings in the crater may cause a decline in English sparrow numbers, however, ample suitable sites occur outside the monument in the surrounding urban area.

**Common Myna (*Acridotheres tristis*)**

Myna birds were not abundant in the crater. They were encountered on four count stations. Mynas can be common to abundant in lowland areas of the inhabited islands, being most common in residential areas in the vicinity of human habitation in outlying districts (Berger 1972). Mynas are expected components of a naturalized kiawe woodland. They are omnivorous, feeding on fruits and animal matter and may be in competition with the more recently introduced red-vented bulbul in some portions of their shared ranges. Mynas are cavity nesters and often use buildings to nest. They roost communally and occur in large numbers in banyan trees or other densely foliated tree. Mynas are known to pilfer both spotted dove and zebra dove nests (Schwartz and Schwartz 1949).

**Red-vented Bulbul (*Pycnonotus cafer*)**

Red-vented bulbuls were the most abundant bird during survey counts and on thirteen of the count stations, in every type of vegetation and terrain. The red-vented bulbul is a relatively recent addition to the avifauna of Oahu. They are presently restricted to the island of Oahu, although there have been reports of red-vented bulbul in the Puainako area of Hilo on the Big Island. They inhabit dry lowlands and upper elevation wet forests. They are aggressive, highly adaptable and omnivorous in diet. The red-whiskered bulbul (*Pycnonotus jocosus*) which is closely related, is locally common from Hawaii Kai to Pearl City. Red-whiskered bulbul may prefer wetter areas on the leeward side, although they have been seen in Kailua town. No red-whiskered bulbul were encountered within the project site.

**Java Sparrow (*Passer oryzivora*)**

Four Java sparrows were counted during station counts and could be seen foraging on the lawn grass seeds near the restrooms of Diamond Head State Monument. Like the bulbuls, Java sparrows have become common on Oahu within the last 20 years. They are often seen in pairs or in flocks. They are primarily seedeaters and can be seen foraging on lawn grasses in urban areas. They roost communally in trees and nest in tree cavities or under the eaves of buildings (HAS 1996).

Diamond Head State Monument Wildlife Survey

Red crested cardinal (*Paroaria coronata*)

The red-crested cardinal is also known as the Brazilian cardinal. It is a common bird of lowland habitats and is a component of the naturalized the kiawe woodland on Oahu. It is often seen in pairs, where the sexes are similar. It is omnivorous in diet and were seen feeding among the fallen pods of the kiawe.

Japanese Bush Warbler (*Cettia diphone*)

A Japanese bush warbler was detected at one count station and later was observed clearly among the sparse dry grasses and shrubs of the crater floor. They are usually secretive and difficult to see in the dense understory. It is primarily insectivorous but will take fruit and nectar (Berger 1972).

Japanese White-eye (*Zosterops japonicus*)

The Japanese white-eye was common in the project site. It is a ubiquitous species inhabiting a variety of vegetation zones from sea level to high elevation forests. It feeds on fruit, nectar and insects. Its population will probably be enhanced with the increase in semi-wild areas.

Northern Cardinal (*Cardinalis cardinalis*)

Northern cardinals are also known as the Kentucky cardinal or Virginia cardinal. It was observed on two count stations during the survey. It has a wide range of habitat preferences and does very well in dry lowlands. It feeds on seeds, fruit and insects. Planned improvements to the park will enhance the northern cardinal population since it will increase the semi-wild conditions. Northern cardinals are introduced birds with a legal status of migratory bird, thereby being protected by federal treaty.

Pacific Golden Plover (*Pluvialis dominica*)

Six Pacific golden plovers were seen on feeding territories on the grassfield in the central part of the crater and along the roads. Pacific golden plovers are winter residents and are in Hawaii from August to May. They are solitary birds and

Diamond Head State Monument Wildlife Survey

establish daytime feeding territories which they will defend, but may form roosting flocks or roost alone on roof tops at night for safety. A plover will often feed in one location and roost in another. An increase in mowed grass or sparsely vegetated bare ground, plover feeding habitat may increase to support more territorial birds.

Gray Francolin (*Francolinus pondicerianus*)

Gray francolins were observed during the survey. The gray francolin population in Diamond Head is an isolated population that may be from later releases after their introduction into Hawaii in 1958 (HAS 1996). They were not common on Oahu, being restricted to Luahalei Valley and Diamond Head (HAS 1996), until the Division of Forestry and Wildlife began releasing birds about five years ago from Molokai. They are omnivorous and may take mice and lizards as well as plant seeds and fruit. The gray francolin population may be limited in Diamond Head due to predation from cats and mongoose.

Nutmeg Mannikin (*Lonchura punctulata*)

Two nutmeg mannikins or rice birds were observed behind residences feeding on fountain grass seeds in a dry drainage channel. No mannikins were encountered during the count periods. There was a noticeable lack of grass seed production throughout the crater, but with the winter rains approaching there will be a flush of production which will benefit mannikins and other seedeaters.

Common Barn Owl (*Tyto alba*)

No owls were seen during the survey during the dusk period, but the skeleton and feathers of a common barn owl were found near the intake box at the wetland. The partially digested exoskeleton of roaches were within the rib cage suggesting that the owl had been feeding on these insects. Owls are very conspicuous, if one was present in the crater, it would have been seen.

Common Waxbill (*Estrilda astrild*)

A pair of waxbills was observed outside the count period within the crater. They are locally common and widespread in lowlands of Oahu and a relatively recent

#### Diamond Head State Monument Wildlife Survey

introduction being first identified in the late 1970's. Diamond Head and Kapiolani Park were once noted for their interesting array of introduced finches, however, these were not observed during this survey.

#### White Tern (*Gygis alba*)

White terns were seen outside monument boundaries over the coastal residences south of Diamond Head. White terns are common around Diamond Head, Kapiolani Park and throughout Honolulu. They will nest on tree branches or ledges without building any nest. Predation is a factor in limiting their numbers. Adults will arrive from sea in February and depart by September, but some pairs remain on Oahu where they nest year-round (HAS 1996).

#### Parrots (Psittacidae)

A flock of thirteen parrots, probably red-crowned amazons (*Amazona viridigenalis*) were seen flying northward on the outside of the crater over the main entrance high above the crater rim on the morning of November 9. They had medium length tails but were not readily identifiable. Judging by their flight, it is unlikely that they originated their flight from within the monument boundaries and they appeared not to be headed anywhere within the project site.

#### Other Birds

Recent surveys (FWS 1997) reported the federally listed endangered common moorhen (*Gallinula chloropus sandwichensis*) and the Hawaiian coot (*Fulica alai*) being present in the wetland of Diamond Head State Monument during April 1997. The berm around the wetland would suggest that it is being restricted to an area of approximately 4,000 to 8,000 square feet including the ditch that leads under the road to the north of the pump. Dry California grass rimmed the bermed area. In times of rainfall the water that accumulates within the berm is pumped out. Aquatic snail shells were found in low lying depressions south of the berm area suggesting that the kiawe forest may also be flooded with heavy rains. Waterbirds are opportunistic and rely on intermittent water for feeding. If water persists, they can be expected to colonize the wetland if feeding, nesting, loafing and cover conditions are favorable.

#### Diamond Head State Monument Wildlife Survey

Heritage (1998) records show a pueo (*Asio flammeus sandwichensis*) record for Diamond Head Crater on September 19, 1992. Knowledge of pueo distribution and status on Oahu is poor. Pueo population on Oahu is listed by the state as endangered. They are definitely rare on Oahu, and most pueo reports turn out to be the introduced common barn owl. Pueo are active at dawn, dusk and often at mid-day. They inhabit dry lowlands and rain forests but are more often seen in grasslands where they hunt for rodents. Pueo do take birds which may explain why they have developed a habit of foraging during the day. They build their nests on the ground, and may be highly vulnerable to introduced mammalian predators.

#### 5.0 Conclusion

The Diamond Head State Monument Master Plan calls for the enhancement and expansion of the semi-wild environment within the crater and development of amenities for more recreational park-like qualities on the outside. It also prescribes the improvement of the wetland to allow open water to persist which will provide permanent wetland habitat for endangered Hawaiian waterbirds. A wetland will probably draw other native waterbirds to the crater such as the black-crowned night heron (*Nycticorax nycticorax hoactli*), the Hawaiian stilt (*Himantopus mexicanus knudseni*), the koloa (*Anas wyvilliana*) and migratory waterfowl and shorebirds. This master plan will not negatively impact any of the introduced species described in this report. Wetland enhancement will not only encourage waterbirds to reside within the crater but will provide a ready source of water necessary to enhance the survival of many introduced species. A wetland will require continual maintenance to control vegetation that may choke out the open water. Predator control is recommended and unlike any other state or city park, the deliberate maintenance of a feral cat colony through feeding, will be counter productive to the development of a wetland to sustain native endangered waterbirds.

Diamond Head sediments may have never been examined for prehistoric bird bones. Ziegler (1998) suggested that care should be taken in any significant excavation. An archeologist experienced with identifying fossil remains should monitor such excavations and investigate whether Diamond Head sediments contain fossil bird bones as have been found at Mokapu within Ulupa'u Head.

Diamond Head State Monument Wildlife Survey

Count Station: Species	1	2	3	4	5	6	7	8	9	10	11	12	13	14	Total
Zebra Dove	5	3	1	2	3	2	7	7	3	1	1	1	0	0	36
Spotted Dove	1	2	1	1	2	1	4	4	0	0	1	0	2	0	19
Feral Pigeon	0	0	0	0	0	0	0	0	0	1	2	1	0	0	4
House Finch	0	1	6	0	1	0	0	1	1	1	2	0	0	0	13
English Sparrow	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Common Myna	0	0	0	0	0	0	2	2	1	0	0	1	0	0	6
Red-vented Bulbul	0	0	0	0	0	0	2	2	1	0	0	1	0	0	6
Java Sparrow	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Red Crested Cardinal	0	0	2	2	0	1	0	0	0	0	0	0	0	0	5
Japanese Bush Warbler	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1
Japanese White-eye	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1
Northern Cardinal	2	0	1	0	0	0	1	3	2	1	4	0	0	0	14
Pacific Golden Plover	1	0	0	0	0	1	0	0	0	0	0	0	0	0	2
Gray Francolin	0	0	0	0	0	0	6	0	0	0	0	0	0	0	6
	0	1	1	0	1	0	0	0	0	0	1	0	0	0	4

Table 1. Bird numbers at fourteen count stations, Diamond Head State Monument, Oahu, November 8 and 9, 1998.

Diamond Head State Monument Wildlife Survey

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DIAMOND HEAD STATE MONUMENT

Legend  
[Symbol] Court Station

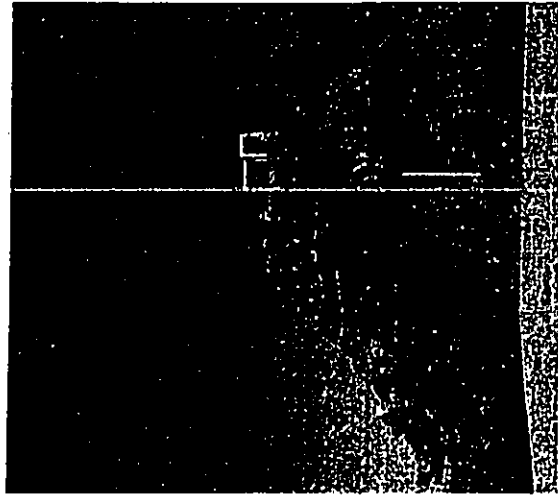
Figure 1  
Wells Survey



*Appendix D*

**Historical Research and Archaeological Assessment**

**Exploring a Backdrop to Waikiki's Past:  
Historical Research and  
Archaeological Assessment of  
Diamond Head State Monument, O'ahu**



*by  
M.J. Tomonari-Tuggle  
Roger Blankfein*

*with a contribution by  
J. Stephen Athens  
Jerome V. Ward*

**INTERNATIONAL ARCHAEOLOGICAL RESEARCH INSTITUTE, INC.  
OCTOBER 1998**

**EXPLORING A BACKDROP TO WAIKIKI'S PAST:  
HISTORICAL RESEARCH AND  
ARCHAEOLOGICAL ASSESSMENT OF  
DIAMOND HEAD STATE MONUMENT, O'AHU**

*by  
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*October 1998*

*A ride round the Head enables the excursionist to see its massive buttresses, and the deep channels of its ancient lava streams; and scattered about its foot beds of volcanic rock mingled confusedly with coral, forming a barrier to the encroaching sea, the tides of which, however, flow among the gigantic fragments, uttering their hoarse song of triumph over its long since extinguished fires.*

H. Willis Baxley, Special Commissioner of the United States, 1865

## ACKNOWLEDGMENTS

Research for projects such as this, where documentation is hard to come by, are only made possible when those involved all have a shared interest and are eager to cooperate. For this, we are grateful to the many individuals who assisted in gathering materials and offering data. From the Division of State Parks, Clyde Hosokawa provided abundant information about the various localities within the monument, and guided the researchers to many of the less accessible features; Alan Carpenter of State Parks was very helpful in organizing excursions and accompanying us on the survey; Martha Yent offered comments on interpretive possibilities and plans for the monument. Muffet Jourdan of the State Historic Preservation Division checked site documentation. Ross Togashi of the UH Map Collection scurried to all corners of his collections to show some wonderful old maps. Judy Bowman and Dorian Travers of the U.S. Army Museum at Fort DeRussy, as always, shared their extensive military archives. All the people of Bishop Museum Archives had some hand in pulling out resources and offering fruitful advice on where to find useful tidbits. Jim Hawkins demonstrated what it truly means to be an educator by volunteering abundant information and insights.

Captain Charles Anthony, the Public Affairs Officer for the Hawaii Air National Guard, was very accommodating and provided the Fort Ruger History file. Colonel Edward Hoffer, the Senior Army Advisor, U.S. Army, set off an avalanche of contacts and information by sharing his time, advice, and refreshing enthusiasm.

Melissa Dumanan and Major Ron Swafford in the Environmental Office of the Hawaii Army National Guard showed their passion for Diamond Head by asking thoughtful, probing questions, sharing what they've learned, and offering welcomed guidance. In addition to sharing her findings from the National Archives, Wendy Goodman, the HIARNG Cultural Resources Manager, was tireless in her willingness to help, and sincerity for the dissemination of knowledge and the future use and enjoyment of Diamond Head State Monument.

Finally, as always, Joan Clarke worked her miracles in making this document presentable from scattered files, scraps of paper and even more scatterbrained instructions. Coral Magnuson and Celeste LeSueur produced the report.

*This document is printed on acid-free, archival bond paper. It is intended to provide a long term record of the cultural resources of Hawai'i.*

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I. INTRODUCTION

At the request of FBR Hawaii, International Archaeological Research Institute, Inc. (IARI) has conducted historical research and archaeological reconnaissance survey of Diamond Head State Monument (Fig. 1). The project area that was contracted for study includes all areas of the monument with the exceptions of the narrow parcel of Kapiolani Community College on the northeast side of Diamond Head Road and the Cannon Club Federal Reserve on Monsarrat Avenue. FBR Hawaii is tasked with preparation of a master plan and environmental impact statement (EIS) for the State monument, under contract with the State of Hawaii. The master plan will update a 1979 master plan prepared by the Division of State Parks (1979), Department of Land and Natural Resources (DLNR). The EIS is intended to document development impacts and mitigating measures related to the updated master plan.

PROJECT AREA

Diamond Head State Monument encompasses over 500 acres of the interior crater and exterior slopes of Diamond Head, a prominent landmark of the Honolulu-Waikiki urban area (TMK 3-1-42:various). All State lands within and adjacent to the monument are managed by the State Department of Land and Natural Resources. Buildings in the crater include Division of State Parks comfort and recreation facilities, as well as structures administered and used by the Federal Aviation Administration (FAA), U.S. Department of Defense, and State Department of Defense (Photo 1).

Primary access to the crater is through Kahala Tunnel, which cuts through the east wall of the crater. Other limited means of access include helicopter landing, hiking over the crater rim, and by means of the Kapahulu Tunnel in the north wall of the crater. Kapahulu Tunnel, part of the original military construction in Diamond Head, now acts as an emergency thoroughfare and for use for official business.

SCOPE OF WORK

The scope of work for this project calls for a review of documentary information and historic maps concerning traditional and historic land uses in Diamond Head crater and limited field survey of selected areas within the State monument. A report of the work will [1] provide a general background history of Diamond Head and its immediate environs, [2] define criteria for evaluating areas of potential cultural resource sensitivity, and [3] delineate areas of potential cultural resource sensitivity. Where possible, specific sites will be

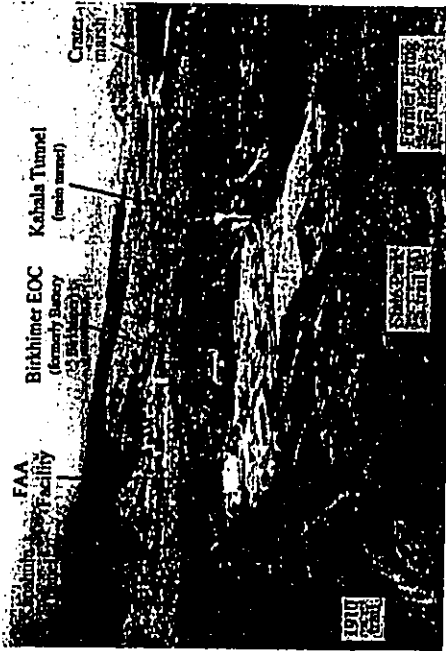


Photo 1. View of the interior of the crater from atop the Leahi Fire Control Station.

identified and a preliminary evaluation of significance made based on archival research and the walk-through survey. The report will include a map of the project area showing locations of sensitive areas and identified specific sites. No site mapping or excavation will be conducted.

**SUMMARY OF RESEARCH AND SURVEY**

Historical research was carried out by Myra Jean Tuggle, M.A., and Roger Blankfein, B.A., between April and June 1998. Archival repositories that were checked include the State Archives and Library, the State Historic Preservation Division, State Survey Office, and Division of State Parks, the Bernice Pauahi Bishop Museum Archives, the Hawaii Air National Guard, the U.S. Army Museum at Fort DeRussy, and the University of Hawaii's Mānoa Hamilton Library.

Field survey was also carried out between April and June 1998. On April 23 and 26 and May 5, IARII archaeologist Roger Blankfein, accompanied by archaeologists Myra Tuggle on the first day and Ingrid Carlson on the remaining two days, visited various locations throughout the monument. State Parks staff Clyde Hosokawa, who is extremely knowledgeable about the monument, and archaeologist Alan Carpenter guided the IARII researchers to most of the locations. A follow-up visit to Battery 407 was conducted on

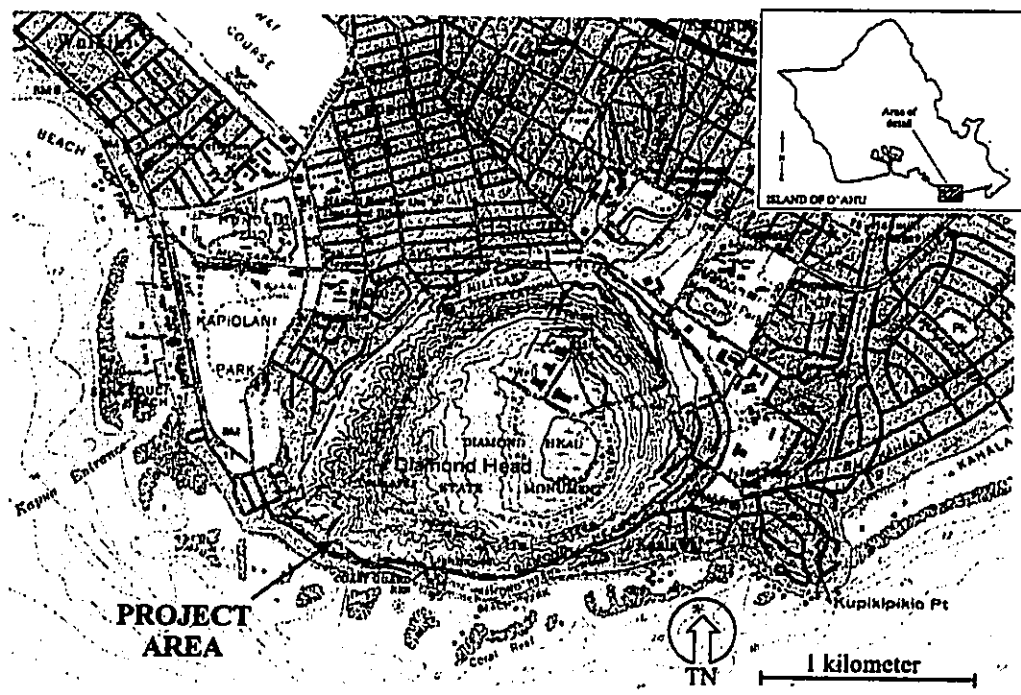


Figure 1. Diamond Head State Monument (USGS topographic quadrangle).



June 5, 1998 at the invitation of Wendy Goodman, cultural resource manager for the Hawaii Army National Guard.

In addition to reconnaissance survey, Dr. J. Stephen Athens of IARIJ conducted preliminary test coring in the wetland portion of the crater floor on May 5, 1998. The purpose of this work was to see if intact deposits that might yield paleoenvironmental or cultural information still remained. The coring shows that probable intact wetland deposits exist beneath approximately 80 cm (32 inches) of fill. The details of this work are presented in Appendix A.

**ORGANIZATION OF REPORT**

The report is organized in four sections, of which this introduction is the first part. Section II presents the environmental and historical background of Diamond Head, as well as the history of archaeological research in the Diamond Head region. Section III describes the assessment survey that was carried out and summarizes the survey results by defined assessment areas. Section IV presents a general summary of the resources of the monument and recommendations for incorporation into master plan update and the EIS.

Appendix A details the preliminary paleoenvironmental work that was conducted. Appendix B is a copy of the National Register of Historic Places nomination form for the Fort Ruger Historic District.

**II. BACKGROUND**

This section of the report summarizes the natural history of Diamond Head and provides a general cultural and historical context of the crater, in terms of the Waikiki region. The section concludes with a discussion of previous archaeological investigations in the region.

**PHYSICAL ENVIRONMENT**

Diamond Head is a tuff cone formed during the Honolulu Volcanic Series, the last period of activity of the Ko'olau volcano that created the eastern half of O'ahu (Macdonald and Abbott 1970:366). The Honolulu Series consisted of over 30 relatively explosive eruptions at the southern end of the Ko'olau range. It left behind a legacy of cinder, spatter, and ash cones that now make up some of southeastern O'ahu's notable landforms, including Mokuapu peninsulas in the north, Koko Head in the east, and Salt Lake in the west, in addition to Diamond Head.

As evidenced by the symmetry of its cone, Diamond Head was formed during a single, relatively brief volcanic event. Macdonald and Abbott (1970:373) note that the "southwestern rim of the cone is higher than the northeastern rim because trade winds at the time of the eruption blew the ash southwestward." The Diamond Head eruption is estimated to have occurred roughly 500,000 years ago during the Illinoian glacial (the Waipio stand of the sea; Macdonald and Abbott 1970:369).

Soils in the interior crater are Mahana silt loam (MaC) around the perimeter, and fill and Makalapa clay (MdB) in the center (Foote et al. 1972). Makalapa clay is also found on the lower exterior slopes along the boundary of the monument. The steep upper slopes of the crater walls are largely exposed rock. Mahana silt loam is described as occurring on the tops of ridges and on moderately sloping uplands, with moderately rapid permeability and slow runoff characteristics (Foote et al. 1972:86). Makalapa clay occurs on gently sloping lands, with characteristics of slow permeability and slow runoff. The small area of this soil type inside Diamond Head crater is saline (Foote et al. 1972:87) and is roughly coterminous with the developed, filled portion of the crater.

Average annual rainfall is less than 30 inches (Armstrong 1973:56). Given this low rainfall, native vegetation in the crater was almost certainly xerophytic in character during the Holocene prior to human settlement of Hawai'i. Before western contact, vegetation in the crater was probably dominated by trees such as *wiliwili* (*Erythrina sandwicensis*), *aloha* (*Canthium odoratum*), *ohia* (*Setbania tomentosa*), *ilialii* (*Santalum* spp.), and *lama* (*Diospyros sandwicensis*), with an understory of *ilima* (*Sida fallax*) (Vent 1998:19). Today,

the undeveloped portions of the interior of Diamond Head are covered in the exotic trees, *Kiawe* (*Prosopis pallida*) and *Koa hooie* (*Leucaena glauca*), with a variety of grasses and *lantana* (*Lantana camara*) provide ground cover, *ilima* is still common. Of important note is the small shrub, *Schiedea adamanis* St. John, which was listed as an endangered species in 1984 (U.S. Fish and Wildlife 1994:1-2):

*Schiedea adamanis* St John is a small shrub known only from one population on the dry slopes of Diamond Head crater in Honolulu, Hawaii. It has survived in the midst of this urban area largely because access is limited by proximity to Federal Administration Agency (FAA) facility. Although this urban location has protected the species from browsing by feral and domestic livestock, and its location and topography have protected it from development for agriculture, it remains threatened by fire, competition from alien plants, and users of a hiking trail immediately adjacent to the population.

A marshy area towards the eastern part of the crater varies in size from roughly 0.5 to 18 acres, depending on rainfall (Goodman 1998). A report prepared in the late 1960s (Pacific Planners [1968a]:2) notes:

The water of this lake was a source of *Engelma*, a microscopic plant-animal. And the load, *Byo mariner*, once thrived on the lake's shores. In 1848, a Punahou schoolboy, describing his visit to the crater's interior, told of wild fowl which he saw on the banks of this pond.

Typically during dry summer months, the wetland gradually dries and alien grasses flourish. During heavy rains, a pumping station installed in 1972 serves to lower the depth of standing water to control mosquito breeding and prevent flooding of the adjacent road. The pump house is located on the northwest side of the wetland.

Noteworthy species in the wetland are the two sedges, the rare *Torulinum odoratum auriculatum* and the endangered *Cyperus trochizanthos* (M. Dumaran, pers. comm.). There is presently an attempt to reestablish native vegetation in the area (M. Dumaran, pers. comm.).

In the 1950s, a xerophytic botanical garden was developed on the exterior western slope of the crater by George Munro, who collected and planted a variety of native dryland plants. Maintenance of the garden was assumed by the State Parks Division in the 1960s and continued through the mid-1970s when active maintenance and public use was discontinued. Although the garden is no longer maintained, remnants of Munro's plantings, particularly *wilifii* trees and succulents, and the public trail are still visible. A monument to Munro, funded by the Garden Club of Honolulu and built in the early 1960s, is still present although in ruins.

#### BUILT ENVIRONMENT

The built environment of Diamond Head includes historical buildings and structures dating from as early as 1909, as well as modern buildings constructed in the late 1950s. Figure 2 shows locations of buildings that are still in use at Diamond Head. The State Department of Defense (Civil Defense and Hawaii National Guard) and the Federal Aviation Administration occupy a complex of buildings in the north portion of the crater; the FAA has a link site on the northeast crater rim. The Hawaii Army National Guard uses Battery 407 for office space and storage. Various other batteries and magazine tunnels are used for storage. The State Parks comfort station, built in the late 1970s, is the newest facility in the crater.

Since the Division of State Parks (1979) prepared a partial structure inventory of the monument in 1979, numerous changes have occurred in the built environment, primarily demolition of Fort Roger buildings to the northeast of the crater. Table 1 updates this inventory with the present status of buildings.

#### CULTURAL GEOGRAPHY

Diamond Head falls within the *ahupua'a* of Waikiki, a traditional land area that encompassed the entire eastern half of the Kona district of O'ahu. Waikiki includes the seven valleys from Mānoa on the west to Kuli'ou'ou on the east; in contrast, the western half of Kona district consisted of smaller *ahupua'a* whose boundaries were generally coterminous with valley areas (e.g., Nu'uuanu, Kalahehi, Kahauike, and Moanalua) (Fig. 3). The reasoning behind this difference in *ahupua'a* size is unknown, although the political prominence of Waikiki and the concentration of chiefs who came to live and play in this area may have been a factor.

#### TRADITIONAL HISTORY OF WAIKIKI

The history of human settlement at Waikiki begins with the initial settlement of O'ahu. Until recently, debate over the time of Polynesian colonization of the island ranged from A.D. 1 to 800 (Emory 1963; Hunt and Holson 1991; Kirch 1985; Simoto 1970, 1983). New data, however, from paleoenvironmental research (Athens 1997; Athens et al. 1997), analysis of archaeoastronomy and oral accounts (Masse and Tuggle, in press), and a critical reassessment of radiocarbon dates (Spriggs and Anderson 1993) have resulted in something of a consensus that initial settlement occurred after about A.D. 700, but probably not later than A.D. 800.

Table 1. Update to 1979 Partial Structure Inventory of Diamond Head State Monument (adapted from Division of State Parks 1979; Nishimura 1988:10-12).

Facility/Structure	Date of Construction	Location	Present Use/Status	Original Use
Bldgs 5, 31	1912	DH Rd to Makapuu Rd	Demolished	Barracks
Bldgs 16, 33, 34	1912	DH Rd to Makapuu Rd	DLNR	16-Hospital Stewards Qtrs 33-Stables 34- Wagon shed
Bldgs 11, 14	prior to 1920	DH Rd (Kapehulu)	Demolished*	Recreation
Cannon Club	1945	DH Rd (Kapehulu)	Abandoned	Siege gun shelters
Bldgs 20, 49	prior to 1920	DH Rd (Kapehulu)	Demolished*	20-Searchlight shed 49-Shop building
Bldgs 69, 22, 39, 32	prior to 1920	DH Rd near Makapuu Rd	Demolished*	22-Q.M. office & suppl. 32-Administration 59-Radio school 69-Rock bin
Bldg 18	prior to 1920	DH Rd across entry to KCC	Demolished*	Guard House
Bldgs 6, 24	1912	DH Rd below Battery Harlow	Demolished*	6-Ord. Mach. shop 24-Ord. & Eng. shop
Bldg 76, 95, 96		Exterior below Kapehulu tunnel	76-Abandoned 95, 96-Demolished?***	76, 95, 96-Storage
Bldg 99		Exterior of Battery Harlow	Demolished	Barracks
Tunnels MO-M6	prior to 1947	Exterior slope & roadway	Emergency storage	MO-Communications M1-6-Magazines N.C.O. Quarters
Bldgs 40, 41, 42	prior to 1920	DH Rd near 18th Ave.	Demolished*	Battery 407 construction
Battery Harlow	1910	Exterior slope	Emergency storage	Leahi Fire Control Station construction, FAA
Kapehulu Tunnel	1941		Access to crater	Leahi Fire Control Station construction, FAA
Kapehulu Tunnel	1909 (enlarged 1934, 1961)		FAA use	Emergency access
Birkhimer EOC	1916	Mauka interior slope	Emergency access	Emergency HQ
Tunnel 407	1945	Makal int-to-ext slope	Emergency HQ	Coastal Defense

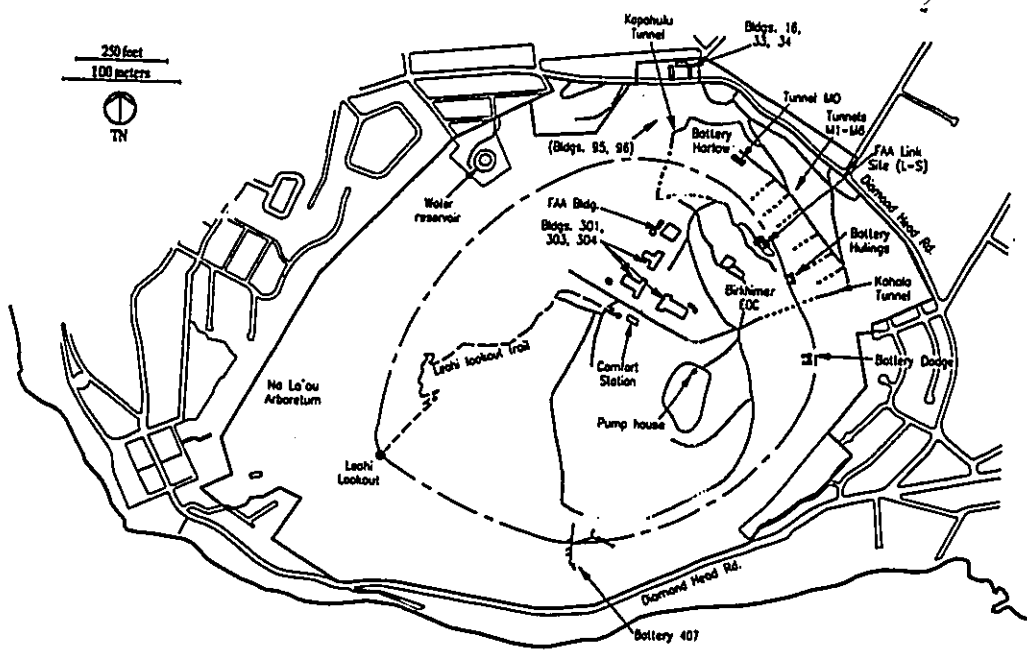


Figure 2. Currently used buildings in Diamond Head State Monument.

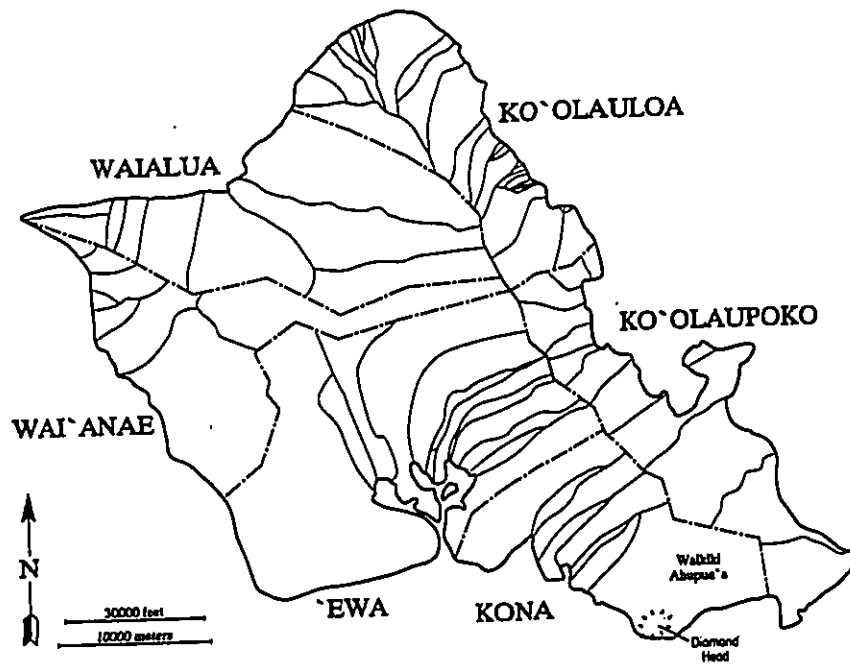


Figure 3. Ahupua'a of the Island of Oahu.

Table 1. Update to 1979 Partial Structure Inventory of Diamond Head State Monument (adapted from Division of State Parks 1979; Nishimura 1988:10-12). (continued)

Facility/Structure	Date of Construction	Location	Present Use/Status	Original Use
FAA Bldg	1961	Crater floor, mauka	FAA air traffic control center	FAA air traffic control center
Bldgs 301, 303, 304	1962	Crater floor, mauka	Armory, maintenance, & office	Armory, maintenance, & office
Comfort Station	late 1970s	Crater floor	Public sanitary facility	Public sanitary facility
Miscellaneous tunnels, bunkers, antennas	1909-1960s	Crater slopes & rim	DOD storage; FAA communications abandoned	Coastal/Land defense, communications
Water reservoirs (3)	SW exterior - pre-1920 NW exterior - pre-1934 Interior - 1911	2 on exterior slope 1 on interior slope	SW Exterior - abandoned NW Exterior - in use Interior - abandoned	Water storage
Utility poles & wires	---	Throughout Monument	Utility services, electricity & telephone	Utilities
Roadways/parking	---	Throughout Monument	Transit routes	Transit routes
Rifle & pistol ranges	?	Crater floor	Open space/abandoned	Military/Law enforcement training
Na La'au Arboretum	1950s	West exterior slope	Abandoned	Xerophytic garden
FAA link site (L-S)	1961	Mauka crater rim	Communications	FAA air traffic control
Pump house**	1972	Crater floor	Flood control	Flood control
Leahi Fire Control Station**	1911	Crater summit	Public lookout	Fire control for Batteries Harlow, Dudley, Randolph
Crater trail***	1910	Crater floor	Public trail	Construction access for Leahi Fire Control Station

\* foundations remain.

\*\* not included in 1979 planning report.

\*\*\* believed to be demolished; could not access site because of fence and locked gate.

Kapaluna] in Kona, and that of Hosiā [near Waipahu] in Ewa, are said to have been literally choked with the corpses of the slain. The native O'ahu aristocracy were [sic] almost entirely extirpated.

Thrum (1926:109) suggests that Kahekili, who claimed the lands of Waikiki for himself, dedicated Papa'ena'ena Heiau on the slopes of Diamond Head at the end of this war.

Kahekili died in 1794, and his successor, Kalamikupule, faced an invasion from Kamehameha. Like Kahekili, Kamehameha landed his forces, which may have included 10,000 warriors, at Waikiki and encamped along the sandy beaches from Wai'alea around Diamond Head to Kalia (Kanabele 1995:87). The invasion ended at the battle of Nu'uuanu when O'ahu warriors, finding themselves trapped between the overwhelming and superior-armed forces of Kamehameha and the precipice of the *paik*, chose to leap to their deaths.

Kamehameha made Waikiki his capital, and thus it was the chiefly center of the southern O'ahu coast, home to the ruling chief and his subordinate *ali'i* (Cordy 1996; Ngpōkā 1986; Tomonari-Tuggle 1994). In 1809, however, Kamehameha moved his court to Honolulu to be more accessible to the increasingly important Western visitors and the times of Waikiki as a center of power came to an end.

PLACE NAMES OF THE DIAMOND HEAD AREA

Diamond Head was given its name by British sailors who found natural calcite crystals on the slopes of the mountain and mistook them for diamonds (Macdonald and Abbott 1970:373). Hawaiians called the volcanic cone *Lé'ahi*, *Lae'ahi*, or *Lae-ahi*; for this report, the name *Lé'ahi* is used interchangeably with Diamond Head. Clark (1977:41) summarizes the etymology of the Hawaiian name:

...to the old Hawaiians the mountain was either *Lé'ahi* or *Lae'ahi*. Because the original meaning of the name is obscure, the correct spelling and translation have never been agreed upon by students of Hawaiian. One interpretation says that *Lé'ahi* is a contraction of the two words *lei* (a wreath) and *ahi* (fire)<sup>2</sup>, the two words combining to mean "wreath of fire" ... The other popular interpretation is that *Lé'ahi* is a contraction of *lae* (a cape or promontory) and *ahi* (the yellow-fin tuna), the combination meaning "point of the *ahi* fish."

In the legend of Pele and Hi'iaka, Hi'iaka is said to have compared Diamond Head to the brow of the *ahi* (Palikapu n.d.):

*Me he i'a lae o Ahi*  
*E kalali au oe nei i ke kai*  
Like a fish is the Brow-of-the-ahi  
Resting high above the sea.

<sup>2</sup> Clark misspells the Hawaiian word for fire, which is *ahi*; there is no glottal at the beginning of the word. The word for the yellow-fin tuna begins with the glottal (*ahi*).

The earliest settlers probably made their homes on the windward shores of the islands, coming to the drier southern and western areas only for selected resources like fish and birds. But from A.D. 1000 on, Hawaiians moved outward from their original settlements, spreading into leeward areas along O'ahu's southern shores (Cordy 1996:597). Coastal Waikiki was almost certainly settled during this period, offering easy access to rich ocean resources, a ready freshwater supply from springs and streams, level and easily developed lands for cultivation and aquaculture, and a bounty of game foods like ducks and other wildfowl. Some cultivation probably followed the stream courses into valleys like Mānoa, which were also sources for items like hardwood (for tools, weapons, and building materials) and birds (for feathers).

During the A.D. 1400s, the island was unified into one political unit,<sup>1</sup> with the royal center initially located at Lihū'e in inland Ewa. When Mā'ilikūhāhi became high chief of the island about a century later, chosen by a council of chiefs to succeed Haka, a "bad chief and a stingy one" (Kamakau 1991:53), he moved the royal center to Waikiki. The times were said to have been prosperous and peaceful. One of the significant acts attributed to Mā'ilikūhāhi is the division of the island into districts and smaller units; Kanabele (1995:65) writes that "Waikiki was made part of the *moku* of Kona, the district that extended from Maunaloa (Koko Head) to Moanalua (Honolulu International Airport) of which Waikiki is still a part today."

The 15th and 16th centuries saw the Hawaiian political system change, as political power gradually replaced kinship as the means of legitimizing rule (Kolb 1991; Hommon 1986). One way that chiefs expressed their power was through construction of monumental architecture including *heiau*, irrigation systems, and fishponds (Cordy 1996:599-600), all requiring the ability to mobilize enormous expenditures of labor. Traditions say the taro fields (and presumably the fishponds) of the Waikiki plain were built by the chief Kalamakua at this time.

The 17th century saw a disintegration of the unified kingdom, replaced by warring factions among district chiefs. However, in the early A.D. 1700s, the chief Kūali'i came to power and re-established the primacy of the island ruler (Kanabele 1995:74-75). But his successors were less successful in maintaining the unified domain, and in 1780, the island was invaded by the Maui chief Kahekili. "The warrior-chief of the black taro" (Kanabele 1995:76). His invasion force landed at Waikiki "carpeting the beaches from Ke'āhualai (near Diamond Head) to Kawehewehe (next to the Halekālani Hotel)" (Kanabele 1995:79), launching three years of battle and confrontation that ended with the final subjugation of the island. A subsequent revolt by O'ahu chiefs was crushed and Kahekili commenced a war of retaliation, of which Fomander (1969:226, brackets added) writes:

Gathering his forces together, he [Kahekili] overran the districts of Kona and Ewa, and a war of extermination ensued. Men, women, and children were killed without discrimination and without mercy. The screams of Mākaio and Niūbelevai [a

<sup>1</sup> Cordy (1996:598) calls this entity the O'ahu Kingdom.

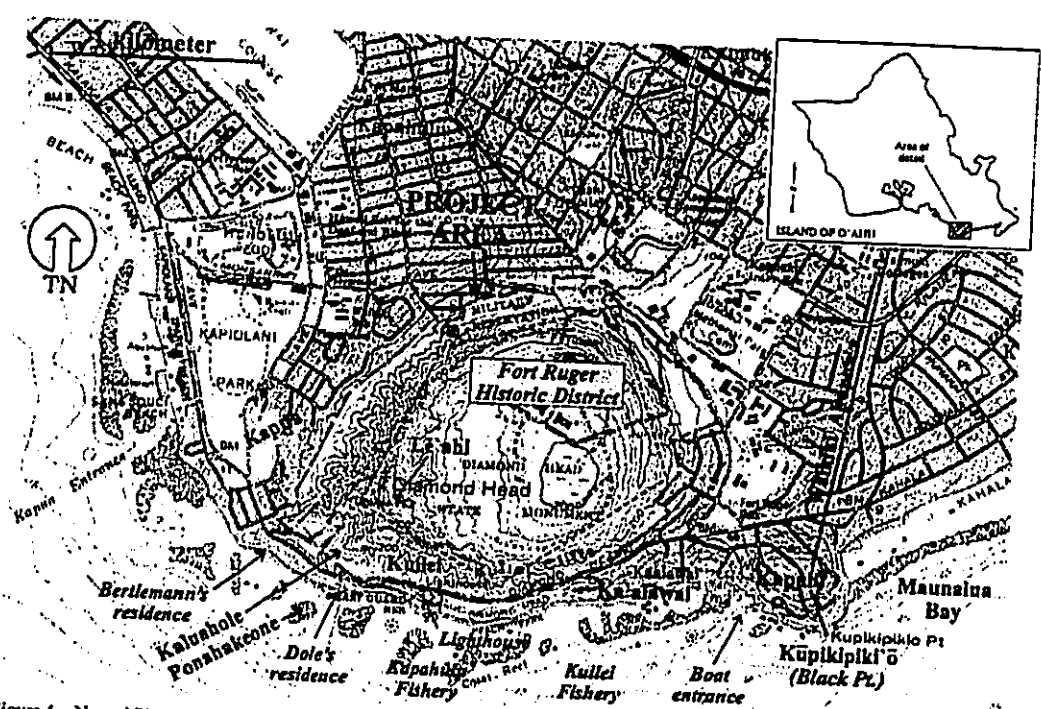


Figure 4. Named Places in the vicinity of Diamond Head.

Clark (1977:41) also suggests the possibility that the cone was used as a reference point in locating the fishing grounds of the 'ohi.

An alternative translation of the name combines *lae* and *ahi* as "cape of fire" (D. Tuggle, pers. comm.). From certain points of the southern coast of O'ahu, the rising sun on the summer solstice appears to emerge as a glowing fire from the center of the crater. This translation may also tie into the presence of a *heiau* called Ahi that was reputed to be located on the crater rim; this *heiau* was "dedicated to the god of the winds as a protection against sudden, violent updrafts which could put out" the navigation fire that was tended at the *heiau* (Division of State Parks 1979:21).

Other names for Diamond Head include Point Rose (given to the geologic feature in 1786 by Captain Nathaniel Portlock in honor of the secretary of the British treasury), Diamond Hill, and Conical Mountain.

Other places around the crater are also named. These are shown in Figure 4.

Black Point is the promontory that extends to the southeast of Diamond Head, separating Kahala (to the east) from the narrow shoreline of Ka'alawai and Kaluahole (to the west). The Hawaiian name for the promontory is *Lae o Kupikipiiki'o*, which is translated "rough sea" (Pukui et al. 1974:125) or "point of raging sea" (Clark 1977:39). An 1883 map of Kapahulu government lands labels the point "Kupikipiiki'o" and the land area "Kapuhi" (HGS 1883). Fort Ruger originally extended out to Black Point.

Ka'alawai is the white sand beach located between Black Point and the Diamond Head lighthouse. It is noted as a famous fishing grounds for *'amae-holo*, schools of which numbered in the thousands, as well as a place for collecting *limu* (edible seaweed) and shellfish (Clark 1977:39). It is translated "the water basin" (Pukui et al. 1974:50) or "the watery rock" (Clark 1977:39), which can be a reference to several freshwater springs that are said to emerge at the water's edge (Clark 1977:39). The 1883 Kapahulu map shows the place name "kaalawai" immediately west of Black Point; a break in the fringing reef at this location is marked "boat entrance" (HGS 1883).

Kaluahole is the traditional land area at the southwest tip of the exterior crater slopes. It is translated as the "whole fish cavern" (Pukui et al. 1974:78) or "the pit of the whole". (Kawaharada 1992:22). In both cases referring to the fish *holehole* (*Kuhila zonadvivatus*). This place, as well as Ka'alawai, figures in the story of Ai'ai, the son of Ku-ula-kai, a fishing god that "some say... had control over all the gods of the sea" (Beckwith 1970:19). Beckwith (1970:19, brackets added) writes:

3 Clark (1977:39) does not give the scientific name for *'amae-holo*. He is probably referring to the adult stage of the *'amae* *'ama* fish (*Mugil cephalus*).

Traditional use of the interior crater of Lē'ahi is somewhat of a mystery. The only legendary reference to the crater is in the story of Pele and her sister Hii'iaka. Pele is the fire goddess who is popularly associated with the active volcano Kilauea on the island of Hawai'i. Beckwith (1970:168) writes:

The Pele myth is believed to have developed in Hawai'i, where it is closely associated with *sumakua* worship of the deities of the volcano, with the development of the hula dance, and with innumerable stories in which odd rock or cone formations are ascribed to contests between Pele and her rivals, human or divine. The myth narrates the migration or expulsion of Pele from her distant homeland and her effort to dig for herself a pit deep enough to house her whole family in cool comfort or to exhibit them in their spirit forms of flame and cloud and other volcanic phenomena.

Diamond Head is one of a number of extinct, shallow craters at which Pele and her sister Hii'iaka stopped in their search for a new home. Formander (1916:104) describes the journey of Pele and Hii'iaka, who begin their travels on Kaua'i. Their first attempt at a new home on the island of O'ahu is at Aliamanu and Aliapaakai (the present day Salt Lake). Finding these places too shallow, they then try to live at Lē'ahi but also find it unsatisfactory. Their journey takes them to Mōlōkai, then to Maui, and then finally to what becomes their home at Moku'āweoweo on the island of Hawai'i, where Pele is "successful in digging deep without striking water, an element inimical to her fiery nature" (Beckwith 1970:170).

The crater also figures in stories related to its use as a burial ground. In 1823, the Scottish botanist James Macrae (1972:39) climbed the summit of Diamond Head:

... we had gained the summit, which is high and steep, without anything growing on it but tufts of dry grass in loose sand, which came up very easily and rendered the ascent more difficult... In the centre is a level flat, two acres in size, covered with longer grass than the external declivity. On the inside part next to the sea, the depth is upwards of 500 feet, counting from the narrow ridge round the top, which is almost circular.

In the dark of the afternoon twilight, Macrae's assistant found many human skulls on the inside slopes of the crater. Macrae (1972:40) was later told by his American cook (who had been in the islands for six years) that "the chiefs used to take their criminals upon the top of Diamond Hill to put them to death by throwing them over the precipice, where they were left unburied in the hollow." There are no other references to this practice so its veracity cannot be checked (compare with Mark Twain's story, below).

Addleman (1940:4) writes that "on the ewa side of the mountain, accessible only from the top, are some of the oldest burial caves on the island, though they were rifled of their contents." He does not cite a source for this information.

The American writer Mark Twain describes a harrowing horseback ride up the side of the crater, and the presence of a large mass grave at the foot of the hill (Day 1975:58-59, brackets added):

Aial, following his [Ko'ouka-kai] instructions, traveled about the islands, establishing fishing stations (to's) at fishing grounds (to'a aina) where fish were accustomed to feed and setting up altars (tuuis) upon which to lay, as offerings to the fishing gods, two fish from the first catch: one for the male, the other for the female *sumakua*.

At Kaluahole, Ai'ai is said to have placed a rock to mark an underwater pit filled with *hōlōhōle*. Nearby, he established a *to'a* at a place called Ponahakeone where the *hōlōhōle* spawn. Kawaharada (1992:22) states:

In ancient times the chiefs selected a very secret place wherein to hide the dead bodies of their greatly beloved, lest someone should steal the bones to make fishhooks, or arrows with which to shoot mice. For that reason the ancients referred to Ponahakeone as "He Luahoa no Na'ii'i" ("A Deep Pit for the Chiefs").

Clark (1977:43) suggests that Kaluahole originally included the area of Ka'aiawai. However, the 1883 Kapaehulu map shows Kaluahole to the southwest of the crater and Ka'aiawai to the southeast (HGS 1883). This map also shows a break in the reef at Kaluahole that is marked "entrance." The label "Kaluahole" is placed within the boundaries of Grant 3219 to Kahololilo.

Kuilei is the name of the area on the south side of the crater, between the beach areas of Kaluahole and Ka'aiawai. The 1883 map of Kapaehulu shows a portion of the fringing reef in this area as "Kuilei Fishery" (HGS 1883).

Kapua is the land area to the west of the crater along the Waikūiū shoreline. It encompasses LCA 5931 to Pehu (RP 5667, Apsara 3). Kanahale (1995:101) describes the high chiefess Ka'ahumānu (Kamehameha's favorite wife) surfing at Kapua. The 1883 Kapaehulu map shows an "entrance" through the reef at this location.

#### LEGENDS AND TRADITIONAL USE

Diamond Head is a prominent feature of Honolulu's landscape, and Hawaiian traditions and historical accounts paint Lē'ahi as a backdrop to a continuum of social, political, and religious events. From at least the 15th century, chiefly residences lined the shore of Waikūiū, and cultivated fields spread across the Waikūiū plain to the foot of the crater and inland to the Ko'olau valleys. There were numerous temples in Waikūiū, of which several were located around Diamond Head.

One of Kamehameha's main *heiau*, Papa'ena'ena, was situated at the base of the southern slopes. Other *heiau* in the vicinity include Kupalaha Heiau, which may have been connected with Papa'ena'ena, Pahu-a-Maui Heiau on the crater's eastern cliffs overlooking the ocean (the site of the present Diamond Head lighthouse), Kapua Heiau near the present Kapiolani Park, and Ahi Heiau on the peak of Diamond Head (Division of State Parks 1979:21). Kanahale (1995:71) writes also of a *heiau* Hale Kumukā'aha that was built by the ruling chief of O'ahu, Ka'ihikapumanuia.

botanist, Dr. F.F. Meyen, noted that the crater contained a small pool of water "which was completely covered with plants" (Meyen 1981:55).<sup>4</sup>

**MAHELE AND LAND DISTRIBUTION**

In the mid-century division of lands between the king and his high chiefs, Diamond Head, which lies within the 'i'i of Kapahulu in the *ahupua'a* of Waikiki, was awarded to William C. Lunaillo, the future king of Hawaii (1873-1874). It was designated Apana 32 of Land Commission Award (LCA) 8559-B (dated May 25, 1854).

The 'i'i of Kapahulu was one of 239 lands held by Lunaillo before the Mahele (Kame'elehiwa 1992:229). Lunaillo inherited most of these lands from his mother Kekauloohi, the daughter of Ka'ahumanu's younger sister Kahuheimalie, and Kamehameha's younger half-brother Kalaimamahā (Kame'elehiwa 1992:125). His father Kana'ina, who was a lower ranking chief, was instructed in Kekauloohi's will to act as the *kahu* (administrator) of Lunaillo's inheritance. During the Mahele, Lunaillo relinquished 174 of his lands and retained 65 of them, including Kapahulu. In 1850, he gave up another 22 lands as commutation to the government (Kame'elehiwa 1992:243).

In 1858, Kana'ina, acting as Lunaillo's *kahu*, succeeded in having legal guardians appointed to manage his son's estate. He believed that Lunaillo, who was 24 at the time, was incapable of handling his personal affairs and that the estate would be lost if not placed under guardianship. From that point until Lunaillo's death in 1874, the estate was managed by others. In his will, Lunaillo bequeathed his lands to his father, with the stipulation that upon the latter's death, the estate would be placed in a trust for the benefit of "poor, aged and infirm people of Hawaiian ancestry" (Kame'elehiwa 1992:309). Kana'ina died three years after his son, in 1877, and the Lunaillo Trust was formed to carry out Lunaillo's benevolent directive.

In 1884, the Kapahulu portion of Lunaillo's Mahele award, LCA 8559-B, was subdivided by the Lunaillo Estate. Diamond Head was encompassed in Parcel 36, an area of 729 acres, and was transferred from the estate to the Hawaiian Government for the sum of \$3,310 (Bureau of Conveyances Liber 88:223-224). Over the next 10 years, at least two requests to lease all or portions of Parcel 36 were made (Dole 1889; Isenberg 1894), although records do not indicate the intended uses. One of the applicants for a lease, Sanford B. Dole, had a grant at the base of the southwestern slope of the crater.

A list of Kapahulu lands indicates that the areas to the north and east of the crater were used for pasture (Dole Collection 1884). The "Kapahulu sea fishery" is listed as Lot 40 (Probate Record 2414); an 1852 letter from Kana'ina (1852) to the Minister of Interior specifies that *he'e* (octopus) is the *kapa* fish of the Kapahulu lands.

<sup>4</sup> The crater pond was filled in by military bulldozing (Pacific Planners Corp. [1968b]:Ecology, 2), and a pump was installed in 1972; standing water can occasionally be seen there today.

... we got to a point [along the base of Diamond Head] which we were expecting to go around in order to strike an easy road home; but we were too late; it was full tide and the sea had closed in on the shore. Young Henry McFarlane said he knew a nice, comfortable route over the hill... We climbed a hill a hundred and fifty feet high, and about as straight up and down as the side of a house, and as full of rough lava blocks as it could stick.

... It was a great relief to me to know that we were all safe and sound on the summit at last, because the sun just disappearing in the waves, night was abroad in the land, candles and lamps were already twinkling in the distant town... But a new trouble arose while the party were admiring the rising moon and the cool balmy night breeze, with its odor of countless flowers, for it was discovered that we had got into a place we could not get out of - we were apparently surrounded by precipices...

... A Kanaka came along presently and found a first-rate road for us down an almost imperceptible decline, and the party set out on a cheerful gallop again, and O'ahu [Twain's horse] struck up his miraculous canter once more.

Gaily laughing and talking, the party galloped on, and with set teeth and bouncing body I clung to the pommel and cantered after. Presently we came to a place where no grass grew - a wide expanse of deep sand. They said it was an old battleground. All around everywhere, not three feet apart, the bleached bones of men gleamed white in the moonlight.

Just a few years previous to Twain's visit, Dr. H. Willis Baxley visited Hawaii as a special commissioner of the United States. In a tour of the Diamond Head area, he noted burials off the "eastern face of the headland" (Baxley 1865:522):

... In the sands of the sea-shore, beyond the reach of ordinary high water, an immense trench is found, in which lie innumerable human bones piled in indiscriminate confusion, and in every degree of disorganization; some few of them being perfect in structure, and bleached by the sun, where disturbed by the northeast wind, forming interesting ethnological specimens.

Baxley's tour began on Waikiki beach and continued on to Wai'alea, suggesting that the location of the burials (in the context of Baxley's transit around the crater) is near the Black Point peninsula.

It should be noted that burials in the Waikiki area are not uncommon. Davis (1989:22-23) lists several archaeological sites with human remains, extending over an area from the present Fort DeRussy to Diamond Head.

**DIAMOND HEAD IN THE 19<sup>TH</sup> CENTURY**

In the early years of the 19th century, people tended gardens in the crater (Pacific Planners [1968b]:History, 2) and one visitor described finding "an abundance of melons and watermelons growing wild, upon which we feasted" (Mathison 1825:376). In 1831, the



### THE LATE 1800S

From the 1870s, Charlie Peterson, also known as "Diamond Head Charlie" (Scott 1968:669), sat atop Lē'ahi with his telescope to watch for ships approaching on the horizon. To alert Honolulu of an approaching vessel, he would descend the crater on horseback and gallop to town. Later, he used signal flares and a telephone. It was he who, on January 20, 1891, announced the arrival of the U.S.S. *Charleston* which was sailing draped in black with flags at half-mast. The *Charleston* was returning with the body of King Kalākaua who had died in San Francisco (Pacific Planners [1968b]:History, 9). In 1892, lighthouse beacons installed on the lower slopes of the promontory added lighthouse keeper to Peterson's roles (Thompson n.d.:12). The advent of the Pacific Cable in 1902 made Diamond Head Charlie's job obsolete (Scott 1968:669).

Diamond Head was the site of a brief military skirmish in 1895. Following the overthrow of Queen Lili'uokalani in 1893, loyalists made plans for an armed attempt to restore the monarchy. Weapons were smuggled into the islands from San Francisco, landed at Rabbit Island near Makapu'u Point, and then "secretly transported and buried in the sands of Ka'alāwai, near Henry Bertlemann's home" (Clark 1977:39). Kuykendall and Day (1961:185) continue the story:

The time set for the uprising was early on the morning of January 7, 1895, but rumors had put the government on guard, and an advance unit of the insurrectionists was intercepted at Waikiki on the night of January 6. In a brief exchange of shots, a prominent supporter of the government, Charles L. Carter, was mortally wounded.

Fighting between rebels and Republic soldiers continued across the slopes of Diamond Head. The rebels retreated into the Ko'olau valleys where they were eventually captured (Kamahele 1993:154).

Diamond Head at the turn-of-the-century was a backdrop to changes in the face of Hawai'i, O'ahu, and Waikiki. An 1899 photograph shows livestock, probably horses, grazing in the crater (Photo 2). In 1905, a lone Hawaiian tended a cow and a garden of lima beans, radishes, tomatoes, tobacco, and beets (Advertiser 1945:editorial page). A year later, the farmer was gone, at least as it appears from a description of the crater as a "rarely visited local attraction" (Advertiser 1906:5):

From the rim of Diamond Head crater the wonderfully symmetrical basin strikes one as a beautifully laid out park. There had formerly been a large pond in the center from which the water has either all evaporated or percolated into the soil leaving a remarkably circular basin which is covered with verdure of a different shade from that surrounding it. The balance of the floor of the crater is covered with *laniana* and *mimosa* with innumerable *algaroba* trees interspersed. If the climber were to see

5 A 1920 map by M.D. Monsarrat shows that a "Bertlemann" was resident at the southwest point of Diamond Head, in the area called Kaluahohe (see Fig. 4 for location).



Photo 2. View of the interior of Diamond Head from the east rim in 1899; photograph credited to Frank Davey in Scott (1968) (photograph courtesy of Hawai'i State Archives).

Battery Harlow became part of Hawaii's first coastal defense system, the Artillery District of Honolulu.<sup>7</sup> Dorrance (n.d.:3) describes the strategy of the coastal defenses (Fig. 6):

The [Battery Harlow] mortars covered the approaches to Honolulu Harbor and could reach as far as the approaches to the entrance to Pearl Harbor. They complemented the 6-inch and 14-inch guns emplaced at the closer approaches to Honolulu Harbor at Fort DeRussy and the harbor entrance submarine mining facilities. Any enemy vessel attempting to enter Honolulu Harbor would encounter, first, the deck-piercing projectiles of the Armstrongs located at the Honolulu Harbor entrance. Next, the side armor piercing projectiles of the Fort DeRussy guns, and, if they survived those weapons, last, the hull-breasting submarine mines planted in the harbor entrance by the soldiers at Fort Armstrong.

Built in 1910-1911, the fire control station at Lē'ahi was the core of Oahu's coastal defense (Hibbard 1980:9). The view to the ocean from Battery Harlow was blocked by the protective slopes of Diamond Head and thus, the battery commander could not spot enemy vessels at sea. To solve this problem, Winslow designed a lookout and fire control station to be constructed at the remote location on the peak of Lē'ahi. Dorrance (n.d.:3) writes of the construction challenge posed by the difficult access to the crater floor:

The engineers drove a tunnel through the crater wall a little above and to the right of the mortar battery. Narrow gauge tracks were put down through the tunnel and across the crater floor to the base of the inner crater wall below Leahi. A switch back path was constructed from the end of the tracks and up to a ledge at the 360 foot level. Here a stairway rose some 40 feet up to a tunnel leading to another small ledge. A winch and cable lift was installed here to hoist construction material. From this position another 99 step concrete staircase led to a tunnel at the upper end that constituted the lowest level of the four-level fire control station.

Materials for the control station were transported on a multi-powered rail line through the tunnel next to Battery Harlow (now called Kapaehulu Tunnel), and then hauled by trail from the tunnel to the base of the escarpment below the peak. The winch and cable system (the foundations of which remain) lifted materials and supplies to the peak.

7 The Artillery District was headquartered at Fort Ruger and consisted of additional batteries and gun emplacements at Forts Kamehameha at Pearl Harbor, DeRussy on Waikū Beach, and Armstrong at Honolulu Harbor (Mecken 1974:26). The Artillery District was renamed Headquarters Coast Defenses of Oahu sometime between 1911 and 1913, and redesignated Hawaiian Coast Artillery District in 1921. At that time, the headquarters was moved to the Alexander Young Hotel in Honolulu and then shortly after to Fort Shafter. Fort Ruger was named a subordinate command, Coast Defenses of Honolulu (Mecken 1974:40).

nothing more than the floor of the crater and the green sides sloping into it he would feel repaid for his exertions in climbing. Once on the rim he finds that he can walk around two-thirds of the crest on a comparatively good path from every point of which an ever changing panorama presents itself of the beautiful city of Honolulu and its suburbs and the irregular surf-bordered shore of the island.

Outside the crater, the U.S. government had annexed the Hawaiian islands less than a decade earlier and a military camp had been set up in the fields of Kapiolani Park under the shadow of Diamond Head.<sup>6</sup> This small garrison at Camp McKinley consisted of the 1st New York Volunteer Infantry Regiment and a battalion of the 2nd U.S. Volunteer Engineers (Linn 1997:9), the first formal presence of U.S. military troops in Hawaii.

#### DIAMOND HEAD AND COASTAL DEFENSES

The pinnacle of Lē'ahi, at 230 m (761 feet) above sea level, affords an excellent and unobstructed view of the ocean from Koko Head in the east to beyond the 'Ewa Plain to Wai'anae in the west. The quality of this vantage point and its location in proximity to Honolulu Harbor and Pearl Harbor made Diamond Head the obvious ground from which to observe naval activities and protect O'ahu's southern shoreline.

The utility of Diamond Head did not go unnoticed by the U.S. Army. In 1905, Secretary of War William Howard Taft visited Honolulu, and then recommended to the National Coast Defense Board that harbor defenses be strongly improved. This recommendation was in line with an overall national strategy in which Pearl Harbor and Honolulu, the only significant deep water ports in Hawaii, served as the first line of defense against an enemy invasion of the West Coast. These harbors were to be protected by a number of coastal defense forts.

In 1906, the U.S. government purchased the 729 acres of Lunaliio's Parcel 36 from the Hawaiian Government, as well as other adjacent lands (including Black Point), to create Fort Ruger Military Reservation, the easternmost of the coastal defense forts. It was named after Major General Thomas H. Ruger who served in the Civil War (Addleman [1940]:4).

In April 1907, Captain Curtis W. Otwell, District Engineer of the Army Corps of Engineers, was charged with construction of an eight-mortar battery (Dorrance n.d.:1). Eventually named Battery Harlow, it was located on the northern flat outside the crater and was the first structure to be built at the newly designated fort. Construction was completed in 1910 under the direction of Otwell's successor, Major E. Evelt Winslow (Fig. 5), and

6 Camp McKinley was intended as a temporary encampment, pending construction of a permanent installation (Mecken 1974:54). The last units to occupy the camp departed in 1907.

-25-

Schematic of Taft Period Defense System

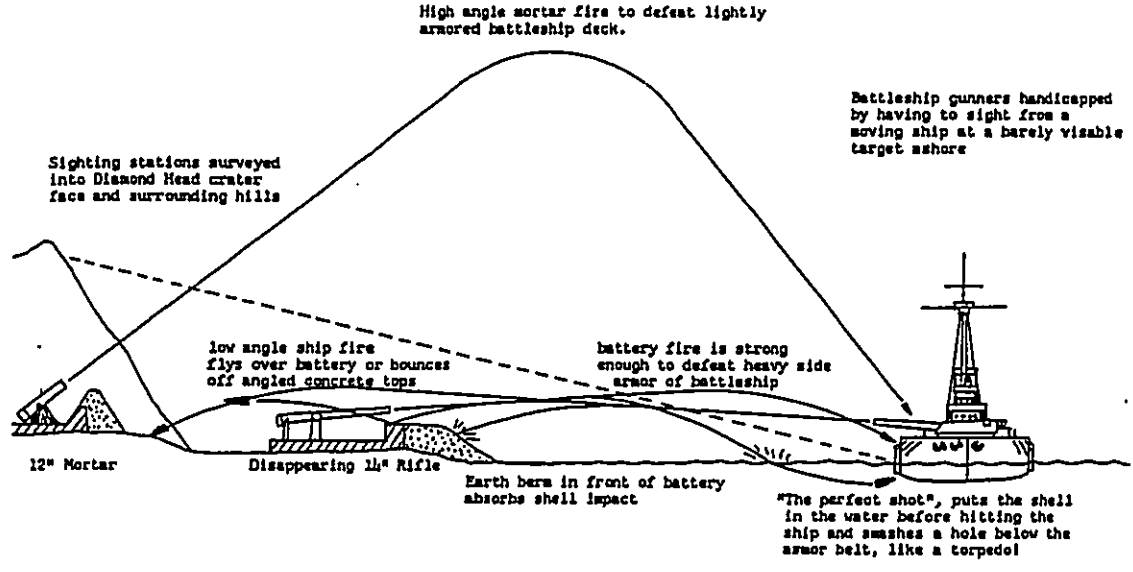


Figure 6. Schematic diagram of projectile trajectories (courtesy of the U.S. Army Museum at Fort DeRussy).

-24-

FORM NO. 1108

**POSTAL TELEGRAPH COMMERCIAL CABLES**

CLARENCE H. MACKAY, PRESIDENT.

**CABLEGRAM**

The Postal Telegraph-Cable Company (Incorporated) transmits and delivers this cablegram subject to the terms and conditions printed on the back of this blank.

Number SENT BY Rec'd BY CHARGE Received at

1 Po. Fy.Me. 6 U. S. G. WAB DEPARTMENT

From Honolulu. Feb. 16, 1910. 100

Cengwar,

Washington.

Buneki adogik dukesi.

Winslow.

1:45 a.m.

Battery<sup>1</sup> Harlow<sup>2</sup> completed<sup>3</sup>.

CHIEF CLERK FEB 16 1910

No inquiry respecting this message can be attended to without the production of this paper. Interpretations of doubtful words should be obtained through the Company's office, and not by DIRECT application to the sender.

Figure 5. Encrypted cablegram from Major E.E. Winslow to War Department announcing the completion of Battery Harlow (courtesy of the U.S. Army Museum at Fort DeRussy).

Two companies of the Coast Artillery arrived in 1909, before the battery or support facilities were completed. They lived in a tent camp while they cleared the parade grounds (see Allen and Shideler 1996:Figure 2, which is a photograph of Fort Ruger in 1910), graded the future fort area, built roads and sewer lines, and constructed temporary officers' quarters (Dorrance n.d.:6). Addleman (1940:5) writes that "there was no appropriation for roads so the troops exchanged labor on roads for the city in return for the use of road equipment." The Quartermaster Corps completed construction of permanent facilities, including officers' quarters, barracks, offices, a storehouse, machine shop, and stables, in 1912 (Dorrance n.d.:9).

In 1914, construction on inland defenses began, in response to growing American suspicion of its residents of Japanese descent (Linn 1997:104) and fears of Japanese aggression like that seen at German-held possessions in the western Pacific; the Alien Land Law passed in California forbidding immigrants to own land was also thought to be a possible provocation of war (Thompson n.d.:40; Hibbard 1989:1). On the rim of the crater, Batteries Hulings and Dodge each contained two 4.7-inch guns to protect the Waialae and Kahala regions to the east. An additional six rapid-fire 6-pounder guns pointed in the same direction were emplaced on the crater rim (Dorrance 1995:154) and a road connected all components of the complex (Thompson n.d.:41). Battery Birkhimer, with a 360 degree field of fire with four 12-inch mortars, was situated on the crater floor; the cannons were too large to be taken through the existing tunnel and were carried over the crater wall. Some researchers mention a ramp or possibly a graded road that was constructed to transport these guns (J. Bowman, pers. comm.; C. Hosokawa (pers. comm.) suggests some of the grooves in the hillside behind Battery Birkhimer might be evidence of sliding the cannons into place; Thompson (n.d.:41) simply states that "the mortars had to be hauled over the rim of the crater, the tunnel being too narrow to admit them." Also completed in 1916 were two 5-inch guns on pedestal mounts at Battery S.C. Mills on Black Point. Virtually all fortifications at Fort Ruger were completed by 1916 (Linn 1997:92).

The 1920s saw new construction at Fort Ruger, as well as changes to defense facilities. Additional support buildings in the form of officers' quarters, barracks, service club, and chapel were built at Fort Ruger in the 1920s. The 3rd Balloon Company arrived at the fort (Anonymous n.d.:3), requiring construction of an appropriate hangar; Allen and Shideler (1996:26, referencing a photograph at the U.S. Army Museum at Fort DeRussy) note that it was located outside the northeast crater rim and that the balloon field was south of the hangar. By the mid-1920s, the land defense batteries of only a decade earlier were determined to be obsolete and were dismantled or assigned other functions (Dorrance 1995:158, brackets added):

The 4.7 inch guns were removed from Batteries Bari (at Pearl Harbor), Hulings, and Dodge. Battery Birkhimer (four 12-inch mortars) was found to be too cramped and poorly designed. The battery was extensively rebuilt and subsequently listed as a harbor-defense battery.

A 1932 photograph (Photo 3) shows development in the crater interior that includes a rifle range in the center of the crater, as well as roads and various structures. Also visible is the marshy area in the eastern portion of the crater.

The last major development at Fort Ruger before World War II was the construction of Battery Granger Adams at Black Point in 1935; this battery was named in honor of Brigadier General Granger Adams, an artilleryman and 1876 West Point graduate (Thompson n.d.:73). Around the same time, the original tunnel next to Battery Harlow was widened and a six-room complex for a Coast Artillery fire command post was built in the tunnel (Thompson n.d.:76).

On December 7, 1941, the Japanese attacked Pearl Harbor. Considerable damage to sites in Honolulu, including Diamond Head (most likely Battery Birkhimer), was initially thought to be from the attack, but was eventually attributed to defective navy ammunition (Allen 1950:8, quoting the commander of the coast artillery; brackets original):

A great deal of it [the ammunition] was defective, and "duds," unfortunately, the "duds" detonated on contact with the ground... they did not burst in the air. They burst all over town. They burst all over De Russy, where I was. I saw them burst, two of them, up in the crater on Diamond Head, knocking out one of my mortars.

At the time of the attack, Battery Granger Adams was the only Fort Ruger battery that was manned (Allen and Shideler 1996:21). On the night before the attack, a submarine was sighted off the Oahu coast. Holmes (1979:33) writes:

When word came down the line that night to "open fire on a surfaced submarine in grid position Hiten seven five," the battery was ready. The two big guns were swung around to proper bearing and the gunpointers found they were looking right into the windows of the house we knew as "George Hunter's old house," not fifty yards away. Moreover, ranged down the slope to the water's edge, under the muzzles of the guns, were twenty other houses where families were sleeping in blissful ignorance of what was happening on the other side of the chain-link fence that divided the Army from the civilian area.

In the aftermath of the attack, Hawaii shifted to a state of continuous emergency and plans for building up the coastal defenses were made. Construction of Battery 407 on the southern face of Diamond Head, one of four permanent batteries for 8-inch guns that were installed during the war, was begun in 1943 (Thompson n.d.:117). Troops poured into the islands en route to the western Pacific, and hundreds of soldiers were housed in barracks built on the crater floor (Division of State Parks 1979:21). The Hawaiian Seacoast Artillery Command was established at Fort Ruger, and controlled operations at Fort DeRussy, Kamehameha, Weaver (on the west side of the Pearl Harbor entrance), Barrette (on the Ewa plain), Hase (on Mōkapu peninsula), and battery positions on the North Shore of the island (Meeklen 1974:40). A second tunnel, now called Kahala Tunnel, was bored through the wall of the crater.

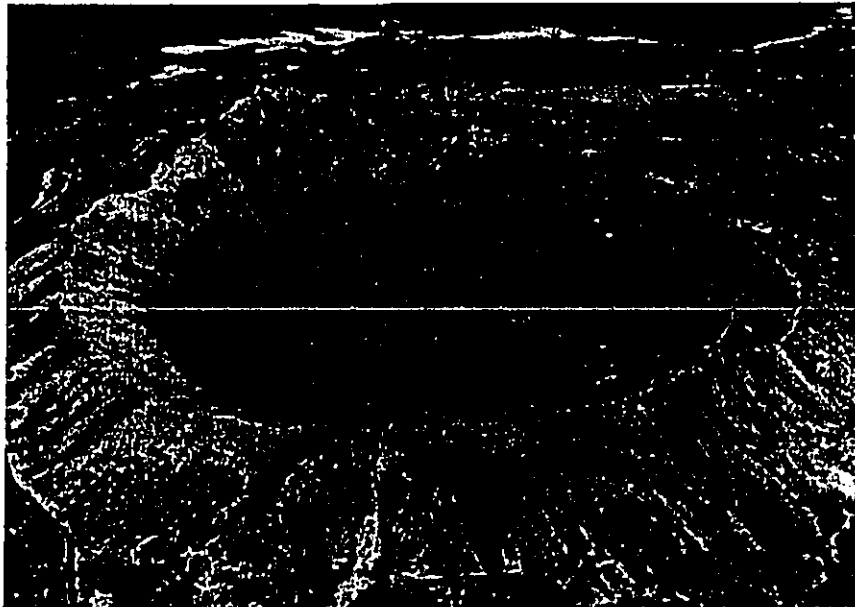


Photo 3. 1932 aerial view of Diamond Head crater (courtesy of National Archives, College Park, Maryland; negative no. 182609).

#### AFTER WORLD WAR II

In 1947, Fort Ruger became the headquarters of the new South Sector Command. An undated map attributed to the South Sector Command (Office of the Engineer n.d.) shows the layout of the installation in the early post-war period; a tracing of this map is illustrated in Figure 7.

After World War II, however, seacoast artillery was declared obsolete and all guns in the United States, including those at Fort Ruger, were scrapped (Meek 1974:41). In 1950, Fort Ruger, including parts of Diamond Head crater, became the headquarters of the Hawaii National Guard. And for the first time since 1906, the crater was accessible to the non-military public.

In some of the construction that ensued after this transfer, Hawaiian myth mixed with modern legend (Luomala 1986:124):

In 1951, dismayed workmen moving rocks in Diamond Head Crater quit because, said they, the Menehunes, to show their displeasure about something, tampered every night with what had been done during the day. In order that the workmen would proceed with the job, a foreman experienced with the gremlin habits of Menehunes advised calling in a native seer (kahuna) to find out what was annoying the little people.

Also in 1950, George C. Munro began a campaign to set aside an area at Diamond Head for the preservation of xerophytic Hawaiian plants (Pacific Planners [1968a]:3). He received permission from the National Guard to plant on a 9-acre tract on the west exterior slopes of the crater. This garden, which was called Na La'au Arboretum, was gradually enlarged to over 100 acres, eventually becoming part of the State Parks program; a special 2-acre parcel called Kc Kua'aina was planted in endemic plants. In the early years of Na La'au, Munro, with help from family and friends, personally developed the garden; when rainfall was insufficient, he "carried buckets of water up the steep slopes to supplement the natural supply" (Pacific Planners [1968a]:4). In 1958, the governor of Hawaii designated the garden as a sanctuary (Pacific Planners [1968a]:5). A water system consisting of a pump, tank, and an irrigation line were constructed in the arboretum. In 1961, the Garden Club of Honolulu funded the construction of a lookout area with benches and a memorial plaque to Munro (C. Hosokawa, pers. comm.).

In 1959, the FAA acquired a parcel of land in the crater and "a \$12 million blast-resistant facility, designed to withstand a possible H-bomb hit on Pearl Harbor, was completed in 1961" (Watanabe 1973:95). A new armory for the 613th Ordnance Company of the Hawaii National Guard was occupied the following year (Watanabe 1973:96). Demolition of obsolete buildings in and around the crater occurred throughout the 1950s and 1960s (Division of State Parks 1979:21).



In 1962, the governor of Hawai'i established Diamond Head Monument by Executive Order 2000, encompassing 145,323 acres of the outer slopes of the crater (Division of State Parks 1979:22).

In 1965, Legislative Act 249 (SLH 1965) designated Diamond Head Monument as an historic site and changed the Department of Land and Natural Resources with managing all but 3.4 acres of Federally controlled land (Nishimura 1988:11). In the years following passage of Act 249, other legislative actions relating to Diamond Head focused on a theme of historic preservation as a "guiding concept for the planning and development" of the monument (Nishimura 1988:19). During the 1970 Legislative Session, both houses of the Legislature held a "united posture" (Nishimura 1988:19) on the recommended use of the crater as a historic-nature park, with emphasis on the military landmarks of the crater.

In 1968, Diamond Head was designated a National Natural Landmark. However, the designation was essentially a "special award" as there are neither rules nor regulations that accompany the landmark status, conservation being the responsibility of the land owner (Division of State Parks 1979:40).

For a period from the late 1960s to 1979, Diamond Head was the site of rock concerts, the first concert in 1969 called the Sunshine Music Festival (Division of State Parks 1979:23). The "crater festivals" usually occurred on New Year's Day and the Fourth of July (Division of State Parks 1979:32). Watanabe (1973:160) writes:

The usual tranquility of the crater interior is shattered one day a year when a sunrise to sunset rock music festival is permitted. The Hawaiian kings and their *alii* and *Kuhouas* and the Artillery cannoneers of the early 1900s, if they could be there, probably would join in the swing of the music of guitars and zithers, flutes and other loots.

In 1975, the legislature acted to place Diamond Head under the management authority of the Department of Land and Natural Resources, with the monument boundaries proposed for expansion to include all adjacent State lands (Division of State Parks 1979:23). In 1978-1979, the governor of Hawai'i officially opened the crater for public recreational use, and construction of infrastructure, grading, and landscaping began (Division of State Parks 1979:23). Since then, crater lands under the jurisdiction of other agencies have gradually been assumed under the authority of the Department of Land and Natural Resources as part of the Diamond Head State Monument.

#### PREVIOUS ARCHAEOLOGICAL STUDIES IN THE DIAMOND HEAD AREA

Several archaeological investigations have taken place within and in the vicinity of Diamond Head (Fig. 8). None entailed detailed survey and only one involved excavation (Erickens and Tomonari-Tuggle 1997).

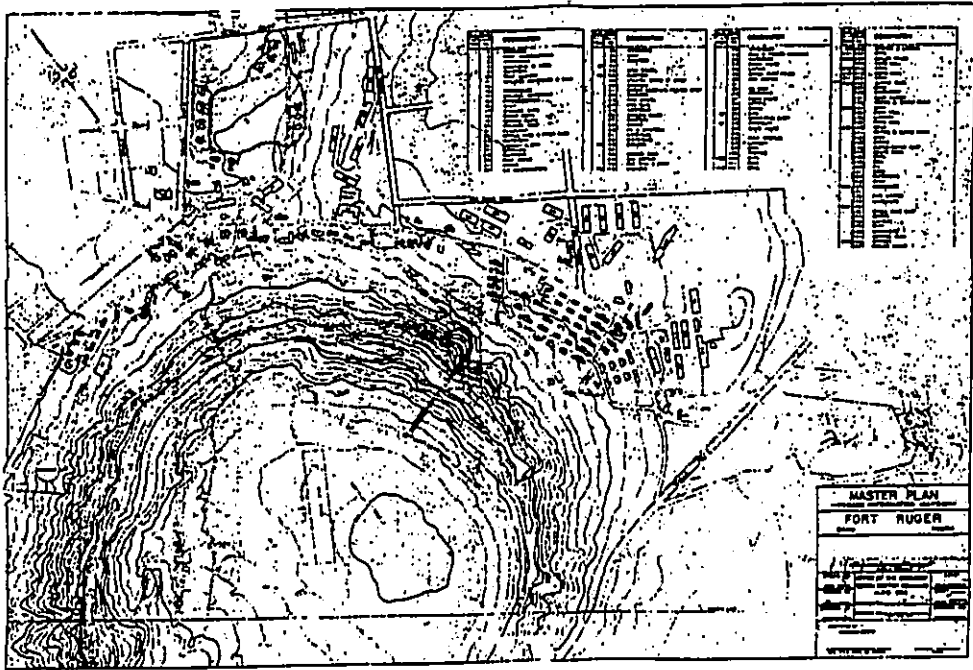


Figure 7. Tracing of a map of Fort Ruger in the late 1940s.

The earliest interest in things archaeological dates from the first decade of this century. Clark (1977:39) writes that "in 1906, George Carter and James Wilder made an amateur archaeological survey along the beach at Ka'alawai. They discovered some foundation stones of what they determined to be *heiau*." This is the only reference to a specific *heiau* at this location and Clark does not cite a source for his information.

In the late 1800s and early 1900s, Thomas Thrum, a prolific writer and publisher of a Hawaiian almanac, produced several articles on *heiau* throughout the islands (e.g., Thrum 1906), and in 1926, wrote a detailed description of Papa'ena'ena Heiau (Thrum 1926).

The first professional archaeological study that touched on the sites of Waikiki and Diamond Head was carried out by Gilbert McAllister (1933) of the Bishop Museum, as part of a survey of archaeological and cultural sites of O'ahu.

In 1968, Kenneth Emory (1968) of the Bishop Museum carried out testing at an area posited to be the location of Papa'ena'ena Heiau. Based on a historic map found in the State Archives, the location was determined by engineering survey and two test pits were excavated by Emory and a volunteer crew. Both test pits showed 0.9 m (3 feet) of imported top soil overlying a one to two inch thick layer of original soil on top of bedrock; no evidence of the *heiau* was found. Emory (1968:2) concludes that the original structure was "thoroughly eradicated," although he suggests that an observer be posted during future landscaping and trenching (for development) to note any possible remnants of a structure or "skeletal material resulting from the animal and human sacrifices on the altar of the *heiau*."

Since Emory's work, seven archaeological studies have been carried out within or near the crater. In late 1977, Griffin and Yent (1978) of the Division of State Parks carried out a reconnaissance survey of the proposed State Parks comfort station and the summit trail along the rim of the crater. No traditional Hawaiian sites were located; two concrete foundations of probable World War II origin were found downslope of the trail.

Department of Land and Natural Resources records of known burial sites in the area mentions one set of human remains located by Earl Neiler in 1984 in the vicinity of the lighthouse (E. Jourdan, pers. comm.).

In 1988, McMahon (1988) carried out a reconnaissance survey of 19 acres at the base of the northeastern exterior slopes of Diamond Head. Only the remains of military activity related to Fort Ruger Military Reservation were found.

In late 1989, Social Research Systems Co-op (1990) monitored water line excavations along the seaward side of Diamond Head Road on the southeast side of Diamond Head. No archaeological sites were identified, but historical research suggested links among the *heiau* of Waikiki; Papa'ena'ena (on the southwestern slope of Diamond Head), 'Apuakēhau (also called Helumoa), Pahu-a-Maui (site of present lighthouse), and Makahuna. Diamond Head was also described as a traditional place of execution.

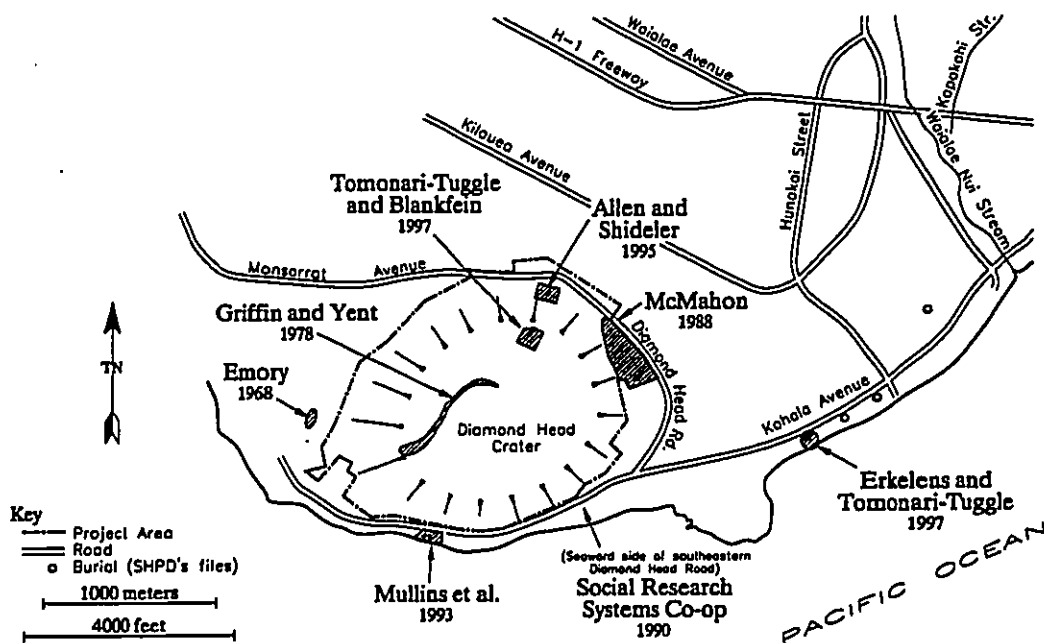


Figure 8. Archaeological studies within and in the vicinity of Diamond Head.

In 1992, Mullins et al. (1993) carried out archaeological monitoring related to installation of a new sewage system at the Diamond Head lighthouse property, a 2.19 acre parcel on the south side of the crater, on the seaward side of Diamond Head Road. The property is the residence of the commanding general of the U.S. Coast Guard. The lighthouse, which is recorded as State Site 50-80-14-1338, was constructed in 1892 (Scott 1968:669). Monitoring found no evidence of pre-contact occupation on the parcel and in fact, showed that the parcel had been created by cut-and-fill terracing. There were sparse artifacts dating from the late 1800s and early 1900s.

An intensive literature search and limited inspection of Battery Harlow was carried out in 1995 (Allen and Shideler 1996). This work was done as a prelude to preparation of a preservation and conservation plan.

Also in 1995, three burials were uncovered at a residence along Kahala beach to the east of the crater (Eckelers and Tomonari-Tuggle 1997). Stratigraphic, artifactual, and osteological analyses indicated that the burials are of probable 19th century origin. There appeared to be an underlying prehistoric occupation layer, probably reflecting use of the area as a temporary fishing camp.

In 1997, an archaeological assessment of the FAA property within Diamond Head crater was prepared, with the conclusion that there is little likelihood of any cultural remains on the parcel (Tomonari-Tuggle and Blankfein 1997).

**POTENTIAL FOR ARCHAEOLOGICAL AND HISTORICAL SITES**

Based on the historical research and substantiated by previous archaeological investigations, there is little likelihood for archaeological sites of pre-contact Hawaiian or early post-contact origin in the crater. The archival research suggests that the only Hawaiian activity that might have taken place in the crater was dry/land farming (dating to 1822). Although there are unsubstantiated stories describing the remains of human sacrifices on the interior slopes (see Macrae 1972, described above), and human burials in caves and crevices within the crater walls (Addleman [1940]:4, Division of State Parks 1979:21), no physical evidence of human sacrifices or human remains have been found.

**HEIAU OF WAIKIKI**

There are several *heiau* that have been mentioned to be in the vicinity of Diamond Head, although none remain intact (Fig. 9). Only one (Ahi Heiau) falls within the boundaries of the State monument. However, the association of the temples with the politically important region of Waikiki merits comment in this report.

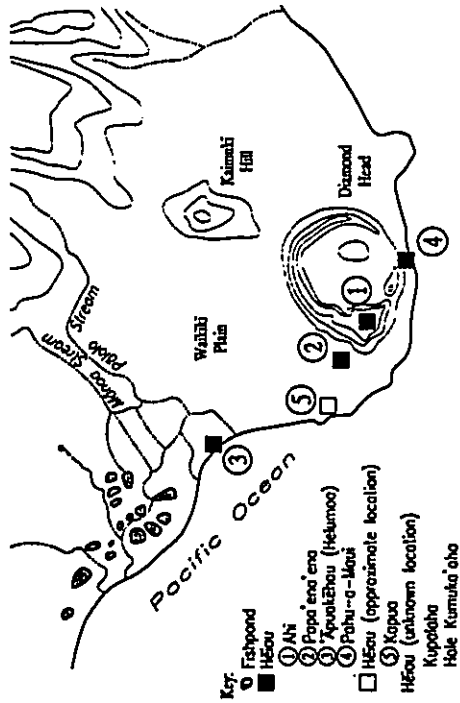


Figure 9. Heiau in the vicinity of Diamond Head.

Ahi Heiau is said to have been located on the rim of the crater (within the monument boundaries), where navigational signal fires were kept lit. There is only one uncited reference to this *heiau* (Division of State Parks 1979:21) and no physical evidence of a structure has been identified. If such a *heiau* or signal fires were an actuality, this would be a compelling argument for the name of the crater to be *Lae-ahi* or "cape of fire" (as opposed to the translated reference to the "ahi fish").

The most significant *heiau* in proximity to the crater is Papa'ena'ena Heiau, also called La'ahi Heiau. It was located on the western slopes of the crater, on a prominence overlooking Waikiki. McAllister (1933:71-74), who labels it Site 58, describes it as a large, quadrangular, paved terrace, with walls on three sides and open on the west side; a series of stepped terraces descended to the west from the top of the platform. It has been described as ranging in size from as small as 18 x 12 m (60 x 40 feet) to as large as 60 x 30 m (200 x 100 feet); McAllister (1933:74) averages the various measurements to 38 x 21 m (128 x 68 feet) with walls over 1.8 m (6 feet) high and 0.9 m (3 feet) wide. An illustration of the *heiau* by Paul Rockwood based on a description by John Papa I'i (1959:34) is shown as Figure 10.



Kanahēle (1995:56) writes that Papa'ena'ena was also a surfing *heiau*, "where surfers came to offer their sacrifices in order to obtain *mana* and knowledge of the surf."

Several visitors to Waikiki made observations of the *heiau* (see McAllister 1933:71-74), one of the first being Tyerman and Bennett's graphic description of the 1804 ceremony. In 1824, the visitor Stewart (1970:299) described the *heiau*:

It seems well situated for the cruel and sanguinary immolations of the heathen, standing far from every habitation, and being surrounded by a wide extent of dark lava, partially decomposed and slightly covered with an impoverished and sunburnt vegetation. It is the largest most perfect ruin of the idolatry of the island I have yet seen.

... Pieces of cocoa-nut shells, and fragments of human bones ... were discoverable in different parts of the area.

Probably the last description of the structure before it was destroyed was by G.W. Bates in 1854 (McAllister 1933:74, quoting Bates 1854:94). Although he found no human remains, Bates found the structure itself to be in remarkably intact condition:

The walls I found to be from six to eight feet high, eight feet thick at the base, and four at the top. On climbing the broken wall near the ocean, and by carefully looking over the interior, I discovered the remains of three altars located at the western extremity, and closely resembling parallelograms.

Thrum (1926) states that the stones of the *heiau* were removed by Kana'ina in 1856 for building walls and roads in Waikiki. A copy of an 1875-1877 map by surveyor C.J. Lyons shows the *heiau* on the boundary between the Diamond Head lands of Lunali'okana'ina and LCA 5931 to Pēhu. An 1883 map of government lands in Kapahulu (HGS 1883) shows only the label "heiau of Papahāna'ana" in Parcels 28 and 29 of Lunali'io's lands.

A temple drum from the *heiau*, shown in a photograph accompanying a 1968 newspaper article (Cooke 1968), is curated at the Bishop Museum:

It is made of a hollowed coconut trunk, and the border of its base is inlaid with human teeth. Shark skin, stretched over the 24-inch top, is held with lacings of ancient semait cord.

Kupalaha Heiau may have been a sister *heiau* to Papa'ena'ena (Kanahēle 1995:61). McAllister (1933:78) notes that Thrum recorded this *heiau* as "entirely obliterated" and its location is uncertain.

Pahu-a-Maui Heiau (McAllister's Site 59) is located at the site of the present lighthouse on Diamond Head Road. It is said to be a *heiau* for "fishermen and seamen, and priests made offerings while watching for schools of fish in the channel" (Division of State Parks 1979:21).

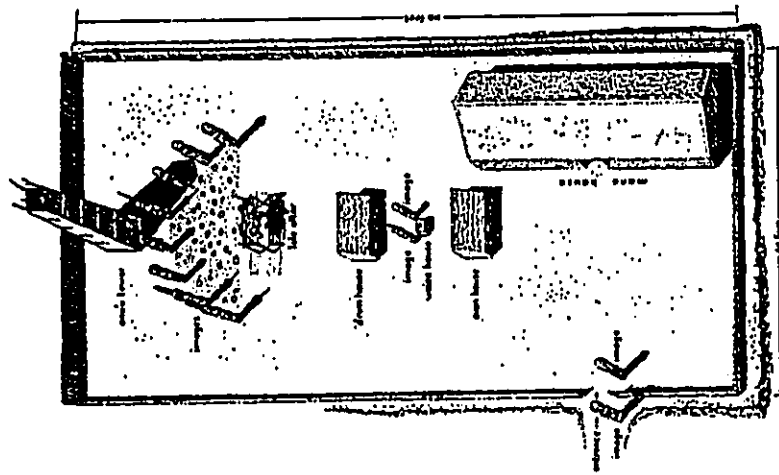


Figure 10. Papa'ena'ena Heiau, drawn by Paul Rockwood based on a description by John Papa I'i (1959:34).

Thrum (1926:109; see quote below under 'Āpuakāhau Heiau) suggests that this *heiau* may have been constructed by the Maui chief Kahakili after his conquest of O'ahu in 1783, but most historical accounts and descriptions of the *heiau* place its most noted use in the time of Kamehameha in the early 1800s. The ruling chief is said to have offered sacrifices in conciliation to the gods after two-thirds of his army was wiped out by the *maui oku'u*, possibly yellow fever, in 1804 (McAllister 1933:71, referencing Tyerman and Bennett 1831:423); during this ceremony, Kamehameha chose his young son Liholiho to say the *'amama* prayer, thus indicating that Liholiho, rather than his other sons Kina'u or Lunali'io, would be his heir (I'i 1959:37).



Makahuna Heiau was also a fishing heiau located near Diamond Head. Kanabele (1995:61) writes that it was "dedicated to Kamaioa, the god of the Seas, and hence attended to by fishermen and seamen." This is likely the same temple referred to in a 1911 newspaper feature article (Advertiser 1911):

In front of Diamond Head, by Judge Doie's place,<sup>8</sup> can still be seen the remains of a Kuia heiau, a temple to the fish god of all the islands, and place of the Kuia cult which played so great a part in ancient Hawaii. Here is where the priests offered sacrifice to Kuia, and where they watched for the shoals of fish in the channel beyond. There are still traces of the floors and walls to be seen in this spot.

McAllister (1933:196), however, quotes Tucker (1916) as saying that Makahuna Heiau was of the *po'okanaka* class. Tucker places his heiau near Doie's residence:

... located at this place in order to propitiate, by human sacrifice, the departure of the Aiiis to foreign shores, and Black Point, between that and Kahala, was called Keala o Kahiki (the way to Tahiti). These ruins are mostly all overthrown [sic] and have been used probably to make fences or for road purposes.

Other heiau in Waikiki include Kulanihakoi Heiau (Kanabele 1995:61) and 'Āpuakāhau Heiau (also called Helumoa). The latter temple is where the Maui chief Kauhākama was sacrificed in the 16th or early 17th century. The desecration of his bones incited his descendant Kahēkili to wreak vengeance on the O'ahu people when he succeeded in conquering the island in the late 1700s (Thrum 1926:109):

The time of Papeenana's construction, or to which of Oahu's rulers it is to be accredited is nowhere shown in the native accounts; nor when it succeeded the activities of the Āpuakāhau (Waikiki) temple, Helumoa, on whose altar Kauihikama, a high chief of Maui, was offered in sacrifice with great indignities by the Oahu chiefs, about the middle of the 16th century. Many years later, Kahēkili, a noted descendant and king of Maui, with an invading army avenged this outrage in the sanguinary battle of Niuhalewai, Kapalama, defeating King Kahahana and conquering the island. This was in 1783, and it is not unlikely that the heiau of Papeenana was erected by Kahēkili in recognition of his victory, and ignoring the hitherto important and prominent temple of Helumoa, at Āpuakāhau, whose altar was so defiled by the ignominious treatment of his illustrious ancestor.

Kapua Heiau was a *huahua* heiau (Kanabele 1995:61); McAllister (1933:78) references Thrum in describing Kapua Heiau as a heiau *po'okanaka* and says that its walls were torn down in 1860. The name of the heiau suggests that it was located within the land area called Kapua at the western foot of the crater (see Fig. 4 for location of Kapua).

Hale Kumukā'aha Heiau was built by the ruling chief of O'ahu, Ka'ūhikapūmānia (Kanabele 1995:71). It is not known where the heiau was located.

<sup>8</sup> An 1883 map of Kapahulu government lands shows Grant 4081 to S.B. Doie located at Kahuhole, just west of and below the peak of Diamond Head (see Fig. 4 for location).

### HISTORICAL SITES

There are two historically notable sites in the Diamond Head area. Site 50-80-14-1338 is the Diamond Head Lighthouse, which was originally constructed in 1892 (Scott 1968:669). In 1919, it was rebuilt and shortly thereafter, installed with automatic electric equipment (Scott 1968:669). The site is presently the residence of the commanding general of the U.S. Coast Guard in Hawaii. The lighthouse is located on the seaward side of Diamond Head Road, just outside the southern boundary of the monument.

The second site is the Fort Ruger Historic District, which was listed on the National Register of Historic Places (NRHP) in 1983 (Allen and Shideler 1996:23). It is a noncontiguous district that includes the remnants of O'ahu's earliest U.S. Army coastal defense fortification (Hibbard and Napoka 1980): five batteries, 12 gun emplacements on the rim of the crater, the Leahi Fire Control Station, remnants of a winch and cable system, the Kapahulu Tunnel, and remnants of the original guardhouse (which has since been demolished). Appendix B is a reproduction of the Historic District nomination form, including a map that locates the component structures of the district, as well as other structures that are related to Fort Ruger but not included in the NRHP nomination form. Those structures that fall within the State monument are discussed further in the following section.

### III. SURVEY AREAS AND RESULTS

An archaeological assessment survey of Diamond Head State Monument was carried out between April and June 1998. State Parks and Hawaii Army National Guard staff who are knowledgeable about crater features and natural resources accompanied IARTH personnel during the field survey.

#### SURVEY METHODS

For the purposes of the archaeological assessment, Diamond Head State Monument was divided into geographic regions based primarily on topography: the crater rim; the crater interior; and the exterior slopes; the general Fort Ruger area on the outside of the crater, including Battery Harlow, was separated into an additional assessment area (Fig. 11). Areas within each of the four assessment regions were then selected for on-the-ground survey on the basis of ease of access, the historical research that indicated different uses for the four areas, and the potential for different types of archaeological/historical sites. State Parks staff also provided information about the locations of potential sites and the history of recent land uses and alterations that may have affected site preservation.

A preliminary examination of the wetland area was carried out on May 5, 1998. A boring was placed roughly 75 m (246 feet) southwest of the sump pump in a relatively low spot with no evidence of disturbance on the surface. At the time of the boring, the entire wetland was completely dry. Initial boring to a depth of 138 cm (55 inches) below surface was undertaken with a 3 1/2 inch diameter bucket auger; at the 138 cm depth, a Voinov/Colinvaux piston coring apparatus was used to extract a completely undisturbed sample of the sediment. Using a 5 kg drop hammer, the coring tube was driven to a depth of 158 cm (62 inches) and then was extracted with a winch. The core was cut, capped, and labeled for study of the sediments in the laboratory. Use of the auger resumed to a depth of 281 cm (111 inches) at which point, the Voinov/Colinvaux corer was again inserted, this time to a depth of 302 cm (119 inches). During the winching process, the tube unfortunately broke free of the core head and remained firmly inside the bore hole and was thus abandoned.

A detailed presentation of the boring process and results is included as Appendix A of this report.



Table 2. Summary of Sites Identified During Diamond Head State Monument Assessment Survey (continued).

Feature	Survey Area	Date of Construction	Comment	Fort Ruger HD Feature No. <sup>a</sup>
Tunnel M0	Ft. Ruger Grounds	1943	Communications tunnel; U-shaped	
Various concrete foundations	Ft. Ruger Grounds	various	Variation in design	
Retaining Walls	Ft. Ruger Grounds	various	Basalt with and without concrete mortar	
Kahala Tunnel	Ft. Ruger Grounds	1943	Built to deliver material for Battery 407 construction.	
Building 31B	Ft. Ruger Grounds		Concrete storage structure	
Building 75	Ft. Ruger Grounds		Basalt fuse and primer magazine	
Building 76	Ft. Ruger Grounds		Corrugated tin storage structure	
Building 287	Ft. Ruger Grounds		Standing concrete brick pillars and boiler	
Generator House to Battery 407	Exterior Slopes	1943-1943?	Sealed	
Searchlight No. 3	Exterior Slopes	1911-1913	Complex of tunnels with latrine and stairs	
Searchlight No. 4	Exterior Slopes	1932?	Housing in crater wall with generator room of double wall construction. Rail line for positioning light.	
Reservoir	Exterior Slopes	pre-1920	Collapsed corrugated tin roof, extensive graffiti	
Na La'au Arboretum	Exterior Slopes	1950s	Varieties of succulents on trail	
George Munro Monument	Exterior Slopes	1961	Flagstone paving with copper plaque	

<sup>a</sup> Feature numbers used in the Fort Ruger Historic District nomination form (Hibbard and Napoka 1980); see Appendix B.

Table 2. Summary of Sites Identified During Diamond Head State Monument Assessment Survey.

Feature	Survey Area	Date of Construction	Comment	Fort Ruger HD Feature No. <sup>a</sup>
Leahi Fire Control Station	Crater Rim	1911	4-level, unique underground design; intense public use	8
Construction Trail	Crater Rim/ Crater Interior	1910	Used for Leahi Fire Control Station material transport and construction; portions now used as part of State Parks trail	9
Winch and Cable	Crater Rim/ Crater Interior	1910	Used for Leahi Fire Control Station material transport and construction; adjacent to State Parks trail	3 and 4, respectively
Batteries Hulings and Dodge	Crater Rim	1913	4.7" guns, unique underground design	
Pit	Crater Rim	?	1 x 3 m; probable defensive gunner position	
Ramp/Retaining Wall	Crater Rim	1915-1925?	Access to portable gun emplacement/possible black powder magazine at end of ramp	5
Portable Gun Emplacements	Crater Rim	1915-1925	Semi-circular concrete embankments	
Searchlight No. 16	Crater Rim	1936	Sliding roof with elevating platform	
Various Fire Controls & Bunkers	Crater Rim	various	Not checked during present survey	
Battery Birkhimer	Crater Interior	1916/1921	Restricted access/State Civil Defense EOC	6
Battery 407	Crater Interior	1943-1945	Restricted access/Hawaii National Guard	7
Road to Battery 407	Crater Interior	1943	On large terraces with culverts	
Flat-top Reservoir	Crater Interior	1911	Conforms to natural topography	
Tunnel/Bunker	Crater Interior	1911?	Probably related to reservoir operation	
Firing Ranges (U-shaped berms)	Crater Interior	post-1958	West berm is transected by public trail	
Firing Ranges (Linear berms)	Crater Interior	pre-1932	Landscaped	
Concrete Pit	Crater Interior	?	6 x 6 x 6 foot with steel doors	
Small Arms Bullet Casings	Crater Interior	late 19thC or early 20th C?	Possibly related to 1895 skirmish, Camp McKinley troops, or use of crater firing ranges	
Wetland Sediments	Crater Interior	?	Intact sediments with charcoal, good pollen preservation	
Battery Harlow	Ft. Ruger Grounds	1910	First coastal defense structure on O'ahu	2
Kapahulu Tunnel	Ft. Ruger Grounds	1910 (mod. 1934+)	Built to deliver material for Leahi construction. Modified and enlarged in 1934, 1961	10
Tunnels M1-M6	Ft. Ruger Grounds	1943	Munitions storage	

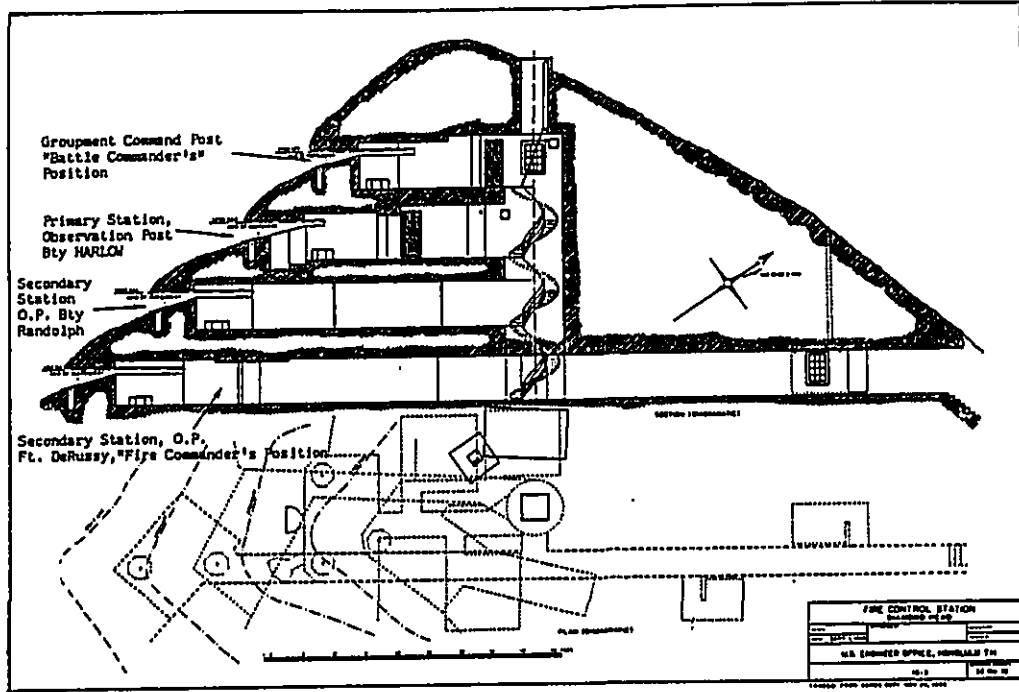


Figure 12. Cross-section of Leahi Fire Control Station (courtesy of U.S. Army Museum at Fort DeRussy).

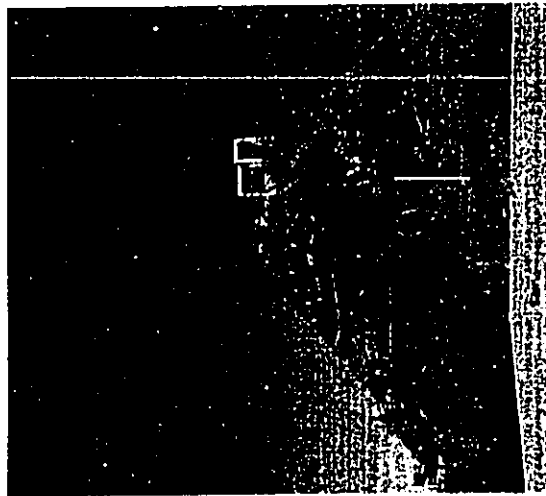


Photo 4. View to west of the Leahi Fire Control Station from the rim road.

The first two floors of the fire control station served Batteries Randolph and Dudley at Fort DeRussy, located on the Waikiki plain to the west (Fig. 12). The third level was dedicated to fire control for Fort Ruger and "contained instrument piers for two depression position finders (DPFs) and space at the rear for two plotting rooms" (Dorrance n.d.:7). The top level was the battle commander's station. The crest of Le'ahi above the battle commander's station housed an emergency observation post for Battery Harlow (Dorrance n.d.:7-8). The rest of the command station was excavated within the wall of the crater. The exposed portions of the structure were concealed with boulders embedded in a concrete facade and through various other camouflaging methods (Thompson n.d.:40).

The National Register of Historic Places nomination form for the Fort Ruger Historic District (Hibbard and Napoka 1980) states that:

The four-story fire control station at the peak of Leahi is of special importance. It is the most elaborate structure of its kind in the United States as most fire control stations are simple free-standing towers built of metal. Major E.E. Winslow, who graduated first in West Point's class of 1889, was responsible for its design and construction.

There are two concrete structures along the rim in proximity to the fire control station. One is to the south and its function is unknown. A similar structure to the north is the primary station for Battery Bikkhimer. Yent (1998:29) states that these were two of "12 bunkers and gun emplacements built along the rim of the crater in 1915 to protect the batteries from ground attack."

The present State Parks trail incorporates many of the original sections of the route to the Leahi Fire Control Station. The trail was modified for public use in 1981 and underwent a major restoration in 1996 (Yent 1998:24). Along the trail is a winch and cable on a concrete platform that was used to transport materials during construction of the fire control station; this complex is Feature 9 in the National Register nomination form for the Fort Ruger Historic District (Hibbard and Napoka 1980:3).

#### Batteries Hulings and Dodge

Batteries Hulings and Dodge are located just below and inside the crater rim on the eastern portion of the crater. They are listed as Features 3 and 4 (respectively) on the National Register nomination form for the Fort Ruger Historic District (Hibbard and Napoka 1980:2). The batteries were built in 1915 as part of an Army land defense system for the island, but by the mid-1920s, the land defense batteries were determined to be obsolete and were disarmed.

The entrances to the two batteries face on to a dirt road that is cut into the interior hillside just below the top of the rim. The road provides access to the batteries, as well as to various gun emplacements along the top of the rim and to the retractable searchlight on the southern rim (see Fig. 11). Sections of the road, particularly along the southeastern rim, are cut into basalt bedrock or are faced with basalt boulders.

The batteries are reinforced steel concrete tunnels that extend through the wall of the crater (Hibbard and Napoka 1980). Each contains a single room, with access from the interior rim road; the names of the batteries are painted over the entrance doors (Photo 5). The gun platforms for each battery are on the exterior of the crater.

The batteries are unique in their design in that they are contained within underground tunnels (using the natural earthen cover as protection from bombardment) and access to the cannon is from within the housing. Most cannon of the type installed at these batteries were mounted in open-air staging areas similar to those at Battery Randolph at Fort DeRussy.

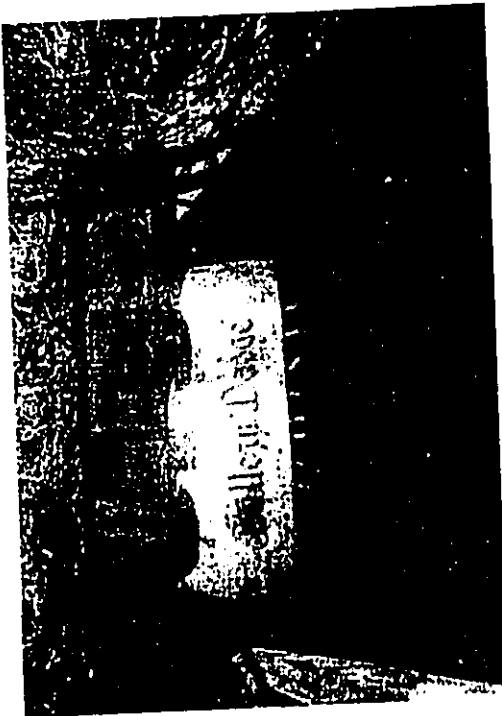


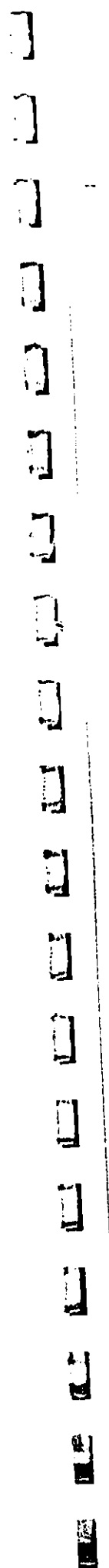
Photo 5. Entrance to Battery Dodge. Note the painted name over the door.

Each battery contained two 4.7-inch Armstrong guns on pedestal mounts; these guns were manufactured in Great Britain during the 1898 Spanish-American War. The guns were originally situated in coastal defenses in Narragansett Bay (Fort Adams) and in Mississippi (J. Hawkins, pers. comm.). The field of fire of these emplacements protected the eastern shoreline of the island from amphibious landing parties (Photo 6). Straddling the Kahala Tunnel (which was constructed just prior World War II), the two batteries loom over Maunaloa Bay and Kahala to the east.

Batteries Hulings and Dodge are now used by the State Department of Defense for storage and communications equipment. Dorrance (1995:158) writes that "the two 4.7-inch Armstrong guns of Battery Dodge are mounted on concrete pedestals in front of the Hawaii National Guard Armory located in Wahiawa."

On the rim road between Batteries Hulings and Dodge, directly over Kahala Tunnel, is a pit approximately 1 m (3.25 ft) deep and 3 m (9.75 ft) wide. This may have been the position of a machine gun pit, anti-aircraft gun emplacement, or some other defensive stronghold.

Just south of the Battery Dodge entrance and on the eastern and upslope side of the rim road is a basalt boulder and concrete retaining wall with basalt chinking. The retaining



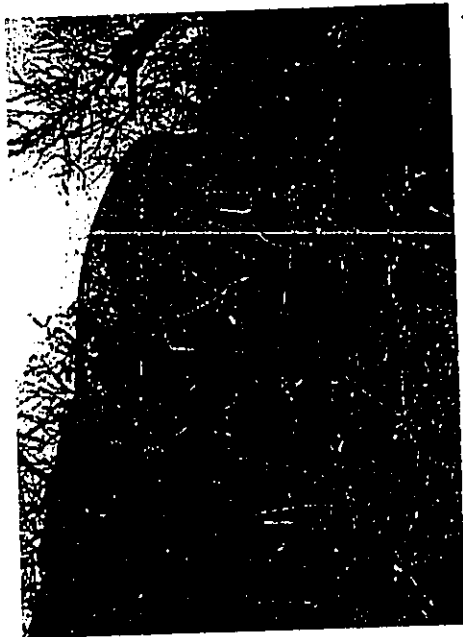


Photo 6. Western gunport of Battery Dodge. Note the notch on the wall on the left to allow greater field of fire (J. Hawkins, pers. comm.).

Wall ranges up to 2 m (about 6 feet) high and fronts a level area that is approximately 1 to 2 m (3 to 6 feet) wide. This platform appears to be the lower end of a road that extends to a concrete emplacement at the top of the rim. This may have been the location of a black powder magazine depicted on a 1935 map (Hicks 1934).

#### Emplacement Positions

Intermittently spaced along the eastern portion of the crater rim road are pairs of semi-circular-shaped retaining walls around circular concrete floors; tie-down fasteners are set in the center of each concrete floor. These structures are listed collectively as Feature 5 on the National Register nomination form for the Fort Ruger Historic District (Hibbard and Napoka 1980:2).

These structures, which correspond to positions marked "B" and keyed as "Portable Emplacement Only" on a 1922 Fort Ruger map (Fig. 13), are the foundations for rapid-firing 6-pound guns that were installed as part of the land defense system for southern Oahu (1915 to 1925) contemporaneous with Batteries Hulings and Dodge. The guns which serviced these positions were not stored in these locations, but rather, were housed in protected armories (gun parks) and wheeled out as needed; the guns were harnessed to the tie-downs to control their re-coil during firing (J. Hawkins, pers. comm.).

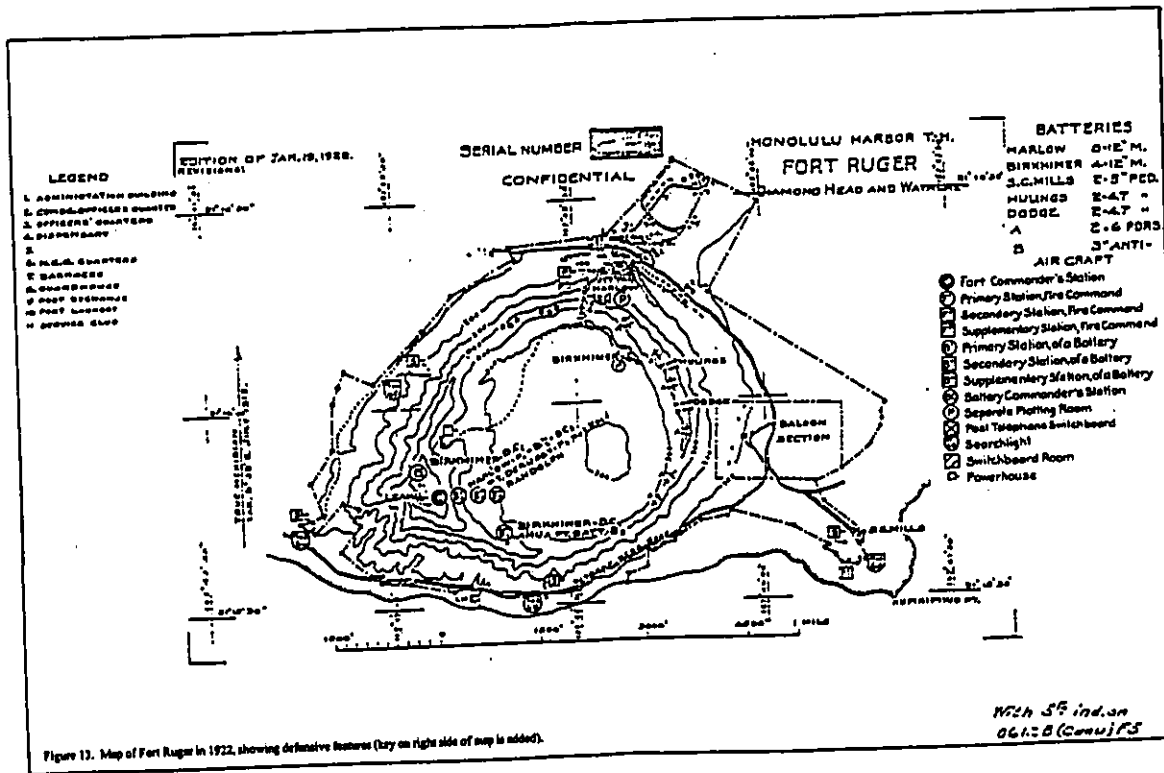


Figure 13. Map of Fort Ruger in 1922, showing definitive features (key on right side of map is added).



**Searchlight No. 16 - Retractable Platform**

At the terminus of the southern rim road is a retractable searchlight housing (not shown on the 1922 map) that resembles Dorrance's (n.d.:9) description of earlier searchlights at Fort Ruger. This facility was a "concealed reinforced concrete shelter having a sliding top (Thompson n.d.:74)." The top of the structure slid open when the searchlight was to be operated; gears connected to a winch raised the searchlight (mounted on a platform) to operating position above the sliding top (Photo 7).

With the completion of the 8" guns at Battery Granger Adams on Black Point, Searchlight No. 1 (see Fig. 13) became ineffective and was repositioned on the crater rim. Upon completion of the facility, it was named Searchlight No. 16 (Board of Officers 1937).

Inside the concrete housing are remnants of the platform and the generator; a side room with one window overlooks the crater interior (there are no openings to the outside of the crater). Outside the searchlight housing to the southeast (on the outside slope of the rim) is a key-hole-shaped pit that is postulated to have served as the secondary remote control operator position affording protection from enemy fire that such a target might draw (J. Hawkins, pers. comm.). The circular part of the pit is approximately 1 to 1.2 m (3.5 to 4 feet) deep and about 1.2 m (4 feet) across; there is a pipe sticking out of the center of this portion of the pit and there are rebar stakes and decaying timber on the surface just outside

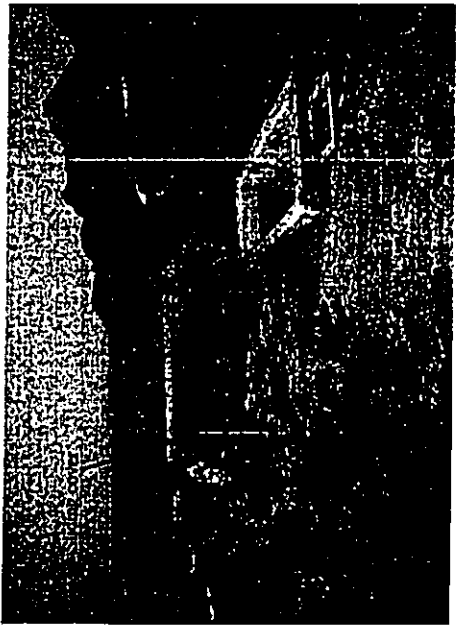


Photo 7. Retractable searchlight. View to west.

the pit. The primary remote control of the light was connected by controller cable (Hicks 1934) to Battery Granger Adams' Fire Control Station situated on the southern rim of the crater (Figure 14).

**South Rim Fire Control Stations**

Located on a high point on the south rim of the crater is a concrete structure that served as a supplementary station for a number of different batteries. Throughout the years, the concrete structures on the crater rim that served as fire control stations were dedicated to different batteries (Fig. 14). In the left-hand portion of the below, the structure on the high point of the south rim is shown as a Supplementary station of Batteries Birkhimer and Ahua Point Battery B during the early 1920s. It was later converted to the Secondary and Supplementary station for Battery Closson, as shown in the figure on the right below. The figure on the right also shows a fire control station for Battery Granger Adams that was constructed to the immediate east of the station on the high point of the rim. Neither of these stations were examined during the present survey.

**Other Possible Sites on the Crater Rim**

A report by the National Board of Fire Underwriters (1941:2) describes a "concrete reservoir of 6,940 gallons capacity in the top of Diamond Head at elevation of about 740. This is used to supply the barracks in Diamond Head, the observation room, and radio station." This feature was not relocated during the present project.

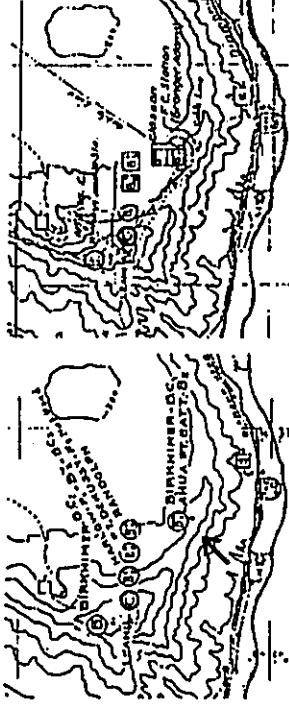


Figure 14. A comparison of details of the Fort Ruger Batteries Fire Control map. January 19, 1922 on the left and November 7, 1934 revision on the right (courtesy of the U.S. Army Museum at Fort De-Russy).

A black powder magazine is noted on a 1935 map (Hicks 1934). It may be in on the ridge at the terminus of the ramp mentioned earlier in this section.

There are reports of traditional Hawaiian use of the crater for ceremonial practices and of burial interments in the numerous caves and crevices found on the crater walls. However, accounts from the early Fort Ruger era note that the burial sites had been thoroughly ransacked (see Adelleman [1940]). During the present project, a field inspection of several locations likely to have been used by early Hawaiians for these purposes turned up no supporting evidence; many of the sheltered "caves" proved to be very shallow (Photo 8). Colonel E. Hoffer (pers. comm.) suggests that such caves would most likely have been sealed by the Army to prevent them from offering protection to invading forces.

#### CRATER INTERIOR

The Crater Interior assessment area encompasses the entire basin of the crater. It is easily accessed via the public Kahala Tunnel and is the most intensively used of the areas that were surveyed. Public parking, a State Parks comfort station, and a trailhead to the Leahi Fire Control Station are centrally located in the crater, adjacent to several large bermed areas that are former pistol and rifle ranges. The paved trail to the fire control station extends

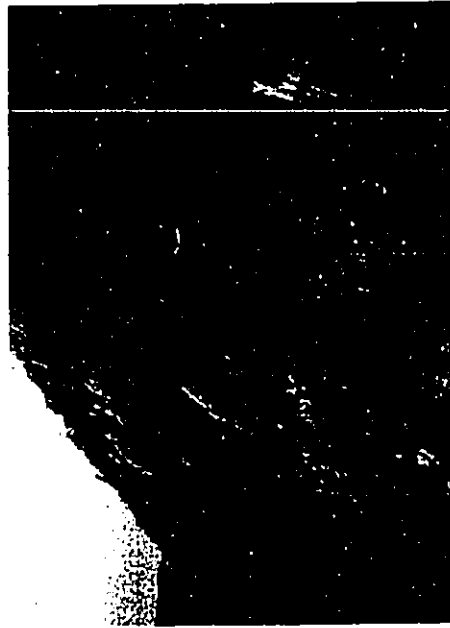


Photo 8. View of a sheltered area below the crater rim. Note the shallow depth of the shelter.

southwest from the comfort station and winds through and around a major gully in the western wall of the crater. North and west of the State Parks trail are several small ridges and gullies that appear to be relatively undisturbed, although there are remnants of military structures, including a flat-topped reservoir, a bunker transecting one of the ridges, and a concrete pit with two steel doors (see discussion below).

Hawaii National Guard and FAA buildings in the northern portion of the crater were constructed in the 1950s and continue in use by these agencies; large asphalt parking lots are associated with these buildings. The southern portion of the crater, within the area marked by perimeter dirt roads, has been extensively bulldozed and graded (C. Hosokawa, pers. comm.). During a major fire that swept through the crater interior about three years ago, numerous fire break roads were bladed through this area; although these roads may have originated with military use, they were widened and filled for fire control. Recently, a large area to the south of the welland was disturbed during environmental remediation work by the U.S. Army Corps of Engineers (C. Hosokawa, pers. comm.).

There are several historical sites in the crater interior, most related to Fort Ruger development. A welland area in the eastern portion of the crater is also discussed as a site, in the context that it may produce evidence of early environmental changes in the crater.

#### Battery Birkhimer

Battery Birkhimer lies at the northern edge of the crater floor and is presently used by the State Department of Defense as the emergency operating center for the Civil Defense Division. The battery was completed in 1916 and is named after Major William B. Birkhimer, an artillery officer who came to Hawaii in 1903 as part of the review for potential military sites in the islands. The battery covers more than 18,000 square feet of floor space (Watanabe 1973:96). It is listed as Feature 6 on the National Register nomination form for the Fort Ruger Historic District (Hibbard and Napoka 1980:2).

Battery Birkhimer was constructed as part of a land defense system for southern Oahu and was initially designed with a 360 degree field of fire with four 12-inch mortars emplaced in two tandem pairs, separated by a central magazine. At the time of its construction, the cannons were found to be too large for transport through the existing tunnel and were carried over the crater wall. How this was done is the subject of some speculation: a special ramp or graded road was constructed (J. Bowman, pers. comm.); grooves in the hillside behind Battery Birkhimer might be evidence of sliding the cannons into place (C. Hosokawa, pers. comm.); the cannons may have simply been hauled over the rim (Thompson n.d.:41).

Unlike Batteries Hulings and Dodge, with which it is contemporaneous, Battery Birkhimer was remodeled rather than dismantled when it became clear that the land defense system was obsolete. It underwent a major renovation in 1920-21 to shift the mortars to a four-in-line configuration to the south of the original structure, which was then remodeled

into powder magazine space (Fig. 15); the battery was relisted as a harbor defense facility (Dornance 1995:158).

In 1952, Battery Birkhimer was acquired by the Hawaii Civil Defense agency. In the 1960s, it acquired a new Cold War role when it was set up to "accommodate 150 persons working in shifts to operate the Center [for] up to two weeks in coordinating emergency activities in the event of a nuclear attack" (Hawaii Department of Defense 1968):

Some of the walls are eight feet thick, and the thickness of the reinforced concrete ceiling is four to six feet. The structure would withstand 30 [sic] pounds of pressure per square inch, and while it would not withstand a direct hit, it would be safe if a 10-megaton nuclear device was detonated several miles away.

Although Cold War threats are no longer present, Battery Birkhimer still serves as a Civil Defense operating center in the event of other emergencies.

**Battery 407**

Battery 407 is located in the southwestern wall of the crater. The last fortification to be constructed at Diamond Head, it was begun in 1943 and completed near the end of World War II. Battery 407 was intended as a permanent battery for 8-inch guns that could fire a 260-pound armor-piercing projectile a distance of 19 miles, weapons that "artillerymen considered ... valuable against light cruisers and destroyers" (Thompson n.d.:117). Battery 407 was one of nine batteries planned for the island of Oahu, but as World War II progressed, there was less urgency for their construction and by the end of the war, only five batteries had been completed and Battery 407 never received its armament (Thompson n.d.:118).

The battery consists of tunnels that extend through the crater wall. Access from the crater interior is through large iron doors. The exterior openings are the gun emplacements, which were designed with casements that would protect the guns from falling boulders (Thompson n.d.:118), presumably those dislodged due to enemy fire or from concussions

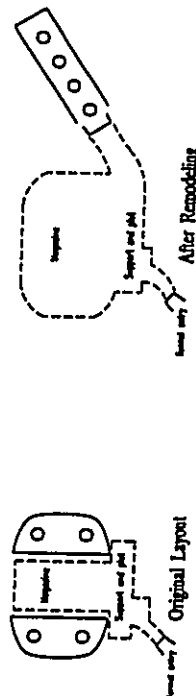


Figure 15. Schematic layout of Battery Birkhimer before and after remodeling (adapted from a sketch in the files of the U.S. Army Museum at Fort DeRussy).

from the battery itself. The cliff face above the western portal is coated with sprayed-on concrete either to reinforce the earth or conceal the construction scars or both.

The road to Battery 407 follows the inner slope of the crater wall and appears to be contemporaneous with the battery. Portions of the road are laid on large terraces, and gullies are drained through culverts under the road.

Battery 407 is presently used by the Hawaii National Guard for office and storage space. The western gunport of the battery is used by National Guard staff as a lunchroom/smoking lounge and is contained within a chainlink fence. Corkscrew-style barbed-wire fence posts are still standing on the surface outside the modern fence (Photo 9). Access to the large casement is by a stairway off to the side adjacent to the cliff.

Below the western gunport, at the base of the steep ridge on which the gunport sits, is the generator house for Battery 407. It is a single-story, flat-topped structure with sealed windows. The structure is situated within an excavated cut in the ridge.

**1911 Reservoir**

A flat-topped, earth-covered reservoir is located in a gully at the base of the northwestern crater wall. It is accessed from the main crater road by another road with a small bridge over a gully. The sides of the reservoir follow the sloping contours of the adjacent ridge and crater wall. The floor is irregular and concrete-lined. The vertical facing wall of the reservoir is supported by large triangular buttresses approximately 0.6 m (2 feet) wide and spaced about 3 m (10 feet apart); this wall is inscribed with the date "1911" (Photo 10), which is presumably the construction date. A letter requesting improvements to Kapahuu Tunnel dated October 18, 1935 describes the urgency of repairing the tunnel floor due to the fact that the water supply for Fort Ruger and DeRussy are fed from the reservoir with pipes buried in the tunnel floor (Office of the Harbor Defense Commander 1935).

A 1941 report describes the reservoir as having a 700,000 gallon capacity, although the report notes that "it has not been kept more than half full for some unknown reason" (National Board of Fire Underwriters 1941:2). A valve house is located next to the wall of the reservoir. Water to fill the reservoir was pumped from a 420 foot deep well located at the intersection of Kapahuu, Winam, and Makiaka Avenues (National Board of Underwriters 1941:1). This same report describes the fire alarm system for Fort Ruger, as it applies to the use of the reservoir (National Board of Fire Underwriters 1941:2):

Ordinarily, one pump is run at a time alternating every 24 hours, under automatic control from a float in the reservoir. If the water level gets down too low, a bell rings in the telephone switchboard room whereupon the operator throws a switch cutting off the belt and lighting a light, and starts the second pump by remote control letting it run until the water in the reservoir gets high enough so that the float switch will cut off the light. The operator also starts the second pump on receipt of an alarm of fire or for a fire drill at Fort Ruger.

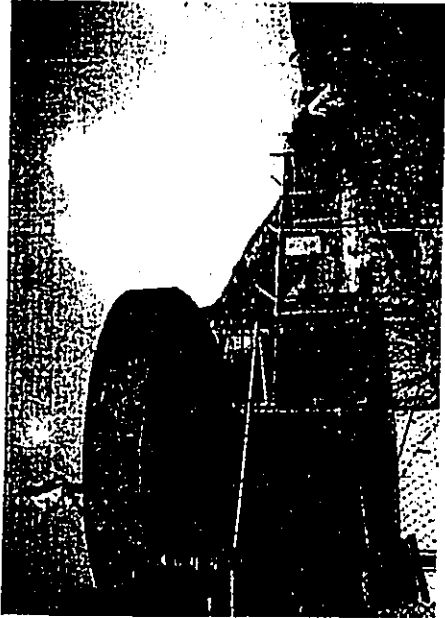


Photo 9. Exterior of the western gunport of Battery 407. Notice the corkscrew-style fence post in the center-right foreground.



Photo 10. Front face of the reservoir. Note the inscription "1911" on the concrete, below and to the right of the person on the top of the reservoir.

A tunnel/bunker transects the nose of the ridge that forms the southern edge of the reservoir. There are doors at both ends of the tunnel. Several chambers within the tunnel are separated by heavy doors lined with insulation, possibly to muffle sounds. A 1 foot deep, 1 foot wide trench in the center of the floor runs the length of the tunnel. Most of the steel sheet covering has been removed. An unusual feature of this tunnel is that the walls and ceiling of the chamber with the toilet and urinal are not concrete-lined like the rest of the tunnel. The function of this structure is unknown although a symbol for "Powerhouse" is marked in the vicinity of this feature on the 1922 map (see Fig. 13).

#### U-Shaped Berms

Two large U-shaped berms enclosing roughly square-shaped level areas are obvious features on the central crater floor near the State Parks comfort station. These berms were constructed for use as firing ranges. The western berm is transected by the State Parks trail to the Leahi Fire Control Station. To the rear of this western berm is a concrete pit of unknown function; it measures approximately 1.8 m (6 feet) deep by 1.8 m (6 feet) wide and has two steel doors. There is a ventilation shaft next to the pit. The pit area is enclosed by a chainlink fence.

A large level area to the south of the State Parks parking lot is also a firing range. Two linear, parallel berms at the southern edge of the level area served as firing range impact walls. A 1932 aerial photograph of the crater (see Photo 3) indicates that the firing range and at least one of the berms was in existence by that date.

The ranges are of probable Army origin, although they were used by the Honolulu Police Department and the Hawaii National Guard in the 1950s and 1960s (C. Hosokawa, pers. comm.).

#### 45-70 Cartridge Shells

45-70 cartridge shells have been found on the surface in the area south of the trail and below the Leahi Fire Control Station, (C. Hosokawa, pers. comm.). The 45-70 caliber ammunition was used in weapons commonly called "trapdoor" Springfield, which were produced by the Springfield Armory. These rifles and carbines were popular breech-loading longarms that were in use from the 1860s until the early 20th century. Flayderman (1990:459) writes that the "trapdoor" Springfield were "truly one of the guns which 'won the West,'" and "long served as the standard longarm for U.S. forces in most of the major Indian engagements, and in government forts and garrisons throughout America." They were the standard weapon used by the majority of militia and volunteers during the Spanish-American War; Hosokawa (pers. comm.) says that they were also used in Hawaii. Barnes (1997:86) notes that the 45-70 was:

...adopted by the U.S. military in 1873 with the single shot "Trapdoor" Springfield rifle, it continued as the official service cartridge for 19 years. It was then replaced

in 1892 by the 30-40 Krag. Though the Krag officially replaced the 45-70 in 1892, all volunteer Spanish-American War regiments—with the reported sole exception being TR's Rough Riders—were equipped with the Trapdoor 45-70. Many state militias were armed with the 45-70 Springfield well beyond 1900.

The 45-70 cartridges found on the crater floor could be attributed to the 1895 skirmish between supporters of the deposed Queen Lili'uokalani and soldiers of the Hawaiian Republic or they could also be evidence of the presence of soldiers from Camp McKinley (from 1898) in the crater. It is also possible that they date from a more recent time since 45-70 cartridges were produced by American companies until the early 1930s (Barnes 1997:86). In any regard, the ammunition is an interesting artifact of possible early military presence in the crater.

#### Wetland

The low area in the eastern portion of the crater is the site of a natural wetland. Beginning in 1972, the wetland was pumped to prevent mosquitoes and other pests from flourishing (Anonymous n.d.b) and to avoid flooding of the road in the crater floor (M. Dumazan, pers. comm). This practice has been curtailed since 1996 as part of the efforts to manage and protect rare and endangered plants (Goodman 1998). Though this feature has suffered extensive bulldozing and filling, intact wetland soils still remain, as evidenced by preliminary coring undertaken during the present project (see Appendix A).

The coring indicates two episodes of fill extending to a total depth of 80 cm (32 inches) below surface. The fill overfills an intact silty clay sediment from which two samples were extracted for pollen analysis. Both samples (from intervals at 90-100 cm [36-39 inches] and 150-156 cm [59-62 inches] below surface) contained good pollen preservation, and there was charcoal in moderate abundance. The charcoal is suggestive of fire use in the area; Athens (1997) notes that charcoal particles do not occur in Holocene sediments dating from before Polynesian settlement on O'ahu. The testing and pollen analysis demonstrate that there is potential for further paleoenvironmental study of the wetland and that analysis of pollen samples from below the 150-156 cm interval could provide a good indication of the type of flora that was present in the crater during Polynesian and pre-Polynesian times.

#### FORT RUGER

The Fort Ruger assessment area lies along the north and northeast exterior slopes of the crater, fronting Diamond Head Road. Fort Ruger was established in 1906 and the area within and surrounding Diamond Head was intensively utilized by the U.S. Army until the early 1950s when much of the installation was transferred to the Hawaii National Guard. Fort Ruger is listed as a Historic District under Hawaii State Site 50-80-14-1350.

Most of the Fort Ruger structures on the exterior of the crater have been demolished, leaving only their concrete foundations (Photo 11). Although the buildings presumably



Photo 11. Example of remaining concrete foundations at Fort Ruger.

followed standard Army plans, there is surprising variation among these foundations. Buildings 102-108, for example, were barracks and each pad is divided into eight square segments. Each of these segments has a different and unique geometric pattern engraved in the floor that is not duplicated elsewhere among these foundations.

Throughout this area of the monument are terraced roads with mortared and non-mortared retaining walls up to 0.9 m (3 feet) high. They are in very good condition (Photo 12).

#### Battery Harlow

Battery Harlow is located at the base of the exterior northeastern crater wall and is presently accessible only by controlled access roads from either Diamond Head Road or Kapahulu Tunnel (see description below). Battery Harlow is listed as Feature 2 on the National Register nomination form for the Fort Ruger Historic District (Hilbard and Napoka 1980:1). Allen and Shideler (1996) present the results of an intensive literature search and limited inspection of the battery carried out as part of preparation of a preservation and conservation plan; for detailed information on Battery Harlow, the reader is referred to this report, which is only briefly summarized here.

transmit the appropriate data via the display drums to the gunners in each pit by turning the handwheels.

This massive, concealed, concrete structure remains in excellent condition, although the mortar pits were filled with concrete when the armaments were removed after World War II (Allen and Shidefer 1996:24). The east and west bunkers are presently used for storage by the State Department of Defense. The central bunker and the command post are unused. A 1995 inspection by historical architects (Allen and Shidefer 1996:27) reports:

Due to the permanent nature of the original construction, the battery is in good structural condition. In general, the structure retains its original materials, features, and finishes. Lack of maintenance has contributed to deterioration of the metal and wood elements, but little permanent damage to the main structure has been sustained.

#### Kapahulu Tunnel

Immediately west of Battery Harlow is the exterior portal of the Kapahulu Tunnel, which is listed as Feature 10 on the National Register nomination form for the Fort Ruger Historic District (Hibbard and Napoka 1980:3). The tunnel was originally 175 m (580 feet) long, 2.4 m (8 feet) wide, and 2.1 m (7 feet) high; it was excavated to expedite construction of the Leahi Fire Control Station and allowed a mule-powered, narrow gauge rail line to enter the crater. In 1934, a six-room complex was built inside the tunnel, at the same time that the tunnel was widened and lined (Thompson n.d.:76). It was expanded again in 1961 and now accommodates motorized vehicle traffic. Hibbard and Napoka (1980:3) note that it "is still considered significant for its associations with the construction of the fire control tower despite its loss of physical integrity."

#### Magazine Tunnels

Immediately southeast of Battery Harlow and along the shelf of the exterior crater slope is a series of magazine tunnels that are presently used for storage. The entrances to the six tunnels are on the upslope side of the road to Kahala Tunnel. There is also a U-shaped communications tunnel in this area.

#### Other Extant Fort Ruger Buildings

Standing structures that remain at Fort Ruger within the boundaries of the Diamond Head State Monument include Buildings 76 and 31B (to the northwest of Battery Harlow), which were used for storage, Building 75, which was a fuse and primer magazine, and Building 287, a boiler house. Buildings 75 and 287 are in the northeastern area below the sharp turn in the road to Kahala Tunnel. Among all the concrete foundations are numerous

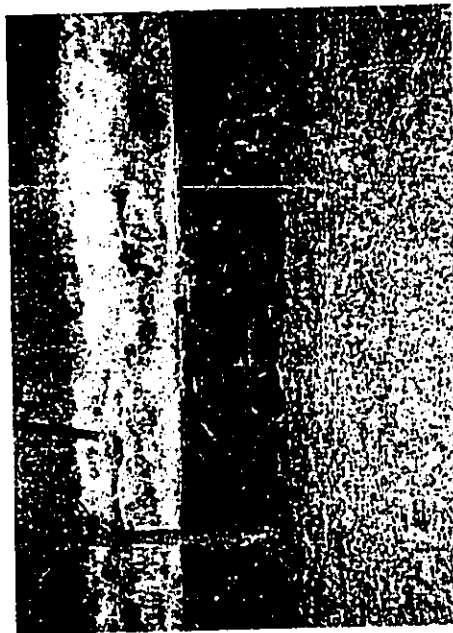


Photo 12. Example of retaining walls for terraced roads at Fort Ruger.

Battery Harlow became operational in 1910 as the first permanent structure at Fort Ruger and the earliest of a system of coastal defense fortifications on O'ahu. It has three bunkers separated by two courtyards that are set below a huge parapet built against the north-facing slope of Diamond Head. The east bunker is two stories (one below grade) and the west and central bunkers each have one story. The central bunker houses the plotting room and mechanical data transmission (DT) system; there is a smaller concrete structure for the command post on top of the central bunker that appears to be accessed by exterior stairs. Each courtyard had four pits for 12-inch mortars.

Deutch (1992:6) describes the "rare, virtually complete, operable, mechanical DT system" at Battery Harlow, which transmitted firing data calculated in the plotting room to the gunners in the mortar pits:

Next to the entrance of each hallway is a DT sending station mounting nine handwheels, 5 azimuth and 4 elevation, each with a small, numbered indicator drum. Nine 1"-diameter control shafts run from the handwheels through two wall-mounted, bronze-bushed (sic) steel supports to the display unit which is located in an aperture in the front wall of the hallway. ... Each display unit, about three feet square and one foot thick, mounts its display drums in two superposed rows - elevation above and azimuth below. The control shafts are coupled by gears to the display drums such that they rotate in synchronism with the indicator drums at the sending station. This arrangement enables the operators, standing next to the plotting boards, to

roads that are often built on terraces with concrete-mortared and unmortared basalt boulder retaining walls.

Building 75 is a fuse and primer magazine solidly built of large basalt boulders and concrete mortar. It has a large north-facing steel door (Photo 13). The roof appears to be a modification to the original structure; it is a corrugated tin vaulted roof with steel I-beam rafters fixed into a 5-inch concrete topping with screened ventilation windows.

Building 287 is a boiler house with some intact components. There are two brick and concrete pillars with semi-circular depressions in the top that, most likely, supported the boiler that is now laying off to the side of the pillars (Photo 14).

Building 76 is a green corrugated tin building (Photo 15) that is visible from Diamond Head Road. Panels in the rear of the structure have been pried open by vandals and/or squatters. There are wooden shelves along the inside walls.

Building 31B (see Photo 15) is a small concrete structure that is partially excavated into the hill on its south side. There is an outer vestibule that opens to the west and a small chamber underground to the south. This structure has also been broken into and is in use by squatters.



Photo 13. Building 75, view to south.



Photo 14. Pillars for Building 287, view to north.



Photo 15. View to the south of Building 76 in the rear and Building 31B in the foreground. The entrance to Building 31B is to the right.



### EXTERIOR SLOPES

The exterior slopes of the monument outside of the Fort Ruger assessment area are reached by trails originating on public roads. There are several structures in dispersed areas of the exterior slopes.

#### Searchlight Numbers 3 and 4

Searchlight Number 3 is located on the toe of a ridge on the exterior slopes of the crater at the western edge of Fort Ruger. Though sealed, it appears to be similar to the retractable searchlight on the southern crater rim (see description above). The roof of this structure is a steel panel that conceivably could have retracted to allow the searchlight stored below to be elevated for use. Off the west side of the ridge is the tunnel access to the structure. Another sealed tunnel, which is much smaller and less prominently positioned northeast on the ridge, may have been for the searchlight generator (Photo 16). A latrine with toilet, shower, and sink is part of this complex; the fixtures are still fairly intact. A trail with stone stairs and a small retaining wall is located between the tunnel and the latrine (Photo 17).

Searchlight Number 4 is located below the northwestern rim of the crater (Photo 18). A mobile searchlight (Photo 19) was moved into position on railroad tracks. The housing for the searchlight is a bunker excavated out of the western crater exterior wall and is protected by large steel doors. The tracks exit the chamber and turn southwest approximately 39 to 48 m (130 to 160 feet), terminating at the ridge overlooking San Souei beach in Waikiki. Inside the housing, the end of the tracks are bent upwards, presumably to prevent the searchlight from impacting the rear wall of the room when it was rolled back for protection. Below the endpoint of the rails is a trench that may have been used for access to carry out repairs. To one side in the interior of the housing is a room that is surrounded on all sides and above the ceiling by double wall construction. The spacing on the sides is about 0.6 m (2 feet) wide and above the room is about 1.2 to 1.5 m (4 to 5 feet) high. The inside room has barred windows to these "hallways" and to the searchlight parking room.

#### Pre-1920 Reservoir

Just northeast of Searchlight Number 3 and higher up on the same ridgeline is a very large concrete reservoir with a collapsed roof (Photo 20). This feature appears on Monsarrat's 1920 map of Waikiki. The interior of the reservoir, which is fully exposed, is painted with graffiti (Photo 21). The 1979 State Parks planning report lists the reservoir as inactive, although still under the jurisdiction of the Honolulu Board of Water Supply.



Photo 16. Steel door to the tunnel access to the searchlight generator housing.





Photo 17. Retaining wall and concrete steps and trail near the tunnel entrance (see steel door at far right of the photograph).



Photo 18. Railroad tracks in front of steel door to the mobile searchlight housing.



Photo 19. Sixty inch mobile searchlight on display at the US Army Museum at Fort DeRussy. Note the wheels that would have been modified for use on railroad tracks.



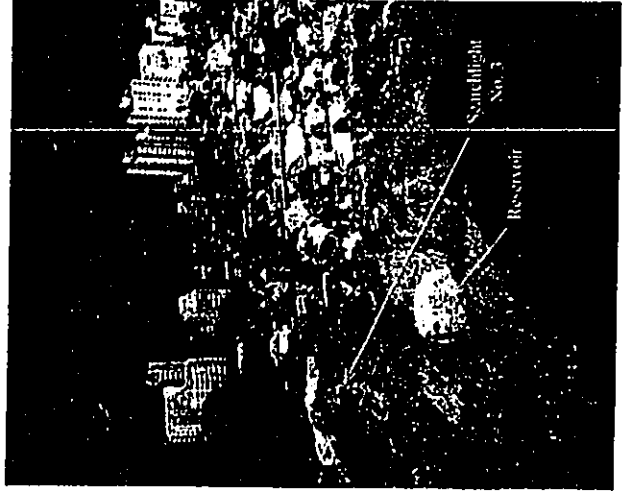


Photo 20. View of the reservoir from the Leahi Fire Control Station; the platform for Searchlight Number 3 is also visible in the upper left.

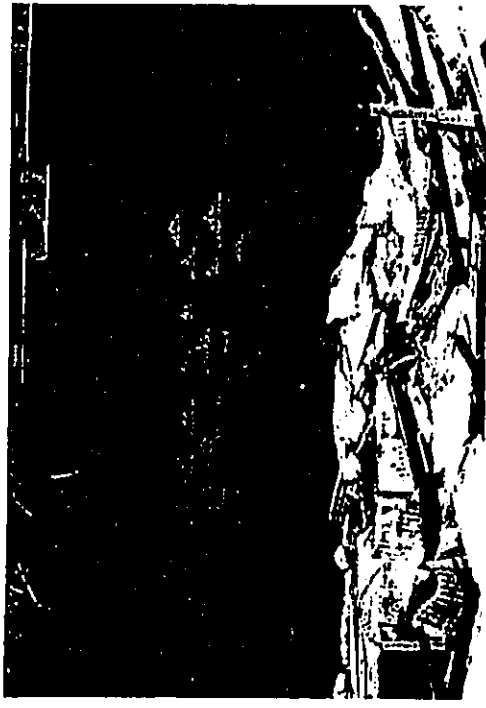


Photo 21. An example of the graffiti on the inside wall of the reservoir; note debris from roofing material on the floor of the reservoir.

**Na La'au Arboretum**

In 1950, George C. Munro dedicated his time and energy to the creation of a botanical garden of Hawaiian arid plant species. His work resulted in the Na La'au Arboretum and its companion Ke Kua'aina garden of endemic plants, which eventually grew to over 100 acres. In 1961, the Garden Club of Hawaii honored Munro with a flagstone bench area and monumental plaque which still remains, although in some disrepair (Photo 22). Maintenance of the garden was taken over by the State government and continued until the mid-1970s.

The remnants of this garden are located along a trail that runs north from Makalei Place. Many cacti and other succulent plants are firmly established there. The extent of the garden over an area 100 m (328 feet) long and 20 to 30 m (66 to 99 feet) wide can still be observed.

**Other Possible Sites on the Exterior Slopes**

Captain Charles Wilkes of the U.S. Exploring Expedition visited O'ahu in 1840. He mentions a structure not discussed elsewhere (Jenkins 1850:386, brackets added):

#### IV. SUMMARY AND RECOMMENDATIONS

Diamond Head is a noted representation of the natural forces of island creation of the Hawaiian chiefs from at least the 15th century until the late 1800s. As the site of Fort Ruger, it was the vanguard installation for the defense of Hawai'i and the mainland in the first half of the 20th century. Since the 1950s, it has suffered bulldozing and demolitions, brush fires and brush fire fighting, and even 1960s rock concerts.

Diamond Head is now preserved as a State monument to the natural and cultural history of the region. Plans are currently in process by the Division of State Parks for an improved interpretive program that transmits an understanding and appreciation of the history of the crater to monument visitors (Yent 1998).

#### ASSESSMENT OF CULTURAL RESOURCES

Historical research indicates a long history of human activity around the crater, but within the crater itself, it was not until the 20th century and the development of coastal defenses that significant, land-form altering events took place. This is reflected in the cultural resources identified during the present survey (see Fig. 11), almost all of which are related to the military occupation of Fort Ruger. The exceptions are the remains of Na La'au Arboretum, which was a recent use of the exterior crater slopes, small arms bullet casings on the interior slopes that might date to the turn-of-the-century, and the wetland area that might hold clues to the paleoenvironment of the crater.

#### TRADITIONAL SITES

The archival research, previous archaeological studies, and the present field survey suggest that there is little likelihood for archaeological sites of pre-contact Hawaiian or early post-contact origin. Historical documents note only that possible dryland farming might have taken place in the crater; there are also stories of human burials in the crater walls and human sacrifices on the interior crater slopes. These historically referenced possibilities for cultural remains were checked during field survey, with no evidence for any such remains found. No other cultural remains that pre-date the military period were discovered.

One *heiau* is said to have been located on the summit of the crater, although the information source for this is ambiguous. Of the numerous other religious sites identified in the Waikiki region, the closest to the State monument were on the lower exterior flanks of the crater, outside of the monument boundaries. The reconstructed distribution of Waikiki *heiau*



Photo 22. George Munro Monument.

... on the flank of Diamond Hill is a battery, also in a state of dilapidation. These positions [including that at Punchbowl] and if properly fortified would afford ample defense of the town.

Yent (1998:98) describes the Punchbowl battery as being constructed in Pooowaina crater in the 1820s:

The dips in the crest of the crater rim were used as natural protection with stone walls added to increase the protection. The battery consisted of 14 large cannons, a powder magazine of adobe bricks, a guardhouse, and a flagpole with the Hawaiian flag.

Wilkes has also been attributed with having described a *holua* slide on the exterior slope of the crater, descending onto the Waikiki plain (Scott 1968:666). However, Wilkes' own account (Jenkins 1850:371) does not indicate any locational data for such a feature at Diamond Head.

A 1906 article in the Pacific Commercial Advertiser (Advertiser 1906:5) notes that "Japanese laborers are building a trail up Diamond Head from a point near the lighthouse." This is the only documented reference to such a trail and no evidence of a trail was found during the present survey.



(see Fig. 9) indicates a clear focus toward the Waikiki plain of *Heiwa* associated with the high chiefs (e.g., Pape'ema Heiau on the prominent overlook below Diamond Head and 'Apukāhau Heiau in the middle of the chiefly residential area along the beach); fishing *Heiwa*, on the other hand, are on the low cliffs overlooking the ocean on the south side of the crater, once noted as a famous fishing grounds (Clark 1977:39). As in pre-military historic times, Diamond Head seems to have been the background to, rather than the stage upon which, events took place.

No subsurface testing was carried out during the present project. There is a slight possibility for buried cultural deposits, particularly in areas that have not been extensively graded or excavated (e.g., southwestern slopes and the upper gullies in the northwestern portions of the interior crater).

#### MILITARY SITES

Virtually all sites located during the present survey are related to the development of Fort Ruger as part of the coastal defenses of O'ahu, which clearly stands as the most significant historical event in the history of Diamond Head. The sites range from massive reinforced concrete batteries to reservoirs to soil-bermed firing ranges, and they date from 1909 to the 1950s. The essential components of the coastal defense complex of Fort Ruger are located within the State monument boundaries. The four batteries are Harlow, Hulings, Dodge, and Birkhimer and they represent three main periods of defense development: Battery Harlow was the original coastal defense facility and the other three batteries were built as part of a subsequent land defense network; Battery Birkhimer was remodeled in 1920-21 and reflects the changing orientation in defensive strategy given post-World War I changes in armament technology. The Leahi Fire Control Station was built in support of Battery Harlow (as well as batteries at Fort DeRussy) and is particularly significant as an unusually complex example of fire control buildings. The other sites include other fire control stations, searchlight housings, observation points, magazine tunnels, and gun emplacements.

The National Register of Historic Places (NRHP) nomination form for Fort Ruger (see Appendix B) states that the fort is "significant in the history of the military in Hawaii as the first coastal defense fortification established by the United States Army in the Islands" (Hibbard and Napoka 1980). It further specifies that the Leahi Fire Control Station is particularly important as a unique example of such facilities, being the most elaborate construction of this type of facility in the United States.

Since the 1950s when the U.S. Army relinquished control over much of the installation, many facilities have been altered and demolished. However, even if most of the support and administrative facilities of the fort are in alternative uses or are only concrete foundations, the defensive structures remain as testament to this important part of U.S. military presence in Hawai'i. Many are in excellent condition and clearly demonstrate the important function they served in protecting O'ahu's southern coastline.

#### WETLAND

In the southeastern quadrant of the crater interior is a seasonally moist wetland that is significant as a potential source of information on past environmental conditions in the crater. Coring and pollen analysis of two samples from the wetland during the present project show that there is an intact sediment underlying fill layers and that pollen preservation is good. The assumption of this work is that, since its inception, the basin should have received a continuous influx of sediments and microfossil plant remains from within the wetlands, as well as from erosional transport of sediments and plants remains from within the crater slopes. The basin, therefore, should contain a stratigraphically intact record of past environmental conditions inside the crater.

#### CRITERIA FOR EVALUATING AREAS OF POTENTIAL CULTURAL RESOURCE SENSITIVITY

Fieldwork for this project was directed to making assessments of cultural resource sensitivity.<sup>9</sup> The monument was initially divided into four regions based primarily on topographical characteristics, and then sample areas within each region were selected for assessment survey based on ease of access, the historical research that indicated different uses for the four areas, and the potential for different types of archaeological/historical sites. Based on this selective survey, an evaluation was made as to the presence of areas of potential cultural resource sensitivity for all areas of the crater. Three criteria were used for this evaluation:

1. documented reference to traditional/historical use that might be applied to specific areas of the crater.
2. the presence of known archaeological or historical resources in the sample survey areas that would suggest similar resources in areas that were not surveyed.
3. the estimated degree of disturbance from historical or recent land use and land modification.

Areas of potential cultural resource sensitivity are thus defined as those localities that were or might have been used in the past and that have not been adversely impacted by historical or modern land uses. These areas would thus have a high probability of archaeological or historical resources being present.

<sup>9</sup> The scope of work for the project did not call for systematic 100 percent coverage of the entire State monument nor for evaluations of site significance based on the criteria of the National Register of Historic Places. Rather, these actions are part of the recommendations to be incorporated into the updated master plan and EIS.

### AREAS OF POTENTIAL CULTURAL RESOURCE SENSITIVITY

Based on the defined evaluation criteria, the following areas (numbered 1 through 4) are designated areas of potential cultural resource sensitivity (Fig. 16). Areas 5 and 6 are evaluated to be areas of low cultural resource sensitivity.

All sites identified during the present survey. Until such time that an inventory level survey can be carried out, sites identified during the present survey should be considered sensitive areas. This includes the Fort Ruger grounds which includes standing structures, concrete foundations, roads, and retaining walls (designated Area 4 in Fig. 16). Inventory level survey will allow the recording of sufficient site information so as to make evaluations of significance as defined by the NRHP. Although many of the major coastal defense features fall within the Fort Ruger Historic District, inventory level documentation of these features has not been completed. The only site for which there is detailed documentation is Battery Harlow (see Allen and Shideler 1996).

**Wetland.** Although this is technically not a cultural site, the wetland has the potential to produce paleoenvironmental data that could contribute to a better understanding of the crater environment in pre-contact times. The full extent of the wetland, however, is difficult to determine because of modern alterations to the central crater and the boundary shown on Figure 16 (Area 2) is an estimation.

**Relatively undisturbed portions of the crater floor.** The absence of historical or traditional references to use of the crater interior does not discount the possibility that it may have been used in pre-contact or early historical periods. There have been no subsurface archaeological investigations (other than the present wetland coring) to refute or substantiate the presence of buried cultural deposits reflecting human use of the crater before the military occupation. The western portion of the crater (the slopes below and south of the Leahi Fire Control Station and the upper gullies north of the State Parks trail) may have some potential for buried deposits, based on the fact that late 19th/early 20th century ammunition was found in this area (which suggests that there may be little disturbance in the area). A rough guide to the boundary of this undisturbed area is the graded road that encircles the central portion of the crater (C. Hosokawa, pers. comm.). This area is designated Area 3 on Figure 16.

**Caves and crevices in the steep portions of the crater wall.** Although there are apocryphal stories of burials in the crater, as well as historical but second-hand references to cave burials being rifled, only a full survey of the cliff areas would eliminate the possibility of human remains in caves and crevices of the crater wall. Area 1 on Figure 16 indicates the portions of the crater rim that would most likely contain burials (if any exist).

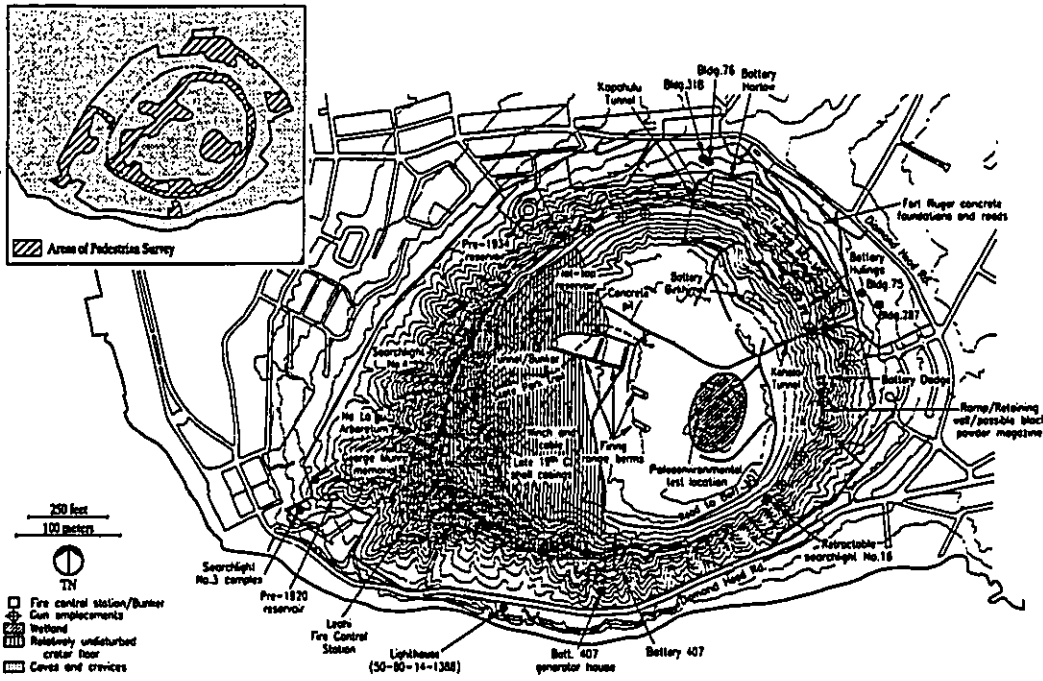


Figure 16. Identified sites and areas of potential cultural resource sensitivity.

Table 3. Recommendations for Sensitive Sites/Areas Identified During Diamond Head State Monument Assessment Survey.

Sensitive Site/Area	Location	Recommended Action		Recommended Treatment		Comment
		Inventory Survey	Monitoring During Construction	Preservation	Preservation w/ Interpretation	
Leahi Fire Control Station	Crater Rim	X	.	.	X	undertake immediate detailed architectural recording; incorporate into summit trail interpretation
Construction Trail	Crater Rim/Interior	X	.	.	X	incorporate into summit trail interpretation
Winch and Cable	Crater Rim/Interior	X	.	.	X	incorporate into summit trail interpretation
Batteries Hullings and Dodge	Crater Rim	X	.	.	X	incorporate into rim trail interpretation
Pit	Crater Rim	X	.	.	X	inventory survey may be sufficient data collection
Ramp/Retaining Wall	Crater Rim	X	.	.	X	incorporate into rim trail interpretation
Portable Gun Emplacements	Crater Rim	X	.	.	X	incorporate into rim trail interpretation
Retractable Searchlight Platform	Crater Rim	X	.	.	X	incorporate into rim trail interpretation
Various Fire Controls & Bunkers	Crater Rim	X	.	X	.	
Area 1-Caves and Crevices*	Crater Rim	X	.	.	.	survey for human remains; consult with Oahu Island Burial Council if remains are found
Battery Birkhimer	Crater Interior	X	.	.	X	incorporate into interior crater interpretation
Battery 407	Crater Interior	X	.	.	X	incorporate into interior crater interpretation
Road to Battery 407	Crater Interior	X	.	.	.	inventory survey may be sufficient data collection
Flat-top Reservoir	Crater Interior	X	.	X	.	
Tunnel/Bunker	Crater Interior	X	.	X	.	
Firing Ranges (U-shaped berms)	Crater Interior	X	.	X	.	
Firing Ranges (Linear berms)	Crater Interior	X	.	X	.	
Concrete Pit	Crater Interior	X	.	.	.	inventory survey may be sufficient data collection
Small Arms Bulker Casings	Crater Interior	X	.	X	.	see Undisturbed Area, below
Area 2-Weiland Sediments*	Crater Interior	X	X	.	.	undertake further paleoenvironmental research
Area 3-Undisturbed Areas*	Crater Interior	X	X	.	.	reassess sensitivity evaluation following survey and/or monitoring actions

**RECOMMENDATIONS**

The evaluation of cultural resource sensitivity is a preliminary step in cultural resource documentation. For the purposes of the master plan/EIS process, it provides a broad view of archaeological and historical site potential that allows for an informed assessment of future data collection and management requirements for defined areas of the monument. The next step in the documentation process, which can be phased as development plans become more detailed and concrete, is an inventory survey, as called for in the State of Hawaii rules governing procedures for historic preservation review (under HRS Chapter 6E).

Table 3 summarizes the recommendations by site and sensitive area. These recommendations should be incorporated into the updated master plan and EIS for implementation as part of future development projects (as they come on-line).

**Inventory Survey.** An inventory level survey would identify, locate, and record sites in sufficient detail to allow evaluations of site significance based on NRHP and State criteria. An additional purpose of the survey (specifically for management purposes) would be to establish baseline data on site conditions against which future conditions can be monitored. Areas designated as having potential cultural sensitivity should be surveyed at the inventory level prior to any State Parks development.

A detailed architectural study of Leahi Fire Control Station is recommended as a mitigation action as part of the current plans for interpretive development of the monument (Yent 1998). The structure, which is highly significant as a unique and complex example of fire control stations, is presently the destination of virtually all visitors to the State monument. The intensity of public use has a deteriorating effect on the integrity of the structure, which should be documented in detail before it is further adversely impacted. It can only be anticipated that public use will increase with additional development of the State monument.

If any future development in sensitive areas of the crater entails subsurface excavation (e.g., trenching, grubbing, or grading), it is recommended that an archaeological monitor be present to examine exposed soil profiles or deposits. This will allow an evaluation of the above sensitivity assessment for relatively undisturbed areas of the crater, which can be revised, if necessary, after the first monitoring has been conducted.

**Management Recommendations.** Based on the recommended inventory survey and particularly the significance evaluations, further recommendations can be made as to [1] future data collection requirements such as detailed architectural recording or archaeological data recovery, and [2] long-term preservation requirements for significant sites, particularly those in areas of high public use.

It should be noted that, at present, the primary sources of potential damage to historic structures are from vandalism and general deterioration. Vandalism is represented primarily by graffiti and trash and is most evident in the Fort Ruger area, at the retractable searchlight bunker on the southern crater rim, and in the exposed concrete reservoir on the western exterior slopes (see Photo 21). All structures are suffering from some degree of deterioration; the Leahi Fire Control Station is particularly vulnerable due to the high public traffic. The present restrictions to public access to most parts of the crater, however, have generally helped to preserve and protect the structures.

**Interpretation.** From the very inception of the monument in the early 1960s, there has been a strong interest in the history of Fort Ruger and the military structures as historic sites. Future interpretive development of the monument should acknowledge this original (and continuing) interest.

An example of integrating interpretation and recreation, as well as disparate interpretive themes, is a crater rim trail that utilizes the 6-pound gun emplacements (see Fig. 16) as observation points. An existing rim trail follows segments of the early 20th century road that connected the various components of the defensive system, and interpretation can deal with the emplacements themselves (how they were used), as well as how they fit into the overall defensive system. The emplacements and rim trail offer excellent (and already constructed) vantage points from which to view the interior of the crater (including almost all of the identified sites), as well as outward to Waikiki, the entire southern coast from Koko Head to the Honolulu Airport, and inland toward the Ko'olau mountain range. Interpretation can be directed into the crater with a focus on the defensive complex and out of the crater addressing any number of interpretive themes (including traditional Hawaiian settlement and activities) that tie the crater to a larger regional and historical context.

As early as 1906, the visual assets of a rim trail were recognized (Advertiser 1906:5):

From the rim of Diamond Head crater the wonderfully symmetrical basin strikes one as a beautifully laid out park... If the climber were to see nothing more than the floor of the crater and the green sides sloping into it he would feel repaid for his exertions in climbing. Once on the rim he finds that he can walk around two-thirds of the crest on a comparatively good path from every point of which an ever changing panorama presents itself of the beautiful city of Honolulu and its suburbs and the irregular surf-bordered shore of the island.

Yent (1998:72-74) describes interpretive trail options including a loop trail to the summit lookout (the Leahi Fire Control Station), a rim trail such as suggested above, a branch

Table 3. Recommendations for Sensitive Sites/Areas Identified During Diamond Head State Monument Assessment Survey. (continued)

Sensitive Site/Area	Location	Recommended Action		Recommended Treatment		Comment
		Inventory Survey	Monitoring During Construction	Preservation	Preservation w/ Interpretation	
Area 4-Disturbed Areas*	Crater Interior	-	-	-	-	no further work
Battery Harlow	FL Ruger Grounds	-	-	-	X	documentation completed; can be primary focus of Fort Ruger interpretation
Kapahulu Tunnel	FL Ruger Grounds	X	-	-	X	Interpret as part of Fort Ruger complex
Tunnels M1-M6	FL Ruger Grounds	X	-	-	-	Inventory survey may be sufficient data collection
Tunnel M0	FL Ruger Grounds	X	-	-	-	Inventory survey may be sufficient data collection
Retaining Walls	FL Ruger Grounds	X	-	-	-	Inventory survey may be sufficient data collection
Kahala Tunnel	FL Ruger Grounds	X	-	-	X	Interpret as part of Fort Ruger complex
Building 31B	FL Ruger Grounds	X	-	-	-	Inventory survey may be sufficient data collection
Building 75	FL Ruger Grounds	X	-	-	X	Interpret as part of Fort Ruger complex
Building 76	FL Ruger Grounds	X	-	-	-	Inventory survey may be sufficient data collection
Building 287	FL Ruger Grounds	X	-	-	-	Inventory survey may be sufficient data collection
Area 5-Concrete Foundations/Roads	FL Ruger Grounds	X	-	-	X	Interpret as part of Fort Ruger complex
Generator House to Battery 407	Exterior Slopes	X	-	-	-	Inventory survey may be sufficient data collection
Searchlight No. 3	Exterior Slopes	X	-	-	X	Interpret as part of exterior slope park development**
Searchlight No. 4	Exterior Slopes	X	-	X	-	-
Reservoir	Exterior Slopes	X	-	-	-	Inventory survey may be sufficient data collection
Na La'au Arboretum	Exterior Slopes	X	-	-	X	restore as botanical garden?*
George Munro Monument	Exterior Slopes	X	-	-	X	restore as park viewpoint?*
Area 6*	Exterior Slopes	-	-	-	-	no further work

Recommended Action = required action per State of Hawaii historic preservation regulation.

Recommended Treatment = preliminary management recommendation; may be revised following completion of inventory survey and final evaluation of significance.

\* See Figure 16 for location.

\*\* These recommendations assume that there will be some future park development of the exterior slopes.

trail from the summit trail to the 1911 reservoir, and a native plants trail system in the wetland area. Reconstruction of the Na La'au Arboretum trail along the lower northern exterior slopes is also suggested.

**Cultural Resource Management Plan.** Ideally, a cultural resource management plan (CRMP) for Diamond Head State Monument should be completed at the earliest opportunity. Such a plan would incorporate the above three recommendations: [1] inventory survey of the monument, including full site documentation and evaluations of significance, [2] management recommendations for identified sites in the context of short-range development plans and long-range maintenance and preservation, and [3] incorporation of historical sites into the monument interpretive program. Although these recommendations could be carried out independently, an integrated CRMP approach is more effective for planning purposes.

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**APPENDIX A.  
WETLAND CORE**

by  
J. Stephen Athens and Jerome V. Ward

The Diamond Head wetland is a seasonally moist basin that occupies an area of roughly 2.5 ha (6.2 acres) (Photo A-1; Fig. A-1). It is a potential repository of information regarding past environmental conditions inside the crater. Through sediment analysis, palynology, and radiocarbon dating, it may be possible to reconstruct the natural history of the crater prior to human disturbance, as well as changes that occurred with Polynesian settlement of Hawai'i. Such information could be helpful for future park planning and management endeavors relating to the restoration of native vegetation, as well as for contributing to the overall understanding of Hawai'i's natural history and the record of anthropogenic impacts since the arrival of the prehistoric Polynesians (see Athens 1997).

Because of the limited scope and funding for the present project, the Diamond Head wetland study is limited to determining the feasibility of, rather than actually undertaking, such a paleoenvironmental study. The primary assumption behind the project is that, since its formation, the Diamond Head wetland has received a continuous influx of sediments and microfossil remains of plants growing within the basin, as well as from the erosional transport of sediments and plant remains on the interior crater slopes. The basin, therefore, contains a stratigraphically intact record of past environmental conditions inside the crater. This, of course, assumes that the wetland basin remains intact despite historic and modern activities, and also that organic microfossil plant remains are preserved in spite of the probable seasonal nature of the wetland.



Photo A-1. Wetland inside Diamond Head crater. The vegetation consists of predominantly star grass (*Chloris divaricata*) and tiawe (*Frasopia pallida*) trees with cocklebur (*Xanthium sacccharatum*). View to north, May 1998.



In view of these contingencies, the major goals of the present effort are to determine 1) the nature of the wetland sediments, 2) the degree of possible historic and modern disturbance to these sediments, and 3) whether or not ancient pollen is preserved in the sediments. As far as is known, no such investigation has been previously conducted in the Diamond Head wetland.

**ENVIRONMENT OF THE WETLAND**

Background information concerning the environment of Diamond Head crater is amply discussed in the 1979 State Parks planning report (Division of State Parks 1979) and only a few points are necessary here. The first is that a State Parks inventory of modern vegetation inside Diamond Head crater, which lists vegetation types according to major physiographic/environmental zones (Division of State Parks 1979:14), provides a baseline against which to compare the results of the paleoenvironmental testing. The vegetation list is presented in Table A-1.

The star-grass/cocklebur (*Chloris divaricata* and *Xanthium sacccharatum*) community is described as occupying the seasonally inundated (wetland) part of the crater. These taxa are dominant in the wetland, occurring with Guinea grass, sticky galangale, and jungle grass. California grass is limited to a man-made pond, the latter presumably being the location of a stump pump employed to keep the wetland dry for control of mosquitoes (see below).

Another important aspect of the environment concerns the nature of the soils within the wetland. These consist of the Makalapa MdB type, which is described as follows (Foote et al. 1972:87; see also Division of State Parks 1979:9):

...the surface layer is very dark grayish-brown clay about 8 inches thick. The next layer, 18-36 inches thick, is very dark grayish-brown clay to silty clay loam that has subangular blocky structure. It is underlain by light-gray to dark grayish-brown, weathered volcanic tuff. The clays are very sticky and very plastic, and they crack widely upon drying. The soil is mildly alkaline in the surface layer and mildly alkaline to moderately alkaline in the next layer.

...The shrink-swell potential is high.

If it can be assumed that the MdB series approximately delimits the area of the wetland inside Diamond Head crater, the distribution of MdB soils suggests that the wetland may have formerly comprised an area of roughly 14 ha (74.6 acres). However, as there is a 6 ha (14.8 acres) area of fill in the central developed part of the crater that is coterminous with the MdB soil type, it may be that the crater wetland once extended over an even larger area, far exceeding its present size of about 2.5 ha (6.2 acres).

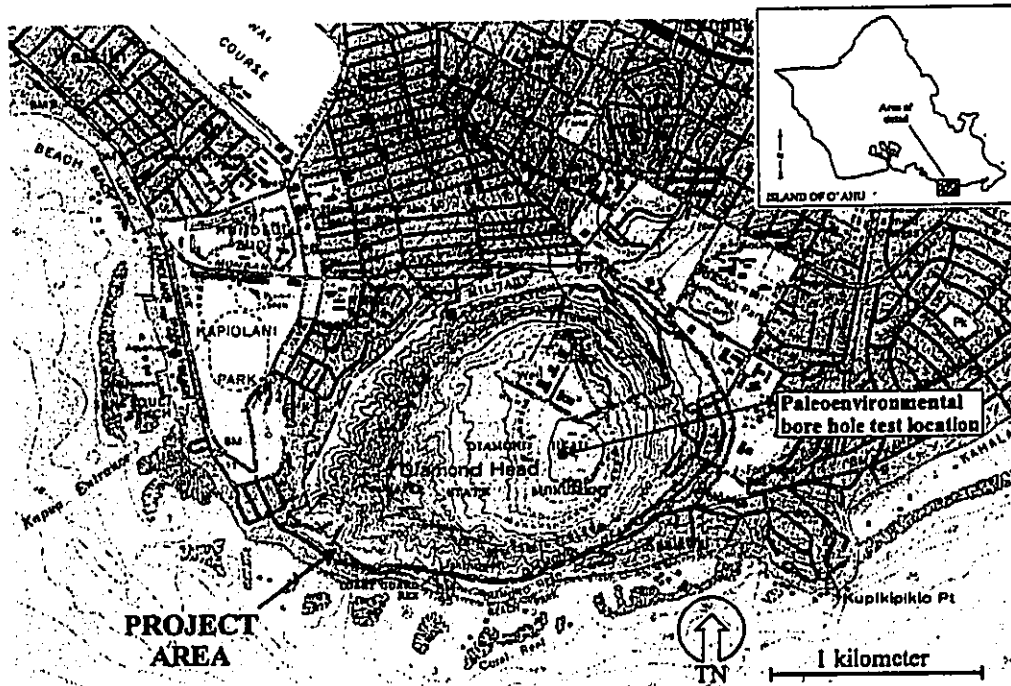


Figure A-1. Portion of USGS topographic map showing Diamond Head crater and wetland (USGS Honolulu 7.5 minute quadrangle, 1983).



The final characteristic of the wetland that is significant for the present study concerns its hydrology. The Division of State Parks (1979:14, 16) notes that heavy winter rains raise the ground-water table, causing the ponding of fresh water for periods of up to several weeks. The pond and high ground-water table, however, quickly evaporate, and the wetland reverts to a dry state. Thus, the Diamond Head wetland is only an intermittent seasonal feature.

Unfortunately, the Division of State Parks report does not discuss the effect of the operation of the sump pump, in use since 1972, on the wetland's hydrology. It is possible that the wetland may have retained water or moisture for longer periods before the pump was installed. Use of the pump has been limited since 1996 as part of management efforts for protecting rare and endangered plants in the wetland.

**FIELD INVESTIGATIONS**

Fieldwork was performed by the senior author on May 5, 1998. The location of the wetland test boring is roughly 75 m southwest of the sump pump (which has large aqua-colored pipes). The entire wetland area appears to have scattered recent trash and some areas have obvious fill material. The location selected for the test boring is a relatively low spot with no evidence of disturbance on the surface. At the time of the boring, the entire wetland was completely dry; the dead grass throughout the wetland was thick and high, and *kiawe* and *koa haole* trees were plentiful (oddly, *kiawe* and *koa haole* are not listed for the wetland by the Division of State Parks survey—perhaps these have only become established in the wetland since the 1979 survey; see Table A-1). Some of the *kiawe* trunks are well over 30 cm in diameter at their bases.

Initial boring was undertaken with a 3½ inch-diameter bucket auger (Photo A-2). Augering extended to a depth of 138 cm below surface. At about 80 cm, the sediment changed to a very stiff, olive-colored silty clay. At the 138 cm depth, the Vohmout/Colinvaux piston coring apparatus was used to extract a completely undisturbed sample of the sediment. Using a 5 kg drop hammer, the coring tube was driven to a depth of 158 cm. The core tube was then extracted with a winch, and cut, capped, and labeled for removal and study of the sediments in the laboratory. Use of the auger resumed, continuing to a depth of 281 cm with no change in the sediment. At this depth, the Vohmout/Colinvaux corer was again employed, and through vigorous hammering, the tube was inserted to a depth of 302 cm. There was no apparent change in the nature of the sediment. During the winching process, the tube unfortunately broke free of the core head and remained firmly inside the bore hole. Because of the difficulty of digging out such a deep tube, the decision was made to abandon it. Thus, it was not possible to retrieve the deepest sample in the bore hole test.

Table A-1. Flora of Diamond Head Crater (from Division of State Parks 1979:13).

Scientific Name	Common Name	Zones			
		Steep Rockland Slopes	Soil-covered Upper Slopes and Ridges	Lower Slopes and Crater Floor	Seasonal Wetland
<i>Amaranthus spinosus</i> L.	Spiny amaranth			x	
<i>Bidens cuneata</i> Sherif	Cuncate bidens ( <i>koko'ala</i> )**		x		
<i>B. cynapiifolia</i>	West Indian beggar's tick			x	
<i>Brachiaria mutica</i> (Forsk.) Stapf	California grass				x
<i>Chloris divaricata</i> R. Br.	Star grass			x	
<i>C. inflata</i> Link.	Swollen fingergrass				x
<i>Convolvulus benghalensis</i> L.	Hairy honohono				x
<i>Cucumis dipsacicus</i> Ehrenb. ex Spach	Wild cucumber				x
<i>Cyperus trochyanthus</i> H. & A.	Sticky galinule				x
<i>Desmanthus virgatus</i> (L.) Willd.	Slender mimosa				x
<i>Echinochloa colomem</i> (L.) Link.	Jungle rice				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 ( <i>ma'ala</i> )**				x
<i>Heteropogon canarius</i> (L.) Beauv. ex R. & S.	Pill grass*	x	x		
<i>Ipomoea cairica</i> (L.) Sweet	Koali*			x	
<i>Leucaena leucocephala</i> (Lam.) de Wit	<i>Haole</i> <i>koa</i>	x	x		
<i>Lipochloa</i> sp.	<i>Neke</i> **		x		
<i>Malvastrum coromandelianum</i> (L.) Garcke	False mallow			x	
<i>Merrania aegyptia</i> (L.) Urban	Hairy merremia				x
<i>Panicum maximum</i> Jacq.	Gulosa grass				x
<i>Phaseolus lathyroides</i> L.	Cow pea			x	
<i>Prosopis pallida</i> (Hump. & Benpl. ex Willd.) HBK	<i>Kiawe</i>				
<i>Santalum ellipticum</i> Gaud.	Coastal sandalwood**		x		
<i>Schidaea odamanis</i> St. John	Schidea**		x		
<i>Setaria verticillata</i> (L.) Beauv.	Bristly foxtail			x	
<i>Sida cordifolia</i> L.	<i>'Ilima</i> *		x		x
<i>Xanthium saccharatum</i> Walfr.	Cocklebur ( <i>tikania</i> )				x

\* Native plants      \*\* Proposed endangered plants



Photo A-2. Soil boring in Diamond Head crater wetland; view is to northeast. May 1998.

A small trench was then dug at the side of the bore hole in order to better define the overlying fill layer and its contact with the lower and presumably intact silt clay layer. A maximum depth of 100 cm was reached in the trench. The profile shows very clearly that there are two episodes (or layers) of fill. The upper deposit (Layer Ia) has a silty clay matrix very similar to the lower silty clay deposit (Layer Ib), but is not nearly as firm. In the Layer Ia deposit, extending to a depth of 41 cm, there is a considerable amount of flat-lying wood (type uncertain), but not much other introduced material. The lower boundary of Layer Ia is somewhat irregular and very abrupt.

The lower fill layer (Layer Ib) extends to a depth of 80 cm and consists of a brown sandy loam with a considerable amount of fairly recent trash (ferrous and non-ferrous metal, wood, plastic, concrete blocks, cobbles and boulders, some glass). The sand is calcareous and the sediment is highly reactive in HCl. The lower boundary of the fill is very abrupt. Below the fill is the very stiff, olive-colored silt clay observed in the auger tailings (Layer II).

Two intact samples for pollen analysis were extracted directly from Layer II in the trench. These were at 82-89 cm and 90-100 cm below surface. Care was taken to ensure that there was no contamination with recent pollen. This was done by removing large intact clods, and then extracting samples from their interior in the laboratory.

The trench excavation yielded no evidence for any disturbance of human origin to Layer II. However, several large vertical cracks were observed, which are undoubtedly related to the seasonal drying of this layer (or possibly the operation of the sump pump). The Layer Ia sediment is obviously derived from Layer II. Since the trash of the underlying Layer Ib is relatively recent, probably not more than 20 to 40 years old, Layer Ia clearly has undergone massive disturbance in the relatively recent past. The sediment matrix of Layer Ib appears to have been transported into the crater from an unknown outside location.

The bore hole and trench were entirely backfilled prior to leaving the area. A piece of blue plastic flagging tape was hung from a *Kiowa* branch to mark the location of the boring should retrieval of the lost core tube be attempted in the future.

#### SEDIMENT ANALYSIS

The bore hole sediment was examined in the laboratory, and a profile and formal descriptions were prepared for the layers using the collected samples from the trench, auger tailings, and the single core tube (Table A-2, Fig. A-2). A sample from the single core tube was also extracted for pollen analysis. In all, two samples from Layer II were submitted for pollen analysis: one from a depth of 90-100 cm (the lower sample collected from the trench), and the other from 150-156 cm (from the core tube).

#### POLLEN ANALYSIS

Two samples from intervals at 90-100 cm and 150-156 cm below surface were analyzed. Both samples contain good pollen preservation. Counts of the different taxa are listed in Table A-3.

Table A-2. Sediment Description, Wetland in Diamond Head Crater.

Layer	Depth, cm	Munsell Color (dry)	Sediment Description
Ia	0-41	2.5Y 4/2 dark grayish brown	Fill; derived from Layer II; silty clay; fair amount of large pieces of wood, but relatively little other historic trash; dry, very hard, sticky, plastic; very abrupt lower boundary.
Ib	41-80	10YR 3/3 dark brown	Fill; sandy loam with abundant calcareous sand (sediment is highly reactive to HCl); abundant modern trash, including wood, metal, plastic, concrete blocks, and rocks; dry, loose; non-sticky, plastic; very abrupt lower boundary.
II	80-302+	2.5Y 4/2 dark grayish brown	Silty clay; very stiff and only slightly moist; some large vertical drying cracks noted in profile; few very fine rootlets but otherwise very limited organic remains; dry, very hard; sticky, plastic; lower boundary not observed.

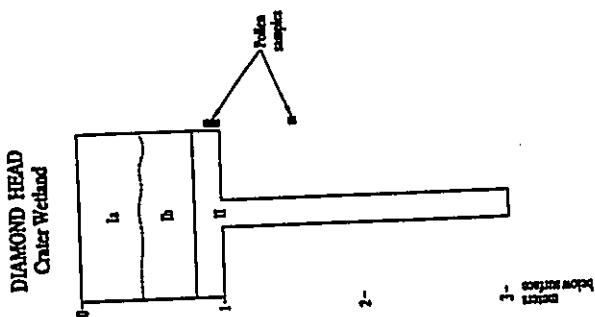


Figure A-2. Profile of core/bore test of wetland at Diamond Head.

The most conspicuous aspect of the microflora is the dominance of chenopod pollen. About 90 percent of both samples are comprised of this pollen, which is unusually high for Hawaii. This pattern could reflect the occurrence of either historically introduced species of Chenopodiaceae or Amaranthaceae or possibly pre-contact (before A.D. 1778), native members of these families. The problem is that the pollen of this type is not distinctive at the family level. It is noted, however, that a high abundance of this type, such as found in the Diamond Head samples, has not been reported from prehistoric horizons (e.g., references listed in Athens 1997) and may be more typical of historic microfloras.

Table A-3. Diamond Head Wetland Core Pollen Counts.

Species or type	Depth, cm	
	90-100	150-156
Trees and shrubs:		
<i>Agave glauca</i> (leaf)	1	
Alacnacae (high-spired)	6	
Alacnacae - <i>Lacnacae</i> (leaf)	4	
Chenopodiaceae	8	
Chenopodiaceae (leaf)	1336	
Chenopodiaceae (leaf)	17	
<i>Cyperus zosterifolius</i>		
<i>Melastomaceae</i> (leaf)		
Myrtaceae		
<i>Pisonia sandwicensis</i>		
<i>Pisonia sandwicensis</i>	16	
<i>Triplaris palmeri</i>		
<i>Waltheria indica</i> (leaf)	1	
Herbs:		
<i>Boraginaceae</i>	2	
<i>Commelinaceae</i> (leaf)	1	
Cyperaceae (sedge)	6	2
<i>Pennisetum</i>	4	
Poaceae (grass)	17	17
Unidentified pollen:		
<i>Monocotyledonae, granulate, oval shape</i>	34	44
<i>Tricolporaceae, reticulate</i>		
Pteridophytes:		
<i>Monolepis</i> types	1	1
<i>Polytrichum pilosulum</i>	29	15
Pollens:		
Tricolporaceae types:		
<i>Cibicides</i>	2	
<i>Gilchristia linearis</i>		
<i>Jacquinia recurva</i>	1	
<i>Perrinitis</i>	3	
<i>Ecclinusa, even spacing</i>	61	
Granulate	3	
Pollens	11	

The other clue suggestive of disturbance in the local flora and historic age of at least the upper sample is the presence of pollen of naturalized species including *Agave sisalana*, Asteraceae-Lactuceae tribe, *Melastoma*, and *Commelina*. With the exception of a single grain of Lactuceae pollen, all of these naturalized types are confined to the upper sample at 90-100 cm. This may suggest that there was greater exposure to the historic flora in the uppermost part of Layer II. Oddly, both *Prosopis pallida* and *Leucaena leucoccephala* are missing from the roster of historic types, despite their commonness in the present day flora.

Notwithstanding the exceptionally high cheno-am count, which might be explained by the seasonal nature of the wetland, there is a possibility that the lower sample could date to the prehistoric Polynesian time period. This is a time when the native lowland flora is known to have undergone a severe decline (Athens 1997). The absence of all but a single pollen grain of the naturalized taxa and the relatively high abundance of *Coccoloba* pollen in this interval suggest such an interpretation. *Coccoloba* is a prehistoric Polynesian introduction to Hawaii. However, if it is to be regarded as prehistoric, the 150-156 cm sampling interval must date to a very late prehistoric time period. This is suggested by the absence of both the *Pritchardia* and *Kanaloa* types, which are known to have dramatically declined with Polynesian settlement (cf. Athens 1997). In view of this interpretation for the 150-156 cm interval, the single grain of Asteraceae-Lactuceae pollen in this interval would be regarded as a contaminant, perhaps having migrated downward in the sediment column as a result of soil cracks caused by shrinking and swelling due to seasonal rains. Certainly the deeper deposits in the Diamond Head wetland should show less of a historic influence if there has been no historic or recent disturbance to these sediments, and this seems to be the case with the 150-156 cm sample.

Charcoal particles are present in both samples in moderate abundance. The presence of charcoal particles at the site suggest fire use in the vicinity. Charcoal particles do not occur in Holocene sediments dating prior to Polynesian settlement on O'ahu (Athens 1997).

#### CONCLUSION

Coring and pollen analysis of samples from a wetland in Diamond Head demonstrate the potential of this methodology to provide information concerning past environmental conditions inside the crater. The sediments appear to be intact below obvious fill layers, and pollen preservation is good. Also the nature of the sediments is consistent with historic observations that the wetland only contained water for brief periods during the winter rainy season; the wetland certainly was not a continuously saturated or inundated basin in the past.

Present indications are that the analysis of pollen samples below the 150-156 cm interval could provide a good indication of the type of flora present inside Diamond Head crater during Polynesian and pre-Polynesian times. If results so warrant, the radiocarbon dating of pollen extracts can provide a reliable means for determining the age of the samples that were analyzed.

#### REFERENCES

- Athens, J. Stephen  
1997 Hawaiian Native Lowland Vegetation in Prehistory. In P.V. Kirch and T.L. Hunt (eds.), *Historical Ecology in the Pacific Islands*, pp. 248-270. Yale University Press, New Haven, Connecticut.
- Division of State Parks  
1979 *Diamond Head State Monument: Planning Report*. Division of State Parks, Department of Land and Natural Resources, Honolulu.
- Foote, Donald E., Elmer L. Hill, Sakuchi Nakamura, and Floyd Stephens  
1972 *Soil Survey of the Islands of Kauai, Oahu, Maui, Molokai, and Lanai, State of Hawaii*. U.S. Department of Agriculture Soil Conservation Service, in cooperation with the University of Hawaii Agricultural Experiment Station, U.S. Government Printing Office, Washington, D.C.

APPENDIX B.  
NATIONAL REGISTER NOMINATION FORM FOR  
THE FORT RUGER HISTORIC DISTRICT





United States Department of the Interior  
National Park Service  
**National Register of Historic Places  
Inventory—Nomination Form**

See Instructions in How to Complete National Register Forms  
Type all entries—complete applicable sections

**1. Name**

historic Fort Ruger Historic District

and/or common

**2. Location**

street & number Diamond Head Road \_\_\_\_\_ not for publication

city, town Honolulu \_\_\_\_\_ vicinity of \_\_\_\_\_  
state Hawaii \_\_\_\_\_ code 15 county Honolulu code 03

**3. Classification**

Category	Ownership	Status	Present Use
<input checked="" type="checkbox"/> district	<input checked="" type="checkbox"/> public	<input checked="" type="checkbox"/> occupied	— agriculture
— building(s)	— private	— unoccupied	<input checked="" type="checkbox"/> park
— structure	— both	— work in progress	— commercial
— site	Public Acquisition	Accessible	— educational
— object	— in process	<input checked="" type="checkbox"/> yes; restricted	— entertainment
	— being considered	— yes; unrestricted	<input checked="" type="checkbox"/> government
	N/A	— no	— scientific
			— transportation
			<input checked="" type="checkbox"/> industrial
			— other:
			— museum
			— private residence
			— religious
			— scientific
			— transportation
			— other:

**4. Owner of Property**

name State of Hawaii  
street & number 1151 Punchbowl Street \_\_\_\_\_ vicinity of state Hawaii  
city, town Honolulu

**5. Location of Legal Description**

courthouse, registry of deeds, etc. Bureau of Conveyances  
street & number 1151 Punchbowl Street \_\_\_\_\_ state Hawaii  
city, town Honolulu

**6. Representation in Existing Surveys**

file State Historic Sites Inventory \_\_\_\_\_ has this property been determined eligible? yes  no   
date 1979 \_\_\_\_\_ federal  state \_\_\_\_\_ county \_\_\_\_\_ local \_\_\_\_\_  
depository for survey records Department of Land and Natural Resources \_\_\_\_\_ state Hawaii  
city, town Honolulu

United States Department of the Interior  
National Park Service

### National Register of Historic Places Inventory—Nomination Form

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#### 7. Description

Condition	Check one	Check one
<input checked="" type="checkbox"/> excellent	<input type="checkbox"/> deteriorated	<input checked="" type="checkbox"/> original site
<input checked="" type="checkbox"/> good	<input type="checkbox"/> ruins	<input type="checkbox"/> moved
<input type="checkbox"/> fair	<input type="checkbox"/> altered	<input type="checkbox"/> date
	<input type="checkbox"/> unexposed	

Describe the present and original (if known) physical appearance

The Fort Ruger Historic District is a noncontiguous district which includes structures located in and on Diamond Head and on lands situated adjacent to the crater. Including five batteries, seven fire control stations, two tunnels, and one building, the district encompasses a portion of the remnants of Oahu's earliest U.S. Army coastal defense fortification.

Located within a primarily residential area, Fort Ruger is a distinct entity located behind and within Diamond Head. The Fort has lost much of its original fabric as numerous buildings have been demolished in preparation of developing the area as a park and community college. The structures included in this nomination are those immediately associated with the coastal defense fortification. A number of buildings have been excluded from this nomination, including a late 1930s chapel and theater, several NCO quarters, a parade grounds and several officers' quarters which are isolated from the defense works in the district, and a number of modest utilitarian warehouses which minimally contribute to the sense of the fort's historic presence in the area.

The fortifications within the district are all made of reinforced concrete and vary in size from the massive Battery Harlow (9) and the four-story fire control station at the top of Leahi (15) to a dozen more modest six pound gun emplacements along the rim of the crater (12). None of these structures presently perform their original functions and most are abandoned, although Batteries Birkhimer, Harlow and 407 are still being used by the State Department of Defense for offices and storage. These fortifications are all within or on Diamond Head, a National Natural Landmark which primarily is used for park purposes.

#### The inventory:

1. The guardhouse is a single-story, Neo-Classical stucco building. It features a rectangular floor plan, a flat roof and an inset porch with a pair of Doric columns. Presently unoccupied, State Parks Division hopes to eventually use this structure as an interpretation center for Diamond Head State Park.

#### The fortifications:

2. Battery Harlow is a massive reinforced concrete structure imbedded into the rear of Diamond Head. Built in 1910, it has three large bunkers which are separated by "courtyards" that served as platforms from which eight 12-inch mortars were fired. The central bunker has a command post on top. The entire structure is made of reinforced concrete and many of its openings have metal doors or barred windows. The command post is abandoned, but the bunkers are used by the National Guard and State Department of Defense for storage purposes.

3-4. Also located on the rear of Diamond Head, near the rim of the crater are Batteries Hulings and Dodge, which were completed in October 1915. These reinforced concrete structures tunnel through the wall of the crater and each contains one small room. The gun platforms are on the exterior wall of the crater. Originally these batteries were armed with 4.7 inch guns. They are no longer in use and their interior passageways have iron gates in front of them. The rear platforms have been sealed off on the exterior with hollow tile blocks.

5. Also dating from 1915 are a dozen 6 pound gun emplacements which are located along the rim of the crater. These are simple concrete slabs with eye rings which helped keep the weapons in place. These were installed to protect the batteries against ground attack.

6. Battery Birkhimer is located on the floor of the crater, near the rear. It also is made of reinforced concrete and primarily lies beneath the ground. Only its concrete portals are visible from the surface. This battery has been recycled and presently serves as office space for the State Department of Defense. Completed in 1916, this battery originally was armed with four 12-inch mortars.

7. Battery 407 was started in 1943 and completed near the end of World War II. Located on the front of Diamond Head, it has tunnels which go through the walls of the crater. Originally armed with two 8-inch guns, this battery is now sealed by large iron doors and used by the Civil Defense Division for storage.

8. The four-story fire control tower located at the top of Leahi was built between 1908-1910. It is reached by a trail which terminates at the 560 foot elevation. Here a forty foot concrete stairway leads to a 225 foot long tunnel. At the tunnel's upper portal a long concrete staircase of 99 steps leads to another tunnel which opens out on the south face of Diamond Head. At the outer end this tunnel widens to form the lowest of four levels of fire control stations. From this floor a vertical shaft with a helical iron staircase allows for further vertical circulation. The four levels are reinforced with I-beams and the interiors are lined with concrete. Each station has 12-inch high observation slots, which originally were protected by moveable steel shutters. Some of these shutters are still intact. The exterior of this complex is camouflaged with rubble embedded in concrete, paint and rock dust.

From this elaborate fire control station all the guns along the leeward coast could be commanded. The lowest level was for Battery Randolph at Fort DeRussy. The next station above served both Randolph and Dudley at DeRussy. The third level commanded Battery Harlow at Fort Ruger and the top level was the battle commander's station. From this vantage point, 761 feet above sea level, the battle commander could view the coast from Koko Head to Waianae.

United States Department of the Interior  
National Park Service

**National Register of Historic Places  
Inventory--Nomination Form**

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Besides this major fire control tower, three smaller concrete stations were constructed along the front rim of Diamond Head.

Other structures which are included within this district because of their associations with the fortifications include:

9. A winch and cable which sit on a concrete platform along the trail to the fire control stations. This was used to transport materials in the construction of the fire control stations.
10. A tunnel through the rear wall of the crater near Battery Harlow. Originally this tunnel was 580 feet in length, eight feet in width and seven feet high. It allowed a mule-pulled train to transport materials into the crater for the construction of the fire control tower. This tunnel has been expanded several times, and is still considered significant for its associations with the construction of the fire control tower despite its loss of physical integrity.

Another tunnel also penetrates Diamond Head's walls. It presently provides vehicular access to the crater. It is not included in this district nomination because it was built during World War II.

**8. Significance**

<b>Period</b>	<b>Areas of Significance--Check and justify below</b>
<input type="checkbox"/> prehistoric	<input type="checkbox"/> archeology-prehistoric
<input type="checkbox"/> 1400-1499	<input type="checkbox"/> archeology-historic
<input type="checkbox"/> 1500-1599	<input type="checkbox"/> conservation
<input type="checkbox"/> 1600-1699	<input type="checkbox"/> economics
<input type="checkbox"/> 1700-1799	<input checked="" type="checkbox"/> education
<input type="checkbox"/> 1800-1899	<input checked="" type="checkbox"/> engineering
<input type="checkbox"/> 1900-	<input type="checkbox"/> exploration/settlement
	<input type="checkbox"/> commerce
	<input type="checkbox"/> communications
	<input type="checkbox"/> landscape architecture
	<input type="checkbox"/> law
	<input type="checkbox"/> literature
	<input checked="" type="checkbox"/> military
	<input type="checkbox"/> music
	<input type="checkbox"/> philosophy
	<input type="checkbox"/> politics/government
	<input type="checkbox"/> religion
	<input type="checkbox"/> science
	<input type="checkbox"/> sculpture
	<input type="checkbox"/> social/humanitarian
	<input type="checkbox"/> theater
	<input type="checkbox"/> transportation
	<input type="checkbox"/> other (specify)

Specific dates 1909-1921

Builder/Architect

N/A

Statement of Significance (in one paragraph)

The structures included in the Fort Ruger historic district are significant as tangible reminders of the U. S. Army's presence at Diamond Head crater. These structures are associated with the role of the coast artillery system on Oahu.

Fort Ruger is significant in the history of the military in Hawaii as the first coastal defense fortification established by the United States Army in the Islands. Between 1909-1921, Fort Ruger served as the headquarters for the Coast Defenses of Oahu. Of the forts which comprised the Artillery District of Honolulu, it remains the most intact. As such, it is the best reflection of this aspect of the military's presence in Hawaii.

Following the United States' annexation of Hawaii, Guam and the Philippines, a question arose as to what the nation's defense strategy would be for the Pacific. During the opening years of the twentieth century two major viewpoints developed; the one favored a close-in naval defense system with Pearl Harbor as the major Pacific base, while the other advocated a forward naval defense strategy with Manila as the hub of operations. President Theodore Roosevelt, in his 1905 address to Congress, settled this issue by designating Hawaii, "the most important point in the Pacific to fortify in order to conserve the interests of this country."<sup>1</sup> This proclamation was based upon the fact that the effective range of a naval fleet was approximately 1500 miles, making the occupation of Hawaii a prerequisite for any enemy invasion of the west coast of America.

The Secretary of War's Report for 1906 provided the basis for the establishment of coast artillery units in Hawaii to protect both Honolulu and Pearl Harbor, the only significant deep water ports in the territory, and in 1909 War Department Government Order No. 74 established the Artillery District of Honolulu which consisted of Fort Ruger, DeRussy, Kamehameha, and Armstrong. Fort Ruger, named in honor of Major General Thomas H. Ruger, a Civil War veteran and former superintendent of the U.S. Military Academy and Commandant of the Command and General Staff College, was until 1913 the only coastal artillery fort garrisoned, and until 1921 served as the headquarters for the Coast Defenses of Oahu.

The 105th and 159th Coastal Artillery Companies occupied Fort Ruger on August 14, 1909, living in tents and temporary quarters. On March 17, 1910, Battery Harlow, which the companies from Fort Ruger manned, was turned over to the Coast Artillery. It was the first of the coast defense

<sup>1</sup> A History of Fort Shafter 1898-1974, p. 1



United States Department of the Interior  
National Park Service

**National Register of Historic Places  
Inventory—Nomination Form**

Continuation sheet

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works to be completed by the Honolulu Resident Engineer. The construction of permanent buildings at the fort was commenced on April 1, 1911 and additional buildings were erected during and immediately following World War I. The conclusion of World War II and the advent of nuclear and missile warfare made the coastal batteries obsolete. Thus in December 1955 the majority of the land was turned over to the State of Hawaii.

The four-story fire control station at the peak of Leahi is of special importance. It is the most elaborate structure of its kind in the United States as most fire control stations are simple free-standing towers built of metal. Major E. E. Winslow, who graduated first in West Point's class of 1889, was responsible for its design and construction.

**9. Major Bibliographical References**

Manuscripts at Fort Ruger:  
A History of the Hawaiian Department 1898-1933  
A History of Fort Shafter 1898-1974  
History of the United States Army in Hawaii 1849-1939  
Erwin Thompson's unpublished manuscript on the history of the Army Corps of Engineers in Hawaii.

**10. Geographical Data**

Acres of nominated property approximately 287.5 acres

Quadrangle scale 1:24000

Quadrangle name Honolulu

UMT References

Zone	East	North	East	North
A	04	10	04	10
B	04	10	04	10
C	04	10	04	10
D	04	10	04	10
E	04	10	04	10
F	04	10	04	10
G	04	10	04	10

Verbal boundary description and justification  
This nomination includes a portion of the lands designated by TMS 3-1-42: 6 and 20 as indicated by the enclosed map labeled "Fort Ruger Historic District."

List all states and counties for properties overlapping state or county boundaries

state	code	county	code

**11. Form Prepared By**

name title Don Hibbard and Nathan Napoka, architectural historian and historian

organization Department of Land and Natural Resources date March 20, 1980

street & number 1151 Punchbowl Street telephone (808) 548-6408

city or town Honolulu state Hawaii

**12. State Historic Preservation Officer Certification**

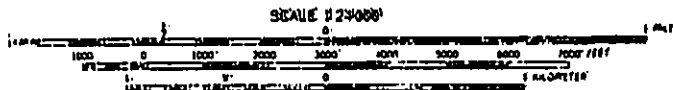
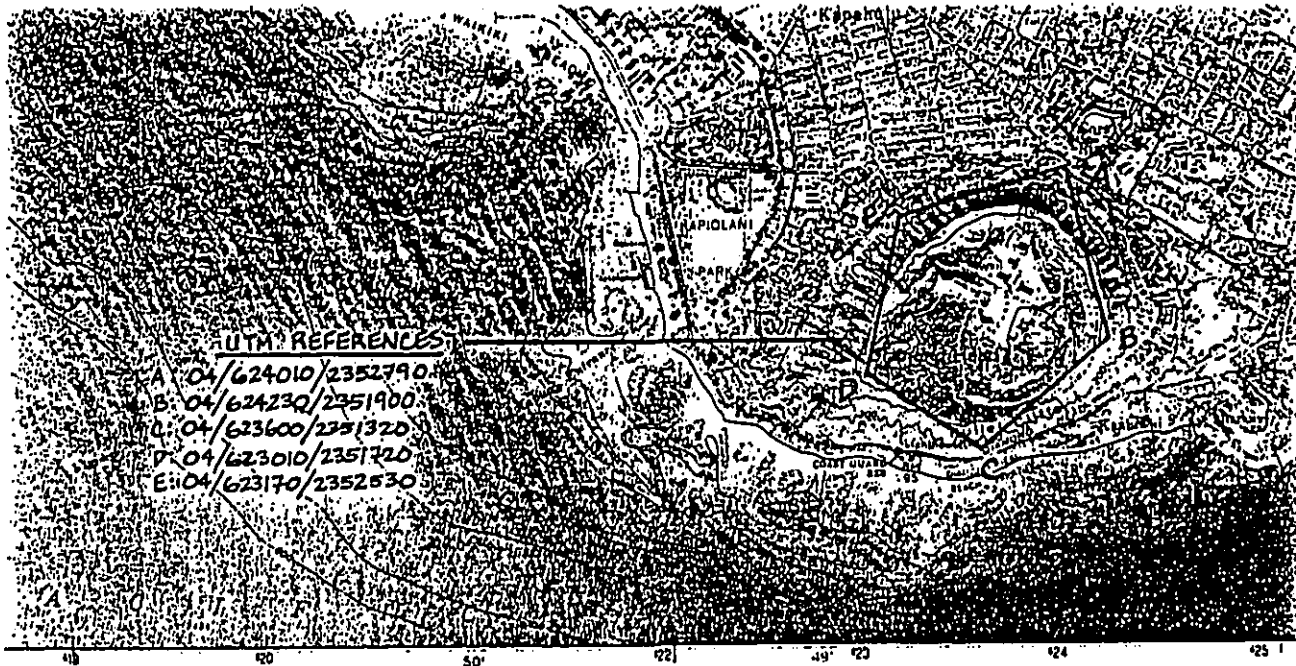
The evaluated significance of this property within the state is:

national  local

As the designated State Historic Preservation Officer for the National Historic Preservation Act of 1966 (Public Law 89-665), I hereby nominate this property for inclusion in the National Register and certify that it has been evaluated according to the criteria and procedures set forth by the National Park Service.

State Historic Preservation Officer signature

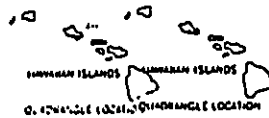
title	State Historic Preservation Officer	date
For NPS use only		
I hereby certify that this property is included in the National Register		
Keeper of the National Register		date
Attest		date
Chief of Registration		



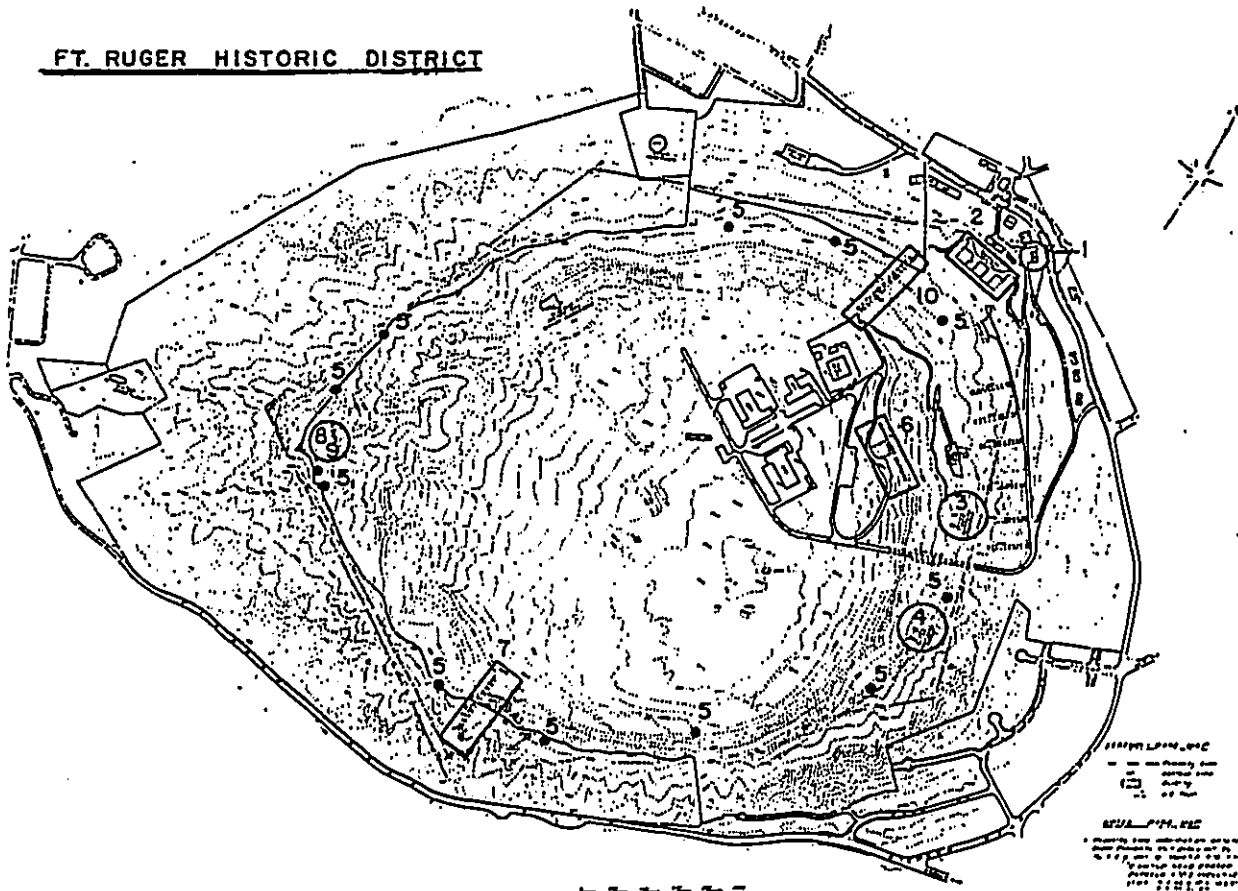
CONTOUR INTERVAL 40 FEET  
 DOTTED LINES REPRESENT 100 FT. CONTOURS  
 DATUM IS MEAN SEA LEVEL

THIS MAP COMPLIES WITH NATIONAL MAP ACCURACY STANDARDS  
 FOR SALE BY U. S. GEOLOGICAL SURVEY, MENLO PARK, CALIF. 94025

FOR SALE BY U. S. GEOLOGICAL SURVEY, OFNVI II, COI GRADE 4125, ON WASHINGTON, D. C. 20542  
 A FURTHER DESCRIPTION OF THIS MAP AND SYMBOLS IS AVAILABLE ON REQUEST



**FT. RUGER HISTORIC DISTRICT**



**FIGURE 1**  
 Existing Crater Improvements

STYLING, INC.  
 1. Contour lines are shown at 40-foot intervals.  
 2. Dotted lines represent 100-foot contours.  
 3. Contour interval is 40 feet.  
 4. Datum is Mean Sea Level.  
 5. Contour lines are shown at 40-foot intervals.  
 6. Dotted lines represent 100-foot contours.  
 7. Contour interval is 40 feet.  
 8. Datum is Mean Sea Level.

RODOLPH L. CAULEY  
GOVERNOR OF HAWAII

JAN - 6 1999



STATE OF HAWAII

December 22, 1998 DEPARTMENT OF LAND AND NATURAL RESOURCES

HISTORIC PRESERVATION DIVISION  
Litchburn Building, Room 555  
1550 Ala Moana Boulevard  
Honolulu, Hawaii 96813

Mr. Vincent Shigekuni  
PBR Hawaii  
1001 Bishop Street  
650 Pacific Tower  
Honolulu, Hawaii 96813-3429

Dear Mr. Shigekuni:

**SUBJECT: Chapter 8E-8 Historic Preservation Review of an Archaeological Assessment of Diamond Head State Monument Waikiki, Kona, O'ahu**  
**IMK: 3-1-042: Vairious**

LOG NO: 22690 ✓  
DOC NO: 9812SC14

MICHAEL S. WILCOX, CHAIRPERSON  
BOARD OF LAND AND NATURAL RESOURCES

DEPUTY  
GILBERT COLUCCI-AGAJAN  
TIMOTHY L. JOHNS

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

Thank you for the opportunity to comment on the archaeological assessment prepared for the updated Diamond Head State Monument master plan (*Exploring a Backdrop to Waikiki's Past: Historical Research and Archaeological Assessment of Diamond Head State Monument, O'ahu, 1998*, IARIH). We apologize for our late response to you; our office's recent move to Kapolei caused a temporary suspension of correspondence. We regret any inconvenience to you caused by this unavoidable delay.

In general, we believe that the archaeological assessment provides an excellent background to the historic and archaeological properties of Diamond Head State Monument. We concur with the recommended assessments of cultural sensitivity for regions within the monument, and believe that an inventory survey based on these assessments will likely produce an acceptable report of findings. We would only recommend that the inventory survey also include a re-assessment of the properties previously listed in the Fort Ruger Historic District.

Should you have any questions, please feel free to call Sara Collins at 692-8026.

Aloha,

DON HIBBARD, Administrator  
State Historic Preservation Division

SC:jk

c: Gary Gill, OEQC  
Myra Tomonari-Tuggle, IARIH



*Appendix E*

**Traffic Impact Analysis Report**



TRAFFIC IMPACT ANALYSIS

TRAFFIC IMPACT ANALYSIS

**DIAMOND HEAD STATE  
MONUMENT MASTER PLAN**

**DIAMOND HEAD STATE MONUMENT MASTER PLAN**

OAHU, HAWAII  
October 1998

Oahu, Hawaii

October 1998

Prepared For:  
PBR Hawaii, Inc.  
Pacific Tower, Suite 650  
1001 Bishop Street  
Honolulu, Hawaii 96813

Prepared By:  
Parsons Brinckerhoff Quade & Douglas, Inc.  
Pacific Tower - Suite 3000  
1001 Bishop Street  
Honolulu, HI 96813  
(808) 531-7094

**PB** PARSONS  
BRINCKERHOFF

*Over a Century of Engineering Excellence*

P80D Reference Number:  
16276A

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APPENDIX A: Traffic Count Data
APPENDIX B: Levels Of Service Definitions
APPENDIX C: Intersection Capacity Analysis Worksheets

## I. INTRODUCTION

This report documents the assumptions and methodology used to conduct a traffic impact assessment for the proposed Diamond Head State Monument (DHSM) Master Plan in Honolulu, Hawaii. Existing and projected Years 2003 and 2008 traffic conditions at key study area intersections were evaluated. As shown in Figure 1, the study area for the traffic impact assessment is defined as the segment of Diamond Head Road between the Fort Ruger Cannon Club entrance and 18th Avenue.

In addition to the current function as a natural resource, the Federal Aviation Administration (FAA) Operations Center, Hawaii National Guard facilities, and the Emergency Operations Center (EOC) are located in Diamond Head crater. The FAA Operations Center will be relocating to a site adjacent to the Honolulu International Airport in the near future, and the Hawaii National Guard facilities will eventually be relocated elsewhere. The EOC plans to remain in Diamond Head crater.

A previous master plan was developed for the DHSM in 1979, and this was adopted in 1992 as the official document directing the future development of the DHSM. This master plan proposed improvements within the crater including a visitor center and other facilities.

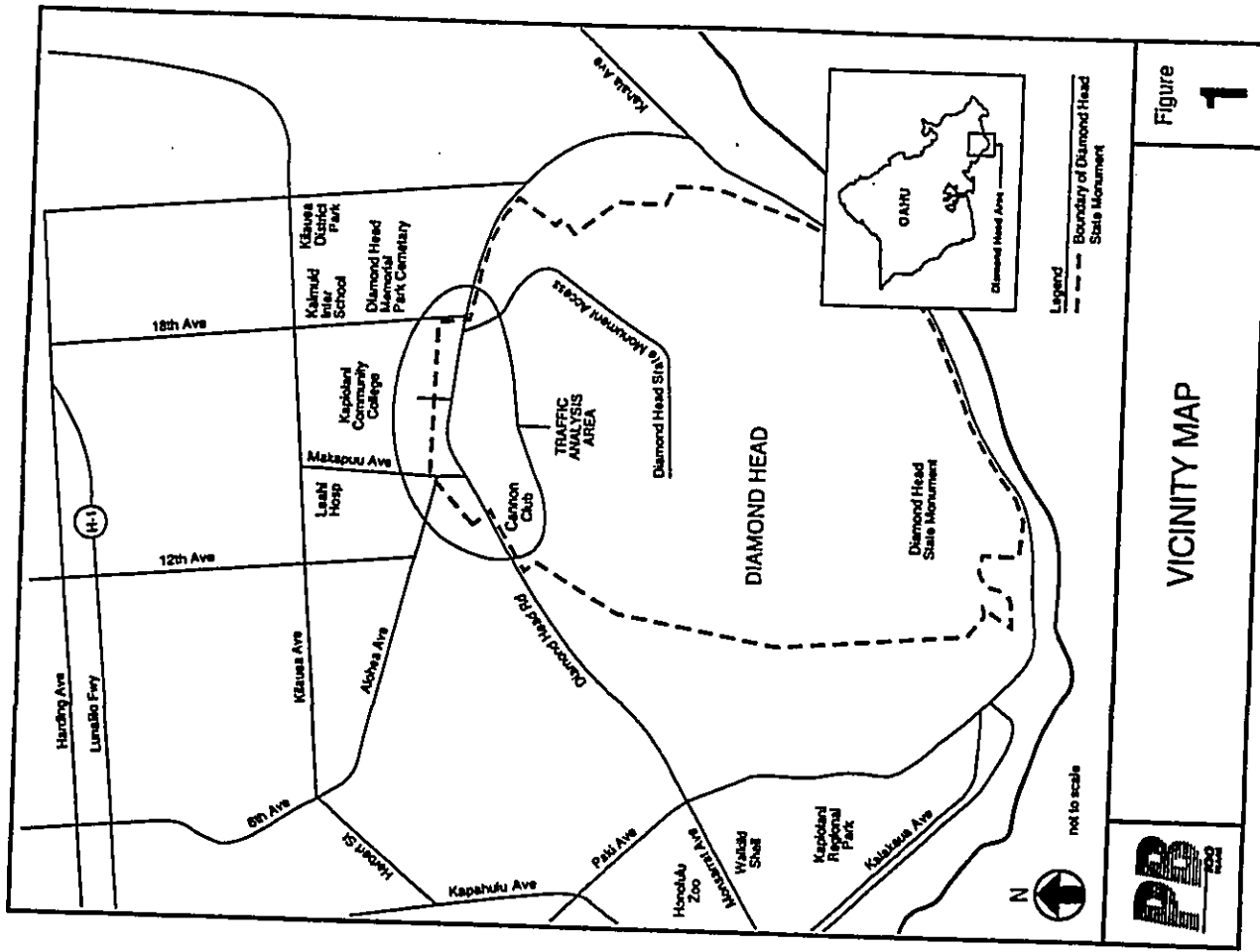
The 1979 master plan is now undergoing review and update by the State of Hawaii Department of Land & Natural Resources (DLNR). They are being advised by a Citizens Advisory Committee (CAC). The updated master plan for the DHSM is focused on the preservation of the crater as a natural resource, and modifications to crater access are being proposed to decrease the amount of vehicular activity in the crater.

Three alternatives were reviewed in this traffic impact assessment. The first, shown in Figure 2, reflects the access plan proposed for DHSM as part of the 1979 master plan. This master plan allows visitors to drive into Diamond Head crater. Figures 3 and 4 illustrate two alternatives that have emerged from the current master plan update process. The current master plan update favors parking visitor vehicles outside the Diamond Head crater and shuttling visitors into the crater using small trolleys. One of these alternatives would relocate the existing DHSM access to a point directly across the Kapoli Community College (KCC) driveway on Diamond Head Road. The relocated driveway

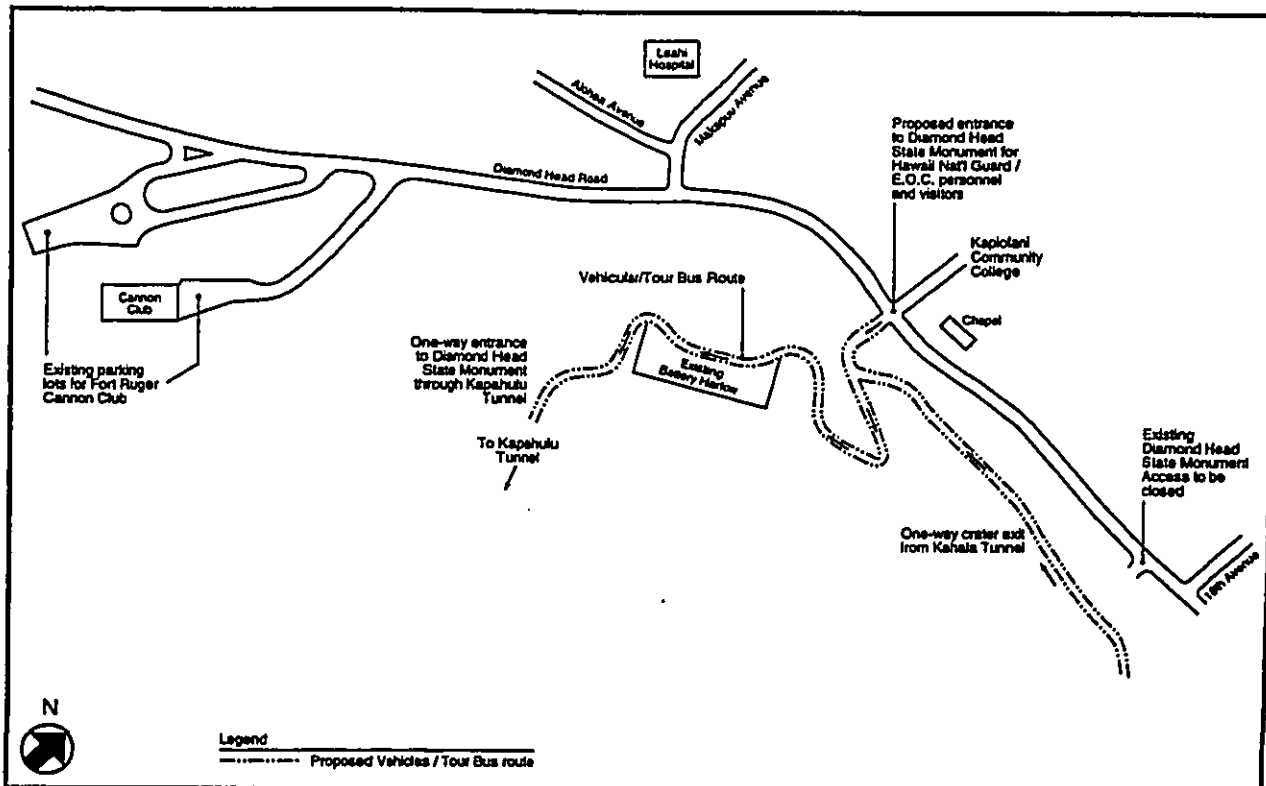
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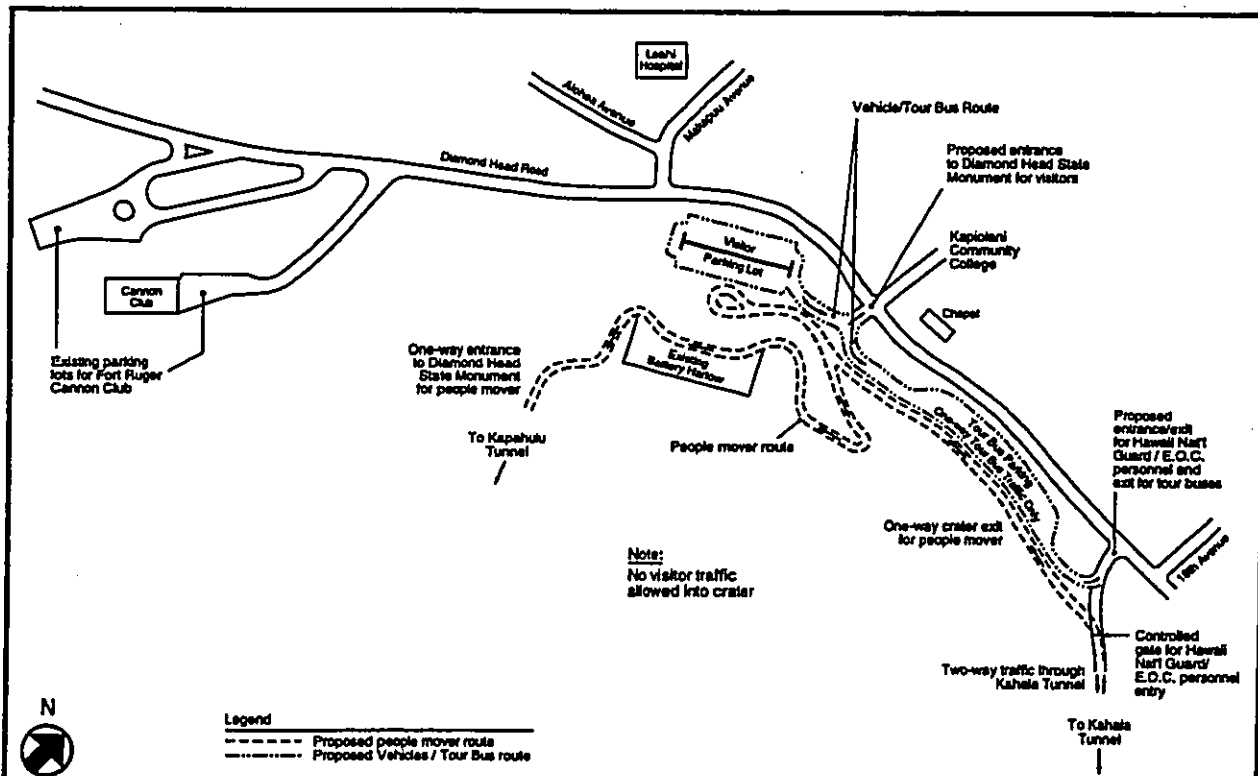






CONCEPTUAL SITE PLAN 1

Figure 2

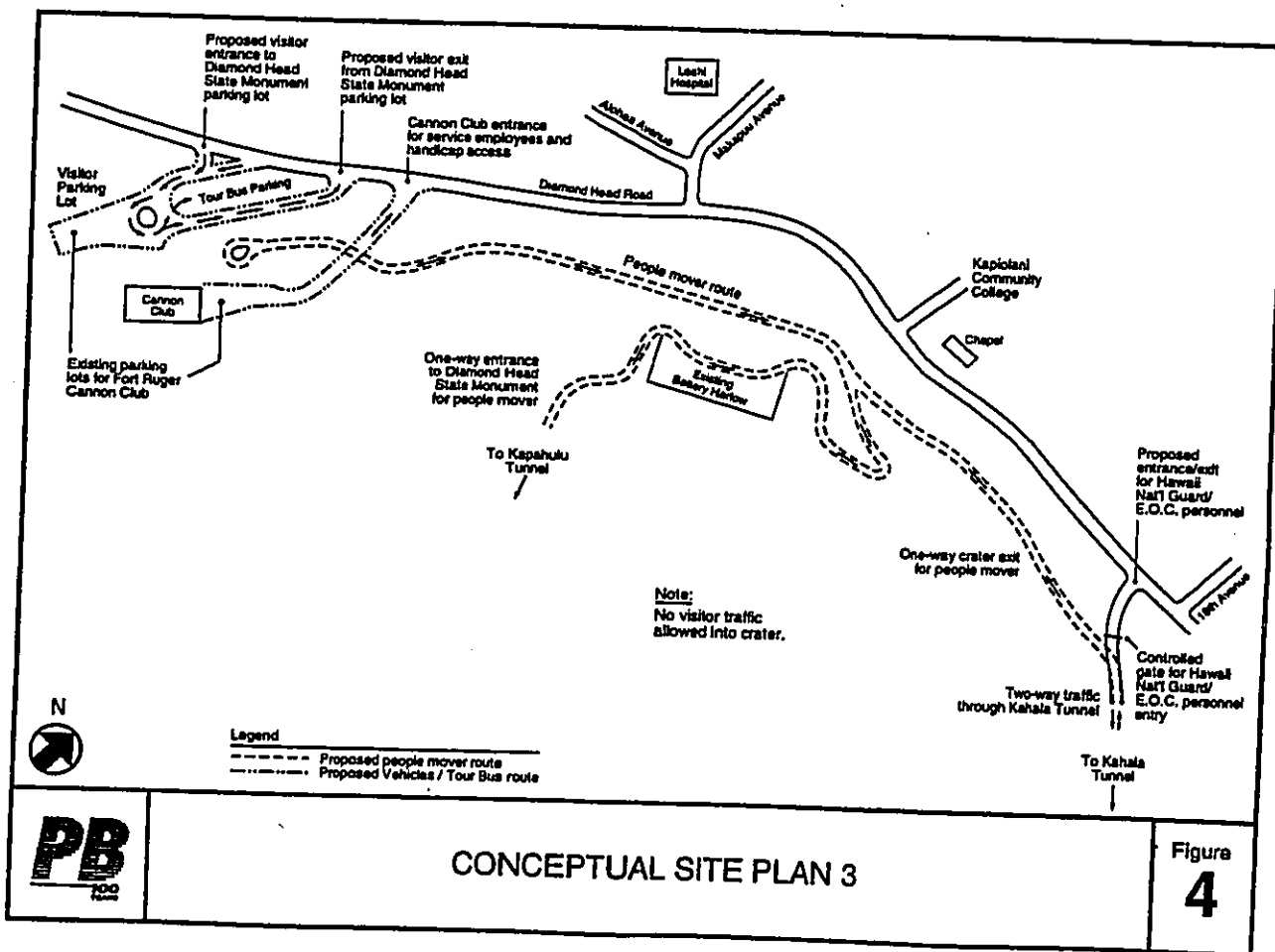


CONCEPTUAL SITE PLAN 2

Figure 3

would direct visitors into a parking lot, where they would transfer to a shuttle that would take them into the crater. The other alternative envisions the use of the currently vacant Fort Ruger Cannon Club parking lot as the site of the transfer to the internal shuttle.

Traffic operations at intersections within the study corridor were evaluated for the AM and PM peak hours of each of these alternatives. The existing, projected Year 2003, and projected Year 2008 time frames were evaluated. The Year 2003 and Year 2008 represent the 5 and 10-year time horizons.



## II. EXISTING CONDITIONS

### A. LAND USES

There are many different land uses in the study area. A primary land use is Kaplani Community College (KCC) located mauka (north) of Diamond Head Road between Makapuu Avenue and 18th Avenue. Kaimuki Intermediate School, Kilauea District Park, Diamond Head Memorial Park Cemetery, and a Hawaii National Guard facility are located northeast of DHSM. Leahi Hospital and Diamond Head Theater are located west of KCC along Makapuu Avenue. The Kaimuki and Waialae/Kahala residential communities are north and northeast of Diamond Head crater, and the area is located approximately two miles from Waikiki where tourists often walk or ride a bus to the DHSM.

The project area developments are mature, and significant additional development is not likely.

### B. TRAFFIC DATA COLLECTED

Traffic-related data were collected for each of the following study intersections along Diamond Head Road:

- Makapuu Avenue,
- KCC entrance,
- DHSM entrance, and
- 18th Avenue.

Traffic turning movement volumes, field observations of intersection operations, and general intersection characteristics were noted. Intersection geometry inventory included the following:

- Number of lanes,
- Sidewalk and crosswalk locations,
- Approach signing locations,
- Entrance and driveway locations.

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- Bus stop locations, and
- Posted speed limits.

These data were used as inputs into the intersection analyses. The existing roadway lane configurations are shown in Figure 5.

### C. EXISTING ROADWAYS

#### 1. Roadway System

Regional and sub-regional access to Diamond Head State Monument is provided primarily by a network of arterial and collector roadways. Access to the H-1 Freeway is provided by a combination of Campbell Avenue and Kapahulu Avenue and a combination of 18<sup>th</sup> Avenue, Kilauea Avenue, Hunakal Street, and Waialae Avenue. Access to Waikiki is provided primarily by Diamond Head Road/Monsarrat Avenue. Residential collector roadways within the Kaimuki area also provide secondary access.

#### Diamond Head Road

Diamond Head Road provides the primary access to the DHSM. Diamond Head Road also provides access to KCC and other non-residential uses in the area. It is a two-lane, two-way major collector that traverses the north, east, and south slopes of Diamond Head crater. It has a posted speed limit of 25 miles per hour (mph). Intersections in the vicinity of the DHSM are located at Makapuu Avenue, KCC Driveway, DHSM Access, and 18th Avenue. All intersections are unsignalized, T-intersections with stop-sign control on the intersecting street approaches.

#### Makapuu Avenue

Makapuu Avenue is a two-lane, undivided major collector that connects Kilauea Avenue to Diamond Head Road. The posted speed limit is 25 mph. Makapuu Avenue provides access to Leahi Hospital and to KCC parking lots.

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**Kapiolani Community College Access**

The entrance to KCC provides access to campus parking. The entrance is approximately 825 feet west of the DHSM access. Additional entrances to KCC are provided along Makapuu Avenue and Kilauea Avenue.

**Diamond Head State Monument Access**

The DHSM access is a two-lane, undivided roadway. The roadway passes through the wall of the crater via Kahala Tunnel. The posted speed limit of the access road is 10 mph and 5 mph through Kahala Tunnel.

**18th Avenue**

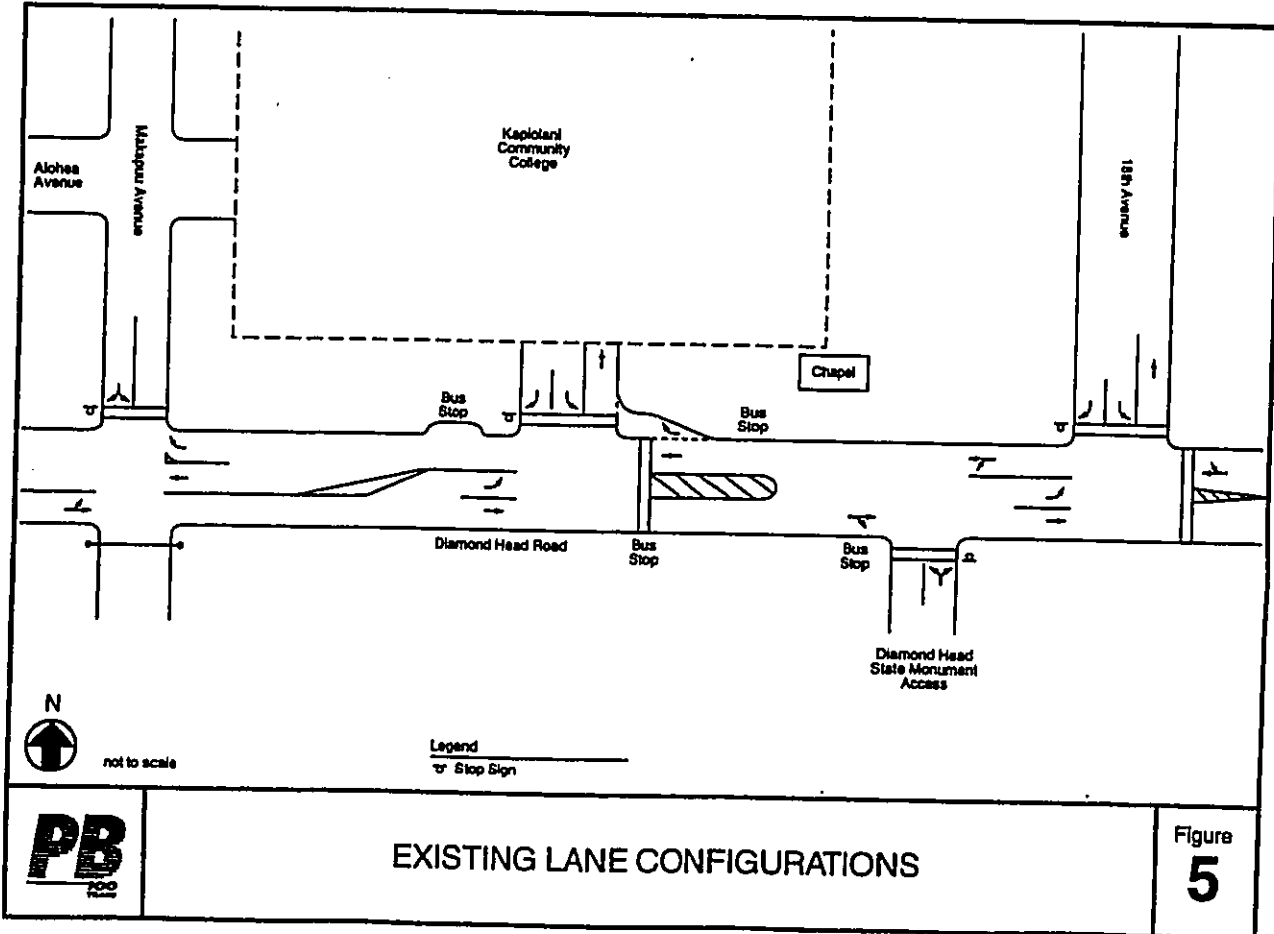
18th Avenue is a two-lane major collector between Diamond Head Road and Kilauea Avenue. North of Kilauea Avenue, 18th Avenue is a two-lane residential roadway. The posted speed limit is 25 mph.

**2. Roadway Geometry and Field Observations**

The following observations on roadway geometry and operations were made along Diamond Head Road:

**Makapuu Avenue**

Makapuu Avenue is a two-way stop controlled intersection at Diamond Head Road. An exclusive right-turn lane is provided for westbound Diamond Head Road. As illustrated in Figure 5, Makapuu Avenue is configured as a single lane approach at Diamond Head Road. When the traffic queue is short, the approach is wide enough that can operate as an exclusive right-turn lane and an exclusive left-turn lane. This widened area quickly narrows down to one lane, and, therefore, longer queues cause this intersection to function as a shared lane approach. There is an existing driveway across from Makapuu Avenue, but the driveway is closed to traffic.



#### Kapolei Community College Access

The KCC access creates a two-way, stop controlled intersection with Diamond Head Road. As illustrated in Figure 5, exclusive left-turn and right-turn lanes are provided along Diamond Head Road at the KCC entrance intersection. The KCC access approach is channelized into exclusive right-turn and left-turn lanes.

#### Diamond Head State Monument Access

The DHSM access intersection is located approximately 145 feet west of the 18th Avenue intersection on Diamond Head Road. This spacing is judged to be closer than desirable, and opportunities to relocate the DHSM access should be investigated.

The Kahala Tunnel along the DHSM access road is narrow, accommodating two-way traffic for regular vehicles. The tunnel cannot accommodate large vehicles in both directions simultaneously, because the tunnel walls curve inward, providing adequate vertical clearance only in the middle of the tunnel. Additionally, a significant number of pedestrians pass through the tunnel, and they walk in the roadway, creating safety concerns.

#### 18th Avenue

18th Avenue is a two-way stop controlled intersection at Diamond Head Road with exclusive right-turn and left-turn lanes. An exclusive left-turn lane is provided at 18th Avenue for eastbound Diamond Head Road.

#### Transit and Pedestrian Facilities

Crosswalks are provided at the following locations:

- North leg of Makapuu Avenue/Diamond Head Road Intersection,
- North and east legs of KCC access/Diamond Head Road Intersection,
- South leg of DHSM access/Diamond Head Road Intersection, and
- North and east legs of 18th Avenue/Diamond Head Road Intersection.

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Two eastbound and two westbound municipal bus stops are located along Diamond Head Road closest to the DHSM and KCC driveways. There are significant pedestrian crossings of Diamond Head Road to reach the westbound bus stop located across from the DHSM driveway, but crosswalks are not provided. As shown in Figure 5, a bus pull-out is also provided west of the KCC entrance.

Attached sidewalks are present on both sides of Diamond Head Road, but the sidewalk along eastbound Diamond Head Road is narrow with an approximate three foot width. Utility poles are located within the sidewalk area and reduce the width even more.

#### D. EXISTING TRAFFIC VOLUMES

Traffic turning movement counts were conducted at the four study intersections on Thursday, May 7, 1998. KCC and Kaimuki Intermediate School were in session when the counts were taken. The resulting AM and PM peak hours were 7:00 to 8:00 AM and from 4:00 to 5:00 PM, respectively. Figure 6 shows the existing peak hour traffic volumes for each turning movement at these intersections. Existing traffic count data can be found in Appendix A.

#### E. EXISTING INTERSECTION OPERATIONS

Operations of the each study intersection were analyzed to identify existing intersection operational characteristics. The intersections were analyzed using the methodologies for unsignalized intersections outlined in the 1994 Highway Capacity Manual (HCM). Operating conditions at an intersection are expressed as a qualitative measure known as Level of Service (LOS) ranging from A to F. LOS A represents free-flow operating conditions, while LOS F represents congested conditions. The overall intersection LOS is a weighted average of the LOS of individual traffic movement groups. Appendix B has more detailed definitions of intersection LOS.

In addition to traffic volumes, intersection analyses included data such as peak hour factors, truck percentages, and roadway grades. Table 1 displays the existing conditions level of service for each intersection.

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On Tuesday, August 25, 1998, an intersection stopped-delay study was completed for the southbound exclusive right-turn lane at the 18th Avenue/Diamond Head Road Intersection. Area schools were in session when the study was completed. The results indicated that the average delay experienced in the lane was approximately 18 seconds per vehicle (sec/veh). The delay of the movement was adjusted according to these field observations (see Appendix A), and the adjustment worksheets are included in Appendix C.

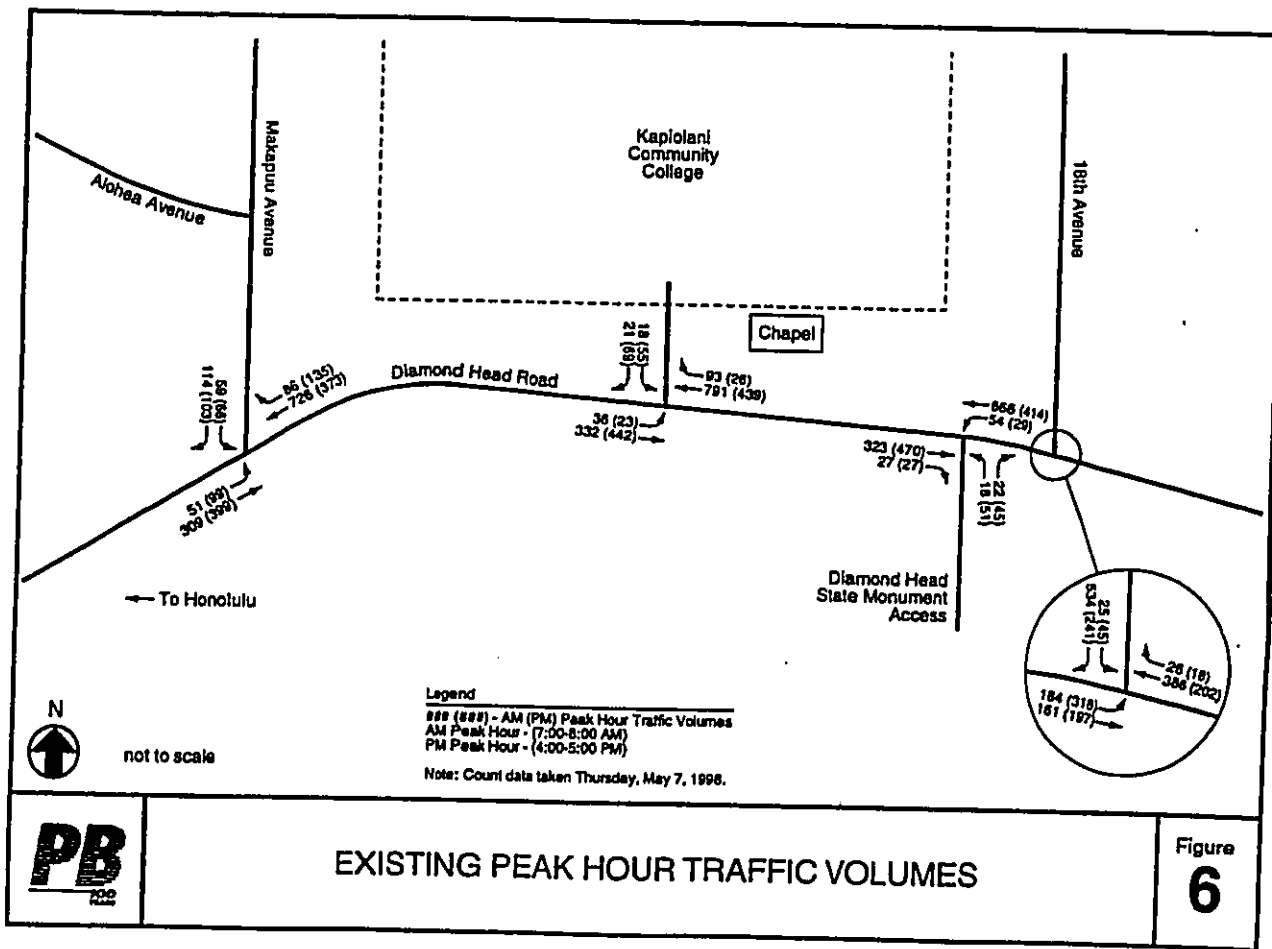
Figure 7 shows these intersection levels of service with existing lane configurations, and Appendix C includes all of the existing analysis worksheets.

Table 1

Existing Conditions Level of Service Summary

Intersection	AM Peak Hour LOS	PM Peak Hour LOS	Delay (sec)
Diamond Head Road/Makapuu Avenue	A	2.6	A
SB Left	E	36.2	D
SB Right	B	8.7	A
EB Left	B	6.3	A
Diamond Head Road/KCC Access	A	0.7	A
SB Left	D	28.6	C
SB Right	B	8.2	B
EB Left	B	6.6	A
Diamond Head Road/DHSM Access	A	0.9	A
NB Left and Right	D	26.1	C
WB Left	A	3.7	A
Diamond Head Road/18th Avenue	B	8.6	A
SB Left	D	24.3	C
SB Right	C	18.1	B
EB Left	B	5.6	A

Note: NB- northbound, SB-southbound, EB- eastbound, WB- westbound



**F. ANALYSIS RESULTS**

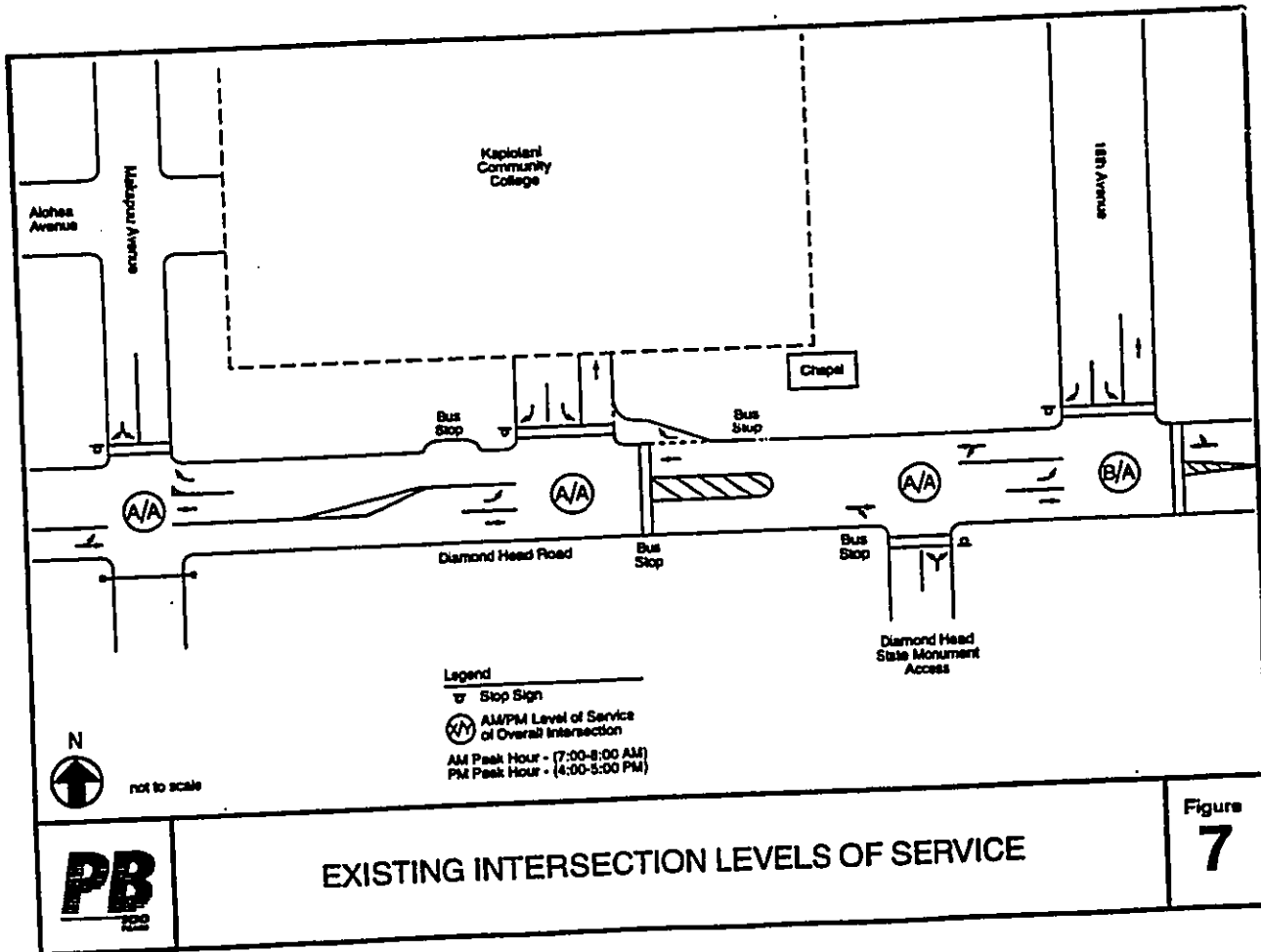
The intersections operate well overall at LOS A and B. The delays of most movements are minimal. However, the left-turns from side streets along Diamond Head Road experience moderate delays in the AM peak hour with LOS D and E.

At the intersection of Diamond Head Road and 18th Avenue, the southbound right-turn lane experience delays during the AM peak hour due to the magnitude of the right-turn demand. Although the left-turn volumes are not large, an LOS D results due to the lack of available gaps in the traffic flow along Diamond Head Road. The other movements at the intersection experience minimal delays during both peak hours.

Eastbound traffic turning left onto 18th Avenue in the PM peak hour is similar to the southbound traffic turning right onto Diamond Head Road in the AM peak hour. This traffic pattern indicates that the trips are probably work-related. Existing AM peak hour volumes at this intersection satisfy the peak hour traffic volume signal warrant as defined by the *Manual on Uniform Traffic Control Devices for Streets and Highways*, Federal Highway Administration, 1988.

As shown in Table 1, the southbound left-turn movement at the intersection of Makapuu Avenue and Diamond Head Road experiences LOS E and D in the AM and PM peak hours, respectively. The delay is caused by infrequent gaps in traffic flow along Diamond Head Road. Existing AM peak hour volumes at this intersection satisfy the peak hour traffic volume signal warrant as defined by the *Manual on Uniform Traffic Control Devices for Streets and Highways*, Federal Highway Administration, 1988.

The accesses to KCC and DHSM operate well overall although the left-turns onto Diamond Head Road result in LOS D and C during the AM and PM peak hours, respectively. The left-turns from both accesses have a more difficult time entering the major street traffic flow than other movements, a common finding with unsignalized intersections. However, the traffic volumes exiting KCC and DHSM are not large compared to the through traffic volumes along Diamond Head Road, and the delays experienced by the side streets are moderate. Similar to the other intersections, Diamondhead Road experiences LOS A and B with minimal delays in both peak hours.



**C. ANALYSIS SUMMARY**

The existing conditions intersection level of service analysis shows that the intersections in the project vicinity operate acceptably overall. During the peak hours, left turns out of Makapuu Avenue and 18<sup>th</sup> Avenue experience delay. Because the magnitude of traffic demand for these movements are relatively low, and because the delay occurs only during the peak hours, this situation may be acceptable. Should there be a community desire to provide traffic signal control, both the Makapuu Avenue and 18<sup>th</sup> Avenue approach volumes satisfy the peak hour traffic volume warrant as defined by the *Manual on Uniform Traffic Control Devices*.

**III. FUTURE TRAFFIC CONDITIONS**

The DHSM master plan alternatives were evaluated for two future scenarios: Year 2003 representing a 5-year horizon and Year 2008 representing a 10-year horizon.

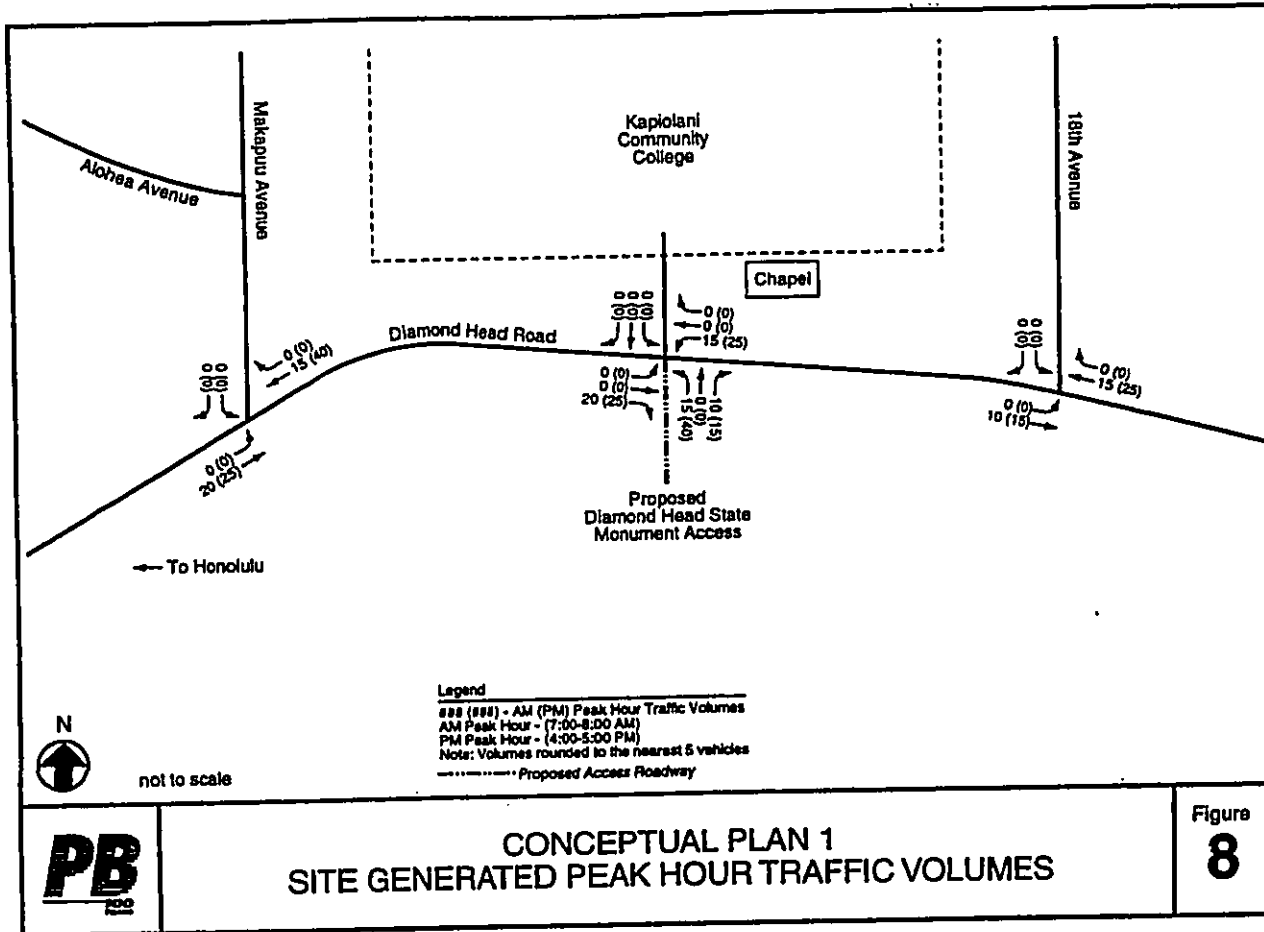
**A. FUTURE ROADWAYS**

The Years 2003 and 2008 roadways in the study area are assumed to retain the same configuration as existing conditions. Minor changes are assumed regarding access to the DHSM. As shown in Figures 2, 3, and 4, two of the conceptual plans include a DHSM access across from KCC along Diamond Head Road. The third conceptual plan focuses visitor operations at the existing Fort Ruger Cannon Club parking lot. In addition to the four intersections analyzed for the existing conditions, the operations of proposed accesses along Diamond Head Road were studied.

**B. TRIP GENERATION**

Existing DHSM visitor traffic was established through traffic counts by PBOD and vehicle classification and interview surveys conducted by SMS Research, Inc. Site-generated traffic was defined as DHSM visitor traffic. The level of future visitor activity was provided to this analysis effort after discussions between DLNR and the CAC. For Conceptual Plan 1, DHSM visitor traffic was assumed to remain the same as existing conditions. For Conceptual Plans 2 and 3, the number of visitors was assumed to decrease ten percent from existing conditions. These two Conceptual Plans propose to shuttle visitors into the crater with people movers as opposed to allowing them to drive into the crater. It was determined that restricting the ability of visitors to drive into the crater would reduce the number of visitors at DHSM. This effect is desirable, according to reports of DLNR and CAC discussions. The people mover transportation into the crater coupled with admission fees are designed to maintain the amount of visitors at a level that would not environmentally degrade the DHSM.





**C. TRIP DISTRIBUTION AND ASSIGNMENT**

The visitor traffic generated in Year 2003 and in Year 2008 was directionally distributed, and then the distributed traffic was assigned to the future roadway network according to each conceptual plan.

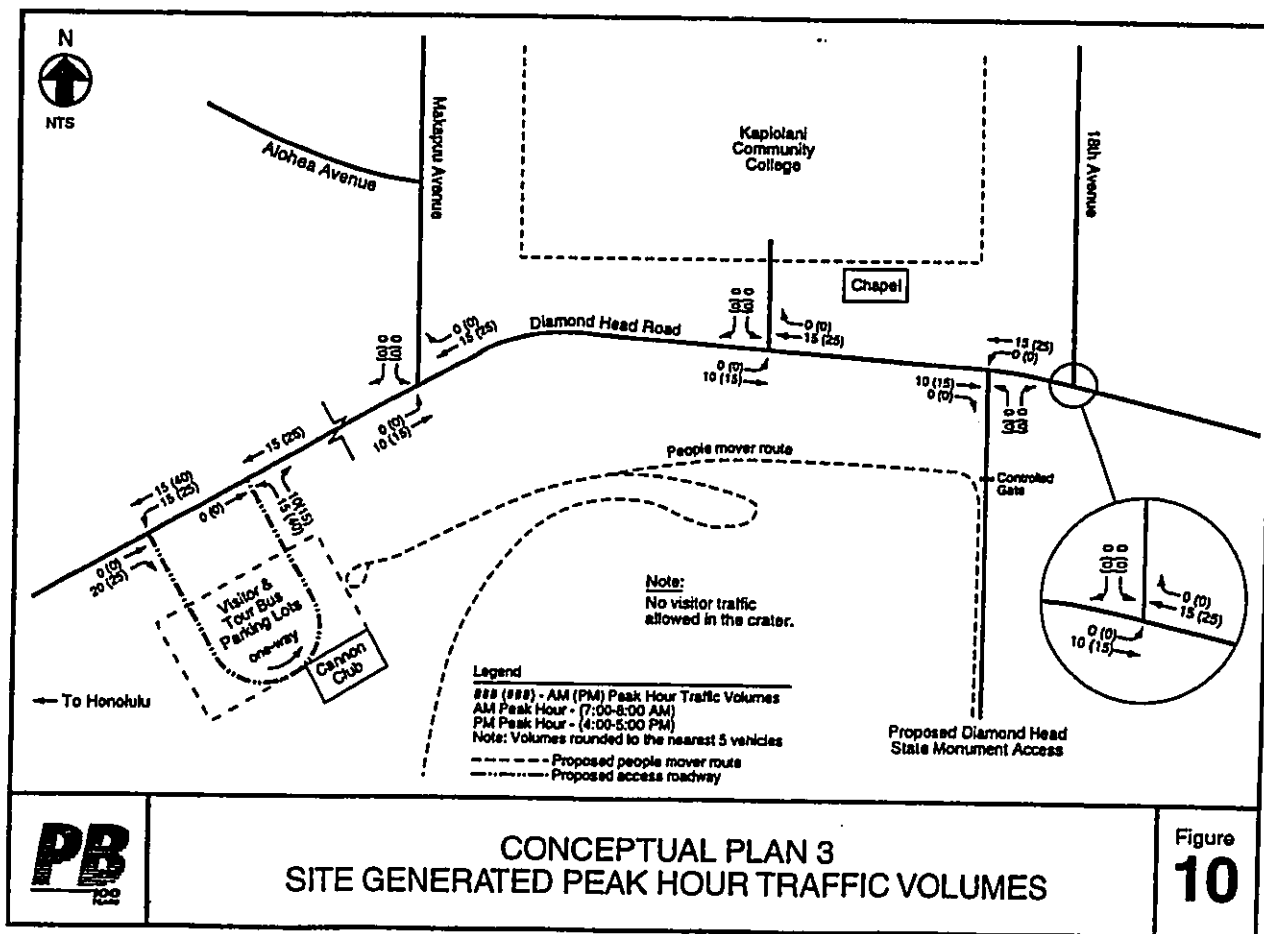
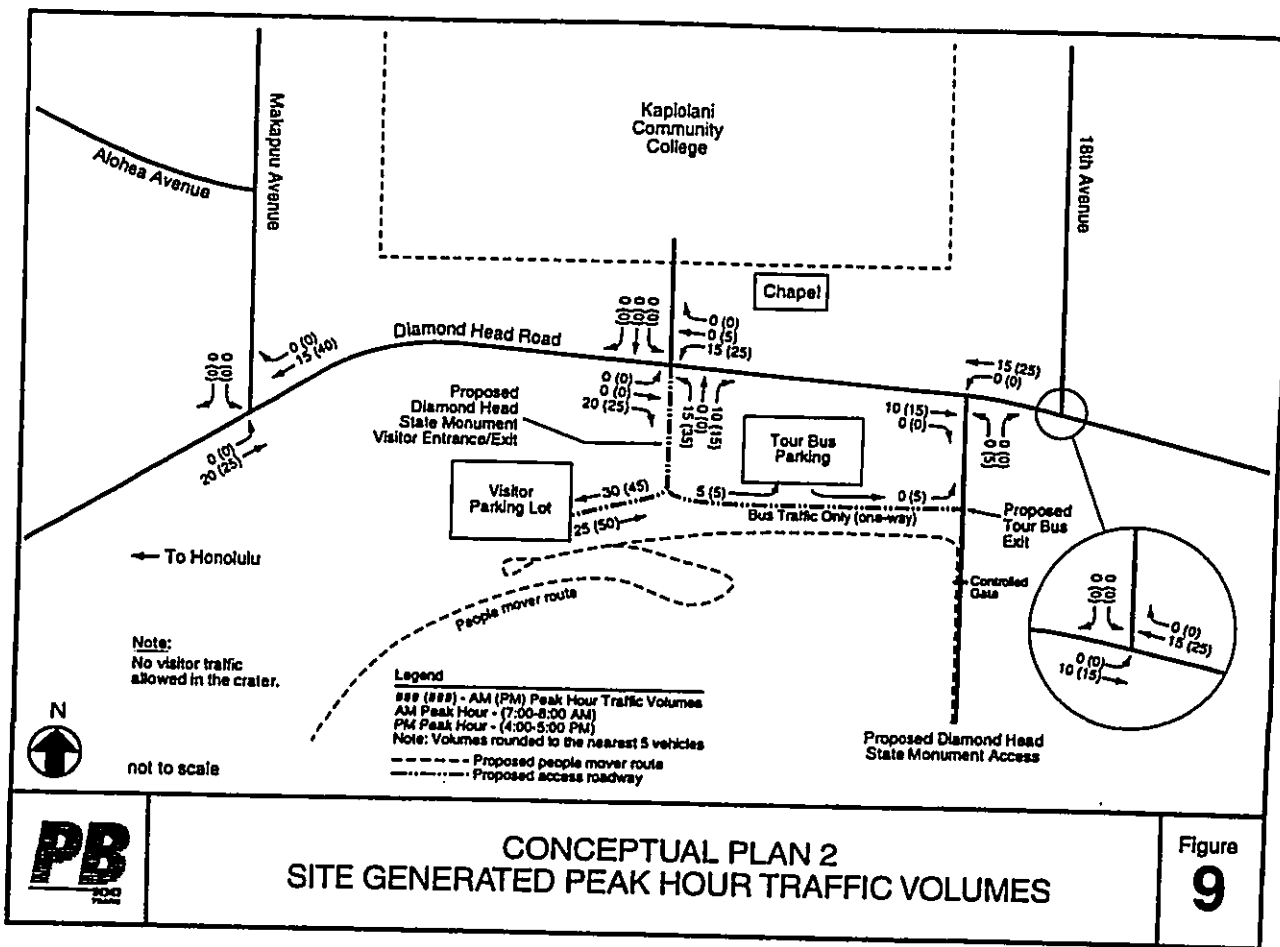
Based on May 14, 1998, observations by SMS Research, Inc., the AM peak hour visitor distribution was judged to be sixty percent to and from the west and forty percent to and from the east of DHSM access. It was assumed that most visitors in the AM peak hour would travel to and from Waikiki/Honolulu. In the PM peak hour, the incoming visitor distribution was assumed to be fifty percent from the east and fifty percent from the west. The outgoing visitor distribution in the PM peak hour was judged to be seventy-five percent to the west (Waikiki) and twenty-five percent to the east. It was judged that visitors in the PM peak hour could equally arrive at DHSM from any part of the island via Diamond Head Road, but the majority of visitors leaving DHSM would likely head west to return to Waikiki.

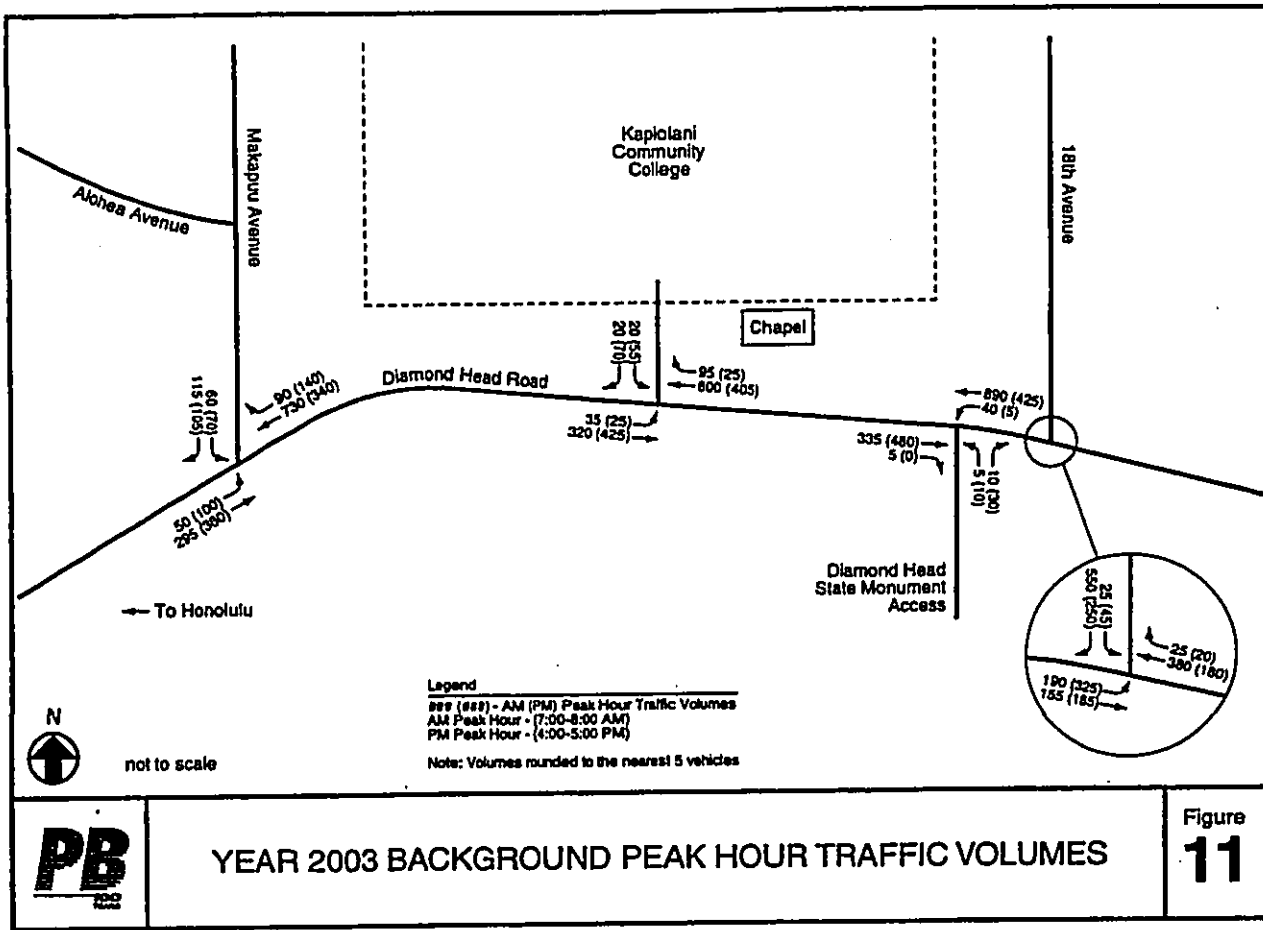
These distributions were applied to the visitor trips generated. As shown in Figures 8, 9, and 10, the visitor trips were assigned to the future roadway networks according to the three conceptual plans.

**D. BACKGROUND TRAFFIC**

The Years 2003 and 2008 background traffic volumes represent the projected non-visitor traffic at the intersections evaluated by this study. The background traffic volumes do include traffic from other Diamond Head uses such as the Hawaii National Guard (HNG) and Emergency Operations Center (EOC).

The background volumes were determined by first applying an annual growth rate of 0.5 percent to existing non-visitor volumes, excluding HNG and EOC traffic. The 0.5 percent annual growth factor was based on a review of volume growth on selected roadways documented in the City and County of Honolulu Waikiki Regional Traffic Impact Plan Summary Report (December 1995). The low growth rate is consistent with development of the area being mature, and significant new development is not expected to occur in the





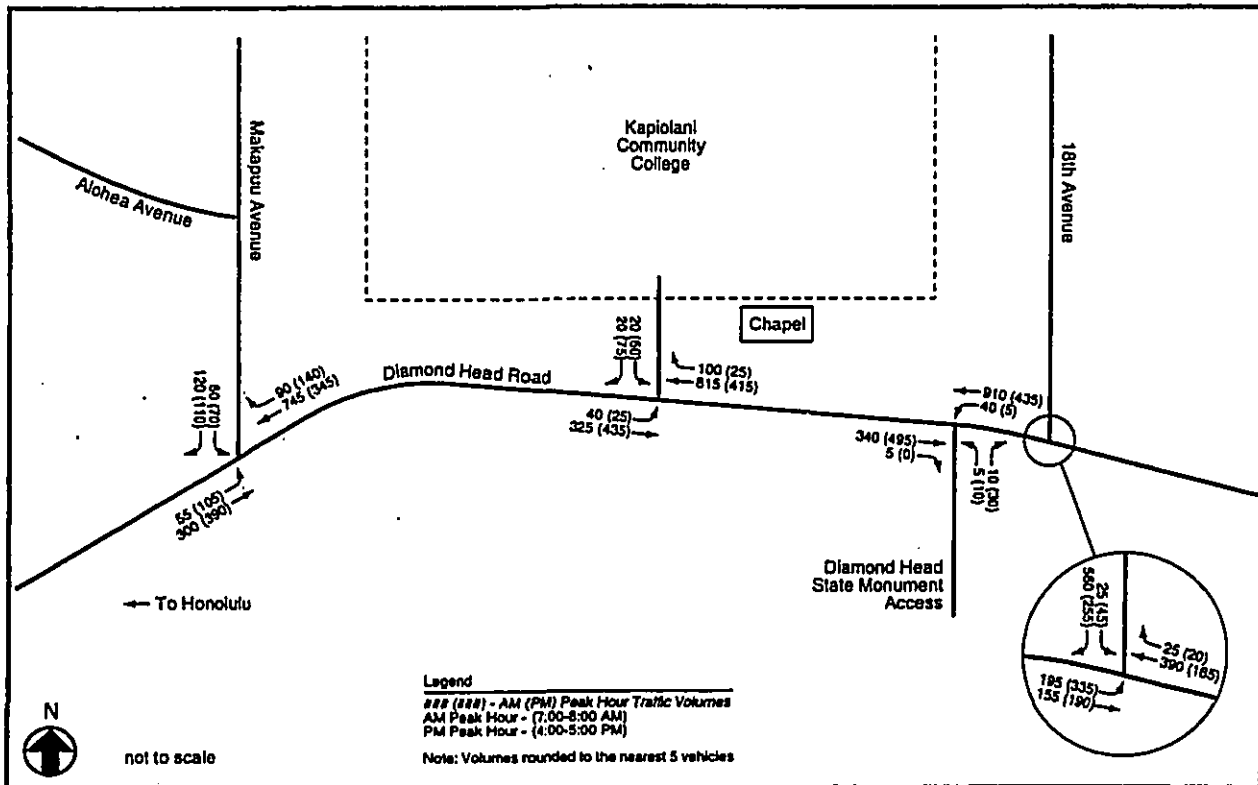
study area. The HNG and EOC traffic were assumed to remain constant within the future time frame evaluated and were, therefore, not growth factored. The HNG and EOC traffic were rerouted, however, to account for the different access schemes proposed by the alternative conceptual plans for the DHSM.

The directional distribution of HNG/EOC trips was derived from the difference between the existing visitor trips and total trips observed. In the AM peak hour, ninety percent of HNG/EOC trips were assumed to arrive and depart DHSM to the east, and ten percent was assumed to arrive and depart DHSM to the west. In the PM peak hour, approximately eighty percent of HNG/EOC trips were assumed to exit DHSM to the east, and the two HNG/EOC trips (one hundred percent) entering DHSM during the PM peak hour were assumed to originate from the east. It was assumed that most personnel would originate from the east, equally utilizing 18th Avenue and Diamond Head Road.

The HNG/EOC trips were added to the growth-factored components to obtain the total Year 2003 and Year 2008 background traffic volumes shown in Figures 11 and 12, respectively.

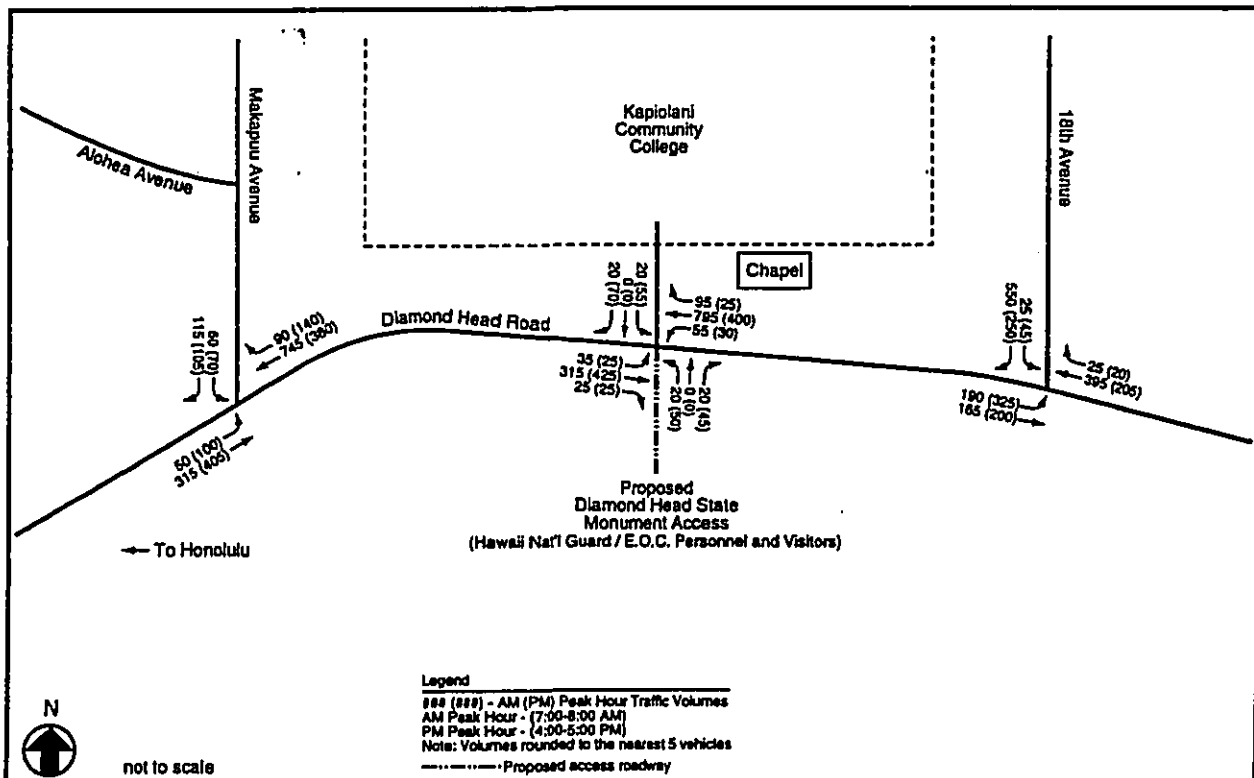
**E. TOTAL TRAFFIC**

The site-generated traffic was added to the projected background traffic to obtain the total peak hour traffic volumes for Years 2003 and 2008 for each of the three alternative conceptual plans as shown in Figures 13, 14, 15, 16, 17, and 18.



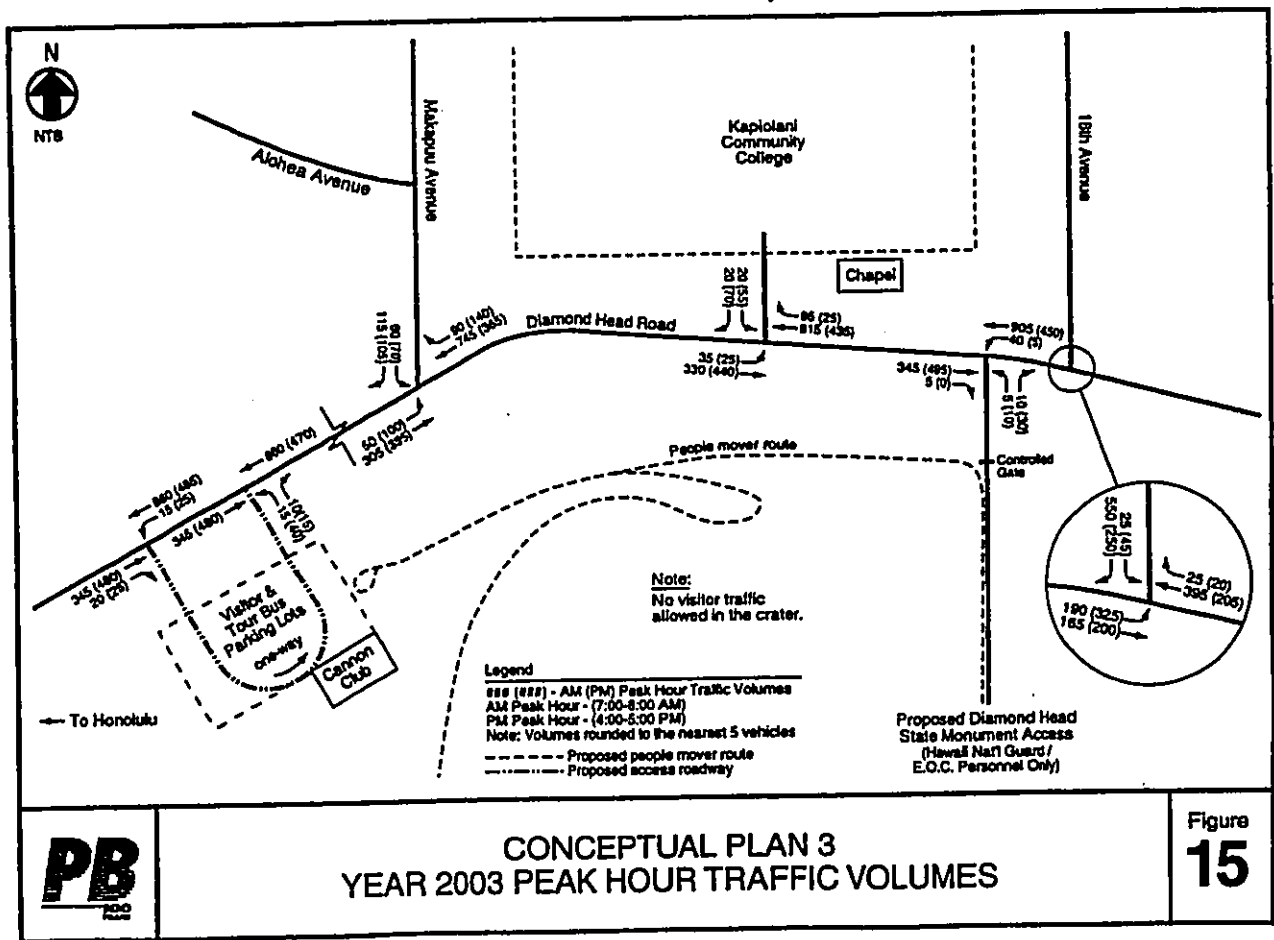
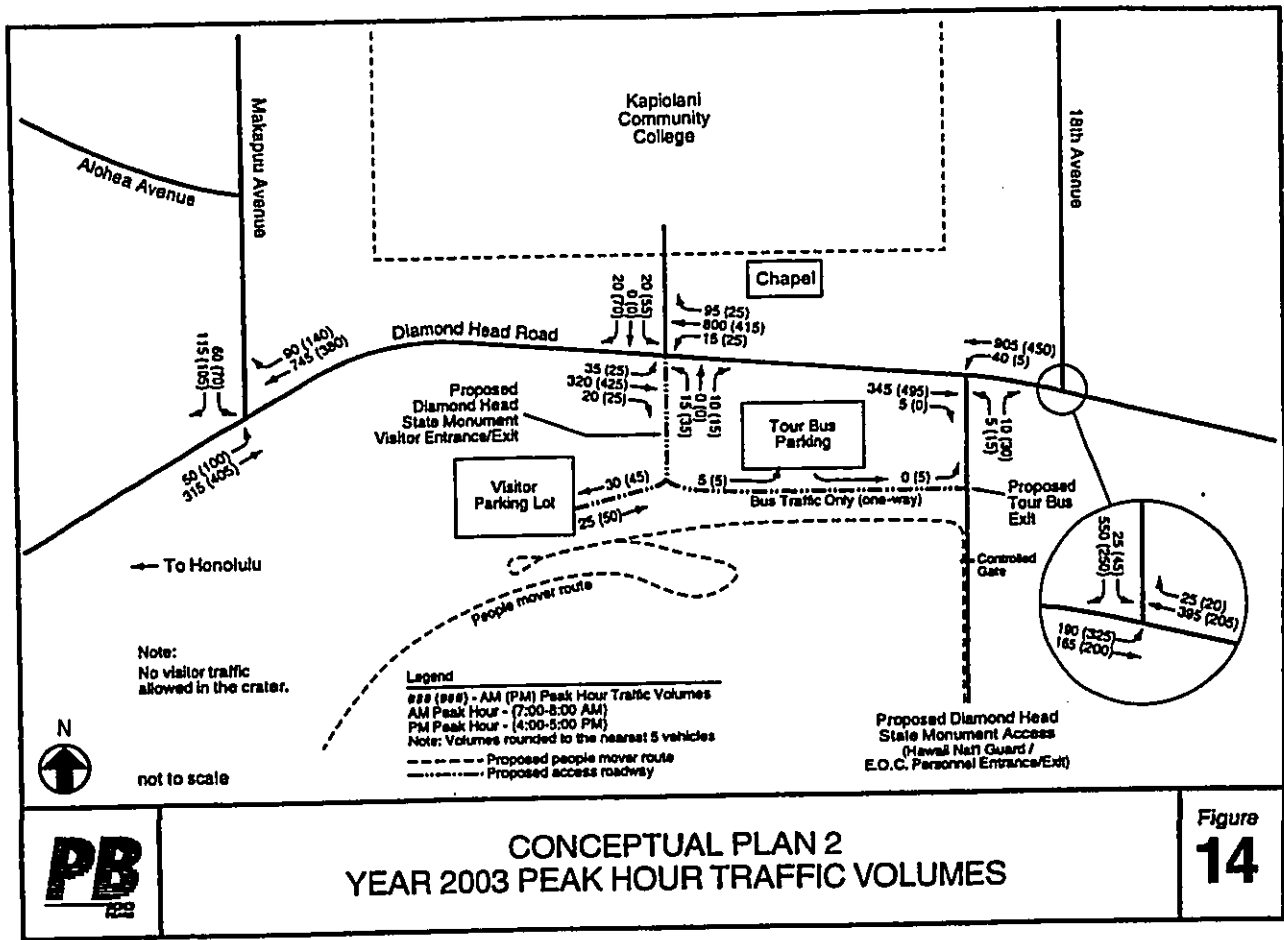
YEAR 2008 BACKGROUND PEAK HOUR TRAFFIC VOLUMES

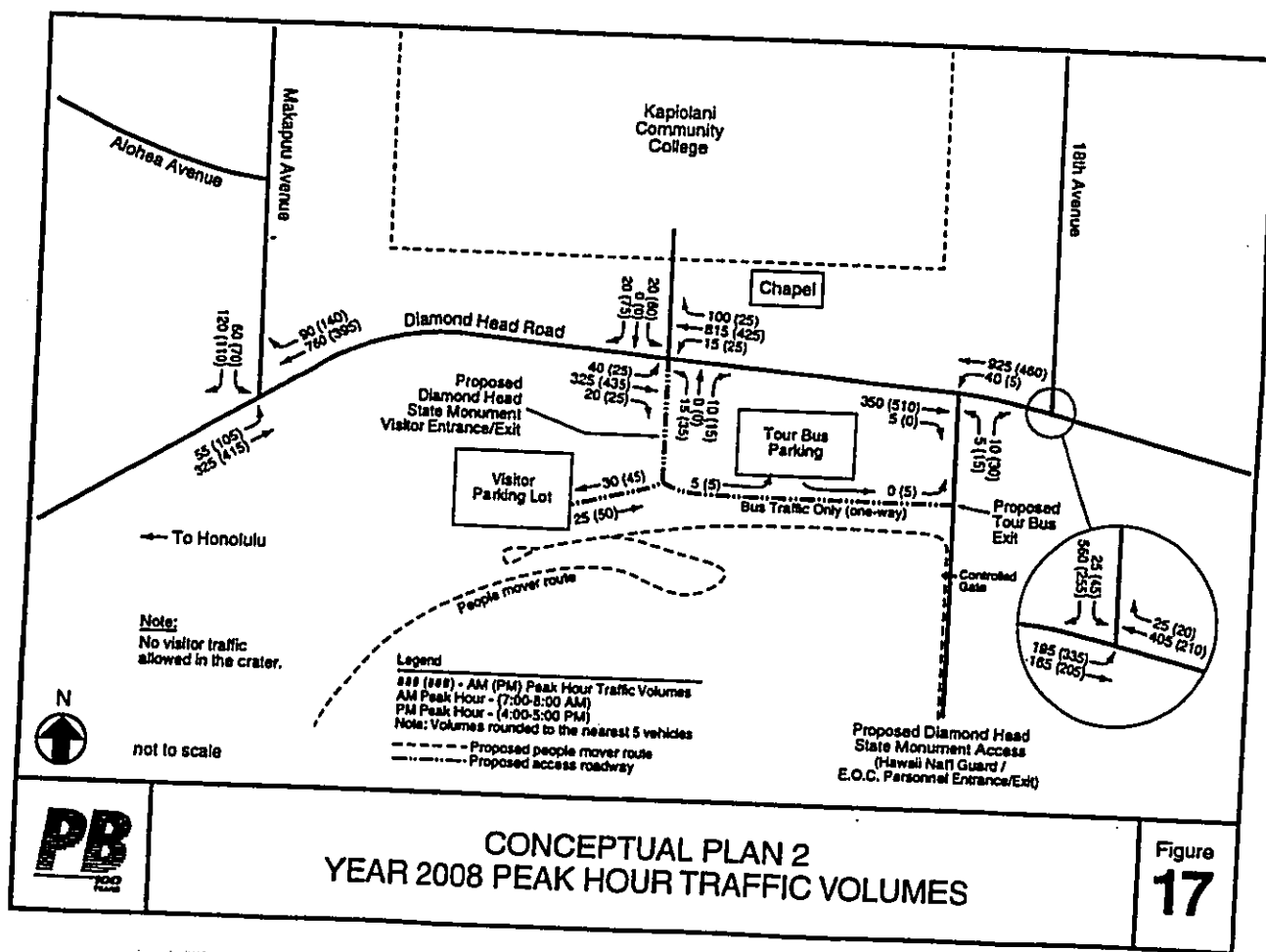
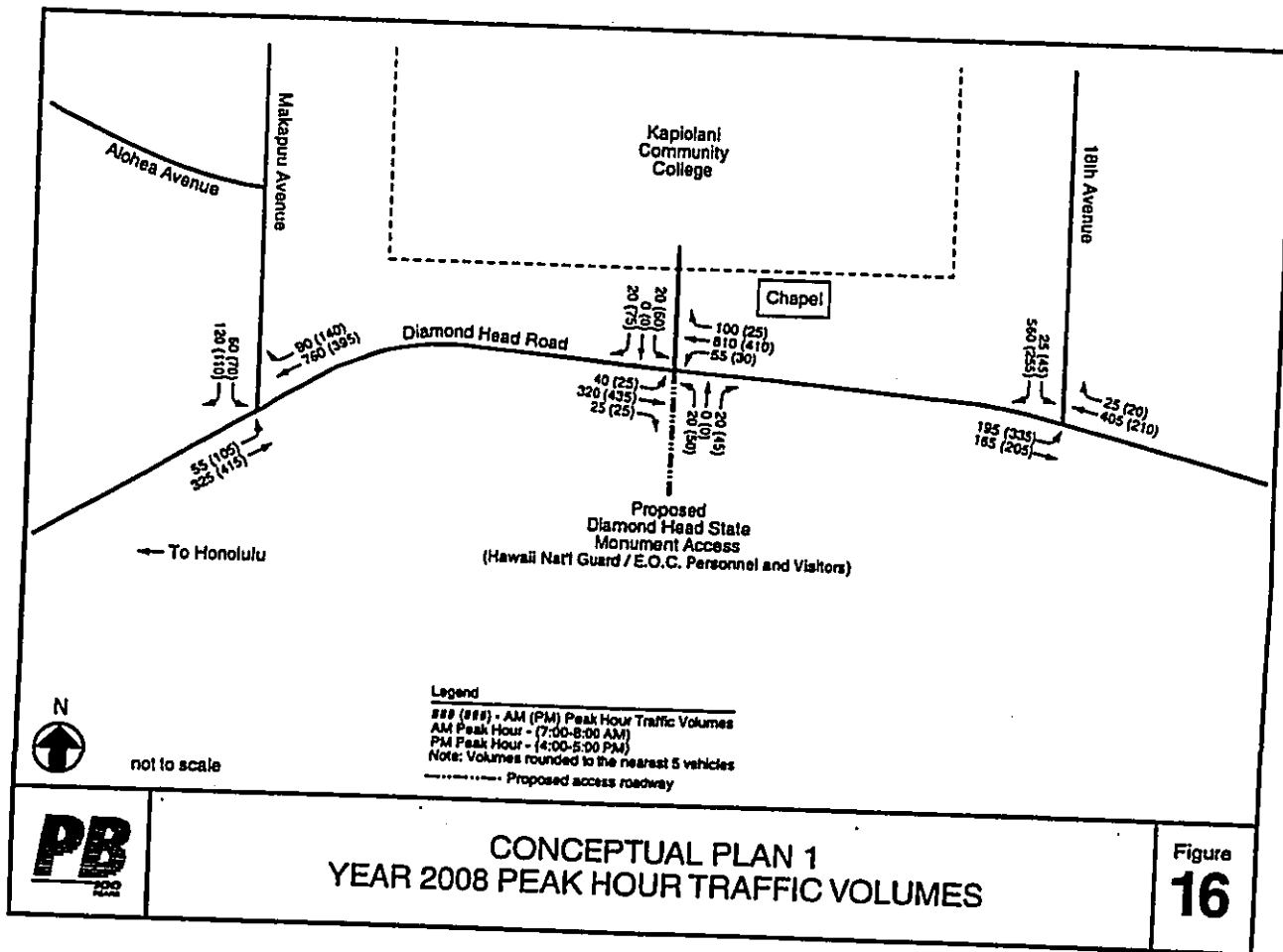
Figure 12



CONCEPTUAL PLAN 1  
 YEAR 2003 PEAK HOUR TRAFFIC VOLUMES

Figure 13





**F. INTERSECTION OPERATIONS ANALYSIS RESULTS**

Key intersections were analyzed using the methodologies for unsignalized and signalized intersections outlined in the 1994 Highway Capacity Manual (HCM). Operating conditions at an intersection are expressed as qualitative measures known as Level of Service (LOS) ranging from A to F. LOS A represents free-flow operating conditions, while LOS F represents congested conditions. The overall intersection LOS is a weighted average of the LOS of individual traffic movement groups. Appendix B has detailed definitions of intersection LOS.

In addition to traffic volumes, intersection analyses considered elements such as peak hour factors, truck percentages, and roadway grades. Field observations were performed at selected intersection to verify reasonableness of the analysis results.

**1. Conceptual Plan 1**

Three intersections were analyzed as unsignalized intersections for Conceptual Plan 1:

- Makapuu Avenue/Diamond Head Road,
- KCC Access/Diamond Head Road, and
- 18th Avenue/Diamond Head Road.

Tables 2 and 3 display the projected Years 2003 and 2008 peak hour intersection levels of service without and with DHSM Conceptual Plan 1.

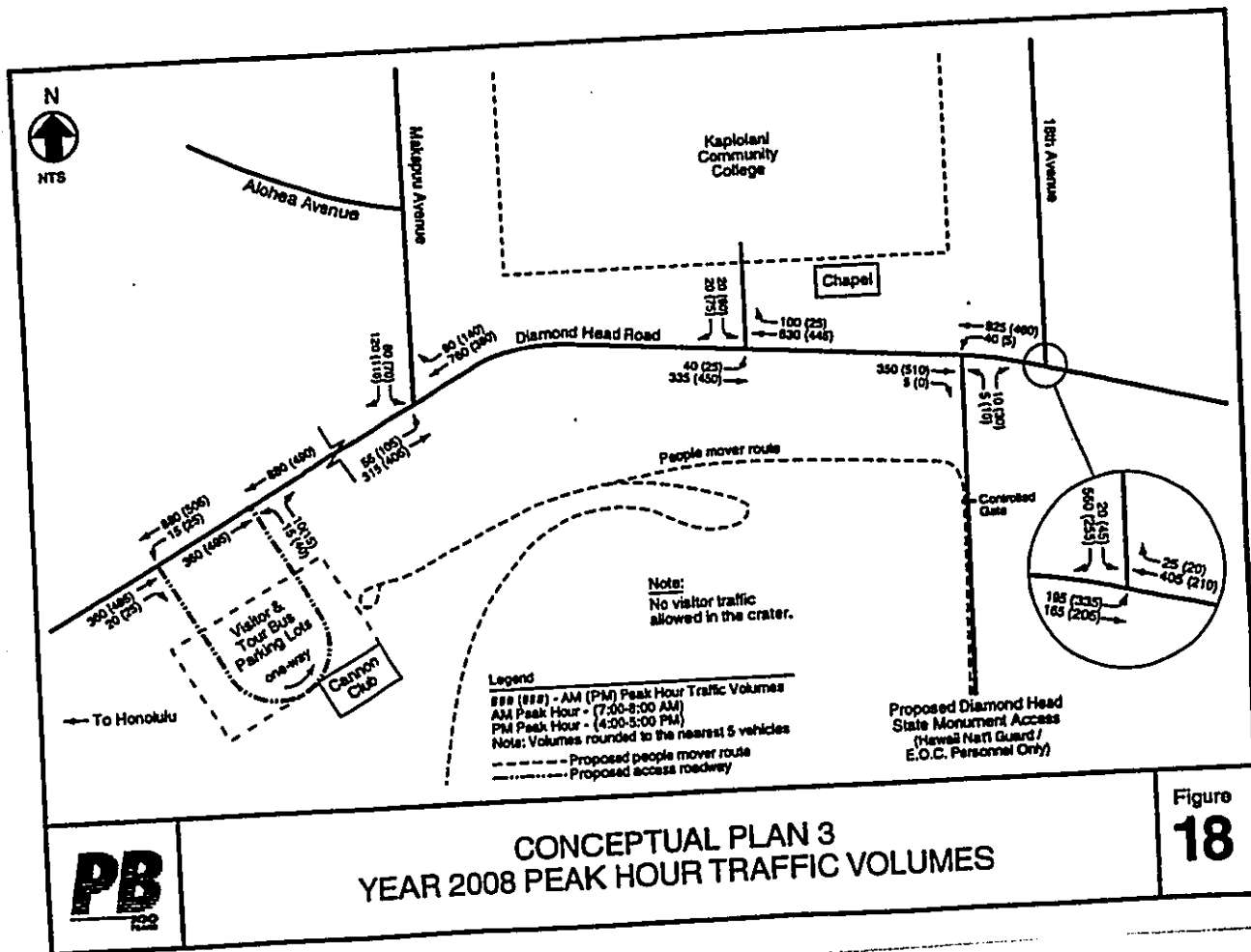


Table 2

Conceptual Plan 1  
Years 2003 and 2008 Level of Service Summary  
AM Peak Hour

Intersection	Year 2003		Year 2008		Year 2008 Without Project	Year 2008 With Project
	With Project	Without Project	With Project	Without Project		
Makepuu Ave /Diamond Head Rd	A	2.6	A	2.7	A	2.9
SB Left	E	35.5	E	38.9	E	43.5
SB Right	B	8.8	B	9.0	B	9.4
EB Left	B	6.3	B	6.5	B	6.7
*KCC & DHSM Access /Diamond Head Rd	*A	*0.8	*A	*1.5	*A	*1.6
NB Left/Through	NA	NA	E	36.3	NA	E
NB Right	NA	NA	A	4.4	NA	A
SB Left/Through	D	29.0	E	35.6	E	38.6
SB Right	B	8.3	B	8.2	B	8.4
EB Left	B	6.7	B	6.6	B	6.9
WB Left			A	3.6		A
18th Ave/Diamond Head Rd	B	8.8	B	8.7	B	8.7
SB Left	D	24.1	D	26.1	D	27.7
SB Right	C	18.1	C	18.1	C	18.1
EB Left	B	5.6	B	5.8	B	6.0

\*Future without project and with project lane configurations differ at this intersection.  
Note: NB- northbound, SB- southbound, EB- eastbound, WB- westbound  
NA = not applicable

Table 3

Conceptual Plan 1  
Years 2003 and 2008 Level of Service Summary  
PM Peak Hour

Intersection	Year 2003		Year 2008		Year 2008 Without Project	Year 2008 With Project
	With Project	Without Project	With Project	Without Project		
Makepuu Ave /Diamond Head Rd	A	2.1	A	2.2	A	2.3
SB Left	D	21.0	D	24.6	D	27.0
SB Right	A	4.5	A	4.8	A	4.9
EB Left	A	4.0	A	4.3	A	4.4
*KCC & DHSM Access /Diamond Head Rd	*A	*1.2	*A	*2.5	*A	*2.6
NB Left/Through	NA	NA	D	20.4	NA	D
NB Right	NA	NA	A	4.9	NA	A
SB Left/Through	C	15.1	C	19.1	C	20.7
SB Right	A	4.8	A	4.8	A	4.9
EB Left	A	3.5	A	3.5	A	3.6
WB Left			A	3.7		A
18th Ave/Diamond Head Rd	A	3.1	A	3.2	A	3.2
SB Left	C	15.8	C	17.2	C	18.2
SB Right	A	5.0	B	5.2	B	5.3
EB Left	A	3.6	A	3.8	A	3.8

\*Future without project and with project lane configurations differ at this intersection.  
Note: NB- northbound, SB- southbound, EB- eastbound, WB- westbound  
NA = not applicable

2. Conceptual Plan 2

Four intersections were analyzed as unsignalized intersections for Conceptual Plan 2:

- Makepuu Avenue/Diamond Head Road,
- KCC & DHSM Access/Diamond Head Road.



- DHSM Access (Tour Bus Exit/ Hawaii National Guard and E.O.C. Personnel Entrance/Exit) /Diamond Head Road, and
- 18th Avenue/Diamond Head Road.

Tables 4 and 5 display the projected Years 2003 and 2008 peak hour intersection levels of service without and with DHSM Conceptual Plan 2.

**Table 4**  
**Conceptual Plan 2**  
**Years 2003 and 2008 Level of Service Summary**  
**AM Peak Hour**

Intersection	Year 2003		Year 2008		Year 2008			
	Without Project (LOS)	With Project (LOS)	Without Project (LOS)	With Project (LOS)	Without Project (LOS)	With Project (LOS)		
Makapuu Ave /Diamond Head Rd	A	2.6	A	2.7	A	2.8	A	2.9
SB Left	E	35.5	E	38.9	E	38.9	E	43.5
SB Right	B	8.8	B	9.0	B	9.2	B	9.4
EB Left	B	6.3	B	6.5	B	6.5	B	6.7
*KCC & DHSM Access /Diamond Head Rd	*A	*0.8	*A	*1.2	*A	*0.8	*A	*1.2
NB Left/Through	NA	NA	E	30.8	NA	NA	E	33.0
NB Right	NA	NA	A	4.3	NA	NA	A	4.3
SB Left/Through	D	29.0	E	31.0	E	31.3	E	33.3
SB Right	B	8.3	B	8.3	B	8.5	B	8.5
EB Left	B	6.7	B	6.7	B	7.0	B	7.0
WB Left			A	3.4			A	3.4
DHSM Access (HNG/EOC/Tour bus) /Diamond Head Rd	A	0.3	A	0.3	A	0.3	A	0.3
NB Left/Right	C	15.6	C	16.4	C	16.3	C	17.1
WB Left	A	3.6	A	3.6	A	3.6	A	3.6
18th Ave/ Diamond Head Rd	B	8.8	B	8.7	B	8.8	B	8.7
SB Left	D	24.1	D	26.1	D	25.7	D	27.7
SB Right	C	18.1	C	18.1	C	18.1	C	18.1
EB Left	B	5.6	B	5.8	B	5.8	B	6.0

\*Flare without project and with project lane configurations differ at this intersection.  
 Note: NB- northbound, SB- southbound, EB- eastbound, WB- westbound  
 NA = not applicable

Table 5

Conceptual Plan 2  
Years 2003 and 2008 Level of Service Summary  
PM Peak Hour

Intersection	Year 2003		Year 2008		Year 2008		Year 2008	
	Without Project	With Project	Without Project	With Project	Without Project	With Project	Without Project	With Project
Makapuu Ave /Diamond Head Rd	A	2.1	A	2.2	A	2.2	A	2.3
SB Left	D	21.0	D	24.6	D	22.3	D	27.0
SB Right	A	4.5	A	4.8	A	4.6	A	4.9
EB Left	A	4.0	A	4.3	A	4.1	A	4.4
*KCC & DHSM Access /Diamond Head Rd	*A	*1.2	*A	*2.0	*A	*1.4	*A	*2.1
NB Left/Through	NA	NA	C	16.7	NA	NA	C	19.7
NB Right	NA	NA	A	4.6	NA	NA	A	4.7
SB Left/Through	C	15.1	C	17.5	C	16.1	C	18.8
SB Right	A	4.8	A	4.9	A	4.9	A	5.0
EB Left	A	3.5	A	3.6	A	3.6	A	3.6
WB Left			A	3.7			A	3.7
DHSM Access (HNG/EOC/Tour bus) /Diamond Head Rd	A	0.3	A	0.4	A	0.3	A	0.4
NB Left/Right	B	7.4	B	8.7	B	7.7	B	8.9
WB Left	A	3.7	A	3.8	A	3.8	A	3.9
18th Ave/ Diamond Head Rd	A	3.1	A	3.2	A	3.2	A	3.2
SB Left	C	15.8	C	17.2	C	16.7	C	18.2
SB Right	A	5.0	B	5.2	B	5.1	B	5.3
EB Left	A	3.6	A	3.8	A	3.7	A	3.8

\*Future without project and with project lane configurations differ at this intersection.  
Note: NB- northbound, SB- southbound, EB- eastbound, WB- westbound  
NA - not applicable

3. Conceptual Plan 3

Six intersections were analyzed as unsignalized intersections for Conceptual Plan 3:

- Makapuu Avenue/Diamond Head Road,
- KCC Access/Diamond Head Road,
- DHSM Access (Hawaii National Guard and E.O.C. Personnel Entrance/Exit) /Diamond Head Road,
- 18th Avenue/Diamond Head Road,
- DHSM Cannon Club Entrance/Diamond Head Road, and
- DHSM Cannon Club Exit/Diamond Head Road.

Tables 6 and 7 display the projected Years 2003 and 2008 peak hour intersection levels of service without and with DHSM Conceptual Plan 3.

Table 6

Conceptual Plan 3  
Years 2003 and 2008 Level of Service Summary  
AM Peak Hour

Intersection	Year 2003		Year 2008		Year 2008		Year 2008	
	Without Project	With Project	Without Project	With Project	Without Project	With Project	Without Project	With Project
	(Veh/Sec)	(Veh/Sec)	(Veh/Sec)	(Veh/Sec)	(Veh/Sec)	(Veh/Sec)	(Veh/Sec)	(Veh/Sec)
Makapu Ave /Diamond Head Rd	A	2.6	A	2.7	A	2.8	A	2.9
SB Left	E	35.5	E	37.7	E	38.9	E	41.5
SB Right	B	8.8	B	9.0	B	9.2	B	11.4
EB Left	B	6.3	B	6.5	B	6.5	B	7.7
KCC Access /Diamond Head Rd	A	0.8	A	0.8	A	0.8	A	0.8
SB Left	D	29.0	E	30.2	E	31.3	E	33.7
SB Right	B	8.3	B	8.4	B	8.5	B	11.3
EB Left	B	6.7	B	6.8	B	7.0	B	7.1
DHSM Access (HNG/EOC) /Diamond Head Rd	A	0.3	A	0.3	A	0.3	A	0.3
NB Left/Right	C	15.6	C	16.4	C	16.3	C	17.1
WB Left	A	3.6	A	3.6	A	3.6	A	3.6
18th Ave/ Diamond Head Rd	B	8.8	B	8.7	B	8.8	B	11.7
SB Left	D	24.1	D	26.1	D	25.7	D	27.7
SB Right	C	18.1	C	18.1	C	18.1	C	18.1
EB Left	B	5.6	B	5.8	B	5.8	B	6.0
DHSM Cannon Club Entrance/Diamond Head Rd	A	0.0	A	0.0			A	0.0
WB Left	A	3.5	A	3.5	A	3.5	A	3.5
DHSM Cannon Club Exit/Diamond Head Rd	A	0.3	A	0.3			A	0.3
NB Left	D	23.8	D	23.8	D	23.8	D	25.2
NB Right	A	4.3	A	4.3	A	4.3	A	4.4

Note: NB- northbound, SB- southbound, EB- eastbound, WB- westbound

Table 7

Conceptual Plan 3  
Years 2003 and 2008 Level of Service Summary  
PM Peak Hour

Intersection	Year 2003		Year 2008		Year 2008		Year 2008	
	Without Project	With Project	Without Project	With Project	Without Project	With Project	Without Project	With Project
	(Veh/Sec)	(Veh/Sec)	(Veh/Sec)	(Veh/Sec)	(Veh/Sec)	(Veh/Sec)	(Veh/Sec)	(Veh/Sec)
Makapu Ave /Diamond Head Rd	A	2.1	A	2.1	A	2.2	A	2.3
SB Left	D	21.0	D	23.0	D	22.3	D	25.3
SB Right	A	4.5	A	4.7	A	4.6	A	4.8
EB Left	A	4.0	A	4.2	A	4.1	A	4.3
KCC Access /Diamond Head Rd	A	1.2	A	1.3	A	1.4	A	1.4
SB Left	C	15.1	C	16.4	C	16.1	C	17.5
SB Right	A	4.8	A	5.0	A	4.9	B	5.1
EB Left	A	3.5	A	3.7	A	3.6	A	3.7
DHSM Access (HNG/EOC) /Diamond Head Rd	A	0.3	A	0.3	A	0.3	A	0.3
NB Left/Right	B	7.4	B	7.7	B	7.7	B	8.0
WB Left	A	3.7	A	3.8	A	3.8	A	3.9
18th Ave/ Diamond Head Rd	A	3.1	A	3.2	A	3.2	A	3.2
SB Left	C	15.8	C	17.2	C	16.7	C	18.2
SB Right	A	5.0	B	5.2	B	5.1	B	5.3
EB Left	A	3.6	A	3.8	A	3.7	A	3.8
DHSM Cannon Club Entrance/Diamond Head Rd			A	0.1			A	0.1
WB Left			A	4.0			A	4.0
DHSM Cannon Club Exit/Diamond Head Rd			A	0.7			A	0.7
NB Left			C	15.6			C	16.7
NB Right			A	4.9			B	5.0

Note: NB- northbound, SB- southbound, EB- eastbound, WB- westbound

#### 4. Intersection Operations Analysis Summary

All study intersections of Conceptual Plans 1, 2, and 3 operate well overall at LOS A. Most movements experience minimal delays, and all movements operate at LOS E or better.

The Makapuu Avenue/Diamond Head Road intersection operates at the same levels of service as existing conditions with minimal delay increases. The southbound left-turn from Makapuu Avenue onto Diamond Head Road experiences LOS E and D in the future AM and PM peak hours respectively. As explained in the existing conditions, the large volumes along Diamond Head Road allow few opportunities for side street traffic to enter the main flow.

At the intersection of KCC & DHSM Access/Diamond Head Road, the southbound right and eastbound left turns experience good levels of service with minimal delays in both peak hours. In the future, the southbound movement is altered from an exclusive left-turn to a shared left/through movement, and with the project the AM peak hour LOS decreases from LOS D to LOS E as delays slightly increase.

The proposed usage of the existing DHSM access operates acceptably in both peak hours for Conceptual Plans 2 and 3. The level of service for the northbound left/right-turn movements improves from existing conditions (LOS D to C in the AM peak hour and LOS C to B in the PM peak hour) due to the rerouting of visitor traffic.

For Conceptual Plan 3, the Cannon Club entrance and exit operate at an overall LOS A in both peak hours. Operations along Diamond Head Road would not be adversely affected by the visitor traffic although the northbound left-turn out of the parking lot would experience some delay in both peak hours.

Additionally, there is little difference between the intersection operations in Years 2003 and 2008. Due to the annual growth, the volumes are slightly higher for the ten year horizon than the five-year horizon, but the delay increases are minimal.

As shown by Tables 2, 3, 4, 5, 6, and 7, there is little difference between the intersection operations of Conceptual Plans 1, 2, and 3. The results suggest that implementation of Conceptual Plans 1, 2, or 3 would result in minimal delay increases for vehicles, and the overall levels of service would not be affected.

#### IV. RECOMMENDATIONS AND CONCLUSION

##### A. OBSERVATIONS AND RECOMMENDATIONS

From the perspective of intersection operations, Conceptual Plans 1, 2, and 3 would result in similar intersection levels of service. The traffic volumes produced by the conceptual plans are similar to each other, and they are superimposed on similar patterns and magnitudes of background traffic on Diamond Head Road. Future intersection levels of service are, therefore, similar and are projected to be acceptable.

The primary traffic-related differences in the conceptual plans pertain to design elements such as the location of DHSM access, visitor access into the crater, and bicycle and pedestrian facilities. From the perspective of transportation issues, all three alternative conceptual plans are workable when implemented properly. The following discussion summarizes the recommendations common to all conceptual plans and recommendations that apply specifically to each conceptual plan.

##### 1. Recommendations Common to All Conceptual Plans *Pedestrian/Bicycle Paths*

The attached sidewalk on the south (Diamond Head) side of Diamond Head Road is narrow, averaging about three feet in width. Street lighting poles located in the sidewalk area further restrict the sidewalk. Wheelchair ramps are not provided. Most of this sidewalk is constrained from widening by an existing rock retaining wall, varying between 3 and 5 feet in height.

All concept plans propose a separated pedestrian/bicycle path, located behind the rock wall. This path would provide a safer and more enjoyable walking, jogging, roller blading, and biking environment than the attached sidewalk that currently exists on the south side of Diamond Head Road.

It is recommended that Americans with Disabilities Act (ADA)-compliant access be provided from Diamond Head Road to the separated pedestrian path at Makapuu Avenue, the KCC Access, and 18<sup>th</sup> Avenue.

This proposed path would not preclude the implementation of bicycle lanes on Diamond Head Road as proposed by the *Draft Honolulu Bicycle Master Plan*. In fact, the creation of a pedestrian/bicycle path as part of the DHSM plan will allow the existing attached sidewalk on the south side of Diamond Head Road to be eliminated. It is, therefore recommended that the pedestrian/bicycle path be an early implementation item for the DHSM. This would allow the implementers of bicycle lanes on Diamond Head Road to eliminate the existing sidewalk and relocate the street light poles behind the rock wall. In eliminating the sidewalk, it is suggested that the implementers of the bicycle lanes on Diamond Head Road leave one foot of the existing sidewalk to serve as a buffer between Diamond Head Road and the wall, similar to the abutment of a bridge. This would increase roadway width by about two feet which could then be used as part of the on-street bicycle lanes.

#### Bus Stop Modifications

All concept plans relocate DHSM access further to the west. It would make sense to relocate the pair of municipal bus stops located near the existing DHSM access to the west as well, since they appear to be utilized primarily by visitors to DHSM. This pair of bus stops could be relocated nearer to Makapuu Avenue. KCC students appear to utilize the existing pair of bus stops near the existing KCC Access, and these are recommended to remain. However, it is recommended that the City & County of Honolulu either adjust the location or modify access to the bus stop serving eastbound Diamond Head Road so that ADA compliant access could be provided after elimination of the attached sidewalk on the south side of Diamond Head Road.

#### Intersection Traffic Control

Relocating the bus stops west to the Makapuu Avenue area would increase pedestrian crossing of Diamond Head Road in this area. Diamond Head Road is curvilinear, both in horizontal and vertical alignment, and it may be prudent to provide additional pedestrian crossing protection.

As presented in the existing conditions analysis, the existing peak hour traffic volumes at the Diamond Head Road/Makapuu Avenue Intersection satisfy the peak hour traffic volume signal warrant as defined by the *Manual on Uniform Traffic Control Devices for Streets and*

*Highways*, Federal Highway Administration, 1988. As a result of annual growth, the future volumes continue to satisfy the peak hour traffic volume signal warrant. Because of the combination of the potential increased pedestrian activity and the existing and future vehicular operations at this intersection, it is recommended that a traffic signal be implemented if a complete engineering analysis and signal design concurs that it is feasible.

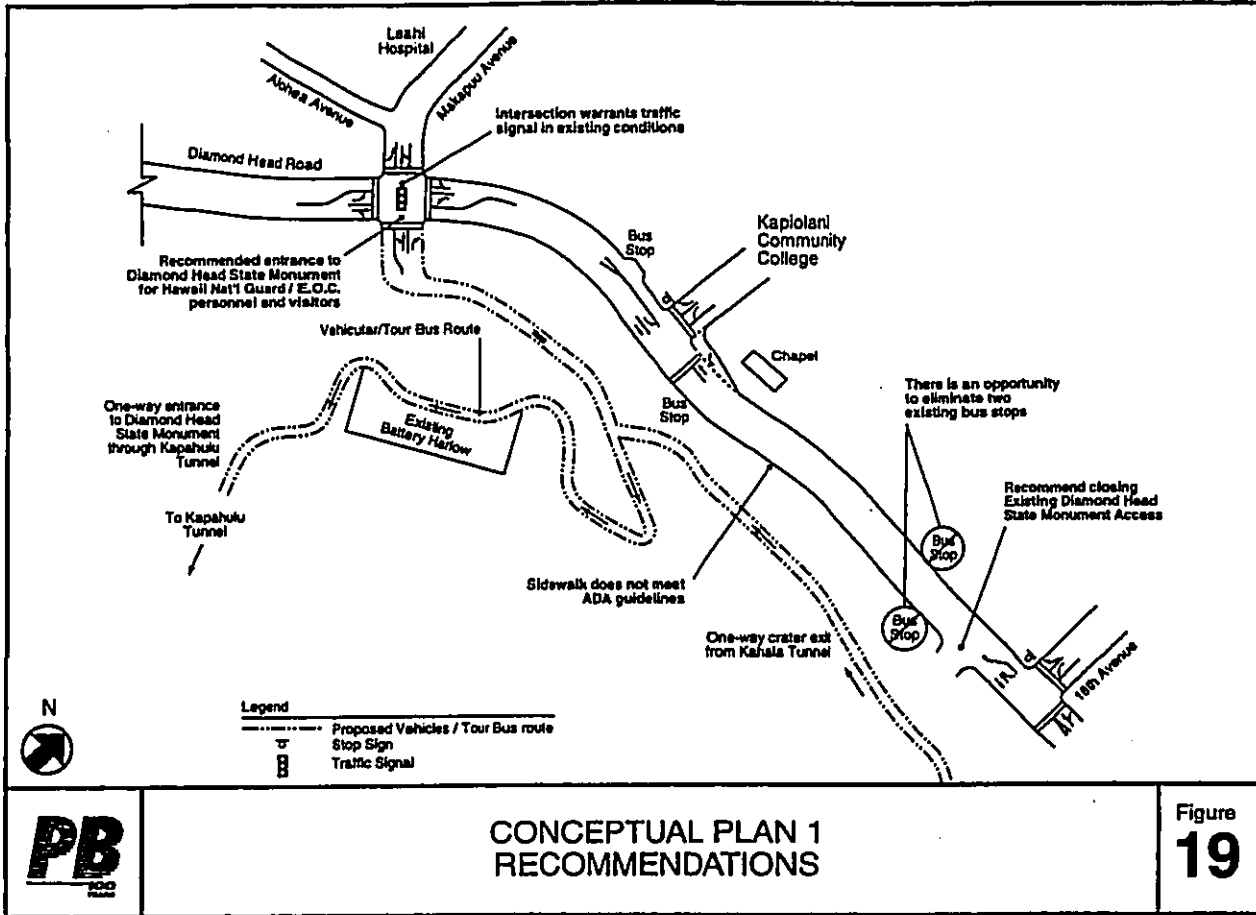
As part of the signalization, it is recommended that the crosswalks be provided for pedestrian crossing of Diamond Head Road at the Makapuu Avenue/Diamond Head intersection.

#### **2. Conceptual Plan 1 Recommendations**

Conceptual Plan 1 proposes a new DHSM access opposite the existing KCC access approximately 820 feet west of the existing DHSM access and approximately 625 feet east of the Makapuu Avenue/Diamond Head Road intersection. The existing DHSM access with sub-standard spacing between it and 18<sup>th</sup> Avenue would be closed in this conceptual plan. Although the new DHSM access is judged to have adequate spacing from adjacent intersections, a field review of this location revealed sub-standard stopping sight distance to the west of the proposed new DHSM access. This is the minimum sight distance required for drivers to react to and stop their vehicles to avoid an obstacle in their path on wet pavement.

This sub-standard stopping sight distance is caused by the curvilinear horizontal and vertical alignments of Diamond Head Road in this area. The proposed new DHSM access lies on the inside of a horizontal curve and on the east side of a vertical curve, resulting in approximately 150 feet line of stopping sight distance when looking to the west of the proposed DHSM access. Table III-1 in *A Policy on Geometric Design of Highways and Streets* (Green Book) (AASHTO, 1990) indicates that the stopping sight distance for a design speed of 30 mph (posted speed limit 25 mph) is 200 feet. Therefore, stopping sight distance from the proposed KCC/DHSM access to the west is not adequate. Stopping sight distance to the east is adequate.

While this situation might be mitigated through the use of warning signs and/or flashing beacons, it is recommended that the location of the proposed new DHSM access be



**CONCEPTUAL PLAN 1 RECOMMENDATIONS**

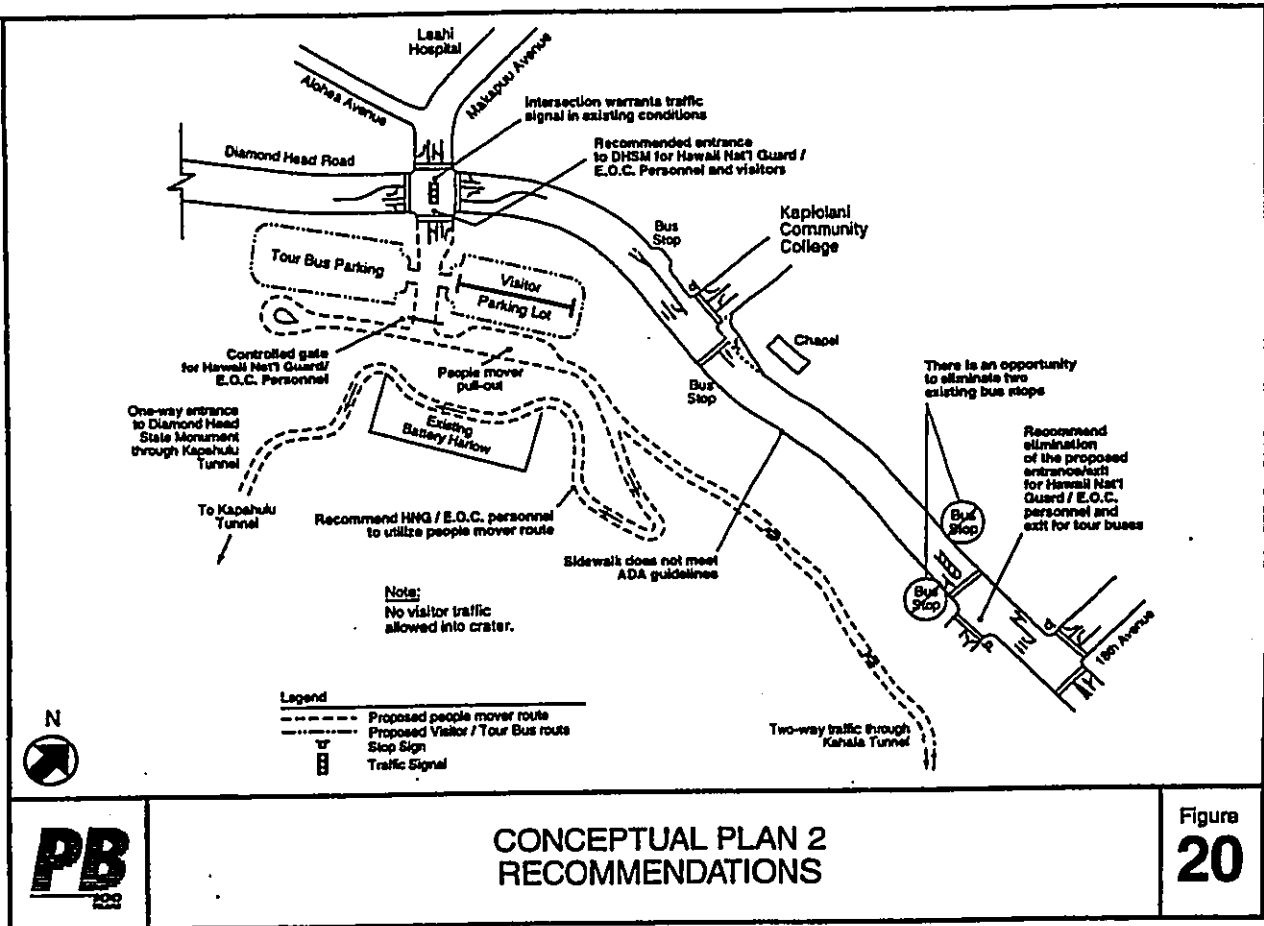
**Figure 19**

changed. Logical places for relocation of the proposed new DHSM access is directly opposite Makapuu Avenue or directly across 18<sup>th</sup> Avenue on Diamond Head Road. Discussions with planners for the DHSM concepts indicate that an access closer to Makapuu Avenue would be preferable. It is, therefore, recommended to change the location of the proposed new DHSM access from being opposite the KCC Access to being opposite Makapuu Avenue.

If Conceptual Plan 1 is selected as the preferred alternative and the new DHSM access is located opposite Makapuu Avenue, the lane configurations shown in Figure 19 are recommended. A shared through/left lane and exclusive right-turn lane is suggested for the DHSM access leg, and exclusive left-turn lanes in Diamond Head Road for traffic turning into both Makapuu Avenue and the proposed DHSM access are recommended. This will require a widening of Diamond Head Road by approximately twelve feet in the vicinity of the Makapuu Avenue intersection. There is an existing structure on the northwest corner of this intersection, and there appear to be utilities like telephone lines running underground on the Diamond Head side of Diamond Head Road. The land on both sides of Diamond Head Road are in the DHSM, so land ownership is probably not an issue. However, because of the physical constraints, conceptual design utilizing survey mapping needs to be conducted to determine the best intersection arrangement.

As noted previously in this report, the AM peak hour volumes at Diamond Head Road/Makapuu Avenue intersection satisfy the peak hour traffic volume signal warrant as defined by the *Manual on Uniform Traffic Control Devices for Streets and Highways*, Federal Highway Administration, 1988. As a result of annual growth, the future volumes continue to satisfy the peak hour traffic volume signal warrant. If Concept Plan 1 is implemented, it is recommended to install traffic signals to facilitate vehicular and pedestrian access into the DHSM. Intersection operational analysis of a signalized Makapuu Avenue/DHSM access intersection indicates that this intersection will operate well in both the Year 2003 and Year 2008 time frames.

As a four-legged signalized intersection, Makapuu Avenue/Diamond Head Road is projected to operate well overall at LOS B in the AM and PM peak hours of both horizon years. Each movement is projected to operate at LOS B or C with minimal delays. With this change in Conceptual Plan 1, the existing KCC access would remain in its present



**CONCEPTUAL PLAN 2  
RECOMMENDATIONS**

**Figure  
20**

configuration and would operate similar to existing conditions. The analysis worksheets for these recommendations are in Appendix C.

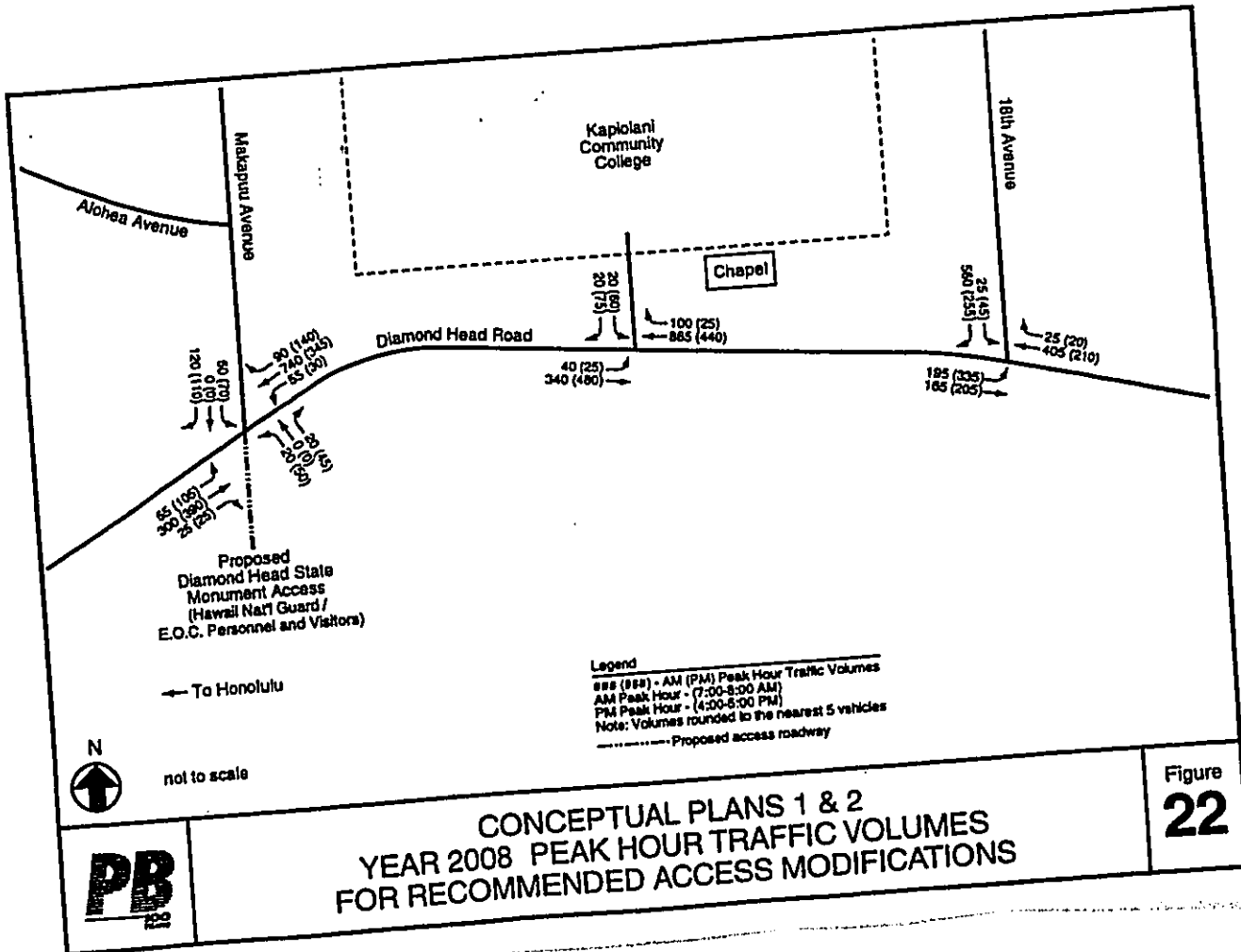
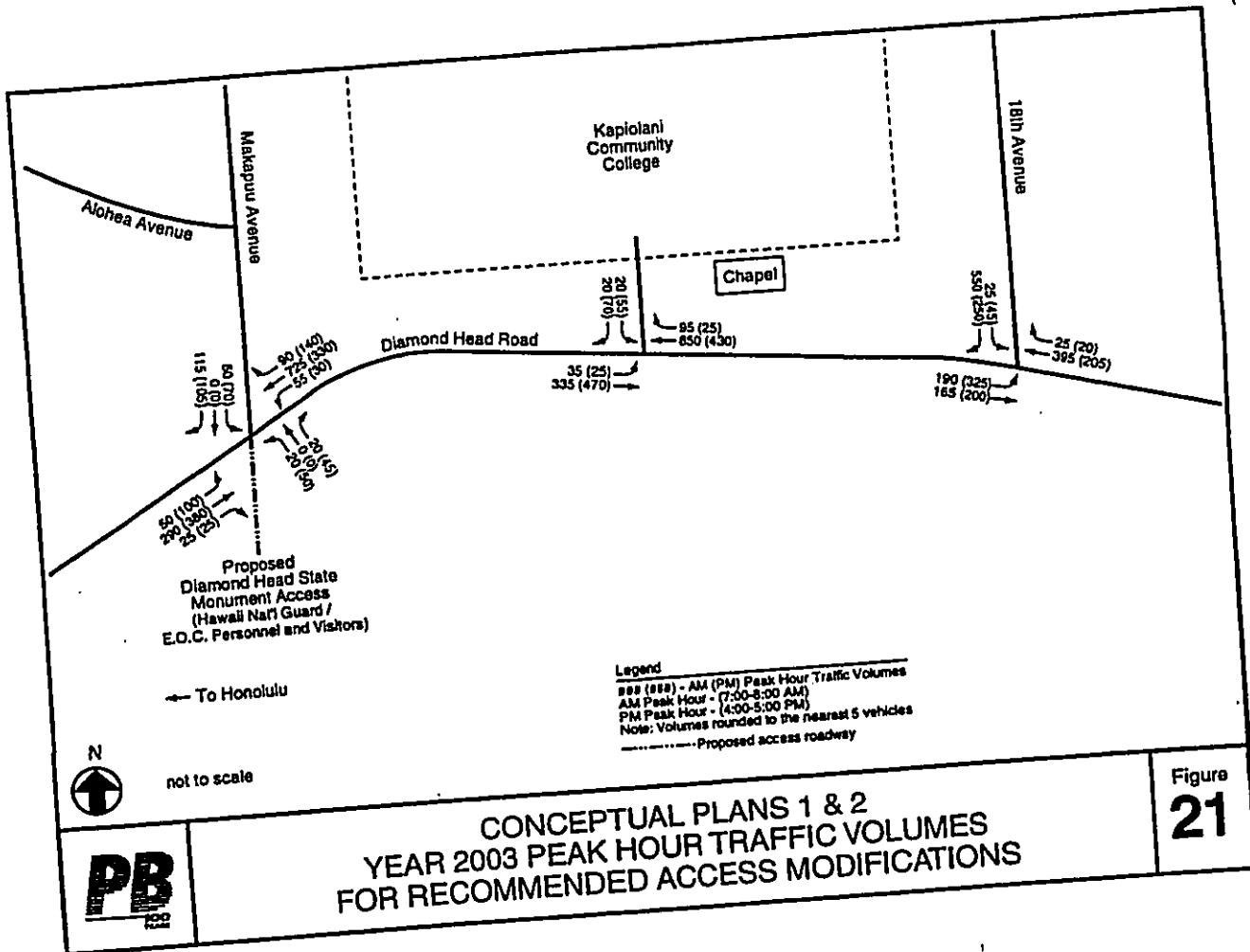
**3. Conceptual Plan 2 Recommendations**

This conceptual plan also proposes to relocate visitor access to DHSM to a point opposite the existing KCC Access. The same discussion pertaining to sight distance documented in the Conceptual Plan 1 recommendations applies to this conceptual plan as well. Therefore, it is recommended that the proposed new DHSM access location be changed from a point opposite the existing KCC Access to a point opposite Makapuu Avenue.

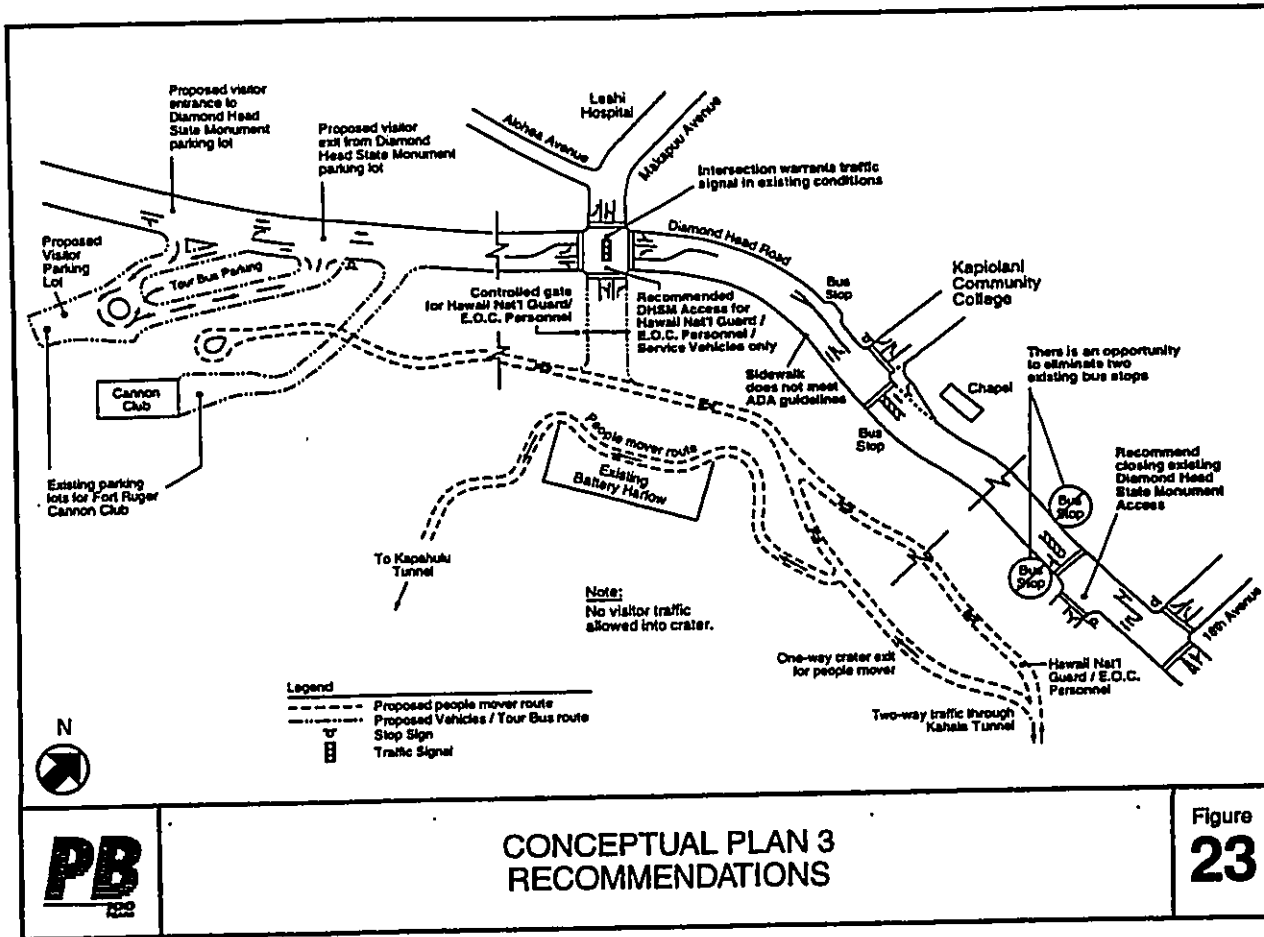
Conceptual Plan 2 also proposes to maintain the existing DHSM access as a tour bus exit and as access for HNG/EOC personnel. As previously discussed in this report, this intersection is located approximately 145 feet west of the 18th Avenue/Diamond Head Road intersection. No left-turn lane is provided for traffic turning into this access, and traffic operations here conflict with traffic operations at the 18th Avenue/Diamond Head Road intersection. Upon further review of this situation, it is recommended that the existing DHSM access be closed and HNG/EOC personnel be directed to the new DHSM Access at Makapuu Avenue. Similar to Conceptual Plan 1, both visitor and HNG/EOC vehicular traffic would use the same entrance/exit to DHSM, but, in Conceptual Plan 2, only HNG/EOC and service traffic would be allowed into the crater. A controlled gate would restrict visitors from driving into the crater.

Figure 20 illustrates the recommended lane configurations for the Makapuu Avenue DHSM access, which are the same as those recommended for Conceptual Plan 1.

The reassigned peak hour traffic volumes according to these recommendations are shown in Figures 21 and 22. Note that the traffic volumes are the same for Conceptual Plans 1 and 2. As recommended previously, the Makapuu Avenue/Diamond Head Road intersection was assumed to be signalized, and the intersection analysis for the conceptual plans shows that the overall intersection is projected to operate at LOS B with minimal delays to all movements.







CONCEPTUAL PLAN 3 RECOMMENDATIONS

Figure 23

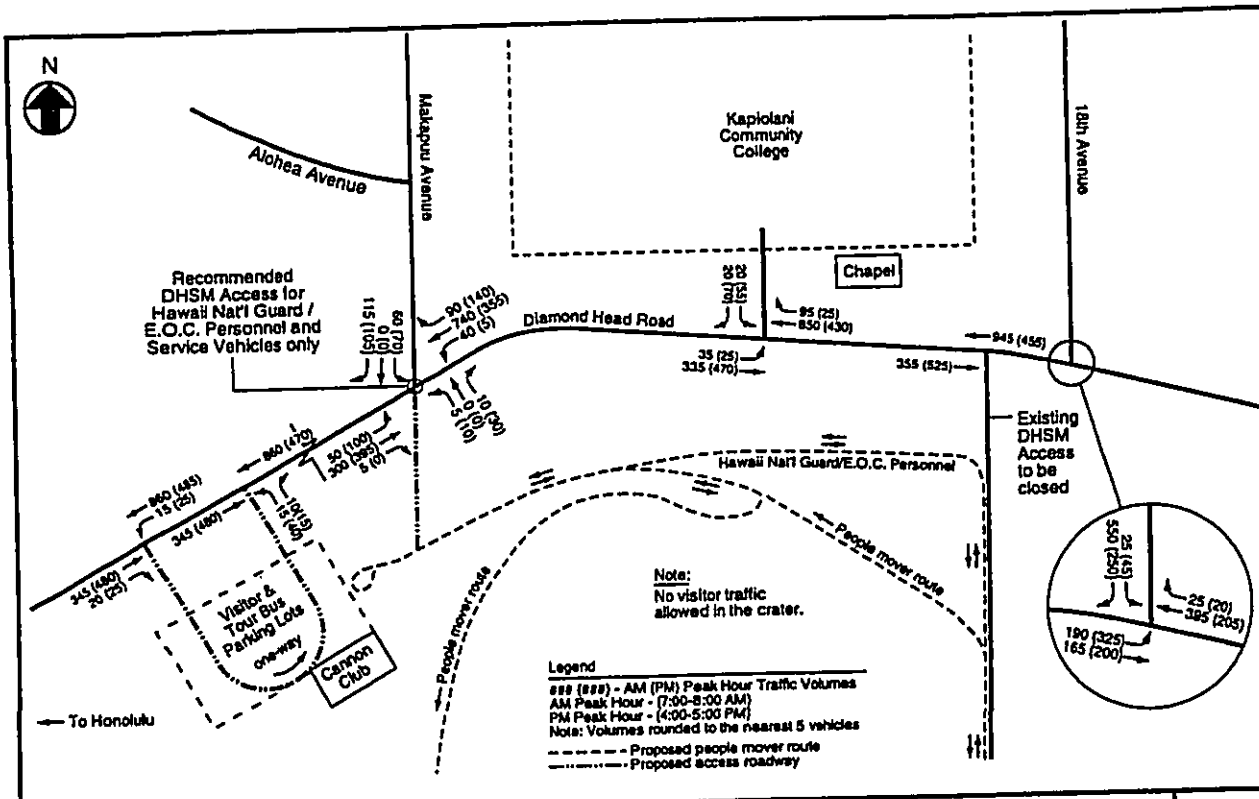
**4. Conceptual Plan 3 Recommendations**

Conceptual Plan 3 proposes to relocate DHSM visitor access to the existing Cannon Club driveways. The Cannon Club is located west of Makapuu Avenue on Diamond Head Road, and it is currently vacant. Because Conceptual Plan 3 calls for visitors to be shuffled into Diamond Head crater by a people mover, the Cannon Club will function as a transfer point where visitors will park their cars or tour buses will drop off their passengers.

The proposed Cannon Club entrance/exit is appropriate for visitor and tour bus access given some modifications. The Cannon Club parking lot is configured with two access driveways designed to operate as a one-way entrance and a one-way exit. The flow through the parking lot is counter-clockwise, entering at the west driveway and leaving via the east driveway. The recommended lane configurations for Conceptual Plan 3 are shown in Figure 23. Given the 25 mph posted speed limit and existing intersection lane configurations along Diamond Head Road, it was judged that a shared through/right-turn lane would be appropriate at the entrance to the Cannon Club. Given the down grade on Diamond Head Road near the Cannon Club, it is recommended to provide a left-turn lane to protect left-turning vehicles from westbound through traffic on Diamond Head Road. This left-turn lane will require some widening of Diamond Head Road. It appears that the widening will have to occur on the south (Diamond Head) side of Diamond Head Road. Exclusive left and right-turn lanes are recommended for the Cannon Club exit approach.

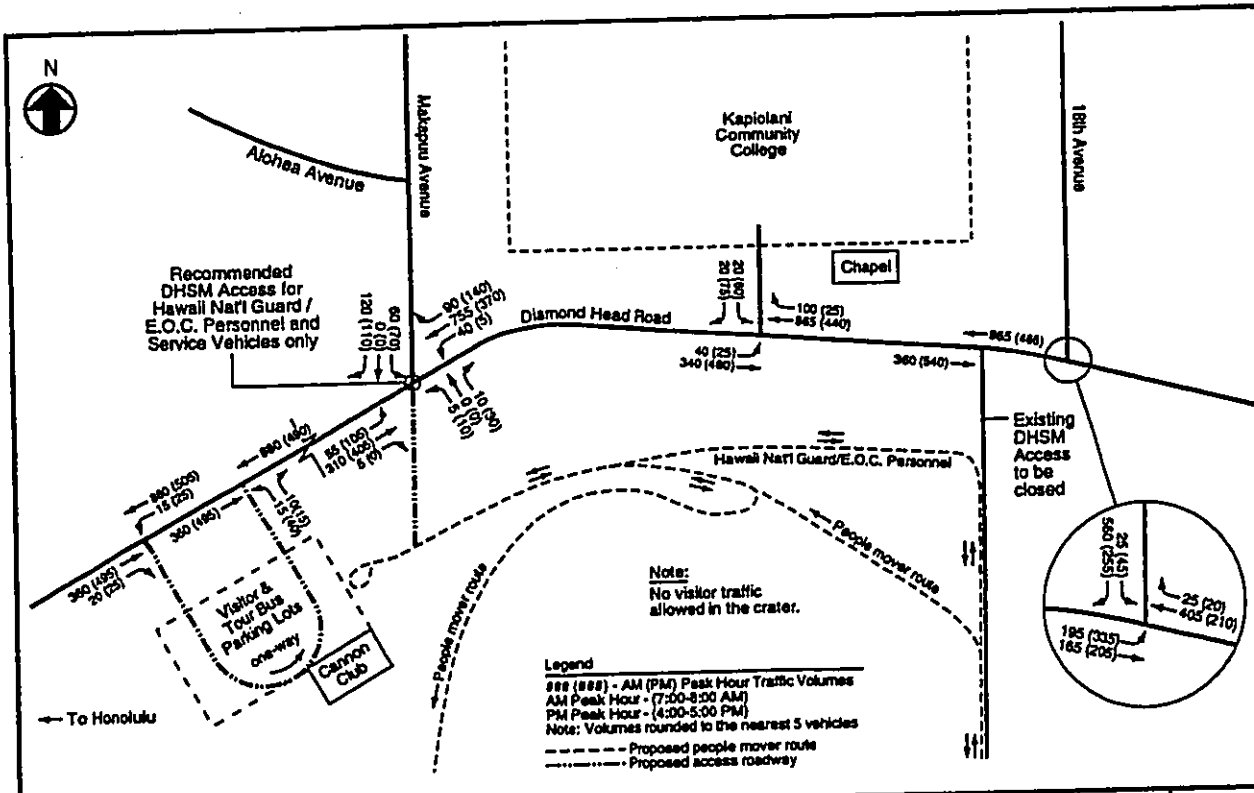
As discussed in the recommendations for Conceptual Plans 1 and 2, the existing DHSM access was proposed to be maintained for use by HNG/EOC personnel. However, upon further review, it is recommended to close this access and direct HNG/EOC personnel to a new access located opposite Makapuu Avenue on Diamond Head Road. The intersection configuration is recommended to be modified in a similar manner to Conceptual Plans 1 and 2.

Figures 24 and 25 illustrate the peak hour traffic volumes for Conceptual Plan 3 with recommended access modifications. The Makapuu Avenue/Diamond Head Road intersection was assumed to be signalized based on the desire to improve pedestrian access and because existing traffic volumes satisfy the peak hour traffic volume signal



**CONCEPTUAL PLAN 3**  
**YEAR 2003 PEAK HOUR TRAFFIC VOLUMES**  
**FOR RECOMMENDED ACCESS MODIFICATIONS**

Figure  
**24**



**CONCEPTUAL PLAN 3**  
**YEAR 2008 PEAK HOUR TRAFFIC VOLUMES**  
**FOR RECOMMENDED ACCESS MODIFICATIONS**

Figure  
**25**

warrant defined by the 1998 Manual on Uniform Traffic Control Devices for Streets and Highways, Federal Highway Administration. Given these modifications, an intersection analysis showed that the overall intersection would operate well at LOS B and minimal delays to all movements (see Appendix C).

Municipal bus access to the Cannon Club requires further discussion and thought. Both Concept Plans 1 and 2 orient their visitor access at Makapuu Avenue. In conjunction with this proposal, it is suggested that the exiting pair of bus stops located near the existing DHSM access be relocated closer to Makapuu Avenue. An extension of this logic would indicate that for Conceptual Plan 3, the pair of bus stops should be located near the Cannon Club. However, it is unlikely that the Cannon Club driveways will warrant signalization in the future. If the bus stops are located near the Cannon Club, a situation could be created in which the visitors are required to cross Diamond Head Road at an unprotected crossing to reach the westbound bus stop. There is a significant downgrade on Diamond Head Road in this area and pedestrian safety is a concern. Either measures to slow traffic on Diamond Head Road need to be implemented or alternative municipal bus access needs to be provided.

One alternative bus access is to locate the bus stops in the vicinity of Makapuu Avenue as described for Conceptual Plan 1 and 2. Then create a people mover stop near this area for people who ride the municipal buses. The people mover has to drive past this area anyway, and an additional stop along its route would probably be acceptable. Additionally, the people mover stop would enable people who walk into the area from the KCC and Kaimuki areas to access the people mover without having to walk down to the Cannon Club.

## B. CONCLUSION

Based on the analysis of proposed intersections and accesses of Conceptual Plans 1, 2, and 3, it was concluded that the existing roadway system could accommodate the traffic generated by the proposed improvements to the DHSM. All conceptual plans improve the handling of DHSM traffic on Diamond Head Road, improve pedestrian and recreational mobility on the makai side of Diamond Head Road, and work well with the recommendations of the *Draft Honolulu Bicycle Master Plan*.

Given the recommendations made for each conceptual plan, the visitor and personnel traffic is projected to be adequately accommodated. For Conceptual Plans 1, 2, and 3, the existing DHSM access road was recommended for closure, and the Makapuu Avenue/Diamond Head Road intersection was recommended as a DHSM access instead of the proposed KCC access, which was judged to have sub-standard stopping sight distance. Intersection analyses showed that the intersections would operate well overall given the recommended access modifications for each conceptual plan.

*Appendix F*

Environmental Noise Assessment

**CONTENTS**

Project No. 98-07

**ENVIRONMENTAL NOISE ASSESSMENT STUDY  
 DIAMOND HEAD STATE MONUMENT MASTER PLAN UPDATE  
 HONOLULU, OAHU, HAWAII**

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 Honolulu, Hawaii

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PROJECT NO. 98-07

Page 1

## 1.0 SUMMARY

- 1.1 The proposed Diamond Head State Monument (DHSM) Master Plan involves the demolition and construction of buildings, parking areas, and other visitor attractions in and around Diamond Head Crater.
- 1.2 The project area is currently exposed to daytime ambient noise levels of 43 to 61 dBA with the dominant noise sources being traffic, wind, and occasional distant aircraft flybys.
- 1.3 Existing noise sensitive areas include residential areas located to the East and West of the crater.
- 1.4 The dominant noise sources during project construction will probably be earth moving equipment, such as bulldozers and diesel powered trucks unless pile driving is necessary. Noise from construction activities will occur inside the crater and on the north side of DHSM during demolition and construction of buildings and infrastructure. The noise from construction and demolition activities could impact nearby residences and will impact any occupied National Guard buildings within the crater. Noise from construction activities should be short term and must comply with State Department of Health noise regulations.
- 1.5 Noise sources following the completion of the project will be vehicular and pedestrian traffic entering and exiting the proposed parking areas to the West of DHSM. The noise emanating from these parking areas could impact nearby residential areas.
- 1.6 Noise created in the crater during park usage is expected to be equal to or less than current levels and should not impact local residences.
- 1.7 Except for the "No-Action Alternative", the predicted noise levels for each of the three alternative conceptual development plans considered are equivalent.

## 2.0 PROJECT DESCRIPTION

The Diamond Head State Monument Master Plan objective is to create a park that lends itself to the interpretation of the natural, cultural, and military "story" of the Diamond Head crater. The project location and study area is shown on Figure 1. The development plans entail the demolition of three National Guard buildings inside the crater as well as the demolition of the FAA CERAP building and Link site equipment and infrastructure, the development and renovation of a parking area at the Cannon Club or across from Kapiolani Community College on Diamond Head Road, the construction of a visitor/interpretive center inside the crater, and the construction and/or improvement of

various roads and trails throughout DHSM. Possible features of the master plan include: a seasonal wetland, a dry/land forest, a picnic area, and a botanical garden. Three alternative conceptual development plans are being considered. These are shown by Figures 2 through 4.

## 3.0 NOISE STANDARDS

Various local and federal agencies have established guidelines and standards for assessing environmental noise impacts and set noise limits as a function of land use. A brief description of common acoustic terminology used in these guidelines and standards is presented in Appendix A.

### 3.1 State Department of Health (DOH)

The State DOH defines three classes of zoning districts and specifies corresponding maximum permissible sound levels due to stationary noise sources such as air-conditioning units, exhaust systems, generators, compressors, pumps, etc., and equipment related agricultural, construction, and industrial activities [Reference 1]. These levels are enforced for any location at or beyond the property line and shall not be exceeded for more than 10% of the time during any 20-minute period. The specified noise limits which apply are a function of the zoning and time of day as shown in Figure 5. With respect to mixed zoning districts, DOH specifies the primary land use designation shall be used to determine the applicable zoning district class and the maximum permissible sound level.

The State Department of Health defines a heavy vehicle as a vehicle which has a manufacturer's gross vehicular weight rating of ten thousand pounds or greater. Such vehicles shall not be operated on any trafficway in such a manner that it emits noise in excess of the limits specified in Reference 2. If these limits will be exceeded a permit from the DOH director is required.

### 3.2 City and County of Honolulu Land Use Ordinance (LUO)

The City's LUO specifies maximum allowable levels at the property line [Reference 3]. The LUO criteria differ from those of the DOH in that they use octave band sound levels instead of A-weighted sound levels and no temporal factor is involved. LUO noise regulations are theoretically enforced by the Building Department; however, since this Department does not have noise measurement capability, noise complaints are usually handled by DOH.

3.3 U.S. Environmental Protection Agency (EPA)

The U.S. EPA has identified a range of yearly day-night equivalent sound levels,  $L_{dn}$ , sufficient to protect public health and welfare from the effects of environmental noise [Reference 4]. The EPA has established a goal to reduce exterior environmental noise to an  $L_{dn}$  not exceeding 65 dBA and a future goal to further reduce exterior environmental noise to an  $L_{dn}$  not exceeding 55 dBA. Additionally, the EPA states that these goals are not intended as regulations as it has no authority to regulate noise levels, but rather they are intended to be viewed as levels below which the general population will not be at risk from any of the identified effects of noise.

3.4 U.S. Federal Highway Administration (FHWA)

The FHWA defines four land use categories and assigns corresponding maximum hourly equivalent sound levels,  $L_{eq}$ , for traffic noise exposure [Reference 5]. For example, Category B, defined as picnic and recreation areas, parks, residences, motels, hotels, schools, churches, libraries, and hospitals, has a corresponding maximum exterior  $L_{eq}$  of 67dBA and a maximum interior  $L_{eq}$  of 52 dBA. These limits are viewed as design goals, and all projects meeting these limits are deemed in conformance with FHWA noise standards.

3.5 State Department of Transportation, Highways Division (HDOT)

The State HDOT has adopted FHWA's design goals for traffic noise exposure in its noise analysis and abatement policy [Reference 6]. According to the policy, a traffic noise impact occurs when the predicted traffic noise levels "approach" or exceed FHWA's design goals or when the predicted traffic noise levels "substantially exceed the existing noise levels." The policy also states that "approach" means at least 1 dB less than FHWA's design goals and "substantially exceed the existing noise levels" means an increase of at least 1 SdB.

4.0 EXISTING ACOUSTICAL ENVIRONMENT

Noise level measurements were conducted on July 7 and 8, 1998 to assess the existing acoustical environment on and adjacent to the project site. The measurements were obtained at Locations 1 through 5 as shown in Figure 6, using Larson-Davis Laboratories, Models 700, 800, and 820, sound level meters. The following results expressed in terms of equivalent sound levels,  $L_{eq}$ , and in units of A-weighted decibels were obtained.

Measurement Location	Time of Measurement	Duration of Measurement	Sound Pressure Levels (dBA)
1	4:00 pm	21 min 55 sec	50.7
2	4:05 pm	10 min 00 sec	60.6
3	4:32 pm	14 min 30 sec	47.5
4	5:03 pm	16 min 30 sec	59.1
5	3:00 pm	60 min 00 sec	42.6

Presently, the dominant noise sources at the above locations include traffic, wind, and occasional distant aircraft flybys. Traffic volumes and vehicle mix were also recorded during measurements at locations 2 and 4.

5.0 POTENTIAL NOISE IMPACT DUE TO THE PROJECT AND NOISE MITIGATION

5.1 Project Construction Noise

Development of the Diamond Head State Monument will involve excavation, grading, demolition of existing buildings, and construction of new buildings and infrastructure. The various construction phases of the project may generate significant amounts of noise, which may impact nearby residential areas. The actual noise levels produced will be a function of the methods employed during each stage of the construction process. Typical ranges of construction equipment noise are shown in Figure 7. Earthmoving equipment, e.g., bulldozers and diesel-powered trucks, will probably be the loudest equipment used during construction, assuming that pile driving will not be required.

In cases where construction noise exceeds, or is expected to exceed the DOH's "maximum permissible" property line noise levels [Reference 1], a permit must be obtained from the DOH to allow the operation of vehicles, construction equipment, power tools, etc., which emit noise levels in excess of "maximum permissible" levels. Specific permit restrictions for construction activities are:

"No permit shall allow any construction activities which emit noise in excess of the maximum permissible sound levels...before 7:00 a.m. and after 6:00 p.m. of the same day, Monday through Friday."

### 5.3 Parking Areas

Development and renovation of the Cannon Club parking area will temporarily impact nearby residences. The DOH construction noise regulations discussed above should be adhered to during all phases of construction and renovation.

The Cannon Club parking area, due to automobiles, trolleys, and people, could impact nearby residences. Noise from stop-and-go traffic as vehicles enter and exit the proposed Cannon Club parking area may cause annoyance to nearby residences. To avoid this problem, the parking area entrance/exit should be located as far as possible from any residences. Additionally, restricting vehicular traffic to the upper portion of the Cannon Club parking area farthest from Mauke Street would significantly reduce the probability of noise complaints. Alternately, development of a parking area across from Kapiolani Community College along Diamond Head Road would significantly reduce the noise impact on local residences but could impact the Chapel, located across from this proposed parking area, if noise sensitive activities are conducted during peak hours. If this alternative is chosen noise mitigation at the Chapel, e.g., air conditioning, should be considered. Finally, to eliminate trolley noise, electric trolleys could be used.

The increased flow of pedestrians in and around the Cannon Club parking area could impact nearby residences. Construction of an enclosed or semi-enclosed trolley waiting area facing away from the residential area would alleviate much of the impact from pedestrians' voices.

"No permit shall allow any construction activities which emit noise in excess of the maximum permissible sound levels...before 9:00 a.m. and after 6:00 p.m. on Saturday."

"No permit shall allow any construction activities which emit noise in excess of the maximum permissible sound levels on Sundays and on holidays."

In addition, construction equipment and on-site vehicles or devices whose operations involve the exhausting of gas or air, excluding pile hammers and pneumatic hand tools weighing less than 15 pounds, must be equipped with mufflers, and construction vehicles using trafficways must satisfy the DOH's vehicular noise requirements [Reference 2].

Blasting, if required, could also produce noise impacts. However, blasting at construction sites near populated areas is usually accomplished by using numerous small charges detonated with small time delays. Blast mats can also be used to assist in directing the explosive energy into the rock, controlling flying debris, and muffling the noise. Thus, with the appropriate blast design techniques, the noise from blasting can be controlled within acceptable limits at the closest noise sensitive locations.

Any construction vehicles stored at the project site should be located inside the crater and not in the Cannon Club parking area in order to reduce noise impact on the residences in the vicinity of the Cannon Club. Additionally, if demolition inside the crater is to occur while the National Guard buildings are still occupied, then noise mitigation for these buildings should be considered.

### 5.2 Project Generated Traffic Noise

Measured traffic noise levels along with the traffic volume and vehicle mix counts obtained during the measurements were used to calibrate the FHWA's Traffic Noise Prediction Model [Reference 7]. The noise model together with the traffic data [Reference 8] was then used to calculate the peak hour traffic noise levels with and without the project. The results are presented in Table 1.

From the results of Table 1, traffic noise level increases, with and without the project, were calculated and are presented in Table 2. As can be seen, the predicted maximum traffic noise level increase along the assessed roadways due to the project is 0.4 dBA, which is below the threshold of change in noise level that is perceptible to most people with normal hearing.



**REFERENCES:**

1. Chapter 46, *Community Noise Control*, Department of Health, State of Hawaii, Administrative Rules, Title 11, September 23, 1996.
2. Chapter 42, *Vehicular Noise Control for Oahu*, Department of Health, State of Hawaii, Administrative Rules, Title 11, November 6, 1981.
3. Section 3.11 *Noise Regulations, Land Use Ordinance*, City and County of Honolulu, Oahu, October 22, 1986.
4. *Toward a National Strategy for Noise Control*, U.S. Environmental Protection Agency, April 1977.
5. *Department of Transportation, Federal Highway Administration Procedures for Abatement of Highway traffic Noise*, Title 23, CFR, Chapter 1, Subchapter J, Part 772, 38 FR 15953, June 19, 1973; Revised at 47 FR 29654, July 8, 1982.
6. *Noise Analysis and Abatement Policy*, Department of Transportation, Highways Division, State of Hawaii, June 1977.
7. *FHWA Highway Traffic Noise Prediction Model*, FHWA-RD-77-108; U.S. Department of Transportation, December 1978.
8. Traffic Data Received from Parsons Brinckerhoff Quade & Douglas, Inc., August 11, 14 and 27, 1998.

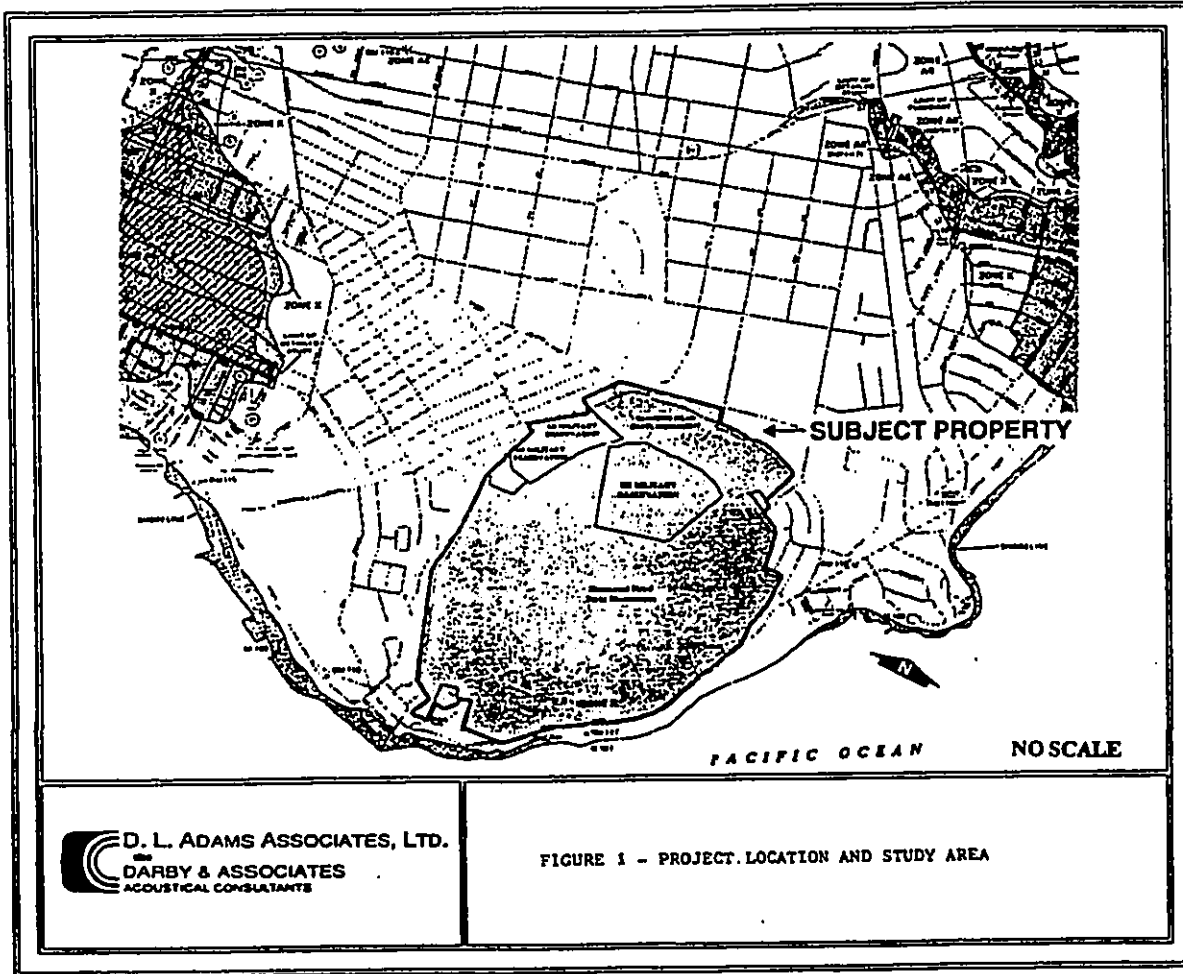
**TABLE 1**  
**EXISTING AND PROJECTED FUTURE PEAK HOUR**  
**TRAFFIC NOISE LEVELS (L<sub>eq</sub> in dBA)**

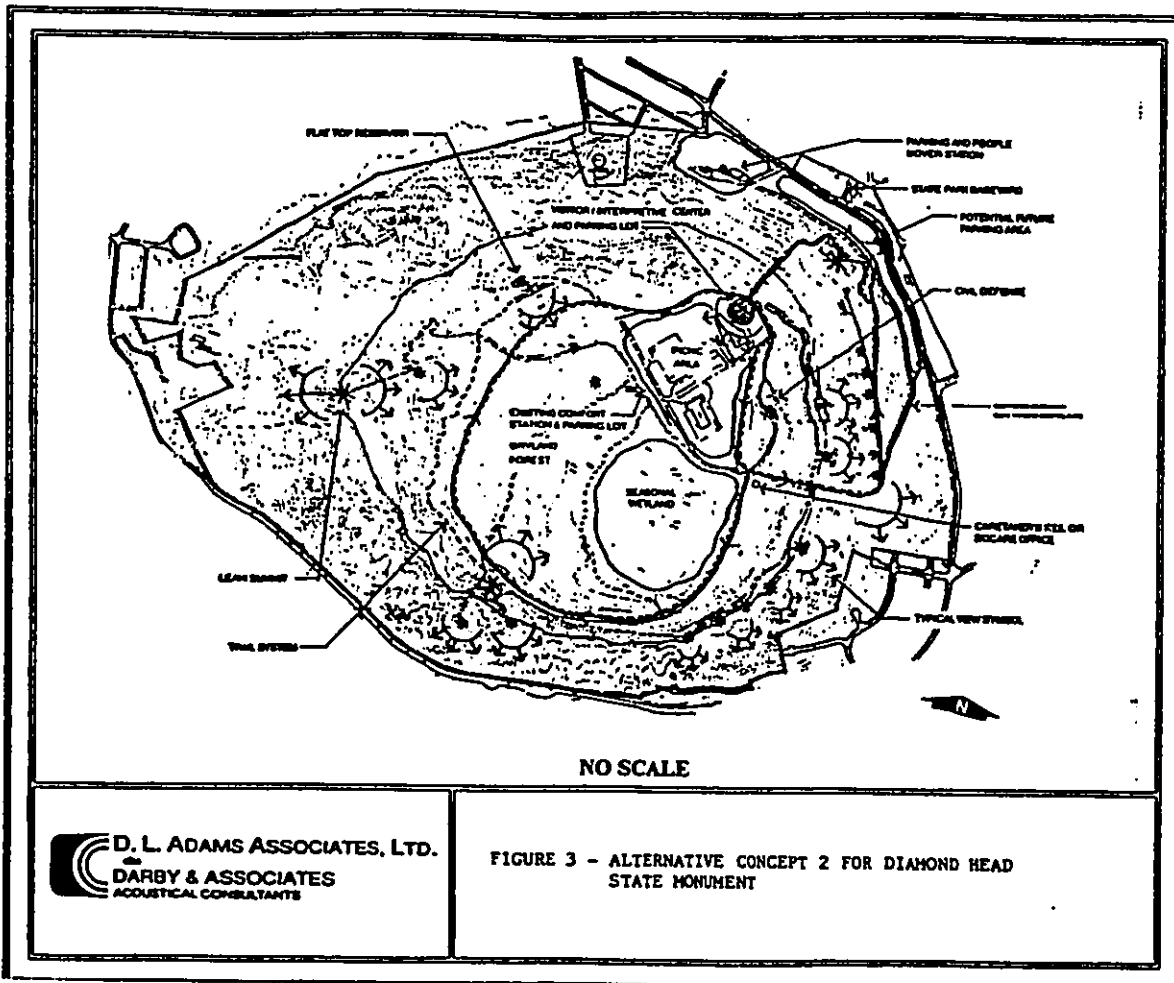
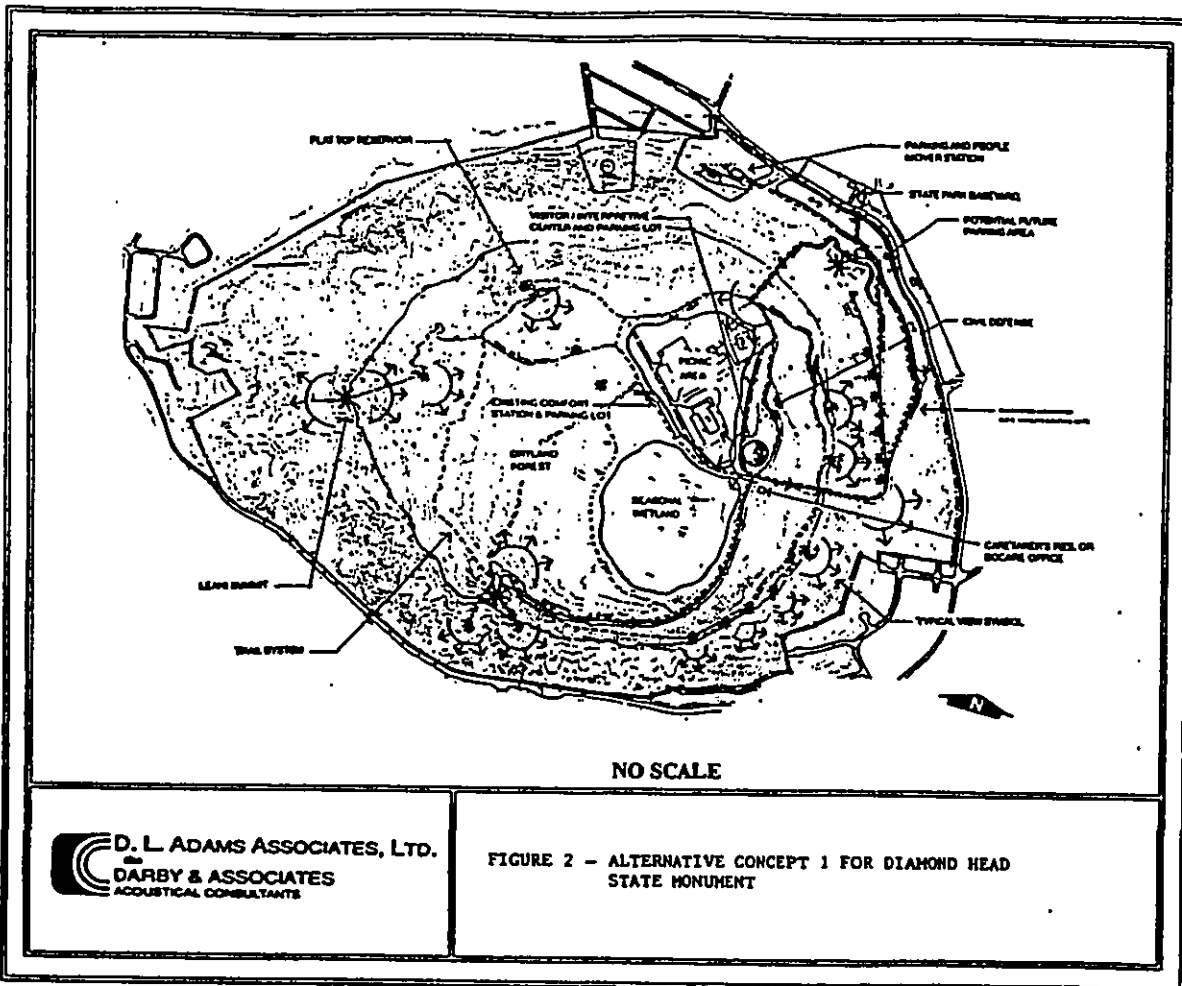
	Diamond Head Road West of Project		Diamond Head Road East of Project		Makapuu Avenue		18 <sup>th</sup> Avenue	
	AM	PM	AM	PM	AM	PM	AM	PM
Existing Level (Calculated)	63.8	63.1	60.2	59.3	57.6	58.6	61.2	60.6
Future Without Project (2003)	63.7	62.9	60.1	59.0	57.7	58.7	61.3	60.7
Future Without Project (2008)	63.8	63.0	60.1	59.5	57.8	58.8	61.4	60.8
Future With Project (2003)	63.8	63.2	60.3	59.4	57.7	58.7	61.3	60.7
Future With Project (2008)	64.0	63.3	60.3	59.5	57.8	58.8	61.4	60.8

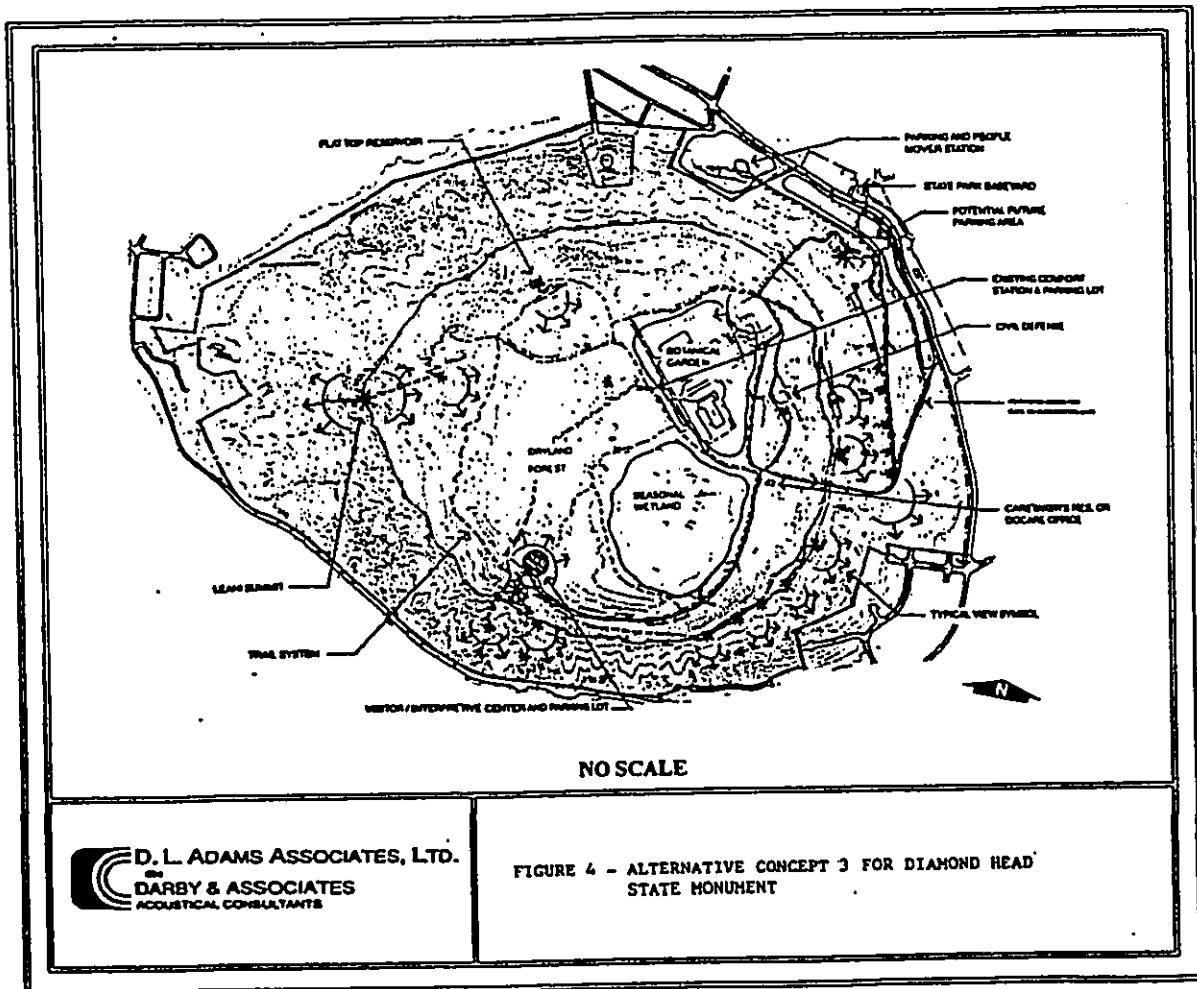
TABLE 2  
PROJECTED FUTURE PEAK HOUR TRAFFIC NOISE  
LEVEL INCREASES ( $L_{eq}$  in dBA)

	Diamond Head Road West of Project		Diamond Head Road East of Project		Makepua Avenue		18 <sup>th</sup> Avenue	
	AM	PM	AM	PM	AM	PM	AM	PM
Future Increase Without Project (2003)	-0.1	-0.2	-0.1	-0.3	0.1	0.1	0.1	0.1
Future Increase Without Project (2008)	0.0	-0.1	-0.1	0.2	0.2	0.2	0.2	0.2
Future Increase With Project (2003)	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Future Increase With Project (2008)	0.2	0.2	0.1	0.2	0.2	0.2	0.2	0.2
Increase Due to the Project (2003)	0.1	0.3	0.2	0.4	0.0	0.0	0.0	0.0
Increase Due to the Project (2008)	0.2	0.3	0.2	0.2	0.0	0.0	0.0	0.0

Note: A negative number indicates a decrease in traffic noise level.

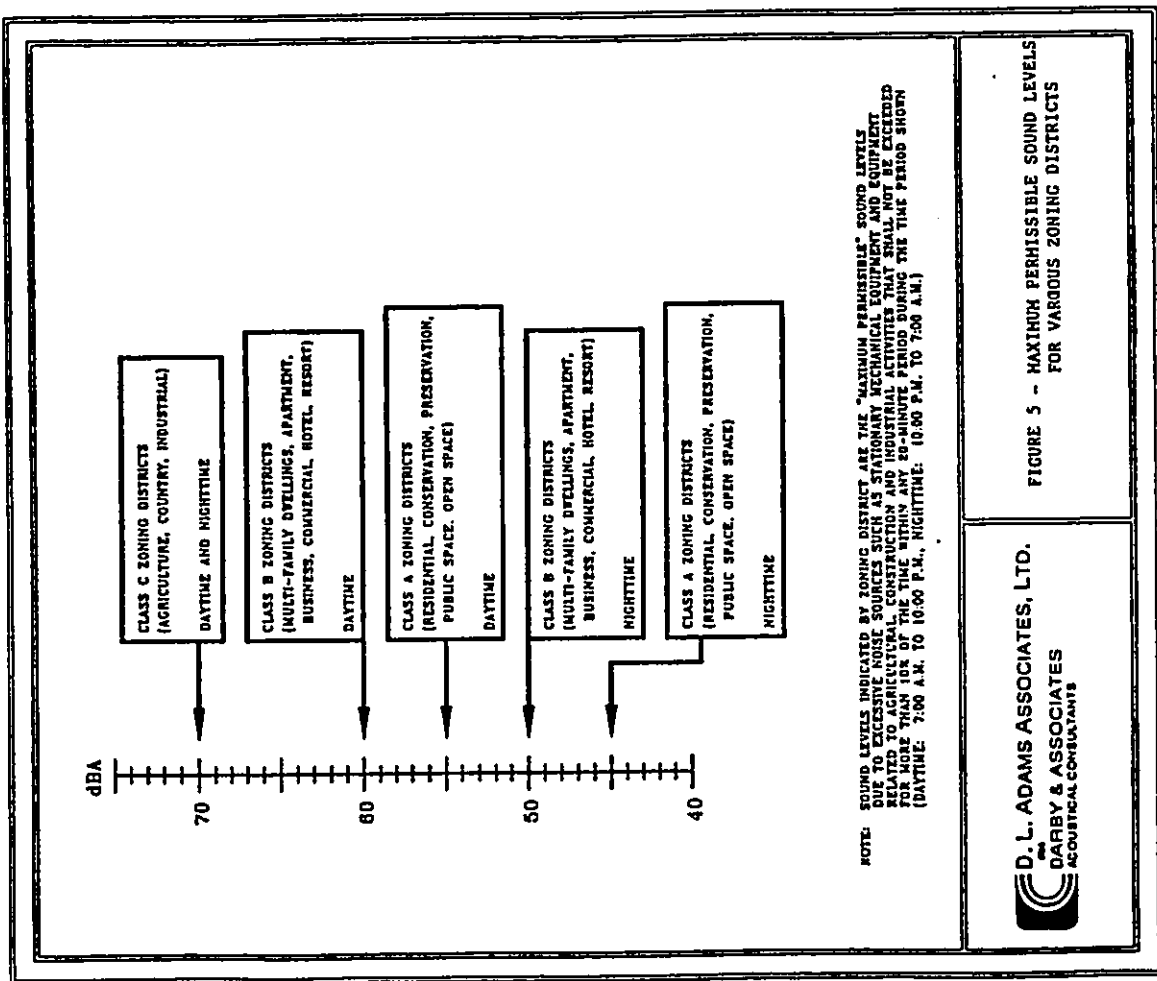






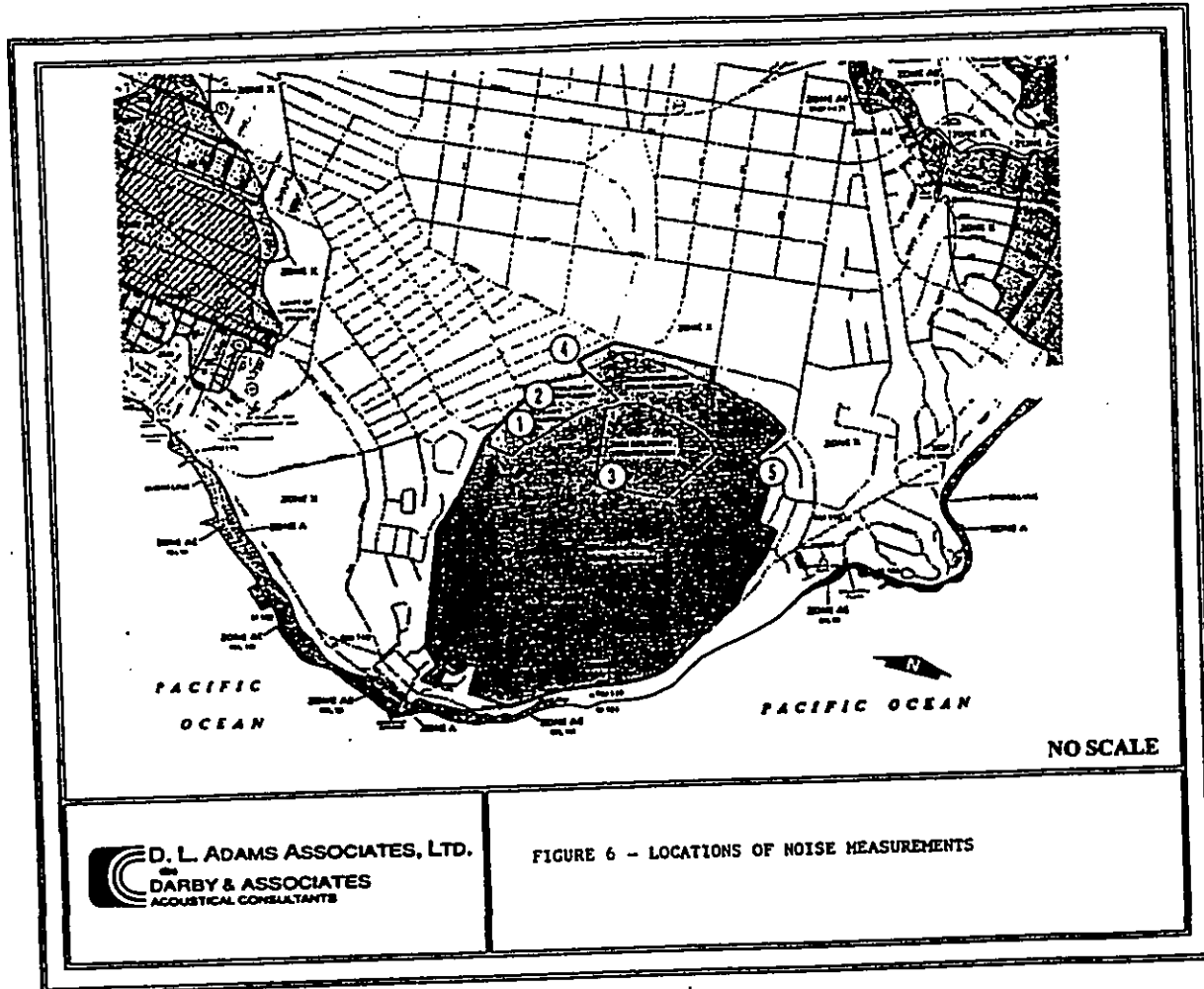
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FIGURE 4 - ALTERNATIVE CONCEPT 3 FOR DIAMOND HEAD STATE MONUMENT



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FIGURE 5 - MAXIMUM PERMISSIBLE SOUND LEVELS FOR VARIOUS ZONING DISTRICTS



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FIGURE 6 - LOCATIONS OF NOISE MEASUREMENTS

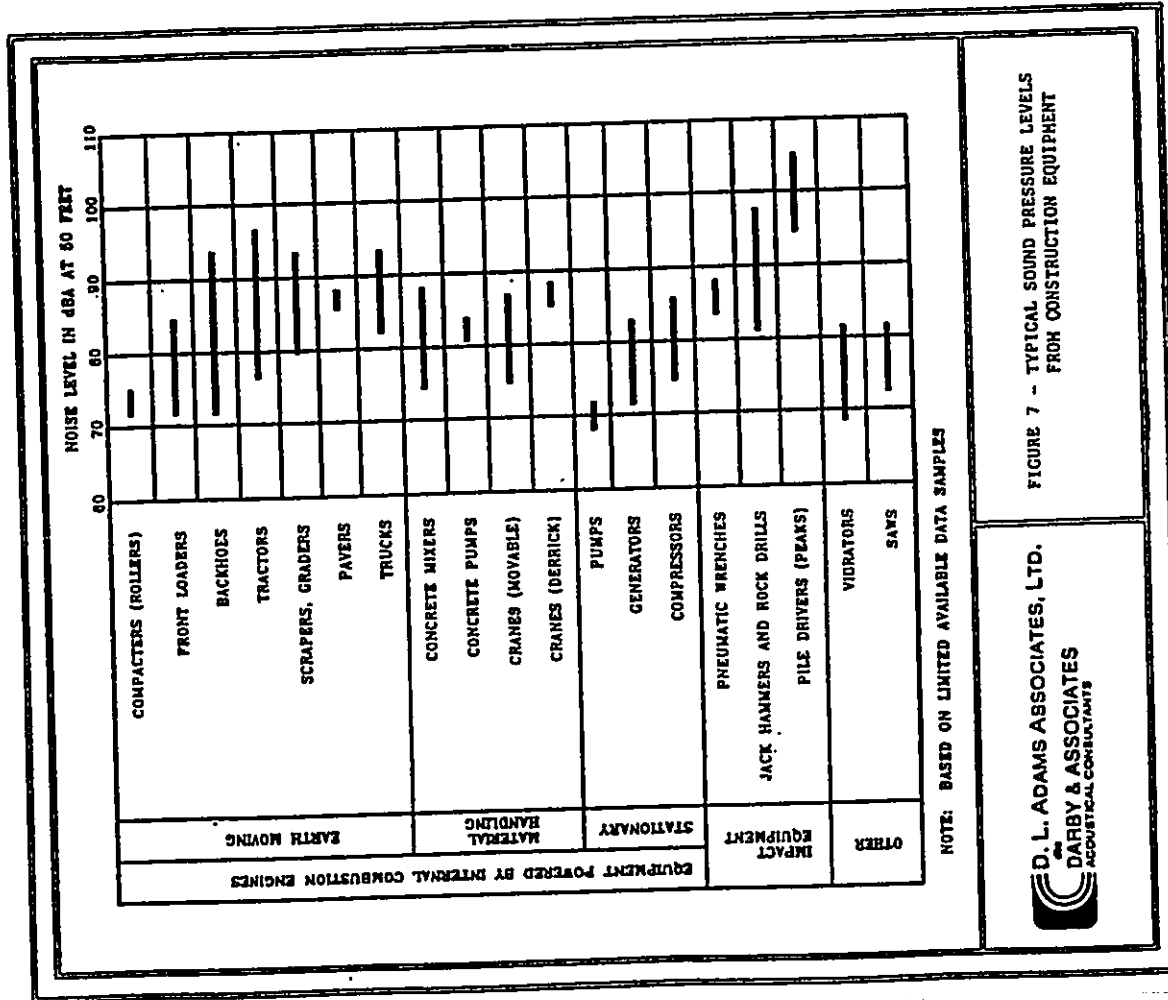


FIGURE 7 - TYPICAL SOUND PRESSURE LEVELS FROM CONSTRUCTION EQUIPMENT

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Statistical Sound Levels

The sound levels of long-term noise producing activities, such as traffic movement, aircraft operations, etc., can vary considerably with time. In order to obtain a single number rating of such a noise source, a statistically-based method of expressing sound or noise levels developed. It is known as the Exceedence Level,  $L_n$ . The Exceedence Level,  $L_n$ , represents the sound level which is exceeded for  $n\%$  of the measurement time period. For example,  $L_{10} = 60$  dBA indicates that for the duration of the measurement period, the sound level exceeded 60 dBA 10% of the time. Commonly used Exceedence Levels include  $L_1$ ,  $L_{10}$ ,  $L_{50}$ , and  $L_{90}$ , which are widely used to assess community and environmental noise. Figure A-2 illustrates the relationship between selected statistical noise levels.

Equivalent Sound Level

The Equivalent Sound Level,  $L_{eq}$ , represents a constant level of sound having the same total acoustic energy as that contained in the actual time-varying sound being measured over a specific time period.  $L_{eq}$  is commonly used to describe community noise, traffic noise, and hearing damage potential. It has units of dBA and is illustrated in Figure A-2.

Day-Night Equivalent Sound Level

The Day-Night Equivalent Sound Level,  $L_{dn}$ , is the Equivalent Sound Level,  $L_{eq}$ , measured over a 24-hour period. However, a 10 dB penalty is added to the noise levels recorded between 10 pm and 7 am to account for people's higher sensitivity to noise at night when the background noise level is typically lower. The  $L_{dn}$  is a commonly used noise descriptor in assessing land use compatibility, and is widely used by federal and local agencies and standards organizations. Qualitative descriptions, as well as local examples of  $L_{dn}$ , are shown in Figure A-3.

Sound Pressure Level

Sound or noise consists of minute fluctuations in atmospheric pressure capable of evoking the sense of hearing. It is measured in terms of decibels (dB) using precision instruments known as sound level meters. Noise is defined as "unwanted" sound.

Technically, sound pressure level (SPL) is defined as:

$$SPL = 20 \log (P/P_{ref}) \text{ dB}$$

where  $P$  is the sound pressure fluctuation (above or below atmospheric pressure) and  $P_{ref}$  is the reference pressure, 20 micropascals, which is approximately the lowest sound pressure that can be detected by the human ear. For example, if  $P$  is 20 micropascals, then  $SPL = 0$  dB, or if  $P$  is 200 micropascals, then  $SPL = 20$  dB. The relation between sound pressure in micropascals and sound pressure level in decibels (dB) is shown in Figure A-1.

The sound pressure level that results from a combination of noise sources is not the arithmetic sum of the individual sound levels, but rather the logarithmic sum. For example, two sound levels of 50 dB produce a combined level of 53 dB, not 100 dB; two sound levels of 40 and 50 dB produce a combined level of 50.4 dB.

Human sensitivity to changes in sound pressure level is highly individualized. Sensitivity to sound depends on frequency content, time of occurrence, duration, and psychological factors such as emotions and expectations. However, in general, a change of 1 or 2 dB in the level of a sound is difficult for most people to detect. A 3 dB change is commonly taken as the smallest perceptible change and a 5 dB change corresponds to a noticeable change in loudness. A 10 dB increase or decrease in sound level corresponds to an approximate doubling or halving of loudness, respectively.

A-Weighted Sound Level

The human ear is more sensitive to sound in the frequency range of 250 Hertz (Hz) and higher, than in frequencies below 250 Hz. Due to this type of frequency response, a frequency weighting system, was developed to emulate the frequency response of the human ear. This system expresses sound levels in units of A-weighted decibels (dBA). A-weighted sound levels de-emphasizes the low frequency portion of the spectrum of a signal. The A-weighted level of a sound is a good measure of the loudness of that sound. Different sounds having the same A-weighted sound level are perceived as being about equally loud. Typical values of the A-weighted sound level of various noise sources are shown in Figure A-1.

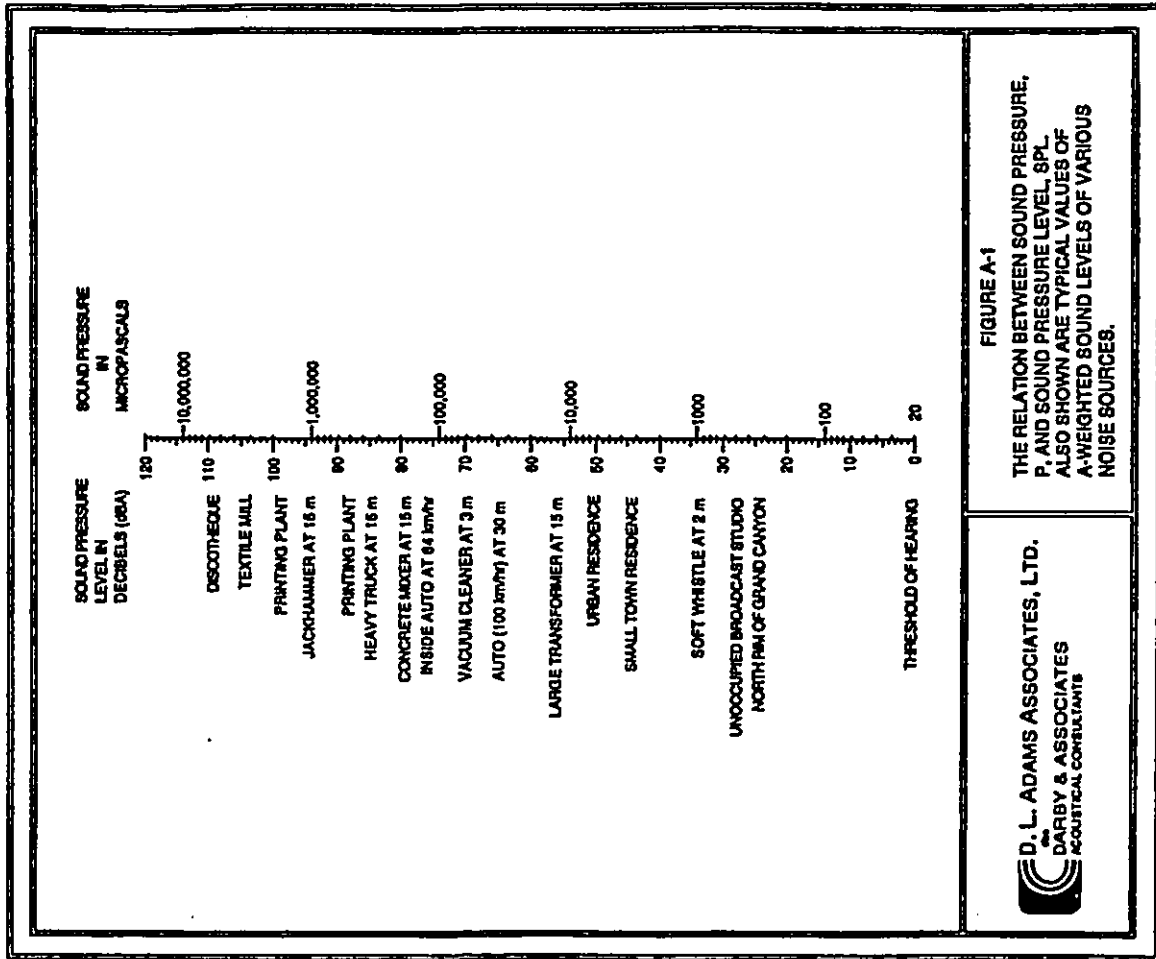


FIGURE A-1  
THE RELATION BETWEEN SOUND PRESSURE, P, AND SOUND PRESSURE LEVEL, SPL. ALSO SHOWN ARE TYPICAL VALUES OF A-WEIGHTED SOUND LEVELS OF VARIOUS NOISE SOURCES.

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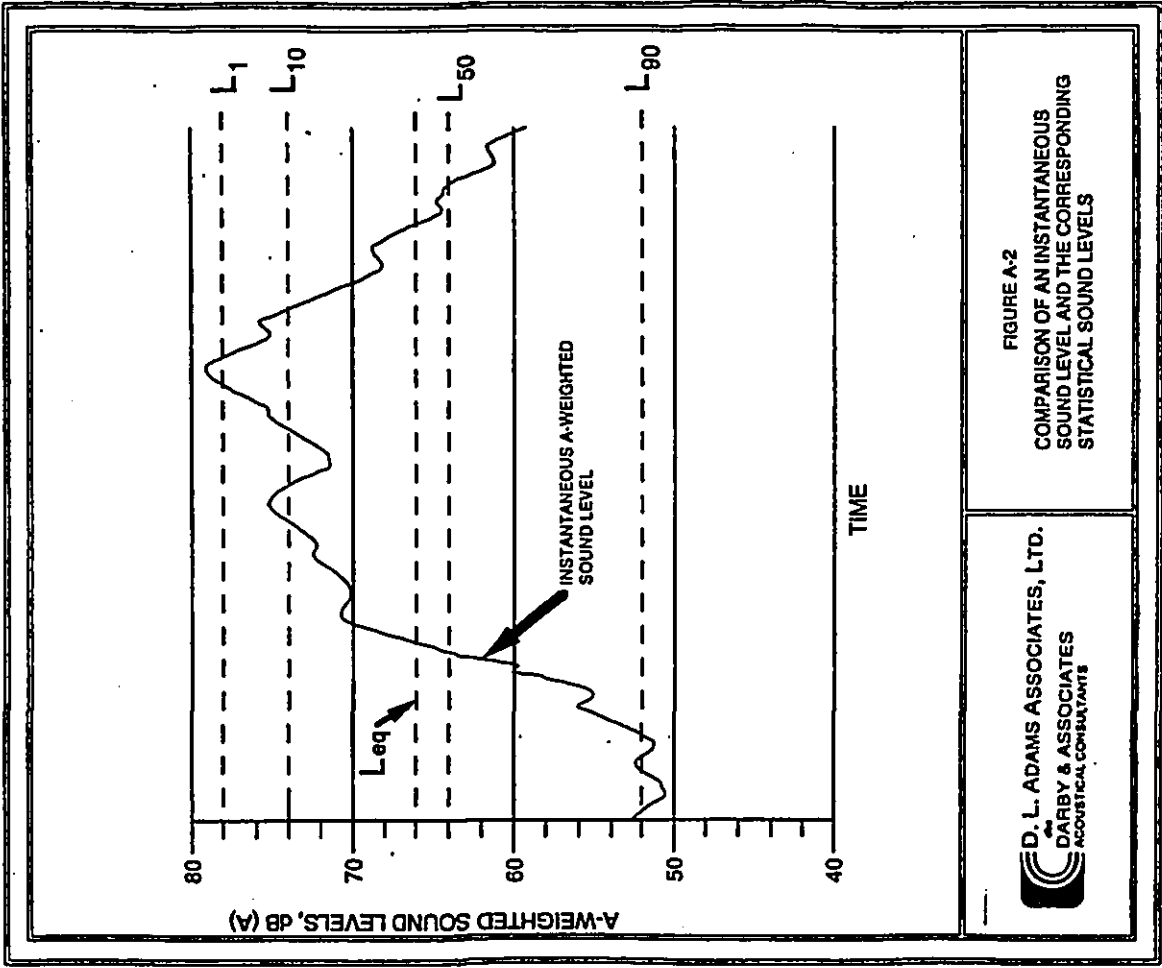


FIGURE A-2  
COMPARISON OF AN INSTANTANEOUS SOUND LEVEL AND THE CORRESPONDING STATISTICAL SOUND LEVELS

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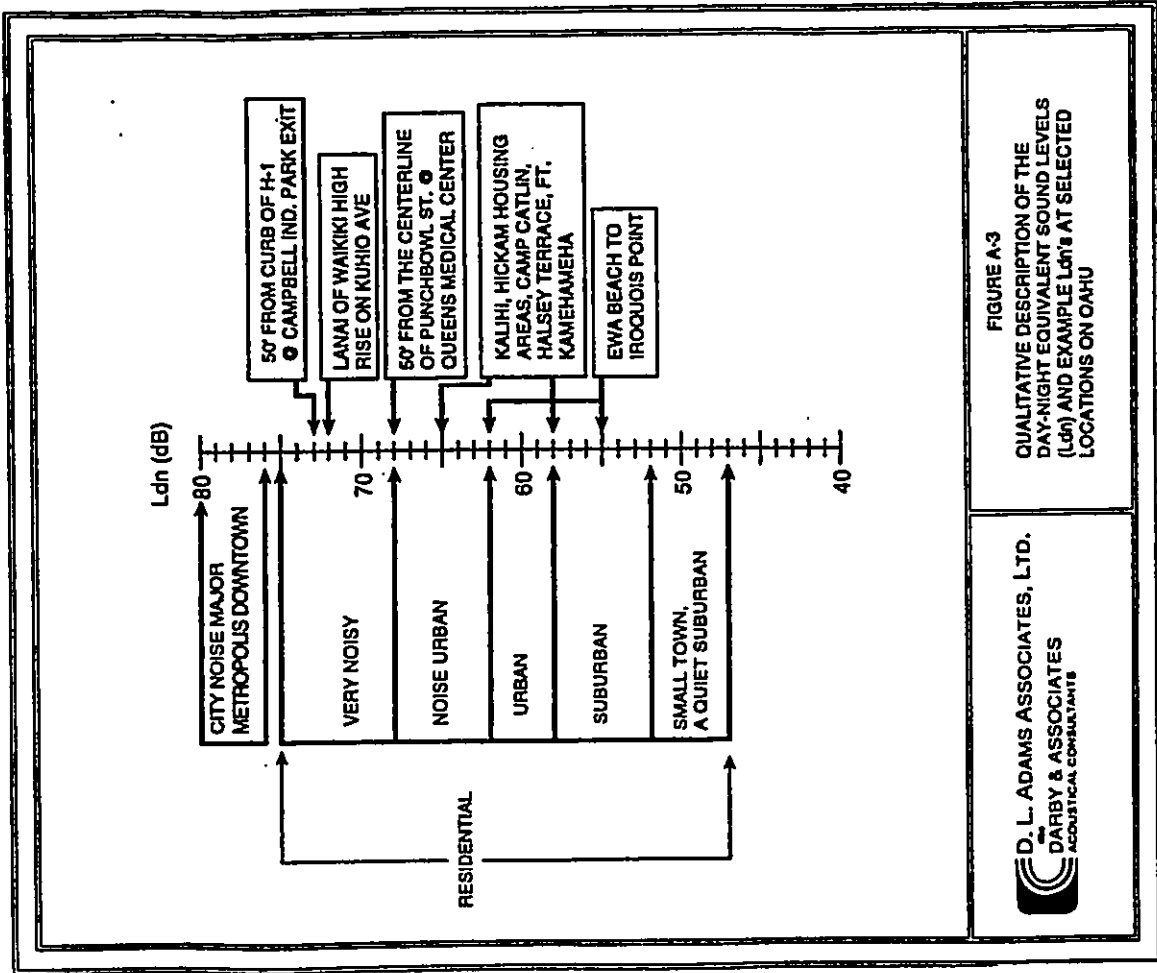


FIGURE A-3  
 QUALITATIVE DESCRIPTION OF THE  
 DAY-NIGHT EQUIVALENT SOUND LEVELS  
 ( $L_{dn}$ ) AND EXAMPLE  $L_{dn}$ 's AT SELECTED  
 LOCATIONS ON OAHU

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*Appendix G*  
Air Quality Study

**AIR QUALITY STUDY  
FOR THE PROPOSED  
DIAMOND HEAD STATE MONUMENT  
MASTER PLAN UPDATE**

**HONOLULU, HAWAII**

Prepared for:  
**YBR Hawaii**

October 1998



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- 2 Annual Wind Frequency for Honolulu International Airport
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- 5 Estimated Worst-Case 1-Hour Carbon Monoxide Concentrations Near Diamond Head State Monument Master Plan Project
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1.0 SUMMARY

The State Department of Land and Natural Resources is proposing to update the Master Plan for the Diamond Head State Monument located on the island of Oahu. The Diamond Head State Monument includes approximately 500 acres of land, including the Diamond Head Crater. The original Master Plan for the Diamond Head State Monument was developed in 1979. Since that time, visitor counts have increased significantly, and areas of the crater used for non-visitor purposes either have been or soon will be vacated. Because of these changes and the long span of time since the original Master Plan was developed, the State Legislature directed that the Master Plan be updated.

Visitor facilities that currently exist at the Diamond Head State Monument include a parking lot, public restrooms and trail to Leahi Summit. Many of the elements envisioned in the original Master Plan which have not yet been realized, such as an interpretive center, a dryland habitat, public picnic areas, a nursery and maintenance yard and beautification of Diamond Head Road, will be retained in the Master Plan Update. Three alternative concepts for the Master Plan Update are being considered. The three alternative concepts differ primarily with respect to site access, visitor parking and interior roadway design. The purpose of this study is to examine the potential short- and long-term air quality impacts that could occur as a result of the implementation of the proposed Master Plan Update. Mitigative measures to reduce any potential air quality impacts from the project are suggested where possible and appropriate.

Both federal and state standards have been established to maintain ambient air quality. At the present time, seven parameters are

regulated including: particulate matter, sulfur dioxide, hydrogen sulfide, nitrogen dioxide, carbon monoxide, ozone and lead. Hawaii air quality standards are more stringent than the comparable national limits except for sulfur dioxide and the recently revised national particulate matter standard.

Regional and local climate together with the amount and type of human activity generally dictate the air quality of a given location. The climate of the Diamond Head area is very much affected by its leeward and coastal situation. Outside of the crater, winds are predominantly trade winds from an easterly direction, and wind speeds typically vary between about 5 and 20 miles per hour, providing good ventilation much of the time. Within the crater, winds can be expected to be lighter and more variable due to the terrain sheltering effects. Temperatures in the Diamond Head area are generally very moderate with average daily minimum and maximum temperatures ranging from about 70°F to 85°F. Average annual rainfall measured at nearby Black Point amounts to about 21 inches. Most of the rainfall usually occurs during the winter months. Temperature and rainfall at the project site may be somewhat different from nearby areas outside the crater due to the microclimatic effects caused by the crater terrain.

Air quality in the vicinity of the proposed project is currently mostly affected by emissions from motor vehicles and to a lesser extent from distant agricultural, industrial and natural sources. The state Department of Health operates a network of air quality monitoring stations located at various sites around the state. Based on data from these stations, it appears likely that both state and national ambient air quality standards are currently

being met in the project area except possibly for occasional exceedances of the more stringent state standard pertaining to ambient ozone. Areas near traffic congestion may also exceed the more stringent state standards for carbon monoxide at times.

If the proposed project is given the necessary approvals to proceed, it is inevitable that some short- and long-term impacts on air quality will occur either directly or indirectly as a consequence of project construction and use. Short-term impacts from fugitive dust will likely occur during project construction phases. This is particularly so because of the relatively dry climate in the project area. To a lesser extent, exhaust emissions from stationary and mobile construction equipment, from the disruption of traffic, and from workers' vehicles may also affect air quality during the period of construction. State air pollution control regulations require that there be no visible fugitive dust emissions at the property line. Hence, an effective dust control plan must be implemented to ensure compliance with state regulations. Fugitive dust emissions can be controlled to a large extent by watering of active work areas, using wind screens, keeping adjacent paved roads clean, and by covering of open-bodied trucks. Other dust control measures could include limiting the area that can be disturbed at any given time and/or mulching or chemically stabilizing inactive areas that have been worked. Paving and landscaping of project areas early in the construction schedule will also reduce dust emissions. Monitoring dust at the project boundary during the period of construction could be considered as a means to evaluate the effectiveness of the project dust control program. Exhaust emissions can be mitigated by moving construction equipment and workers to and from the project site during off-peak traffic hours.

After project construction phases are complete, long-term impacts on air quality could potentially occur indirectly as a result of emissions emanating from vehicular traffic coming to and from the development. Access to the site will be accomplished primarily via Diamond Head Road and an access road or driveway to the visitor parking area. To assess the impact of emissions from these vehicles, an air quality modeling study was undertaken to estimate future maximum ambient concentrations of carbon monoxide at several locations along Diamond Head Road. Based on the modeling results, future worst-case carbon monoxide concentrations at nearby locations outside the crater should remain well within the state and national standards with any of the three project concepts currently being contemplated. Within the crater, Alternative Concept 2 or 3 could be expected to provide a positive impact on air quality by keeping visitor traffic outside the crater, but even if traffic is allowed inside the crater under Alternative Concept 1, it is likely that air pollution levels would remain well within the allowable limits. The only long-term mitigation measure that is suggested is to prohibit tour buses from idling for prolonged periods at visitor parking areas.

## 2.0 INTRODUCTION AND PROJECT DESCRIPTION

The State Department of Land and Natural Resources (DLNR) is proposing to update the Master Plan for the Diamond Head State Monument (DHSM). Currently, the DHSM consists of nearly 500 acres of land that includes the volcanic crater known as Diamond Head, one of Hawaii's most famous landmarks. Diamond Head, also known as Leahi, lies on the southern coastline of the island of Oahu (see Figure 1). The summit of Leahi, at 761 ft above sea level, affords an excellent and unobstructed view of Oahu's southern coast while the crater floor provides a quiet retreat from the

adjacent urban areas of Honolulu. Facilities for visitors currently within the DHSM area include a parking area, public restrooms and a trail to the Leahi Summit. Also, currently co-existing with visitor related facilities, are several structures and facilities that are used by the Federal Aviation Administration, the U.S. Army and the Hawaii Department of Defense. Access to the DHSM is accomplished via an entry road that intersects with Diamond Head Road near Kapiolani Community College.

Since the DHSM Master Plan was originally prepared in 1979, visitor counts at the DHSM have increased from 41,000 in 1980-81 to 1,000,000 in 1996-97. The significant increase in visitors during the past several years has impacted the natural resources and public facilities within the DHSM. Further, in accordance with the 1979 Master Plan, the Federal Aviation Administration, the U.S. Army and the Hawaii Department of Defense are currently in the process of vacating their facilities within the Diamond Head Crater. In 1997, the State Legislature recognized the need to update the Master Plan in response to these changes since the original Plan was prepared, and the expenditure of funds was approved to accomplish this.

The original 1979 Master Plan provided for interior roadways and parking, an interpretive center, a caretaker residence, public restrooms, picnic areas, a dryland habitat, management of Leahi Summit, a trail system, landscaping, a nursery and maintenance yard, and beautification of Diamond Head Road. Many of the original plans have yet to be realized.

Three alternative concepts are currently being considered for the Master Plan Update. All three alternative concepts retain most of

the major elements of the 1979 Plan. The major differences amongst the three concepts relate to the site access, visitor parking areas and interior roadways. In Alternative Concept 1, site access would be provided at the Diamond Head entry road to Kapiolani Community College, and visitor parking would continue to be provided inside the crater. In Alternative Concept 2, site access would occur primarily at the Diamond Head entry road to Kapiolani Community College, and a secondary gate-controlled access road would be provided at the location of the present access road. In this concept, visitor and tour bus parking would be relocated outside the crater to an area below Battery Harlow (a historic defense installation within the DHSM). In Alternative Concept 3, visitor and tour bus parking would be provided outside the crater at the Cannon Club located along Diamond Head Road. In this concept, an entry and an exit would be provided to and from the parking area at the Cannon Club, and a secondary gate-controlled access road would be provided at the location of the present access road. Alternative Concepts 2 and 3 would provide a people mover system to transport visitors back and forth between the exterior parking areas and the crater, i.e., no visitor traffic would be allowed in the crater. Variations of the three concepts as recommended by the project traffic consultant are also being considered.

The purpose of this study is to describe existing air quality in the project area and to assess the potential short-term and long-term direct and indirect air quality impacts that could result from construction and use of the proposed facilities as planned. Measures to mitigate these impacts are suggested where possible and appropriate.

### 3.0 AMBIENT AIR QUALITY STANDARDS

Ambient concentrations of air pollution are regulated by both national and state ambient air quality standards (AAQS). National AAQS are specified in Section 40, Part 50 of the Code of Federal Regulations (CFR), while State of Hawaii AAQS are defined in Chapter 11-59 of the Hawaii Administrative Rules. Table 1 summarizes both the national and the state AAQS that are specified in the cited documents. As indicated in the table, national and state AAQS have been established for particulate matter, sulfur dioxide, nitrogen dioxide, carbon monoxide, ozone and lead. The state has also set a standard for hydrogen sulfide. National AAQS are stated in terms of both primary and secondary standards for most of the regulated air pollutants. National primary standards are designed to protect the public health with an "adequate margin of safety". National secondary standards, on the other hand, define levels of air quality necessary to protect the public welfare from "any known or anticipated adverse effects of a pollutant". Secondary public welfare impacts may include such effects as decreased visibility, diminished comfort levels, or other potential injury to the natural or man-made environment, e.g., soiling of materials, damage to vegetation or other economic damage. In contrast to the national AAQS, Hawaii State AAQS are given in terms of a single standard that is designed "to protect public health and welfare and to prevent the significant deterioration of air quality".

Each of the regulated air pollutants has the potential to create or exacerbate some form of adverse health effect or to produce environmental degradation when present in sufficiently high concentration for prolonged periods of time. The AAQS specify a maximum allowable concentration for a given air pollutant for one or more averaging times to prevent harmful effects. Averaging

times vary from one hour to one year depending on the pollutant and type of exposure necessary to cause adverse effects. In the case of the short-term (i.e., 1- to 24-hour) AAQS, both national and state standards allow a specified number of exceedances each year.

State of Hawaii AAQS are in some cases considerably more stringent than comparable national AAQS. In particular, the State of Hawaii 1-hour AAQS for carbon monoxide is four times more stringent than the comparable national limit, and the state 1-hour limit for ozone is more than two times as stringent as the national 1-hour standard. The national 1-hour ozone standard will be phased out during the next three years in favor of the new (and more stringent) 8-hour standard.

Hawaii AAQS for sulfur dioxide were relaxed in 1986 to make the state standards essentially the same as the national limits. In 1993, the state also revised its particulate standards to follow those set by the federal government. During 1997, the federal government again revised its standards for particulate. To date, the Hawaii Department of Health has not updated the state particulate standards.

#### 4.0 REGIONAL AND LOCAL CLIMATOLOGY

Regional and local climatology significantly affects the air quality of a given location. Wind, temperature, atmospheric turbulence, mixing height and rainfall all influence air quality. Although the climate of Hawaii is relatively moderate throughout most of the state, significant differences in these parameters may occur from one location to another. The most significant differ-

ences in regional and local climates that occur within the state are caused by the mountainous topography.

Hawaii lies well within the belt of northeasterly trade winds generated by the semi-permanent Pacific high-pressure cell located northeast of the islands. On the island of Oahu, the Koolau and Waianae Mountain Ranges are oriented almost perpendicular to the trade winds, which accounts for much of the variation in the local climatology of the island. The site of the proposed project is located within and adjacent to the Diamond Head Crater on the leeward side of the Koolau Mountains.

Long-term wind data have been collected at the Honolulu International Airport and can be expected to be at least somewhat representative of the general project area, but winds within and nearby the crater are undoubtedly affected by the crater terrain. Wind frequency data given in Table 2 for Honolulu International Airport show that the annual prevailing wind direction for this area of Oahu is east-northeast. On an annual basis, 34.7 percent of the time the wind is from this direction, and nearly 75 percent of the time the wind is in the northeast quadrant. Winds from the south are infrequent occurring only a few days during the year and mostly in association with winter storms. Wind speeds average about 11 mph (10 knots) and mostly vary between about 4 and 18 mph (5 and 15 knots). Winds within the crater can be expected to be lighter and more variable.

Air pollution emissions from motor vehicles, the formation of photochemical smog and smoke plume rise all depend in part on air temperature. Colder temperatures tend to result in higher emissions of contaminants from automobiles but lower

incoming solar radiation and the onset and extent of the sea breeze.

Mixing height is defined as the height above the surface through which relatively vigorous vertical mixing occurs. Low mixing heights can result in high ground-level air pollution concentrations because contaminants emitted from or near the surface can become trapped within the mixing layer. In Hawaii, minimum mixing heights tend to be high because of mechanical mixing caused by the trade winds and because of the temperature moderating effect of the surrounding ocean. Low mixing heights may sometimes occur, however, at inland locations and even at times along coastal areas early in the morning following a clear, cool, windless night. Coastal areas also may experience low mixing levels during sea breeze conditions when cooler ocean air rushes in over warmer land. Mixing heights in Hawaii typically are above 1000 meters.

Rainfall can have a beneficial effect on the air quality of an area in that it helps to suppress fugitive dust emissions, and it also may "washout" gaseous contaminants that are water-soluble. Rainfall in Hawaii is highly variable depending on elevation and on location with respect to the trade wind. The Diamond Head area is one of the drier areas on Oahu due to its leeward and near sea level location. Average annual rainfall measured at nearby Black Point amounts to about 21 inches [2]. Most of the rainfall usually occurs during the winter months. Monthly rainfall may vary from as little as a trace to more than 10 inches.

concentrations of photochemical smog and ground-level concentrations of air pollution from elevated plumes. In Hawaii, the annual and daily variations of temperature depend to a large degree on elevation above sea level, distance inland and exposure to the trade winds. Average temperatures at locations near sea level generally are warmer than those at higher elevations. Areas exposed to the trade winds tend to have the least temperature variation, while inland and leeward areas often have the greatest. The project's near coastal, leeward location results in a relatively moderate temperature profile compared to some other locations around Oahu and the state. Based on more than 25 years of data, the average annual daily minimum and maximum temperatures at Honolulu International Airport are 70°F and 84°F, respectively [1]. The extreme minimum temperature on record at Honolulu International Airport is 54°F, and the extreme maximum is 95°F. Temperatures in the DHSM area are similar, although some deviations may occur within the crater due to terrain effects.

Small scale, random motions in the atmosphere (turbulence) cause air pollutants to be dispersed as a function of distance or time from the point of emission. Turbulence is caused by both mechanical and thermal forces in the atmosphere. It is often measured and described in terms of Pasquill-Gifford stability class. Stability class 1 is the most turbulent and class 6 is the least. Thus, air pollution dissipates best during stability class 1 conditions and the worst when stability class 6 prevails. In the project area, stability class 5 or 6 is generally the highest stability class that occurs, developing during clear, calm nighttime or early morning hours when temperature inversions form due to radiational cooling and/or to cold air drainage from the crater walls. Stability classes 1 through 4 occur during the daytime, depending mainly on the amount of cloud cover and



#### 5.0 PRESENT AIR QUALITY

Present air quality in the project area is mostly affected by air pollutants from vehicular, industrial, natural and/or agricultural sources. Table 3 presents an air pollutant emission summary for the island of Oahu for calendar year 1993. The emission rates shown in the table pertain to manmade emissions only, i.e., emissions from natural sources are not included. As suggested in the table, much of the particulate emissions on Oahu originate from area sources, such as the mineral products industry and agriculture. Sulfur oxides are emitted almost exclusively by point sources, such as power plants and refineries. Nitrogen oxides emissions emanate predominantly from industrial point sources, although area sources (mostly motor vehicle traffic) also contribute a significant share. The majority of carbon monoxide emissions occur from area sources (motor vehicle traffic), while hydrocarbons are emitted mainly from point sources. Based on previous emission inventories that have been reported for Oahu, it appears that emissions of particulate and nitrogen oxides have increased during the past ten years, while emissions of sulfur oxides, carbon monoxide and hydrocarbons have declined.

The State Department of Health operates a network of air quality monitoring stations at various locations on Oahu. Each station, however, typically does not monitor the full complement of air quality parameters. Table 4 shows an annual summary of air quality measurements that were made nearest to the project site for each of the regulated air pollutants for the period 1992 through 1996. These are the most recent data that are currently available.

During the years 1992 to 1996, sulfur dioxide was monitored by the State Department of Health at an air quality station located in downtown Honolulu about 4 miles to the northwest of the project site. Three-hour averages were reported only for 1994-1996. No recorded exceedances of the state/national standard were recorded during this period. The maximum 3-hour concentration was  $94 \mu\text{g}/\text{m}^3$ , which is about 7 percent of the state/national standard. There were no exceedances of the state/national 24-hour AAQS for sulfur dioxide during the 1992-1996 period. Concentrations monitored were consistently low with a maximum 24-hour average of  $23 \mu\text{g}/\text{m}^3$ , which is about 6 percent of the allowable value. The maximum annual average concentration during the 1992-1996 monitoring period was  $3 \mu\text{g}/\text{m}^3$ , which is about 4 percent of the state/national standard.

The nearest monitoring station for particulate matter less than 10 microns in diameter (PM-10) was located in downtown Honolulu. Monitoring of PM-10 concentrations at this location began in 1994. Annual maximum 24-hour average PM-10 concentrations ranged from 28 to  $36 \mu\text{g}/\text{m}^3$  between 1994 and 1996. The average annual concentration was  $14 \mu\text{g}/\text{m}^3$  during each of the three years reported. No exceedances of the state/national AAQS were recorded. Maximum 24-hour concentrations were less than 25 percent of the allowable limit, while maximum annual concentrations were about 28 percent of the allowable value.

The nearest carbon monoxide measurements were made at Waikiki about 2 miles northwest of the project site. During the 1992 to 1996 period, maximum annual 1-hour concentrations ranged from 5.2 to  $7.0 \text{ mg}/\text{m}^3$ , generally exhibiting a downward trend. No exceedances of the state 1-hour AAQS were recorded. Data

pertaining to 8-hour average carbon monoxide concentrations were not reported prior to 1994. During 1994-1996, the maximum 8-hour concentration was 3.4 mg/m<sup>3</sup>, which is 68 percent of the allowable state limit.

The nearest available ozone measurements were obtained at Sand Island about 5 miles west of the project site. The maximum 1-hour concentration for each year between 1992 and 1996 ranged from 92 to 126 µg/m<sup>3</sup>. Several exceedances of the state AAQS were recorded, although none were reported for the most recent year, 1996.

Nitrogen dioxide was not monitored by the Department of Health anywhere in the state during 1992. Since 1993 measurements have been obtained at Kapolei, a distance of 19 miles from the project site. Maximum annual average concentrations have ranged between 2 and 12 µg/m<sup>3</sup>, safely inside the state and national AAQS.

The nearest and most recent measurements of ambient lead concentrations that have been reported were made at the downtown Honolulu monitoring station. Lead concentrations at this location have been nearly undetectable for the past several years since the use of unleaded gasoline became mandatory. Average quarterly concentrations were near or below the detection limit, and no exceedances of the state AAQS were recorded.

Based on the data and discussion presented above, it appears likely that the state and national AAQS for sulfur dioxide, nitrogen dioxide, lead and particulate matter less than 10

microns in diameter are currently being met at the project site. In fact, the project area as well as the entire State of Hawaii is presently considered to be an attainment area for all national AAQS. It is likely, however, that the state AAQS for ozone may be exceeded on occasion based on the Sand Island measurements for this parameter. While carbon monoxide measurements from nearby Waikiki suggest that concentrations are in compliance with the state standards, it is conceivable that concentrations near traffic-congested intersections could potentially exceed the state AAQS at times.

#### 6.0 SHORT-TERM IMPACTS OF PROJECT

Short-term direct and indirect impacts on air quality could potentially occur due to project construction. For a project of this nature, there are two potential types of air pollution emissions that could directly result in short-term air quality impacts during project construction: (1) fugitive dust from vehicle movement and soil excavation; and (2) exhaust emissions from on-site construction equipment. Indirectly, there also could be short-term impacts related to slow-moving construction equipment traveling to and from the project site and from a temporary increase in local traffic caused by commuting construction workers. Fugitive dust emissions may arise from the grading and dirt-moving activities associated with site clearing and preparation work.

The emission rate for fugitive dust emissions from construction activities is difficult to estimate accurately because of its elusive nature of emission and because the potential for its generation varies greatly depending upon the type of soil at the construction site, the amount and type of dirt-disturbing activity

taking place, the moisture content of exposed soil in work areas, and the wind speed. The EPA [3] has provided a rough estimate for uncontrolled fugitive dust emissions from construction activity of 1.2 tons per acre per month under conditions of "medium" activity, moderate soil silt content (30%), and precipitation/evaporation (P/E) index of 50. Uncontrolled fugitive dust emissions in the project area would likely be higher because the PE index for the Diamond Head area is less than 50 due to the relatively dry climate. In any case, State of Hawaii Air Pollution Control Regulations [4] prohibit visible emissions of fugitive dust from construction activities at the property line. Thus, an effective dust control plan for project construction phases is essential.

Adequate fugitive dust control can usually be accomplished by the establishment of a frequent watering program to keep bare-dirt surfaces in construction areas from becoming significant sources of dust. In dust-prone or dust-sensitive areas, other control measures such as limiting the area that can be disturbed at any given time, applying chemical soil stabilizers, mulching and/or using wind screens may be necessary. Control regulations further stipulate that open-bodied trucks be covered at all times when in motion if they are transporting materials that could be blown away. Haul trucks tracking dirt onto paved streets from unpaved areas is oftentimes a significant source of dust in construction areas. Some means to alleviate this problem, such as road cleaning or tire washing, may be appropriate. Paving of parking areas and/or establishment of landscaping as early in the construction schedule as possible can also lower the potential for fugitive dust emissions. Monitoring dust at the project property line could be considered to quantify and document the effectiveness of dust control measures.

On-site mobile and stationary construction equipment also will emit air pollutants from engine exhausts. The largest of this equipment is usually diesel-powered. Nitrogen oxides emissions from diesel engines can be relatively high compared to gasoline-powered equipment, but the standard for nitrogen dioxide is set on an annual basis and is not likely to be violated by short-term construction equipment emissions. Carbon monoxide emissions from diesel engines, on the other hand, are low and should be relatively insignificant compared to vehicular emissions on nearby roadways.

Slow-moving construction vehicles traveling on roadways leading to and from the project site could obstruct the normal flow of traffic to such an extent that overall vehicular emissions are increased, but this impact can be mitigated by moving heavy construction equipment during periods of low traffic volume. Likewise, the schedules of commuting construction workers can be adjusted to avoid peak hours in the project vicinity. Thus, most potential short-term air quality impacts from project construction can be mitigated.

#### 7.0 LONG-TERM IMPACTS OF PROJECT OUTSIDE DIAMOND HEAD CRATER

After construction is completed, use of the proposed facilities may result in either increased motor vehicle traffic or possibly the relocation of traffic at locations outside of the Diamond Head Crater, potentially causing long-term impacts on ambient air quality. Motor vehicles with gasoline-powered engines are significant sources of carbon monoxide. They also emit nitrogen oxides and other contaminants.

Federal air pollution control regulations require that new motor vehicles be equipped with emission control devices that reduce emissions significantly compared to a few years ago. In 1990, the President signed into law the Clean Air Act Amendments. This legislation requires further emission reductions which have been phased in since 1994. The restrictions on emissions from new motor vehicles will lower average emissions each year as more and more older vehicles leave the state's roadways. Carbon monoxide emissions, for example, will go down by an average of about 10 percent per vehicle during the next 10 years due to the replacement of older vehicles with newer models.

To evaluate the potential long-term indirect ambient air quality impact of increased roadway traffic associated with a project such as this, computerized emission and atmospheric dispersion models can be used to estimate ambient carbon monoxide concentrations along roadways leading to and from the project. Carbon monoxide is selected for modeling because it is both the most stable and the most abundant of the pollutants generated by motor vehicles. Furthermore, carbon monoxide air pollution is generally considered to be a microscale problem that can be addressed locally to some extent, whereas nitrogen oxides air pollution most often is a regional issue that cannot be addressed by a single new develop-

ment.

For this project, five scenarios were selected for the carbon monoxide modeling study: year 1998 with present conditions, year 2008 without the project, year 2008 with project Alternative Concept 1, year 2008 with project Alternative Concept 2 and year 2008 with project Alternative Concept 3. Each of the with-project alternatives were studied with and without the recommendations from the project traffic consultant. The three

alternative concepts for the project were described previously in Section 2. Figures prepared by the project traffic consultant depicting the three alternatives and the recommended changes to the alternatives are included as an appendix to this report.

After identifying the scenarios to be studied, critical receptor areas in the vicinity of the project were identified for analysis. Generally speaking, roadway intersections are the primary concern because of traffic congestion and because of the increase in vehicular emissions associated with traffic queuing. For this study, the four key intersections identified in the traffic study were also selected for air quality analysis. These included the following:

- Diamond Head Road at Makapuu Avenue;
- Diamond Head Road at the driveway into Kapiolani Community College;
- Diamond Head Road at the Diamond Head State Monument access road;
- Diamond Head Road at 18<sup>th</sup> Avenue.

In Alternative Concept 3, the proposed entrance to and exit from the DHSM visitor parking area along Diamond Head Road at the Cannon Club were also studied. In Alternative Concepts 1 and 2, the project traffic study assumes that the entrance to and exit from the DHSM visitor parking areas would occur at the Diamond Head Road entrance to Kapiolani Community College. The traffic impact assessment report for the project [5] describes the projected future traffic conditions and laneage configurations of these intersections in detail.

The main objective of the modeling study was to estimate worst-case 1-hour average carbon monoxide concentrations for each of the five scenarios studied. To evaluate the significance of the estimated concentrations, a comparison of the predicted values for each scenario can be made. A comparison of the estimated values to the national and state AAQS will provide another measure of significance.

The traffic impact report for the project indicates that traffic volumes are currently somewhat higher during the morning peak hour than during the afternoon peak period and that this will continue to be true in the future. Coincidentally, worst-case emission and meteorological dispersion conditions typically occur during the morning hours at most locations. Thus, the highest concentrations could be expected to occur during the morning peak traffic period. However, to ensure that there were no unusual traffic queuing conditions during the afternoon and that worst-case concentrations were identified, both morning and afternoon peak-traffic hours were examined for each scenario.

The EPA computer model MOBILE5A was used to calculate vehicular carbon monoxide emissions for each year studied. One of the key inputs to MOBILE5A is vehicle mix. Unless very detailed information is available, national average values are typically assumed, which is what was used for the present study. Based on national average vehicle mix figures, the projected vehicle mix in the project area for 1998 was estimated to be 62.3% light-duty gasoline-powered automobiles, 27.2% light-duty gasoline-powered trucks and vans, 3.1% heavy-duty gasoline-powered vehicles, 0.2% light-duty diesel-powered vehicles, 6.5% heavy-duty diesel-powered trucks and buses, and 0.7% motorcycles. For the future scenarios studied, the estimated national average vehicle mix percentages

were substantially the same except that light-duty gasoline-powered automobiles decreased by about 3% while light-duty gasoline-powered trucks and vans increased by about the same amount.

Other key inputs to the MOBILE5A emission model are the cold/hot start fractions. Motor vehicles operating in a cold- or hot-start mode emit excess air pollution. Typically, motor vehicles reach stabilized operating temperatures after about 4 miles of driving. For traffic operating within the project area, it was assumed that about 21 percent of all vehicles would be operating in the cold-start mode and that about 27 percent would be operating in the hot-start mode. These are typical default (national average) values.

Ambient temperatures of 59 and 68 degrees F were used for weekday morning and afternoon peak-hour emission computations, respectively. These are conservative assumptions since morning/afternoon ambient temperatures will generally be warmer than this, and emission estimates given by MOBILE5A are inversely proportional to the ambient temperature.

After computing vehicular carbon monoxide emissions through the use of MOBILE5A, these data were then input to an atmospheric dispersion model. EPA air quality modeling guidelines [6] currently recommend that the computer model CAL3QHC [7] be used to assess carbon monoxide concentrations at roadway intersections, or in areas where its use has previously been established, CALINE4 [8] may be used. Until recently, CALINE4 was used extensively in Hawaii to assess air quality impacts at roadway intersections. In December 1997, the California

Department of Transportation recommended that the intersection mode of CALINE4 no longer be used because it was thought the model has become outdated. Studies have shown that CALINE4 may tend to over-predict maximum concentrations in some situations. Therefore, CAL3QHC was used for the subject analysis.

CAL3QHC was developed for the U.S. EPA primarily to simulate vehicular movement, vehicle queuing and atmospheric dispersion of vehicular emissions near signalized roadway intersections (although it can also be used to simulate atmospheric dispersion at non-intersection locations as well). It is designed to predict 1-hour average pollutant concentrations near roadway intersections based on input traffic and emission data, roadway/receptor geometry and meteorological conditions.

Although CAL3QHC is intended primarily for assessing atmospheric dispersion near signalized roadway intersections, it can also be used to evaluate unsignalized intersections. This is accomplished by manually estimating queue lengths and then applying the same techniques used by the model for signalized intersections. Currently, all of the study intersections are unsignalized, and the project traffic study indicates that the intersections would remain unsignalized for the future scenarios except possibly for Diamond Head Road at Makapuu Avenue.

Input peak-hour traffic data were obtained from the traffic study cited previously. This included vehicle approach volumes, vehicle capacity estimates and intersection laneage. All emission factors that were input to CAL3QHC for free-flow traffic were obtained from MOBILES4 based on an assumed free-flow vehicle speed of

25 mph except for the access road to Diamond Head State Monument where a free-flow speed of 10 mph was assumed.

Model roadways were set up to reflect roadway geometry, physical dimensions and operating characteristics. Sidewalks currently exist very close to most of the roadway intersections studied. Concentrations predicted by air quality models generally are not considered valid within the roadway mixing zone. The roadway mixing zone is usually taken to include 3 meters on either side of the traveled portion of the roadway and the turbulent area within 10 meters of a cross street. Model receptor sites were thus located at the edges of the mixing zones near all intersections and for all scenarios that were studied. All receptor heights were placed at 1.8 meters above ground to simulate levels within the normal human breathing zone.

Input meteorological conditions for this study were defined to provide "worst-case" results. One of the key meteorological inputs is atmospheric stability category. For these analyses, atmospheric stability category 5 was assumed for the morning peak-hour traffic period and stability category 4 was assumed for the afternoon peak-hour traffic period. These are the most conservative stability categories that are generally used for estimating worst-case pollutant dispersion within urban areas for these periods. A surface roughness length of 100 cm and a mixing height of 300 meters were used in all cases. Worst-case wind conditions were defined as a wind speed of 1 meter per second with a wind direction resulting in the highest predicted concentration. Concentration estimates were calculated at wind directions of every 5 degrees.

Existing background concentrations of carbon monoxide in the project vicinity are believed to be at relatively low levels. Hence, background contributions of carbon monoxide from sources or distant roadways not directly considered in the analysis were accounted for by adding a background concentration of 1 ppm to all predicted concentrations for 1998. Even if traffic volumes in the general vicinity of the project increase over the next several years, the background carbon monoxide concentration may remain unchanged or even decrease because of the retirement of older, more-polluting motor vehicles as discussed earlier. For the future (2008) scenarios studied, it was assumed the background carbon monoxide concentration would not change substantially from the 1998 level.

#### Predicted Worst-Case 1-Hour Concentrations

Table 5 summarizes the final results of the modeling study in the form of the estimated worst-case 1-hour morning and afternoon ambient carbon monoxide concentrations. These results can be compared directly to the state and the national AAQS. Estimated worst-case carbon monoxide concentrations are presented in the table for five scenarios: year 1998 with existing traffic, year 2008 without the project and year 2008 with the three without-project alternatives (Concepts 1, 2 and 3). The locations of these estimated worst-case 1-hour concentrations all occurred at or very near the indicated intersections.

As indicated in the table, the highest estimated 1-hour concentration within the project vicinity for the present (1998) case was 7.8 mg/m<sup>3</sup>. This was predicted to occur during the morning peak hour at the intersection of Diamond Head Road and 18<sup>th</sup> Avenue and was mainly attributable to southbound traffic on

18<sup>th</sup> Avenue. The next highest predicted concentration was 7.6 mg/m<sup>3</sup> during the morning peak traffic hour at the intersection of Diamond Head Road and the entrance to the DHSM and was mainly attributable to westbound traffic on Diamond Head Road. Predicted worst-case 1-hour concentrations at other locations and times studied ranged from 3.0 to 4.4 mg/m<sup>3</sup>. All estimated worst-case 1-hour concentrations were within both the national standard of 40 mg/m<sup>3</sup> and the more stringent state limit of 10 mg/m<sup>3</sup>.

In the year 2008 without the proposed project, the predicted worst-case 1-hour concentrations in the project area decreased somewhat compared to the existing case. Similar to the existing case, the highest worst-case 1-hour concentration, 7.3 mg/m<sup>3</sup>, was predicted to occur during the morning near the intersection of Diamond Head Road and 18<sup>th</sup> Avenue. Again, the majority of this concentration was attributable to southbound traffic on 18<sup>th</sup> Avenue. Worst-case 1-hour concentrations at other locations and times ranged from 2.8 to 6.4 mg/m<sup>3</sup>. All predicted worst-case 1-hour concentrations for this scenario were also within both the national and the state AAQS.

As shown in Table 5, there were no substantial differences amongst the three 2008 with-project alternatives that were studied. In all three with-project alternatives, the highest predicted 1-hour worst-case concentration continued to occur at the intersection of Diamond Head Road and 18<sup>th</sup> Avenue during the morning, and the concentration (7.0 mg/m<sup>3</sup>) was slightly lower than the without-project case. At other locations and times, there was virtually no difference compared to the without-project case. In the with-project Concept 3 scenario, worst-case 1-hour concentrations at the Cannon Club entrance and exit were

comparable to those at other locations in the area. All of the predicted worst-case 1-hour concentrations for all with-project scenarios met both the state and the national AQOS.

The results for the with-project alternatives discussed above assume that in Concepts 1 and 2 the access to the DHSM visitor parking area would occur at the Diamond Head entrance to Kapiolani Community College and in Concept 3 it would occur at the Cannon Club. The project traffic consultant has recommended that the access road or driveway occur instead at the intersection of Diamond Head Road and Makapuu Avenue and that this intersection be signalized. Additional analyses were performed to assess the air quality impacts that might occur if these recommendations are accepted. As indicated in the lower portion of Table 5, worst-case concentrations at the Diamond Head Road entrance to Kapiolani Community College were predicted to remain unchanged compared to the three present with-project concepts. At the intersection of Diamond Head Road and Makapuu Avenue, worst-case concentrations were predicted to increase by about 2 mg/m<sup>3</sup> but would remain with both state and national standards.

#### Predicted Worst-Case 8-Hour Concentrations

Worst-case 8-hour carbon monoxide concentrations were estimated by multiplying the worst-case 1-hour values by a persistence factor of 0.5. This accounts for two factors: (1) traffic volumes averaged over eight hours are lower than peak 1-hour values, and (2) meteorological dispersion conditions are more variable (and hence more favorable) over an 8-hour period than they are for a single hour. Based on monitoring data, 1-hour to 8-hour persistence factors for most locations generally vary from 0.4 to 0.8

with 0.6 being the most typical. One recent study based on modeling [9] concluded that 1-hour to 8-hour persistence factors could typically be expected to range from 0.4 to 0.5. EPA guidelines [10] recommend using a value of 0.6 to 0.7 unless a locally derived persistence factor is available. Recent monitoring data for Honolulu reported by the Department of Health for the Waikiki area (see Table 4) suggest that this factor may range between about 0.5 and 0.6. Considering the location of the project and the probable traffic pattern for the area, a 1-hour to 8-hour persistence factor of 0.5 will likely yield reasonable estimates of worst-case 8-hour concentration.

The resulting estimated worst-case 8-hour concentrations are indicated in Table 6. For the 1998 scenario, the estimated worst-case 8-hour carbon monoxide concentrations in the project area ranged between 1.8 and 3.9 mg/m<sup>3</sup>. These values comply with both the state standard of 5 mg/m<sup>3</sup> and the national limit of 10 mg/m<sup>3</sup>. Without the project in the year 2008, the predicted worst-case 8-hour concentrations decreased slightly compared to 1998 levels (due to the attrition of older motor vehicles over time). With any of the with-project alternatives studied, the maximum 8-hour concentrations in the year 2008 were estimated to remain at about the without-project levels, i.e., the project would have no impact. As indicated in the table, if the project traffic consultant's recommendations are followed, it was estimated that the worst-case 8-hour concentration at the intersection of Diamond Head Road and Makapuu Avenue would increase by 1.6 mg/m<sup>3</sup> compared to the without project case, but the concentration would remain within both the state and national standards.



#### Conservativeness of Estimates

The results of this study reflect several assumptions that were made concerning both traffic movement and worst-case meteorological conditions. One such assumption concerning worst-case meteorological conditions is that a wind speed of 1 meter per second with a steady direction for 1 hour will occur. A steady wind of 1 meter per second blowing from a single direction for an hour is extremely unlikely and may occur only once a year or less. With wind speeds of 2 meters per second, for example, computed carbon monoxide concentrations would be only about half the values given above. The 8-hour estimates are also conservative in that it is unlikely that anyone would occupy the assumed receptor sites (within 3 m of the roadways) for a period of 8 hours.

#### 8.0 LONG-TERM IMPACTS OF PROJECT INSIDE DIAMOND HEAD CRATER

Detailed assessments of long-term air quality impacts within the crater were not performed, but obviously, project alternatives that reduce traffic movement within the crater will have a positive impact on air quality. In Alternative Concept 1, traffic would be allowed to park within the crater, but given that detailed analyses of much higher traffic volume areas outside the crater show that compliance with state and national standards would be achieved, air quality levels within the crater could be expected to be well within the allowable limits. Alternative Concepts 2 and 3 would eliminate visitor traffic from within the crater area, creating a situation where the air quality could be expected to be at near background levels.

#### 9.0 CONCLUSIONS AND RECOMMENDATIONS

Ambient air quality data from nearby monitoring stations indicate it is likely that all national ambient air quality standards are currently being met in the project area. However, occasional exceedances of the more stringent state standard for ozone may presently occur at many locations around Honolulu. Occasional exceedances of the state carbon monoxide standards within small "hot-spot" areas near some traffic-congested intersections may also occur.

The major potential short-term air quality impact of the project will likely occur from the emission of fugitive dust during construction phases of the project, particularly because of the relatively dry climate of the project area. Adjacent populated areas outside the crater may be the biggest concern. Uncontrolled fugitive dust emissions from construction activities are estimated to amount to about 1.2 tons per acre per month, depending on rainfall. At a minimum, active work areas and any temporary unpaved work roads should be watered at least twice daily on days without rainfall to control dust emissions. Other dust control measures such as installing wind screens, limiting disturbed areas, soil stabilizing, covering dirt-hauling trucks, cleaning paved roadways, and scheduling the early paving of parking and roadways should also be considered. Monitoring dust at the project boundary during the period of construction could be considered as a means to evaluate the effectiveness of the project dust control program and to adjust the program if necessary.

During construction phases, emissions from engine exhausts (primarily consisting of carbon monoxide and nitrogen oxides) will also occur both from on-site construction equipment and from

vehicles used by construction workers and from trucks traveling to and from the project. Increased vehicular emissions due to disruption of traffic by construction equipment and/or commuting construction workers can be alleviated by moving equipment and personnel to the site during off-peak traffic hours.

After construction of the various phases of the Master Plan are complete, emissions from motor vehicle traffic attracted to the DMSM will occur on a long-term basis. Motor vehicle related emissions of carbon monoxide are the greatest concern. Based on the projected peak-hour traffic volumes and the roadway configurations and laneages given for the roadway intersections affected by the project, air quality model projections for the year 2008 indicate that air quality conditions at nearby locations outside the crater will be in compliance with state and national standards with any of the three project alternatives. From an air quality perspective, there is no difference amongst the alternatives with respect to air quality impacts at nearby locations outside the crater. The recommendation of the traffic consultant to relocate the access point to the Makapuu Avenue intersection with Diamond Head Road and to signalize this intersection would cause some air quality degradation in the immediate area, but worst-case concentrations should remain within the standards.

Alternative Concept 2 or 3 would provide a positive impact on air quality within the crater, but even if Concept 1 is chosen and traffic is continued to be allowed inside the crater, it is unlikely that air pollution levels would reach anywhere near the standards. With any of the three project alternatives, compliance with both state and national standards will likely be achieved both inside and outside the crater, and air quality

levels comparable to existing conditions will likely be maintained. Thus, measures to mitigate any long-term air quality impacts of the project appear to be either unnecessary or unwarranted. The only measure that is recommended to mitigate long-term impacts is to prohibit tour buses from idling for long periods of time in the visitor parking areas.

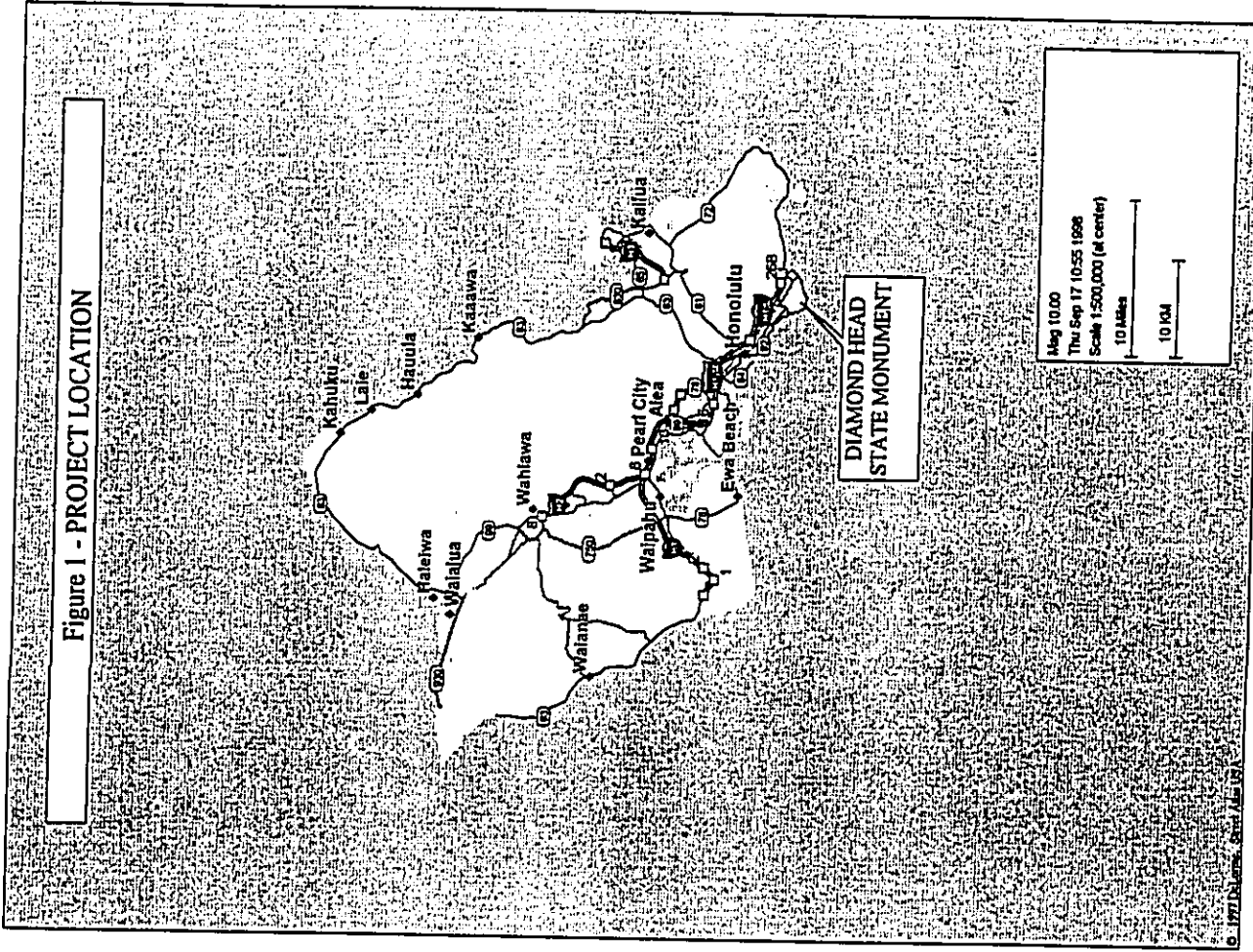


Figure 1 - PROJECT LOCATION

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6. Guideline on Air Quality Models (Revised), Including Supplements A and B, EPA-450/2-78-027R, U.S. Environmental Protection Agency, Research Triangle Park, NC, July 1986.
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8. CALINE4 - A Dispersion Model for Predicting Air Pollutant Concentrations Near Roadways, FHWA/CA/TL-84/15, California State Department of Transportation, November 1984 with June 1989 Revisions.
9. "Persistence Factors for Mobile Source (Roadway) Carbon Monoxide Modeling", C. David Cooper, Journal of the Air & Waste Management Association, Volume 39, Number 5, May 1989.
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Table 1  
SUMMARY OF STATE OF HAWAII AND NATIONAL  
AMBIENT AIR QUALITY STANDARDS

Pollutant	Units	Averaging Time	Maximum Allowable Concentration		
			National Primary	National Secondary	State of Hawaii
Particulate Matter (<10 microns)	µg/m <sup>3</sup>	Annual	50 <sup>a</sup>	50 <sup>a</sup>	50
		24 Hours	150 <sup>b</sup>	150 <sup>b</sup>	150 <sup>c</sup>
Particulate Matter (<2.5 microns)	µg/m <sup>3</sup>	Annual	15 <sup>a</sup>	15 <sup>a</sup>	-
		24 Hours	65 <sup>d</sup>	65 <sup>d</sup>	-
Sulfur Dioxide	µg/m <sup>3</sup>	Annual	80	-	80
		24 Hours 3 Hours	365 <sup>e</sup> 1300 <sup>e</sup>	- 1300 <sup>e</sup>	365 <sup>e</sup> 1300 <sup>e</sup>
Nitrogen Dioxide	µg/m <sup>3</sup>	Annual	100	100	70
Carbon Monoxide	mg/m <sup>3</sup>	8 Hours	10 <sup>f</sup>	-	5 <sup>f</sup>
		1 Hour	40 <sup>f</sup>	-	10 <sup>f</sup>
Ozone	µg/m <sup>3</sup>	8 Hours	157 <sup>g</sup>	157 <sup>g</sup>	-
		1 Hour	235 <sup>g</sup>	235 <sup>g</sup>	100 <sup>g</sup>
Lead	µg/m <sup>3</sup>	Calendar Quarter	1.5	1.5	1.5
Hydrogen Sulfide	µg/m <sup>3</sup>	1 Hour	-	-	35 <sup>h</sup>

<sup>a</sup> Three-year average of annual arithmetic mean.

<sup>b</sup> 99th percentile value averaged over three years.

<sup>c</sup> Not to be exceeded more than once per year.

<sup>d</sup> 98th percentile value averaged over three years.

<sup>e</sup> Three-year average of fourth-highest daily 8-hour maximum.

<sup>f</sup> Standard is attained when the expected number of exceedances is less than or equal to 1.

Table 2  
ANNUAL WIND FREQUENCY FOR HONOLULU INTERNATIONAL AIRPORT (%)

Wind Direction	Wind Speed (knots)										Total
	0-3	4-6	7-10	11-16	17-21	22-27	28-33	34-40	>40		
N	0.5	2.5	1.3	0.5	0.0	0.0	0.0	0.0	0.0	0.0	4.8
NNE	0.3	1.2	1.6	1.5	0.2	0.0	0.0	0.0	0.0	0.0	4.7
NE	0.3	2.1	6.1	11.0	3.2	0.3	0.0	0.0	0.0	0.0	23.0
ENE	0.2	2.5	10.9	16.6	4.1	0.3	0.0	0.0	0.0	0.0	34.7
E	0.1	1.0	2.5	2.8	0.5	0.0	0.0	0.0	0.0	0.0	7.0
ESE	0.0	0.3	0.4	0.3	0.0	0.0	0.0	0.0	0.0	0.0	1.1
SE	0.0	0.3	0.8	1.0	0.1	0.0	0.0	0.0	0.0	0.0	2.2
SSE	0.1	0.4	1.2	0.7	0.1	0.0	0.0	0.0	0.0	0.0	2.4
S	0.1	0.5	1.4	0.6	0.1	0.0	0.0	0.0	0.0	0.0	2.7
SSW	0.0	0.3	0.8	0.3	0.0	0.0	0.0	0.0	0.0	0.0	1.5
SW	0.0	0.2	0.8	0.4	0.0	0.0	0.0	0.0	0.0	0.0	1.5
WSW	0.0	0.3	0.5	0.4	0.0	0.0	0.0	0.0	0.0	0.0	1.2
W	0.1	0.5	0.2	0.2	0.0	0.0	0.0	0.0	0.0	0.0	1.1
WNW	0.2	1.4	0.3	0.1	0.0	0.0	0.0	0.0	0.0	0.0	2.0
W	0.4	2.3	0.8	0.1	0.0	0.0	0.0	0.0	0.0	0.0	3.8
NNW	0.5	2.3	0.8	0.2	0.0	0.0	0.0	0.0	0.0	0.0	3.8
CALM	2.5										2.5
TOTAL	5.4	18.3	30.6	36.5	8.5	0.7					100.0

Source: Climatology of the United States No. 90 (1965-1974), Airport Climatological Summary, Honolulu International Airport, Honolulu, Hawaii, U.S. Department of Commerce, National Climatic Center, Asheville, NC, August 1978.

Table 3  
AIR POLLUTION EMISSIONS INVENTORY FOR  
ISLAND OF OAHU, 1993

Air Pollutant	Point Sources (tons/year)	Area Sources (tons/year)	Total (tons/year)
Particulate	25,891	49,374	75,265
Sulfur Oxides	39,230	nil	39,230
Nitrogen Oxides	92,436	31,141	123,577
Carbon Monoxide	28,757	121,802	150,559
Hydrocarbons	4,160	421	4,581

Source: Final Report, "Review, Revise and Update of the Hawaii Emissions Inventory Systems for the State of Hawaii", prepared for Hawaii Department of Health by J.L. Shoemaker & Associates, Inc., 1996

Table 4  
ANNUAL SUMMARIES OF AIR QUALITY MEASUREMENTS  
FOR MONITORING STATIONS NEARBY  
DIAMOND HEAD STATE MONUMENT

Parameter / Location	1992	1993	1994	1995	1996
<b>Sulfur Dioxide / Downtown Honolulu</b>					
3-Hr Average: Maximum Value ( $\mu\text{g}/\text{m}^3$ )	-	-	54	94	73
No. of State AQG Exceedances	-	-	0	0	0
24-Hr Average: Maximum Value ( $\mu\text{g}/\text{m}^3$ )	3	9	17	23	18
No. of State AQG Exceedances	0	0	0	0	0
Annual Average ( $\mu\text{g}/\text{m}^3$ )	1	2	2	3	3
<b>PM-10 / Downtown Honolulu</b>					
24-Hr Average: Maximum Value ( $\mu\text{g}/\text{m}^3$ )	-	-	28	36	28
No. of State AQG Exceedances*	-	-	0	0	0
Annual Average ( $\mu\text{g}/\text{m}^3$ )	-	-	16	14	14
<b>Carbon Monoxide / Waikiki</b>					
1-Hr Average: Maximum Value ( $\text{mg}/\text{m}^3$ )	5.8	7.0	6.8	5.4	5.2
No. of State AQG Exceedances	0	0	0	0	0
8-Hr Average: Maximum Value ( $\text{mg}/\text{m}^3$ )	-	-	3.3	3.3	3.4
No. of State AQG Exceedances	-	-	0	0	0
Annual Average ( $\text{mg}/\text{m}^3$ )	2.5	2.1	1.0	1.3	1.2
<b>Ozone / Sand Island</b>					
1-Hr Average: Maximum Value ( $\mu\text{g}/\text{m}^3$ )	126	113	110	117	92
No. of State AQG Exceedances	6	7	23	23	0
Annual Average ( $\mu\text{g}/\text{m}^3$ )	54	68	51	39	27
<b>Nitrogen Dioxide / Kapolei</b>					
Annual Average ( $\mu\text{g}/\text{m}^3$ )	-	12	8	8	2
<b>Lead / Downtown Honolulu</b>					
Maximum Quarterly Average ( $\mu\text{g}/\text{m}^3$ )	0.0	0.0	0.0	0.0	0.0

\* No state PM-10 standard existed prior to 1993.

Source: Hawaii Department of Health

Table 5

ESTIMATED WORST-CASE 1-HOUR CARBON MONOXIDE CONCENTRATIONS  
NEAR DIAMOND HEAD STATE MONUMENT MASTER PLAN PROJECT  
(milligrams per cubic meter)

Roadway Intersection	Year/Scenario									
	1998/Present		2008/Without Project		2008/With Project Concept 1		2008/With Project Concept 2		2008/With Project Concept 3	
	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM
Diamond Head Rd at Makapuu Avenue	3.7	3.1	3.5	2.9	3.6	3.1	3.6	3.1	3.6	3.0
Diamond Head Rd at Kapiolani Community College	4.4	3.0	4.2	2.9	4.2	2.9	4.2	2.9	4.2	2.9
Diamond Head Rd at Diamond Head State Monument Access	7.6	3.2	6.4	2.8	-	-	-	-	6.4	2.8
Diamond Head Rd at 18th Avenue	7.8	3.0	7.3	2.8	7.0	2.9	7.0	2.9	7.0	2.9
Diamond Head Rd at Cannon Club Entrance	-	-	-	-	-	-	-	-	3.8	2.7
Diamond Head Rd at Cannon Club Exit	-	-	-	-	-	-	-	-	3.9	3.5
With Traffic Consultant's Recommendations										
Diamond Head Rd at Makapuu Avenue	3.7	3.1	3.5	2.9	6.1	5.3	6.1	5.3	6.0	5.3
Diamond Head Rd at Kapiolani Community College	4.4	3.0	4.2	2.9	4.2	2.9	4.2	2.9	4.2	2.9

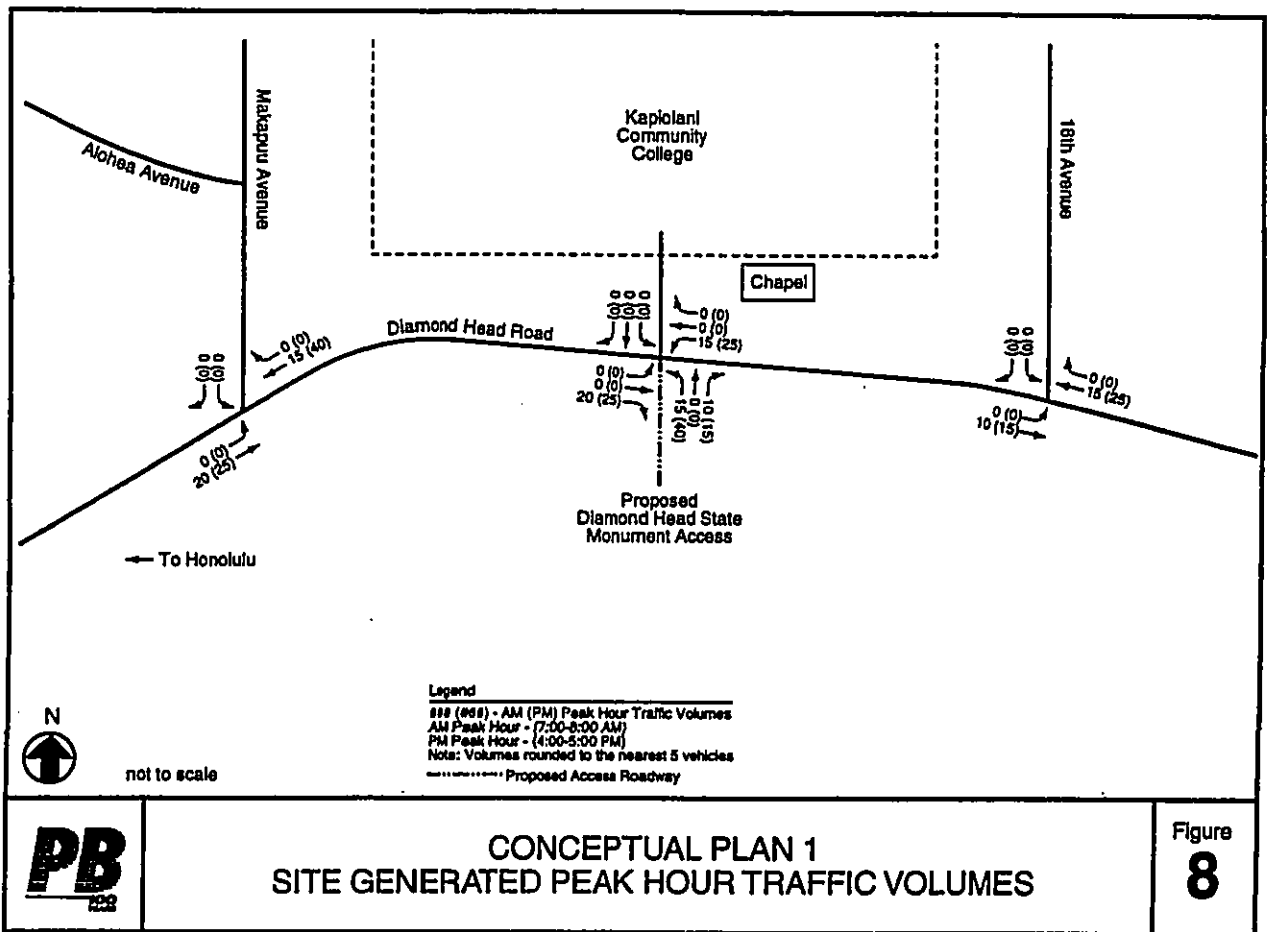
Hawaii State AAQS: 10  
National AAQS: 40

Table 6

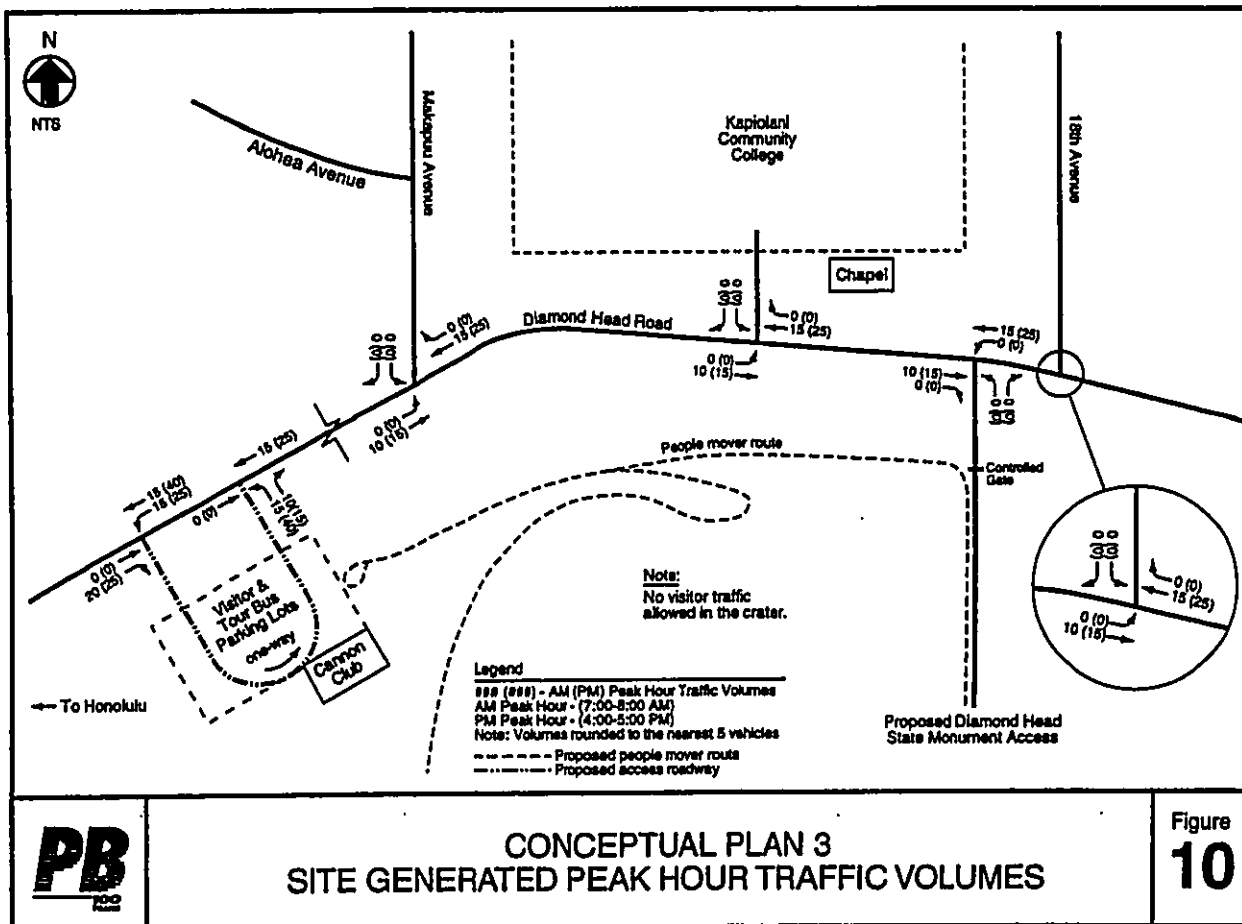
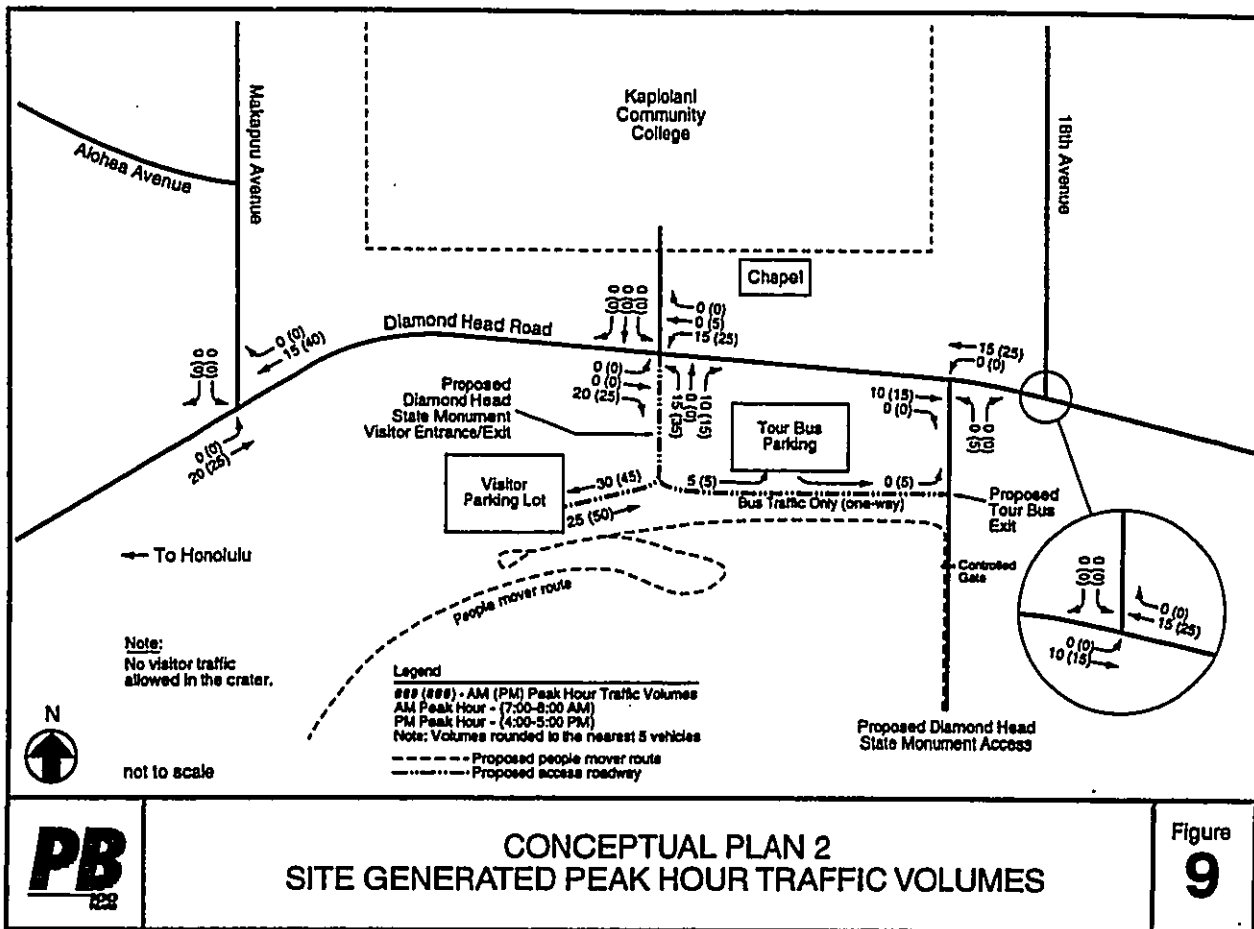
ESTIMATED WORST-CASE 8-HOUR CARBON MONOXIDE CONCENTRATIONS  
NEAR DIAMOND HEAD STATE MONUMENT MASTER PLAN PROJECT  
(milligrams per cubic meter)

Roadway Intersection	Year/Scenario				
	1998/Present	2008/Without Project	2008/With Project Concept 1	2008/With Project Concept 2	2008/With Project Concept 3
Diamond Head Rd at Makapuu Avenue	1.8	1.8	1.8	1.8	1.8
Diamond Head Rd at Kapiolani Community College	2.2	2.1	2.1	2.1	2.1
Diamond Head Rd at Diamond Head State Monument Access	3.8	3.2	-	-	3.2
Diamond Head Rd at 18th Avenue	3.9	3.6	3.5	3.5	3.5
Diamond Head Rd at Cannon Club Entrance	-	-	-	-	1.9
Diamond Head Rd at Cannon Club Exit	-	-	-	-	1.9
With Traffic Consultant's Recommendations					
Diamond Head Rd at Makapuu Avenue	1.8	1.8	3.0	3.0	3.0
Diamond Head Rd at Kapiolani Community College	2.2	2.1	2.1	2.1	2.1

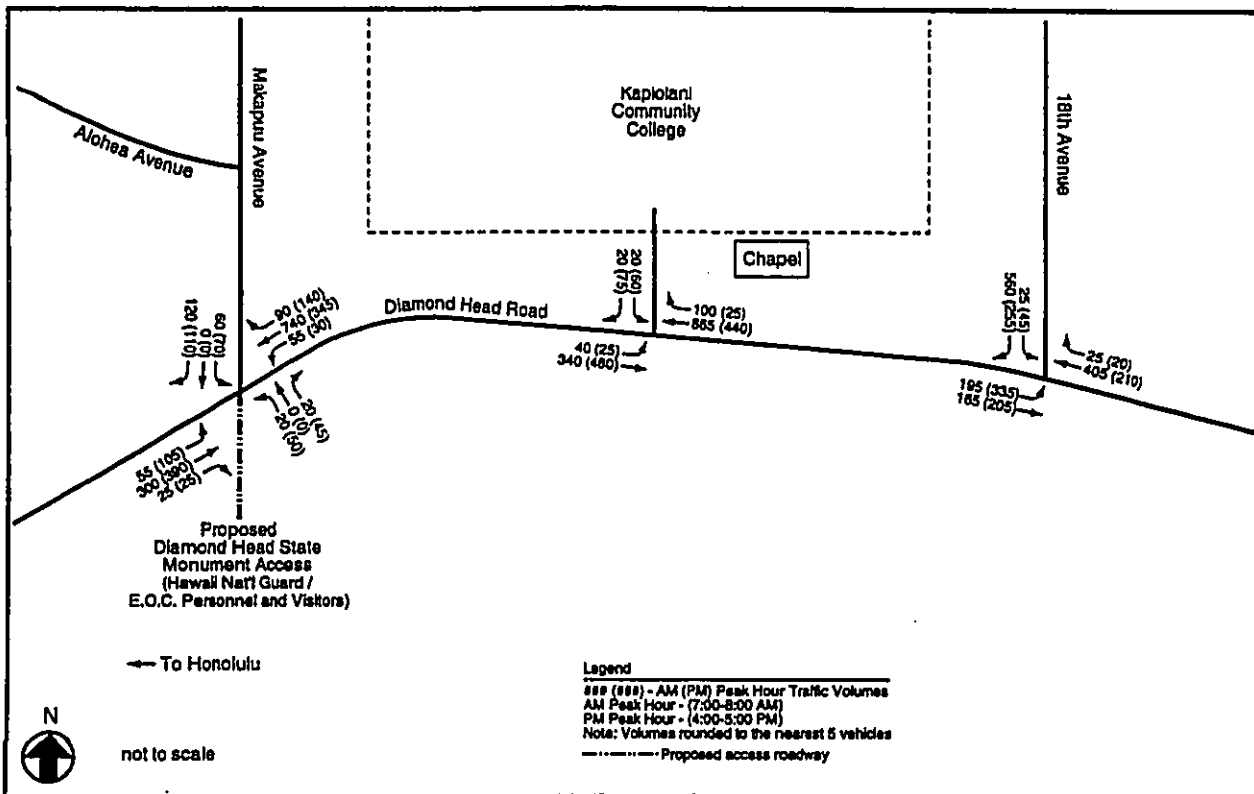
Hawaii State AAQS: 5  
National AAQS: 10



APPENDIX  
 FIGURES FROM PROJECT TRAFFIC STUDY

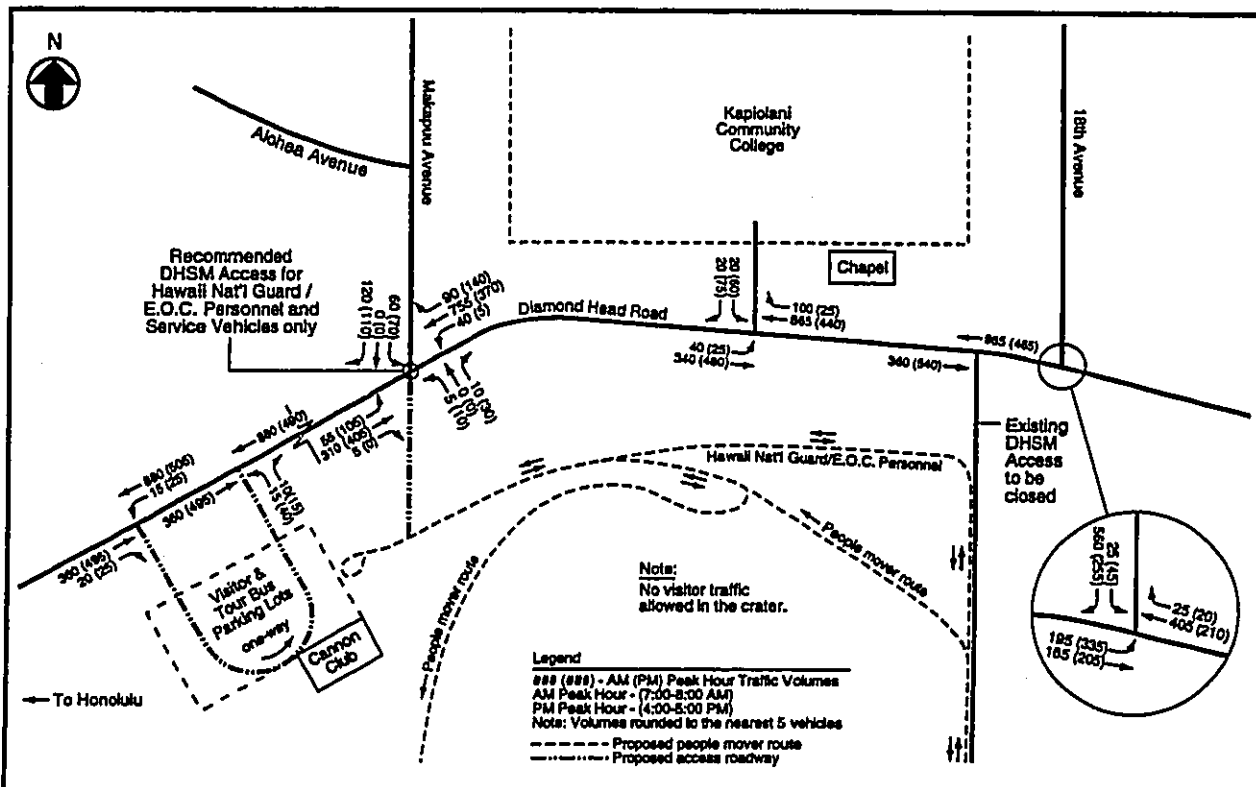






**CONCEPTUAL PLANS 1 & 2**  
**YEAR 2008 PEAK HOUR TRAFFIC VOLUMES**  
**FOR RECOMMENDED ACCESS MODIFICATIONS**

Figure  
**22**



**CONCEPTUAL PLAN 3**  
**YEAR 2008 PEAK HOUR TRAFFIC VOLUMES**  
**FOR RECOMMENDED ACCESS MODIFICATIONS**

Figure  
**25**

*Appendix H*

**Social Impact Assessment and Revenue Analysis**

### NOTE ON TIMING ASPECTS

The following report was completed in August 1998, and represents the situation as of that time.

Since then, there have been additional planning activities and opportunities for public comments on the proposed Diamond Head project. A summary of public input from these events — prepared by PBR Hawaii — is appended at the very end of this report.

Although other events have also occurred since the report's completion (e.g., decisions about an interim fee structure for admission to the crater, and ongoing controversy about the City's proposal for an interpretive center at Hanalei Bay), the fundamental conclusions from this August 1998 report remain basically unaffected as of February 2000.

## DIAMOND HEAD STATE MONUMENT SOCIAL IMPACT ASSESSMENT AND REVENUE ANALYSIS

August 1998

Study Conducted by:

John M. Knox & Associates, Inc.

Study Prepared for:

PBR Hawaii, Inc.  
and  
Hawaii State Dept. of Land and Natural Resources

Report Authored by: John M. Knox, Ph.D.

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## 1.0 PURPOSE AND SUMMARY

### 1.1 Purpose

#### 1.1.1 Introduction

This report provides a social impact assessment and market research (in the context of revenue projections) for the proposed updating of the Master Plan for the Diamond Head State Monument. It is intended as an appendix to the overall planning Impact Statement (EIS) being prepared by PBR Hawaii, the Resources (DLNR), for the Hawaii State Department of Land and Natural

The remaining chapters of this report will include:

- Chapter 2 — Social impact assessment (analysis of project consequences for various "communities" or interest groups);
- Chapter 3 — Case studies of somewhat comparable recreational development, with attention to "lessons learned" for the market feasibility of, and potential revenues from, the Diamond Head project;
- Chapter 4 — Results of a survey of Diamond Head users, to obtain a profile and to determine "willingness to pay" entry fees at various price points;
- Chapter 5 — Interviews with representatives of various tour companies and travel desks, to determine likely market consequences for group tour use of new facilities in the Diamond Head Crater; and
- Chapter 6 — Estimated annual costs vs. potential revenues from the proposed development.

Some of these chapters were written early in the analysis process, in part to meet internal deadlines, and the overall report is lengthy. Therefore, this opening chapter will hopefully serve to "draw together" the specific findings from various subsequent chapters into a summary overview.

#### 1.1.2 Project Components Critical to This Analysis

The overall EIS contains a complete description of various Master Plan alternatives. Included among the list of elements are things like elimination of large existing structures, reforestation of part of the Crater floor, improvements to the trail and restroom facilities, etc.

However, potential components which are particularly critical for this analysis would include:

- Construction of a permanent new visitor/interpretive center inside the Crater;
- Eventual removal of all visitor parking from inside the Crater to a central location on the outside (possibly the old Cannon Club site);
- The imposition of a new entry fee schedule intended to provide revenue adequate to pay for most or all construction costs associated with the project — and possibly generate additional revenues for DLNR's State Parks Division. (DLNR is currently contemplating the imposition of small entry fees, which could be implemented as soon as late 1998, but the project would probably require an increase in whatever fees may be in place in the near future.)

#### 1.1.3 Scope

The original scope of work for this study was focused strictly on social impact assessment — documenting issues and concerns voiced by, and analyzing the likely social consequences for, nearby residents and other affected parties. However, as work began, the social impact consultant and PBR Hawaii jointly decided<sup>1</sup> it would be useful to concentrate most of the available resources on learning more about the project's likely market potential — the number of people who might actually patronize the new park and the revenues it could generate.

Ultimately, these factors are responsible for many of the outcomes which seem to be of particular concern for the community: What size should the visitor/interpretive center be (i.e., what is the likely customer base)? How many people will likely be using the Crater and impacting the resources there? What sort of funds can be raised to keep improving Diamond Head in the future?

As a consequence, the social impact component of this study was completed without the usual set of community interviews which would otherwise be carried out for this study. Conclusions about "issues and concerns" should be considered as particularly tentative, although these will emerge anyway through the normal EIS review process. Consequently, we believe the final scope of this report represents the best use of resources, because it meets the ultimate EIS objective of providing information to the community that might not otherwise have been communicated.

<sup>1</sup>The decision was aided by the fact that there has been an established process to gather public input throughout the 21-year history of the Diamond Head Citizens Advisory Committee.



#### 1.1.4 Topics Outside the Scope of This Report

It is important to note a few subjects which are *not* part of the scope for this analysis.

**Native Hawaiian Issues or Impacts:** Diamond Head State Monument consists of "ceded lands," and the revenue analysis will note that 20% of the proceeds to DLNR will therefore (under present law and practice) be turned over to the Office of Hawaiian Affairs (OHA). Some OHA trustees have called on the State to transfer Diamond Head to OHA as part of a settlement package for claims against the State, and it is possible that other Native Hawaiians have particular desires for, or historical associations with, the Leahi area. These are complex cultural or political issues which may or may not be relevant to the EIS process, but are not — other than the 20% revenue diversion — addressed in this study.

**"Economic Impacts" of the Project:** This study looks at potential revenues for the State government, but it does not include a traditional "economic impact assessment," which would be an analysis of the amount of new employment or income brought into Hawaii. The reason for this exclusion is that the project is not expected to have any direct economic impact in the classical sense. That is, it is unlikely that this project, in and of itself, would be sufficient to attract new visitors or visitor dollars to Hawaii. Rather, it would encourage visitors who are coming anyway to spend money at Diamond Head rather than somewhere else, resulting in more direct revenues for State government but correspondingly less revenue elsewhere in the economy.

The previous statement merits some qualification. There is a feeling in the visitor industry that the tourist product in Hawaii (and on Oahu in particular) is somewhat "tired" and in need of re-invigoration. It is entirely possible that this project, in conjunction with other yet-to-be-specified public or private activities, can contribute to a cumulative revitalization of Oahu's visitor plant. In fact, it seems probable that such a revitalization will come from a combination of relatively small- or medium-sized changes such as this project, rather than from any single large "must-see" theme park or other similar mammoth attraction. However, at this point, it would be impossible to say if the Diamond Head project would actually be a part of such a cumulative effect, or to separate out its particular contribution if it does contribute to such an effect.

#### 1.1.5 Other Caveats

**Nature of the Project:** This study was conducted from May through August 1998, when PBR Hawaii was examining a number of possible Master Plan alternatives, and when changes were being made in some planned components.

As one particularly important example, the expected size of the visitor/interpretive facility was in the range of 100,000 square feet when the study began,<sup>2</sup> was downsized to about 40,000 square feet at the time we surveyed Diamond Head users<sup>3</sup> and interviewed tourism officials; and was tentatively further reduced to about 25,000 square feet (with possible "satellite" facilities<sup>4</sup> inside and outside the Crater) when the final revenue projections were completed.

For the sake of simplicity, this study does not try to address all the various alternatives, nor are results particularly contingent on most specific details. Rather, we are looking in a very broad way at a Crater park characterized by the components previously mentioned — things like reforestation and removal of buildings, but particularly the critical components of a substantial visitor/interpretive center, outside parking, and higher entry fees.<sup>5</sup>

Furthermore, we are looking at the ultimate implementation of such a plan, in five to ten years time. In fact, the project may be built in stages — for example, the visitor/interpretive center might be constructed before parking is moved outside. This could have an effect on revenues in this interim phase which is not reflected in our analysis of the final project.

**Restriction of Case Studies to Hawaii Comparables:** In many regards, the proposed Diamond Head project is unique — particularly the magnitude of the proposed visitor/interpretive center (with its possible separate entry fee) in conjunction with a public park. The "comparable" Hawaii situations examined in this study are in truth only "quasi-comparable." Every study has resource limitations. Given unlimited time and money, we would have looked outside Hawaii to see if we could learn about the market success of other projects that might be more exactly comparable. That was not practical. However, this limitation should be kept in mind when considering that the visitor/interpretive center may actually be developed in some way quite different than the Hawaii "comparables" on which our revenue analysis is based.

<sup>2</sup>This was based on an industry standard for exhibit space of one square foot for 20 visitors per year and a then-assumed 1,000,000 visitors per year at Diamond Head (per DLNR).

<sup>3</sup>The size of the center was not actually given in the survey, though a conceptual rendering of its exterior was shown to survey respondents.

<sup>4</sup>These would utilize existing structures; hence, were not considered in the annual cost projections.

<sup>5</sup>However, for analysis of cost factors, we did use PBR Hawaii's estimates for "Concept 1," which is now considered the preferred alternative.

## 1.2 Summary Overview of Findings

### 1.2.1 Social Impact Assessment

Exhibit 1-A on the following page summarizes the contents of Chapter 2, the social impact analysis. It considers probable issues and concerns (although these will be supplemented by comments and hearings in the actual planning process) and likely actual social impacts for various "communities of interest."

The most obvious "community" consists of nearby neighbors. Because of the Crater's previous history for rock concerts in the 1960s and early 1970s, it is expected that neighbors will have a great sensitivity to possible effects of new operations there. However, the factor which will most seriously affect the surrounding neighborhoods will be traffic and parking — whether the proposed move to outside parking will result in Crater visitors' cars or other vehicles overflowing on to residential streets or other parking lots in the area. This is the domain of traffic consultants and planners rather than of a social impact consultant. If these concerns can be effectively addressed, we would expect that developments inside the Crater will have little effect on area residents.

One of the most important conclusions in Exhibit 1-A is that "Tour groups coming for sightseeing only (especially in large buses) will be effectively eliminated, for both economic and logistical causes." This conclusion is based on discussions with representatives of various tour companies, wholesalers, and travel desks. At the present time, most organized commercial tours to Diamond Head involve brief stops — often the first stop on a multi-destination circle-island tour — for sightseeing, picture-taking, and use of the restroom. Often, tour buses do not even stop to let people out, and the major tour companies do not consider this Crater stop to be an important aspect of their business.

Because the average Oahu group tourist is increasingly budget-conscious, the major companies feel they will almost certainly just skip the Crater interior (although they may go to one of the exterior lookouts) if any fees are imposed. And because they are on a tight schedule, there are logistical considerations as well — there is simply no time to unload passengers at an outside parking lot, worry about keeping them together as they transfer to a proposed people mover system, wait for them to hike or go to the visitor/interpretive center, and then reassemble to go to the next location. The new center might be a draw for some smaller tour groups which actually spend time in the Crater, but this will depend on cost, commissions, etc. The overall effect will be to discourage group tourists and restrict the Crater mostly to residents and tourists arriving independently.

Another noteworthy comment in Exhibit 1-A involves the possibility that longtime Diamond Head "stewards" (champions of its preservation) could become involved in generating revenues for its improvement through giftshop sales, as occurs in National Parks. If so, this would increase their decision-making clout, but would require them to take more of an economic perspective.

EXHIBIT 1-A: SUMMARY OF SOCIAL IMPACT ASSESSMENT	
<b>Affected Community</b> Community of Nearby Residents (especially those living in neighborhoods very close to Diamond Head)	<b>Probable Actual Impacts</b> - Fees may actually reduce number of visitors to area - Traffic parking is key to real level of impact. Potential for conflicts over use of Kapaemahu Community College parking lot, vehicles spilling over into residential streets. - If this can be well handled through good planning, then actual impacts likely neutral as most changes will be inside, not outside, Crater. Master Plan does not affect "First Amendment rights"
<b>Community of On-Site Diamond Head Entrepreneurs</b> Community of Tour Operators	<b>Probable Issues &amp; Concerns</b> - Noise and litter, repetition of nuisances from early use of Crater for concerts, etc. - Traffic parking concerns - Size of interpretive center - Effects of fees on neighborhood access (jogging, etc.) - Perceived inequities if State erects structures when nearby residents limited by DH Special Design District Unknown — probably continuation of activities - Image of Hawaii for visitors: "squeezing" money again - Equity/fairness if tourists must pay more than residents - Govt. assumption of private role in operating "tourist attraction" DH Special Design District Unknown — probably continuation of activities - Image of Hawaii for visitors: "squeezing" money again - Equity/fairness if tourists must pay more than residents - Govt. assumption of private role in operating "tourist attraction"
<b>Community of Diamond Head Recreational Users (both residents and visitors)</b>	<b>Probable Issues &amp; Concerns</b> - Fees never welcome; questions about actual use for DH improvements and if this is precedent for other parks - Concerns about safety, fighting of tunnels, better restrooms, phone at top, etc. - Probable tourist demand for food, gifts in well-organized shops, not from vendors - Fees probably minimal for residents - Better maintenance of trail and viewpoint - More Interpretive Information - Viewpoints more accessible to older, more trail visitors - Inferior more natural, pretty - People wanting only to sight-see probably screened out - Uncertainty about safety, emergency phone at top
<b>Community of Diamond Head "Stewards" (people who have come to feel a special aloha and responsibility — especially Parks staff, CAC, but also many other people)</b>	<b>Probable Issues &amp; Concerns</b> - Preserving objective environmental resources (trail quality, endangered plants) - Preserving nature-oriented subjective experiences (limits to commercialism, human structures in Crater) - Limiting number of people - Use of revenues for DH center - Satisfaction of many long-standing goals, especially related to natural appearance and limiting "commercialism" associated with tour activities - Possibly more concerns about liability for State - If some "stewards" help raise \$ for DH through gift sales, they would be empowered on the one hand, but also now must take more of an economic perspective on operations
<b>Community of Hawaii Taxpayers</b>	<b>Probable Issues &amp; Concerns</b> - Conflicting voices: "Govt. should cut taxes, go to user fees instead" vs. "Don't charge me, my taxes pay for this!" Outcomes will depend on actual level of revenues vs. costs of project. Rest of analysis thus is market research.

### 1.2.2 Background Market Research

In preparation for the final cost and revenue analysis, a number of market research<sup>6</sup> efforts were carried out to gather information about the feasibility of:

- Overall development of the Crater park, with entry fees to help pay for resource management;
- The visitor/interpretive center in particular — i.e., the market appeal of a major facility which might add to Diamond Head's "draw" and/or be self-sustaining.

#### 1.2.2.1 Methods

##### (1) Case studies of Hawaii "comparables" (or quasi-comparables) for:

- The overall Crater park development — with particular attention to Hanauma Bay (an example of a recently "free" recreational attraction which began charging fees);
- The potential visitor/interpretive center — with particular attention to the Iao Nature Center (a stand-alone education-based attraction originally intended to capture FIT visitors to the adjacent State park in Maui's Iao Valley), and with secondary attention to the Koko'e Natural History Museum and a few other museums or aquatic facilities.

##### (2) Additional analysis of a Diamond Head visitor and vehicle count recently conducted within the Crater (SMS Research, 1998). This took place on one weekend day and one weekday during May 1998.

##### (3) An intercept survey of 446 active Diamond Head users<sup>7</sup> to determine both their characteristics and their "willingness to pay," at various likely price points, for the sort of development contemplated for the Crater in various alternative versions of the updated Master Plan. This survey was conducted July 11 - 17, 1998 at various times of each day.

<sup>6</sup>Because of the focus on market feasibility and revenues, most of the remainder of this chapter will use the language of business and commerce, which is in some part appropriate if the major underlying question is, "Will this make money (or at least not lose much)?" However, as noted at the end of the chapter, other values are also involved in planning for Diamond Head.

<sup>7</sup>The survey necessarily excluded people on sightseeing buses who did not emerge from buses or whose buses just drove through without stopping. The original sample included an additional 38 people who said they were on group tours and/or had arrived in tour vehicles, but these were eliminated from the final sample because in some cases we were talking to atypical tourists — those enthusiastic enough to get off the bus while others remained on it. The final sample thus consisted strictly of residents and "free independent travel" (FIT) tourists, as well as a few Japanese tourists who freely got on and off the Japan Travel Bureau charter trolley.

- (4) Interviews with about a dozen representatives of Hawaii's largest organized tour companies and/or tour wholesalers and travel desks. (Included were a few small companies specializing in organized tours with Diamond Head as an occasional specific focus, though we could not find many such companies.)

Full information about these methods is provided in Chapters 3 through 5. The following few pages provide a summary overview of selected key results.

#### 1.2.2.2 Numbers and Types of People Now Coming to Diamond Head

Available estimates of the numbers of people coming into the Crater are rough and approximate, based on counts made just one or two days out of a year. Hence, "official" State estimates summarized in DLNR's July 1998 draft *Interim Interpretive Plan* for the Diamond Head State Monument show some unlikely abrupt increases — e.g., the leap from about 60,000 people in fiscal 1993-94 to about 1,000,000 visitors the next year, or the leap from about 1,000,000 in 1996-97 to about 1.7 million for 1997-98.

Another problem is that past estimates have not adequately distinguished among types of visitors who have very different levels of impact on the Crater and its resources:

- People driving through without stopping at all — i.e., sightseers only (and maybe some intended users who could not find parking);
- Sightseeing groups making only brief stops, for picture taking or bathroom breaks;
- Active park users — mostly hikers, but perhaps a few picnickers, too.

The May 1998 visitor traffic count suggested an annual total of about 690,000 people in the last two categories only. Additional analysis of the May dataset for this report yields a very rough estimate of 600,000 visitors per year for the last category only — i.e., the principal likely "customer base" if sightseeing tour groups are effectively screened out of the Crater.

(These figures leave considerable doubt about the numbers "just driving through." If both the DLNR and SMS figures are true, the implication is that 1 million people drove through the Crater without stopping in the past year — a figure which is of course theoretically possible but highly doubtful. For purposes of this analysis, however, the number of "drive-throughs" is largely irrelevant, because the updated Master Plan is clearly designed to serve active park users only — the "drive-throughs" are not part of the base for revenue purposes.)

The July 1998 survey gives a sense of the characteristics of the roughly 600,000 active users of the Crater:

- Resident, 17%; Asian visitor, 40%; North American visitor, 37%; other visitors (including European), 7%.
- About half came by private car, a quarter by City bus; 14% by trolley; with the remainder by various other methods (taxi, foot, bicycle, etc.). Residents and North Americans came overwhelmingly by private car, while Asians were much more likely to come by bus or the JTB charter trolley.
- 92% had hiked or intended to hike to the top of the Crater. Thus, when drive-through sightseers are excluded, the principal "draw" of the Diamond Head Crater at this time is clearly the hike and the spectacular view from the top of the rim.

#### 1.2.2.3 Market Appeal of Overall Development Under Updated Master Plan

(Both survey respondents and tourism industry interviewees were told that eventual plans may include outside parking, people movers, elimination of the current larger interior buildings, possible return of the "Tunnel 407" with its Kahala coast lookout, reforestation, new picnic areas, and a fairly large new visitor/interpretive center.)

**Evidence from Hanauma Bay:** Data suggest that attendance at the Hanauma Bay Nature Preserve (exclusive of sightseeing only) was sharply affected by the initial \$5 entry fee imposed on tourists in 1995. That fee (along with commercial vehicle fees) was later dropped, but a \$3 non-resident entry fee and \$1 parking fee for all private cars was later re-imposed in 1997. The \$3 fee had little or no apparent effect on attendance, indicating that \$3 was seen as a fair price point but that \$5 was a significant deterrent. In viewing this evidence, it should be kept in mind that Hanauma Bay is a fairly unique Oahu attraction which had been — and still is — heavily promoted in tourist literature. Diamond Head is less unique (Punchbowl Crater offers much the same urban view for free), and it has been much less heavily promoted. Therefore, even a \$3 fee at Diamond Head might have a deterrent effect on attendance.

**Diamond Head Survey — Willingness to Pay Outside Parking Fee:** The great majority (about 80%) of those coming by car were willing to pay \$1, but only about half were willing to pay \$2.

**Diamond Head Survey — Willingness to Pay Additional Fee to Cover Overall Entry and People Mover (Not Covering Visitor/Interpretive Center):** About half of Hawaii residents would not pay even the minimal suggested \$3 fee. Among tourists, however, roughly three-quarters overall were willing to pay \$3 (with North Americans more likely to be deterred by this level of fee and foreign tourists more likely to accept it). Resistance increased sharply at the \$5 level, and only about 10% would pay \$7 or more. This suggests that tourists could not be charged more than \$3 (1998 dollars) without steep losses in attendance.

**Tour Company Acceptance:** As previously noted, the great majority of interviewees agreed the major tour companies will simply skip Diamond Head if (1) any commercial vehicle fee or other cost is imposed (unless a major change has occurred in the current budget-conscious Oahu market), and/or (2) outside parking makes it impossible to see Diamond Head quickly as part of a multi-destination tour. There was more uncertainty about effects on smaller tour group operations spending some time in the Crater, but there was little feeling that the new arrangement, especially the fee structure, would encourage more tour groups — it was more a question of whether or not present tour activities could survive, and that would depend on cost vs. market demand at the time.

#### 1.2.2.4 Market Appeal of New Visitor/Interpretive Center

**Relevant Information from Case Studies:** In its first year of operations (1997-98), the Iao Nature Center — charging adults \$6 for entry to a 4,000 square-foot facility — managed to break even on Maui. In that time, the Nature Center captured just 10% of the estimated attendance at the adjacent Iao Valley State Park. To augment business and generate revenues for its educational programs, the Nature Center now is establishing ties with Maui group tour companies, and hopes to double business this year. However, as previously indicated, the option of connecting with tour companies may not be available at Diamond Head. Thus, the Iao Nature Center's experience is "good news" in the sense that imminent profitability (at least at a small facility) seems possible, but the low capture rate is worrisome. Other conclusions from the examination of case studies:

- There is no Hawaii market "comparable" for a larger interpretive center based on the natural history of a unique landmark. All existing facilities are much smaller and (except for the Iao project) essentially free.
- Revenues for such operations (and, to an extent, for paid facilities like Maui Ocean Center) come heavily from book/giftshop sales, not fees. The mark-up from these sales typically go to nonprofits running the shops, who by law must limit their stock to material relevant to their educational mission. State parks currently benefit little from these profits, but National Parks have standardized arrangements with nonprofit groups which might be a good model for the State.

**Diamond Head Survey — Willingness to Pay Separate Entry Fee for Visitor/Interpretive Center (Over and Above Parking and Overall Park Entry/Shuttle Fees):** Nearly two-thirds of the survey respondents were unwilling to pay the minimal suggested separate entry fee of \$5. Hawaii residents were particularly disinclined to pay a separate fee for the center. (Management at the Iao Nature Center and the Hanauma Bay Nature Preserve both express reservations about the idea of a separate fee for the center, although the revenue analysis to be reported shortly suggests some reason to reconsider that view.)

**Diamond Head Survey — Willingness to Pay Combined Entry Fee for Admission to Overall Park, Visitor/Interpretive Center, and People Mover:** About 50% of the respondents said they would be deterred by the minimal suggested combined fee of \$7. (Again, residents were particularly resistant.) The survey process effectively "marketed" the center by oral description and a visual rendering; thus, it seems probable that in reality more than 50% would be deterred, especially since the initial payment question found 90% were deterred by the \$7 level.

**Tour Company Interest:** Interviewees were generally pessimistic about the market potential of the center. Few could think of any type of interpretive center which could, at the suggested range of fees, draw additional people to Diamond Head, whether on group tours or on an FIT basis. The consensus view was that tourist demand is typically less for "educational" than for "entertaining" experiences. And from the group tour perspective, there are other logistical and economic considerations:

- Keeping tour groups together and moving quickly;
- Fears that State facilities historically have not met the language needs of foreign visitors;
- Commissions for tour operators are significantly greater at competing, higher-fee attractions (e.g., Waimea Valley, Sea Life Park).

#### 1.2.2.5 General Advice of Tour Company Interviewees

Interviews closed with a request for general strategies that would help to pay for Diamond Head improvements. Several people recommended making money from food or gifts, as opposed to a visitor center. Most stressed the need to be clear on the goal of fees. If it is to pay for maintenance and conservation, they thought few people would begrudge a dollar or two. But to generate truly significant revenue, they said the State must develop a major attraction ("with real pizzazz!") and be prepared to heavily market and promote it.

All recognized the need to maintain and upgrade the Crater, but only a few were enthusiastic about the potential for a major tourist attraction with more "pizzazz" than is currently being planned — most thought such a course would be risky for the State and could blur the line between public and private enterprise. The majority recommended that the State focus on the Crater's current assets ("a hike and a view") rather than trying to create something that is not already there now.

#### 1.3.1 Projected Costs vs. Revenues

The following few pages summarize the complete analysis contained in Chapter 6.

##### 1.3.1.1 Critical Conceptual Assumptions

The analysis is based on a variety of assumptions, but it is important to point out three basic assumptions of a conceptual nature:

- (1) Large tour groups now coming to Diamond Head only for sightseeing (and remaining there for just a few minutes) would not be part of the market base for this project — they would no longer come into the Crater.
- (2) The implementation of entry fees would deter some current Diamond Head users from going into the Crater (and/or into the visitor/interpretive center). It is not a matter of assuming the State can get X dollars from everybody going into the Crater, because not everybody would go if they had to pay X dollars.
- (3) The assumed economics of the visitor/interpretive center will be based on existing Hawaii models (particularly those at Hawaii's National Parks). At present, other consultants are working on approaches to the center that could be far different than existing models. However, based on the resources and "comparables" available for this study, it is difficult accurately to estimate the economics of such alternative approaches.

##### 1.3.1.2 Cost Factors

Based on information provided by PBR Hawaii and its subcontractors:

- Construction costs for the project will total about \$25 million in 1998 dollars.
- Annual operating and amortization costs would total about \$2.3 million, which becomes the estimated yearly "break-even" point.

**1.3.1.3 Estimated Revenues**

Revenues were estimated for both a "Separate Entry Fee Scenario" (in which visitors would have to pay one fee to enter the Crater and a separate fee for admission to the visitor/interpretive center) and also a "Combined Entry Fee Scenario" (in which a single, higher combined fee would cover admission both to the overall park and to the center). In the first scenario, more people would pay a lower fee (assumed to be \$3 for adult tourists, nothing for residents) to enter the overall Crater, and only a small proportion would likely pay a separate fee for the center (\$5 for tourists, \$4 for residents). In the second scenario, fewer people would pay the combined entry fee (assumed to be \$7 for tourists, \$3 for residents), but a higher proportion would go into the center thereafter.

Exhibit 1-B summarizes results of the analysis:

EXHIBIT 1-B: SUMMARY OF PROJECTED ANNUAL ATTENDANCE, REVENUES, AND TOTAL COST		
	I. Separate Entry Fee Scenario	II. Combined Entry Fee Scenario
<b>Attendance Levels</b>		
- Overall Crater	517,500	207,000
- Interpretive Center	182,200	144,300
<b>Revenue Levels</b>		
Crater Entry Fee	\$1,214,100	\$1,246,300
Parking Fee	\$119,000	\$47,800
Shuttle Concession	\$84,500	\$25,800
(Subtotal from Outside Center)	\$1,397,600	\$1,319,700
Center Entry Fee	\$843,100	\$471,800
Gift Shop Profits	\$51,000	\$40,400
Food Concession	\$178,300	\$71,300
(Subtotal from Interpretive Center)	\$1,072,400	\$583,500
<b>TOTAL REVENUES</b>	\$2,470,000	\$1,903,200
State Portion (80%)	\$1,976,000	\$1,522,560
	vs.	vs.
Projected Annual Cost	\$2,309,800	\$2,309,800

The analysis suggests neither entry fee scenario would meet projected annual costs, but the Separate Entry Fee approach would come closer.

In fact, given the rough and preliminary nature of these numbers, the best interpretation would be that the Separate Fee approach would be "close to break-even, but a little on the negative side of the mark."

The complete analysis in Chapter 6 also provides further numbers indicating that the Combined Entry Fee approach could reach the level of profitability if fewer people are deterred than we assume ... and/or if it is very effectively marketed and promoted. However, the approach is riskier, because the analysis also shows that if numbers are lower than assumed, the shortfall increases more rapidly than under the Separate Entry Fee Scenario.

This analysis in many ways reinforces the comments offered by tourism company interviewees. To be seriously profitable, the visitor/interpretive center must have far more intrinsic market appeal than anything yet developed in Hawaii, and/or it must be marketed and promoted in a way that local government has not previously attempted for any public park or visitor facility. That would mean a commitment to Diamond Head as a tourist attraction, possibly in competition with other Oahu attractions. Such a commitment does not necessarily imply the "commercialization" of Diamond Head, if — as is the case with National Parks — good planning principles are followed; giftshops are operated by nonprofits; and revenues are used for maintenance and improvements in the area. It does, however, imply a commitment to an economic perspective, to adopting many of the values of good business operations.

Alternatively, the main purpose of the visitor/interpretive center could be viewed as something other than profit. It could be viewed as an appropriate adjunct to a natural resource — as having intrinsic educational value, for both residents and tourists, the sort of value which merits a moderate level of State subsidy. And/or it could be viewed as the sort of traditional government addition to the visitor plant (again, like National Parks) which helps to re-invigorate our "tourism product" by providing facilities which appeal to some if not all segments of the visitor market. This might also argue for a moderate level of State subsidy.

Ideally, the Diamond Head Crater and its visitor/interpretive facility would fulfill all these purposes — it could educate, contribute to the tourism economy, and generate surplus revenues for the State which could be used to improve the Crater environment. Our analysis suggests this ideal will probably not be met, and so a decision needs to be made as to which purpose has priority.

## 2.0 SOCIAL IMPACT ASSESSMENT

### 2.1 Introduction

This chapter provides an assessment of the potential social impacts of revising the current Diamond Head Master Plan — particularly if these revisions include implementation of ideas such as exterior parking, shuttle buses (people movers) into the Crater, construction of a visitor/interpretive center, and a higher fee schedule based on such improvements.<sup>1</sup>

Social impact analysis typically involves two very different perspectives:

- (1) Subjective issues and concerns of affected groups, which may be gleaned through interviews, secondary materials, experience with similar situations, etc. These may be considered impacts of the proposal alone, rather than of the ultimate actual project, since people are reacting to plans and ideas.
- (2) Likely actual social outcomes of implementing the project, which may be determined by examination of comparable situations or other types of relatively "objective" analysis.

It should be noted that the majority of the resources for this study have gone into the market research and revenue analysis to be discussed in the remaining chapters. As a result, there was no significant level of consultation with most affected communities during the preparation of this report — an approach which contradicts the usual professional practice of the preparer of this report.

Nevertheless, this approach was actually adopted at our urging, because it was felt that it would ultimately be more useful to develop some factual basis for project feasibility than to document "issues and concerns" with great precision. (Additionally, the EIS process and associated public hearings will in itself generate a record of public concerns.) In regard to objective or "actual" impacts, many of these would likely depend on project feasibility as well.

Thus, the present chapter is based less on the techniques of social science and more on the preparer's background and immersion in the project through the activities discussed in subsequent chapters — i.e., case studies of somewhat similar areas such as Hanauma Bay, a survey of Diamond Head users, and interviews with some tour company executives.

<sup>1</sup>It should be borne in mind that such project components, if implemented, might well occur gradually over five to ten years. The Department of Land and Natural Resources is already moving this year, independent of the Master Plan revision, to change initial entry fees to Diamond Head Crater and to erect a small kiosk for interpretive and educational purposes.

The social impact assessment will be organized according to various potentially affected "communities":

- Community of Nearby Residents
- Community of On-Site Diamond Head Entrepreneurs
- Community of Tour Operators and Associated Agencies
- Community of Diamond Head Crater Recreational Users
- Community of Diamond Head "Stewards"
- Community of Hawaii Taxpayers

### 2.2 Community of Nearby Residents

Neighborhoods Surrounding the Diamond Head Project Area: Diamond Head is visible and important to many neighborhoods throughout urban Honolulu, but activities inside the Crater would be of most concern to nearby neighborhoods. Exhibit 2-A below shows the location of five U.S. census tracts closest to the project site (including Census Tract 6, which actually contains all of the Diamond Head State Monument). Exhibit 2-B<sup>2</sup> on the following page shows selected 1980 Census data which indicate important ways these areas differ from one another and from the overall Oahu population.

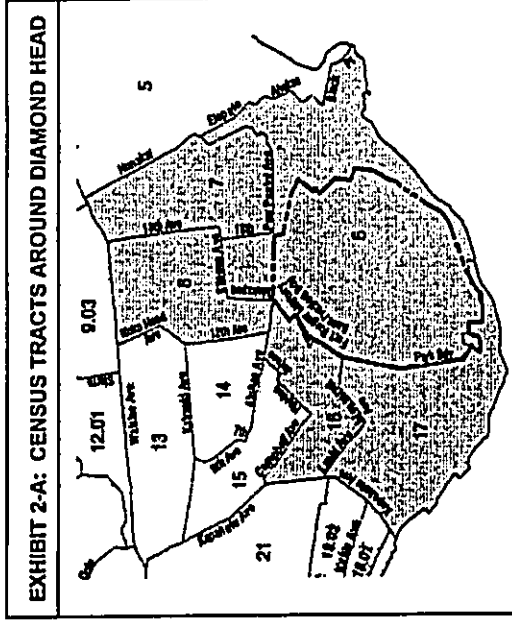


EXHIBIT 2-A: CENSUS TRACTS AROUND DIAMOND HEAD

<sup>2</sup>Taken from more detailed Census data in Appendix Tables A-1 to A-5.

The combined 1990 population for these five census tracts was about 14,600 people. All five areas had a population that was, on average, older than the islandwide population and more likely to have been settled in their homes for many years. Four of the five tracts are marked by a high proportion of single-family rather than apartment units. Some ways in which they differed from one another:

- **West Diamond Head/Waikiki (C.I. 17)** is clearly an "apartment" area, with three-fourths of all housing units located within multiple-unit structures and a very low average household size. It is also the most "Caucasian" area (76% Caucasian, with a majority of people born on the Mainland). Few children under 18 live in this neighborhood, and there is a high proportion of senior citizens. Many employed people are in the professional category, but household incomes are only a little above the islandwide norm (probably due in part to the number of senior citizens, in part to fewer workers per household).
- **Kapahulu and Lower Kaimuki (C.I. 16, 8, and 7)**, the three tracts north of Diamond Head, are roughly similar to one another in being very "local" (particularly Japanese) communities with long-time homeowners living mostly in single-family properties. Kapahulu has a few apartments and an income profile slightly lower than the islandwide norm. As one moves from west to east in these three areas, the profiles switch progressively from slightly lower-middle-class to middle- or slightly upper-middle-class.
- **East Diamond Head/Black Point (C.I. 6)** — which actually contains the Diamond Head State Monument, though its housing is located only to the east and along a small southern coastal strip — is one of the most affluent areas on Oahu. It is ethnically cosmopolitan, with a high percentage of college graduates and professional workers. Its small and aging population lives overwhelmingly in single-family households (with a low average household size and few children), in homes they have owned or held for many years. In terms of place of birth, though, it is no more nor less "local" (Hawaii-born) than Oahu as a whole.

**Probable Issues and Concerns:**

- (1) Because of previous public use of the Crater for concerts in the 1960s and early 1970s, nearby residents may be expected to express concern about noise and litter if Crater attendance increases and/or the visitor/interpretive center is used for any sort of live performances.
- (2) Traffic/parking concerns are also a probable issue, both because of past memories and because of the example of Hanauma Bay.

**EXHIBIT 2-8:  
OAHU VS. CENSUS TRACTS SURROUNDING DIAMOND HEAD CRATER --  
HOUSING AND DEMOGRAPHIC CHARACTERISTICS, 1990**

	OAHU Honolulu County	CT 17 W. Diam. Head/ Waikiki	CT 16 Kapahulu	CT 8 Lower Kaimuki (West)	CT 7 Lower Kaimuki (East)	CT 6 E. Diam. Head/ Black Pt.
<b>HOUSING UNITS</b>	287,400	1,705	1,429	1,772	896	864
<b>UNITS IN STRUCTURE</b>						
1 unit	56%	21%	75%	80%	94%	87%
5 or more units	30%	78%	15%	1%	0%	0%
<b>HOUSEHOLDS</b>	283,304	1,344	1,275	1,233	971	491
<b>OWNER-OCCUPIED</b>	52%	50%	56%	64%	77%	83%
<b>PERSONS PER HOUSEHOLD</b>	3.02	1.81	2.85	2.86	3.04	2.87
<b>POPULATION</b>	838,231	2,838	3,811	3,888	2,993	1,211
<b>ETHNICITY</b>						
Caucasian	32%	78%	18%	18%	15%	38%
Japanese	25%	9%	45%	47%	54%	21%
Other	20%	11%	21%	26%	21%	35%
<b>AGE</b>						
Under 18 years	24%	8%	17%	18%	18%	14%
65 or more years	11%	28%	27%	26%	26%	30%
Median age (years)	32.2	47.2	38.4	42.9	43.9	48.3
<b>COLLEGE EDUCATION (1)</b>	33%	46%	24%	30%	30%	61%
<b>PLACE OF BIRTH (2)</b>						
Born in Hawaii	54%	30%	75%	77%	72%	57%
Other U.S. States, Territories, etc.	30%	54%	18%	13%	17%	33%
<b>PCT. OF HOUSEHOLDERS WHO MOVED INTO UNIT 21+ YEARS AGO</b>	18%	21%	42%	46%	58%	55%
<b>HOUSEHOLD INCOME LEVEL</b>						
\$75,000 or More in 1989	17%	24%	11%	22%	22%	51%
Median, 1989 dollars	\$40,581	\$44,864	\$36,094	\$42,264	\$50,000	\$78,164
<b>EMPLOYED WORKERS IN "MANUAL-GENERAL/PROFESSIONAL" JOBS</b>	26%	47%	21%	25%	27%	52%

**NOTES:** (1) For persons aged 25+. Includes Associates, Bachelor's, and graduate degrees.  
(2) All data below this row based on 15% sample; hence, figures represent estimates only.

**SOURCES:** U.S. Bureau of the Census, 1982, 1991.



(3) A review of Neighborhood Board minutes for the surrounding communities (through early July 1998) indicates that the size of the potential visitor/interpretive center has been the only major topic of discussion yet to emanate from discussions over possible changes to the Diamond Head Master Plan. This may be in part related to the foregoing issues, in part to concerns about the aesthetics in the Crater.

(4) DLNR staff and survey interviewers (see Chapter 4) noted that a small but regular group of neighbors use the Crater for purposes such as jogging, bicycling, and occasional picnics. Effects of fee structures on neighborhood access are therefore a likely concern, although one that will be triggered by current fee proposals longer before some of the Master Plan alternatives might result in even higher entry fees.

(5) During the interviews with tour companies and travel desk representatives (see Chapter 5), it was noted that property owners in the City's "Diamond Head Special District" (roughly equivalent to the census tracts of Exhibit 2-A, but excluding the upper parts of tracts 7 and 8 and including a few parts of tracts 15 and 21) are subject to height limitations, and those closest to the slopes of Diamond Head itself have other design restrictions affecting ability to expand or remodel homes. It is possible there may be perceived inequities if government is permitted to erect large structures in the Crater while nearby residents cannot enlarge the size of their own structures.

**Probable "Actual" Impacts (Following Project Completion):** The most important likely actual impact of project development would involve traffic and parking consequences, rather than conventional "social" consequences such as crime or community disruption. Should outside parking be located at the old Cannon Club site, immediate neighbors would face a resumption and perhaps magnification of the sort of noise, traffic, and evening lights previously experienced when the Club was in operation — although landscaping and other site improvements are expected to minimize much of this impact. The combination of outside parking and parking fees could well result in more people trying to park in the Kapiolani Community College lot (or, if daily rates at the Diamond Head lot are cheaper than student rates at KCC, the reverse problem might occur). It is also possible that parking fees could encourage spillover parking onto neighborhood streets.

While these are serious community concerns, they are also the focus of serious study by the project's planners and traffic consultants, who are expected to provide recommendations for dealing with them. These aside, from a strictly "social" perspective, the project is likely to have an overall neutral impact on surrounding communities. There may be some loss of access to the Crater for purposes such as jogging if fees are imposed, but this issue will probably be worked out in 1998. Based on the Hanauma Bay experience (Chapter 3), it is reasonable to expect residents will be charged limited or even no entry fees.

### 2.3 Community of On-Site Diamond Head Entrepreneurs

At the present time, such on-site entrepreneurs consist primarily of a handful of t-shirt vendors, as well as a few purveyors of trail guides and bottled water. Most of the entrepreneurs are allowed to operate under current DLNR rules pursuant to First Amendment activities. These rules are independent of the Master Plan, and thus the Master Plan would have no direct effect on such activities.

However, it is possible that sales from authorized giftshop concessions would compete with non-authorized entrepreneurs, and that most Crater visitors would shop there rather than on the trail.

### 2.4 Community of Tour Operators and Associated Agencies

**Types of Tour Groups:** Diamond Head also provides some degree of economic return to organizers of tour groups which come to Diamond Head. These are of two overall types:

- **Sightseeing tours,** in which Diamond Head is visited only very briefly, usually as the first stop on a "circle-island" tour from Waikiki. In many cases, these tour vehicles simply drive through the Crater, stopping only long enough for tourists to snap a few pictures. Sometimes — as when arriving Japanese tourists are waiting to check into their hotel rooms — people get out of the vehicles to stretch their legs and use the restroom, but almost never hike to the rim of the Crater.
- **"Destination" tours,** in which Diamond Head is the principal destination (or one of a very few destinations) of the tour. In these cases, the principal activity is hiking up to the spectacular viewpoints on the Crater rim. These tours may include guides or may simply involve transportation to and from the Crater, at appointed times.

<sup>3</sup>A far more numerous group of people who currently make their living in Diamond Head are employees of the Federal Aviation Administration and Hawaii DOD. However, their eventual relocation is not a matter of involuntary elimination, as would be the case with the vendors.

<sup>4</sup>There is a third variant, though arguably not a "tour" — the Japan Travel Bureau's charter trolley, which charges tourists a fee for riding the trolley and gives them some limited comments about each of the possible sites, including Diamond Head. Japanese tourists may choose to stay on the trolley or get off at Diamond Head and then catch a later trolley. If outside vehicles are no longer permitted in the Crater, the trolley would presumably just drop customers outside.

Because of the focus in this report on potential revenues and market feasibility, interviews were conducted with representatives of these groups, as well as tour wholesalers and travel desks who may help to place tourists with such companies. Chapter 5 provides a detailed account of these interviews. However, a brief synopsis of some points is given here.

Based on these interviews, the great majority of group tourists entering Diamond Head Crater arrive on sightseeing-only tours. Only a very few small companies have recently been offering "destination tours" to Diamond Head, although the New Otani Kaimana Beach Hotel (located at the Diamond Head end of Waikiki) encourages its guests to visit Diamond Head and sometimes organizes tours led by the hotel general manager.<sup>9</sup>

**Probable Issues and Concerns:** The large tour companies which bring people to Diamond Head strictly for sightseeing view the Crater as a very incidental part of their business. However, the idea that the State may restrict vehicle access and institute significant entry fees raised some issues for them, to some extent left over from past debates on Hanauma Bay:

- (1) **Image of Hawaii** — The visitor economy is poor now, and tourists to Oahu in particular have become very budget-conscious. There have been other places which were once free and now have entry charges (e.g., Hanauma, the Honolulu Zoo), and some industry officials are anxious about yet another apparent attempt to, in their view, "hit up" or "gouge" visitors who have expressed clear irritation with the trend.
- (2) **Equity** — Based on past experience, industry officials assume that residents will be given discounted or free entry while tourists must pay. They believe this is inequitable and is also detrimental to Hawaii's long-term economic best interests. Another perceived "equity" issue involves the appropriateness of possibly charging entry fees for sightseeing only. If the rationale for fees at Diamond Head is to pay for resource protection in the Crater alone (although this is not clear to them), then the argument is that sightseers in the parking lot cause far less impact than do actual hikers.
- (3) **Government Assumption of "Private-Sector" Role** — A few industry interviewees questioned whether local government should appropriately "get in the business of running tourist attractions."

<sup>9</sup>Steve Boyle, the former manager of that hotel, is often credited with making the tourist population more aware of the Crater and the hiking opportunity therein. He wrote several booklets on Diamond Head; began the practice of providing hiker "kits" with bottled water and flashlights, and of awarding "certificates" to successful climbers; and was responsible for much of the little specific promotion of Diamond Head Crater which has occurred to date in Japanese travel magazines and brochures.

These people assumed the rationale for fees was to make a profit for other State activities, not just pay for Diamond Head. While some voices in the business sector have urged local government to earn revenues in new and imaginative ways in order to avoid raising taxes, people in the tour and transportation industry (or at least some of them) are currently alarmed by the City's attempt to woo tourists onto City buses with discounted passes. They view the move to create a significant attraction at Diamond Head — which would most likely result in people going there on an FIT basis, rather than on tours — in the context of that sort of government competition.

The few organizations which provide some form of "destination tour" to Diamond Head would, of course, be primarily concerned with the impacts on their activities — would such tours continue to attract customers if costs are higher? would Diamond Head still be a symbol of "aloha" that helps attract guests to hotels near it? There may also be some concerns over equity if a nonprofit operating any new visitor/interpretive center offers guided tours. Some small businessmen who operate what might be called "acolour" operations feel that their respect for, and impact on, the environment matches those of nonprofit groups, and they resent the special discounts or advantages which government sometimes offers to nonprofits in use of trails or other natural resources.

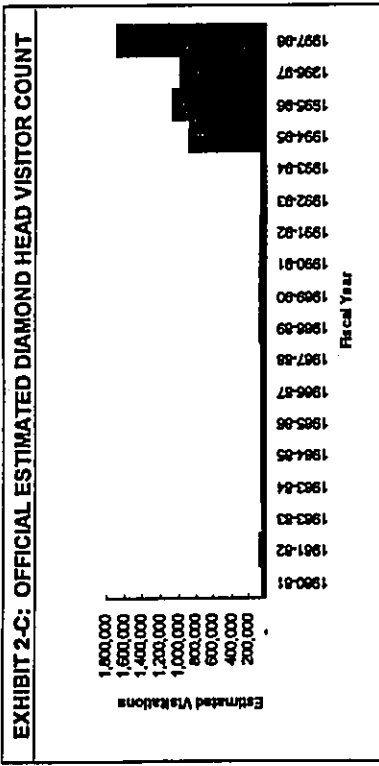
**Probable Actual Impacts:** If all parking is moved outside the Crater and/or commercial vehicle assessment fees are implemented, it seems probable that sightseeing tours will simply skip the Diamond Head Crater. This is due not only to cost considerations, but also to logistics — the time it takes to see the Crater, difficulties in keeping groups together, and, for Japanese or other foreign-language groups, the probability that signage and commentary would be in English only.

The impact on smaller groups spending more time in the Crater is less certain. It would be a matter of the level of additional cost vs. the average disposable income levels of the tourist market at that point in time. However, the overall effect would probably be to make even small group tours more problematic, such that tourists really interested in Diamond Head would be even more likely to go on an FIT basis (and tourists who are only somewhat interested would be less likely to go).

## 2.5. Community of Diamond Head Crater Recreational Users

(For purposes of this sub-section, FAA and State Department of Defense [DOD] employees will not be considered, since their relocation is expected with or without Master Plan revisions. The word "user" here is intended in a neutral sense, without any connotation of "exploiter." A synonym could be "visitor.")

How Many Are There? Exhibit 2-C below gives official State DLNR visitation estimates from 1980 to 1998, according to the July 1998 draft *Interim Interpretive Plan* for the Diamond Head State Monument.



The apparent sudden dramatic increases in 1994 and 1998 are, of course, highly doubtful. It seems likely that visitations were underestimated prior to 1994 and may well be overestimated for this year. As DLNR notes, "Unfortunately, annual visitor counts have not been done systematically and in most cases, the counts are extrapolated by visitor counts taken for a couple of hours during one day of the year." (*Ibid.*, p. 54)

Perhaps more important, studies to date have not attempted to estimate visitor count by degree of impact on park resources. Possible levels would be:

- People driving through without stopping at all — i.e., sightseers only.<sup>6</sup>
- Sightseeing groups making only brief stops, but no real use of the park facilities (except perhaps the restrooms).
- Active park users — mostly hikers, but perhaps a few picnickers, etc.<sup>7</sup>

<sup>6</sup>Arguably, some "drive-throughs" could be intended park users unable to find parking space. In market research terminology, these people would represent "pent-up demand" for use of the Crater's current recreational resources. However, it is difficult at this point to estimate whether many of the drive-through vehicles counted in traffic surveys at Diamond Head were deliberately not stopping or might have stopped had space been available.

<sup>7</sup> The JTB tourist trolley represents a unique problem in this categorization scheme. People getting off the trolley are probably active users, but other passengers are "drive-throughs."

A May 1998 visitor and traffic count commissioned by PBR Hawaii for the Master Plan revision effort (SMS Research, 1998)<sup>6</sup> resulted in figures which suggest about 700,000 visitations per year in the last two of the above categories only — i.e., people arriving in vehicles which actually stopped, as well as some pedestrians. Some further analysis of that data in Chapter 4 of this report suggests the number of active park users (the third category alone) this year may be roughly 600,000 people. However, the main point here is that visitation estimates to date are extremely rough and unreliable, and it is important in future efforts to distinguish different types of users according to their level of impact on facilities and/or their demand for different types of experiences in the Crater.

As will be discussed in Chapter 4, the May count produced an estimate that 12% of the people actually stopping in the Crater were Hawaii residents, while a July 1998 survey conducted for this report found 17% were residents. The great majority of users thus are tourists. Differing methodologies produce different estimates of the breakdown of tourists by origin, but it is clear that a substantial and perhaps growing portion is of Asian origin.

**Probable Issues and Concerns:** Some non-systematic comments taken this year by DLNR staff and/or survey interviewers (see pp. 4-5 and 4-17 later in this report) suggest that some Crater users will be concerned about paying fees if there is no assurance the revenues will be used for actual improvements in the Crater. Resident users were also concerned about the possible precedent for user fees in other State parks.

While some people want more information and interpretation, there is probably an equal or greater demand for snack and gift concessions which are orderly and contained, as opposed to being provided by a sort of "gauntlet" of entrepreneurs.

Improved restroom facilities and improved safety were also mentioned — i.e., better lighting of tunnels and emergency phones for people who may be hurt or become ill at the top of the trail.

**Probable Actual Impacts:** These are of both positive and negative (or at least uncertain) types.

Positive Outcomes

- The central experience for active users — trail and viewpoint — will be protected and improved.

<sup>6</sup>The SMS count was carried out in a way that deliberately excluded FAA and National Guard personnel. These people represent another category which must be explicitly addressed (either excluded or separately counted) in future visitation estimates based on traffic counts.

- Opportunities for information and interpretation will be greatly enhanced.
- The proposed people mover system will make all parts of the Crater more accessible, even to older or less physically fit visitors.
- If the DOD's Tunnel 407 is returned, even disabled people will have access to a stunning view.
- Removal of large buildings, new picnic areas, elimination of parking, and reforestation combined will make the Crater's interior much more aesthetically pleasing for users.

#### Negative/Uncertain Outcomes

- A substantial portion of current users — those coming on group tours for sightseeing only — will probably be eliminated. Some of these people may choose to come anyway on an FIT basis, especially if the visitor/interpretive center is effectively marketed as a major attraction in itself. However, the sort of person who prefers to travel in a group (perhaps for cultural/language reasons), and whose principal interest in Diamond Head was simply to see the interior of a volcanic crater, is only marginally likely to pay to come on an individual basis.
- At the present time, it is uncertain whether the tunnel stairs will be lighted, and such a lack of safety improvements could produce dissatisfied visitors if fees are charged. The present experience of struggling through a darkened area and emerging into the light is almost mystical in nature, and keeping this experience will be greatly valued by many people. But it does come at the expense of occasional accidents, and these may be less tolerated by users if they have paid a fee and hence might expect more safety.
- Similarly, it is uncertain whether emergency communications will be installed on the Crater rim for people who may happen to fall ill, and this may also be more expected if fees are charged.

\*They have, in fact, been very occasional. According to Capt. Manuel Neves (Honolulu Fire Dept., Fire Communications Center, personal communication, August 14, 1988), the vast majority of emergency calls to Diamond Head have involved people who simply became ill on the trail or at the rim, not people who had hurt themselves in the darkened stair areas. No exact figures on the latter type of accident are available, but Capt. Neves could recall few if any such incidents. The total number of "medical emergency incidents" in the Crater numbered 33 in 1985, 24 in 1986, 49 in 1987, and 32 in 1988 through August 17.

#### 2.6 Community of Diamond Head "Stewards"

The term "stewards" is intended to refer to people who have established a special sense of emotional connection with the Crater environment, and who feel a responsibility to the place and to the people who go there.

Officially recognized stewards would include State Parks personnel and the Diamond Head Citizens Advisory Committee (CAC), which includes representatives of many neighborhood and environmental groups with a longstanding interest in preserving both the exterior and interior of Diamond Head. For the most part, this sub-section will be concerned with these people, or people much like them. But it should again be noted that others also feel a sense of voluntary care and responsibility for Diamond Head — including some people who have a commercial connection to the Crater and some area residents not represented on the CAC.

**Issues and Concerns (Highly Truncated):** These brief paragraphs are offered in a spirit of some humility and inadequacy, because the State Parks staff, the CAC, and associated groups have worked on Diamond Head planning for decades. They have produced numerous reports, extending to hundreds of pages. Their issues and concerns are far more extensive and complex than can possibly be summarized here.

However, some topics have been particularly relevant in recent months:

- **Preservation of environmental resources:** Key issues for Diamond Head stewards of a strictly objective, environmental nature have included the hiking trail itself (its quality) and the protection of endangered plant species growing mostly near the Crater Rim.
- **Preservation of nature-oriented human experience:** On the subjective, experiential side, the CAC has been concerned with limiting overt commercialism, restoring original natural features, and maintaining a natural visual quality in the Crater. This had led to concerns about the size of the possible visitor/interpretive center.
- **Desire for limitation of human use of the Crater:** Although it has not always been clear whether those who discuss the Crater's "carrying capacity" are referring to the objective or to the subjective aspects, there has been definite concern that too many people may now be coming, and many more should not be encouraged.

- **Use of revenues generated from entry fees:** As also mentioned by some Diamond Head users in asides during surveys, various Diamond Head "stewards" have expressed concern that entry fees — both the preliminary fees which may be implemented in 1998 and the more substantial fees which could be collected later if the Master Plan is revised — would probably just go into the General Fund rather than come back for needed improvements in the Crater. There has been a call to establish a Special Fund for any entry fees.<sup>1011</sup>

**Probable Actual Impacts:** Consequences for Diamond Head "stewards" will depend on the exact alternatives selected and the exact form of governance adopted for the new attraction. These include:

- **Satisfaction of many goals** — a Crater which is visually much more "natural," reforestation, protection of species, etc. Assuming elimination or great reduction in the number of sightseeing tours, this would also include the goal of reducing numbers of people to the Crater — although the reduction would be more meaningful for the subjective goal of reducing "commercialism" (i.e., elimination of large buses and/or obvious paid tours) than for the objective goal of resource preservation, since the group being eliminated would include few if any hikers.
- **Potential for increased liability:** As noted previously, imposition of fees without significant safety improvements could result in more unhappy users, and that unhappiness might take legal forms.
- **Shift to a more economic perspective in stewardship** — It is not clear at this time to what extent the present "stewards" would retain their current level of responsibility for Diamond Head under any system which involves collection of entry fee and/or other revenues which are, in fact, clearly earmarked for Crater maintenance and improvements. As will be discussed in Chapter 3, gift shop profits in other State parks and in the National Parks are major potential sources of revenues for those parks.

<sup>1010</sup>A Special Fund of this nature was created for entry fees received at Hanalei Bay, but the way it has been implemented has not always met the concerns expressed here. See discussion on pp. 3-17 and 3-18.

<sup>1011</sup>This was the subject of some discussion at the August 8, 1988 meeting of the Diamond Head CAC meeting. According to the minutes (p. 7) for that meeting: "In response to a question about whether revenue generated at Diamond Head could be earmarked for Diamond Head and not go into the general fund, [DLNR Chair] Mike Wilson noted that DLNR does have a general fund for an interpretive parks program [the 'Alua Ho'omalu Special Fund]. However, the revenues generated from facilities at [Diamond Head] would not all go directly to Diamond Head. Mike Wilson noted that DLNR is comfortable with that arrangement, but that this decision is not to be made only by DLNR as the Legislature will be involved."

Thus, the operator of the visitor/interpretive center (or at least of the profit centers within that facility) could become an important funder and possible "steward" as well. This could be a new agency, or the present CAC might form a "Friends of Diamond Head" organization to fulfill that function.

At any rate, if Diamond Head becomes a significant revenue-generating attraction, it will be necessary to attend to the business and economic aspects, just as is now done in National Parks. This will have several aspects.

On the one hand, it could seem awkward and inappropriate to people whose main mission for years has been environmental and who have resisted intrusion of "commercial" activities in the Crater.<sup>12</sup> On the other hand, the budget is the ultimate tool to assure preservation and enhancement of park facilities, and participation in raising funds and deciding how to spend them would be a way to increase the role of current stewards from an "advisory" function to more true partnership with the State in decisions about Diamond Head.

## 2.7 Community of Hawaii Taxpayers

This "larger community" would primarily be affected by implementation of fees (although that may well occur this year, independently of any Master Plan considerations) and consequent revenue for the State.

**Probable Issues and Concerns:** The State of Hawaii has been hearing several conflicting messages from different segments of taxpayers:

- (1) "Find new revenue sources to help balance the budget without raising taxes!" One consequence of this has been to examine additional possible revenue sources, including more user fees at recreational facilities.
- (2) "I am already being taxed to pay for public parks — why should I have to pay entry fees there?"

Any proposal to make Diamond Head a revenue-producing attraction would push both these buttons, although obviously in different ways.

<sup>12</sup>The manager of the Hanalei Bay Nature Preserve said he has sometimes felt this sense of conflict since entry fees and the Special Fund system were implemented there (personal communication, Alan Hong, July 8, 1988).

### 3.0 REVENUE ANALYSIS: CONTEXT AND CASE STUDIES

The purpose of this chapter is to explore comparable attractions in Hawaii in order to determine various "lessons learned" for Diamond Head — primarily although not exclusively related to the issue of fees and potential revenue. Other data relevant to revenue analysis will include a user survey (Chapter 4) and interviews with tour company officials (Chapter 5). The final revenue projections themselves will be discussed in Chapter 6.

#### 3.1 Hawaii Attractions Comparable to the Overall "New" Diamond Head

##### 3.1.1 Overview of Various Potential Comparables

Specifying what is and what is not a "comparable" attraction is somewhat subjective. In certain respects, history-based attractions (such as the USS Arizona) or activities focused on lifelike forms (such as the Honolulu Zoo or Aquarium) might arguably be comparable to the "new" Diamond Head envisioned under the proposed Revised Master Plan.

However, the essential appeal of Diamond Head is that it is an outdoor, nature-based attraction capitalizing on a unique geological feature. With this as the essential screening criterion, seven or eight other Hawaii sites emerge as obvious comparables. Most of these are on government-owned property.

The analysis carried out in Exhibit 3-A (following page) suggests there is no true satisfactory comparable Hawaii attraction.

Were it not for the issue of scale, the several major National Parks on Maui and Hawaii Island might be the best comparables. But scale is a very important consideration if the principal objective is to get some sense of appropriate fees and likely revenues. Punchbowl Crater is most similar to Diamond Head in terms of geology, relative proximity to Waikiki, and views. But fees cannot be charged there because it is a National Memorial.

Hanauma Bay emerges as the most important single "comparable" — not because it is similar in all respects, but because it has been a popular Oahu attraction where both economic and political experience has been gained in the imposition of fees for a recreational area which previously had none.

Resource constraints prevented us from looking at national or international comparables. We felt that it was more important at this time to conduct the survey and tourism company interviews reported in the next two chapters. However, when it comes time to implement actual entry fees for an upgraded Diamond Head Crater, we would recommend that the State conduct a supplemental market research project including a search for national or even international comparables, with attention to market support for various fee levels.

Diamond Head Social Impacts & Revenues P. 3-1 John M. Knox & Associates, Inc.

As noted in Chapters 4 and 5, a common reaction of residents both in business and at the Diamond Head Crater was, "Next they'll be charging us to go to the beaches!" Nonetheless, user fees have helped to produce significant improvements at places like the Honolulu Zoo and Hanauma Bay, and in some cases have helped generate revenue to meet taxpayer needs elsewhere.

**Comment:** In one of their studies on the economics and politics of user fees at Hanauma Bay, University of Hawaii professors James Mak and James Moncur noted there had been confusion about the purpose of the fees. Various parties to the debate had supported or opposed the fees because of assumptions they were actually intended to reduce the number of resource users, paying for resource restoration, generate funds for other parks, prevent property tax increases, underwrite public environmental education efforts, etc. The potential for this confusion seems to exist at Diamond Head, too.

In their conclusion, Mak and Moncur (1988, p. 22) cited what they termed the "classic recommendations" of Clawson and Kneitsch (1966) in regard to levying recreational user fees, and these may also have value for Diamond Head:

- i) Avoid user charges that are administratively unworkable or unsound.
- ii) Define carefully the purpose to be achieved by the collection of user fees; is it to raise revenue or to increase economic efficiency?
- iii) Choose a method of levying charges which is appropriate to the goal.
- iv) Tell the recreational users why a charge is being imposed and what will be done with the money collected.
- v) Consider the equity effects carefully; try to anticipate the side effects and eliminate the most undesirable ones.

**Probable Actual Impacts:** The actual outcomes for Hawaii taxpayers will depend on the likely revenues generated vs. the level of costs involved for implemented proposed changes to the Master Plan. Generating those estimated figures is the purpose of the rest of this report (along with the more general task of assessing overall project feasibility). This will be done by:

- Examining some instinctive Hawaii case studies (Chapter 3);
- Reviewing various survey studies, including a survey of Diamond Head users conducted for this report (Chapter 4);
- Reporting on interviews with expert representatives of the tour and transportation industry (Chapter 5); and
- Running preliminary figures for the actual cost-revenue analysis (Chapter 6).

Diamond Head Social Impacts & Revenues P. 2-15 John M. Knox & Associates, Inc.

3.1.2 Hanauma Bay Case Study

3.1.2.1 Overview and History

Hanauma Bay is one of Oahu's most popular tourist attractions and a unique resource for local residents as well. "Created by an underwater volcanic eruption some 35,000 years ago, it looks today like a partially submerged volcanic crater with one side open to the ocean, creating a bowl-shaped bay" (Mak and Moncur, 1995, p. 51).

A number of government agencies have various degrees of authority over Hanauma Bay and the surrounding lands. The bay itself is administered by the Hawaii State Board of Land Natural Resources, which designated it as Hawaii's first Marine Life Conservation District in 1967. The waters between Palea and Paiohulu Points are considered a "State Underwater Park." Protected from deliberate harm by man, the bay's marine biota have flourished, and the "friendly fish" (along with turtles, coral, etc.) attract hundreds of snorkelers, scuba divers, or just waders and swimmers. Fish-feeding has been a popular tourist activity, but one which has resulted in ecological imbalances; the Board recently decided to ban the practice after some years of debate.

In many respects, however, the lead government agency for the bay has been the City and County of Honolulu's Department of Parks and Recreation (DPR), because it is this agency which operates the surrounding beach park and has levied user fees in recent years. This ten-acre "Hanauma Bay Nature Preserve" is part of a 1,265-acre City and County regional park area which includes Koko Head District Park, Halona Blowhole, Koko Crater Botanical Garden, Koko Head Rifle Range, and Sandy Beach Park.

This tract of land was sold by the trustees of the Estate of Bernice P. Bishop to the City and County of Honolulu for recreational and park use in 1928. In 1950, the City built an access road, lookout area, and cliff trail, and many other improvements were made in subsequent years.

**Transition from Primarily Residential to Primarily Tourist Use:** In a 1975 Hanauma user count and survey, 68% of the facility users were residents and a little under a third were tourists. The total 1975 attendance was roughly estimated as about 500,000 (Wilson Okamoto & Associates, 1992).

Tour companies dramatically increased their promotion of Hanauma in the 1970s and 1980s, for two basic types of organized tour activities:

<sup>2</sup>The agency was recently renamed "Department of Parks and Recreation Services" as part of a City departmental reorganization. The old name will be retained here for the sake of simplicity.

EXHIBIT 3-A: COMPARABILITY OF VARIOUS NATURE-BASED HAWAII ATTRACTIONS WITH PROPOSED NEW DIAMOND HEAD COMPLEX								
Potential Comparable	Key Features of Diamond Head State Monument Under Proposed New Master Plan							
	Unique/ Famed/ Natural Feature	Compact Size (Less 1 Sq. Mi.)	Principal Experience Is Hiking, Viewpoint	Additional Historic/ Cultural Character	Close to Waikiki	Major Visitor Center	Shuttle from Outside Parking	Entry Fee Required
Hanauma Bay	Yes	Yes	No (Ocean)	No	No	Very small facilities	Shuttle serves some visitors	Yes
Punchbowl Crater	Yes	Yes	View, not hiking	Yes	Some- what	No, but Memorial	No	No
Koko Crater	Unique, less famed	Yes	Hiking, but not to top	No	No	No	No	No
Heleakala Natl. Park Or Volcanoes Natl. Park	Yes	No, much larger	For most people, just views	Yes	No (other island)	Smaller facilities	No	Yes \$10 per vehicle
Kilauea Point Lighthouse (in Kaula Natl. Wildlife Refuge Complex)	Somewhat unique, not famed	Smaller than DH	Ocean view	Somewhat	No (other island)	Very small facilities	No	Yes, \$2/adult
Waimea Canyon (Kaula)	Unique, less famed	No, much larger	For most people, just views	No	No (other island)	Small museum at top (Koko'e)	No	No
Waimea Valley (Oahu)	Scenic valley	Several times larger than DH	To some extent	Yes	No	Food/ gift shop	Yes	Yes private business; \$24/adult

- "Destination tours," which brought groups of tourists to Hanauma — with or without a guide — to spend a substantial part of the day there engaging in actual beach or ocean activities. These tours were heavily promoted, particularly in Japan. They were the principal target of restrictions imposed in 1990 (see below).

- "Circle-island tours," in which Hanauma was a brief stop, for sightseeing only (perhaps including picture-taking and a restroom break), as part of a longer tour circling all or part of the island. Park staff did not have a good sense of how many people were coming on these tours prior to the 1990 restrictions, although there was an impression that they increased after the 1990 restrictions resulted in some people being unable to obtain full "destination" tours (personal communication, Martha McDaniel, Hanauma Recreation Specialist, July 31, 1998).

A side effect of tour company promotions was growing popularity for Hanauma as a destination for independent tourists, who came to the bay in private rental cars, on the City bus, by moped, etc.

By 1990, the tourist count had increased six times, such that residents now comprised only 13% of Hanauma users. The total number of resident visitations remained roughly unchanged from 1975 to 1990, even though the resident population had increased by 17% in that time. Additionally, surveys found that residents who did go to Hanauma went there more times per year on average in 1990 than in 1975; this suggests that the absolute number of residents using the facilities had somewhat declined and consisted proportionately more of a hard-core group of frequent Hanauma users. These aside, staff believe many residents now come to Hanauma only when hosting off-island friends or family.

**Goals and Objectives of 1990 Management Plan, and Subsequent Restrictions:** In the late 1980s, the City began work with its consulting firm, Wilson Okamoto and Associates, to update the 1977 Hanauma Master Plan. The resulting master plan<sup>3</sup>, in combination with a flurry of newspaper stories in 1989 on environmental deterioration and overuse at the park (Reynolds, 1991), led the City Council to enact restrictions on commercial activities in mid-1990.

The goals and objectives in the plan (Exhibit 3-8) included several elements of potential relevance to the current Diamond Head planning effort:

- A focus on limiting attendance (Objective #1);
- A new emphasis on education as a primary purpose (Goal #3 and Objectives #5 and #7).

<sup>3</sup>Not actually published in document form until 1992 (Wilson Okamoto 1992).

### EXHIBIT 3-B: GOALS AND POLICIES, CURRENT HANAUMA BAY MASTER PLAN

#### GOALS

- (1) Continue to preserve and enhance the natural qualities and opportunities unique to Hanauma Bay and its environs.
  - (2) Optimize the use of Hanauma Bay as an important recreational resource for the people of the State of Hawaii.
  - (3) Promote public education and appreciation of Hanauma Bay Nature Park's natural environment by providing opportunities for the safe enjoyment of park resources.
- Note: First two goals carried over from 1977 Master Plan; third added for new plan.

#### OBJECTIVES

- (1) Limit overall park user volumes as a means of controlling impacts on natural resources and park facilities.
- (2) Better match intensities of park usage with available park resources.
- (3) Produce new park facilities and improve existing facilities to reduce their impact on natural park resources.
- (4) Achieve safer participation in park activities.
- (5) Foster park user respect for natural resources and park facilities.
- (6) Develop informational bases on which to formulate future park policies.
- (7) Establish public education and awareness as a primary purpose of park policy.

Source: Wilson Okamoto, 1992.

Given these emphases, the City targeted commercial activities — particularly the "destination tours" — for restriction. Two University of Hawaii economists summarized the consequent political debate and City action in a recent article in a scholarly journal:

"In 1989, the City's Department of Parks and Recreation (DPR) presented to the City Council an 8-point management plan for Hanauma Bay Nature Park. Tour operators, however, vigorously opposed the plan because it prohibited all tour vehicles from dropping off visitors at the park except for brief sightseeing stops in the upper parking lot. Several tour companies threatened to file a lawsuit against the City, arguing that the proposed rules favored residents and those tourists who rented cars. More than half, and perhaps as many as 80% of all tourists visiting Hanauma Bay came by tour bus or vans ... Japanese tourists and tour operators would be particularly hard hit, since most Japanese tourists to Hanauma Bay purchased tours.



EXHIBIT 3-C: HANAUMA BAY NATURE PRESERVE -- CHANGING CONDITIONS AND OUTCOMES IN PAST DECADE						
Date	Fee Structure	Parking/Vehicle Access to Park	Nature of Service/Attraction	Attendance Level or Characteristics	Revenues	Other
1989 to June 1990	No City fees: tram concessionaire charged \$1 each way or \$1.50 round trip. (This remained in place until recent reduction: 50 cents to go down, \$1 to come up.)	Separate commercial vehicle parking lot. Otherwise, no restrictions. When 300 stalls of regular lot filled, often 100 cars parking illegally on lawn, and another 100-200 on highway or in Koko Head District Park. Commercial tour group vehicles unrestricted - could drop off large groups in park.	Marine preserve, lifeguards, food concession, snorkel rental, tram concession (all still in place at present time).  Park open 24 hours a day, 7 days a week.	Est. 3 million plus per year; 86% visitor, 14% resident. (Note: No systematic counting procedure in effect at this time.)	Food, snorkel, & tram concession fees all going to City General Fund. Permit fees for commercial tours (e.g., dive groups) paid by only a few of tour operators.	
July 1990 to June 1995	(Same as above)	Banned tour buses (except those who had paid for one of the 21 commercial tour permits) from off-loading passengers, though passengers could get out long enough to use restroom or take pictures from upper park. Security hired to turn cars away when parking lot became full.	"Hanauma Bay Educational Program" set up on beach by UH. Focus on marine life but some walking tours included history, geology.  Park now closed nights and half-days Wednesdays.	In 1991, reduced to about 1.8 million/yr. (estimate of park consultants Wilson Okamoto, 1992), and ca. 2 million/yr. next few fiscal years (State Data Book, based on City estimates)	With enforcement of permit requirement for commercial tour groups, all 21 permits quickly paid for - but this money also goes to City General Fund.	Additional operating costs for enforcement/security personnel.
July 1995 to Jan. 1996	\$5 entry fee for non-residents 13+; children, residents free. Commercial vehicle entry assessment (\$5, \$15, or \$35 for different sizes.)	(Same as above)	(Same as above)	Systematic counts begin at this point. July - Dec., 1995: 568,673 (17% resident) Annual equivalent: 1.10 million	July to Dec. '95: Admission Fees \$2,068,870 Commercial Vehicle Fees \$282,510 All revenues into General Fund.	Additional operating costs for cashiers & related jobs.

(CONTINUED)

In early 1990, the Hanauma Bay Users Committee, representing 39 Hawaii and 80 Japanese companies which sold sightseeing and snorkeling/scuba tours to Hanauma Bay, proposed industry self-regulation as an alternative to City regulation. Committee members agreed not to use the park and marine reserve on Sundays and major holidays for a 6-month period beginning 18 February 1990. While there were noticeably fewer people at the bay when the self-imposed ban first went into effect ... by early summer the voluntary measures were deemed insufficient to avert further deterioration of Hanauma Bay. On 12 June 1990, the City Department of Parks and Recreation implemented the Hanauma Bay-General Plan.

The 1990 management plan was designed to restrict access to the bay, to educate visitors on the proper use of the bay, and to improve facilities at the bay. Access to the park was restricted by (i) hiring traffic attendants to turn away automobiles at the entrance of the park when the 300 parking stalls were filled and to prevent illegal parking on the shoulders of the highway leading to the park; (ii) prohibiting limousines, tour buses and tour vans from discharging passengers at the park except for a 15-minute sightseeing stop at the upper level of the park, and (iii) closing the park on Wednesday mornings. The restrictions put in place were designed to favor individual and local resident use of the park over commercial use." (Mak and Moncur, 1998, pp. 217-218)

Exhibit 3-C summarizes conditions in the park prior to and following these restrictions, as well as following several different user fee schedules imposed later in the 1990s (below).

Imposition of Fees: In mid-1995, the City Council imposed a \$5 entry fee at Hanauma for non-resident adults (children and Hawaii residents were free). Additionally, all commercial vehicles entering the Nature Preserve - even those coming for brief sightseeing and picture-taking purposes - were assessed an "entry fee," the amount of which depended on the size of the vehicle.

According to the University of Hawaii study, the purpose of the new fees was not so much to restrict attendance at Hanauma (which had already dropped sharply after the 1990 restrictions) as it was to raise funds:

... after four consecutive years of economic stagnation in Hawaii, which produced falling property values and property tax revenues, the new administration was pressed to find new revenue sources to meet an expected \$50 million budget shortfall ... Rather than raising property tax rates, the Administration proposed to raise existing user fees (e.g., parking fees, green fees at municipal golf courses, and entry fees at the zoos and botanical gardens) and to impose new user fees on some City services (e.g., school children's summer fun program and Hanauma Bay). Thus, the decision to levy an admission fee at Hanauma Bay was not driven by efficiency considerations but solely by budgetary considerations ... (ibid., p. 220)

The fees generated only one non-resident visitor complaint in the first three months, and park manager Alan C. Hong (personal communication, July 8, 1998) believes the fees have had a beneficial effect on visitor perceptions toward the park. He feels the need to pay money to enter the area has made visitors more sensitive to the unique resource of the reef and its wildlife, and has made them more interested in the educational programs which the Preserve has been developing since 1990 (see Exhibit 3-C).

Nevertheless, there was substantial opposition to the 1995 fee structure from the Oahu tourism industry. An effort in the City Council to "equalize" the fees by requiring resident payment was unsuccessful, and opponents then mounted a (temporarily) successful campaign to eliminate the fees. According to Mak and Moncur (1998), the key arguments were:

- (1) Concern that charging residents but not visitors would give Hawaii a bad image and hurt tourism.
- (2) Concern that revenues were going into General Fund, rather than into a special fund for exclusive use at Hanauma. Objections were raised to using Hanauma as a "cash cow" for improving other parks — in effect, it was said, the fees amounted to a new tax and were thus illegal because this "tax" lacked specific State authority.
- (3) The Administration had failed to get a Special Management Area (SMA) permit from the City Department of Land Utilization for its admission ticket booths.
- (4) Bishop Estate lawyers said the City, by generating a "profit" (i.e., more money than needed for Hanauma itself, which was then used for improving other parks) may have been violating the original deed agreement, which required land to remain noncommercial.<sup>4</sup>

The Council overturned the original fee structure in December 1995 and overrode a mayoral veto in January 1996. Subsequently, the Administration posted a sign at Hanauma requesting voluntary donations from people entering the park, a system that remained in place until new entry fees were levied in mid-March 1997.

The City Council actually acted almost immediately in 1996 to reimpose a new fee structure, though it could not be implemented until the following year due to the need to complete the SMA permit processing.

<sup>4</sup>This was eventually resolved by an agreement in which all where excess revenues went only to those parks and the shooting range immediately proximate to Hanauma — i.e., the facilities that were part of the original 1928 deed.

EXHIBIT 3-C (CONTINUED): HANAUMA BAY NATURE PRESERVE -- CHANGING CONDITIONS AND OUTCOMES IN PAST DECADE						
Date	Fee Structure	Parking/Vehicle Access to Park	Nature of Service/Attraction	Attendance Level or Characteristics	Revenues	Other
Jan. 1996 to Mid-March 1997	Voluntary donation only — no set entry fee or commercial vehicle assessment. Just organized tour permit fees (& tram concessionaire optional fee)	Still restricting tour vehicles ability to offload passengers, except in upper park. However, tour companies learning to circumvent restrictions by off-loading outside park and sending sub-groups in via taxis.	New restroom facility and administrative headquarters.	Calendar 1996: 1.16 million (14% resident)	Calendar 1996: Donations of \$1.12 million placed in special trust account (total amount donated over 14 months was \$1.30 million)	
Mid-March 1997 to July 1998	\$3 entry fee for non-residents 13+; children, residents free. Private car parking fee of \$1. But no resumption of the commercial vehicle entry assessments. Optional tram fees slightly reduced.	(Same as above)	Jan. 1998: Small educational facility opened in upper park to supplement beach activity. Exhibits more focused on geology, culture, etc.	Apr. - Dec. 1997: 838,889 (14% resident) Annual Equivalent*: 1.08 million Jan. - June 1998: 510,298 (13% resident) Annual Equivalent*: 1.05 million	Though concession fees still go into Genl. Fund, entry & parking fees now go to dedicated "Hanauma Bay Account." For this account — FY July 1997 to June 1998: \$2.72 million	
August 1998 (scheduled)	(Same as above)	Prohibit off-site commercial tour groups from skirting ban by use of taxis into park (new legal definitions and enforcement actions).	On busiest days, use turnstiles to limit number in beach/bay to 2,000 max. Close all day Tues. Instead of half-day Wed.			

\* "Annual Equivalent" Attendance based on ratios for partial years from 1996, the only recent full calendar year Hanauma has opened under the same system all year long.

Source: Personal communication, Alan C. Hong, Manager, Hanauma Bay Nature Preserve, July 8, 1998; unpublished City Parks Dept. records

The new fee structure — which remains in place today — eliminated commercial vehicle entry assessment fees for short stays, so brief sightseeing tours are again free. Non-residents now pay just \$3 for entry (residents and children are still free), and all vehicles remaining longer than 30 minutes are subject to a \$1 parking fee, for residents and non-residents alike. Revenues from the parking and entry fees today go into a special account, which is used for improvements at Hanauma and at other nearby recreational facilities which were also originally conveyed from the Bishop Estate in 1928.

**Current Park Facilities:** Somewhat like the Diamond Head Crater, the Hanauma Bay Nature Preserve has an anterior and an interior portion, each of which serve different functions and/or types of visitors.

Hanauma's anterior portion, the "upper park," is functionally comparable to Diamond Head's entry area. It provides parking for private cars (a 300-space parking lot), a grassy picnic area, and restroom accommodations. Unlike Diamond Head, it has a separate turnaround area specifically designed for short-term visits by sightseeing groups — a scenic area overlooking the bay below. The upper park also now has a small office building and a very modest (754-square-foot) visitor interpretive facility with exhibits on marine life. (This takes up half of a building originally intended as a food concession stand.) Ticket booths for the parking lot and for entry into the lower park are also located here, as well as caretaker's quarters sited near the commercial vehicle turnaround.

Hanauma's interior portion, the "lower park," is somewhat analogous to the Diamond Head hike up to the crater rim. But whereas the main attraction at Diamond Head is the lookout, Hanauma's key feature is the State Underwater Park and the surrounding City-administered beach. The lower park is accessible from the upper level only by a single-lane road open to pedestrian traffic (or the tram service, which operates on a concession basis and is available as an option to walking for tourists willing to pay). The land portion below includes a sandy beach area, grassy picnic areas, bay rim trails, three comfort stations with showers, food and snorkel concessions, and lifeguard facilities.

**Planned Changes:** The current master plan (Wilson Okamoto, 1992) calls for various additional modest improvements at Hanauma Bay Nature Preserve. However, the City has recently decided to implement much more dramatic changes, not only at Hanauma but at several adjoining recreational areas. The City originally referred to the integrated area as a "Ka Iwi" recreational complex, but now refers to the "Koko Head Nature Preserve."

The City Council recently approved \$1 million planning and design funds plus \$13 million construction money for the project in its 1998-99 fiscal year budget. As of this writing, a "Koko Head Nature Preserve Planning Committee" (including one representative from the State DLNR) has been assigned the task of providing master plan criteria for consultants to be selected in August 1998.

According to the committee's June 29, 1998 meeting notes, the project reflects the Mayor's vision ... to integrate the entire region into a unique visitor experience.<sup>5</sup> The region in question includes:

- the old Job Corps site, which would serve as the "hub" for the complex;
- Hanauma Bay;
- Koko Head Crater (top);
- Botanical Gardens inside the Koko Head Crater.

Exhibit 3-D summarizes major planned or contemplated components of the project.

EXHIBIT 3-D: ELEMENTS OF PROPOSED "KOKO HEAD NATURE PRESERVE"	
NOTE: Project still in planning phase; thus, components are subject to change.	
<b>FORMER JOB CORPS SITE</b>	
(1)	Demolish existing buildings.
(2)	Create centralized parking to service entire complex, with transportation links (tram, bike trails, electric vehicles, horseback or possibly horse carriage) to other sites.
(3)	Construct a Main Visitor Center and also a Nature Learning Center (with exhibits about Hanauma and the overall Ka Iwi Coast).
<b>HANAUMA</b>	
(1)	Eliminate current parking lot. (Documents are silent on potential future of the separate turnaround/lookout area for sightseeing vehicles.)
(2)	Replace with Hawaiian landscaping and new marine education center for expected 4,000 visitor daily capacity.
(3)	Restrict visitation to lower park to individual guided tours, with educational programs appropriate to type of tour (e.g., scuba, beginning or advanced snorkeling, wading).
<b>KOKO CRATER UPPER RIM</b>	
(1)	Restore old cable car system to rim lookout points.
<b>KOKO CRATER BOTANICAL GARDEN (CRATER INTERIOR)</b>	
(1)	New visitor education center, plus administration/visitor complex.
(2)	Improvements to existing gardens and trails, including interpretive exhibits and graphics.
(3)	Equestrian center and horse trails.

Source: Koko Head Nature Preserve Planning Committee meeting notes of June 29, 1998, and associated documents; personal communications, Alan C. Hong, Hanauma Bay Nature Preserve, July 8, 1998, and Don Griffin, City Parks Planning Branch Chief, July 17, 1998.

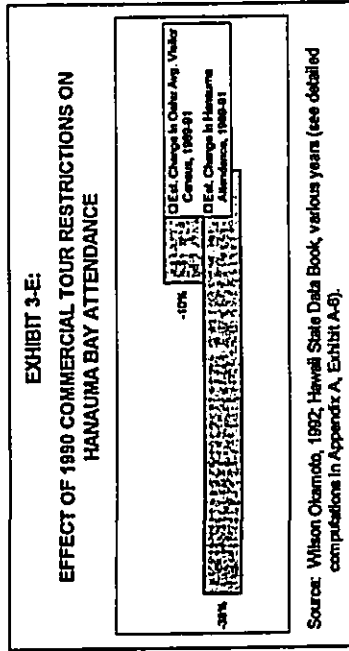
<sup>5</sup>According to staff for the City Council's Parks Committee, the issue of entry fees — whether for residents or visitors — or other user fees for the new project has yet to be specifically addressed.

On the other hand, there is some degree of comparability between the exposure Hanauma received from "destination tours" and the exposure Diamond Head receives from being a stop on "circle-island" sightseeing tours (which might be effectively discontinued if parking is moved outside and fees are imposed). And the effects of the 1990 restrictions also provide interesting context for looking at the later effects of imposing user fees at Hanauma.

Any discussion of attendance figures at Hanauma must be tempered by recognition of these factors:

- As with Diamond Head, the very rough nature of attendance estimates (at least prior to July 1995, when entry fees led to good counts). These estimates for various years in the 1980s and early 1990s were generally based on counts obtained from only one day to six days in a given calendar or fiscal year. Thus, it is uncertain to what extent wide swings in attendance figures during this period — e.g., from 1.5 million in 1985 up to 3.4 million in 1987, then back down to 2.9 million in 1988 — really reflect major changes in attendance vs. the sort of measurement problems now concerning Diamond Head planners.
- Unlike Diamond Head, Hanauma attendance figures generally exclude sightseeing tours, and focus only on the "lower park" where the critical environmental resource is at stake. (Hanauma officials do estimate sightseeing attendance but report only lower park beach attendance.)
- Change in attendance at any Oahu tourist attraction would also be a function of change in the number of tourists on Oahu. The island's average daily visitor census was plummeting at the time the restrictions went into effect.

Nevertheless, available figures indicate the drop in overall Hanauma attendance associated with the 1990 restrictions was much greater than the drop in Oahu's overall tourist count:



The potential for sharply limiting the number of visitors to Hanauma Bay may be a concern to the visitor industry," according to the planning committee's meeting notes of June 29, 1998, although a carrying capacity study — requested by the City Council during its debate on admission fees and due to be carried out in the near future — is expected to indicate the exact extent of needed limits.

The same meeting notes emphasize that education is to be a major function of the completed complex, but more for tourists than for local residents: "The committee ... should also provide the means for local residents to visit these activities with more freedom than the local visitor. ... The Committee shall consider how best to preserve access of local residents to [Hanauma] Bay without having to go through the educational programs."

It should be noted that goals and objectives for Hanauma Bay — see Exhibit 3-C — have focused on "education" of two different kinds: (1) education in the usual sense of absorbing knowledge, and (2) education in the specific sense of using the area without harming the reef or marine life. The Diamond Head equivalents might be (1) education about, say, volcanic geology or military history, and (2) education about avoiding damage to endangered plant species.

### 3.1.2.2. Information and/or "Lessons Learned" for Diamond Head

Inference about "lessons learned" is by nature a subjective process, but certain topics clearly suggest themselves. In some cases, the relevant information is simply factual input for later use in revenue projections (Chapter 6). In other cases, there are potential "lessons" of a practical or policy nature.

**Effects of Restricting Commercial Activities on Attendance:** In one sense the 1990 restrictions on "destination tours" to Hanauma are of very limited relevance to Diamond Head planning. This sort of tour activity was heavily marketed for years at Hanauma, and played a major role in generating tourist demand there. By contrast, the marketing of Diamond Head by the New Otani Kaimana Beach Hotel and a few small tour operators has undoubtedly had some effect, but prohibiting the few guided "destination tours" by these groups would have negligible impact on Diamond Head's overall attendance figures. In fact, from the perspective of generating revenues, the relative lack of such past "destination tour" marketing of Diamond Head raises questions about the extent to which the Crater experience has been truly established as the sort of "must-see" tourist attraction which could survive the imposition of entry fees. In this regard, the marketing histories of Hanauma and Diamond Head have been very different.

\*Tourism company representatives interviewed for this report pointed out a number of other critical differences between Hanauma and Diamond Head. See final page of Chapter 5.

The estimated 1989 Hanauma attendance stood at around 2.9 million in 1989, falling to an estimated 1.8 million in 1991, the next full year after the restrictions went into effect.<sup>7</sup> With some fluctuations, Hanauma's estimated attendance remained at about that 1.8 million annual level until the user fees went first levied.

**Effects of User Fees on Attendance:** Attendance estimates just prior to the July 1995 implementation of the initial \$5 entry fee were, of course, still rough and suspect. However, figures thereafter were both fairly precise and also broken down into resident vs. non-resident data. Since fees applied only to non-residents, it is this effect which should be studied and compared to changes in the average daily visitor count for various years (Exhibit 3-F below).

EXHIBIT 3-F: EFFECTS OF CHANGING FEE STRUCTURES ON HANAUMA NON-RESIDENT ATTENDANCE									
Year/ Period	Fee Status	HANAUMA ATTENDANCE			Pct. Change Previous Year or Period	COMPARISON		Pct. Change Previous Year	Oahu Avg. Daily Visitor Count <sup>1</sup>
		Total	Non- Resident	Annualized Non- Resident Entry <sup>2</sup>		Oahu Daily Visitor Count <sup>1</sup>			
1994 <sup>3</sup>	None	1,700,000	1,462,000	1,462,000	N/A	83,400	83,400	0%	
1995 Jan-Dec	(Mixed) \$5	598,673	470,671	923,988	-37%	83,090	84,500	2%	
1996 Partial Year Figures for Comparison to Other Partial Years: Jan-Dec	Voluntary	1,178,009	1,014,273	1,014,273	10%	77,020	77,020	-9%	
Apr-Dec	(Mixed) \$3	608,046	518,782	518,782	10%	N/A	N/A		
1997 Jan-Jun	(Mixed) \$3	838,889	724,960	845,960	-7%				
1998 Jan-Jun	(Mixed) \$3	510,298	443,640	904,483	-4%				

<sup>1</sup> For years when a fee system covered only part of the year, the non-resident attendance for that part is extrapolated to a full-year figure (i.e., "annualized") based on the proportion of attendance observed for that same part of year in 1993, the only recent year in which Hanauma operated for essentially a full calendar year under a single system (voluntary donations).

<sup>2</sup> "1994" Hanauma attendance figures actually for Fiscal 1994-95 (July 1994 through June 1995).

<sup>3</sup> Non-resident estimate based on 85% figure calculated by Wilson Okamoto (1992).

<sup>4</sup> Percentages based on comparing full-year data to foregoing annualized figures, or vice-versa.

<sup>5</sup> Percentages based on comparing partial-year data to same period in foregoing year.

<sup>7</sup> Citing estimates by the park management and a task force at that time, Mak and Moncur (1998) believe attendance may have been cut even more, perhaps by 50%. However, the 1.8 million figure appears more consistent with estimates made in several subsequent years.

According to Exhibit 3-F:

- The initial introduction of the \$5 entry fee was associated with a major drop in non-resident attendance at Hanauma, during a period when the average visitor count for the island as a whole held fairly steady. This conclusion is of course highly dependent on the accuracy of the last estimate for attendance prior to implementation of the fee. However, if the estimates were accurate, the \$5 fee in 1995 produced an effect equal to the elimination of "destination tours" in 1990 — and arguably greater, since the 1990 drop was partially fueled by a decline in the overall Oahu visitor count.
- When the fees were rescinded in 1996 (but a voluntary donation still requested), Hanauma visitor counts went back up — at a pace exceeding the modest gain in the overall Oahu visitor count. However, the increase was not as dramatic as the previous drop.
- When the smaller fees were re-introduced in 1997, Hanauma visitor counts again dropped, although the drop was now roughly consistent with the decline in the overall Oahu visitor count. In other words, the re-introduction of fees did not seem to have the same effect of reducing tourist demand as did the initial implementation of fees. The reasons for this are not clear, and could be complex. One possibility, though, is that the \$3 price point appeared both affordable and reasonable for the value received, while the \$5 fee did not.

The tentative conclusion, therefore, is the current \$3 fee at Hanauma is not sufficient to reduce tourist demand, but a \$5 entry fee did have such an effect. Given the fact that Hanauma has had greater marketing and exposure in the tourist market than has had Diamond Head, the implication is that a Diamond Head entry fee at the \$5 level would produce as much or more reduction of tourist use as it did at Hanauma.

**Validity of Surveys for Predicting Attendance Impacts of User Fees:** One of the techniques used for the present study will be a survey of Diamond Head users on willingness to pay (see following Chapter 4).

Prior to the initiation of the \$5 entry fee, a University class conducted a simplified survey of Hanauma users on their willingness to pay at that particular level. As indicated in Exhibit 3-G (next page), Hawaii residents were generally quite unwilling to pay, while a majority of out-of-state residents said they would be willing to pay the \$5 fee.

<sup>8</sup> Exhibit 3-F draws on more detailed figures and sources contained in Appendix Tables A-6 to A-8.

EXHIBIT 3-G:			
RESULTS OF 1994 HANAUMA SURVEY ON \$5 ENTRY FEE			
Students from a University of Hawaii at Manoa undergraduate environmental economics class intercepted Hanauma Bay users during the November 1994 Veterans Day holiday weekend.			
A. "A 1993 city council bill proposed to charge \$5 per person admission fee to Hanauma Bay. If this change were levied, would you still have come today?"			
B. "Hanauma Bay Nature Park has been overcrowded and misused. To reduce crowding and protect the environment, which of the following policies would you prefer: (1) charge an admission fee so fewer people would come, or (2) keep the current first-come, first-served system?"			
Residence	Number	% Saying "Yes, Would Still Come"	% Preferring Admission Fee
Oahu (incl. military)*	100	38%	38%
Neighbor Islands*	10	30%	50%
Other U.S. States	115	75%	63%
Japan	45	87%	67%
Canada	14	93%	71%
Other foreign country	17	65%	47%
Non-Resident Avg.	191	78%	63%
* Hawaii residents were deliberately oversampled.			
Source: Mak and Moncur, 1995, p. 55			

Exhibit 3-G suggests the decline in out-of-state Hanauma attendance would be somewhere in the range of 22% to 37%. As indicated previously (Exhibit 3-E), the estimated decline was in the order of 28% (an actual 38% decline minus 10% attributable to a drop in the overall Oahu visitor count) — solidly within this range. This indicates that such Hawaii surveys can predict (at rough order of magnitude) likely effects of implementing user fees. Thus, the Diamond Head survey to be discussed in Chapter 4 likely has predictive validity as well.

**Concession Revenues for Local Government:** Money from the three Hanauma concessions — for snorkel equipment, food, and shuttle service — goes into the City's General Fund. These concessions are awarded as five-year contracts, so effects of changes in user fee structures may not be immediately apparent. As indicated in Exhibit 3-H:

- The City has made between \$900,000 and \$1 million a year from the three concessions total over the last decade, with government earnings largely sheltered from effects of changing attendance levels.
- The shuttle concession (most likely to be replicated at Diamond Head) has earned the least for the City, while the snorkel concession has earned the most — in fact, it produces the majority of the money.

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EXHIBIT 3-H: HANAUMA BAY CONCESSION REVENUES					
NOTE: Concessions are awarded on five-year contract basis.					
Time Period	Snorkel	Food	Shuttle	Total	
Prior to 1990 Restrictions	\$518,000	\$384,000	\$72,000	\$972,000	
Following 1990 Restrictions	\$474,000 <sup>1</sup>	\$384,000	\$72,000	\$930,000	
Fiscal Year 1998 - 1997	\$554,382	\$372,000	\$67,320	\$993,702	
Fiscal Year 1997 - 1998	\$540,120 <sup>2</sup>	\$372,000	\$67,320	\$979,440	
<sup>1</sup> Amount reportedly lowered due to reduced volume following 1990 restrictions.					
<sup>2</sup> Month-to-month basis while in renewal negotiations.					
Source: For first two rows, extrapolation of City figures reported in Mak and Moncur (1998); for second two rows, revenue reports, City Department of Parks and Recreation Services (unpublished).					

**Practical Consequences of Special Fund:** As is currently true in the political dialogue over possible Diamond Head user fees, the initial debate on user fees at Hanauma included objections about the funneling of user fees into the General Fund. This led to creation of a Special Fund for Hanauma, into which are placed the proceeds of parking and entry fees (but not concession revenues). The money is used to pay for operating expenses at Hanauma and needed improvements at other nearby East Honolulu parks.

According to Hanauma Bay Nature Preserve manager Alan C. Hong (personal communication, July 8, 1998), the Special Account has been "no real advantage" and in some ways an administrative burden. This has been because of the way it has worked in practice: The City projects the expected revenue to be derived from the Special Fund and eliminates this amount from appropriations which would otherwise have come from the General Fund. Additionally, because Special Fund surpluses are used to fund improvements at other parks, the budget for Hanauma has been cut back in order to assure "profits" which can be diverted to other parks. This outcome has been due in part to the tight fiscal conditions facing local government during the current long economic stagnation afflicting both the State and City.

**Interpretive/Educational Programs:** The University of Hawaii's Sea Grant Extension Service has a contract with the City to operate the "Hanauma Bay Education Program" (HBEP). This effort to date has been fairly limited — although, as previously noted, future expansion at Hanauma and Koko Crater would include several additional educational and/or interpretive facilities.

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The current program was established to provide on-site education to park users about natural history and ways to help protect and conserve coral reefs, fish populations, and the near-shore marine ecosystem.

The first venue, since 1990, has been a "Beach Information Desk" — as the name suggests, not a permanent structure but simply a desk on the beach staffed by volunteers who answer questions, show marine specimens, and allow access to reference books. (By ordinance, no sales of books or educational materials are allowed there, despite efforts by the "Friends of Hanauma Bay" lobbying group to gain permission for such sales to help fund additional educational programs.)

Since the fall of 1997, the HBEP has also operated a small (under 600 square feet), free visitor center in the upper park. It is a temporary facility, located in half of a structure originally intended as a food concession. If the City decides to proceed with the food concession, the exhibits now located there — on the ecology and geological history of Hanauma Bay — would have to be eliminated, as there is no other facility currently available for them.

The entire City budget for the HBEP last year was approximately \$100,000, covering two full-time positions, a new beach desk, the start of the "museum," and miscellaneous office expenses. Larger budgets have been requested but denied. The current HBEP coordinator has submitted his resignation in protest, and has expressed his frustration that the "Special Fund" containing gate receipts from Hanauma entry fees is being "drained off" and not used for more extensive interpretation activities within Hanauma Bay Nature Preserve (personal communication, Dr. John Culliney, August 7, 1998).

It is thus questionable whether Hanauma's experience provides any "lessons learned" for one of the most critical new proposals for the future of Diamond Head — a possible major new visitor/interpretive center. Therefore, a number of other Hawaii facilities were examined in that regard (below).

### 3.2. Hawaii Attractions Comparable to the Potential Interpretive Facility

#### 3.2.1 Overview of Various Potential Comparables

A true comparable would be a facility which:

- Is about the size of the contemplated Diamond Head center, and is integrated into a public park about the size of the Crater;
- Is supported in part by entry fees; and
- Focuses on natural history associated with its unique surrounding park.

Exhibit 3-1 contains the results of the search for such comparables — six facilities in City, State, or National Parks; one facility immediately adjacent to a State park; and, to provide some additional context, three stand-alone aquatic attractions.<sup>9</sup> (Appendix Exhibits B-1 to B-12 provide more detailed information about these and a few other attractions.)

Conclusions from Exhibit 3-1 and the interviews which derived this information would include:

(1) *There is no Hawaii market experience with an interpretive facility of the nature being considered for Diamond Head.*

- None of the interpretive facilities in or by public parks are anywhere remotely near the size of the planned Diamond Head visitor center.<sup>10</sup> Most are modest spaces, around 1,000 square feet.
- Everything actually within a public park has no separate entry fee (except for the \$1 "suggested donation" at the Koko'e Natural History Museum).

(2) *Interpretive facilities (and/or gift shops and books stores) on government property are almost always run by private nonprofit organizations — rather than by government employees or private concessionaires.*

The City and County still makes substantial use of concessionaires in some of its recreational facilities for things like transportation, food, and equipment rental. However, the City has also been turning to nonprofit "Friends of" groups to assist in places such as Foster Botanical Gardens and the Honolulu Zoo. "The real trend is to go to nonprofit corporations. Taxpayers don't have to pay, or pay much less; services are improved; and fair levels of income are added to government revenues. As the groups become more experienced, they are even able to take care of capital improvements." (Personal communication, John Eveland, Assistant for Administrative Management Services, City Department of Parks and Recreation Services, August 6, 1998)

<sup>9</sup>The aquatic facilities obviously depart substantially from the previously given criteria. Additional context might also be provided by a look at cultural, historical, or military museums, since the Diamond Head facility may well include some of these elements. But the principal focus at Diamond Head is expected to be natural history. The aquatic attractions are closer to this focus, and the Waikiki Aquarium has the virtue of somewhat comparable size and entry fee.

<sup>10</sup>That size was changing during the time this report was written. It was originally contemplated to be 100,000 square feet; then 40,000 square feet in the Crater, with ancillary facilities outside; then, as one alternative, just 25,000 square feet in the Crater. Further design changes or planning alternatives are possible.

EXHIBIT 3-1 (CONT.): OVERVIEW OF "COMPARABLES" FOR DIAMOND HEAD INTERPRETIVE CENTER							
Overall Attraction	Associated Separate Interpretive Facilities	Approx. Size	Fee for Overall Attraction	Additional Fee for Interp. Facilities	Interp. Facility Operator/ Arrangement	Other Revenue-Producing Activities	Pct. Gross Revenues from Various Sources <sup>1</sup>
<b>INTERPRETIVE FACILITIES WITHIN PUBLIC PARKS (CONTINUED)</b>							
Hawaii Volcanoes National Park (Big Island) under U.S. National Park Service (NPS)	Kilauea Visitor Center and nearby Thomas A. Jaggar Museum	Visitor Center 1,000 s.f. (plus adjoining 2,500-s.f. Auditorium) Museum 3,500 s.f.	\$10/vehicle or \$5/person (larger fees for commercial tour vehicles)	None	Hawaii Natural History Assn. (nonprofit) operates under cooperative agreement with NPS	Book/ gift shop	Essentially 100% from sales - HNHA dedicates profits to NPS for public educational projects
<b>STAND-ALONE INTERPRETIVE FACILITY ADJACENT TO PUBLIC PARK</b>							
Iao Nature Center (is immediately adjacent to Iao Needle State Park) (private nonprofit)	N/A	4,000 s.f. (plus two support bldgs. totaling about 14,000 s.f., on 1.8-acre parcel)	\$8/adult \$4/child (also, annual family memberships available)	N/A	Hawaii Nature Center (nonprofit); owns land and buildings	Gift shop comprising about 800 s.f. within facility	Entry fees, 25% Gift shop, 70% Other, 5%
<b>AQUATIC SCIENCE FACILITIES</b>							
Waikiki Aquarium (1/2 nonprofit; 1/2 UH Research Corp.)	N/A	19,000 s.f.	\$8/tourist; \$4/resident; children free	N/A	Friends of Aquarium have gift shop	Gift/ book shop	Entry fees, 44% Gift shop, 20% State funds, 18% Misc., 18%
Maul Ocean Center (private for-profit)	N/A	Five-acre parcel; half is built upon	Tourist \$17.50/adult, \$12/child; Resident \$12/adult, \$8/child	N/A	N/A	Gift shop; food and beverage	Entry fees, 65% Gifts, 23% Food, 12%
Sea Life Park (private for-profit)	N/A	16 acres of visitor facilities	\$24/adult; \$12/child (res. 1/2 price)	N/A	N/A	Gift shop; food, jewel concessions	Entry fees, 60% Shops/concessions, 20%

<sup>1</sup> When interpretive center operated separately from overall attraction, these columns apply to interpretive center and its operator.

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EXHIBIT 3-1: OVERVIEW OF "COMPARABLES" FOR DIAMOND HEAD INTERPRETIVE CENTER							
Overall Attraction	Associated Separate Interpretive Facilities	Approx. Size	Fee for Overall Attraction	Additional Fee for Interp. Facilities	Interp. Facility Operator/ Arrangement	Other Revenue-Producing Activities	Pct. Gross Revenues from Various Sources <sup>1</sup>
<b>INTERPRETIVE FACILITIES WITHIN PUBLIC PARKS</b>							
Koko'e State Park (Kauai)	Koko'e Natural History Museum	1,200 s.f. (Exhibits, ca. 900 s.f.; gift shop, 300 s.f.)	None (though cabin rentals and Lodge concession \$ go to State)	None, but \$1 "suggested donation" and membership fees	Hul O Laka (nonprofit) - mgt. agreement w/ State	Gift shop	entry donations, 8.5% Gift shop, 62% Memberships/ other, 9.5%
Kauai National Wildlife Refuge (Kilauea Point, Hanalei, Huleia)	Kilauea Point Visitor Center	800 s.f. (including office space)	\$2/adult children free	None, but membership fees	Kilauea Pt. Natural History Assn.	Book/ gift shop	Sales, 99% Memberships, 1%
Heela State Park (Oahu)	Friends of Heela Visitor Center	10,000 s.f. (+ 1,600 s.f. classroom)	None	None, but membership and program fees	Friends of Heela State Park - mgt. agreement w/ State	Gift shop (very small)	Donations and grants, 88% Memberships/ program fees, 1% Gift shop, 1%
Hanauma Bay Nature Preserve (Oahu)	(unnamed visitor center in upper park)	572 s.f. (1/2 of building intended to be food concession)	\$3 tourist adult; children, residents free; \$1 parking	None	UH Sea Grant Extension service, under City contract	None	N/A
Haleakala National Park (Maui) under U.S. National Park Service (NPS)	(three small separate centers, at summit, Park headquarters, and Kipahulu Ranger Station)	Summit area, w/ gift shop is ca. 675 s.f.; other two are slightly smaller (800-860 s.f.)	\$10/vehicle or \$5/person (larger fees for commercial tour vehicles)	None	Hawaii Natural History Assn. (nonprofit) operates under cooperative agreement with NPS	Book/ gift shop	Essentially 100% from sales - HNHA dedicates profits to NPS for public educational projects

(CONTINUED)

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Within the State Department of Land and Natural Resources, the State Parks Division has "management agreements" with half a dozen private nonprofit groups which allow these organizations to charge fees and/or sell some types of materials in exchange for providing some type of public service — docent programs, education, information, cabin rentals, etc. For the most part, the State collects *little or no revenue* from these organizations. The basic assumption is that the nonprofit organizations are providing services which are legitimate State functions and possibly save the State the expense of staffing (personal communication, Ralston Nagata, Administrator, State Parks Division, August 7, 1998).

By contrast, the National Park Service maintains "cooperative agreements" with nonprofit support groups ("Cooperating Associations"), and these result in substantial revenues for park improvements from gift shop profits. At the Haleakala and Hawaii Volcanoes National Parks, the Hawaii Natural History Association (HNHA) workers and park rangers work side-by-side in providing information and interpretive services, as well as selling educational materials. On the Big Island alone, the HNHA gives back \$120,000 to \$150,000 a year to the National Park<sup>11</sup> (personal communication, Kathleen English, Executive Director, HNHA, August 5, 1998). The Arizona Memorial Museum Association (AMMA) — which also services the Kalaupapa National Historical Park and Guam's "War in the Pacific" National Historical Park — is essentially limited to book sales on Oahu but assists with interpretation at the other sites. The AMMA raised \$100,000 to purchase initial exhibits for the museum, and over \$500,000 to fund the most recent film on the sinking of the USS Arizona (personal communication, Gary Veito, Executive Director, AMMA, August 3, 1998). Opportunities exist for nonprofit educational groups supporting local Hawaii parks to interact with the national umbrella organization for such associations.<sup>12</sup>

(3) *Gift shop sales are crucial revenue sources for nonprofits involved in visitor/interpretive centers in or by public parks.*

As shown in Exhibit 3-1, in most cases they provide from 70% to 100% of revenues.

<sup>11</sup>This figure includes 50% of HNHA salaries because of the public interface of the work, but it also includes specific amounts for items proposed by Park management to the HNHA board of directors each year — these items can vary, but may include things like trail guides, honoraria for educational speakers, printing of special bulletins, or new exhibits in interpretive centers.

<sup>12</sup>The national network of "Cooperating Associations" is called the "Association of Partners for Public Lands" or APPL. While primary membership in the APPL is for organizations which work with the National Park Service, "affiliate membership" is open to similar groups which support public parks at a local governmental level. Benefits include informational resources, training opportunities, group health insurance programs, etc. The APPL's website at <http://www.nps.gov/coop/member.htm> also contains basic information about the overall framework for National Park Cooperating Associations.

The contributions to National Parks cited above came nearly 100% from these sales, since Cooperating Associations generally are not permitted to charge entry fees to facilities which are actually the property of the federal government (personal communication, Gary Veito, *ibid.*). Even the few for-profit aquatic facilities listed in Exhibit 3-1 receive a substantial part of their gross revenues from such sales, though the percentage shrinks as entry fees move up.

In order to keep their nonprofit status with the Internal Revenue Service, nonprofits may only sell products related to their mission. Thus, there is a focus on educational materials — especially books, videos, tapes, CD's, etc. Souvenir items are limited in nature, and no significant food sales take place on the premises operated by the nonprofits.

### 3.2.2 Focus on "Quasi-Comparables"

While none of the facilities in Exhibit 3-1 can be considered true comparables for the proposed Diamond Head facility, three "quasi-comparables" do provide some instructive additional information:

- Iao Nature Center;
- Waikiki Aquarium;
- Koko'e Natural History Museum (in Koko'e State Park).

#### 3.2.2.1 Iao Nature Center

**Nature of Facility:** The "Iao Valley Interactive Science Arcade and Gift Shop" is the portion of the Iao Nature Center which is open to the general public as a paid attraction. Open since June 1997, it is a stand-alone interpretive facility which focuses on the natural history of the area surrounding the Iao Needle, a famous Maui landmark, and on the broader history of Hawaii lifeforms in general (but particularly those which may be found in streams and valleys such as Iao). Exhibits are imaginative and "hands-on," rather than static, and are organized around a number of concepts and themes (see Exhibit 3-1).

The overall 1.6-acre property is sandwiched between the Iao Valley State Park and Maui County's Keponiwal cultural park. Given its relationship to the Iao Needle (in some ways analogous to Diamond Head as a landmark), the nature of its exhibits, and the fact that it has an entry fee, this facility might be considered a "comparable" for a Diamond Head facility if that facility must act as a stand-alone attraction — i.e., separate entry fee, requiring independent marketing, needing to pay for itself to survive. The main difference, of course, is that the Iao facility at 4,000 square feet is much smaller than the center being considered for Diamond Head.

The facility is owned and operated by the Hawaii Nature Center,<sup>13</sup> a private nonprofit organization focused on environmental education programs, especially although not exclusively for children and families. At both its statewide headquarters off Makiki Heights Drive on Oahu and also at the Iao location on Maui, the Nature Center provides school programs to educate children (pre-school through 6th grade) about nature through both interactive exhibits and immersion in Hawaii's outdoor environment. Additionally, for both adults and children, the Nature Center offers weekend hikes, nature excursions, week-long "summer adventures," and other community programs.

**History of Development:** On Oahu, the Nature Center has been in operation since October 1981. Its board of directors includes many prominent Hawaii business and civic leaders.

On Maui, the Nature Center in 1990 acquired several buildings in Iao Valley, outside Wailuku, with the assistance of grants from the Harry and Jeanette Weinberg Foundation and the State of Hawaii. These were originally built as a small inn during the 1950s and later operated as a restaurant, among other uses. The Nature Center began operating school programs there in 1991.

According to Executive Director Tamar Cholzen (personal communication, August 5, 1998), the idea of a tourist-oriented interpretive facility arose because 50 to 75 Iao visitors a day were stopping at the Iao Nature Center and interrupting programs to "ask what we had for them." Many of these requests were for things like food and information, but enough touched on things like possible hikes or programs (i.e., things related to the nonprofit group's actual mission) that the organization perceived a market opportunity and began studying the possibility of opening a visitor/interpretive center and gift store.

After a \$1.2 million renovation of one of the three buildings on the property — the remaining two buildings are used for offices and the original types of program activities — the Interactive Science Arcade and Gift Shop opened in June 1997. It operates from 10 a.m. to 4 p.m., seven days a week, and charges an entry fee of \$6 for adults, \$4 for children. However, as noted in Exhibit 3-1, the small gift shop generates far more of the gross revenues than do the entry fees.

**Attendance and Profitability to Date:** Prior to opening, a survey implemented with assistance of UH Travel Industry Management students suggested that 45% of Iao Park's 450,000 visitors/year were "very interested" in learning about Hawaii's environment. Originally, this was hopefully interpreted as a potential ultimate market of over 200,000 visitors/year for the new facility.

<sup>13</sup>Information in this section comes from materials provided by the Hawaii Nature Center; various interviews conducted from June through July 1998 with executive staff; and a site visit in July 1998.

EXHIBIT 3-J: IAO VALLEY NATURE CENTER EXHIBITS -- THEMES AND EXAMPLES		
Concept/Theme	Selected Sample Exhibits and Explanation	
"ISOLATION" Implications of Hawaii's extreme physical distance from other landmasses.	"World Globe and Log-In"	Colored 5-foot spinning globe where one can measure distance to Hawaii from hometown or lands of ancestors.
	"Pacific Rim Game"	Illustrates role of chance in colonization of islands by birds and plants. Six-foot convex map of Pacific Basin; hole in middle represents Hawaii. Players from "continents" on rim toss balls to see if their "lifeforms" can ever reach Hawaii.
"DISPERSAL" Ways that life traveled to Hawaii — via waves, winds, and wings of birds	"Reel of Fortune"	A "wheel of chance" which shows fates of various species.
	"Plantball"	Game in which players attempt to bring new plants to islands.
"INTERDEPENDENCE" Ecological systems — food chains, etc.	Stream and Aquarium Exhibits	Ten-foot high by 30-foot long rock formation in main exhibit hall, with miniature flowing streams and waterfalls tumbling into aquarium exhibits. Table top aquarium with floating magnifiers and periscope focusing on native stream organisms. Touch pool, waterfall for climbing o'o'pu, and overhead aquarium.
	Reinforest "Cabinet"	Eight-foot tall by 12-foot wide full-color mural of Hawaiian rainforest with more than a dozen drawers, pull-outs, and pull-ups focusing on unique details — e.g., a "bat drawer," "ohia slide-out," butterfly exhibit, etc.
"ADAPTATION" Evolution in the "natural laboratory" of an island archipelago	Bird Status Mural	Evolution of Hawaiian birds, including extinct or endangered types.
	Happyface Spiders	Examples of designs and opportunities to create new designs.
	Dragonfly Ride	Arm-in-winged simulation of dragonfly flight through Iao Valley.

Source: Hawaii Nature Center brochures and independent observation of exhibits, 1998.

However, according to Nature Center staff, experience to date suggests such a figure will be very difficult to attain, as most vacationers are actually less interested in an "educational" rather than an "entertaining" experience — though the facility tries to provide both. In its first year (June 1997 through May 1998), attendance was 45,000 visitors, or an average of about 125 per day. This represents about 10% of all visitors to the Iao Park.

Still, the Iao facility reached a financial break-even point in its first year, and profitability appears imminent, according to the executive director.<sup>14</sup>

The Nature Center's projected attendance for 1998-99 is 90,000, and attendance in the first few months of the new fiscal year has been consistent with that figure, according to staff. It may be noted that attendance to date has been limited almost entirely to the FIT traveler, as the Nature Center is still in the process of establishing linkages with group tour operators (below).

**Efforts to Expand the Market:** According to its staff, the Hawaii Nature Center did not conduct any significant marketing activities prior to opening the Iao facility, which has proved highly problematic. They believe that one important "lesson learned" for Diamond Head and similar facilities is that *marketing should begin at least a year prior to opening, so that written materials can be disseminated; hotel activity desks, travel agents, tour companies, etc. can become familiar with operations; and marketing relationships can be developed.*

The Iao facility was initially opened on the assumption that adequate attendance would be generated from drive-in FIT travelers going to or coming from Iao Needle. When this assumption was judged faulty, the organization decided to seek tour groups as well. It then had to go through a significant learning curve on aspects of this business — particularly the issue of commission rebates for tour operators and/or for hotel travel desks or concierges dealing even with FIT travelers.

#### Implications for Diamond Head Interpretive Facility:

- Any stand-alone interpretive facility with its own entry fee would have to function as a business.
- That business cannot expect to capture a significant portion of the FIT "walk-in" market to Diamond Head. The tentative solution at Iao has been to try to establish relationships with group tour operators. This could be problematic at Diamond Head, because group tour operators say they are unlikely to come to Diamond Head if interior parking is eliminated and commercial vehicle fees are assessed (see Chapter 5).

<sup>14</sup>Personal communication, Tamar Chotzen, August 19, 1998. As profits are generated, they will be returned for improvements and programs, first at Iao and then statewide.

- Based on its Iao experience, the Hawaii Nature Center believes that a stand-alone visitor/interpretive center with a separate entry fee will not be a viable business. (Also, based on Hanauma's experience, park manager Alan Hong said he would recommend an integrated entry fee for both the overall Diamond Head Crater and the visitor/interpretive center [personal communication, August 11, 1998], even though separate fees have been necessary at Hanauma.)<sup>15</sup>

- Nature Center staff also believe that the costs of operating a visitor/interpretive center should be integrated into an overall entry fee for Diamond Head. This raises the issue of why a center would be developed:

- If it is considered part of the "draw" for attracting paying customers to Diamond Head, then its market appeal — even if integrated into an overall entry fee — must be assessed by determining willingness to pay on the part of FIT travelers and/or tour operators. Evidence to be presented in Chapters 4 and 5 raise serious questions about such market appeal.

- If, on the other hand, education about Diamond Head — either imparting factual information or else cautioning about protection of the resource — is considered a legitimate State function in its own right, then the question arises as to whether the potential size of the facility is appropriate to this non-market mission (or as to whether the facility needs to be "self-sustaining").

- Whether or not the visitor/interpretive center is a "stand-alone," to the extent that tourist revenues become important at Diamond Head, the Iao experience underscores the importance of —

- a promotion and marketing strategy;
- advance communication with the visitor industry so that standard brochures and visitor information materials can be issued or modified on a timely basis.

#### 3.2.2.2 Waikiki Aquarium

Of all the places which were listed in Exhibit 3-1, the Waikiki Aquarium comes closest to the envisioned Diamond Head center in terms of size, potential entry fee, and proximity to Waikiki — though it is a fundamentally different type of facility. However, only a very few points need be made about the Aquarium:

<sup>15</sup>However, the revenue analysis in Chapter 6 raises some questions about this view.

Although it is a well-established operation, it still requires some State funding. Out of its \$2.5 million budget, \$450,000 comes from the State for grounds, maintenance, and education programs.

As with many other government facilities, the Aquarium has a nonprofit support group operating its gift and book store. However, the "Friends of the Waikiki Aquarium," unlike groups in several State parks, do not have a truly independent operation. Their gift shop budget is part of the overall Aquarium budget. And 20% of profits go back to the Aquarium, while the remaining 80% are used for shop improvements and expansion (personal communication, Dr. Bruce Carison, Executive Director, Waikiki Aquarium, August 6, 1998).

### 3.2.2.3 Koke'e Natural History Museum

Operated by the nonprofit "Hui O Laka" group, the Koke'e Natural History Museum (KNMH) is a very small facility (1,200 square feet), but it is the only current Hawaii visitor/interpretive center with an "entry fee" — actually, just a "suggested donation" of \$1. It operates with three full-time and three part-time employees, plus volunteers. The Hui does not yield any revenue to the State, but it serves informational functions which the State might otherwise have to provide with its own paid staff. The State had no interpretive program of its own at the Koke'e State Park when the KNMH began; now it does, and attempts to coordinate with the Hui's programs (personal communication, Raiston Negata, State Parks Division Administrator, August 7, 1998).

With 4,345 acres, the Koke'e State Park is far larger than the Diamond Head Crater. It has 45 miles of trails. The informational function served by the KNMH is therefore a crucial one, and it would make little sense to charge a significant entry fee when profits can be obtained by selling trail guides. Thus, the sales aspect here in some senses outweighs the educational and interpretive functions, at least from a strictly financial perspective.

The real value of the KNMH for purposes of this study is its 1997-98 profit and loss statement (Exhibit 3-K). This shows:

- The sort of items which might legitimately be sold in a Diamond Head book and gift shop. Printed materials and trail guides constitute the majority of sales at KNMH, followed by several types of resource-relevant souvenirs. (At Diamond Head, hiking accessories might also be a legitimate sales item.)

- The rough level of profitability (exclusive of overhead) for various types of items. Books, the least profitable if most plentiful item on the inventory, produce about a 70% profit, and other items generate from 80% to 140%.

EXHIBIT 3-K: KOKE'E NATURAL HISTORY MUSEUM, 1997 - 98 PROFIT AND LOSS					
(Figures are for Fiscal Year from June 1, 1997 - May 31, 1998 — data provided by Thome Clarke, administrative assistant)					
Income			Expenses/Inventory Purchases		
<b>Total</b>	<b>\$407,061.33</b>	<b>%</b>	<b>Total</b>	<b>\$407,061.33</b>	<b>%</b>
Shop Sales	\$333,691.30	82%	Shop Sales	\$178,298.59	44%
(Breakout of Shop Sales by Type of Item:)			(Shop Costs, primarily Inventory purchases, for:)		
		<b>% of Shop Sales Income</b>			<b>% of Shop Expenses</b>
- Books	\$123,971.41	37.2%	- Books	\$73,080.76	41.0%
- Paper (Trail Maps, etc.)	\$68,974.53	20.7%	- Paper (Trail Maps, etc.)	\$28,952.99	16.2%
- Wood Crafts	\$32,333.40	9.7%	- Wood Crafts	\$18,266.95	9.1%
- T-Shirts	\$28,965.77	8.7%	- T-Shirts	\$13,886.82	7.8%
- Hand Crafts	\$24,841.30	7.4%	- Hand Crafts	\$11,032.81	6.2%
- Tapes/CD's	\$18,717.21	5.6%	- Tapes/CD's	\$9,701.21	5.4%
- Prints	\$15,323.05	4.6%	- Prints	\$6,294.21	3.5%
- Fabric Crafts	\$8,877.80	2.7%	- Fabric Crafts	\$4,491.67	2.5%
- Jewelry	\$4,311.00	1.3%	- Jewelry	\$1,819.97	1.0%
- Misc./Overage	\$7,375.83	2.2%	- Misc.	\$3,574.30	2.0%
Entry Donations	\$34,787.24	9%	Other Costs <sup>2</sup>	\$9,195.10	5.2%
Memberships	\$16,655.00	4%	Employee Salaries, Sick Pay, etc.	\$130,054.90	32%
Volunteer Programs Income (mostly handmade bookmarks, luggage tags sold in shop but not counted as "shop sales" since donated)	\$4,501.00	1%	Employee Taxes & Insurance	\$28,125.27	7%
Combined Other Program Receipts	\$3,214.84	1%	Administration	\$19,186.28	5%
Grants ("Fund Income")	\$12,363.00	3%	Facilities & Equipment	\$18,976.76	5%
Misc. (Interest, Endowment, Freight)	\$1,848.95	0%	Combined Program/Grant Expenses	\$24,928.09	6%
			Interpretation (Exhibits, Library, etc.)	\$1,419.13	0%
			Other (e.g., Membership, Volunteer)	\$3,583.60	1%
			Operating Profit	\$2,490.73	1%

<sup>1</sup> Excluding overhead costs. Percentages are approximate, since not all inventory bought in a year is always sold in same year.  
<sup>2</sup> Principal "other costs" were charge card discounts, \$5,036.38; State Taxes (t-shirts only), \$1,387.27; freight, \$1,333.58.

## 4.0 REVENUE ANALYSIS: DIAMOND HEAD SURVEY

### 4.1 Introduction and Summary of Key Findings

The principal focus of this chapter will be on a survey conducted in July 1998 to determine "willingness to pay" of Diamond Head users not coming in group tour vehicles<sup>1</sup>. It was found that the overwhelming majority of people coming into the Crater in group tour vehicles (buses, vans, etc.) did not emerge from those vehicles, and so the final survey dataset consisted strictly of residents and tourists arriving by private car, City bus, taxi, foot, etc. "Willingness to pay" on the part of people coming in guided tour vehicles will be addressed indirectly in the following Chapter 5, which discusses interviews with representatives of organizations which bring such tourists into Diamond Head.

Before discussing this new survey, however, we will briefly review other evidence from previous surveys, including a recent Diamond Head traffic count.

Some of the key findings from this chapter will be:

- (1) Current attendance at the Diamond Head Crater by both tourists and residents appears to be about 690,000 people per year, excluding people just driving through. On any given day, a little over half of Diamond Head's visitors are estimated to be Asian (primarily Japanese) visitors; 36% to be westbound visitors; and 12% to be residents.
- (2) Further excluding people who just stop briefly in the parking lot, active use of Diamond Head (primarily hiking to the top) is between 543,000 and 656,000 people, with a mid-range estimate of 600,000. This restricted group has somewhat lower percentages of Asia visitors (a group found to be a little more willing than others to pay entry fees to Diamond Head).
- (3) Our survey, which excluded people coming in group tour vehicles, found 40% Asia visitors, 37% North American tourists, 7% European or "other" tourists, and 17% Hawaii residents actively using the Crater. More than 90% of these were intended hikers to the summit. About half came in private or rented cars, with the remainder arriving by City bus, trolley, on foot, etc. (The great majority of Hawaii residents and North America visitors came by car, Japanese or other visitors tended to use other modes.)
- (4) A very large majority of those coming by car would pay a \$1 parking fee, but fewer than half the respondents were willing to pay any more than that.

<sup>1</sup> An exception was JTB (Japan Travel Bureau) charter trolleys. Tourists coming this way were left in the sample because these are not guided tours — the tourists are free to choose to stay on the trolley without stopping or to get off the trolley, hike the Crater, and then catch a later trolley. In this regard, tourists arriving by trolley are much the same as those arriving by City bus.

(5) Survey results suggest that a combined incremental shuttle/entry fee (over and above a parking fee) could not exceed \$3 without significant erosion of attendance, particularly among Hawaii residents and North America visitors. Even a \$3 fee would be strongly resisted by a majority of Hawaii residents. (However, some residents voluntarily told interviewers they would be open to the idea of a lower-cost annual pass.)

(6) It was assumed for purposes of this survey that a visitor "visitor/interpretive center" would be primarily a sort of museum about Diamond Head, with an entry fee in the range of \$5 to \$7 per adult. However, there was little public willingness to pay a separate fee of that level for this sort of attraction — nearly two-thirds were unwilling to pay as much as \$5. Past HVCB visitor surveys indicate limited market demand for this sort of experience. Some respondents voluntarily told interviewers they would like to see snack or gift shops at Diamond Head, but they did not want to pay just to enter them.

(7) There was somewhat more willingness to pay a combined fee for overall entry, shuttle use, and optional visitor/interpretive center entry. However, survey results suggest such a combined fee should be in the \$5 range.

### 4.2 Review and Analysis of Previous Surveys

#### 4.2.1 Indirect Information — Non-Diamond Head Surveys

Periodic "visitor activity" and/or "visitor satisfaction" surveys conducted by the Hawaii Visitors and Convention Bureau (HVCB, formerly known as the Hawaii Visitors Bureau, or HVB) are the primary public data source for tourist visits to particular attractions and/or tourist participation in activities relevant to Diamond Head Crater use.

Unfortunately, (1) the frequency and breadth of these surveys declined in the 1990s, due to budget cuts necessitated by the economy; and (2) Diamond Head Crater is not on the list of specific attractions for these surveys. Therefore, all results are of limited and indirect relevance.

Exhibit 4-A on the next page shows selected results from the two most recent HVCB surveys, each of which had both a U.S. and Japanese version. These results suggest:

- U.S. visitors are generally more likely than Japanese to visit attractions comparable to Diamond Head or to engage in hiking and natural site visits. This is not a uniform finding, however, since the attraction perhaps most comparable to Diamond Head — Punchbowl Cemetery, another crater with spectacular urban views — was more likely to be visited by Japanese than by U.S. visitors, at least in the early 1990s.

EXHIBIT 4-A

SELECTED VISITOR ACTIVITIES OF POTENTIAL RELEVANCE TO CURRENT OR FUTURE DIAMOND HEAD ATTENDANCE: 1991, 1996

(Percentage of Statewide visitors reporting participation at least once during Hawaii stay.)

Activity	1991		1996	
	U.S. 2264	Japan 316	U.S. 1319	Japan 1061
<b>General Activities Suggestive of Diamond Head</b>				
Natural Site Visits	54%	33%	N/A	N/A
Hiking/Climbing	32%	7%	28%	5%
<b>Specific Activities/Attractions Suggestive of Diamond Head</b>				
"Historic Site"	N/A	N/A	60%	49%
"Museum/Art Gallery"	N/A	N/A	32%	14%
National Parks	42%	6%	N/A	N/A
USS Arizona Memorial	35%	8%	N/A	N/A
Punchbowl National Cemetery	17%	38%	N/A	N/A
Waimea Falls Park	29%	4%	N/A	N/A
Military Museums	11%	3%	N/A	N/A
Other Museums (other than Bishop, Bowfin, Maritime, or Art Museums)	9%	2%	N/A	N/A
<b>Sight-Seeing Patterns Relevant to Diamond Head</b>				
Personal Tour (Rental Car)	N/A	N/A	73%	28%
Walking Tours	29%	3%	41%	11%
Tour Bus Excursion	N/A	N/A	22%	39%
Trolley Tour	N/A	N/A	9%	10%
<b>Transportation Patterns Relevant to Travelling to Diamond Head</b>				
Rented a Car	N/A	N/A	79%	18%
Rode Public Bus	N/A	N/A	24%	58%
Used Taxi	N/A	N/A	15%	29%
Rode Trolley	N/A	N/A	9%	28%
Hired Limousine	N/A	N/A	4%	21%

Source: Hawaii Visitors Bureau, 1991a; Hawaii Visitors and Convention Bureau, 1997a

The reported activity of "hiking/climbing" declined very slightly from 1991 to 1996 among both U.S. and Japanese visitors. Nevertheless, in both years, roughly 30% of U.S. and 6% of Japanese tourists statewide said they participated in this activity.

In contrast to the 1991 "hiking/climbing" numbers, higher percentages in both groups (54% U.S. and 33% Japanese) participated in "natural site visits." This may suggest that a shuttle bus system — which could make it possible to get up to the Diamond Head viewpoints with less "hiking" — would result in more tourist interest.

Small military museums or "other" museums — presumably comparable to the planned visitor/interpretive center at Diamond Head — were not significant tourist draws, at least as of 1991. Only about 10% of U.S. and 3% of Japanese visitors reported attending these.

Additionally, Exhibit A-9 in Appendix A shows that repeat visitors to Hawaii are less likely than first-timers to go to specific Hawaii attractions such as Punchbowl, National Parks, or small museums. Private-sector attractions are concerned that, as Hawaii's percentage of repeat visitors increases, attractions of all sorts will face greater challenges in maintaining attendance (personal communication, Lori Lum, president, Hawaii Attractions Association, June 15, 1998). This would apply to Diamond Head as well. If growth in the Oahu visitor count does resume, Diamond Head's capture rate of all tourists would probably decline somewhat in the future, unless that growth consists more of first-time visitors than has been the case in recent years.

In addition to the HVCB surveys, the Hawaii State Dept. of Land and Natural Resources conducts periodic "State Comprehensive Outdoor Recreation Program" (SCORP) surveys of tourists and residents. Appendix Exhibits A-10 to A-12 show selected results. Some conclusions from these appendix tables:

- Tourists are less likely to hike on Oahu than on other islands. (Note that the foregoing HVCB figures were based on statewide samples.)
- Among both tourists and residents, hiking is considerably less popular than swimming or other beach activities.
- Among Hawaii residents, there were slight increases in the percentages of people reporting participation in both "hiking" and "fitness walking" from 1990 to 1995.

4.2.2 Preliminary DLNR Diamond Head User Survey Results

Staffers in the Parks Division of the Hawaii State Department of Land and Natural Resources (DLNR) have conducted periodic visitor interviews on-site at the Crater in various days during the months of January, February, and May 1998 (Han Palermo, 1998; Hawaii State DLNR, 1998).

Survey questions focused on visitor concerns and satisfaction. However, due to limited staff time, only 46 interviews had yet been completed and compiled as of this writing. This is too small a number to be statistically meaningful, and DLNR's conclusions have been limited to qualitative observations with no percentage figures attached:

- Satisfaction with the hiking experience per se was generally high.
- However, complaints were voiced in regard to:
  - Need for lighting in tunnels and stairwell;
  - Inadequate or unclean restroom facilities;
  - Lack of water and/or emergency phone on top;
  - Need for information and interpretation;
  - Presence of vendors.
- Some interviewees said they would be willing to pay entry fees if money goes back to maintenance and upkeep of the park.

#### 4.2.3 Diamond Head Visitor Origin Profile from Traffic Count

SMS Research (1998) was contracted by PBR Hawaii to perform a Diamond Head traffic count on a single weekday (Thursday, May 14, 1998) and weekend day (Saturday, May 16, 1998). The tally included:

- Vehicle parties which did not stop, either due to lack of parking space or because tourist occupants were simply conducting sight-seeing without deboarding. (For these parties, SMS generally did not try to estimate either number of persons or origin of most in party.) These figures are not relevant to the present analysis.
- For vehicles which did stop in the Crater —
  - Type of vehicle;
  - Estimated number in vehicle party; and
  - Estimated origin of most in party (resident, Asia visitor, etc.).

The SMS report discussed estimated origin only in terms of the numbers of parties (people sharing a vehicle). The company provided the author of this report with the spreadsheet containing all results of the tally, which made it possible for John M. Knox & Associates to calculate estimated origin in terms of actual Diamond Head "users" (including both sight-seeing from stopped vehicles and hiking, picnicking, etc.). Exhibit 4-B provides these estimates, as well as projections of annual Diamond Head visitor counts based on the counts.

**EXHIBIT 4-B**  
**ESTIMATED ORIGIN OF PERSONS ENTERING**  
**DIAMOND HEAD CRATER (SMS TRAFFIC COUNT, 1998)**

[Origin of Most in Party\* was based on judgment of person taking tally. Number for "Weekends" represents count for Saturday, May 16, multiplied by two. Number for "Weekdays" represents count for Thursday, May 14, multiplied by five.]

**A. All Persons Entering Crater, Including Tour Group Vehicles Which Stopped**  
(Tour or residential vehicles which did not stop are not included in these figures.)

	Weekdays		Weekends		Total Week		Annualized Numbers
	Number	%	Number	%	Number	%	
Residents	710	16%	895	10%	1,605	13%	83,700
Westbound Visitors	1,588	35%	3,230	37%	4,818	36%	251,200
Japanese Visitors	2,124	47%	4,215	49%	6,339	48%	330,500
Other Asian Visitors	94	2%	320	4%	414	3%	21,600
Undeclared	32	1%	20	0%	52	0%	2,700
<b>Total:</b>	<b>4,548</b>	<b>100%</b>	<b>8,680</b>	<b>100%</b>	<b>13,228</b>	<b>100%</b>	<b>689,700</b>

**B. Excluding Buses — HIGH Estimate of Active Users**  
(Above figures minus counts for tour buses. Most tour bus occupants simply take pictures, get out to stretch, or perhaps use the restroom.)

	Weekdays		Weekends		Total Week		Annualized Numbers
	Number	%	Number	%	Number	%	
Residents	710	17%	895	11%	1,605	13%	83,700
Westbound Visitors	1,588	38%	3,140	37%	4,728	38%	246,600
Japanese Visitors	1,732	42%	4,045	46%	5,777	46%	301,200
Other Asian Visitors	94	2%	320	4%	414	3%	21,600
Undeclared	32	1%	20	0%	52	0%	2,700
<b>Total:</b>	<b>4,156</b>	<b>100%</b>	<b>8,420</b>	<b>100%</b>	<b>12,576</b>	<b>100%</b>	<b>655,700</b>

**C. Also Excluding Tour Vans and Mini-Buses — LOW Estimate of Active Users**  
(Some occupants of tour vans and mini-buses could be hikers, but others are not. Their exclusion results in a conservative estimate of "active" users — mostly hikers or would-be hikers, plus some miscellaneous active residential use for jogging, picnics, etc.)

	Weekdays		Weekends		Total Week		Annualized Numbers
	Number	%	Number	%	Number	%	
Residents	710	19%	865	15%	1,595	15%	83,200
Westbound Visitors	1,536	41%	2,930	44%	4,466	43%	232,900
Japanese Visitors	1,356	37%	2,820	42%	4,176	40%	217,700
Other Asian Visitors	80	2%	50	1%	130	1%	6,800
Undeclared	32	1%	20	0%	52	0%	2,700
<b>Total:</b>	<b>3,714</b>	<b>100%</b>	<b>6,705</b>	<b>100%</b>	<b>10,419</b>	<b>100%</b>	<b>543,300</b>

Source: Calculations performed on spreadsheet provided by SMS Research following Diamond Head traffic count.

**All Diamond Head Users:** The first part of Exhibit 4-B is based on the total SMS count. It implies an annual visitor attendance (excluding drive-throughs) of a little under 700,000 people. The largest single group — almost 48% — was thought to consist of Japanese visitors. Including non-Japanese Asians, eastbound visitors were estimated to comprise more than half the Diamond Head attendance. The SMS observers thought residents comprised about 12% of the total, with the remaining 36% comprised of westbound (North American and some European) tourists.

**High Estimate of "Active" Users:** Most people who come in large tour buses do little more than take pictures and use the restrooms. Very few of them hike to the summit. The middle portion of Exhibit 4-B replicates the SMS figures after removing parties who arrived in buses. This is considered a "high" estimate of active users because it still retains people arriving in tour vans and mini-buses — some but not all of whom are probably hikers. (Occasional bus charter groups may also be Diamond Head hikers, but this is very rare.)

The effect of this restriction is to reduce estimated Diamond Head "user" figures slightly, to about 656,000 per year. Most of this reduction would be in the numbers of Japanese visitors, since the percentages shift slightly down for Japanese and slightly up for residents and westbound visitors.

**Low Estimate of "Active" Users:** The final part of Exhibit 4-B shows numbers and percentages which result from the further exclusion of "tour vans" and "mini-buses" — some occupants of which would actually be hikers, while others would not. This conservative estimate drops the projected annual number of Diamond Head users much more sharply, to a level of about 543,000. ("middle-figure" estimate of active users would thus be around 600,000 per year.)

Again, Japanese percentages decline, while resident and westbound visitor percentages increase. By these numbers, westbound visitors edge out Asians as the largest single group of "users" (which means, for the most part, hikers).

#### 4.3 Purpose and Methodology of Survey Conducted for This Report

**Primary Purpose:** Determine "willingness to pay" various parking fees, entry and/or shuttle fees, and fees for the visitor visitor/interpretive center. (The word "visitor" here means "visitor to Diamond Head" — it does not mean "tourist".)

**Secondary Purpose:** Compile additional information about Diamond Head visitor profiles, travel modes, and activities in the Crater. This information has value in itself and for cross-tabulation with willingness to pay.

Diamond Head Social Impacts & Revenues P. 4-7 John M. Knox & Associates, Inc.

**Excluded Purposes:** The survey did not address issues such as visitor motivation, satisfaction, complaints, etc. — although interviewers reported that some people commented about such topics. However, these topics were not included in the survey — partly because DLNR is in the process of gathering this data; partly because time and resource constraints made it necessary to conduct a brief and focused survey to achieve a good sample size.

**Survey Design:** John M. Knox & Associates, Inc. designed the survey questionnaire, in consultation with DLNR, PBR Hawaii, the Hawaii Nature Center, and Market Trends Pacific (the research company which subcontracted to collect the data and provide computerized analysis). The final questionnaire, along with Market Trends Pacific's methodology report, is contained in Appendix B. The five-minute survey form was supplemented by several visual aides — one of the alternative conceptual renderings for the revised Master Plan and a sketch of the visitor interpretive center.

**Interviewing Process:** Market Trends Pacific interviewers intercepted Diamond Head users at a point near the restroom facility. Some of the interviewers were bilingual and concentrated on Japanese respondents. An attempt was made to interview residents, eastbound, and westbound visitors in actual proportion to their numbers, although in an intercept survey it is sometimes difficult to be certain this has actually been done. Interviews took place at all hours (6:30 a.m. - 5:45 p.m.) in all days from July 11 to July 17, 1998.

**Sample:** The initial sample consisted of 484 persons. However, only 38 of these people were from group tour vehicles. Interviewers reported that often only a small proportion of people from these vehicles actually boarded at Diamond Head. It was obvious that the responses of these 38 people should not be generalized to all people arriving in group tour vehicles. Not only was the sub-sample size too small, but it may well have been biased toward people who were far more enthusiastic about the Crater experience than were the majority who remained on the bus or in the vans.

Therefore, the final sample of 446 Diamond Head "users" excluded people arriving in group tour vehicles and consisted exclusively of people arriving either in private cars or by a variety of other means (City bus, taxi, trolley, on foot, etc.). The sample thus also consisted overwhelmingly of active Diamond Head users — mostly hikers or would-be hikers, with a few residential joggers or picnickers.

A random sample of 446 people would have an error rate of  $\pm 4.6\%$  (at the 95% confidence level), although intercept surveys fall short of perfect randomness. However, the sample size is certainly adequate for drawing solid conclusions of a general nature.

<sup>2</sup> The questionnaire included some items aimed at people arriving in group tour vehicles. However, as discussed in this section, these people constituted a small number and were excluded from the final sample. Therefore, results to these questions will not be discussed here.

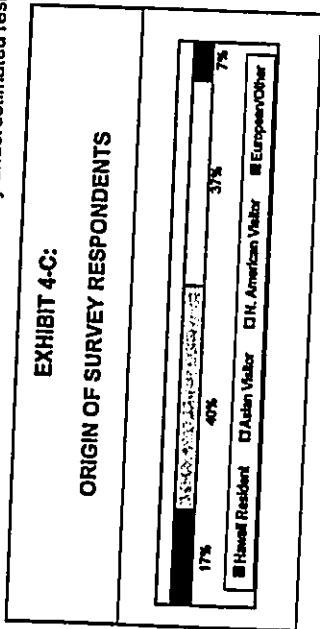
Diamond Head Social Impacts & Revenues P. 4-8 John M. Knox & Associates, Inc.



Data Processing: Market Trends Pacific computer-entered all data and produced final results using the SPSS-PC software, according to specifications provided by John M. Knox & Associates.

**4.4 Results Pertaining to Visitor Profiles and Activities**

**Origin:** The sample profile (Exhibit 4-C below) closely matches corresponding figures from the SMS tally, excluding tour vehicles (bottom portion of Exhibit 4-B). It is possible that residents were slightly oversampled for this survey, but it is also possible that the SMS visual tally underestimated residents.



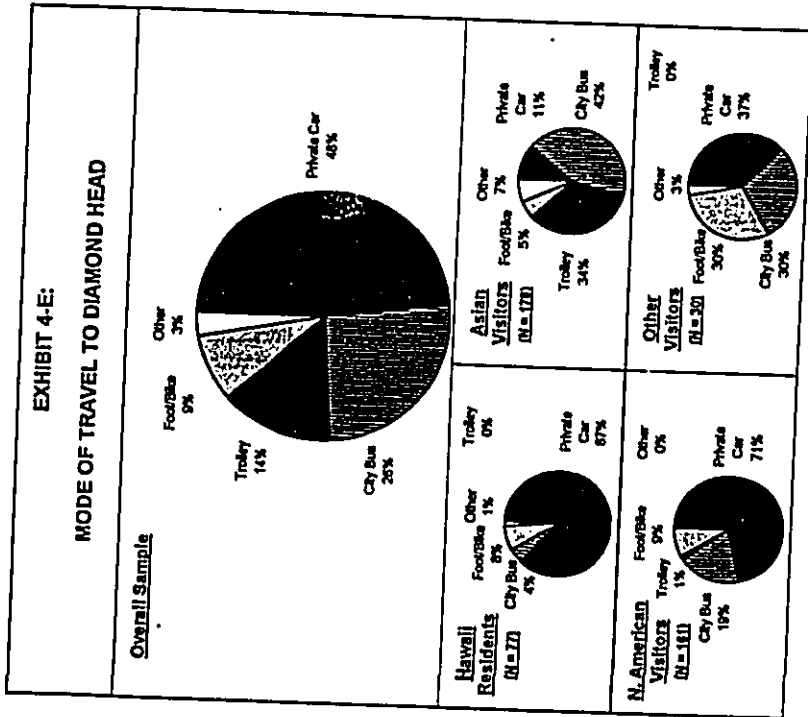
**Mode of Travel:** Overall, private cars (including rentals) constitute the main travel mode for active Diamond Head users, but Asia visitors are much more likely than others to take a City bus or visitor trolley (Exhibit 4-E, next page). Due to language issues, Asia visitors rent cars less often (Exhibit 4-A).

**Hiking Vs. Other Uses:** More than 90% of this sample consisted of people who had hiked or intended to hike to the top of the Crater rim. Of course, this reflects both the inability to survey "drive-through" vehicles and the decision to exclude people who came in group tour vehicles.<sup>3</sup> North America visitors were a little more likely than others simply to linger around the parking lot.

**EXHIBIT 4-D: PERCENTAGE HIKING TO TOP OF RIM**

	Total	Asian		N. Amer.		Other	
		Resident	Visitor	Visitor	Visitor	Arrived by ...	Other
Did/will hike	92%	87%	95%	87%	90%	Car	89%
Stay at parking	7%	3%	4%	12%	7%	Trolley	9%
Other/no answer	1%	0%	0%	1%	3%	Other	4%
(Sample Size)	(446)	(77)	(176)	(181)	(30)		(233)

<sup>3</sup> However, a little more than two-thirds of the excluded 38 respondents were also hikers. Presumably these were people from the smaller rather than the larger tour vehicles.



**Frequency of Residential Use:** Residents were asked how often, counting today, they had been inside Diamond Head Crater in the last 12 months.<sup>3</sup> Heavy use by a small group resulted in a high average level:

**EXHIBIT 4-F: RESIDENT VISITS IN LAST YEAR**

	Total	Arrived by ...	
		Car	Other
1 time	34%	36%	20%
2-5 times	32%	34%	20%
6+ times	22%	19%	40%
refused	20%	10%	20%
Average Number: (Sample Size)	13.8 times (77)	12.0 times (67)	26.9 times (10)

**4.5 Results Pertaining to "Willingness to Pay"**

This was the primary purpose of the survey. Respondents were given a verbal description<sup>4</sup> of contemplated improvements to the Crater, and were also shown a conceptual plan. They were then asked four questions about fees:

- (1) Willingness to pay a parking fee — asked only of those who came in a private car (including rentals). The stated range of possible fees was \$1, \$2, \$3, or more than \$3.
- (2) Willingness to pay an incremental combined entry/shuttle fee, on top of any parking. The stated range of possible fees was \$3, \$5, \$7, or more than \$7. (NOTE: DLNR is currently considering the possibility that entry and shuttle fees may be separate, so that some people could pay a lower entry fee simply to walk into the upgrade Crater park. However, for the sake of questionnaire simplicity, only the combined fee was addressed.)
- (3) Willingness to pay an incremental visitor/interpretive center fee, on top of the overall entry/shuttle fee and any parking fee. The stated range of possible fees was \$5, \$6, \$7, or more than \$7.
- (4) Alternatively, willingness to pay a combined entry, shuttle, AND visitor/interpretive center fee. The stated range of possible combined fees was \$7, \$9, \$11, or more than \$11.

For each of these questions, interviewers asked: "What is the most you would be willing to pay — X dollars? Y dollars? Z dollars? more than Z dollars?" (with Z always being the highest amount ... for the parking example, it would be \$3). If the respondent balked or even hesitated at the lowest given fee, interviewers would indicate the response was "less than X dollars or wouldn't enter."

The indicated range of potential fees for each question was based on input from DLNR, other consultants, and PBR Hawaii, which made final decisions.

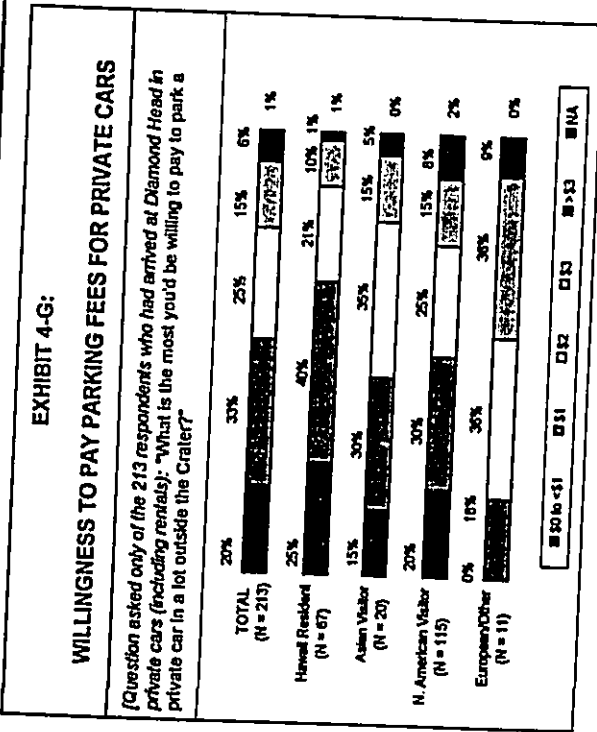
<sup>4</sup> The State hopes to make Diamond Head a much nicer place in the future. Someday the larger buildings here will be torn down. A well-designed visitor center will be put up to teach people about the history of the Crater. All parking will eventually be outside, but people can take a shuttle through the tunnel, ride around the inside edge of the crater floor, and get off to hike if they want. They might get to walk into a high tunnel now closed to the public which opens out into a beautiful view. The Crater will still be mostly dry, but more of the original trees and plants will be restored to make it somewhat greener.

<sup>5</sup> This will cost money to build and maintain, so we'd like to know if people would be willing to pay for it, and how much. There would probably be separate charges for parking, for entering on the shuttle, and maybe an optional price for going to the visitor center. Keeping that in mind ... [Fee questions were then asked.]

It should be noted that the suggested fees were, at this point in time, based on highly preliminary estimates and "gut feels." It is possible that any actual future fees might fall outside the suggested range of X dollars to Z dollars in the survey questions.

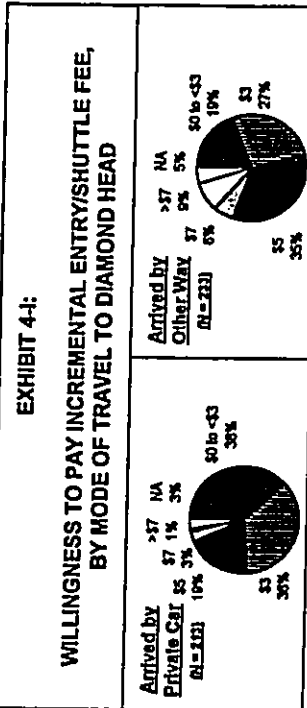
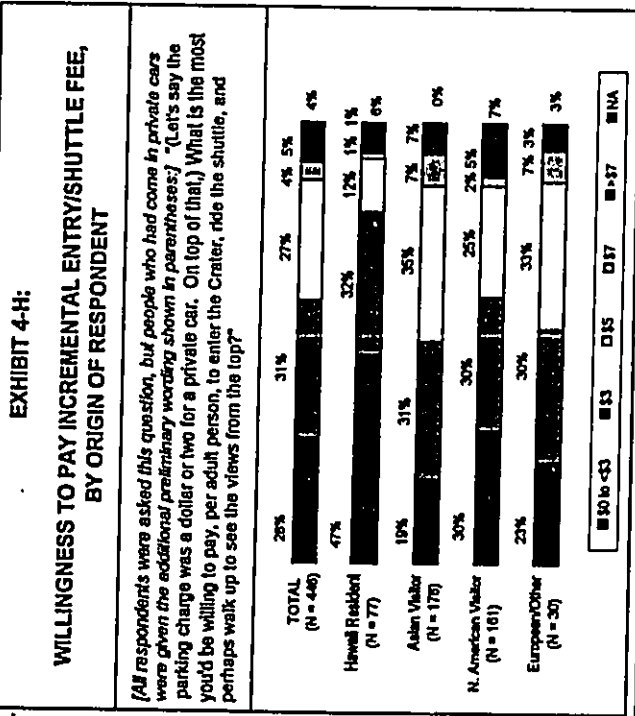
**Results for Parking Fee Question:** As indicated in Exhibit 4-G, about 80% would pay at least \$1 as a parking fee for private cars, but half the sample was unwilling to pay any more than \$1. Hawaii residents were most resistant to parking fees, while the very small sub-sample of European or "other" visitors seemed amenable to higher fees. The largest group coming by private car consisted of North America visitors, and only about 50% of these said they would be willing to pay more than \$1.

*Based on these survey results, a parking fee over \$1 (1998 dollars) would likely produce significant erosion in attendance, but a \$1 fee appears generally acceptable to most people.*



**Results for Combined Shuttle/Entry Fee:** People who had driven cars were asked to assume the shuttle/entry fee would be in addition to "a dollar or two" parking fee. All respondents were asked about adult entry fees. (Possible discounts for children, seniors, or residents were not addressed in the survey.)

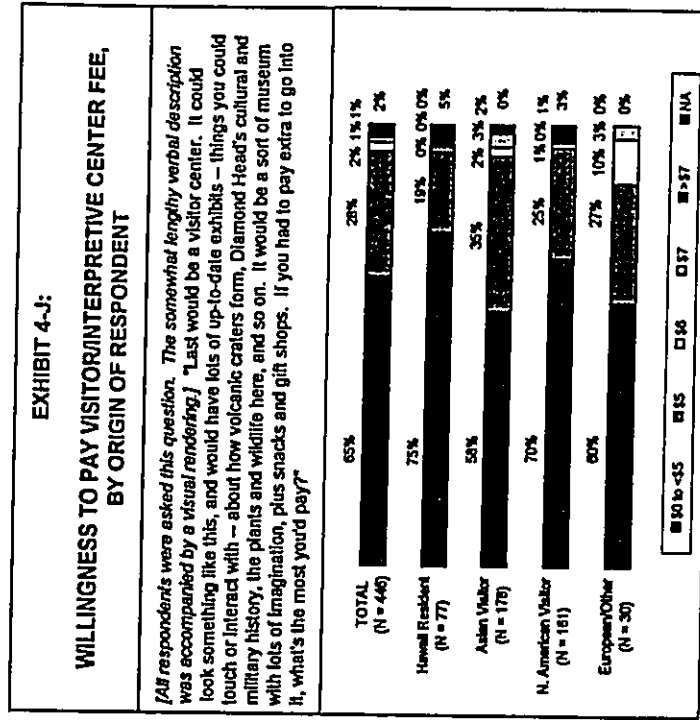
As shown in Exhibit 4-H, about 70% were willing to pay at least \$3, but acceptance dropped off to only about 36% for any higher level. Hawaii residents were strongly resistant to any fee at all, while Asian and European other visitors were most willing to pay a fee. People who came by car were relatively more price-resistant than others (Exhibit 4-I) — probably because they were less likely to be Asian or European, possibly also because of the effect of assuming they had already paid a parking fee (i.e., effects of having to pay a second fee).



*The survey results suggest that a combined incremental shuttle/entry fee (one and above a parking fee) could not exceed \$3 without significant erosion of attendance, particularly among Hawaii residents and North America visitors. Even a \$3 fee would be strongly resisted by a majority of Hawaii residents.*

**Results for Separate Visitor/Interpretive Center Fee:** The next question asked about willingness to pay another incremental fee for admission to a visitor/interpretive center. It should be noted that this was probably the most "hypothetical" of the questions, in the sense that no such activity now exists in Diamond Head, nor is there any extremely well-known comparable facility which could be referenced in the question. Respondents had to react to a verbal description, a visual conceptual rendering, and a set of potential admission prices based on very preliminary speculation. (PBR Hawaii supplied the suggested price range.)

Exhibit 4-J presents results by origin of respondent:



Nearly two-thirds of the respondents would be unwilling to pay the minimum incremental \$5 entry fee posited in the survey question. Only 4% would be willing to pay any more than \$5. Again, Hawaii residents were the most price-resistant, while Asian and European or "other" visitors were relatively most open to fees. However, even among the latter groups, majorities would not pay as much as \$5. People arriving by private car were more price-resistant than people coming by bus, trolley, foot, etc. (Exhibit 4-K below).

**EXHIBIT 4-K:**

**WILLINGNESS TO PAY INCREMENTAL ENTRY/SHUTTLE FEE,  
BY MODE OF TRAVEL TO DIAMOND HEAD**

	Total	Arrived by ...	
		Car	Other
Unwilling to pay even \$5	65%	72%	59%
Willing to pay \$5	28%	23%	33%
Willing to pay more than \$5	4%	1%	5%
Other / No Answer	2%	3%	1%

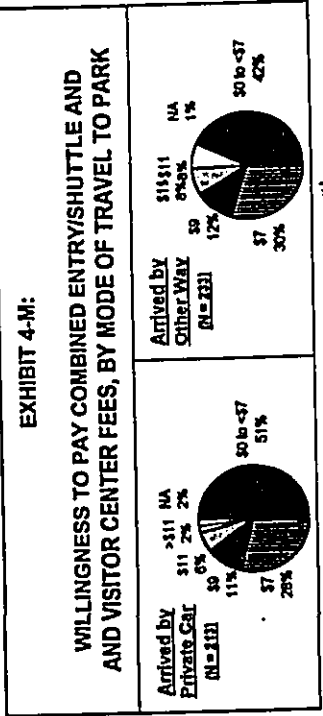
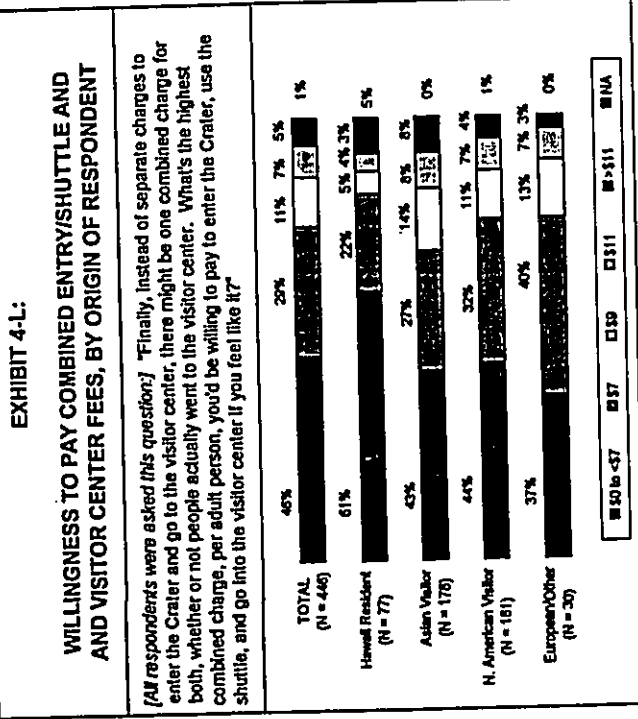
Survey results suggest that the sort of visitor/interpreative center described in the question would be unlikely to generate any substantial level of attendance if a separate entry fee of \$5 or more would be charged.

**Results for Combined Shuttle/Entry and Visitor/Interpreative Center Fee:**  
An alternative to charging a separate entry fee for the visitor/interpreative center would be to charge a higher overall fee for entry into the improved Diamond Head Crater. The higher fee would include money for the visitor/interpreative center, though attendance at the center would be optional.

The lowest figure given in this final question — to cover overall entry, shuttle use, and optional entry to the visitor/interpreative center — was \$7 per adult, with a probable high of \$11 per person. The \$7 figure is a little less than the sum of the lowest figure previously suggested for a separate entry/shuttle fee (\$3) and a separate visitor/interpreative center fee (\$5). The logic of the various people who gave input to the pricing level was that a combined fee should reflect assumed economies of scale in an integrated park operation.

Exhibits 4-L and 4-M (next page) show that respondents were somewhat more willing to pay a combined fee than separate fees for overall entry and entry to the visitor/interpreative center. However, barely half the respondents would pay the minimal suggested \$7 adult fee. Price resistance was again greatest for Hawaii residents and/or people coming by private car, relatively least among Asian and European visitors and/or those coming by bus, trolley, foot, etc.

These survey results suggest that a combined entry/shuttle and visitor/interpreative center fee would be more successful than separate fees but they also indicate that the combined fee would probably have to be somewhat less than \$7, possibly in the \$5 range, to continue to attract significant attendance at an improved Diamond Head Crater.



#### 4.6 Observations by Survey Interviewees

Following the interview process, a number of the interviewees were debriefed and reported incidental comments made by respondents, as well as some of their own impressions. These observations were, of course, subjective in nature, as there was no systematic recording process involved.

- (1) Interviewees felt that respondents gave considered, truthful answers to the questions about willingness to pay. There may have been a little overstatement of willingness to pay, but this effect was felt to be small.
- (2) Hawaii residents often had a strong negative reaction to the idea of entry fees for Diamond Head. Some local people refused to be interviewed, and characterized that refusal as a protest against the idea of fees. They felt their taxes were already subsidizing the park system, and they worried that "Next thing, we'll have to pay to go to the beaches!" However, some residents suggested they would be satisfied with low-cost annual passes.
- (3) Some people (tourists as well as residents) said they were willing to pay fees to assure upkeep and improvements within the Crater, but feared the State would spend the money elsewhere. A few residents complained that part of any fees would be siphoned off to OHA.  
There were also financial objections to the idea of having to pay an entry fee to go into a visitor/interpretive center in order to buy gifts or food. (For these people, gifts and food rather than exhibits would be the main attraction of a visitor/interpretive center.) People said the State should make money from profits on sales, not from an entry fee to the visitor/interpretive center.
- (4) Both residents and visitors expressed a desire for certain types of improvements to the area:
  - Improved number and quality of restrooms (comment made by all types of people, and the principal concern of Japanese visitors).
  - Snack and/or gift facilities, replacing vendors. For some people, the best part of the proposed Master Plan would be the presumed elimination of vendors.
  - Safety improvements in tunnel steps to the rim, narrow tunnels into the Crater, and emergency phones at the summit. The dark steps were seen as an adventure at present, but there was some assumption that lighting would be provided if people were to pay admission fees.
  - A few people wanted ways to get the frail or handicapped up to the summit — perhaps even some sort of gondola system.

## 5.0 REVENUE ANALYSIS: TOUR COMPANY INTERVIEWS

### 5.1 Purpose and Methods

Semi-structured interviews were conducted with 13 representatives of 11 companies (Exhibit 5-A). All interviews were conducted face-to-face, except for one telephone interview. Interviewees gave personal opinions rather than "official" corporate positions. After one initial free-form interview, a semi-structured guide was used; chapter sub-sections reflect questions asked.

EXHIBIT 5-A: LIST OF PERSONS INTERVIEWED FROM TOUR-RELATED COMPANIES	
Name/Title <sup>1</sup>	Organization
<b>TOUR OPERATORS</b>	
Michael A. Carr, President	Polynesian Adventure Tours
Daniel Kao, President	Seahorse Tours, Inc.
Maki Kuroda, Director of Sales & Marketing	E. Noa Corporation
Dean Mori, Vice President, Marketing & Product Development; Roy E. Phund, General Manager; Reggie DeSilva, General Manager	Trans Hawaiian Services, Inc.
Deema Narimatsu, Vice President, Sales	Roberts Hawaii
Michael Walther, President	Oahu Nature Tours
<b>TRAVEL DESKS, TOUR WHOLESALERS, TOUR RETAILERS</b>	
Charli Freeman, Conderge <sup>2</sup>	New Olani Kaimama Beach Hotel
Leona G. Nakashiki, Sr. Director, Sales and Marketing <sup>3</sup>	Pleasant Hawaiian Holidays
Loke Sale, Operations Manager	Outigger Activities Center
Jonahynn Sing, Administrative Assistant	Connoisseur Holidays Unlimited
Ronald K. Takeuchi, President	Aloha V.I.P. Tours, Inc. <sup>4</sup>

<sup>1</sup>NOTE: Persons interviewed expressed personal opinions, not official corporate or organizational policy.

<sup>2</sup> Preliminary interview, conducted prior to standardization of interview questions.

<sup>3</sup> In the course of the interview, limited telephone input was also given by Pleasant Hawaiian travel desk staff at Hawaiian Regent, Waikiki Beachcomber, Outigger, Hilton Hawaiian Village, and Hale Koa hotels.

<sup>4</sup> Though contacted as a ground handler, Aloha VIP also operates tours as well.

All interviews took place during July 1998, concurrently with the Diamond Head user survey data collection and analysis described in the previous chapter. (That survey was not, however, discussed with tourism company interviewees.)

The overall purpose of the interviews was to obtain expert industry opinion on:

- Likely effects of the proposed Diamond Head Master Plan improvements (and concomitant fee increases) on visitor attendance in general; and
- Effects on the group tour segment in particular, including business impacts for companies providing tours to Diamond Head. As noted in the previous chapter, the survey of Diamond Head users conducted for this report excluded people coming in group tours — in part because many of these came for brief sight-seeing only, and in part because people on tours (including those who do hike) pay additional costs, such that the survey questions may not have been quite accurate or appropriate for them.

The companies whose representatives were included in these interviews are of two broad types — (1) tour operators, who actually take people to see the various attractions; and (2) travel desks, tour wholesalers, and tour retailers — organizations which refer tourists to activities and/or make reservations for people to take the tours. Thus, the latter group interacts with visitors who are making decisions about what to see (and, often, how much to pay), while the former group has more sustained contact with visitors during their experiences and possibly may better be able to judge their satisfaction levels.

Among the tour operators contacted, Polynesian Adventures, Roberts, and Trans-Hawaiian are among the largest operators of guided tours using full-sized buses (although they operate smaller vehicles as well). A number of these bus tours include Diamond Head as an initial stop — not for hiking, but for sight-seeing only (sometimes going into the Crater but sometimes only from the lookout at the current entrance). Seahorse Tours and Oahu Nature Tours are smaller companies, but they are among the very few which feature Diamond Head hiking tours as specialties. (Seahorse provides transportation and equipment<sup>1</sup> only; Oahu Nature Tours also provides a guide.) E Noa is in something of a separate category — it operates small-group tours, several of which could include Diamond Head stops at the discretion of the driver, and it also charters trolleys to the Japan Travel Bureau, which allows Japanese visitors to stop in the Crater to hike, if they wish, and then catch a later trolley.

<sup>1</sup>Flashlight and bottled waters, as well as certificates at end attesting that the person actually hiked Diamond Head. The Kaimana provides similar services, as does Oahu Nature Tours. The certificates are said to be valued by those who complete the hike.

For the organizations in the lower part of Exhibit 5-A, the New Olani Kaimana Beach Hotel is close to Diamond Head and has encouraged patrons to go there independently, though the General Manager also sometimes personally escorts groups of hikers there. The Outrigger Activities Center supervises travel desks throughout the Outrigger chain of hotels. Pleasant Hawaiian Holidays is one of the state's largest tour wholesalers, and also has travel desks in various hotels. Aloha VIP is one of the state's largest ground handlers, briefing groups which have been sold by other tour wholesalers, and operating travel desks in hotels throughout Waikiki. (Aloha VIP also operates some tours, including one which stops at Diamond Head just for picture-taking, and hence could have been placed in the upper part of Exhibit 5-A as well.) Connoisseur Holidays is a tour wholesaler with various travel desks catering largely to a European or other "non-Asian international" clientele. Thus, (with the exception of the Kaimana condierge) people in this group sell the Diamond Head hiking or sight-seeing tours actually conducted by the previous group of tour operators, and receive commissions on the sales — though their travel desks may also simply answer questions and possibly recommend Diamond Head as an individual activity which people may access on foot, via City bus, etc.

## 5.2 Importance of Diamond Head to Businesses at This Time

**Tour Operators:** The large tour operators consider Diamond Head to be a minor, incidental aspect of their businesses. The smaller operators were, of course, chosen because they feature Diamond Head tours; they consider Diamond Head to be quite important to their businesses, though it does not represent the majority of their revenues because they have other tours as well.

**Travel Desks, Tour Retailers, Tour Wholesalers:** The New Olani Kaimana Beach Hotel has heavily promoted Diamond Head, and considers the nearby landmark to be "critical" to its business. However, others interviewed for this report did not feel it was particularly important from a business perspective. Several said their travel desks tended to recommend that people go on individual basis or take one of the few available hiking tours if they were interested. Most were unimpressed themselves with Diamond Head's interior, but acknowledged a certain level of interest among tourists. Sample comments:

- "Tourists always think it's a mystery. They want to know what's in there. But they're often disappointed when they find out."
- "It's a request at our desks, but not a real popular one. People just want to know if it's on their tour, or how to catch a City bus there."

- "We tell people to take a few hours for Diamond Head if they want a nice simple starter hike. We warn them about the vendors and the dry landscape, but they like the view and the panorama from the top."

#### 5.3 Trends in Tourist Demand for Diamond Head Crater Experience

All interviewees were asked if they thought the level of tourist interest in the Diamond Head Crater had been increasing or just holding steady in recent years. Three people thought there had been little or no change, but the rest thought there had been some degree of increased interest. Most thought the recent increase has been small to moderate, though one person said it has been dramatic from a long-term perspective (i.e., over the past 15 to 20 years).

To the extent that there has been an increase, it was thought to be:

- Primarily among people going there on an individual basis, rather than large group tours (on the other hand, both of the smaller operators have started their Diamond Head tours only in the last year); and
- More evident among Japanese than among westbound tourists. Several people thought that climbing Diamond Head has become a "vogue" among Japanese tourists, particularly since more Japanese are traveling on an independent rather than group basis now.

Several people mentioned the role of the New Olani Kaimana Beach Hotel in promoting Diamond Head, especially among Japanese. Other factors mentioned were (1) Diamond Head's prominence and its proximity to Waikiki; (2) the growing interest in "eco-tour" activities in general; and (3) the fact that it is currently a free experience.

There was general agreement that Diamond Head's main attraction — at least for those who go there on an individual basis, as opposed to those who simply sight-see or take pictures from buses — was the panoramic view from the top. It is a hiking experience, but not a particularly rugged one, with spectacular scenery as the pay-off.

#### 5.4 Expected Impact of Small Entry Fees for Diamond Head in Late 1998

**Effect on Large Sight-Seeing Tours:** The consensus — of both large tour operators and travel desks or tour wholesalers — was that any commercial vehicle fees would result in large tour operators simply eliminating the Crater as a stop on these tours. (One tour operator, however, thought a small vehicle fee of \$15 to \$20 for large buses might be absorbed.)

Almost all interviewees emphasized the extreme cost-consciousness of Oahu's westbound tourists and the growing price sensitivity of Japanese tourists as the yen weakens against the dollar. Sample comments:

- "We'll stop going there, just as we did at Hanauma when they wanted a fee for a five-minute stop. People coming to Oahu now are very price-conscious. We've become the bargain basement for the Hawaii experience. Tourists may pay a little more for new attractions on Maui, but not here. In this market, I can't afford to add five cents to our tours."
- "I think our JTB Charter will still go, but only if they can pass it on. That's a little more questionable now than it used to be. But it will probably have much more effect on westbound travelers, who are very cost-conscious!"
- "My understanding is that fees would be just for hikers. If there are commercial vehicle fees, we're gone — unless there's enough of a market demand that we can pass fees along, and that would surprise me very much."
- "Why pay to go in when you can just stop at the lookout outside Diamond Head, and see the view from there?"

**NOTE:** Oahu membership surveys taken by the Hawaii Attractions Association tend to confirm allegations of increasing price sensitivity and reluctance to pay substantial admission fees. Revenues in April and May of 1998 were down about 7% from the previous year, and higher-priced attractions were most affected as the dwindling numbers of Japanese tourists bargained for the lowest available prices (Hawaii Attractions Association, 1998; Lynch, 1998).

HVCB Expenditure Survey data indicate statewide Japanese expenditures in 1997 fell 2.5% from the previous year, following an even steeper 19% drop the year before (Hawaii Visitors and Convention Bureau, 1997b). However, the HVCB publishes Oahu vs. Neighbor Island figures only every four years, and the last available data are from 1990 and 1994. As shown in Exhibit 5-B, the amounts which both U.S. and Japanese visitors spent for attractions — e.g., money spent "at the door" for some place like Sea Life Park or Diamond Head, had fees been in place then — did decline precipitously on Oahu as well as the Neighbor Islands from 1990 to 1994, for both U.S. and Japanese visitors. For sight-seeing tours, which would include the same attractions if seen on a tour, the trend was much more mixed for Oahu, while it was significantly upward on the Neighbor Islands. This also indicates problems for attraction fee levels, and it does provide some validation for the perception that tour companies could more easily pass on costs to Neighbor Island customers than Oahu customers.

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**EXHIBIT 6-B**  
**AVERAGE DAILY EXPENDITURES FOR VISITORS TO OAHU**  
**VS. NEIGHBOR ISLANDS: 1990, 1994**

	1990 RESULTS		1994 RESULTS	
	Oahu 1990	Neighbor Islands <sup>1</sup> 1978	Oahu 1994	Neighbor Islands <sup>1</sup> 1978
Day Survey Sample Size:	120	1078	381	3173
Overall Avg. Daily Expenditure:	\$ 120.00	\$ 163.02	\$ 120.52	\$ 148.25
Specific Expenditure Types Relevant to Diamond Head (Avo. Daily Figures)				
"Attractions"	\$ 5.48	\$ 6.86	\$ 2.62	\$ 2.39
"Sight-Seeing Tours"	\$ 3.38	\$ 1.80	\$ 3.15	\$ 3.49
Overall Avg. Daily Expenditure:	\$ 296.76	\$ 240.91	\$ 342.27	\$ 318.02
Specific Expenditure Types Relevant to Diamond Head (Avo. Daily Figures)				
"Attractions"	\$ 8.95	\$ 11.50	\$ 5.05	\$ 5.17
"Sight-Seeing Tours"	\$ 5.05	\$ 4.80	\$ 5.78	\$ 10.90

**PERCENTAGE CHANGE, 1990 - 1994, UNADJUSTED FOR EFFECTS OF INFLATION**

	Oahu	Neighbor Islands <sup>1</sup>
Overall Avg. Daily Expenditure:	0.4%	-10.3%
Specific Expenditure Types Relevant to Diamond Head (Avo. Daily Figures)		
"Attractions"	-52.2%	-65.2%
"Sight-Seeing Tours"	-6.6%	93.6%

<sup>1</sup> In both years, sample sizes for Japanese visitors to Neighbor Islands are small; hence, these figures should be treated with caution.  
 Source: Hawaii Visitors Bureau, 1990, 1994.

**Effect on Independent Visitors and Small Hiking Tours:** By contrast, there was much less concern about the effects of small individual entry fees on attendance by tourists going to Diamond Head on an independent basis or with small hiking tours.

There was a sense that tourists would not like it very much, but they would accept a minimal fee, particularly if it could be demonstrated that it was both needed and would be used for maintenance and upkeep of the trails and park. (One hotel travel desk even said a few tourists had wanted such a fee to prevent further trail deterioration.) However, there was also some uncertainty as to how fees would affect the small hiking tours' economic viability for their tours:

- "We'll have to recalculate everything. The Japanese are now getting very tight on their expenditures. People are happy with the experience now. Fees could change that."
- "If it's just \$1 or \$2, I think it would have little effect [on people going independently]. But at \$5 or more, I think you'd see a 40% drop-off."
- "People would pay \$1. Everybody understands the need for upkeep and maintenance. But if it's \$2 or more, I'm not sure our westbound people would pay that — you could lose at least 50% of them."
- "A dollar's fine, but I'd guess you'd see a 30% decline if you went to \$3."

**5.5 Expected Impacts of Long-Term Improvements, Higher Fees**

At this point, interviewees were shown one of the conceptual plans for Diamond Head Improvements under the proposed revised Master Plan. It was emphasized that full implementation could take five to ten years, but that key elements would include a shuttle bus system from an outside parking lot, a major visitor/interpretive center, removal of existing large structures (as under the current Master Plan), improvements to the Crater interior (reforestation, etc.), and possible use of tunnels now closed to the public.

Interviewees were also told that fees would have to be increased to pay for the improvements — both vehicle parking fees and entry fees. They were told that, while it is too early to be certain of the level, entry fees might be in the range of \$6 to \$12 per adult, including the visitor/interpretive center admission.

**Expected Appeal for Organized Group Tours:** Interviewees generally liked the idea that "Diamond Head will be fixed up," but the majority view was that the project would have little appeal for the organized group tours. Concerns included:

- **Time:** "This [outside parking with shuttle] eliminates our ability to make it a quick stop. Time is everything on a circle-island tour."



— Logistics: If shuttle trams are smaller than tour vehicles, the arriving party would have to be broken up. One guide could not stay with the entire group. People might get separated or left behind.

— Japanese Language: Logistics problems might be compounded for Japanese tour groups, because of Hawaii's traditional reluctance to put Japanese-language signage in public places. Unless a Japanese-speaking tour guide is provided or can accompany each group, there is increased likelihood of visitors becoming confused, separated, etc.

— Liability: Major tour companies already shy away from organizing or even recommending use of the Crater (other than sight-seeing or picture-taking) because of liability concerns. If improvements entice visitors to climb up to the rim more easily, but if lighting and other safety improvements are not made at the same time, the companies will become even more nervous about accidents and their liability for damages.

— Doubts About Value of Shuttle for Hiking Tours: "Hikers want to hike; they don't want to pay to ride a tram." "What's neat about Diamond Head is the view and the hike. I'm not sure about the shuttle. Remember, this is hiking; it's supposed to have dirt and dust and rocks!"

— Cost: Perhaps the single most consistent refrain in these interviews was the idea that "willingness to pay depends on the value of the experience." There were a few interviewees who thought that value *might* be delivered from an excellent interpretive center (see next sub-section), but most felt that the overall plan would not justify the probable fee range for the average visitor. Some of this had to do with the economics of the group tour business in particular, and some of it was a generalized feeling that would also apply to individual visitors. Sample comments:

- "It sounds great, but it would be hard to sell at \$6. After mark-ups and other costs, it would really go for \$20 to \$30 — way too much. I just talked to a couple of travel agents [during an hour between telephone conversations], and they did not like it; would not recommend it."
- "It's going to be hard to package or sell this through the usual outlets. The cost is large for an FIT, but still low for an attraction, so the commission — which is usually 20% to 40% — would still be very low."
- "Why should I promote a \$12 ticket for a dead volcano when I can promote an all-day tour to Hilo? And why should I pay a parking fee when I can just drop them off and park down the road?"

- "In the present environment, we could not sell this. If something costs \$5, really it's \$8 because of commissions."

• "Unless we somehow reposition Oahu toward the high end in all of our marketing, improvements such as this just will not sell."

• "Maybe you could generate more demand for small hiking tours if it [the Crater] gets nicer. But you need a nonprofit 'Friends of Diamond Head' to coordinate all this, make sure the fees get used for actual improvements on site, and explain the reasons for admission fees to visitors. If it's too expensive or too easy, people will bypass it."

Expected Appeal for Independent Visitors: Interviewees were then asked if they thought the improved Diamond Head Crater would have substantially more appeal for independent visitors — i.e., if some of the "lost" group tour business would be made up by more people going by bus, on foot, in private cars, etc.

There was one strong "Yes," and a few decided "No's," but the majority response was along the lines of: "I don't know — again, it depends on the value for the cost. But I tend to doubt it." Sample comments:

- "Yes, this will have lots of advantages in attracting FIT's. People can access Diamond Head in lots of ways. That's why [former Kaimana general manager] Steve Boyle got into promoting it."
- "No, not at those fees. Westbound people are already grumbling about costs in Hawaii."
- "Yes, some would switch from group tours to going to Diamond Head on an FIT basis. But just some of them; I don't think it would be a lot."
- "Because it's so close to Waikiki, it certainly makes more sense for people to go there on their own than with a tour. And I think a small user fee would be reasonable and acceptable. But a whole new park? I have my doubts."
- "The FIT response depends on value for the money. Some international visitors are used to admission fees, but people from the Mainland just aren't used to paying for everything."
- "We'd probably bypass Diamond Head on the tours we assemble and just recommend people do it on an FIT basis. But I'm not sure we'd make any real effort to promote it. Seems it would only work if someone were really promoting it. Who would do that, and why?"

### 5.6 Value of Visitor/Interpretive Center for Attracting Tourists

If interviewees had not already mentioned the visitor/interpretive center in responding to the previous question, they were specifically probed on the issue. If they were initially negative or uncertain, they were asked if they could imagine some sort of facility which would make a strong positive contribution.

The majority of interviewees were doubtful about the visitor/interpretive center, even after probing. Sample comments:

- "From an ecological perspective, as an educator myself, I love the idea. But I doubt there's a market for it. You'd be doing this because you think people *should* want it, not because they do want it."
- "I can't imagine an interpretive center tremendous enough to justify the [overall Diamond Head] entry fees you've mentioned. Maybe if it were turned over to Disneyland-type people to do something really creative, make Diamond Head a destination that goes beyond just its natural and historical features."
- "I can't think of any visitor center that successfully charges that sort of fee, or is worth it."
- "No, I can't imagine putting anything in there to justify that sort of space [40,000 square feet] or fee. But you could probably sell lots of knickknacks! T-shirts would sell better than exhibits. You know, we take surveys of our customers. They always tell us they want more Hawaiian culture and history. But when we put together historical and cultural tours, they just don't sell."

However, a minority of interviewees felt that a state-of-the-art visitor center might be the key to making an improved Diamond Head a successful visitor destination:

- "The visitor center is going to have to be *really* good, so it's clear that people are paying for something more than just the view. If you can deliver on that, then maybe charge a high overall entry fee, \$10 or so, and give them the sense of a super-attraction!"
- "The view alone is not enough for the State to have a real success there. For us to really market and promote it, the interpretive center has to be really good. You need more than geological exhibits. You need some cultural things tied in, too — not necessarily performance, but a 'mini-cultural center' showing our Polynesian roots. Make sure there are cultural or historical aspects that appeal to kamaainas, too."

### 5.7 Assessment of Potential Shuttle Concession

Most interviewees with vehicle operations were asked if they thought there would be interest in any shuttle concession among companies such as their own. The unanimous response was that, in the current economic environment, there would be definite interest and fierce competition. At the same time, there was a sense that this would be a risky contract which would be studied very carefully. Several people stressed that they would be interested only if they were paid a fixed price for operations, independent of actual ridership.

Asked what they thought the market would bear for a shuttle fee independent of other Diamond Head fees, most people thought it would be in the range of \$1 to \$2 (1998 dollars), with \$2 representing the very top limit.

### 5.8 Effect of Potential City "Ka Iwi" Improvements on Diamond Head

Interviewees were reminded that the City and County of Honolulu has announced plans to implement a new "Ka Iwi Park" system featuring an expanded Hanauma Bay Interpretive center, moving all parking out of Hanauma to the old Job Corps site; resurfacing lower Hanauma use to guided tours; possibly restoring the old cable car to the top of Koko Crater; and integrating expanded botanical gardens within the crater into the complex.

They were asked if they thought such a City complex would compete with an improved Diamond Head in the visitor's mind, or if there would be synergy between the two sites — i.e., if tour companies might package them together. There was no clear consensus in answers to this question, as indicated by the following range of responses:

- "It depends on the fees. Diamond Head is much more accessible. If you keep the cost minimal there, tourists would have *much* more interest in it than in Koko Crater!"
- "Hanauma's beach activity is much more of a draw than Diamond Head. If you threw in Koko Crater improvements, it would have much more value from the tour perspective. Ka Iwi would leave Diamond Head in the dust!"
- "Hanauma and Diamond Head would fit together well; they'd make a new tour. I have mixed feelings about the Ka Iwi proposal; it sounds too much like a Disneyland. But at least it's something new."
- "We wouldn't try to package or serve either of them."

### 5.9 Overall Recommendations

As a final broad summary question, interviewees were asked: "Assuming the goal for Diamond Head is a balanced attraction for both residents and visitors, generating enough revenues to pay for expanded activities, do you have any words of advice about how to achieve this goal?"

Almost everyone answered in ways that included two or more of the following inter-related elements —

— **Clarify Objectives:** Distinguish among and articulate whether the improvements are being carried out to preserve environmental resources, generate revenues, educate visitors and residents, maintain/improve existing facilities, or create a major new visitor attraction. If more than one, clearly prioritize to identify the most important.

— **Make Modest, Nature-Oriented Improvements:** Although a few people felt that something with (in one person's words) "a whole lot of pizzazz" would be needed to justify significant entry fees, in the final analysis virtually everyone recommended capitalizing on the Crater's basic natural attributes (a hike up to a scenic view) and resisting "glitzy" improvements.

— **Keep Entry Fees Low as Possible:** The central concept was to define limited objectives, calculate actual costs, and work backward to arrive at fee levels needed to meet only these objectives and nothing more. Implicit (and sometimes explicit) in this idea was the further concept that the logic of the fees could and should then be communicated to people who would be asked to pay the fees.

Sample comments included:

- "The main recommendation — minimize fees! It's just a crater and a hike. Fix it up, but don't do anything too ambitious. The plan sounds good, but not at those [admission] costs."
- "Be clear on the goals. Are we just focusing on what's in the Crater, or are we developing new uses, too? Keep the fees reasonable. Work backward from the actual costs to determine the fees. Make sure the money goes in good part for protection and preservation, especially of the endangered plant species. Definitely proceed on the reforestation, but it doesn't have to be large-scale if that adds lots to the cost."
- "Keep it low-cost. You have to know your actual dollar needs, and just meet those. Keep the fees reasonable."

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▪ "Be clear about what the problem is. If there are serious environmental problems, I couldn't tell you what the solution is. But if it's simply congestion, then you can resolve it with internal changes, like a bigger parking lot. It's better just to take care of what you've got than try to make something different out of it."

▪ "So many times, if we leave well-enough alone we're better off. Don't try to squeeze the tourists. All people want is a good view. They'll pay a small, reasonable view for that."

▪ "Choose what you want to make better — the trail? or beautifying the whole Crater? If the trail, a minimal fee (50 cents, a buck) would be quite acceptable for a leisurely walk to a panoramic view. If the State wants to develop a real new destination for visitors, that's a whole other issue. But it seems like a very expensive gamble."

▪ "Work backward from real costs for improvements and upkeep to get a realistic fee you can explain to people. Then and only then will people accept it. Consider xeriscaped botanical gardens — something attractive that is also natural for that environment."

▪ "Keep fees to \$5 or less. Don't go for the 'spectacular' — keep it natural. Mostly, just clean it up and make it safer. Tourists want safety. Light the tunnels. Maybe have a few buses, but not enough to destroy the natural feeling. Have concession stands, not exhibits."

**Other Recommendations:** A few pieces of "advice" fell outside the overall scope cited above —

- "Guided tours or docents might justify admission fees more than exhibits." (This was stated as a positive recommendation by one person, but as a fear or concern by one of the companies which provided such services to tourists as a business.)
- "If you want something significant, you have to generate more market demand than exists now. You'd have to figure out a way to promote it. The only way I can think of to do that is to give one [tour] company an exclusive marketing contract, in order to motivate it."
- "The State should pull in people from the industry to an advisory committee. Let us put our heads together, tell you what we think would work. But do something! It's deteriorating."

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#### 5.10 Additional Miscellaneous Comments

In the course of the interviews, several other themes or comments were repeated by more than one person, although at different points in the interview, not necessarily in the course of answering the same questions.

**"Commercialism" and Local Resident Response:** In line with the comments about growing price sensitivity among Oahu tourists, many of the interviewees said they as residents perceived an increase in "commercialism" of public venues on Oahu (e.g., Hanauma Bay, the zoo, even the Kodak hula show). The same words uttered by some of the survey respondents — "Next thing, we'll have to pay to go to the beaches!" — were also spoken by several tourism company interviewees. Others just muttered, "Seems they're charging for everything now!" And some people predicted that opposition to the proposed Diamond Head improvements (with fees) would be greater among residents than visitors.

At the same time, several people predicted that a Diamond Head fee structure which featured free or discounted "kamaaina" admission would be deeply resented by tourists, especially price-conscious westbound visitors.<sup>2</sup>

**Appropriateness of Government Role in Operating "Visitor Attractions:"** Several of the interviewees pointed out that the prospective State plans for Diamond Head would make it a de facto operator of a visitor attraction (especially if revenues were to come disproportionately from tourists). While people felt — with varying degrees of reluctance — that there is some clear environmental reason to limit access to Hanauma Bay via fees and other regulations, some interviewees also expressed less restrained resentment toward the City for soliciting tourist business on the City Bus (i.e., special bus passes) and for planning a "Ka Iwi" park complex which seems likely to be primarily a revenue-generating visitor attraction. For these people, the proposed Diamond Head venture suggested the State may also blur a line between private- and public-sector functions.

**Phasing of Any Diamond Head Fee Increases:** Several people volunteered the opinion that increases in Diamond Head fees (after initial implementation later this year) should occur gradually, in concert with phasing of improvements. That way, they said, serious market resistance could be detected at some point in time, and further projects and fee increases might be reconsidered.<sup>3</sup>

<sup>2</sup>This is subject to disagreement. Another interviewee thought few tourists are really concerned, and that other tour companies were "whipping up the sense of discrimination."

<sup>3</sup>Again, another interviewee (the same dissenter as in the above footnote) had an opposite opinion: The final Master Plan should be implemented at one time, even though this would likely mean closing the Crater during construction, and the new completed attraction should be opened at once, along the new higher total fee, to avoid any sense of constant ongoing fee increases.

**Hanauma Bay vs. Diamond Head:** At various points in the discussion, many of the interviewees found occasion to mention what they believed were important distinctions between Hanauma Bay and Diamond Head as visitor attractions which could generate revenue for local government:

- At present, a number of people said, Hanauma Bay has much greater touristic appeal than the Diamond Head Crater, if simply because its ocean nature is more of a "draw" than Diamond Head's geological or hiking nature. Greater market demand for Hanauma implies more acceptance of fees (or higher fees) there than at Diamond Head.
- Additionally, Hanauma still has a greater word-of-mouth reputation than does Diamond Head (or, at any rate, than does Diamond Head Crater, since the exterior of Diamond Head is unquestionably recognized internationally). The Crater is growing in popularity, but is still far short of Hanauma's "must-see" status, various people said.
- While one of the Crater's strengths as a tourist attraction is its proximity to Waikiki, a few suggested, this can also be a disadvantage relative to Hanauma. In the past (and, to some extent, still at present), tour companies have had more motivation to promote Hanauma, which they do not have with the Diamond Head Crater.
- When fees were implemented at Hanauma Bay, there was no easily accessible free substitute for this beach and marine preserve experience. But there is a relatively easily accessible free substitute for the Diamond Head Crater, which also features panoramic views of Honolulu — Punchbowl Crater, also imbued with history.
- At Hanauma, there was a clear environmental threat to the reef, and that threat helped generate substantial political support for regulations, including fees. The situation at Diamond Head is not so clear-cut or well-known.

**And On the Other Hand ...** Although it was in no way part of the consensus of interviewees, at least one person gave passing mention to the fact that much of the current "conventional wisdom" reflects an economic context which could change in ten years: "A decade ago, we all thought tourism would never stop expanding. Now we all think it's never going to grow again." The current anxiety over fees and cost-consciousness could be very time-bounded.

Furthermore, one said, "I do think you should ask yourselves if what you'll do at Diamond Head will really be worth the charge to most people. On the other hand, tour companies all follow suit — what one does, the others will do. Hanauma wasn't popular for a long time, until tour companies made it so. The trick will be in figuring out how you can get a few really wanting to go there."

## 6.0 REVENUE ANALYSIS: CALCULATIONS

The purpose of this chapter is to provide a preliminary estimate of actual revenues to the State of Hawaii, as compared to potential costs. It should be emphasized that this is a *rough* and *preliminary* analysis of one concept (PBR Hawaii's alternative "Concept 1"), which involves ultimate implementation of a plan involving previously mentioned components — e.g., outside parking with a people mover system, a visitor/interpretive center of about 25,000 square feet, reforestation, and an entry fee system intended to cover most or all of the costs.

This plan would take some years to develop. During that time, market conditions can change, and specific components of the plan (e.g., the visitor/interpretive system) may take on greater definition. As this occurs, it would make sense to revisit and update this analysis.

### 6.1 Critical Conceptual Assumptions

The outcome of any cost-revenue analysis is a product of the assumptions on which it is based. All assumptions are specified in the exhibits to be presented in the chapter. Some of them are highly critical in a strictly mathematical sense. For example, an increase of several percentage points in any State bonds sold to underwrite construction would have a substantial effect on overall cost.

However, it is important here to emphasize certain *conceptual* assumptions underlying the logic of the analysis:

- (1) Large tour groups now coming to Diamond Head only for sightseeing (and remaining there for just a few minutes) would not be part of the market base for this project — they would no longer come into the Crater.

The reasons for this were set forth in the previous chapter. They involve both the economics and the logistics of multiple-destination sightseeing tours.

This means that the 1998 potential initial base of "Diamond Head users" who might be paying customers would be restricted to the 690,000 figure extrapolated from the May (SMS, 1998) visitor and traffic count. Since even that figure includes some people there for sightseeing only, the real 1998 base would probably be closer to the 600,000 figure resulting from the analysis that was conducted in Section 4.2.3 (Exhibit 4-B). However, the Crater project will not be implemented for five to ten years, so some growth in the overall visitor count should be assumed. The 690,000 figure allows for such growth.

We should note that there is some uncertainty over the number of people coming to Diamond Head for sightseeing only — i.e., the number of people being "assumed away" for this analysis. But the exact number is not actually important. The updated Diamond Head plan is not only targeted for, but effectively restricts access to, people who are coming into the Crater for more than just a brief sightseeing and restroom stop. The plan services people who want to take the time to hike to the Crater rim, go out to the Tunnel 407 lookout, and/or learn about Diamond Head in the new visitor/interpretive center. This is simply not possible in a 5- to 15-minute bus stop, even if these tourists were somehow willing to pay the future entry fees. So it matters little for purposes of this analysis whether the large-group sightseers currently number 100,000 or 1,000,000. The key 1998 base number is the estimated 690,000 actual users.

- (2) The implementation of entry fees would deter some current Diamond Head users from going into the Crater (and/or into the visitor/interpretive center).

Sometimes people have looked at the number of tourists and residents hiking the Crater, and they have imagined, "What if we could get X dollars from each one?" However, it is a fundamental economic principle that not everyone is willing to pay X dollars for a particular good or service. The higher the cost of X, the more people are deterred from buying it.

The survey conducted for this study (Chapter 4) shows that this is so, and gives us a basis for estimating the percentages of people who would be deterred at certain price points. The survey also indicates that residents would be more deterred than tourists, and so their reactions should be separately studied.

Thus, the 690,000 potential customer base is an initial starting point — it will shrink when fees are imposed. And the numbers going into the visitor/interpretive center will be even less than the numbers paying fees to enter the Crater (partly due to interest factors, and partly due to the possibility of an additional entry fee for that facility).

- (3) The economics of the visitor/interpretive center will be based on existing Hawaii models (particularly those at Hawaii's National Parks).

We will assume that the center is essentially a State operation, but with a nonprofit "Friends of Diamond Head" group running a giftshop and a food and beverage operation as a separate concession. We will further assume that the State moves in the direction of the National Parks' relationship with their nonprofit "cooperating associations" by harvesting some of the store's profits — although we will assume only 50% of net revenues are given to the State, rather than 100% as with the National Park groups, because it will take time to convert to a new system and it may not be possible to fully replicate the national model.

(Note: In Chapter 3, we stressed that mark-up on store sales comprise a substantial part of the revenues for nonprofits which run them. But in this analysis, we look at revenues from the overall State perspective (money which will go to the State), not the perspective of the nonprofits. Therefore, this revenue stream will produce a smaller percentage of the State's total than might seem indicated by those previous comments.)

In fact, the visitor/interpretive center might operate in a very different fashion — different from anything now operating in Hawaii in association with local government. It might incorporate all elements, including food and beverage, as a single concession. It might even be integrated with overall Crater park operations (including trail maintenance, people movers, etc.) as one comprehensive concession operation. Some of the State's other consultants are exploring these options and are considering innovative approaches to operating the center, and these approaches do not match existing Hawaii models.

However, based on the resources and "comparables" available for this study, it is difficult accurately to estimate the economics of such approaches. For example, we are unsure how or if a State property could be marketed and promoted in the manner of a privately-operated visitor attraction — especially given the logistical difficulties imposed on tour groups by the proposed plan (e.g., parking restrictions), and the probability that marketing would have to focus on FIT's — and we are uncertain how any such marketing would impact the "willingness to pay" which was measured by our survey. Therefore, we take the conservative approach of basing our analysis on data and models which are actually available to us here. If organizations proposing a very different approach can provide alternative analyses based on experiences elsewhere, then any such analyses should be given careful consideration. In the meantime, this analysis must be based on present experience in Hawaii.

## 6.2 Cost Factors

Exhibit 6-A on the following page indicates assumptions (primarily provided by PBR Hawaii and its subcontractors) and totals for cost factors:

- Construction costs totaling about \$25 million;
- Annual operating and amortization costs of about \$2.3 million — which becomes the estimated "break-even" point for operations.

These cost estimates do not include inventory, salaries, or other costs for the assumed nonprofit organization running the giftshop or associated parts of the visitor/interpretive center. Based on the models described in Chapter 3, this operation is assumed to be self-sustaining, though it may take the efforts of volunteers to make it so.

## EXHIBIT 6-A: ASSUMED COSTS (1988 DOLLARS) FOR FUTURE PARK OPERATIONS

(Based on Alternative Concept 1)

(Unless otherwise indicated, cost assumptions from PBR Hawaii and subcontractors)

**Amortization Assumptions:**

Years:	20			
Rate:	5%			

	Total Construction Cost	Annual Payments/ Cost	% of Annual Total
<b>Components Other Than Interpretive Center</b>			
Landscape	\$8,310,727	\$508,400	22%
Parking at Cannon Club	\$1,100,000	\$88,300	4%
Infrastructure	\$1,948,080	\$156,300	7%
Electrical/Telephone/CATV	\$537,266	\$46,200	2%
Operating Costs (Personnel, Expenses, Equipment) <sup>1</sup>	\$9,896,073	\$300,000	13%
Subtotals:		\$1,097,200	48%
<b>Interpretive Center<sup>2</sup></b>			
Site Improvements	\$737,710	\$59,200	3%
Facility Construction <sup>3</sup>	\$8,250,000	\$501,500	22%
Furnishings, Fixtures, Equipment, Exhibits <sup>3</sup>	\$8,250,000	\$501,500	22%
Design Fees <sup>4</sup>	\$1,500,000	\$120,400	5%
State Personnel <sup>5</sup>		\$30,000	1%
Subtotals:	\$14,737,710	\$1,212,600	52%
<b>TOTAL</b>	<b>\$24,633,783</b>	<b>\$2,309,800</b>	<b>100%</b>

<sup>1</sup> Source: Diamond Head State Monument Implementation Notebook (Hawaii State DLNR, 1987)

<sup>2</sup> For purposes of this analysis, it will be assumed that food & beverage operations within the interpretive center will be run as a concession; hence, no annual cost to State. Similarly, it will be assumed that center's giftshop will be operated by a nonprofit group funneling a percentage of profits back to State; hence, again, no annual cost to State.

<sup>3</sup> Both estimated at \$250/square foot times 25,000 square feet.

<sup>4</sup> At 12% of construction costs.

<sup>5</sup> Only positions on State payroll. One additional position assumed.



### 6.3.2 Results of Analysis

Exhibit 6-C on the following page shows the results for the primary analysis (based on the assumptions in Exhibit 6-B), while Exhibit 6-D on the page after that shows the results of the sensitivity analysis which examined the effects of differing assumptions about deterrence due to price. This analysis could reasonably be taken to reflect possible marketing and promotion effects.

**Separate Entry-Fee Scenario:** The analysis suggests annual revenues in the range of \$2.5 million. However, assuming 20% of net revenues are transferred to the Office of Hawaiian Affairs (OHA), the portion left for the State is a little under \$2 million — somewhat under the projected "break-even" point of \$2.3 million. (Given the rough and preliminary nature of these numbers, the best interpretation of these numbers would be "close to break-even, but a little on the negative side of that mark.")

A little over half the total revenues would come from components not associated with the visitor/interpretive center (mostly from the overall Crater entry fee). These revenues (about \$1.4 million, minus 20%, equals \$1.1 million) would be roughly adequate to pay off the annual costs associated with development of components other than the center (about \$1.1 million — see Exhibit 6-A). The modest loss projected for the visitor/interpretive center under this scenario is thus responsible for the overall shortfall.

For this scenario, Exhibit 6-C also projects an overall Crater attendance of a little over half a million people a year, with about 180,000 of them going into the visitor/interpretive center.

**Combined Entry-Fee Scenario:** This scenario assumes a higher overall Crater entry fee and no separate fee for the visitor/interpretive center. It is therefore projected to result in a much smaller overall Crater attendance (only about 200,000 people per year) and a slightly smaller visitor/interpretive center attendance (around 144,000 people per year).

This scenario results in significantly less revenue for the State — just about \$1.5 million per year, after the 20% for OHA is taken out. Consistent with the attendance figures, the reduction is primarily due to even lower projected revenues for the visitor/interpretive center under this scenario than under the first one.

It thus appears that the "Separate Entry Fee Scenario" — charging a separate admission fee for the visitor/interpretive center — would be financially preferable to the "Combined Entry Fee Scenario." Given the assumptions in Exhibit 6-B, that would be the correct conclusion. However, that is why we have also carried out the sensitivity analysis in Exhibit 6-D.

EXHIBIT 6-C: ESTIMATED ANNUAL REVENUES (1998 DOLLARS)				
Overall Crater Entry Fees/Shuttle Revenues	I. Separate Entry Fee Scenario		II. Combined Entry Fee Scenario	
	Crater Attendance	Revenue by Segment Total	Crater Attendance	Revenue by Segment Total
Total Crater Attendance:				
Tourist Adult	387,100	\$1,181,300	154,800	\$1,093,600
Tourist Child	52,800	\$52,800	21,100	\$84,400
Resident Adult	59,000	\$0	23,600	\$70,600
Resident Child	18,600	\$0	7,500	\$7,500
Crater Entry Fee Subtotal		\$1,214,100		\$1,246,300
Parking Fee Revenue		\$119,000		\$47,000
Shuttle Concession Rent		\$84,500		\$25,000
<b>SUBTOTAL REVENUES OTHER THAN INTERPRETIVE CENTER</b>		<b>\$1,397,600</b>		<b>\$1,318,700</b>
Interpretive Center Attendance and Entry Fees				
Attendance Subtotal	182,200		144,300	
Tourist Adult	143,200	\$716,000	110,100	\$422,600
Tourist Child	19,500	\$58,500	15,800	\$32,900
Resident Adult	14,800	\$59,200	9,400	\$14,700
Resident Child	4,700	\$9,400	3,000	\$1,600
Center Entry Fee Subtotal		\$843,100		\$ 471,800
Gift Shop Profits <sup>1</sup>		\$51,000		\$40,400
Food Concession Rent		\$178,300		\$71,300
<b>SUBTOTAL REVENUES ASSOCIATED WITH INTERPRETIVE CENTER<sup>2</sup></b>		<b>\$1,072,600</b>		<b>\$583,900</b>
<b>TOTAL REVENUES</b>		<b>\$2,470,200</b>		<b>\$1,902,600</b>
- to OHA (20%)		- \$494,000		- \$380,640
- to State (80%)		- \$1,976,200		- \$1,521,960

<sup>1</sup> Just portion of net profit returned to State; most profits assumed to remain with organization operating shop. Calculations based on total gross revenues would show much higher figure.

<sup>2</sup> Interpretive Center revenues calculated as though State is operator, with nonprofit group running gift shop and food/concession on concession. If entire center run as concession, return to State would be less.



**Sensitivity Analysis (Potential Effects of Marketing/Promotion):** The analysis below shows the effects of different assumptions about the percentage of people deterred by fees. The main way that deterrence would be overcome would be an active effort to convince people that the product is worth the price, via marketing and promotion.

If the combined entry fee were actually to deter just 50% rather than 70% of potential overall Crater attendees, the State revenues after OHA's deduction would reach about \$2.5 million, a little higher than the "break-even" point. This is important to note, because our use of the 70% deterrence level was highly judgmental, and the survey evidence could be taken to justify the 50% deterrence level instead.

**EXHIBIT 6-D: SENSITIVITY OF ASSUMPTIONS ON DETERRENCE EFFECT OF FEES**

Assumed Deterrence Effect from Overall Crater Entry Fee	I. Separate Entry Fee Scenario			II. Combined Entry Fee Scenario		
	If More Assumed Deterrence		If Less Deterrence	If More Assumed Deterrence		If Less Deterrence
	45%	25%	5%	90%	70%	50%
Attendance Levels - Overall Crater - Interpretive Center:	379,500	517,500	655,500	69,000	207,000	345,000
Revenue Levels - Crater Entry Fee	133,500	182,200	230,800	48,200	144,300	240,700
Revenue Levels - Crater Entry Fee	\$890,400	\$1,214,100	\$1,537,800	\$415,400	\$1,248,300	\$2,077,800
Revenue Levels - Crater Entry Fee	\$87,300	\$119,000	\$150,800	\$15,900	\$47,600	\$79,400
Revenue Levels - Shuttle Concession	\$47,300	\$64,500	\$81,700	\$8,600	\$25,800	\$43,000
Revenue Levels - Shuttle Concession	\$1,025,000	\$1,367,600	\$1,770,300	\$439,900	\$1,319,700	\$2,200,200
Revenue Levels - Gift Shop Profits	\$817,800	\$943,100	\$1,068,000	\$157,400	\$471,800	\$786,700
Revenue Levels - Food Concession	\$37,400	\$51,000	\$64,000	\$13,500	\$40,400	\$67,400
Revenue Levels - Food Concession	\$130,700	\$178,300	\$225,800	\$23,800	\$71,300	\$118,800
Revenue Levels - Interpretive Center	\$ 788,000	\$1,072,400	\$1,358,400	\$ 194,700	\$583,900	\$ 972,900
<b>TOTAL</b>	<b>\$1,811,000</b>	<b>\$2,470,000</b>	<b>\$3,128,700</b>	<b>\$ 634,600</b>	<b>\$1,903,200</b>	<b>\$3,173,100</b>
State Portion (80%)	<b>\$1,448,800</b>	<b>\$1,976,000</b>	<b>\$2,502,960</b>	<b>\$ 507,680</b>	<b>\$1,522,560</b>	<b>\$2,538,480</b>

On the other hand, the analysis above shows that a similar adjustment of 20 percentage points in the direction of "less deterrence" (possibly through more effective marketing) could boost revenues to the same \$2.5 million level for the Separate Entry Fee Scenario. And outcomes are much more sensitive to effects of changes in assumptions under the Combined Entry Fee Scenario — if people are actually more deterred by fees than was assumed for the analysis in Exhibit 6-C, the financial effects are greater if the entry fees were combined.

In summary:

- Profitability is in some part a function of marketing and promotion.
- An effectively promoted visitor/interpretive center could produce more revenue than we have assumed, and the difference is especially important if there are combined entry fees.
- But the combined entry fee approach is riskier. If marketing and promotion efforts result in even more market acceptance (less deterrence) than we have assumed in Exhibits 6-C or 6-D, the outcomes would be better with that approach than with the separate entry fee approach. But if the efforts do not work, or if the ambient market appeal is less than we have assumed, the downside with combined fees is greater than with separate entry fees.

This analysis in many ways reinforces the comments from tourism company interviewees in Chapter 5. To be seriously profitable, the visitor/interpretive center must have far more intrinsic market appeal than anything yet developed in Hawaii, and/or it must be marketed and promoted in a way that local government has not previously attempted for any public park or visitor facility. That would mean a commitment to Diamond Head as a tourist attraction, possibly in competition with other Oahu attractions. Such a commitment does not necessarily imply the "commercialization" of Diamond Head, if — as is the case with National Parks — good planning principles are followed; giftshops are operated by nonprofits; and revenues are used for maintenance and improvements in the area. It does, however, imply a commitment to an economic perspective (and perhaps a degree of communication and partnership with the visitor industry's private sector to assure that the development is not seen as inappropriate and to assure that marketing is effective).

Alternatively, the main purpose of the visitor/interpretive center could be viewed as something other than profit. It could be viewed as an appropriate adjunct to a natural resource — as having intrinsic educational value, for both residents and tourists, the sort of value which merits a moderate level of State subsidy. And/or it could be viewed as the sort of traditional government addition to the visitor plant (again, like National Parks) which helps to re-invigorate our "tourism product" by providing facilities which appeal to some if not all segments of the visitor market. This might also argue for a moderate level of State subsidy.

Ideally, the Diamond Head Crater and its visitor/interpretive facility would fulfill all these purposes — it could educate, contribute to the tourism economy, and generate surplus revenues for the State which could be used to improve the Crater environment. Our analysis suggests this ideal will probably not be met, and so a decision needs to be made as to which purpose has priority.

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APPENDIX A:

SUPPLEMENTARY TABLES



**EXHIBIT A-1:**  
**OAHU VS. CENSUS TRACTS SURROUNDING DIAMOND HEAD CRATER --**  
**DEMOGRAPHIC CHARACTERISTICS, 1990**

	OAHU Honolulu County	CT 17 W. Diam. Head/ Waikiki	CT 16 Kapahulu	CT 8 Lower Kaimuki (West)	CT 7 Lower Kaimuki (East)	CT 6 E. Diam. Head/ Black Pt.
<b>POPULATION</b>	636,231	2,536	3,911	3,856	2,980	1,311
<b>ETHNICITY</b>						
Caucasian	32%	78%	19%	19%	15%	36%
Japanese	23%	9%	45%	42%	50%	23%
Filipino	14%	1%	3%	4%	2%	2%
Hawaiian	11%	4%	12%	8%	6%	5%
Other	20%	11%	21%	26%	21%	33%
<b>AGE</b>						
Under 5 years	7%	2%	5%	5%	3%	4%
5 to 17 years	17%	6%	12%	11%	13%	10%
18 to 34 years	31%	21%	26%	22%	21%	17%
35 to 64 years	34%	44%	34%	36%	37%	40%
65 or more years	11%	26%	23%	26%	26%	30%
Median age (years)	32.2	47.2	36.4	42.9	43.9	49.3
<b>EDUCATION OF PERSONS AGED 25 &amp; OVER (1)</b>						
High School Diploma (2)	81%	94%	78%	76%	78%	96%
College Degree (3)	33%	45%	24%	30%	30%	61%
<b>PERSONS AGED 5 &amp; OVER WHO SPEAK A LANGUAGE OTHER THAN ENGLISH AT HOME (1)</b>	26%	20%	29%	25%	31%	24%
<b>PERSONS WITH MOBILITY OR SELF-CARE LIMITATIONS (1)</b>	4%	2%	4%	5%	4%	5%
% of persons aged 18 to 64	18%	11%	20%	18%	16%	9%

NOTES: (1) Based on 15% sample; hence, figures represent estimates only.  
(2) All persons with a high school diploma, including those with college education.  
(3) Includes Associate, Bachelor's, and graduate degrees.

SOURCES: U.S. Bureau of the Census, 1992, 1991.

**EXHIBIT A-2:**  
**OAHU VS. CENSUS TRACTS SURROUNDING DIAMOND HEAD CRATER --**  
**GEOGRAPHIC MOBILITY, 1990 (1)**

	OAHU Honolulu County	CT 17 W. Diam. Head/ Waikiki	CT 16 Kapahulu	CT 8 Lower Kaimuki (West)	CT 7 Lower Kaimuki (East)	CT 6 E. Diam. Head/ Black Pt.
<b>PERSONS (2)</b>						
<b>PLACE OF BIRTH</b>						
Born in Hawaii	54%	30%	73%	77%	72%	53%
Other U.S.-born (3)	30%	54%	16%	13%	17%	33%
Foreign-born	16%	16%	11%	10%	11%	14%
<b>RESIDENCE 5 YEARS PREVIOUS FOR PERSONS AGED 5 &amp; OVER</b>						
Same house	50%	47%	70%	71%	74%	66%
Same county, different house	26%	26%	22%	26%	18%	17%
Same state, different county	1%	3%	1%	0%	0%	1%
Different state	17%	18%	6%	2%	6%	10%
Lived abroad	5%	3%	2%	0%	2%	5%
<b>HOUSEHOLDERS (2)</b>						
<b>WHEN HOUSEHOLDER MOVED INTO UNIT</b>						
In the last 5 years	53%	46%	36%	27%	19%	22%
6 to 20 years ago	29%	29%	22%	24%	24%	23%
21 to 30 years ago	10%	11%	10%	14%	15%	41%
31 years ago or more	8%	10%	32%	36%	43%	15%

NOTES: (1) Based on 15% sample; hence, figures represent estimates only.  
(2) Base figures used in calculating these data may be different than in 100% count.  
(3) Includes persons born in U.S. territories, and persons born abroad or at sea to American parents.

SOURCE: U.S. Bureau of the Census, 1992.

**EXHIBIT A-3:**  
**OAHU VS. CENSUS TRACTS SURROUNDING DIAMOND HEAD CRATER --**  
**HOUSING CHARACTERISTICS, 1990**

	OAHU Honolulu County	CT 17 W. Diam. Head/ Waikiki	CT 18 Kapahulu	CT 8 Lower Kaimuki (West)	CT 7 Lower Kaimuki (East)	CT 6 E. Diam. Head/ Black Pt.
<b>HOUSING UNITS</b>	281,883	1,703	1,429	1,272	990	554
<b>TOTAL VACANT UNITS</b> Seasonal/recreational	8%	19%	4%	3%	2%	11%
<b>AGE OF STRUCTURE (1)</b>						
1 year	2%	0%	0%	2%	2%	4%
2 to 10 years	14%	2%	4%	6%	3%	1%
11 to 20 years	30%	16%	10%	10%	6%	9%
21 years or more	54%	63%	86%	83%	89%	87%
<b>UNITS IN STRUCTURE</b>						
1 unit	55%	21%	75%	80%	94%	97%
2 to 4 units	7%	2%	7%	7%	4%	2%
5 or more units	36%	76%	15%	1%	0%	0%
Trailer, other	1%	1%	1%	2%	2%	1%
<b>NOT COMPLETE PLUMBING (1)</b>	1%	0%	0%	0%	0%	0%
<b>HOUSEHOLDS</b>	285,304	1,384	1,373	1,233	971	481
<b>HOUSEHOLD TYPE</b>						
1 or more non-relatives	12%	16%	15%	12%	6%	12%
No non-relatives	88%	84%	85%	88%	91%	88%
<b>TENURE</b>						
Owner-occupied	52%	59%	55%	64%	77%	63%
Renter-occupied	48%	41%	45%	36%	23%	37%
<b>PERSONS PER HOUSEHOLD</b>	3.02	1.81	2.85	2.96	3.04	2.67
<b>CROWDED HOUSEHOLDS</b>						
Mildly crowded (2)	8%	1%	8%	5%	5%	3%
Very crowded (3)	8%	5%	6%	3%	2%	1%
<b>MEDIAN VALUE (4)</b>	\$283,600	\$500,001	\$309,000	\$329,800	\$387,200	\$500,001

NOTES: (1) Based on 15% sample; hence, figures represent estimates only.  
(2) Indicated by households with 1.00 to 1.50 persons per room.  
(3) Indicated by households with 1.51 or more persons per room.  
(4) For owner-occupied, non-condominium housing units.

SOURCES: U.S. Bureau of the Census, 1992, 1991.

**EXHIBIT A-4:**  
**OAHU VS. CENSUS TRACTS SURROUNDING DIAMOND HEAD CRATER --**  
**INCOME CHARACTERISTICS, 1990 (1)**

	OAHU Honolulu County	CT 17 W. Diam. Head/ Waikiki	CT 18 Kapahulu	CT 8 Lower Kaimuki (West)	CT 7 Lower Kaimuki (East)	CT 6 E. Diam. Head/ Black Pt.
<b>HOUSEHOLDS (2)</b>						
Income level						
Lowest (3)	13%	8%	15%	10%	10%	5%
Highest (4)	17%	24%	11%	23%	23%	51%
Median income (5)	\$40,581	\$44,654	\$38,094	\$42,264	\$50,090	\$78,184
<b>WITH SELECTED INCOME SOURCES</b>						
Social Security income	24%	34%	42%	44%	55%	48%
Retirement income	20%	24%	20%	32%	43%	36%
Public Assistance income	6%	4%	6%	3%	3%	3%
<b>OWNER HOUSING COSTS (6)</b>						
35% or more of household income	15%	20%	9%	10%	11%	14%
Median Monthly Costs (5)	\$1,121	\$2,001	\$676	\$1,172	\$792	\$1,236
<b>RENTER HOUSING COSTS (7)</b>						
35% or more of household income	34%	46%	27%	34%	15%	36%
Median Gross Rent (5)	\$683	\$985	\$813	\$683	\$738	\$1,001
Median Contract Rent (5,8)	\$815	\$884	\$544	\$616	\$710	\$1,001
<b>POPULATION (2)</b>						
<b>PERSONS BELOW POVERTY LEVEL</b>						
% of persons aged 18 to 64	7%	5%	6%	3%	3%	2%
% of persons aged 65 or more	6%	6%	5%	2%	3%	0%
% of related children aged under 18	8%	8%	4%	6%	0%	5%
% of unrelated individuals	19%	11%	20%	9%	15%	0%

NOTES: (1) Based on 15% sample (except "Median Contract Rent"); hence, figures represent estimates only.  
(2) Base figures used in calculating this data may be different than in 100% count.  
(3) Income of less than \$15,000 (based on lowest 14.8% of incomes statewide).  
(4) Income of \$75,000 or more (based on highest 15.6% of incomes statewide).  
(5) In 1980 dollars.  
(6) Owner costs include (but are not limited to) mortgage, real property tax, property insurance, utilities, and fuel.  
(7) Renter costs include (but are not limited to) rent, utilities, and fuel.  
(8) Monthly cash rent only. Does not include other costs.

SOURCES: U.S. Bureau of the Census, 1992, 1991.

**EXHIBIT A-5:**  
**OAHU VS. CENSUS TRACTS SURROUNDING DIAMOND HEAD CRATER --**  
**LABOR FORCE CHARACTERISTICS, 1990 (1)**

	OAHU Honolulu County	CT 17 W. Diam. Head/ Waikiki	CT 16 Kapahulu	CT 8 Lower Kaimuki (West)	CT 7 Lower Kaimuki (East)	CT 6 E. Diam. Head/ Black Pt.
<b>POPULATION AGED 18 &amp; OVER</b> In Armed Forces	651,820 8%	2,251 0%	3,327 0%	3,327 0%	2,532 0%	1,182 0%
<b>POTENTIAL CLF (2)</b> % Actually in Civilian Labor Force	599,371 92%	2,251 100%	3,302 99%	3,321 100%	2,524 99%	1,182 100%
<b>ACTUAL CLF</b>	410,023	1,455	2,116	2,020	1,403	789
<b>MALE</b>						
Labor force participation (3)	75%	74%	72%	68%	63%	75%
Unemployed	4%	3%	3%	1%	2%	0%
<b>FEMALE</b>						
Labor force participation (3)	63%	55%	56%	56%	55%	54%
Unemployed	3%	1%	2%	0%	4%	0%
<b>EMPLOYED CLF</b>	395,811	1,430	2,000	2,020	1,398	789
<b>BY SELECTED INDUSTRY</b>						
Agriculture, forestry, fisheries, mining	2%	0%	0%	1%	1%	0%
Construction	7%	5%	5%	6%	5%	4%
Manufacturing	6%	5%	6%	7%	5%	7%
Transportation	7%	8%	9%	9%	8%	3%
Retail trade	19%	18%	22%	23%	24%	15%
Finance, insurance, real estate	8%	11%	6%	9%	10%	14%
Personal, entertainment, recreation	8%	11%	13%	8%	8%	11%
Health, education, professional	22%	23%	17%	18%	20%	20%
Public administration	9%	4%	8%	9%	6%	6%
<b>BY OCCUPATION</b>						
Managerial, professional	26%	47%	21%	25%	27%	52%
Technical, sales, support	35%	30%	38%	43%	41%	38%
Service	17%	12%	20%	18%	14%	6%
Farming, forestry, fishing	2%	0%	1%	1%	1%	1%
Production, craft, repair	10%	6%	11%	9%	9%	1%
Operators, cleaners, laborers	9%	5%	8%	8%	8%	1%
<b>COMMUTE TO WORK</b>						
More than 45 minutes	16%	4%	9%	6%	5%	7%
Mean travel time (minutes)	24.6	18.5	21.7	21.3	21.8	21.4

NOTES: (1) Based on 15% sample; hence, figures represent estimates only.  
(2) CLF = Civilian Labor Force. Potential CLF calculated by subtracting persons in armed forces from Population Aged 18 & Over.  
(3) Calculated by dividing Actual CLF by Potential CLF.

SOURCE: U.S. Bureau of the Census, 1992.

**EXHIBIT A-6:**  
**HANAUMA ATTENDANCE FIGURES BEFORE AND AFTER**  
**1990 RESTRICTIONS ON COMMERCIAL TOUR ACTIVITIES**

Note: Figures prior to July 1985 very rough estimates, usually based on a few days' visitor counts.

Period/ Year	Hanauma Attendance Source <sup>2</sup> (in Millions)	Hanauma <sup>1</sup> Attendance (in Millions)	% Change, Previous Yr.	Oahu Avg. Daily Visitor Census <sup>3</sup>	% Change, Previous Yr.
1975	(A)	0.5	N/A		
1985	(A)	1.5	N/A		
1987	(A)	3.4	N/A		
1988	(A)	2.9	-15%		
1989	(A)	2.9	0%	88,750	
FY 1989-90	(B)	3.4	N/A		
1990	(A)	2.9	0%	87,400	-2%
<b>FOLLOWING COMMERCIAL TOUR RESTRICTIONS, MID-1990</b>					
1991	(A)	1.8	% Change, 1989 to 1991 -38%	79,700	% Change, 1989 to 1991 -10%
1992	(C)	2.3		78,390	-2%
1993	(C)	1.9		79,070	1%
1994	(C)	1.7		83,400	5%
FY 1994-95	(C)	1.7			

<sup>1</sup> Attendance figures prior to July 1985 assumed to be for lower park only, exclusive of brief sightseeing stops in upper park. Data sources actually somewhat ambiguous on this point, but park staff provided reassurances they are comparable to the figures for July 1995 on, which are for entry to lower park only (personal communication, Martha McDaniel, July 31, 1998).

<sup>2</sup> Sources are: (A) Hanauma Master Plan (Wilson Okamoto, 1982); (B) extrapolation from UH Marine Options counts in late 1989, early 1990 (Reynolds, 1991); (C) figures in various Hawaii State Data Books, based on headcounts by City Parks Illegals over an 8-hour day.

<sup>3</sup> Source for Average Daily Visitor Census: Hawaii State Data Book, various years, based on Annual Reports of Hawaii Visitors and Convention Bureau, various years.

EXHIBIT A-7: HANAUMA ATTENDANCE FIGURES BEFORE AND AFTER IMPLEMENTATION OF VARIOUS USER FEE STRUCTURES					
Period/ Year	Hanauma Attendance Sources <sup>2</sup> (in Millions)	% Change, Previous Yr.	Oahu Avg. Daily Visitor Census <sup>3</sup>	% Change, Previous Yr.	
Note: Figures prior to July 1995 very rough estimates, usually based on a few days' visitor counts.					
FOLLOWING COMMERCIAL TOUR RESTRICTIONS, MID-1990					
FY 1992-93	[C] 2.3		78,390	-2%	
FY 1993-94	[C] 1.9	-17%	79,070	1%	
FY 1994-95	[C] 1.7 [D] 1.48	-11%	83,400	5%	
FOLLOWING IMPLEMENTATION OF INITIAL \$5 ENTRY FEE (IN EFFECT JULY-DEC. 1995)					
1995 July-Dec.					
-Total	[E] 0.57		83,090	0%	
-Non-Resident	[E] 0.47				
Annualized:	[F] 1.10				
-Total	[F] 0.92				
-Non-Resident					
FOLLOWING CONVERSION TO VOLUNTARY DONATIONS (NEARLY ALL CALENDAR 1996)					
1996					
-Total	[E] 1.18		64,500	2%	
-Non-Resident	[E] 1.01				
[CONTINUED]					

EXHIBIT A-7 (CONTINUED): HANAUMA ATTENDANCE FIGURES BEFORE AND AFTER IMPLEMENTATION OF VARIOUS USER FEE STRUCTURES					
Period/ Year	Hanauma Attendance Sources <sup>2</sup> (in Millions)	% Change, Previous Yr.	Oahu Avg. Daily Visitor Census <sup>3</sup>	% Change, Previous Yr.	
FOLLOWING IMPLEMENTATION OF CURRENT \$3 ENTRY FEE (IN EFFECT MID-MARCH 1997)					
1997 April-Dec.					
-Total	[E] 0.84		77,020	-9%	
-Non-Resident	[E] 0.72				
Annualized:	[F] 1.08				
-Total	[F] 0.95				
-Non-Resident					
1998 Jan-June					
-Total	[E] 0.51		N/A		
-Non-Resident	[E] 0.44				
Annualized:	[F] 1.05				
-Total	[F] 0.90				
-Non-Resident					
<sup>1</sup> Attendance figures prior to July 1995 assumed to be for lower park only, exclusive of brief sightseeing stops in upper park. Data sources actually somewhat ambiguous on this point, but park staff provided reassurance they are comparable to the figures for July 1995 on, which are for entry to lower park only (personal communication, Martha McDaniel, July 31, 1998). <sup>2</sup> Sources are: [C] figures in various Hawaii State Data Books, based on headcounts by City Parks lifeguards over an 8-hour day; [D] assumption of 86% non-residents in this period, based on Wilson Okamoto (1992); [E] Hanauma admission records, courtesy of manager Alan Hong; [F] extrapolations to annualized counts based on proportions observed for residents vs. non-residents in various months of 1996, (only recent full calendar year operating under one system). <sup>3</sup> Sources for Average Daily Visitor Census: Hawaii State Data Book, various years, based on Annual Reports of Hawaii Visitors and Convention Bureau, various years.					



**EXHIBIT A-8:**

**CHANGES IN FEE STRUCTURE VS. NON-RESIDENT HANAUMA ATTENDANCE**

1998	on-Resident Adult Fee	Hanauma Attendance		Oahu Average Daily Visitor Census (Calendar Year)	
		Total	Non-Resident		
July	\$5	122,122	95,988	83,090 (for total 1995)	
August	\$5	28,136	107,532		
September	\$5	23,075	78,811		
October	\$5	14,248	64,646		
November	\$5	12,390	51,890		
December	\$5	9,348	74,408		
Cumulative Non-Resident, July - December 1995:		12,609	470,371		
1996					84,500 (for total 1996)
January	Voluntary	80,845	71,650		
February	Voluntary	80,885	72,894		
March	Voluntary	7,991	92,816		
April	Voluntary	11,737	83,791		
May	Voluntary	10,832	83,574		
June	Voluntary	95,993	93,168		
July	Voluntary	114,384	108,342		
August	Voluntary	132,023	122,710		
September	Voluntary	147,163	84,243		
October	Voluntary	98,419	70,408		
November	Voluntary	61,904	55,839		
December	Voluntary	83,254	77,442		
Cumulative Non-Resident, Calendar Year 1996:		85,283	77,442		
Cumulative Non-Resident, July - December 1996:		1,014,273	616,782		
Cumulative Non-Resident, April - December 1996:		777,313	777,313		
1997				77,020 (for total 1997) (preliminary estimate from HVCB Research)	
January	Voluntary	88,119	9,001		
February	Voluntary	84,795	11,311		
March	Voluntary	92,230	13,316		
April	Voluntary (fee-increase change)	88,447	11,481		
May	\$3	89,192	15,322		
June	\$3	103,804	17,641		
July	\$3	110,493	16,143		
August	\$3	132,468	17,127		
September	\$3	93,372	9,951		
October	\$3	82,252	9,247		
November	\$3	62,498	9,548		
December	\$3	78,385	7,489		
Cumulative Non-Resident, Calendar Year 1997:		984,474	88,898		
Cumulative Non-Resident, April - December 1997:		724,960	724,960		
% Change, \$5 Fee to "Voluntary" (Jul-Dec., 1995 to '96):			9.8%		
% Change, "Voluntary" to \$3 Fee (Apr-Dec., 1996 to '97):			-6.7%		

Source: Unpublished City Parks Dept. records, Hawaii State DBEDT, 1997.

**EXHIBIT A-9:**

**FIRST-TIME VS. REPEAT VISITOR PATTERNS (1991) - ACTIVITIES POTENTIALLY RELEVANT TO DIAMOND HEAD**

(Percentage of Statewide visitors reporting participation at least once during Hawaii stay.)

General Activities Suggestive of Diamond Head	United States		Japan	
	1st-Time	Repeat	1st-Time	Repeat
Natural Site Visits	60%	52%	34%	32%
Hiking/Climbing	35%	31%	8%	8%
Specific Activities/Attractions Suggestive of Diamond Head				
National Parks	54%	38%	7%	5%
USS Arizona Memorial	64%	28%	12%	2%
Punchbowl National Cemetery	29%	13%	41%	33%
Waimea Falls Park	42%	24%	3%	5%
Military Museums	15%	10%	4%	2%
Other Museums (other than Bishop, Bowfin, Maritime, or Art Museums)	7%	5%	2%	2%

Source: Hawaii Visitors Bureau, 1991A

**EXHIBIT A-10:**  
**SELECTED VISITOR ACTIVITIES OF POTENTIAL RELEVANCE TO CURRENT OR FUTURE DIAMOND HEAD ATTENDANCE: 1989**

Phone Interview Sample Size	State	Oahu Japanese	Oahu Non-Japanese
	1002	105	487
<b>Percentages Reporting Participation At Least Once During Stay on Island**</b>			
Hiking	16%	11%	10%
Diving	39%	33%	35%
Bodysurfing/Boogyboarding	16%	12%	16%
Other Beach Activities	85%	85%	85%
<b>Percentages Reporting Participation On Any Given Day During Stay on Island</b>			
Hiking	4%	2%	3%
Diving	11%	6%	8%
Bodysurfing/Boogyboarding	8%	3%	5%
Other Beach Activities	30%	24%	28%

\* Sample consisted of tourists. Figures for individuals computed by asking how many in party engaged in that activity. Statewide total included disproportionate Neighbor Island sampling.

\*\* Statewide figures for hiking and diving "at least once during stay" differ significantly from the 1991 HVB figures - they are lower, and there is less disparity between U.S. and Japanese figures. It is somewhat difficult to compare the two surveys and decide which is correct because of different methods. The HVB survey has the advantage of larger samples taken throughout the year, but respondents are self-selected because of the mail-out methodology. The Hawaii Visitors Bureau (HVB) report suggests that these two activities are disproportionately reported by higher-income residents, who in fact are usually over-represented in mail-out samples. The 1989-90 SCORP survey by Community Resources had smaller sample sizes and was taken only during the summer, but its in-person airport exit interview method is far less biased in favor of groups who are disproportionately inclined to report certain activities. Another factor noted in the Community Resources report is that a significant minority of tourist "filers" said they had done all their hiking within resort areas, leading to the suspicion that some tourists may confuse questionnaire items about "hiking" with the idea of "long walks" - e.g., "hiking" along Waialae Beach. If this is true, hiking percentages from both surveys may be somewhat overstated.

Source: Community Resources, Inc. and Datametric Research, 1990A

**EXHIBIT A-11:**  
**SELECTED RESIDENT ACTIVITIES OF POTENTIAL RELEVANCE TO CURRENT OR FUTURE DIAMOND HEAD ATTENDANCE: 1989**

Phone Interview Sample Size	State	Oahu
	1017	222
<b>Percentages Reporting Participation At Least Once During Last 2 WEEKEND DAYS</b>		
Hiking on Trails	1%	2%
Walking/Jogging/Running	8%	8%
Bodysurfing/Boogyboarding	3%	3%
Nearshore Diving	1%	1%
Other Beach Activities	15%	15%
<b>Percentages Reporting Participation At Least Once During Last 6 WEEKDAYS</b>		
Hiking on Trails	1%	1%
Walking/Jogging/Running	16%	15%
Bodysurfing/Boogyboarding	2%	2%
Nearshore Diving	1%	1%
Other Beach Activities	6%	5%
<b>Percentages Reporting Participation On Any Given WEEKEND DAY</b>		
Hiking on Trails	1%	1%
Walking/Jogging/Running	7%	7%
Bodysurfing/Boogyboarding	2%	2%
Nearshore Diving	1%	1%
Other Beach Activities	6%	6%
<b>Percentages Reporting Participation On Any Given WEEKDAY</b>		
Hiking on Trails	**	**
Walking/Jogging/Running	7%	7%
Bodysurfing/Boogyboarding	1%	1%
Nearshore Diving	**	**
Other Beach Activities	2%	2%

\* Sample consisted of households. Figures for individuals computed by asking how many in household engaged in that activity. Statewide total included disproportionate Neighbor Island sampling.

\*\* Indicates less than one-half of one percent.

Source: Community Resources, Inc. and Datametric Research, 1990B

**EXHIBIT A-12:**

**SELECTED RESIDENT ACTIVITIES OF POTENTIAL RELEVANCE TO  
CURRENT OR FUTURE DIAMOND HEAD ATTENDANCE: 1990, 1995**

(Percentage of Statewide adult residents reporting participation at least once during last year.)

Phone Interview Sample Size	1990 (Not given in published report)	1995
Hiking	12%	15%
Fitness Walking	28%	38%
Jogging/Running	N/A	20%
Skin Diving or Snorkeling	N/A	10%
Swimming	N/A	34%

Source: Hawaii State Dept. of Land and Natural Resources, 1998.

**APPENDIX B:**  
**DETAILED DESCRIPTIONS OF**  
**INTERPRETIVE CENTER**  
**"COMPARABLES"**



**EXHIBIT B-1: SUMMARY OF  
HAWAII NATURE CENTER, IAO VALLEY -- INDEPENDENT FACILITY ADJACENT TO PARKS**

<u>Location and Type</u>	<u>Fee Structure</u>	<u>Nature of Facilities</u>	<u>Exhibits/Activities</u>	<u>Revenues</u>
<p>875 Iao Valley Rd. Wailuku, Maui, 96783 Located between Iao Needle State Park and Kepanui County park (featuring traditional housing forms for Hawaii's various cultures).</p> <p>Nonprofit, privately run and operated.</p> <p>Focus is on natural history of Hawaii, with emphasis on Iao Valley itself.</p> <p>Main administrative branch is in Makiki Valley on Oahu.</p>	<p>General fee is \$8/adult and \$4/child.</p> <p>\$50/yr. family membership provides free admission and access to special programs. Group rates and program rates vary.</p>	<p>The interpretive center is known as the Interactive Science Arcade. The facility is 4000 sq. ft. with 800 sq. ft. gift shop inside.</p> <p>There is an office building and an old lodge used for youth education. These two support buildings together total about 14,000 square feet.</p> <p>Total land parcel about 1.6 acres.</p>	<p>The facility displays 35 exhibits on Hawaii natural history and Iao Valley. Most displays are informational and low-tech. Intent is for exhibits to be hands-on, e.g. learning about Hawaiian culture and using scientific reasoning to understand biology and ecology of the area.</p> <p>Along with youth education programs on the biology, culture and geology of the area, there are many hiking trails and streams that act as an informal classroom for visitors.</p>	<p>About 70% of current gross is from gift shop sales.</p> <p>Entry fees yield about 25% of gross with remainder from facility rentals and programs (such as hikes, group tours, etc.).</p>

**EXHIBIT B-2: SUMMARY OF  
KAUAI NATIONAL WILDLIFE REFUGE COMPLEX -- U.S. NATURAL AREA PLUS VISITOR CENTER**

<u>Location and Type</u>	<u>Fee Structure</u>	<u>Nature of Facilities</u>	<u>Exhibits/Activities</u>	<u>Revenues</u>
<p>Located on Kilauea Point Lighthouse, Kauai.</p> <p>Address is Lighthouse Rd. Kilauea, HI 96754</p> <p>Nonprofit run by US Fish and Wildlife Service.</p> <p>Complex made of 3 Refuges: Kilauea Point, Hanalei and Halele.</p> <p>No concessions allowed.</p>	<p>Entry fee for Refuge is \$2/adult, free if under 16.</p> <p>Annual kama'aina pass is sold for \$12.</p> <p>As part of US park system, Golden Age Pass for US citizens 62 and over pay \$10 for lifetime access to all US national parks; \$50 annually for general public for Golden Eagle Pass; free Golden Access Pass for disabled users.</p> <p>Membership in supporting agency KPNHA is \$15.</p> <p>No separate fees for visitor centers.</p>	<p>There is a Visitor Center. Within Center is small bookstore/gift shop operated by nonprofit supporting group called Kilauea Point Natural History Association.</p> <p>Next to Kilauea Point Lighthouse is radio beacon called Visitor Contact Station, which acts as main site for interpretation and visitor contact.</p> <p>Visitor Center with office included is about 800 sq. ft. (upstairs and down). Limited exhibits on lighthouse &amp; history; view points to surrounding area.</p> <p>Total acreage of Kilauea Point portion of Refuge is 203 acres.</p>	<p>Inside Visitor Center are exhibits on Kilauea Point's and Kauai's ecosystems, relief map of Hawaiian Islands, wildlife displays, wooden models of birds &amp; vegetation, dioramas, and interactive computer terminal with touch screen for more information on Kilauea Point.</p> <p>At Visitor Contact Station are exhibits on the lighthouse and its history, books and pamphlets and views of surroundings.</p> <p>Guided hiking tour occurs once a day in closed section of Refuge (Crater Hill) where ground nesting birds live.</p>	<p>For KPNHA, bookstore revenues account for 99% of gross income; memberships, other 1%</p>

EXHIBIT B-3: SUMMARY OF KOKE'E NATURAL HISTORY MUSEUM -- INDEPENDENT FACILITY WITHIN STATE PARK				
<u>Location and Type</u>	<u>Fee Structure</u>	<u>Nature of Facilities</u>	<u>Exhibits/Activities</u>	<u>Revenues</u>
<p>Location is within Koke'e State Park at 3600' altitude.</p> <p>Hui O Laka, a nonprofit organization, operates the Koke'e Natural History Museum (KNHM) under a management agreement with the State of Hawaii. (No revenue to State, but Hui employees and volunteers serve informational functions which park rangers might otherwise serve.)</p> <p>KNHM sits on Park with 45 miles of hiking trails.</p> <p>Focus is natural history for Koke'e State Park, Kauai and Hawaiian Islands.</p>	<p>No admission fee, just \$1 suggested donation. (No admission fee to overall park, either.)</p> <p>Membership is \$15/adult and \$5/child. Grants discount at shop, newsletter and various workshops.</p> <p>For nonmembers, guided hikes are \$3/person.</p>	<p>There is a museum with small gift shop.</p> <p>Next to museum is Koke'e Lodge, a private restaurant and gift shop run by Koke'e Venture on concession.</p> <p>Plans are to lease old CCC Camp to create field/research center.</p> <p>Museum/gift shop is about 1200 sq. ft.</p> <p>Park itself is 4,345 acres.</p>	<p>Museum contains exhibits on the following: weather and hurricane Iniki, stuffed birds, native woods, maps, Queen Emma display, petroglyphs, shells and mammals of Koke'e.</p> <p>Content of museum is stationary, for purpose of informing and educating about science, biology and cultural issues.</p> <p>Sold at gift shop are educational materials and T-shirts, the only taxable item.</p> <p>Hiking is the most popular activity. Guided tours are offered during summer.</p>	<p>Last fiscal year (end May 31, 1998), entry donations accounted for 8.5% of gross revenues.</p> <p>Gift shop sales comprised 62% of gross; memberships and miscellaneous sources accounted for the other 9.5%</p>

EXHIBIT B-4: SUMMARY OF FRIENDS OF HEEIA VISITOR CENTER -- INDEPENDENT FACILITY WITHIN STATE PARK				
<u>Location and Type</u>	<u>Fee Structure</u>	<u>Nature of Facilities</u>	<u>Exhibits/Activities</u>	<u>Revenues</u>
<p>Heeia State Park 46-485 Kamehameha Hwy. Kaneohe, Oahu, HI 96744</p> <p>Nonprofit organization (Friends of Heeia State Park) operating Friends of Heeia visitor center under management agreement with State of Hawaii.</p> <p>Mission is to re-establish native coastal flora. Primary target is school-aged children on fieldtrips for environmental education.</p>	<p>No entry fees (visitor center or park). Membership is \$25 per family, \$15 per individual and \$10 per student.</p> <p>Program fees are \$5 - \$10. Members get free newsletter and discounts at gift shop but not waiver on program fees.</p>	<p>One visitor center and one classroom/exhibit hall are within small Park. Visitor center contains office and small gift shop.</p> <p>Gift shop sells Hawaiian items and educational books.</p> <p>Overall park is 18 acres; visitor center is 10,000 sq. ft. and classroom is 1600 sq. ft.</p>	<p>Inside visitor center are exhibits on marine life and corals and another on Hawaiian culture (i.e. tapa and wood carvings).</p> <p>Classroom/exhibit hall contains displays of marine life and geology and three aquariums for ethnobotany.</p> <p>Subject matter is interactive and hands-on: learning how to weave, use fishpond and do ethnobotany studies.</p>	<p>Membership and program fees account for about 1% of gross revenues; gift shop makes up about 1%.</p> <p>98% donations and grants.</p>

**EXHIBIT B-5: SUMMARY OF  
FOSTER BOTANICAL GARDENS – NATURAL AREA PLUS BOOKSTORE (NO INTERPRETIVE CENTER)**

<u>Location and Type</u>	<u>Fee Structure</u>	<u>Nature of Facilities</u>	<u>Exhibits/Activities</u>	<u>Revenues</u>
<p>Address is 50 N. Vineyard Blvd., Honolulu 96817. .</p> <p>Status is nonprofit, administered by City and County Dept of Parks and Recreation.</p> <p>Foster Garden Gallery and Bookstore (FGG&amp;B) is operated by Friends of Honolulu Botanical Gardens (FHBG).</p>	<p>\$5/person, \$3/kama'aina or \$1/child 6 - 12 years.</p> <p>No admission fees at other Garden sites, including Gallery &amp; Bookstore.</p> <p>Membership to Friends of Honolulu Botanical Gardens starts at \$35 for regular dues.</p>	<p>No interpretive center. Just office for administration &amp; visitor sign-up.</p> <p>Size of overall facility is 850 acres. Gallery/Bookstore is 1000 sq. ft.</p>	<p>Main attraction is large collection of trees, plants and flowering plants.</p> <p>Docent-led tours daily.</p> <p>Orchid display features 200 sq. ft. exhibit with some interpretation but mostly samples of varieties.</p> <p>Large plant sale is held bi-annually.</p> <p>Tours, wedding and picnics are special events for general public.</p>	<p>Admission fees make up about 5% of total revenues for Botanical Gardens. Most revenues from grants and donations.</p> <p>FHBG receives donations and any profits from Gallery/Bookstore, but funds above operating expenses are given to City to pay for specific needed improvements at Foster Botanical Gardens.</p> <p>No other concessions.</p>

**EXHIBIT B-6: SUMMARY OF  
MOANALUA GARDENS FOUNDATION – NATURAL AREA PLUS GIFT SHOP (NO INTERPRETIVE CENTER)**

<u>Location and Type</u>	<u>Fee Structure</u>	<u>Nature of Facilities</u>	<u>Exhibits/Activities</u>	<u>Revenues</u>
<p>1352 Pineapple Place Moanalua Valley, Oahu 96819</p> <p>Site is on private Damon Estate land known as Moanalua Gardens, which has no connection to the Foundation.</p> <p>Nonprofit organization</p> <p>Mission is to educate public, especially children, on culture, history and environmental awareness. The operations thus consists primarily of <u>activities</u> rather than <u>facilities</u>.</p>	<p>No entry fees for Garden. Donation for walks is \$5 per person.</p> <p>Foundation program rates: Four day outer island weekend trips are \$500 and up per person. Oahu day trips are \$20 - \$30 per person.</p>	<p>Small cottage on Damon Estate is administrative center. MGF has no visitor center or exhibit hall.</p> <p>A mini "giftshop/bookstore" (closet) sells educational products to school and community (i.e. CD Roms, books and booklets on fieldsites).</p> <p>Office itself is about 1500 sq. ft. with Moanalua Gardens occupying 23 acres, 18 of which are used by MGF for its programs or by general public for weddings, picnics, etc.</p>	<p>No exhibits, except at festivals.</p> <p>Educational programs include annual Prince Lot Hula Festival to promote cultural and historical awareness; school visits and teacher workshops to inform about how Islands evolved from environmental, social, cultural and natural history points of views.</p> <p>Fieldtrips for students and hiking trips for general public (on site and elsewhere) offered weekly.</p>	<p>Donations and day and weekend trips account for about 30% gross.</p> <p>Educational products sold yield about 5% of total.</p> <p>Remainder comes from grants.</p>

EXHIBIT B-7: SUMMARY OF HALEAKALA NATIONAL PARK (WITH INTEGRATED VISITOR CENTERS)				
Location and Type	Fee Structure	Nature of Facilities	Exhibits/Activities	Revenues
<p>Location is the summit district atop Haleakala mountain between 7000' and 10,000' altitude.</p> <p>P.O. Box 389 Makawao, Maui, 96788</p> <p>Three small separate visitor centers (at summit, Park HQ and Kipahulu Ranger Station) run by Hawaii Natural History Assn. (NHA), headquartered at Volcanoes National Park.</p> <p>Buildings &amp; exhibits owned by National Park Service (NPS, US Dept. of Interior). NHA and NPS personnel jointly provide public information and exhibit maintenance; NHA administers sale of educational literature and videos in store areas.</p>	<p>Admission is \$10/vehicle for 7 days or \$5/person on bicycle or foot. Annual Haleakala Pass is \$20/ea.</p> <p>Commercial tours are \$25 for passenger vans of 15 people, \$40 if 15 - 25 people and \$100 if larger.</p> <p>As part of US park system, Golden Age Pass for US citizens 62 and over pay \$10 for lifetime access to all US national parks; \$50 annually for general public for Golden Eagle Pass; free Golden Access Pass for disabled users.</p> <p><i>No separate fees for visitor centers.</i></p>	<p>Facilities include 3 visitor centers, a Summit Building, 4 campgrounds (2 wilderness and 2 upcountry).</p> <p>Main visitor center is Haleakala Visitor Center. Within this Center is nonprofit Natural History Association. Other visitor centers are Park Headquarters and Kipahulu Ranger station.</p> <p>Park is 28,091 acres total, but small piece of land recently acquired on top of that.</p> <p>Facility space is minor, about 100 acres maximum.</p> <p>Downhill biking, horseback and guided hikes offered by concessions.</p>	<p>There are guided or solo hiking treks, bird- and animal-watching, sky- and star-gazing, presentations and orientations on geology, natural history and culture of area.</p> <p>The visitor centers have cultural and natural history exhibits. The Summit Bldg is an enclosed glass display with informational and educational contents. There is slight scientific bent to exhibits, but not too academic, and informative rather than interational.</p> <p>Books, maps and post-cards are for sale by NHA.</p>	<p>Except for a few unsolicited donations, NHA makes 100% of revenues from sales. Profits are used to meet NPS needs, particularly for new exhibits, interpretive materials, speakers, etc.</p>

EXHIBIT B-8: SUMMARY OF HAWAII VOLCANOES NATIONAL PARK (WITH INTEGRATED VISITOR CENTERS)				
Location and Type	Fee Structure	Nature of Facilities	Exhibits/Activities	Revenues
<p>Located on Island of Hawaii, 30 south of Hilo.</p> <p>Two adjacent facilities — a visitor center and a museum focusing on geological exhibits — are run by the Hawaii Natural History Association (NHA).</p> <p>Buildings &amp; exhibits owned by National Park Service (NPS, US Dept. of Interior). NHA and NPS personnel jointly provide public information and exhibit maintenance; NHA administers sale of educational literature and videos in store areas.</p>	<p>General entrance is \$10 for one car, which covers 7 days of coming and going.</p> <p>There is a Hawaii Volcanoes Annual Pass for \$20.</p> <p>As part of US park system, Golden Age Pass for US citizens 62 and over pay \$10 for lifetime access to all US national parks; \$50 annually for general public for Golden Eagle Pass; free Golden Access Pass for disabled users.</p> <p><i>No separate fees for visitor centers.</i></p>	<p>Kilauea Visitor Center and Thomas A. Jaggar Museum are in Park. Auditorium is adjacent to Visitor Center.</p> <p>The Volcano House Hotel is for-profit concessionaire. Under special use is Kilauea Military Camp, an R &amp; R camp for military not given any Park funds.</p> <p>The Hawaii Natural History Association is nonprofit cooperating agency that feeds money back to Park. A bookstore is operated by HNHA as money-generating source.</p> <p>Park is 209,000 acres. Visitor Center is 1000 sq. ft. Auditorium is 2500 sq. ft. and Museum is 3500 sq. ft.</p>	<p>Orientation desk/bookstore in Visitor Center makes sales on educational items.</p> <p>Exhibits in Visitor Center include geology and rock specimens, taxiderm animal models, petroglyphs, endangered species maps, cultural exhibits, light board on resource management, large maps for orientation and recommended day hikes or drives. Adjacent auditorium shows films and hosts ranger talks.</p> <p>Bookstore in Museum is for HNHA and exhibits on geological phenomenon, Loihi, seismographs, old footage of eruptions, etc. Artwork on Pele legends &amp; Hawaii migrations also displayed.</p>	<p>Except for a few unsolicited donations, NHA makes 100% of revenues from sales. Profits are used to meet NPS needs, particularly for new exhibits, interpretive materials, speakers, etc.</p>



**EXHIBIT B-9: SUMMARY OF  
WAIKIKI AQUARIUM (PAID ATTRACTION PLUS GIFT SHOP)**

<u>Location and Type</u>	<u>Fee Structure</u>	<u>Nature of Facilities</u>	<u>Exhibits/Activities</u>	<u>Revenues</u>
<p>2777 Kalakaua Ave., Waikiki (Oahu)</p> <p>Half nonprofit; half University of Hawaii Research Corporation</p>	<p>Non-resident adults, \$8; ages 13-17, \$4; 12 and under free.</p> <p>Resident adults, \$4; children free.</p>	<p>Primary focus is series of tanks and aquariums which feature Hawaii sealife.</p> <p>Aquarium is on 2.53-acre parcel; two-floor building totals 19,000 square feet.</p> <p>Nonprofit support group "Friends of Waikiki Aquarium" operates gift shop within larger facility.</p>	<p>(Standard aquarium)</p>	<p>Of Aquarium's \$2.5 million budget, 44% comes from ticket sales; 20% from gift shop sales; 18% from State allocations for grounds, maintenance and education; and remaining 18% from memberships, rentals, various other sources.</p> <p>Of the 20% (\$500K) from gift shop sales, 1/5 goes to Aquarium and remainder used for gift shop's own improvements and expansion. However, gift shop budget is subsumed in overall Aquarium budget; not an independent operation.</p>

**EXHIBIT B-10: SUMMARY OF  
MAUI OCEAN CENTER (PAID ATTRACTION PLUS GIFT SHOPS, FOOD & BEVERAGE)**

<u>Location and Type</u>	<u>Fee Structure</u>	<u>Nature of Facilities</u>	<u>Exhibits/Activities</u>	<u>Revenues</u>
<p>Maialaea, Maui</p> <p>Private, for-profit facility owned by Coral World Intl. (which operates similar ocean centers in Israel &amp; Australia).</p> <p>Opened March 1998.</p>	<p>Non-resident adults, \$17.50; children 3-13, \$12; resident adults, \$12; resident children, \$6.</p> <p>Also special school programs allowing children entrance for \$5 each, with limited number of free chaperones.</p>	<p>Viewing exhibits (no live performing animals).</p> <p>Five-acre parcel, about half of which is developed with structures.</p> <p>Retail area of 5,000 sq. ft. offering "higher-quality gifts."</p> <p>Food and beverage (cafeteria style).</p> <p>No separate concessions.</p>	<p>Whale Discovery Center depicting migration patterns (but no live whales).</p> <p>800,000-gallon reef tank containing Hawaiian marine biota — visitors can walk through tunnel and have 360-degree view.</p> <p>Also, reef building with 30-40 smaller tanks. Turtle pool. Manta ray pool. Marine life feeding.</p>	<p>About 65% of gross revenues come from entry fees.</p> <p>Gift shop sales represent 23%, and 12% from food and beverage sales.</p>

EXHIBIT B-11: SUMMARY OF SEA LIFE PARK HAWAII (PAID ATTRACTION PLUS FOOD/GIFT CONCESSIONS)				
<u>Location and Type</u>	<u>Fee Structure</u>	<u>Nature of Facilities</u>	<u>Exhibits/Activities</u>	<u>Revenues</u>
<p>41-202 Kalanianaʻole Hwy. Waimanalo, Oahu 96795</p> <p>Owned by Attractions Hawaii (private for-profit company).</p> <p>Nonprofit branch operates independently through educational department by name of Sea Life Park Marine Research Education Foundation.</p>	<p>General admission is \$24 for adults and \$12 for children aged 4 - 12. Kama'aina rate is half- price (\$12/\$6). Individual annual passes are general admission price plus \$10.</p>	<p>Fenced area, or developed area, contains visitor attractions. This main park is 16 acres.</p> <p>Outside the perimeter are support facilities, i.e. mainte- nance, administration and educational buildings.</p> <p>Internally, SLPH operates a Coral Shop and Sea Life Park General Store.</p> <p>Volume Services independ- ently operates food estab- lishments (Rabbit Island Bar and Grill and Sea Lion Cafe). Maul Divers and Pearl Factory are other private concessions.</p>	<p>For profit branch offers en- tertainment and educational components with sea life medium.</p> <p>Most displays are inform- ational in that they educate about various sea biota. Performances can be somewhat interactive. Hands-on element comes with sea life touching area.</p> <p>The nonprofit SLPMPREF runs volunteer program, school outreach program on endangered species and receives donations to rehabilitate animals.</p>	<p>Entry fees and annual passes represent about 80% gross of total revenues.</p> <p>An estimated 20% of total revenues comes from food and retail concessions.</p> <p>No estimate given for how much the educational arm receives in donations.</p>

EXHIBIT B-12: SUMMARY OF WAIMEA VALLEY ADVENTURE PARK (PAID ATTRACTION PLUS FOOD/GIFT CONCESSIONS)				
<u>Location and Type</u>	<u>Fee Structure</u>	<u>Nature of Facilities</u>	<u>Exhibits/Activities</u>	<u>Revenues</u>
<p>59-884 Kamehameha Hwy. Haleiwa, HI 96712</p> <p>Owned by Attractions Hawaii (private for-profit company).</p> <p>Nonprofit branch called Waimea Valley Arboretum and Botanical Garden.</p> <p>Main attraction is waterfall and natural valley.</p>	<p>General admission is \$24 per adult and \$12 per 4 - 12 year old (plus tax).</p> <p>Kama'aina rates are half- price, i.e. \$12 per adult and \$6 per junior.</p> <p>Annual pass is an additional \$10 per person on top of general admission fee.</p> <p>One-hour tours (horseback riding, all terrain vehicles, mountain bike or kayak) are \$35 plus tax.</p>	<p>Visitor center with gift shop and snack shop is in one location and restaurant is in another facility.</p> <p>Gift shop is owned by WVAP and restaurant is owned by Volume Services, Inc. along with snack shop. Jewelry retailers run by Pearl Factory and Island Sea Gems.</p> <p>The Arboretum is a separ- ate nonprofit within Park.</p> <p>Concessions independently run mountain biking and kayaking activities.</p> <p>Entire WVAP is 1800 acres and facilities' area unavailable.</p>	<p>The Arboretum gives nursery tours and has mini- exhibits and educational displays.</p> <p>There are also signs about flora all throughout Park.</p> <p>The Adventure component includes all terrain vehicles, mountain biking and kayaking within the Park and horseback riding out- side the Park.</p>	<p>Entry fees account for about 80% of gross revenues.</p> <p>Food sales account for about 20%.</p> <p>No figures given for proportion that private conces- sions contribute.</p>

**APPENDIX C:**

**SURVEY QUESTIONNAIRE AND  
METHODOLOGY STATEMENT**

**DIAMOND HEAD USER SURVEY**  
July 1998

Date _____	Reference No. _____
Interviewer Name _____	Interviewer ID _____
Time Start _____	Time End _____
Total Minutes _____	

Hello, my name is \_\_\_\_\_. I work for a private research company, Market Trends Pacific. The State government hired us to conduct a short survey of people who come into the Diamond Head Crater.

- Are you a ... (READ:)
 

Full-time Hawaii resident	1 (GO TO Q2)
Visitor to Hawaii	2 (CONTINUE)
(Other/DK/NA)	9 (CONTINUE)

  - Are you from ... (READ:)
 

Mainland US or Canada	1 (CONTINUE)
Europe	2 (CONTINUE)
Asia	3 (CONTINUE)
(Other/DK/NA)	9 (CONTINUE)
  - Are you here today as part of an organized tour group, or are you visiting Diamond Head on your own?
 

Part of tour group	1 (CONTINUE)
On our own	2 (GO TO Q3)
(Other/DK/NA)	9 (GO TO Q3)
  - Is your group mostly walking to check into a hotel, or did you already stay in Hawaii last night?
 

Walking to check in	1 (CONTINUE)
Stayed in Hawaii last night	2 (CONTINUE)
(Other/DK/NA)	9 (CONTINUE)
  - Was it really important for you to see Diamond Head Crater, or did you mostly come just because it was part of today's tour?
 

Really important to see DH	1 (GO TO Q3)
Mostly just because it was part of tour	2 (GO TO Q3)
(Other/DK/NA)	9 (GO TO Q3)
- (FOR RESIDENTS:) Counting today, how many times in the last 12 months have you been here inside Diamond Head Crater? (DK/NA = 99)
 

privately-owned car (includes rentals)	1
large tour bus	2
mid-sized tour van	3
limousine or other small commercial tour vehicle	4
trolley for visitors	5
City bus	6
foot or bicycle	7
(other - taxi, pedicab, etc.)	8
(DK/NA)	9
- Which of these best describes the way you traveled to Diamond Head today? Was it by ... (READ:)
 

Private car (wherever parked)	1 (Q3 = 1)
Group tour vehicle	2 (Q3 = 2, 3, 4)
Unclear/other (trolley/bus/etc)	3 (Q3 = 5 to 9)

(REFER TO VISUAL AND READ:) The State hopes to make Diamond Head Crater a much nicer place in the future. Someday the larger buildings here will be torn down. A well-designed visitor center will be put up to teach people about the history of the Crater. All parking will eventually be outside, but people can take a shuttle through the tunnel, ride around the inside edge of the crater floor, and get off to hike if they want. They might get to walk into a high tunnel now closed to the public which opens out into a beautiful view. The Crater will still be mostly dry, but more of the original trees and plants will be restored to make it somewhat greener.

This will cost money to build and maintain, so we'd like to know if people would be willing to pay for it, and how much. There would probably be separate charges for parking, for entering on the shuttle, and maybe an optional price for going to the visitor center. Keeping that in mind ...

**FOR PEOPLE WHO CAME IN PRIVATE CARS (REFERENCE Q4 = 1)**

- What is the most you'd be willing to pay to park a private car in a lot outside the Crater? (READ:)
 

one dollar	2
two dollars	3
three dollars	4
more than three dollars	5
(less than \$1 or wouldn't park)	1
(other/DK/NA)	9

(ON ALL PRICE QUESTIONS, IF RESPONDENT GIVES LOWEST ANSWER BUT SEEMS HESITANT, PROBE TO SEE IF ACTUALLY UNLIKELY TO PAY AT ALL)

- Let's say the parking charge was a dollar or two for a private car. On top of that, what is the most you'd be willing to pay, per adult person, to enter the Crater, ride the shuttle, and perhaps walk up to see the views from the top? (READ:)
 

three dollars	2
five dollars	3
seven dollars	4
more than seven dollars	5
(less than \$3 or wouldn't enter)	1
(other/DK/NA)	9

**HOW GO TO Q. 9**

**FOR PEOPLE WHO CAME IN GROUP TOUR VEHICLES (REFERENCE Q4 = 2)**

- What is the most you would be willing to add to the cost of your tour, per adult person, to enter the Crater, ride the shuttle, and perhaps walk up to see the views from the top with your group? (READ:)
 

four dollars	2
six dollars	3
eight dollars	4
more than eight dollars	5
(less than \$4 or wouldn't enter)	1
(other/DK/NA)	9

**HOW GO TO Q. 9**

**FOR PEOPLE WHO CAME SOME OTHER WAY (REFERENCE Q4 = 3)**

- What is the most you'd be willing to pay, per adult person, to enter the Crater, ride the shuttle, and perhaps walk up to see the views from the top? (READ:)
 

three dollars	2
five dollars	3
seven dollars	4
more than seven dollars	5
(less than \$3 or wouldn't enter)	1
(other/DK/NA)	9

**FOR EVERYONE**

9. Last would be a visitor center. It could look something like this (SHOW VISUAL) and would have lots of up-to-date exhibits — things you could touch or interact with — about how volcanic craters form, Diamond Head's cultural and military history, the plants and wildlife here, and so. It would be a sort of museum with lots of imagination, plus snacks and gift shops.

If you had to pay extra to go into it, what's the most you'd pay? (READ:)

- five dollars 2
- six dollars 3
- seven dollars 4
- more than seven dollars 5
- (less than \$5 or wouldn't go) 1
- (other/DK/NA) 9

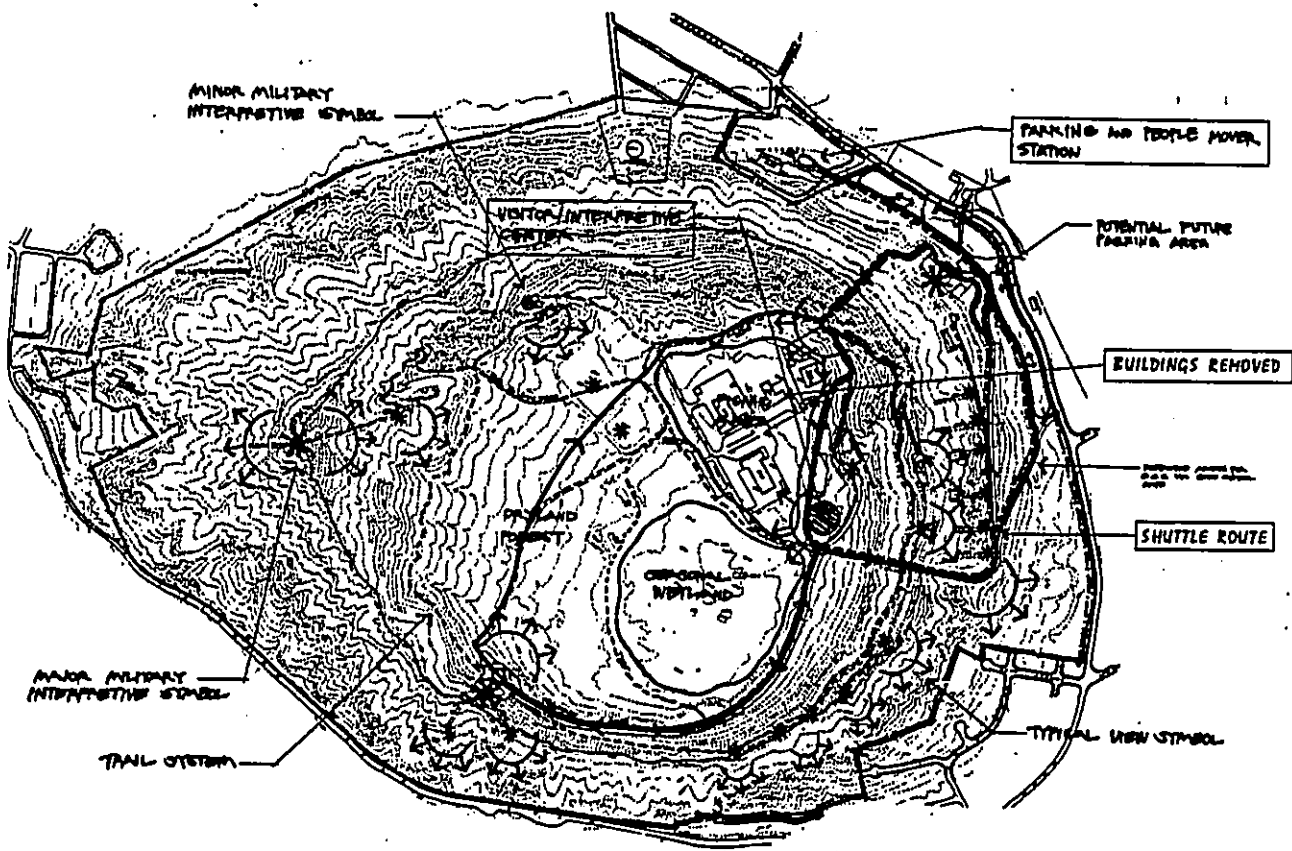
10. Finally, instead of separate charges to enter the Crater and go to the visitor center, there might be one combined charge for both, whether or not people actually went to the visitor center. What's the highest combined charge per adult person you'd be willing to pay to enter the Crater, use the shuttle, and go into the visitor center if you feel like it? (READ:)

- seven dollars 2
- nine dollars 3
- eleven dollars 4
- more than eleven dollars 5
- (less than \$7 or wouldn't go) 1
- (other/DK/NA) 9

11. Did you or will you try to hike all the way up to the top of the rim?

- Yes, hike to top 1
- No, just stay around parking lot 2
- DK/NA 9

Thank you very much for your time and cooperation in this survey!



**CONCEPT 1  
DIAMOND HEAD STATE MONUMENT**



June 1998





## Market Trends Pacific, Inc.

A Marketing Information Center

### Methodology Summary for Diamond Head State Monument Park Intercept Study

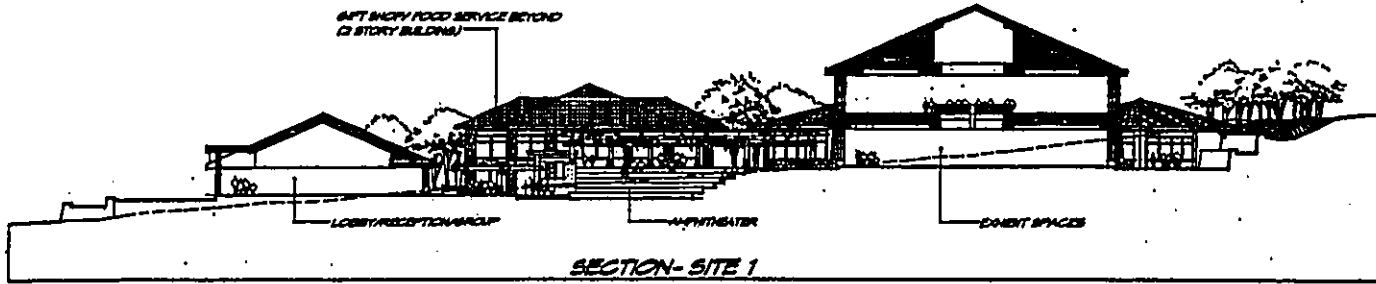
Market Trends Pacific, Inc. surveyed visitors to Diamond Head State Monument park July 11 through July 17. Interviews were conducted during different times (between the hours of 6:30 a.m. and 5:45 p.m.) of the day during the course of a week (7 days) to ensure that the sample was representative of a good cross-section of visitors to the park.

Both eastbound (Japanese) visitors, westbound (North American/European/Canadian) visitors, and Oahu residents were intercepted at the parking lot as well as by the entrance to the hiking trail. Interviewers randomly selected every fourth visitor to complete the survey.

Market Trends Pacific, Inc. had six interviewers, (three interviewers who speak, read, and write the Japanese language fluently and three English-speaking interviewers) intercept and conduct the surveys with both Oahu residents and the visitors from North America, Europe, and Japan.

The Japanese version of the survey instrument was translated and reversed-translated from the English version of the questionnaire.

Upon receipt of the completed questionnaires, Market Trends Pacific, Inc. edited and keypunched all surveys. All data processing was performed using SPSSPC+, an in-house statistical software program. Cross-tabulations of data believed to be important in the analysis was processed by Market Trends Pacific, Inc. and presented in tabular form.



CONCEPTUAL DRAWING OF VISITOR/INTERPRETIVE FACILITY "SUBJECT TO CHANGE"

1136 Union Mall, Suite 310 • Honolulu, Hawaii 96813 • (808) 532-0733 • Fax: (808) 532-0744

**APPENDIX D:**

**SUMMARY OF COMMENTS AND HEARING INPUT  
FOLLOWING COMPLETION OF THIS REPORT**

**GROUP MEMORY: COMMENTS & QUESTIONS**  
**DIAMOND HEAD STATE MONUMENT PUBLIC INFORMATIONAL MEETING,**  
**NOVEMBER 23, 1998, 7:00 P.M., ALA WAI CLUBHOUSE**

**PRESENT:**

Linda Anakawa/Honolulu Advertiser  
Nancy Bannick/Historic Hawaii  
Dave K. Chun/Neighborhood Board #8  
Sue Garner/Ka Iwi Action Council, Sierra Club  
Ruth Gay  
Matt Gilbertson/Architects Hawaii  
E. Alison Kay/Save Diamond Head Association and Diamond Head  
Citizen Advisory Committee  
Linda Jameson/Chainel 2  
Wesley C. Kinder/Kapiolani Park Preservation Society  
Michelle Maisson/DHGAC, Kapiolani Park Advisory Committee,  
Neighborhood Board #5  
Pua Mendonca/Kapiolani Community College  
Mary Steiner/Outdoor Circle  
Rebecca Sullivan  
Ray Tabata/UH Sea Grant  
Clyde Hosokawa/Department of Land and Natural Resources  
Yara Lamadrid-Rose/Department of Land and Natural Resources  
Relation Nagata/Department of Land and Natural Resources  
Sherric Samuels/Department of Land and Natural Resources  
Eric Yuasa/Department of Land and Natural Resources  
Winona Char/Char & Associates  
Roslyn Van Zyle/Hawaii Nature Center  
Frank Brandt/PBR HAWAII  
Carrie Kotoshirodo/PBR HAWAII  
Tom Witten/Friends of Honolulu Botanical Gardens, PBR HAWAII  
Vincent Shigekuni/PBR HAWAII

**Comments Related to the Diamond Head State Monument Preliminary Master Plan:**

Preliminary Master Plan appears to assume the acquisition of the Cannon Club. When will the Cannon Club be available?

Wm. Frank Brandt • Thomas S. Witten • R. Stan Ducean • Russell V. J. Chung

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**GROUP MEMORY: COMMENTS & QUESTIONS**  
**SUBJECT: DIAMOND HEAD STATE MONUMENT PUBLIC INFORMATIONAL**  
**MEETING, NOVEMBER 23, 1998, 7:00 P.M., ALA WAI CLUBHOUSE**

Where are the new comfort stations proposed to be located?

Will the proposed improvements be able to pay for itself?

The focus of the visitor/interpretive center is interpretation with some income generation.

Diamond Head shouldn't be seen as a cash cow for the State.

Income generated in Diamond Head should be used for Diamond Head.

Maybe an amphitheater should be included for revenue generation to support Diamond Head.

What were the Citizen Advisory Committee feelings about the disposition of military features?

Concerned about size of visitor/interpretive facility.

Concerned about the need for a snack bar.

Concerned about landscaping.

Ruthi Gay and Evangeline Funk can contribute to landscaping effort.

Concerned about ADA.

No fires at picnic areas!

Would there be seating at picnic areas? Don't want a lot of tables.

Design of site furniture such as trash receptacles are important.

How will the Master Plan be phased?

Concerned that the focus of Master Plan is the visitor/interpretive center.

Concerned about the mix of bicycles, pedestrians, and rollerbladers within the crater.

Would the crater be used at night? If so would lighting be provided?



**GROUP MEMORY: COMMENTS & QUESTIONS**  
**SUBJECT: DIAMOND HEAD STATE MONUMENT PUBLIC INFORMATIONAL**  
**MEETING, NOVEMBER 23, 1998, 7:00 P.M., ALA WAI CLUBHOUSE**

- Concerned about security within the crater.

- Any plans for current trail, tunnel?

- Maybe interpretive exhibits should be placed outdoors?

**Comments Related to the Proposed Entrance Fees for the Diamond Head State Monument.**

- Would there be a special fee for users who use Diamond Head frequently?

- Will fees be charged before the master plan is implemented?



LAND PLANNING  
LANDSCAPE ARCHITECTURE  
ENVIRONMENTAL STUDIES

**GROUP MEMORY: COMMENTS & QUESTIONS**  
**DIAMOND HEAD STATE MONUMENT PUBLIC INFORMATIONAL MEETING,**  
**NOVEMBER 24, 1998, 6:00 P.M., BLNR BOARD ROOM**

**PRESENT:**

- Brooks Bachur/KHNL-TV
- John Cullinney/Hawaii Pacific University
- Sue Garner/Ka Iwi Action Council, Sierra Club
- Russell Griham/Asian Pacific Cultural Center
- E. Allison Kay/Save Diamond Head Association and Diamond Head Citizen Advisory Committee
- Linda Jameson/Channel 2
- Michelle Matsou/DHCAC, Kapiolani Park Advisory Committee, Neighborhood Board #5
- Theresa Menard
- Frank Smith/New Kapahulu Business Association
- Sid Snyder/DHCAC, Save Diamond Head Association
- Susan Bright Spangler/DHCAC, Outdoor Circle
- Glen Takahashi/Rep. Marcus Oshiro
- Kim Wilson/UH Law School
- Clyde Hosokawa/Department of Land and Natural Resources
- Yara Lamadrid-Rose/Department of Land and Natural Resources
- Andy Monden/Department of Land and Natural Resources
- Ralston Nagata/Department of Land and Natural Resources
- Sherrie Samuels/Department of Land and Natural Resources
- Roger Blankfein/International Archaeological Research Institute, Inc.
- Frank Brandt/PBR HAWAII
- Vincent Shigekuni/PBR HAWAII

**Comments Related to the Diamond Head State Monument Preliminary Master Plan:**

- Why did the estimated visitor count jump so dramatically (in 1994-1995 from the previous year)?
- How were counts taken?
- Are there proposals to improve the safety of existing trails?

Wm. Frank Brandt • Thomas S. Whitten • R. Sun Duocan • Russell Y. J. Chung

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**GROUP MEMORY: COMMENTS & QUESTIONS**  
**SUBJECT: DIAMOND HEAD STATE MONUMENT PUBLIC INFORMATIONAL**  
**MEETING, NOVEMBER 24, 1998, 6:00 P.M., BLNR BOARDROOM**

- Why not include an asian-pacific cultural center within the crater, especially given the state of Hawaii's economy? (see attached entitled "A Modest Proposal")
- The Master Plan should include other recreational activities within the crater, including facilities for running, biking and rollerblading.
- The inside of the crater has the potential to be an "incubator" or safe place for beginning bicyclists.
- Does the Master Plan include provisions for school groups?
- A possible source of revenue is to charge fees to out-of-state school groups.
- The crater is a peaceful place. Save Diamond Head as open space.
- A cultural center would not take up all the open space.
- Provide more shade within the crater.
- Consider traffic calming instead of a signal at the proposed entry/improved intersection of Makepanu Avenue and Diamond Head Road.
- Consider solar-powered lighting for crater trail stairs.
- Why should Civil Defense remain inside the crater?
- Control potential conflicts between slower moving pedestrians and faster moving bicyclists and rollerbladers on trails and paths.
- As Ruth Gay mentioned at the previous public informational meeting, maintain the "sense of wild."
- Include plantings of native plants.
- Consider opening the trail on the crater exterior between Makalei Place and Campbell Avenue.

1762.01/pbr/mg/pubmg2-61