# FINAL ENVIRONMENTAL IMPACT STATEMENT

## Honolulu Area Rail Rapid Transit Project



**U.S. DEPARTMENT OF TRANSPORTATION**

**URBAN MASS TRANSPORTATION ADMINISTRATION**



April 1982

MUNICIPAL REFERENCE LIBRARY CATALOGING-IN-PUBLICATION:

United States. Urban Mass Transportation Administration.
Honolulu area rail rapid transit project.

In cooperation with the City and County of Honolulu, Department of Transportation Services.

1. Honolulu—Transit systems. 2. Local transit—Honolulu. I. Honolulu. Department of Transportation Services.
TD194.5.E91 no. 153 Final

U.S. Department of Transportation
Urban Mass Transportation Administration

400 Seventh St., S.W.
Washington, D.C. 20590

April 20, 1982

Ms. Agnes Conrad, State Archivist
State Archives
Iolani Palace Grounds
Honolulu, Hawaii 96813

Dear Sir:

The enclosed Final Environmental Impact Statement (EIS) documents the environmental impacts of the various alternative transit systems studied for central Honolulu. The locally preferred alternative is the Rail Rapid Transit Alternative. This alternative consists of a guideway segment length of 8.4 miles, served by 11 stations from the Honolulu International Airport to the University of Hawaii-Manoa Campus.

This Final EIS is being sent to appropriate agencies as well as to those who commented on the Draft EIS. UMTA is required to wait a minimum of 30 days before making any further decisions on the preferred alternative; however, further decisions on this and other rail transit projects are being deferred at least until the Nation's economic situation and the condition of the Federal budget improve.

Sincerely,

Edward R. Fleischman
Acting Director
Office of Program Analysis

Enclosure

DEPARTMENT OF TRANSPORTATION SERVICES
CITY AND COUNTY OF HONOLULU
HONOLULU MUNICIPAL BUILDING
650 SOUTH KING STREET
HONOLULU, HAWAII 96813

EILEEN R. ANDERSON
MAYOR

ROY A. PARKER
DIRECTOR

April 1982

# FINAL ENVIRONMENTAL IMPACT STATEMENT
for the
HONOLULU AREA RAIL RAPID TRANSIT PROJECT

Pursuant to the State of Hawaii, Environmental Quality Commission "Environmental Impact Statement Regulation", this supplemental document to the Final EIS addresses the unresolved issues and the necessary Approvals/Permits as they affect the implementation of the proposed action.

A. Unresolved Issues

There are no known unresolved issues at this time; however, there is always the potential for issues to arise during final engineering and construction of the project. In such cases, the regulating agency or authority will be consulted and the issue resolved by the approving line agency or authority.

B. Necessary Approvals/Permits

1. Approval of the Alternatives Analyses Study by the Secretary of Transportation, U.S. Department of Transportation -- approved November 15, 1976
2. Acceptance of Final EIS by the Mayor -- accepted July 30, 1980 (by the Department of Land Utilization, designated the authorized representative of the Mayor)
3. Acceptance of Final EIS by the Governor -- accepted December 15, 1980
4. Approval of Final EIS by the Secretary of Transportation, U.S. Department of Transportation -- February 10, 1982
5. Approvals by the Oahu Metropolitan Planning Organization (OMPO) of:

   a) the Long-Range Transportation Plan -- is required annually

   b) the Transportation Improvement Program -- is required annually

6. Approval of the City's Development Plans incorporating the proposed action by the City Council -- (DP for PUC adopted November 1981)

7. Approval of the Capital Grant for 80 percent of the project cost by the Secretary of Transportation, U.S. Department of Transportation -- not started

8. Approvals for authorization of 20 percent of local share of the project cost -- local share not approved

9. Approvals/permits required from Federal agencies include:

   a) U.S. Army Corps of Engineers*: Section 10 and Section 404 permits to work in wetlands and navigable waters

   b) U.S. Coast Guard*: Section 9 permit for crossing navigable waters

10. Approvals/permits required from State agencies include:

   a) Department of Land and Natural Resources: transfer of State owned lands* and Section 106 - Historic Sites agreement (Agreement signed Aug. 1981)

   b) Department of Transportation*: construction within highway, harbor, or airport properties

   c) Department of Health*: review of construction plans

   d) Department of Accounting and General Services*: coordination of construction activities near State facilities

11. Approvals/permits required from City agencies include:

   a) Building Department: building permits

   b) Department of Public Works: grading permits, review of construction plans

   c) Department of Land Utilization*: special management area permits and certificates of appropriateness

   d) Board of Water Supply: review of construction plans

   e) Fire Department: review of construction plans

   f) Department of Parks and Recreation*: right-of-entry permits to parklands for construction purposes

   g) Department of Transportation Services*: roadway use permits

*Initiated coordination

EXECUTIVE CHAMBERS

HONOLULU

GEORGE R. ARIYOSHI
GOVERNOR

December 15, 1980

Mr. Donald A. Bremner, Chairman
Environmental Quality Commission
550 Halekauwila Street, Room 301
Honolulu, Hawaii 96813

Dear Mr. Bremner:

Subject: Environmental Impact Statement for the Proposed Honolulu Area Rapid Transit Project

Based upon the recommendation of the Office of Environmental Quality Control, I am pleased to accept the subject document as satisfactory fulfillment of the requirements of Chapter 343, Hawaii Revised Statutes. This environmental impact statement will be a useful tool in the process of deciding whether or not the action described therein should or should not be allowed to proceed. My acceptance of the statement is an affirmation of the adequacy of that statement under the applicable laws, and does not constitute an endorsement of the proposed action.

When the decision is made regarding the proposed action itself, I expect the proposing agency to weigh carefully whether the societal benefits justify the environmental impacts which will likely occur. These impacts are adequately described in the statement, and, together with the comments made by reviewers, provide a useful analysis of alternatives to the proposed action.

With warm personal regards, I remain,

Yours very truly,

George R. Ariyoshi

cc: Mr. Akira Fujita, Acting Director
Department of Transportation

DEPARTMENT OF TRANSPORTATION
URBAN MASS TRANSPORTATION ADMINISTRATION
WASHINGTON, D.C. 20590

# FINAL ENVIRONMENTAL IMPACT STATEMENT AND 4(f) STATEMENT

## CITY AND COUNTY OF HONOLULU

## RAIL RAPID TRANSIT PROJECT

This statement is submitted pursuant to Section 102(2)(C) of the National Environmental Policy Act of 1969 (PL 91-190); Sections 3(d) and 14 of the Urban Mass Transportation Act of 1964 as amended; Section 4(f) of the Department of Transportation Act of 1966; and Section 106 of the National Historic Preservation Act of 1966.

February 10, 1982
Date

Robert H McManus
ROBERT H. McMANUS
Associate Administer
for Transit Assistance

# PREFACE

This Final Environmental Impact Statement (EIS) was prepared by the Urban Mass Transportation Administration (UMTA) in cooperation with the City and County of Honolulu, Department of Transportation Services (DTS) to meet the requirements of the National Environmental Policy Act of 1969 (NEPA) and the Urban Mass Transportation Act of 1964, as Amended. This Final EIS represents documentation of the probable environmental impacts of a proposed rail rapid transit project in the City and County of Honolulu.

UMTA and the City and County of Honolulu have been substantially involved in the preparation and development of the Draft and Final EIS. The proposed project has been the subject of extensive discussion and review with local officials and the public since 1971. Public meetings were held in Honolulu and in the neighborhoods where the proposed project is located.

The Draft EIS was circulated to various Federal, State, and local agencies and to interested organizations and individuals in accordance with the applicable guidelines and regulations adopted pursuant to NEPA. UMTA received comments on the Draft EIS for one hundred and fifty two (152) days after the official start of circulation on Friday, July 27, 1979, in Honolulu, Hawaii.

The City and County of Honolulu held public hearings on the Draft EIS on Tuesday, December 11 and Wednesday, December 12, 1979, for the proposed project in Honolulu, Hawaii. UMTA and the City and County of Honolulu have addressed all substantive comments received on the social, economic, and environmental issues in this Final EIS. Changes from the Draft EIS are indicated by vertical margin lines in this final text.

Copies of the Final Statement and the Comments and Responses on the Draft EIS may be obtained, as supplies permit, or inspected at:

- Urban Mass Transportation Administration
  Region IX
  Two Embarcadero Center, Suite 620
  San Francisco, California 94111

- Department of Transportation Services
  City and County of Honolulu
  650 South King Street, 3rd Floor
  Honolulu, Hawaii 96813

Copies of the Final EIS and the Comments and Responses on the Draft EIS may be inspected at:

<u>Public Libraries</u>

State Main Branch

Regional:

Kaimuki Regional Library
Kaneohe Regional Library
Pearl City Regional Library
Hilo Regional Library
Wailuku Regional Library
Lihue Regional Library

Branch:

Aiea Library
Aina Haina Library
Ewa Beach C/S Library
Hawaii Kai Library
Kahuku C/S Library
Kailua Library
Kalihi-Palama Library
Liliha Library
Manoa Library
McCully-Moiliili Library
Wahiawa Library
Waialua Library
Waianae Library
Waikiki-Kapahulu Library
Waipahu Library

Other:

Hamilton Library, Hawaiian Collection
State Archives
LRB Library
Municipal Reference Center (for Oahu EIS's)
Leeward Community College Library
Windward Community College Library
Makiki Library

Copies of the Final EIS and the Comments and Responses on the Draft EIS can be purchased from:

Environmental Law Institute
1346 Connecticut Avenue, N.W.
Washington, D.C. 20036

## SUMMARY

# FINAL ENVIRONMENTAL IMPACT STATEMENT

Department of Transportation
Urban Mass Transportation Administration

1. Name of Action: Administrative Action

2. Description of Proposed Action:

   A. The proposed action is the implementation of a fixed guideway (rail) rapid transit system. Supplemented by an island-wide local and express feeder bus system, the proposed system would provide improved transit service to all urbanized areas on the island of Oahu. The development of the proposed system consists of a guideway segment length of 8.4 miles (hereinafter referred to as 8-mile segment) served by 11 stations from the Honolulu International Airport to the University of Hawaii-Manoa Campus. The estimated daily patronage for the proposed system for 1990 and 1995 are projected to be 360,000 and 413,000, respectively.

   The system would traverse the downtown Honolulu area where a 1.7-mile subway segment would be located with the remainder of the guideway on elevated structures. The maintenance yard and shop site would be located on the east bank of Keehi Lagoon.

   B. The estimated total capital cost for the 8-mile project is currently estimated at $870 million if construction is started in early 1983. Construction would then take place between 1983 and 1988 and certain portions of the system would be affecting the environment to a varying degree. Capital cost includes right-of-way and relocation, construction, equipment procurement, transit vehicles (84), control and surveillance systems, administration and engineering, and contingency funds.

3. Summary of Effects:

A. Long-Term Beneficial Effects:

1. The proposed fixed guideway system would decrease average trip time, increase rider convenience and comfort, and improve mobility and accessibility compared to "no-build" or all-bus alternatives.

2. The system would improve mobility for the transit dependent, including the elderly and handicapped.

3. The system would provide needed transportation capacity and a broader choice of travel modes to meet projected travel demand in the Central Honolulu Area.

4. The system would provide positive economic benefits to the island in terms of travel time and cost savings and in potential urban development.

5. The system would support land use policies by providing transportation capabilities that are compatible with more intensive use of urban lands along with the preservation of agricultural land.

6. The rate of increase in overall concentration of air pollutants in the Central Honolulu area would be reduced.

7. The project would result in a reduction of petroleum use by 2.36 billion Btu per day compared to a "no-build" alternative.

B. Long-Term Adverse Effects:

1. The fixed guideway system would require the permanent use of 1.7 acres of parklands for a transit station and up to 1,000 sq. ft. for guideway support columns and a 2-acre easement for the aerial guideway with the ground surface retained for park use at the Keehi Lagoon Beach Park. At the Ala Wai Park, some 100 sq. ft. of land will be permanently used for guideway support columns and up to 2,000 sq. ft. of easement for foundations. The 4(f) statements have been prepared and are included in Chapter VI.

2. The Robinson and McCorriston Buildings and the Hotel Street Sidewalk Elements, all eligible for inclusion in the National Register of Historic Places, would be adversely affected. Section 106 of the National Historic Preservation Act procedures have been followed, including coordination and consultation with the State Historic Preservation Officer, and documented in Chapter VI.

3. Approximately 140 to 150 residential units and 170 to 180 business units would be displaced.

4. Some elevated sections would cause some negative visual impacts to the community and obstruct scenic views in certain areas.

5. Local increases or changes in vehicular emissions, noise, and traffic patterns would result in direct proportion to any increase in traffic volume especially around transit stations.

6. The system may cause minor disturbance to the natural flow of water at the mouth of Moanalua Stream through the construction of several guideway columns within the stream. This could affect the habitat of the nehu (fish) in Keehi Lagoon.

7. Traffic patterns on local streets, especially around stations, would be affected with changes in total and turning movement volumes.

8. Increase demands for housing and office space along the transit route, especially around stations, would encourage high density developments and cause pressures for upzoning of certain properties.

C. Short-Term Effects During Construction:

1. Construction of the proposed system would affect historic buildings on or eligible for the National Register of Historic Places in Chinatown, the CBD and the Capital District. These buildings will have to be protected during underground construction and the Municipal Reference Center Building must also be protected by underpinning.

2. Increase in noise, vibrations, and air pollution emissions would be anticipated.

3. Temporary traffic congestion and pedestrian inconveniences would occur along the route and adjacent streets, especially around the stations.

4. Some businesses could be affected by a reduction in business activity during the construction phase, which in some areas, such as along Hotel Street, could take up to 3 1/2 years.

5. Removal of vegetation in certain areas would result in unsightly conditions until construction of the facilities are completed and landscaping is in place.

6. Construction of the subway structure through the Aala International Park would require a temporary construction easement affecting some 3,000 sq. ft. of land.

7. The construction of the proposed system is estimated to require approximately 3 billion kwh of energy.

4. <u>Alternatives Considered</u>:

A. System Alternatives:

1. Non-Grade-Separated Alternatives

a. Baseline Bus ("no-build" System: This alternative represents the continuation of the standard bus service and the implementation of the City's Short-Range Bus Plan.

b. TSM/Expanded Bus System: This system includes a vastly expanded transit bus system operating on existing streets and freeways that are modified to provide more expeditious service and increase capacity.

2. Grade-Separated Alternatives

a. Busway: This alternative includes an all-bus system running on exclusive rights-of-way through the central corridor of Honolulu and supported by express and feeder buses.

b. Light Rail Rapid Transit (LRRT): This alternative incorporates many elements associated with fixed guideway technology including grade-separated rights-of-way and stations to the light rail transit concept which can be operated in existing street and highway rights-of-way and in mixed traffic.

c. Fixed Guideway Rapid Transit: This alternative is a fixed guideway rapid transit system operating entirely on exclusive right-of-way through the central corridor of Honolulu and supported by express and feeder buses.

3. Other Alternatives

Various other transit system alternatives that were examined but dismissed in favor of the above described Non-Grade-Separated and Grade-Separated Alternatives included the Light Rail (streetcar), Trolley Bus, Downtown People Mover, and Waterborne Systems.

4. Evaluation of Alternatives

Alternative transit systems were divided into two groups for evaluation -- non-grade-separated (low capital cost) and grade-separated (high capital cost) systems. Each group of alternatives was separately evaluated due to the limitations of the non-grade-separated systems in meeting the long-term needs of the area. The TSM/Expanded Bus (non-grade separated) and the Fixed Guideway Rapid Transit (grade-separated) systems were selected as representing the best within their respective groups.

The two "best" systems were evaluated for feasibility comparison (5 to 10 years) to determine whether the investment in the Fixed Guideway system would be warranted in the near-term. It was found that by 1990, the advantages of the Fixed Guideway system's ability to attract more riders at a lower marginal operating cost than the TSM/Expanded Bus system became apparent.

Summary
of
COMPARATIVE EVALUATION

| FACTOR | TSM/EXPANDED BUS | 8-MILE FIXED GUIDEWAY |
|---|---|---|
| TRANSPORTATION | Nominal increase in ridership, service quality, and transportation capacity | Substantial increase in ridership, service quality, and transportation capacity |
| LAND USE | May not be compatible in the long term | Compatible with and supports land use policies |
| DISPLACEMENT | Some displacement | Substantial displacement |
| ENVIRONMENTAL | | |
| Air Quality | Adverse, esp. in CBD | Generally improves |
| Water Quality | Not significant | Not significant |
| Noise | Adverse, esp. in CBD | Adverse, but not significant |
| Visual | Not significant | Adverse along aerial sections |
| Historic | Not significant | Adverse, but not significant |
| Ecology | Not significant | Not significant |
| ENERGY | Slight savings | Greater savings |

B. Corridor Alternatives:

Central Honolulu is the most densely urbanized region on Oahu. It is characterized by a narrow band of residential, industrial, business, government, social, and recreational land uses, approximately 12 miles long and 2 to 3 miles wide. This dense band of activity is bordered by the Koolau Mountains to the north and the Pacific Ocean to the south. In this high activity corridor, a number of alignment and station location alternatives were considered and a selection made as described in Section III.D.

C. System Length Alternatives:

Various alternative system lengths up to a maximum of 14 miles with terminals at Halawa and Kahala and 14 intermediate stations were considered. The shortest length was 7 miles with terminals at Keehi Lagoon and the University. In total, 5 alternative lengths were considered and all were found to provide a viable system, with the 8-mile length selected as discussed in Section III.E.

D. Vehicle System Alternatives:

Two basic types of vehicle systems were considered -- the conventional heavy rail steel-wheeled vehicles and the rubber-tired vehicles. The heavy rail vehicles considered were the modern 75-ft. long cars similar to those used in the Washington D.C. and Atlanta systems. The rubber-tired vehicles are somewhat smaller, approximately 60 ft. in length, and similar to those employed by the Montreal, Mexico City and Sapporo (Japan) systems. The conventional heavy-rail steel-wheeled vehicle system was selected as discussed in Section III.F.

5. Comments on the Draft Environmental Impact Statement Were Received from the Following Federal, State and Local Agencies and Other Sources

Federal Agencies:

U.S. Department of Transportation
Federal Aviation Administration
Federal Highway Administration

U.S. Department of Agriculture
Soil Conservation Service

U.S. Department of Commerce
Assistant Secretary for Science & Technology
National Oceanic and Atmospheric Administration

U.S. Department of Defense
U.S. Air Force, 15 ABWg/DEE
U.S. Army-Commanding Gen./Support Command Hawaii
Corps of Engineers, Pacific Ocean Division
U.S. Navy, 14th Naval District
U.S. Navy, Headquarters Naval Base Pearl Harbor

U.S. Department of Housing and Urban Development
Area Manager

U.S. Department of Interior
Office of the Secretary,
Environment Project Review

Advisory Council on Historic Preservation

U.S. Environmental Protection Agency
Region IX Office, Administrator

State Agencies:

Office of Environmental Quality Control
Department of Agriculture
Department of Health
Department of Defense
Department of Transportation
Department of Education
Office of the Governor, Marine Affairs Coordinator
University of Hawaii, Environmental Center
University of Hawaii, Water Resources Research Center
House of Representatives, The Honorable
Clifford T. Uwaine & David M. Hagino

City and County of Honolulu Agencies:

Department of Land Utilization
Department of Public Works
Department of Housing and Community Development
Board of Water Supply
Building Department

Other Organizations and Individuals:

1) American Lung Association of Hawaii
2) Cement and Concrete Products Industry of Hawaii
3) Chamber of Commerce of Hawaii
4) Citizens Against Noise
5) Construction Industry Legislative Organization
6) Council of Presidents

7) Downtown Improvement Association
8) Hawaii Bicycling League
9) Hawaii Building and Construction Trades Council, AFL-CIO
10) Hawaii Society of the American Institute of Architects
11) Hawaii State Federation of Labor, AFL-CIO
12) Hawaiian Electric Company
13) Hawaiian Telephone Company
14) International Association of Bridge, Structural and Ornamental Iron Workers
15) International Brotherhood of Electrical Workers, Local Union 1186
16) International Union of Bricklayers and Allied Craftsman, Local 1
17) Laborer's International Union of North America, Local 368
18) Land Use Research Foundation of Hawaii
19) League of Women Voters
20) Life of the Land
21) Makiki Community Association
22) Moiliili-McCully Community Council
23) Neighborhood Board No. 2 - Kuliouou-Kalani Iki
24) Neighborhood Board No. 3 - Waialae-Kahala
25) Neighborhood Board No. 4 - Kaimuki
26) Neighborhood Board No. 7 - Manoa
27) Neighborhood Board No. 8 - McCully-Moiliili
28) Neighborhood Board No. 9 - Waikiki
29) Neighborhood Board No. 10 - Makiki
30) Neighborhood Board No. 21 - Pearl City
31) Neighborhood Board No. 27 - North Shore
32) Oahu Development Conference
33) Operative Plasterer's and Cement Mason's, Local 630
34) Painters and Allied Trades
35) The Council of Downtown Honolulu Merchants
36) United Brotherhood of Carpenters and Joiners of America, Local 745
37) Waikiki Residents Association
38) Stephen L. Brown
39) Donald R. Hanson
40) Letitia Hickson, PhD. & Andrew Arno, Phd.
41) Philip Thayer
42) Revocato Medina
43) Clyde V. Preece
44) Michael DiCarlo
45) Gene Heston
46) James Marn, Jr.
47) Tom Rainey
48) Dr. Philip Ellison
49) Philip Blackman
50) Virginia MacDonald
51) Jane Hanson
52) Helen C. Priester

## REVIEW AND FINDINGS

This Final Environmental Impact Statement represents a detailed statement, as required by Section 14 of the Urban Mass Transportation Act of 1964 and Section 102(2)(C) of the National Environmental Policy Act of 1969, as amended, on:

(1) the environmental impact of the proposed project;

(2) any adverse environmental effects which cannot be avoided should the proposal be implemented;

(3) alternatives to the proposed project;

(4) the relationship between local short-term uses of man's environment and the maintenance and enhancement of long-term productivity; and

(5) any irreversible and irretrievable impacts on the environment which may be involved in the proposed project should it be implemented.

Based on the information contained in this Final Environmental Impact Statement and on consideration of the written and oral comments offered on the draft document, the Urban Mass Transportation Administration has determined in accordance with Section 14 of the Act that:

(1) adequate opportunity was afforded for the presentation of views by all parties with a significant economic, social, or environmental interest, and fair consideration has been given to the preservation and enhancement of the environment and to the interest of the community in which the proposed project is located, and

(2) all reasonable steps have been taken to minimize adverse environmental effects of the proposed project, and where adverse environmetnal effects remain there exists no feasible and prudent alternative to avoid or mitigate such effects.

TABLE OF CONTENTS

Page No.

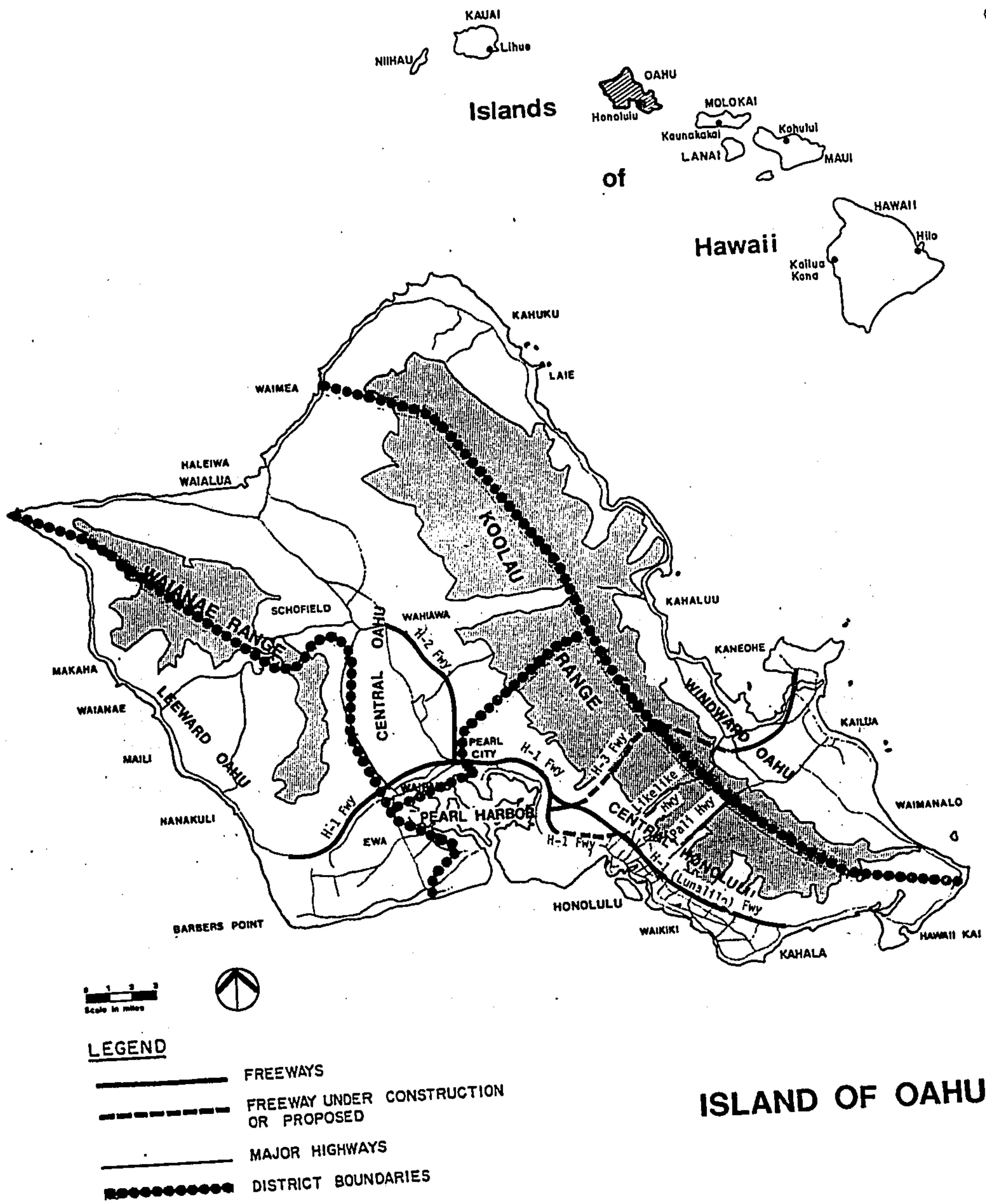
Page No.

## LIST OF FIGURES

| Figure No. | | Page No. |
|---|---|---|
| V-14 | Existing Development Along Transit Route - Keehi Lagoon-Kalihi . . . . . | V-46 |
| V-15 | Existing Development Along Transit Route - Downtown-Civic Center . . . . | V-46 |
| V-16 | Existing Development Along Transit Route - Ala Moana-Waikiki-University. | V-46 |
| V-17 | Existing and Proposed Bikeway Routes . . | V-50 |
| V-18 | Dislocation Impact . . . . . . . . . . . | V-62 |
| V-19 | Existing Spoils Disposal Sites . . . . . | V-79 |
| VI-1 | General Location of Section 4(f) Parkland Takings and Eligible Historic Buildings . . . . . . . . . | VI-1 |
| VI-2 | Keehi Lagoon Beach Park with Proposed Action and Alternatives . . | VI-2 |
| VI-3 | Proposed Keehi Lagoon Station Site Plan. | VI-3 |
| VI-4 | Alternatives to the Proposed Action . . | VI-4 |
| VI-5 | Aala International Park . . . . . . . . | VI-13 |
| VI-6 | Alternatives to the Proposed Action . . | VI-15 |
| VI-7 | Ala Wai Park Field and Playground . . . | VI-18 |
| VI-8 | Proposed Action . . . . . . . . . . . . | VI-20 |
| VI-9 | Alternative to the Proposed Action . . . | VI-21 |
| VI-10 | Robinson Building . . . . . . . . . . . | VI-23 |
| VI-11 | Fort Street Station Alternative Location for Robinson Building . . . | VI-24 |
| VI-12 | McCorriston Building . . . . . . . . . . | VI-25 |
| VI-13 | Fort Street Station Alternative Location for McCorriston Building . . | VI-26 |
| VI-14 | Hotel Street Sidewalk Elements . . . . . | VI-27 |
| VI-15 | General Location of Historic Properties - Kalihi Area . . . . . . | VI-29 |
| VI-16 | General Location of Historic Properties - Downtown-Kakaako Area. . | VI-29 |
| VI-17 | General Location of Historic Properties - Moiliili-University Area . . . . . | VI-29 |
| VI-18 | Capital Historic District . . . . . . . | VI-32 |
| VI-19 | Portland Building . . . . . . . . . . . | VI-35 |
| VI-20 | Alexander Young Hotel Building . . . . . | VI-37 |
| VI-21 | James Campbell Building . . . . . . . . | VI-39 |
| VI-22 | Hawaii Building . . . . . . . . . . . . | VI-41 |
| VI-23 | S.H. Kress Building . . . . . . . . . . | VI-43 |
| VI-24 | Advertiser Building . . . . . . . . . . | VI-45 |
| VI-25 | Oahu Ice and Cold Storage Building . . . | VI-47 |
| VI-26 | (omitted) | |
| VI-27 | OR & L Station . . . . . . . . . . . . | VI-50 |
| VI-28 | Tong Fat Co. Building . . . . . . . . . | VI-52 |
| VI-29 | Ala Wai Clubhouse . . . . . . . . . . . | VI-54 |
| VI-30 | Oahu Prison Administration Building . . | VI-56 |
| VI-31 | Brass Foundry Building . . . . . . . . . | VI-57 |
| VI-32 | Church of the Crossroads . . . . . . . . | VI-58 |

# LIST OF TABLES

| Table No. | | Page No. |
|---|---|---|
| III-14 | Route Evaluation Factors . . . . . . . . . | III-45 |
| III-15 | Weighting of Intangible Factors in PEEP I Route Planning . . . . . . | III-46 |
| III-16 | Rapid Transit Alternative Route Alignments and Station Locations . . | III-48 - 53 |
| III-17 | Fixed Guideway Only - Total Annual Cost Analysis . . . . . . . . | III-60 |
| III-18 | Total Annual Cost Analysis . . . . . . . . | III-61 |
| III-19 | Benefit - Cost Ratio . . . . . . . . . . | III-61 |
| III-20 | Alternative Segment Length Evaluation Matrix (1990) . . . . . . | III-63 |
| IV-1 | Preliminary Capital Cost Estimate . . . | IV-8 |
| IV-2 | Annual Operating and Maintenance Costs and Revenues for 8-Mile System. | IV-9 |
| V-1 | Emission Factors . . . . . . . . . . . . . . | V-2 |
| V-2 | Comparison of Daily Vehicle Miles Traveled - 1995 . . . . . . . . . . . | V-3 |
| V-3 | Comparison of Pollution Emission in 1995 . . . . . . . . . . | V-4 |
| V-4 | Annual Power Plant Emission for Fixed Guideway in 1995 . . . . . . . | V-5 |
| V-5 | Vehicular Activity Generated by Fixed Guideway . . . . . . . . . . | V-6 |
| V-6 | Traffic Projection in Impact Area of Selected Stations . . . . . . . . | V-7 |
| V-7 | Plant Materials Affected . . . . . . . . | V-19 |
| V-8 | Energy Savings . . . . . . . . . . . . | V-20 |
| V-9 | Guidelines for Maximum Noise from Train Operations . . . . . . . . | V-22 |
| V-10 | Typical Airborne Noise Levels from Surface Transit Operations . . . . . | V-24 |
| V-11 | Typical Ground-Borne Noise Levels from Subway Transit Operations . . . | V-25 |
| V-12 | Typical Airborne Noise Levels from Fan and Shafts of Subway Transit Operations . . . . . . . . . . | V-26 |
| V-13 | Noise Sensitive Areas Exceeding Design Goals . . . . . . . . . . . . | V-37 |
| V-14 | Mode of Access to and from Stations during 1995 Peak Hour . . . . . . . . | V-52 |
| VI-1 | Comparative Summary - Alternative Route Evaluation . . . . . . . . . . | VI-7 |
| VI-2 | Summary of Alternative Route Evaluation . . . . . . . . . . . . . | VI-16 |




# ISLAND OF OAHU

FIGURE I-1

# I. REGIONAL DESCRIPTION

## A. STATE OF HAWAII

The State of Hawaii consists of eight major islands and 124 minor islands. The eight major islands (Figure I-1) are Oahu, Kauai, Molokai, Lanai, Maui, Hawaii, Niihau (privately owned), and Kahoolawe (a military bombing range currently uninhabited). The State encompasses 6,450 square miles, of which 6,425 are land and 25 are inland waters, and features a total coastline of some 750 miles, fourth greatest among the states and territories of the nation. Only 185 miles of this coastline are sandy and of those only 24 miles are considered to be safe, clean, accessible, and suitable for year-round swimming. Half in the latter category is on the Island of Oahu. The capital city of Honolulu, on Oahu, is 2,397 miles from San Francisco, and 4,829 miles from Washington, D.C. The State is 1,523 miles in length, second only to Alaska in this respect.

### A.1. Climate

Hawaii's balmy climate is generally considered to be one of the State's greatest assets by visitors and residents alike. Temperature and rainfall vary more by location than season. Temperature extremes in downtown Honolulu are 57°F to 88°F. Average precipitation ranges from 5.7 inches near Kawaihae on the Island of Hawaii to 486.1 inches at Waialeale Summit on Kauai, the wettest spot in the United States. The longest volcanic eruption in Hawaii's history lasted 867 days and the highest tsunami (tidal wave) reached 56 feet.

### A.2. Population

The 1978 resident population of the State of Hawaii was estimated at 896,600 including 56,500 members of the armed forces and 61,100 military dependents.[1] The de facto state population was approximately 984,700. This figure takes into account all persons physically present in the State, including the State's daily average of 96,000 visitors, and excludes approximately 7,900 residents temporarily absent.

The population is young - 50 percent were under 25 years of age in 1970 - and racially diversified, over one-fourth of the population being the product of mixed marriages. U.S. Census figures show that everyone in the State is a member of a minority group, for no single ethnic group is in the majority. Hawaii's ethnic groups include: Caucasian, 26.2 percent; Japanese, 25.2 percent; Hawaiian and Part-Hawaiian, 9.7 percent; Filipino, 9.7 percent; Chinese, 4.2 percent; Negro, 1.1 percent; Korean, 1.1 percent; Samoan, 0.9 percent; mixed (except Part-Hawaiian), 10.2 percent; and other groups, 1.7 percent.[1]

## A.3. Industries

Hawaii's economic base consists of three major components: Federal government (particularly military) expenditures, tourism, and agriculture (principally sugar and pineapple). Their relative proportions are indicated in the table below.

TABLE I-1

MAJOR SOURCES OF STATE INCOME[1]
-1978-

| Source | Amount (Millions of $) | Percent |
|---|---|---|
| Federal Expenditure | 2,507 | 49 |
| Tourism | 2,188 | 42 |
| Agriculture | 442 | 9 |
| Sugar | 285 | 6 |
| Pineapple | 157 | 3 |

Since the immediate post-war years, Hawaii has experienced spectacular growth which has been reflected in its construction industry. Completed construction in 1957 was valued at $134 million; in 1967, $346 million; in 1972, $696 million; in 1975, $1,160 million; and in 1978, $1,060 million. The Island of Oahu accounts for over 80 percent of both the total State income and retail sales; construction on Oahu amounted to nearly 90 percent of the State total.

## A.4. Land Use

Hawaii has a unique State Land Use Law which designates all land in the State as one of the following "district" classifications: urban, agricultural, conservation, or rural. One of the main objectives of the Land Use Law is to preserve urban-rural balance and prevent encroachment on prime agricultural land. District classification and boundaries are assigned by a quasi-judicial State Land Use Commission.

Since the islands are volcanic in origin, much of the land is too steep for development or lacks productive capacity. Thus, of the more than four million acres on the six major islands, in 1979 only 151,930 were in urban use. Primary uses, statewide, as defined by the Hawaii State Land Use

Commission are: Urban (151,930 acres); Conservation (1,976,110); Agricultural (1,974,230); and Rural (9,235).[1]

### A.5. Energy Resources

Hawaii depends almost entirely on petroleum products for its energy requirements. Whereas the mainland States collectively have only a 46 percent petroleum energy base, Hawaii has no coal, natural gas, nuclear energy, significant hydroelectric power, or developed geothermal resources. Hawaii is currently exploring potential alternate energy sources to alleviate its total dependence on petroleum.

## B. ISLAND OF OAHU

The Island of Oahu comprises 9.4 percent of the State's total area. It is the seat of State government and the entire island constitutes the City and County of Honolulu.

Oahu lies on the edge of the tropical zone, just below the Tropic of Cancer at about the same latitude as Mexico City. It is longitudinally bisected by the 158° West Meridian. Oahu's greatest dimensions are 44 by 30 miles. Encompassed in its irregular 112-mile coastline are 608 square miles.

The island can be divided into four distinct geographical regions (Figure I-1):

- Central Honolulu: the leeward side of the Koolau Range and the center of trade, commerce, communication, transportation, manufacturing, and tourism for the State of Hawaii; a subsequent section is focused on the Central Honolulu region
- Central Oahu: the central plains between the Koolau and Waianae Ranges
- Windward Oahu: the windward side of the Koolau Range
- Leeward Oahu: the leeward side of the Waianae Range

### B.1. Environmental Factors

The following discussions of geology and topography, climate, hydrology, energy sources, and air quality are intended to shed light on Oahu's environmental setting. Where appropriate, comparative discussions by region are provided. In some cases, extensive discussion of environmental factors as they relate to the Central Honolulu region are provided in a subsequent chapter pertaining to the Central Honolulu Study Area.

a. Geology and Topography: The Island of Oahu is comprised of the remnants of two elongated shield volcanoes joined by a broad convex plateau into a form which roughly resembles an embossed "H" (Figure I-1).

The eroded remains of the Koolau volcanic dome, stretching in a nearly straight northwest-southeast line for 37 miles from the northernmost to the southernmost tip of the island, form Oahu's main mountain range. The older Waianae Volcano is represented by an arcuate mountain range covering a distance of 20 miles, making up the western bulwark of the island.

The peaks of the Koolau Range average about 2,500 feet in elevation. The highest point, an unnamed peak which overlooks Nuuanu and Manoa Valleys in Honolulu, rises to 3,150 feet. The Waianae Range peaks are somewhat higher, averaging nearly 3,000 feet, including the highest point of the island, Mt. Kaala, at 4,020 feet.

The Central Honolulu region, from Pearl Harbor to Hawaii Kai, comprises the southeasterly coastal plain of the island. The coastal plain is a relatively narrow strip of flat land sloping gently from the leeward slopes of the Koolau Range to the water's edge, fringed with coral reefs. Ground elevation generally ranges from five to 20 feet above sea level, with the exception of the Kaimuki dome, located immediately north of Diamond Head Crater, which has a crest elevation of 240 feet.

Spectacular landmark features such as Diamond Head, Punchbowl, and Koko Head resulted from steam explosion of molten lava brought into sudden contact with water. Characteristically, part of the crater rims were built higher as the result of prevailing winds at the time of formation. The hot, water-rich ash solidified into a tough brown rock known as tuff.

The flat floors of Nuuanu Valley, Manoa Valley, and Kalihi Valley resulted from late lava flows. Kaimuki dome was the site of quiet volcanic activity of sufficient duration to form a low dome 240 feet high and nearly two miles in maximum width.

Historical records imply that danger from earthquakes on Oahu is minimal; the area is classified as seismic zone 1 in the Uniform Building Code. The last recorded earth tremor centered on Oahu was in 1963, when a quake in the 2.0-3.5 range on the Richter Scale originated in the southern Waianae Mountains.

The Hawaiian Islands are, however, vulnerable to tsunamis, earthquake-generated tidal waves. Since the first historical record of a tsunami in the Hawaiian Islands in 1819, 30 have struck the islands, 15 of which have resulted in significant damage. The maximum recorded height to which the waves washed the shores of Oahu -- 30 feet -- occurred during the 1946 tsunami. The maximum recorded height on the southerly leeward side, Central Honolulu, was six feet, occurring during the 1946 and 1960 tsunamis.

b. Climate: The climate of Oahu, mild and equable throughout the year, results from the island's location on the northern fringe of the tropics within the belt of cooling northeasterly trade winds. The average temperature in the lowlands is 75°F, decreasing four degrees with each 1,000 feet increase in elevation.

The coldest month, January, averages 72°F and the warmest, August, 78.5°F. The maximum recorded temperature, obtained in the Waianae district, was 96°F, but rarely is 90°F exceeded. Minimum temperatures hover around 50°F.

The mean maximum relative humidity in Honolulu is 76 percent and the mean minimum is 59 percent. The mean wind speed is 11.6 mph and the prevailing wind direction is from east-northeast.

On Oahu, the lowest annual average rainfall is restricted to the extreme leeward coasts and amounts to less than 20 inches. However, near the mountain crests in the central portion of the Koolau Range an annual average of nearly 300 inches occurs. Extremely heavy rainfalls, such as 300 inches per year, would suggest that Oahu should frequently be subjected to raging floods. This is not the case, however, because of the extraordinary permeability of the soils and rocks that make up most of the island (described in the following discussion of hydrology). Rainfall is heaviest high in the mountains and decreases in the leeward direction. The Waianae Range is a less effective rainmaker since it lies to the lee of the Koolau Range.

Trade winds are present throughout the year, but are least active from October through April, Hawaii's winter season. During these months, tropical storms occasionally buffet the island, bringing with them heavy showers. These showers account for practically all of the rain that falls on the leeward plains.

Intermittent breakdown of typical tradewind flows occurs when deep low-pressure centers form and move slowly from west to east. This produces southerly winds and more rain in many otherwise dry areas. These conditions are known as "Kona Weather" and occur primarily during winter months.

c. Hydrology: Volcanic rocks and their residual soils have a very great capacity to absorb and percolate water; consequently, only a relatively small proportion of rainfall runs over the surface to the sea. Most of it infiltrates the ground, creating the large ground water bodies on which Oahu depends for its water supply. Surface water in forest reserve areas is of good quality, but, except in a few regions, of insufficient flow to justify exploitation. Because water is unable to remain on the surface very long, the universal method of storing water in large open reservoirs is generally impractical on Oahu. However, there are several small reservoirs on the island, only one of which, at Wahiawa, has a relatively large storage capacity -- two billion gallons.

Three types of ground water are found on Oahu, the most extensive being the basal fresh water that floats on sea water under much of the southern and northern portions of the island. Less widespread, but of singular importance in some areas, is ground water restrained between impermeable vertical rock structures called "dikes" in the rugged core of the mountains. The third type is ground water held up, or "perched", on horizontal impermeable beds such as volcanic ash. While Oahu lacks appreciable quantities of perched water, in a few small areas this type of water has solved minor supply problems. It normally occurs as a spring flow, is of excellent quality, and, like dike water, is free from sea water encroachment.

The immense basal water bodies, artesian where they underlie the coastal plain, exist because of the difference in density between fresh and sea waters. The fresh water is slightly lighter than sea water and floats on the heavier sea water, which, like the fresh water, permeates the subsurface rock. Along the Central Honolulu coastal plain, the basal fresh water lens is held under pressure by a relatively impermeable sedimentary "caprock" that retards the water's easy escape to the sea. In this area, due to the pressure, fresh water rises to a height of about 20-25 feet above sea level. This phenomenon is known as the "artesian head". To tap this artesian water, wells must be drilled several hundred feet through the caprock to release a bountiful supply of water under pressure.

Within the Central Honolulu coastal plain, the ground water table elevation generally ranges from sea level near the shoreline to approximately four feet above sea level further inland. This ground water table is caused by the sea water's intrusion into the top portions of the caprock; soil capillary action causes the difference in elevation. Thus, the ground water table elevation varies with the ocean tides.

Where fresh and salt waters merge, a zone of mixture consisting of brackish water forms. The movement of this zone, both horizontally inland from the seacoast and vertically upward, presents a constant potential danger of saline contamination to the fresh water portion of the system. Skillful methods are absolutely necessary in developing the buoyant fresh water.

Although the island is deeply incised by many stream valleys, the amount of perennial stream flow actually reaching the sea is comparatively minor. Most of the flow percolates to become groundwater. Storm flow may be very heavy, but little of it is recharged at this time. Streams and flood plains in the Central Honolulu region are described in a later section.

d. Energy Sources: Most electrical power on Oahu is generated from three fossil fuel power plants. Over 5 billion kilowatt-hours, 84 percent of the electrical power consumed in the State, were sold in 1978 to some 183,500 residential customers and 26,400 other users on Oahu. Manufactured gas is also served on the island to some 26,700 residential customers and over 3,900 other users. A total of 31.8 million therms, or 91 percent of the total consumed in the State was sold to Oahu users in 1978 (Table I-2).

TABLE I-2

ENERGY CONSUMPTION[1/]
-1978-

| | ELECTRICAL | | | | | GAS | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Customers | | Million KWH Sold | | | Customers | | 1,000 Therms Sold | | |
| | Res. | Other | Total | Res. | Other | Res. | Other | Total | Res. | Other |
| STATE | 244,863 | 39,201 | 6,005 | 1,799 | 4,206 | 29,091 | 4,322 | 34,919 | 7,387 | 27,532 |
| OAHU | 183,519 | 26,388 | 5,026 | 1,426 | 3,600 | 26,726 | 3,933 | 31,842 | 6,800 | 25,042 |

e. Air Quality: The Air Pollution Control Implementation Plan, prepared by the State Department of Health in 1972, provides for the implementation, maintenance, and enforcement of the national ambient air quality standards pursuant to the provisions of the Federal Clean Air Act, as amended. Hawaii's air quality, specifically urban Honolulu, is unique in that none of the Federal standards have been exceeded. The standards adopted by the State of Hawaii are more stringent than the Federal standards; Table I-3 compares them. State regulation requires that concentrations of contaminants shall not exceed the standard and, further, that present air quality shall not be degraded, even if well under the standard level.

Most air pollution problems are localized, due to the small incidence of heavy industrial complexes and power plants. However, various measures of air pollution, such as suspended particulate matter, indicate that Honolulu is one of the cleanest cities in the nation.[1]

TABLE I-3

AMBIENT AIR QUALITY STANDARDS

| | State of Hawaii | Federal |
|---|---|---|
| **Sulfur Oxides** | | |
| Annual Arithmetic Mean | 20 ug/m$^3$ | 80 ug/m$^3$ |
| Average for any 24-hour Period | 80 ug/m$^3$ | 365 ug/m$^3$ |
| Average for any 3-hour Period | 400 ug/m$^3$ | 1300 ug/m$^3$ |
| **Nitrogen Oxides** | | |
| Annual Arithmetic Mean | 70 ug/m$^3$ | 100 ug/m$^3$ |
| Average for any 24-hour Period | 150 ug/m$^3$ | -- |
| **Particulate Matter** | | |
| Annual Arithmetic Mean | 55 ug/m$^3$ | -- |
| Average for any 24-hour Period | 100 ug/m$^3$ | 260 ug/m$^3$ |
| **Photochemical Oxidants** | | |
| Average for any 1-hour Daylight Period | 100 ug/m$^3$ | 160 ug/m$^3$ |
| **Hydrocarbons** | | |
| Average for any 3-hour Morning Period | 100 ug/m$^3$ | 160 ug/m$^3$ |
| **Carbon Monoxide** | | |
| Average for any 8-hour Period | 5 mg/m$^3$ | 10 mg/m$^3$ |
| Average for any 1-hour Period | 10 mg/m$^3$ | 40 mg/m$^3$ |

## B.2. Socio-Economic Factors

The Island of Oahu consists of dense population centers separated by agricultural and undeveloped lands. The island constitutes a U.S. Bureau of the Census Standard Metropolitan Statistical Area (SMSA) by virtue of its size and population. 1970 U.S. Census data and State of Hawaii-generated updates are the data sources for discussions that follow on islandwide population, housing, income, and employment characteristics. A subsequent chapter will focus on certain demographic aspects of the Central Honolulu region.

a. Population: At the time of the 1970 Census, close to four out of five persons in the State of Hawaii resided in the Honolulu SMSA, a considerably greater portion than in other states. Since statehood in 1959, Hawaii's population growth rate has been approximately twice that of the nation. About 94 percent of new Hawaii residents settle on Oahu.

The City and County of Honolulu had an estimated resident population of 719,600 as of July 1978. Population density on Oahu was 1.90 persons per acre. The Central Honolulu district density was 5.22 persons per acre. The comparative growth of the four Oahu geographical regions between 1970 and 1978 appears in Table I-4 (along with concurrent housing statistics, which have bearing on the following discussion). Significant trends indicated by these figures include:

- over 14 percent population growth on Oahu between 1970 and 1978
- most rapid growth occurring in Central Oahu - 31 percent
- least rapid growth occurring in Central Honolulu - 11 percent
- a shift in islandwide population distribution of approximately two percent from Central Honolulu to Central Oahu
- the continuing dominance of Central Honolulu, despite modest growth, as the most densely populated region on Oahu, with over 60 percent of the island's population

TABLE I-4

POPULATION AND HOUSING ON OAHU*1/

| | POPULATION | | | | | HOUSING | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1970 | | 1978 | | % | 1970 | | 1978 | | % |
| | Persons | % | Persons | % | Chg. | Units | % | Units | % | Chg. |
| Oahu | 630,497 | 100 | 719,577 | 100 | 14.1 | 174,742 | 100 | 221,542 | 100 | 26.8 |
| Central Hono. | 407,560 | 65 | 451,385 | 63 | 10.7 | 120,459 | 69 | 148,935 | 67 | 23.6 |
| Central Oahu | 76,751 | 12 | 100,753 | 14 | 31.3 | 18,866 | 11 | 27,250 | 13 | 44.4 |
| Leeward Oahu | 43,405 | 7 | 50,416 | 7 | 16.2 | 10,155 | 6 | 13,791 | 6 | 35.8 |
| Windward Oahu | 102,781 | 16 | 117,023 | 16 | 13.9 | 25,262 | 14 | 31,566 | 14 | 25.0 |

*Population includes armed forces in the islands, and residents temporarily out of the State on business or vacation, but excludes visitors temporarily present.

the people of Hawaii entail an estimated 64 racial combinations. No single racial group constitutes more than 40 percent of the population on Oahu.

On Oahu, the median age is 25.9 years. Over 30 percent of the population is 17 years of age or younger and about six percent is 65 years of age or older.

At the time of the 1970 Census, 48 percent of Oahu households owned one automobile, 33 percent owned two automobiles, and eight percent owned three or more cars. The remaining 11 percent of households on the island had no car available.

Between 1960 and 1970, the average number of automobiles per household remained stable at 1.11 in non-urban areas, while it grew somewhat in the Honolulu urban area, from 1.01 to 1.15.

b. Housing: The housing inventory on Oahu increased 27 percent between 1970 and 1978, from 174,700 units to 221,500 units. This compares with a 14 percent increase in population during the same period. Regional fluctuations in the housing inventory closely followed population trends, ranging from 24 percent growth in Central Honolulu to 44 percent growth in Central Oahu. Central Honolulu nevertheless retains nearly 70 percent of the Oahu housing inventory. Due to the shortage of developable urban land and its high cost, an increasing proportion of new units are expected to be multi-family units, resulting in higher densities.

c. Income: In 1950, per capita income in Hawaii was below the national average, but, during the 1960's and early 1970's, per capita personal income grew at a relatively rapid rate that exceeded the national average. Honolulu County enjoys the highest per capita and family income in the State. Per capita income for Honolulu in 1977 was estimated at $7,950 exceeding the national average by 13 percent. Median family income on Oahu for 1975 was $18,230.

Based on the 1970 Census, nearly 49,000 families, or 35 percent of all families in the City and County of Honolulu, had incomes of $15,000 or more; nearly 12,000 families, or 8.5 percent of the total, had incomes that exceed $25,000. Over 10,000 families, or 7.3 percent of all families on the island, had incomes below the poverty level.

The higher average income levels in Honolulu are offset by a cost of living that is some 20 percent higher than the urban U.S. average and second only to Anchorage among major American metropolitan areas.

d. Employment: The top two employers on Oahu in 1950 were government and wholesale/retail businesses. They retain their prominent position today. In 1978, government and wholesale/retail trade provided almost half the jobs on the island. The service sector, spurred by the growth of visitors and population, was the third largest employer in 1978.

The growing economy created demands for new public facilities, hotels, houses, and commercial centers. As a result, the construction industry expanded and became a more important source of jobs.

As shown in Table I-5, the State has experienced fairly rapid growth in employment and has maintained relatively low unemployment rates. But employment competition, especially for professional positions, is becoming increasingly intense.

TABLE I-5

OAHU HISTORICAL EMPLOYMENT GROWTH AND UNEMPLOYMENT RATES[1]

| Years | Annual Rate of Employment (% Increase) Over Previous Year | Unemployed as Percent of Total Labor Force |
|---|---|---|
| 1971 | 2.4 | 6.3 |
| 1972 | 3.3 | 7.1 |
| 1973 | 4.6 | 6.5 |
| 1974 | 1.5 | 7.2 |
| 1975 | -0.8 | 6.8 |
| 1976 | 6.5* | 9.6 |
| 1977 | 3.7* | 7.3 |
| 1978 | -1.5* | 7.6 |

Between 1970 and 1975, the number of employed persons grew at an average annual rate of about 2.2 percent, increasing from 240,000 to 267,000, with over 40 percent of the non-military population employed. During this same period, the number of available jobs grew at an average annual rate of 2.7 percent, from 270,000** to 309,000**[1]. These data indicate that the number of available jobs grew faster than the number of employed persons, suggesting a higher proportion of the labor force holding two or more jobs.

The labor force also contains above-average proportions of young persons and women. The 1970 Census reported that 49 percent of all females 16 years of age or over were either employed or seeking work, a proportion higher than that of any other State and second only to the District of Columbia.

*Based on new data source and not comparable to previous years.
**Numbers of jobs do not include military employment.

More than four out of five jobs on Oahu are located in the Central Honolulu region, where most of the island's industry, business, and governmental facilities are located.

## B.3. Development and Planning Forecasts

The Oahu General Plan is the basic land use policy statement of the City and County of Honolulu and is referred to in all matters related to planning and urban growth on Oahu. Land uses designated in the General Plan are based on the 1964 State land use districts (described in Section I.A.4), as revised, which designate all land in the State as urban, rural, agricultural, or conservation land, allocating space for urban expansion through 1984. Official reviews in 1969 and 1975 produced only minor changes in the Oahu districts; they confirmed the regulations' effectiveness in protecting prime agricultural land against urban sprawl, despite pressure toward urbanization. Table I-6 summarizes the State land use classification changes that have occurred since 1964 on Oahu. Figure I-2 indicates the current land use dispositions on Oahu (which currently has no land assigned as "rural").

TABLE I-6
LAND USE CLASSIFICATION CHANGES 1964-1979[1]
(Acres)

| | Urban | Rural | Agricultural | Conservation | Total |
|---|---|---|---|---|---|
| August 1964 | 75,700 | 0 | 158,200 | 151,400 | 385,300 |
| August 1969 (After completion of 5-year Comprehensive Review) | 82,592.9 | 0 | 145,906.1 | 156,801.0 | 385,300 |
| March 1974 | 84,093.4 | 0 | 144,285.7 | 156,920.9 | 385,300 |
| February 1975 (After completion of 2nd 5-year Comprehensive Review) | 85,186.5 | 0 | 145,205.9 | 154,907.6 | 385,300 |
| January 1979 | 86,492.0 | 0 | 143,903.2 | 154,904.8 | 385,300 |

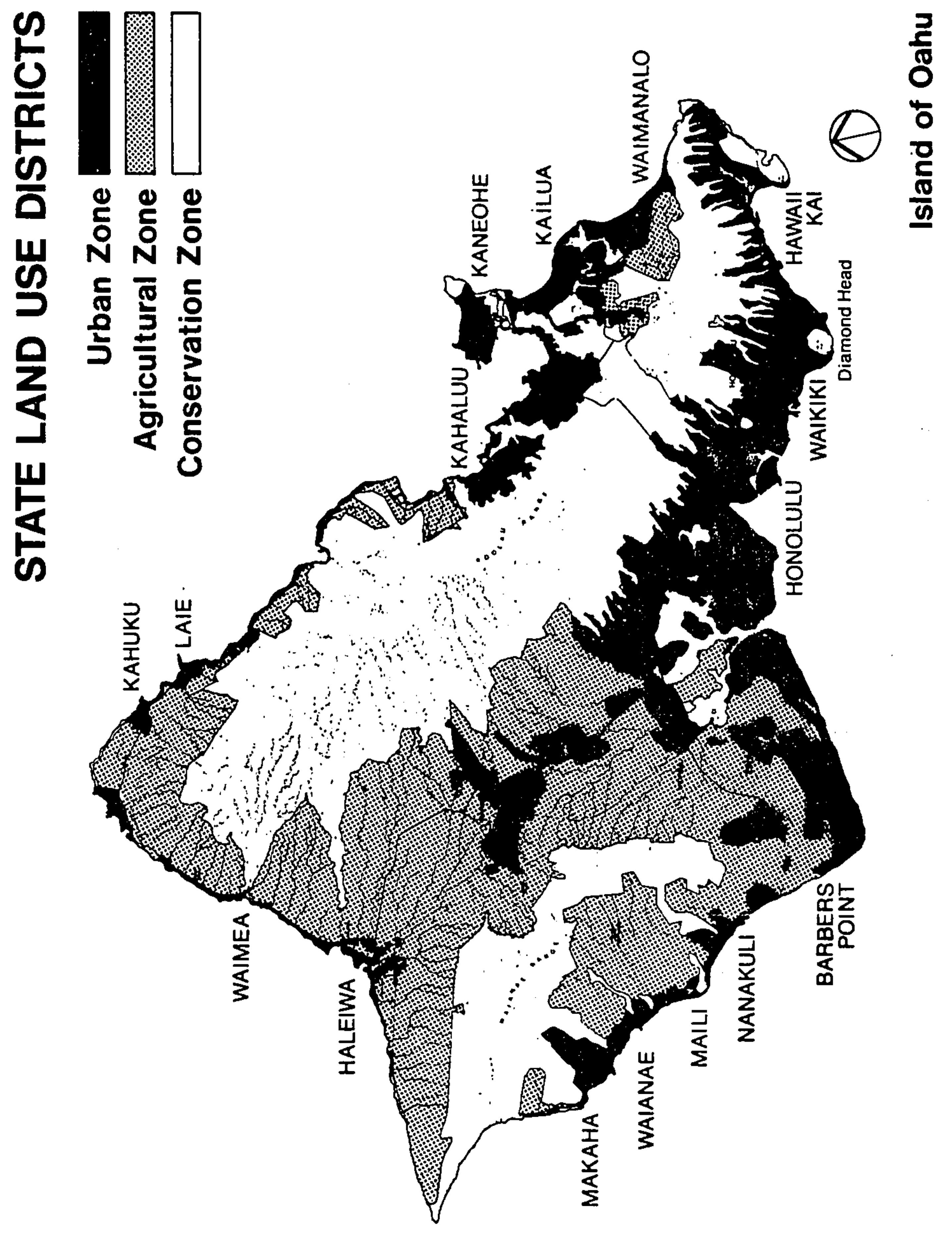

STATE LAND USE DISTRICTS
Urban Zone
Agricultural Zone
Conservation Zone
KAHUKU
LAIE
WAIMEA
HALEIWA
KAHALUU
KANEOHE
KAILUA
WAIMANALO
HAWAII KAI
Diamond Head
WAIKIKI
HONOLULU
BARBERS POINT
NANAKULI
MAILI
WAIANAE
MAKAHA
Island of Oahu

Figure I-2

The first General Plan for the City and County of Honolulu was adopted in 1964. In addition to delineating future land use patterns and pertinent planning policies, the 1964 General Plan was supported by Development Plans for public facilities and a Comprehensive Zoning Code for development intensity and design control.

A new General Plan, adopted by the Honolulu City Council in January 1977, enumerates Oahu's long-range social, economic, environmental, and design objectives for the Year 2000 and suggests broad policies to support those objectives. It addresses nine areas of concern: (1) population, (2) economic activity, (3) natural environment, (4) housing, (5) transportation and utilities, (6) physical development and urban design, (7) public safety, (8) health and education, and (9) culture and recreation. The new General Plan is by design a very general document, establishing broad guidelines for an island-wide set of Development Plans. Currently in preparation, the Development Plans will in turn guide the physical development of the island in conformance to General Plan policies and objectives. Until the Development Plans are completed, the Island of Oahu has been designated an "Interim Zoning Control Area" by Ordinance Number 77-9, Bill Number 124. Any application for rezoning must substantially meet the intent of the General Plan objectives and policies.

Population and employment forecasts on the Island of Oahu (Table I-7) were developed by the State Department of Planning and Economic Development (DPED) and adopted in 1971 by the Oahu Transportation Planning Program (predecessor of the Oahu Metropolitan Planning Organization) as the basis for all long-range transportation planning on Oahu.

TABLE I-7

POPULATION AND EMPLOYMENT FORECASTS[2]

| Year | Population | Employment |
|---|---|---|
| 1970 | 630,000 | 315,800 |
| 1975 | 680,000 | 333,000 |
| 1980 | 735,000 | 375,000 |
| 1985 | 795,000 | 419,000 |
| 1990 | 859,000 | 464,700 |
| 1995 | 924,000* | 515,700* |

*The latest projections developed by the State DPED in 1978, designated Series II-F, forecasts a population of 886,000 and employment, including both civilian and military jobs, of 472,000 in 1995.[3]

B.4. Transportation

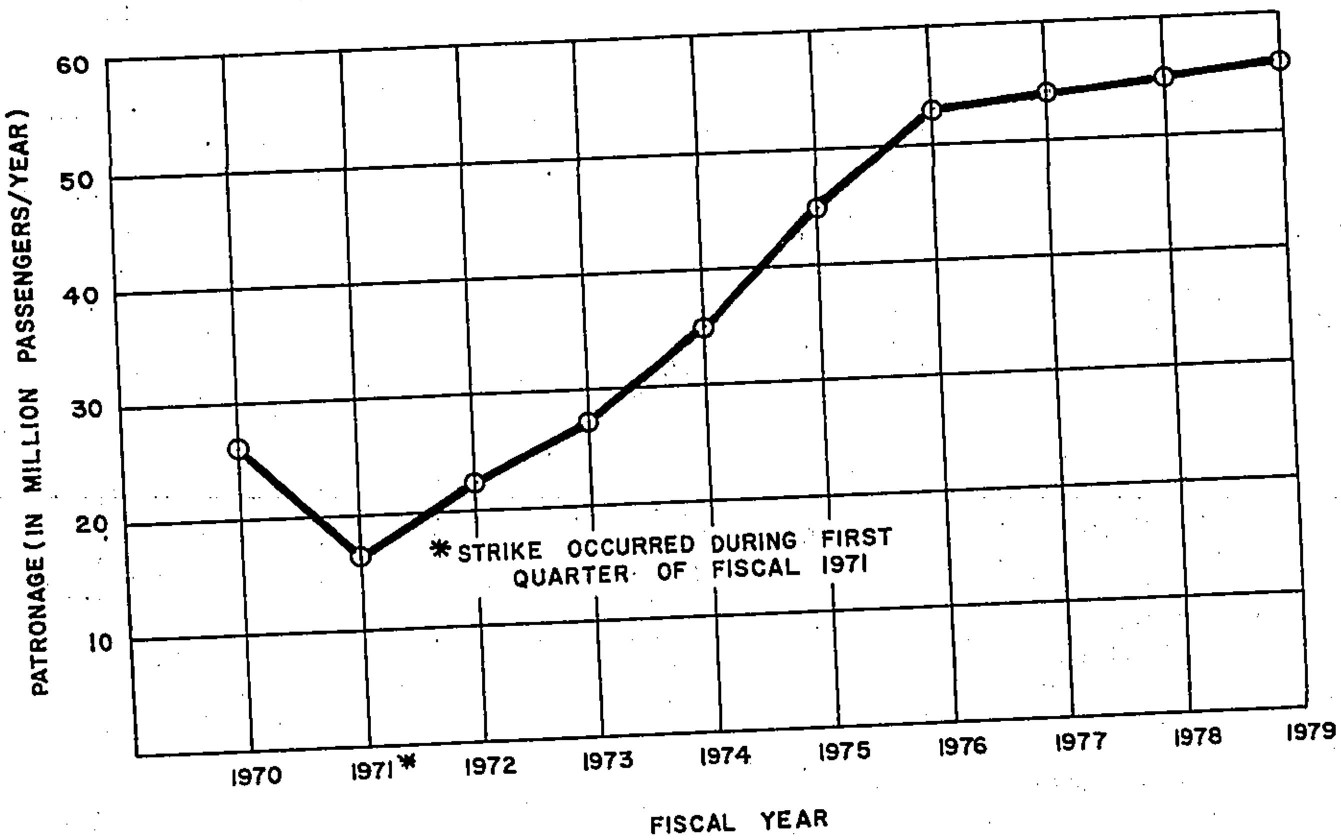
The Long-Range Transportation Plan as adopted by the Oahu Metropolitan Planning Organization (OMPO) guides the orderly development of transportation systems on Oahu. The plan identifies major transportation improvements such as freeways, major arterials and rapid transit facilities, required to meet future travel demands on Oahu.

a. Streets and Highways: Oahu has more than 1,230 miles of streets and highways. Existing and planned Federal interstate highways (H-1, H-2, and H-3) will comprise approximately 52 miles of freeway (Figure I-1) providing improved access to urban Honolulu from Oahu's Leeward, Central, and Windward regions. A portion of the H-1 (Lunalilo) Freeway between Pearl Harbor and Middle Street is currently under construction. When completed, the freeway will span 27 miles from Kahala to Ewa. The segment between Kahala and Middle Street is the critical link in the interstate system, serving centers of government, commerce, and tourism in urban Honolulu. The 8.5-mile H-2 Freeway from Pearl City to Wahiawa was recently completed. The proposed H-3 Freeway would provide another link from the windward Kailua-Kaneohe area to leeward Oahu.

Most travel on Oahu is by private automobile. In 1978 there were 432,954 motor vehicles of all types registered. Other vehicles included 9,512 trailers and semi-trailers, 8,177 motorcycles and motor scooters, and 73,426 bicycles.

b. Transit: Public transit on Oahu is provided by the City and County of Honolulu, which consolidated the operations of three private companies and began services in 1971. State Act 300 (Chapter 51, HRS) in 1967 authorized counties to own and operate mass transit systems. In 1968 the City Council established by ordinance a Mass Transit Division within the Department of Traffic (Ordinance No. 3315); its name was later changed to the Department of Transportation Services by the Revised City Charter.

Approximately 45 million transit trips were made in FY 74-75 on the islandwide bus system with a fleet of some 280 buses. Over 50 million transit trips were made during FY 75-76 due to increased service provided by an expanded bus fleet of 350 buses. Today, nearly 57 million annual transit trips are made on the island. Annual ridership trends are depicted in Figure I-3. Since the 1971 takeover of the mass transit system in Honolulu by the City, transit ridership has increased by over 200 percent.




TREND IN PASSENGERS ON THE BUS

FIGURE I-3

# II. CENTRAL HONOLULU STUDY AREA

Central Honolulu is the most densely urbanized region on Oahu. It contains most of the island's industry, business, and government facilities and is the focus of major social, cultural, educational, and recreational activities. The Honolulu urban core, located within Central Honolulu, is approximately 12 miles long and two to three miles wide, with numerous developments extending into the valleys and ridges of the Koolau Range. It is characterized by a relatively narrow band of densely developed residential, commercial, and industrial land uses, most intense between the H-1 (Lunalilo) Freeway and the ocean -- a distance of approximately one mile (Figure II-1).

Developments on the western extreme of the study area include Pearl City and Waipahu; those on the eastern extreme include Hawaii Kai and numerous communities adjacent to the Kalanianaole Highway. Inasmuch as the proposed transit system lies entirely within the Central Honolulu area, this area is considered to be the project study area, for which project impacts will be assessed in subsequent chapters.

## A. URBAN ENVIRONMENTAL FACTORS

Most environmental factors discussed in the previous chapter pertain fairly uniformly to the entire Island of Oahu. Those that warrant more detailed scrutiny in their bearing on Central Honolulu include streams/floodplains, coastal zone management, vegetation/wildlife, air quality, and ambient noise.

### A.1. Streams/Floodplains

Approximately 15 major streams or waterways, most formed by two or more tributaries, flow into the ocean from the Central Honolulu region. All originate in heavy rainfall areas of the Koolau Mountains and flow across the Central Honolulu coastal plain into the ocean. Stream flows are generally flashy in nature, particularly in mountainous areas. Minimum flows consist mainly of ground water seepage and spring discharges. Occasionally, as a result of heavy rains, high stream flow occurs and large quantities of water flow into the sea.

Several streams have been lined and channeled to accommodate high stream flows during periods of heavy rainfall to prevent flood damage in urbanized areas. Those not improved pose potential problems to the adjacent urbanized areas.

# Central Honolulu

LEGEND

FREEWAYS

FREEWAYS UNDER CONSTRUCTION OR PROPOSED

MAJOR HIGHWAYS

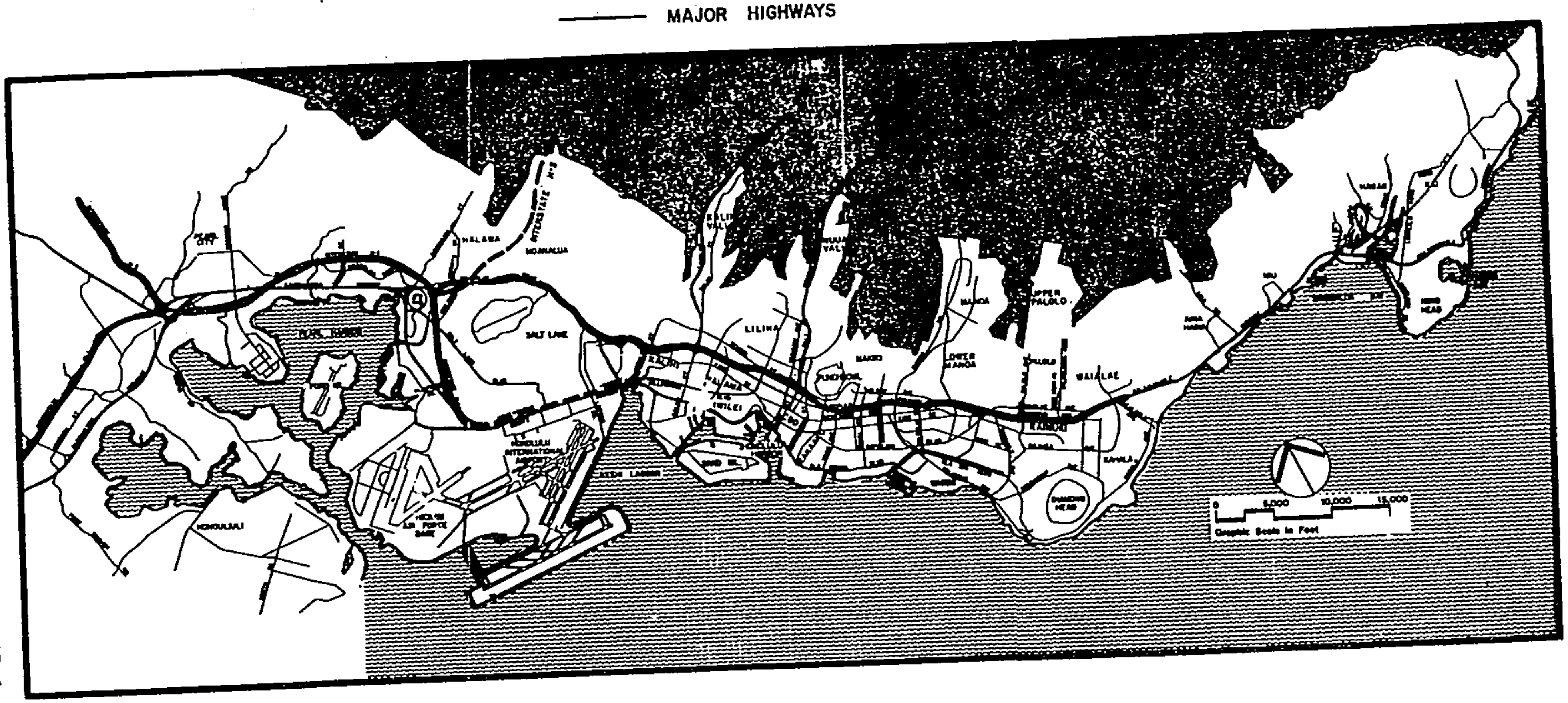



Figure II-1

These areas which would be inundated by the 100-year flood are identified as flood hazard zones as determined by the Flood Insurance Study of Oahu and delineated on the Flood Insurance Rate Maps, prepared by the U.S. Department of Housing and Urban Development, Federal Insurance Administration. Figure II-2 shows the locations of these flood hazard or floodplain areas in the Central Honolulu region.

The City Department of Public Works' study on "Water Quality Program for Oahu With Special Emphasis on Waste Disposal" found that runoffs from streams and springs in the Central Honolulu region contribute sizable amounts of potential pollutants to Pearl Harbor and Mamala Bay. For example, daily mass emission rates (MER) to Pearl Harbor from stream runoffs are estimated to contain approximately 610 lbs. of nitrogen and 150 lbs. of phosphorous. In addition, average surface storm runoff from the streams tributary to Pearl Harbor amounts to approximately 45 mgd, contributing 69,000 tons of sediments per year.

Between June 1970 and February 1971, the "Water Quality Program for Oahu" analyzed numerous water samples from 57 different locations to determine fresh and marine water quality conditions around Oahu. This water quality monitoring program covered six streams in the Central Honolulu region and several points along the shoreline and in various bays around the island. Table II-1 lists the six streams monitored and their average annual levels of pollutants. Areas with low dissolved oxygen, shallow Secchi depth, high nutrient and total coliform concentration, and high BOD were considered to have the poorest water quality. Data indicated that water quality in all the streams monitored except the Nuuanu Stream just below the reservoir was generally poor. However, water quality in general is being continually improved by eliminating direct waste discharges into streams.

TABLE II-1

WATER QUALITY IN CERTAIN STREAMS IN CENTRAL HONOLULU

| Stream | Annual Avg. D.O.*mg/l | Annual Avg. Total N*mg/l | Annual Avg. Total P*mg/l | Annual Avg. Secchi Depth | Annual Avg. B.O.D.-mg/l | Annual Avg. Total Coliform-Col/100 |
|---|---|---|---|---|---|---|
| Waiawa | 4.23 | 0.390 | 0.236 | 3 | 18.1 | 139.793 |
| Moanalua | 5.53 | 0.471 | 0.271 | 3 | 19.2 | 60,043 |
| Kalihi | 6.06 | 0.521 | 0.074 | 2 | 19.2 | 147,645 |
| Kapalama Canal | 2.70 | 0.130 | 0.367 | 2 | 41.2 | 680,123 |
| Nuuanu | 4.68 | 0.330 | 0.061 | 5 | 18.6 | 108,761 |
| Manoa | 6.55 | 0.295 | 0.068 | 2 | 23.0 | 44,021 |
| Nuuanu** | 6.56 | 0.431 | 0.101 | - | 22.9 | 268 |

*D.O. = Dissolved Oxygen
*N = Nitrogen (organic + ammonia)
*P = Phosphorous

**Monitoring station located just below reservoir, outside urban areas. The other stream monitoring stations were located within the urbanized areas.

## Map of Floodplain Areas

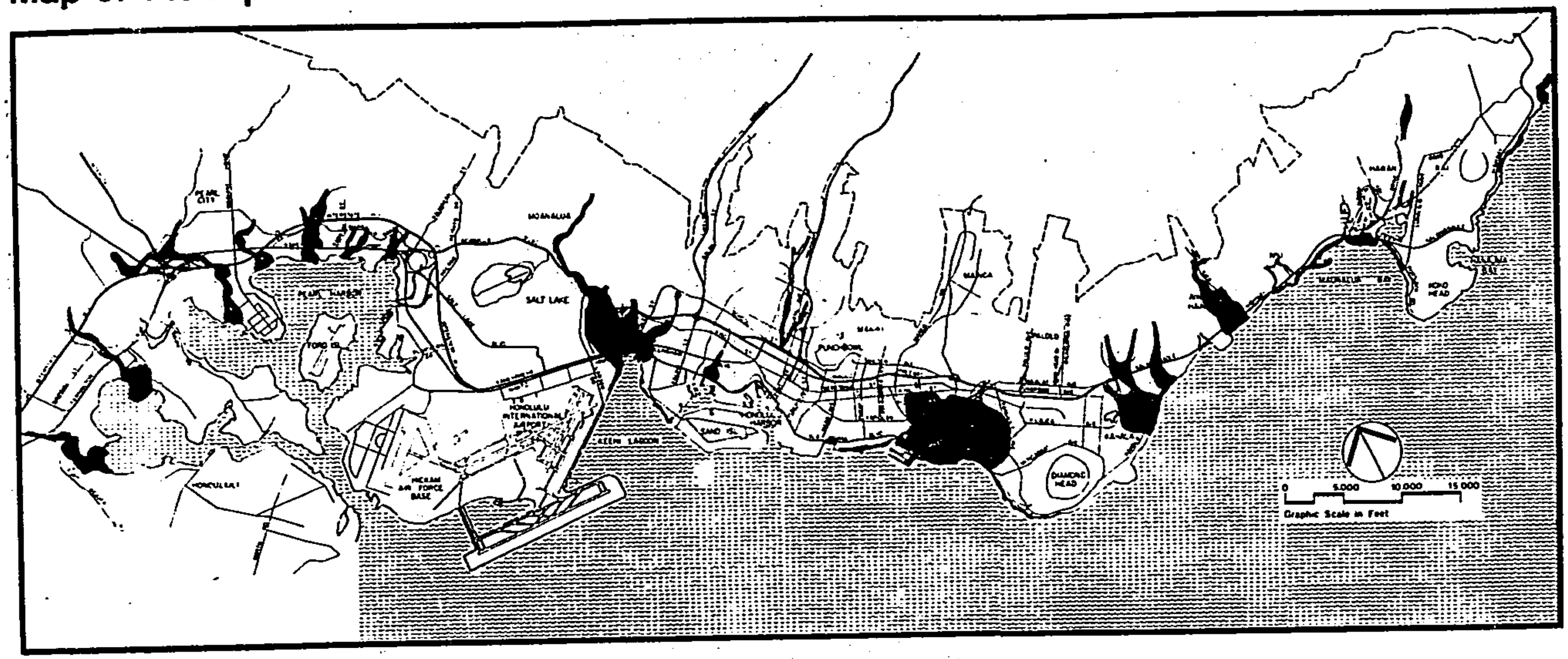



Figure II-2

More specifically, of the 57 different locations monitored, all six streams in Central Honolulu with poor water quality were found to have the lowest overall ranking or the poorest water quality based upon the water quality parameters measured. Furthermore, a comparison was made of the water quality found at the monitoring stations with the State of Hawaii Water Quality Standards to note those areas presently with water quality problems. The observed water quality at the six streams exceeded a majority of the standards being compared. Thus, the quality of water in the streams located in Central Honolulu has been greatly modified and is therefore not considered pristine.

A.2. Coastal Zone Management

Chapter 205A, as amended, of the Hawaii Revised Statutes (relating to environmental shoreline protection) established special controls for development within an area along the shoreline called the "special management area". These controls are based on a general coastal management program for Hawaii pursuant to the National Coastal Zone Management Act of 1972 (P.L. 92-583). The Hawaii CZM Program was approved by the U.S. Department of Commerce in September, 1978, and incorporated into Chapter 205-A, HRS in 1979. Basically, Chapter 205A seeks to protect valuable resources, preserve management options, ensure public access to beaches, recreation areas, and natural reserves, and provide for solid and liquid waste treatment within the special management area. The statute stipulates that the development will not have any substantial adverse environmental or ecological effect, except as such adverse effect is minimized to the extent practicable and clearly outweighed by public health, safety, or compelling public interest.

The Honolulu City Council is authorized to carry out the policies and procedures of Chapter 205A, as amended, as it affects the coastal zones of Oahu. The City Department of Land Utilization is designated the administering agency. Implementation of the Special Management Area, is embodied in the provisions of Ordinance No. 4529, as amended. Development within the SMA will require a public hearing and action by the City Council.

A set of maps delineating the special management area on Oahu has been developed by the City Department of Land Utilization and approved by the City Council. Figure II-3 shows the location of the special management area in the Central Honolulu region.

# Central Honolulu Coastline Special Management Area

Special Management Area

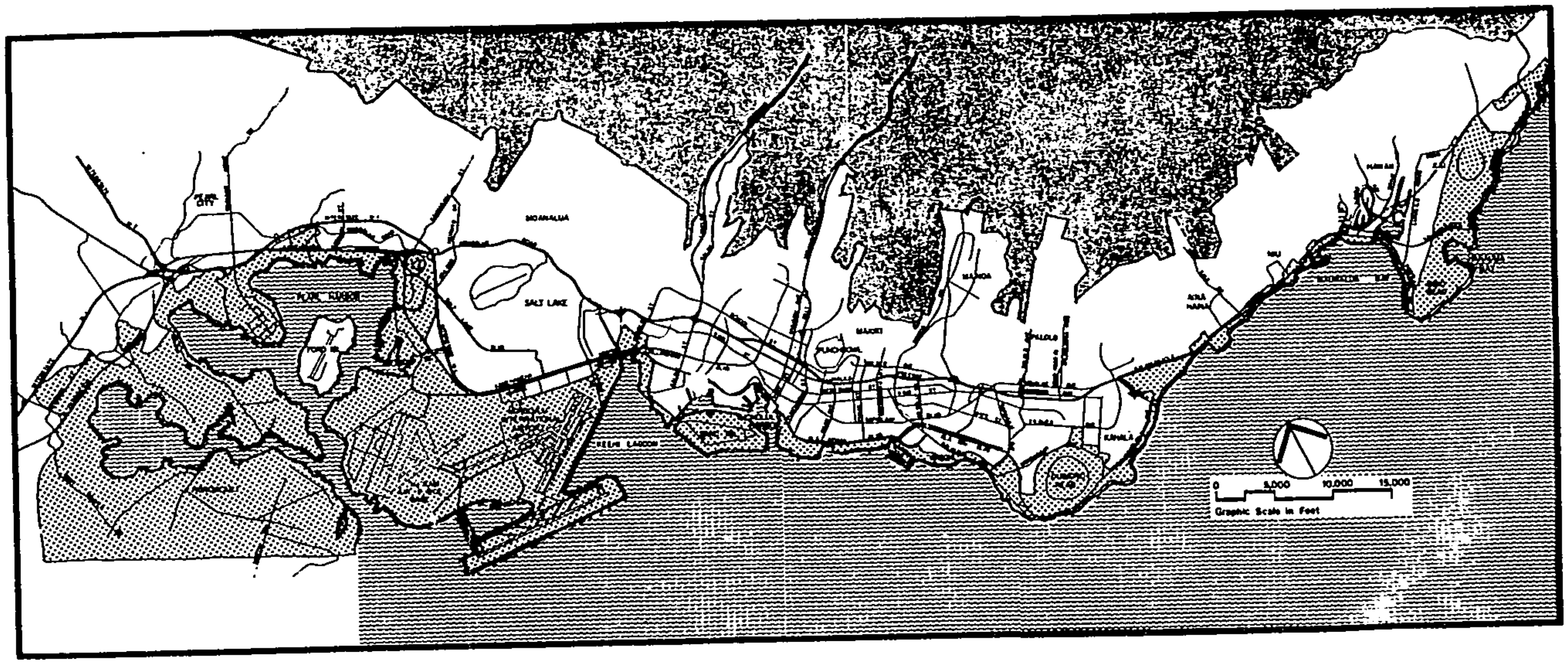



Figure II-3

## A.3. Vegetation and Wildlife

In the urbanized area of the Central Honolulu study area, endemic species of dry-land terrestrial flora and fauna have been replaced by common exotic species. There are, however, species of endangered flora in collections at Foster Botanic Garden and at Lyon Arboretum. Previous studies[14] indicate that no species of endangered dry-land terrestrial birds and mammals are found in the urbanized portions of the study area.

Waterbird habitats, however, can be found in urbanized portions of the study area. According to the Department of Land and Natural Resources, prime wetland areas located in the study area include: Paiko Lagoon, islands within Keehi Lagoon, Pearl Harbor, Pouhala Pond, Fort Kamehameha tidal flats, and Salt Lake and Nuuanu Reservoirs (Figure II-4). Endangered species of water birds which may be found in these wetlands are the Hawaiian coot, Hawaiian duck, Hawaiian gallinule and Hawaiian stilt.

Endemic and indigenous marine and freshwater animals are common near shore and in the streams located within the study area. These species are typical of aquatic and marine habitats in other areas of Oahu.

## A.4. Air Quality

The State Department of Health monitors ambient air quality at selected population centers, industrial sites, and areas of expected maximum pollutant concentrations. Currently, four of the seven sampling stations on Oahu are in the Central Honolulu region (Figure II-5).

The main Oahu sampling station (Station #1 on Figure II-5) is located near the center of downtown Honolulu. Heavy automotive traffic in this area has caused the maximum hourly average concentration of carbon monoxide to exceed State ambient air quality standards -- but not the Federal standards. During 1978, the State standard for the maximum hourly average concentration of carbon monoxide ($10 mg/m^3$) was exceeded on 19 days out of the year, primarily during Hawaii's winter season. The highest value recorded during this year was $20.7 mg/m^3$ which exceeds the State standard by $10.7 mg/m^3$; however it is well within the Federal standard of $40 mg/m^3$. Table II-2 presents key annual pollution levels at the downtown Honolulu monitoring station from 1973 through 1978.

# Location of Endangered Bird Habitats

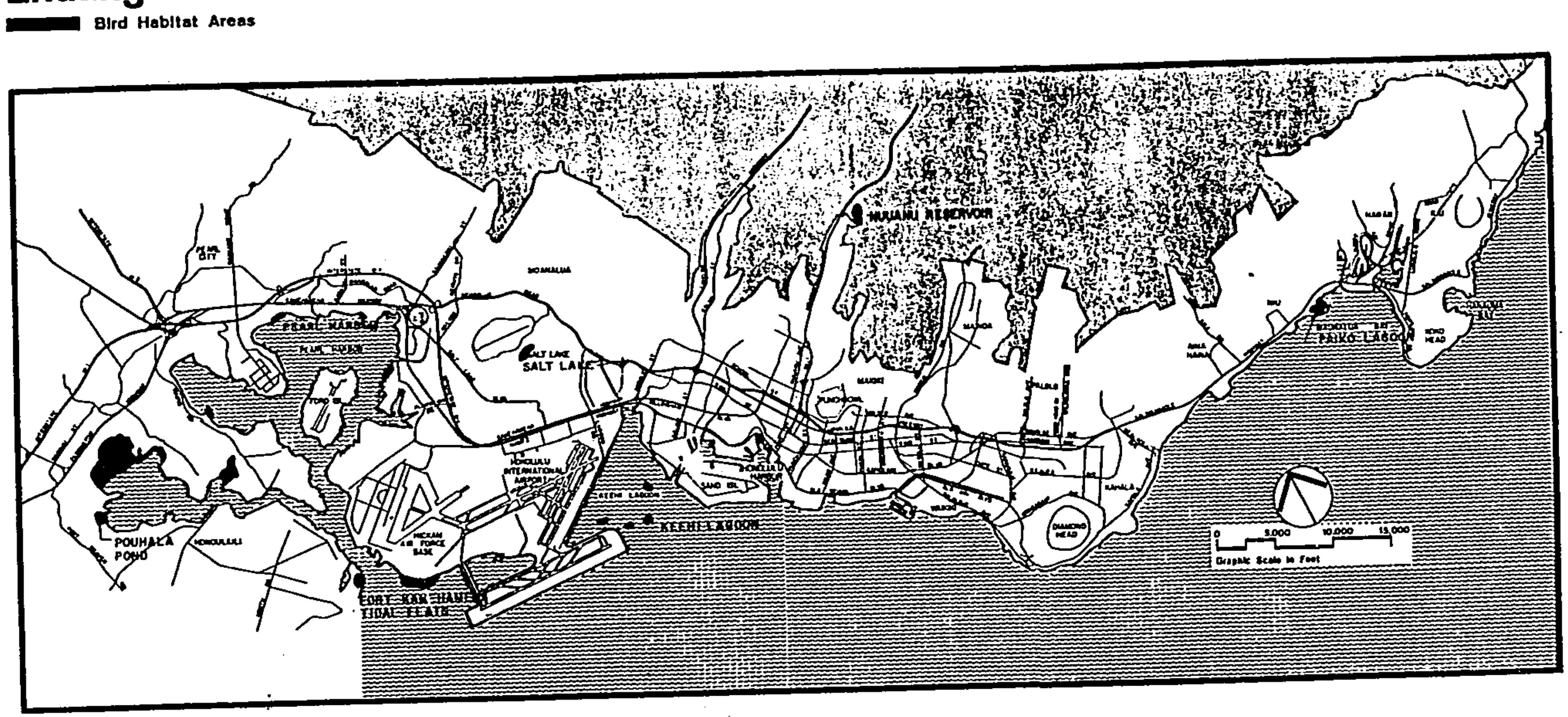



Figure II-4

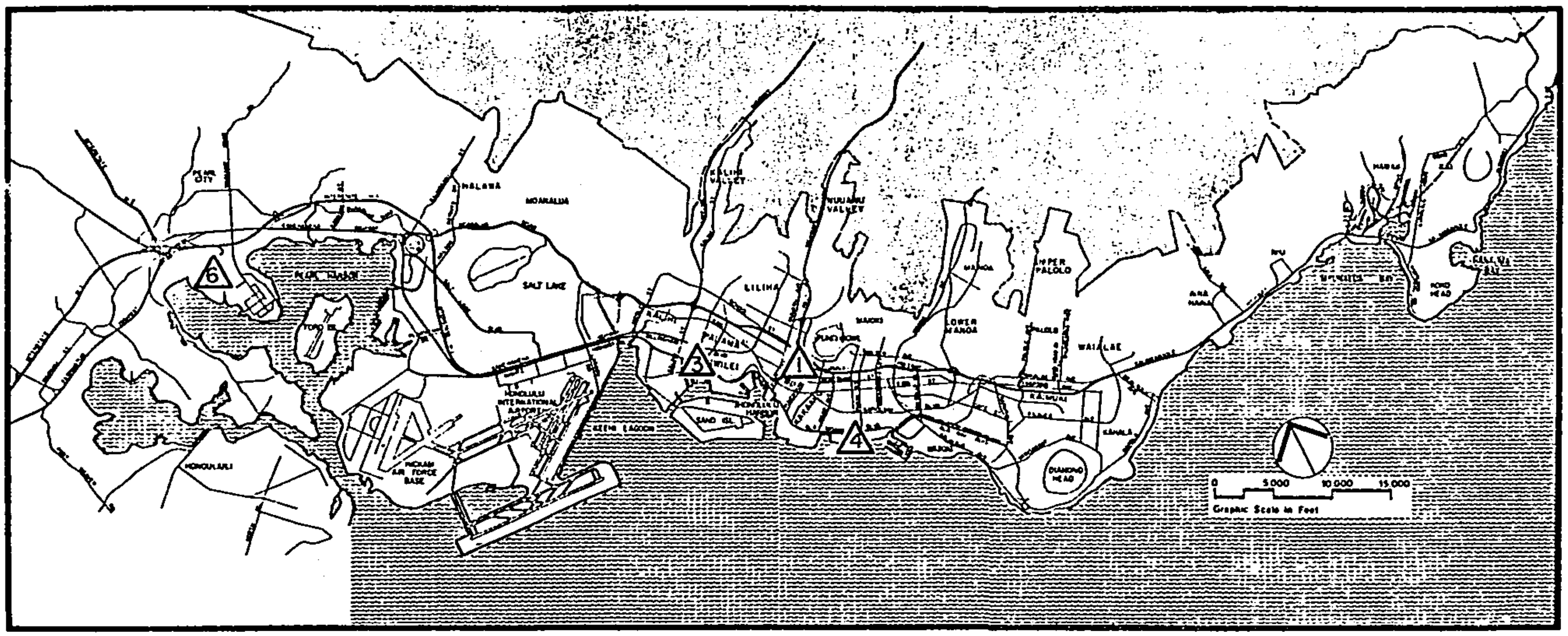
## Ambient Air Quality Monitoring Station Locations

△ MONITORING STATION

MONITORING STATION LOCATIONS ON OAHU

1. State Department of Health Building*
2. Barbers Point Lighthouse
3. Kalihi-Kai Firestation*
4. Ala Moana Park at McCoy Pavillion*
5. Waimanalo Sewage Treatment Plant
6. Pearl City Sewage Treatment Plant*
7. Campbell Industrial Park

*Stations Located in Central Honolulu.




NOTE: CURRENT MONITORING STATION LOCATIONS SHOWN.

Figure II-5

TABLE II-2

AMBIENT AIR QUALITY LEVELS
IN DOWNTOWN HONOLULU*

| | CO (1 hr.) | OXIDANTS (1 hr.) | PART. (24 hrs.) | $SO_2$ (24 hrs.) | $NO_x$ (24 hrs.) |
|---|---|---|---|---|---|
| | ($mg/m^3$) | ($ug/m^3$) | ($ug/m^3$) | $ug/m^3$) | ($ug/m^3$) |
| 1/1 to 12/31: 1973 | 8.8 | 28 | 34 | 7 | 46 |
| 1/1 to 12/31: 1974 | 6.5 | 29 | 35 | 10 | 37 |
| 1/1 to 12/31: 1975 | 6.6 | 25 | 40 | 9 | 33 |
| 1/1 to 12/31: 1976 | 5.4 | 40 | 34 | 23 | 35 |
| 1/1 to 12/31: 1977 | 3.5 | 25 | 31 | 17 | NA |
| 1/1 to 12/31: 1978 | 3.1 | 33 | 29 | 18 | NA |

*Average annual levels of pollutants as measured from a monitoring station located at the Department of Health Building. The different measurement periods shown for each pollutant correspond to both State and Federal standards.

## A.5. Ambient Noise

Honolulu's tropical climate and dependence on prevailing trade winds for ventilation result in an "open window" lifestyle and, consequently, high noise sensitivity. As in other urban areas, general background noise of the community is a varying quantity and is primarily due to automotive traffic on streets and highways.

Three regulations relate to noise control on Oahu:

- Vehicular Noise Control for Oahu, State Department of Health
- Community Noise Control for Oahu, State Department of Health
- Sec. 21-232, Noise Regulation, Comprehensive Zoning Code, City and County of Honolulu

The Vehicular Noise Control Regulation, Chapter 44A, Public Health Regulations, limits the maximum vehicle-generated sound levels on trafficways on Oahu. The Community Noise Control Regulation, Chapter 44B, Public Health Regulations, assigns maximum permissible noise levels to various zoning districts on Oahu by time of day and noise source (e.g., construction activities, agricultural equipment and processing plants, lawn mowers, stationary equipment). The Comprehensive Zoning Code also regulates stationary noise levels within a private property.

In Honolulu, background noise levels are largely determined by the proximity of major arterials and freeways and are typically high, in the range of 50 to 60 dBA for $L_{90}$.*[4] The $L_{50}$* noise level ranges between 55 to 75 dBA in the daytime and 50 to 60 dBA at night. $L_{10}$* indicates typical levels for automobile and truck traffic of 70 to 80 dBA with levels below 70 dBA occurring in residential areas well removed from major arterials and freeways.

## B. ARCHAELOGICAL AND HISTORIC SITES

Evidence of early man on Oahu has been almost completely lost because of the overwhelming influence of the succession of visitors since Hawaii's discovery by the western world. Early visitors made no attempt at scientific exploration of ruins and identification of artifacts due to the religious taboos of the islanders and the relatively narrow interests of early missionary settlers. Consequently, the significance of many ruins was lost as the traditions of the native islanders began to fade.

Central Honolulu, particularly the Chinatown and Hawaii Capital Districts, are replete with historic structures and artifacts, though all represent times following Hawaii's discovery by Western cultures. The Historic Sites Division of the State Department of Land and Natural Resources was consulted regarding the presence of buildings and sites of known historic significance in the Central Honolulu region. In addition, a survey was conducted to identify any other buildings of historic or architectural significance that might be influenced by proposed transportation improvements. A discussion of these and related analyses follows in a subsequent chapter (Chapter VI).

*$L_{90}$, $L_{50}$, and $L_{10}$ are the A-weighted noise levels exceeded 90, 50 and 10 percent of the time, respectively, $L_{90}$ is a description of a typical minimum noise level observed and is normally made up of the summation of a very large number of sound sources distant from the listener and not recognizable as individual sound sources. $L_{50}$ represents the long-term statistical average sound level and reveals the long-term influence of local traffic. $L_{10}$ is an approximation of the typical high or average peak sound level which occurs during nearby passbys of trucks, buses, automobiles, airplanes, or transit vehicles.

## C. URBAN SOCIO-ECONOMIC FACTORS

### C.1. Central Honolulu Population/Employment Forecasts

Table II-3 illustrates Central Honolulu's share of 1970, 1980, and 1995 population and employment on the island of Oahu. The highly urbanized Central Honolulu region is projected to continue as Oahu's population and employment center.

TABLE II-3

CENTRAL HONOLULU SHARE OF POPULATION AND EMPLOYMENT[5]

| | Population | % of Total Island | Employment | % of Total Island |
|---|---|---|---|---|
| 1970 | 407,600 | 65% | 259,000 | 82% |
| 1980* | 483,500 | 66% | 309,000 | 82% |
| 1995* | 573,500 | 62% | 410,000 | 79% |

*The 1980 and 1995 population and employment figures and percentages are based on the State DPED forecasts adopted in 1971 as shown in Table I-7 and the 1964 Oahu General Plan, as amended.

The forecast indicates that there will be continued growth in both population and employment within urban Honolulu. However, in 1995, the percentage of population and employment in urban Honolulu relative to the entire island drops slightly. This shift reflects pressure for the urbanization of outlying areas as a result of both policy direction and the fact that the current urbanized area can accommodate increases only through reuse of existing developed land. Regardless of this shift, Central Honolulu is projected to contain some 60 percent of the population and nearly 80 percent of the employment on the island in 1995.

The employment forecast reflects the continued projected growth in government, tourism, and service employment in the Honolulu core area. Increases in major employment areas are forecasted for the following locations (Table II-4):

TABLE II-4

MAJOR URBAN EMPLOYMENT AREAS[5]

| Districts | Employment 1970 | 1980 | 1995 |
|---|---|---|---|
| CBD-Civic Center | 52,000 | 64,000 | 90,000 |
| Waikiki | 19,000 | 24,000 | 40,000 |
| Ala Moana-Ward | 42,000 | 42,000 | 49,000 |
| Kalihi-Iwilei | 30,000 | 39,000 | 56,000 |
| Airport | 15,000 | 17,000 | 28,000 |
| Pearl Harbor-Hickam | 40,000 | 41,000 | 41,000 |

The above projected employment will reinforce the continued growth and importance of the urban core and the attendant increase in travel demand. Adequate transportation facilities will be vital to the efficient movement of goods and people and the economic well-being of the entire State.

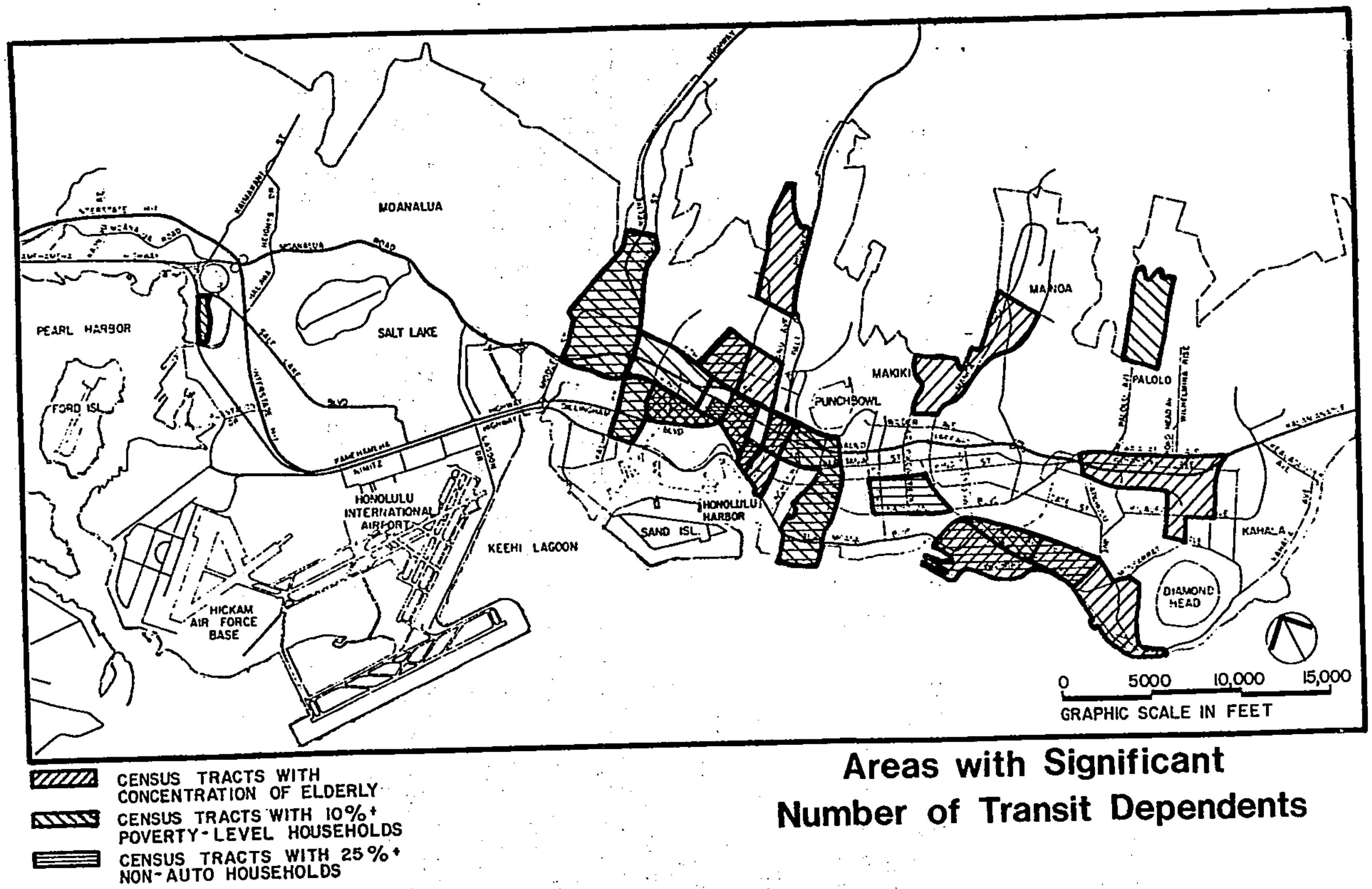
## C.2. Transit Dependence

Though a public transportation system has a profound effect on the entire population of an urban area, its effect is most acute on those who are dependent, by some means, on its use. The transit dependent, consisting of many elderly and handicapped persons, school-age children, and members of households without access to an automobile (often with low incomes), are difficult to identify with precision. However, a study conducted in 1974[6] scrutinized some elements of Oahu's transit dependent population. This study, along with 1970 Census data, contributed to the following discussion of Oahu's transit dependent population:

Elderly and Handicapped: The 1970 population of elderly on Oahu (persons 65 years of age and older) was 31,400, according to the Census. Most of this population was concentrated in high-rise areas such as Waikiki and Ala Moana, while 11 percent resided in the older residential areas of Central Honolulu. These concentrations are listed below and keyed to Figure II-6.

Areas with Concentrations of Elderly

- Waialae, Kaimuki
- Waikiki
- Lower Manoa
- Nuuanu Valley
- CBD
- Palama-Liliha
- Iwilei




**Areas with Significant Number of Transit Dependents**

Figure II-6

The following areas were determined to be the primary activity centers for the elderly and keyed to Figure II-7:

- Makua Alii-Paokalani Complex
- Kalanihuia at Aala Park
- Punchbowl Puowaina Center
- Keolahoonanea High Rise
- Makamae Complex
- Lanakila Senior Citizens Center
- Pumehana Residential Building

The handicapped tend to be more dispersed than the elderly, since they encompass all age and social groups. Nevertheless, certain key activity centers for the handicapped are listed below and illustrated in Figure II-7:

- Ho'opono Rehabilitation Center for the Blind
- Pacific Institute for the Orthopedically Handicapped
- Lanakila Rehabilitation Center
- Convalescent Center of Hawaii
- Honolulu Community College
- Waikiki
- Hawaii School for the Deaf and Blind
- Hawaii Association for Retarded Children
- Vocational Development Center at Fort Ruger
- Leahi, St. Francis, and Maluhia Hospitals
- University of Hawaii

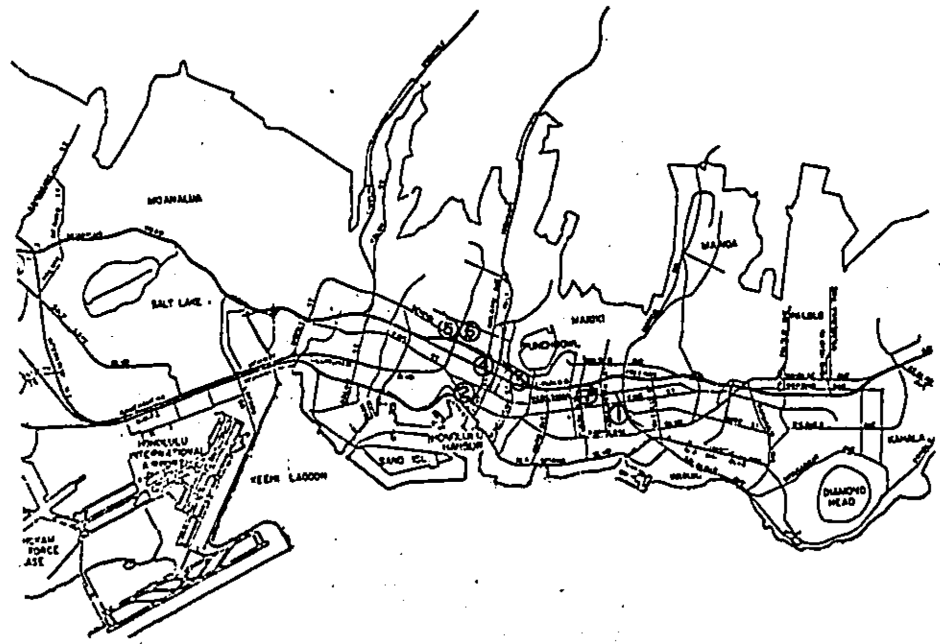
School-Age Children: According to the 1970 Census, areas with high proportions (25 to 45 percent) of school-age (five to 15 years) children tended to be outlying residential areas such as Hawaii Kai, Kaneohe, Kailua, Waimanalo, Pearl City, and Leeward Oahu. Residences in these areas are generally single-family dwelling units. Exceptions are areas with low-income housing projects, including Palolo Valley, Palama, and Kalihi. Older residential areas, generally closer to the Honolulu CBD, tended to have a lower proportion (0 to 14 percent) of school-age children.

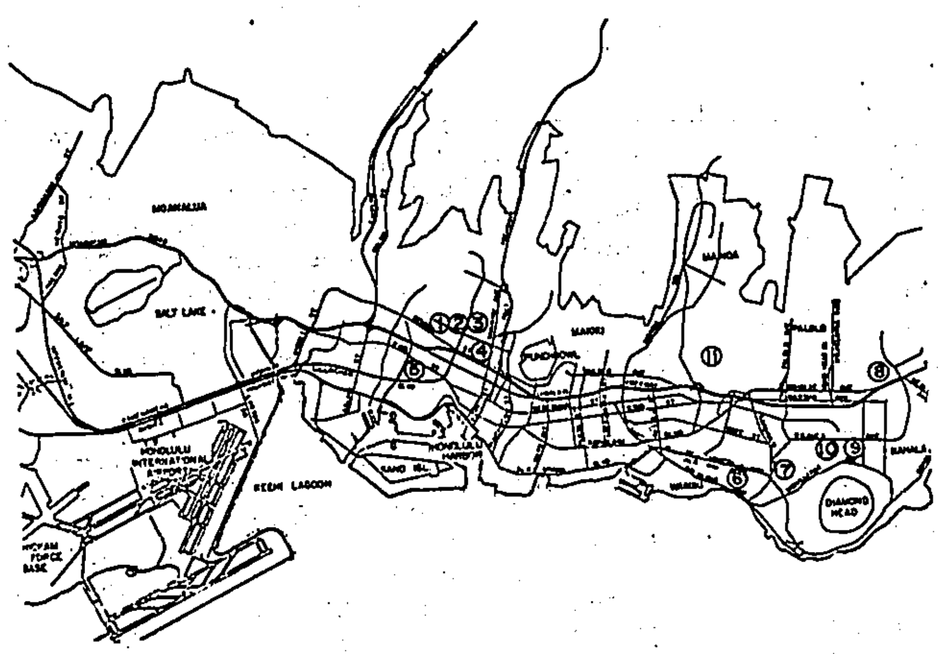
Non-Drivers and Persons with No Auto Available: This category was defined to include households with no or one car, low-income households and persons who do not drive to work (automobile passengers, transit users, cyclists, and walkers). A high correlation between low income and low automobile ownership/usage was indicated in the 1970 Census. Areas with such characteristics were the older portions of Honolulu between Waikiki and Kalihi, often centered around housing projects. Areas with high (25 percent or more) concentrations of households with no automobile are listed below and keyed to Figure II-6:

ELDERLY AND HANDICAPPED ACTIVITY AREAS

ELDERLY : ACTIVITY AREAS

1. MAKUA ALII
2. KALANIHUIA
3. PUOWAINA
4. KEOLAHOONANEA
5. MAKAMAE
6. LANAKILA SR. CITIZENS CENTER
7. PUMEHANA




HANDICAPPED : ACTIVITY AREA

1. HO'OPONO REHAB. CENTER FOR THE BLIND.
2. PACIFIC INST. FOR ORTHOPEDICALLY HANDICAPPED
3. LANAKILA REHABILITATION CENTER
4. CONVALESCENT CENTER OF HAWAII
5. HONOLULU COMMUNITY COLLEGE
6. WAIKIKI
7. HAWAII SCHOOL FOR THE DEAF & BLIND
8. HAWAII ASSOCIATION FOR RETARDED CHILDREN
9. VOCATIONAL DEV. CNTR. AT FORT RUGER
10. LEAHI, ST. FRANCIS & MALUHIA HOSPITALS
11. UNIVERSITY OF HAWAII

Figure II-7

Areas with 25%+ Non-Auto Households

- Waikiki
- Kalakaua Housing
- Kakaako
- CBD
- Palama
- Iwilei
- Kalihi and Kalihi Valley Housing

Rural areas classified as having high concentrations of low-income families did not exhibit as strong a non-driver pattern as their urban counterparts. This may be due to the fact that there was no substantial rural bus service in 1970; families might thus have been forced to own a car or limit activities to their immediate neighborhoods, with resultant restrictions on employment, shopping, and social opportunities.

1970 Census data identified areas with high proportions (10 percent or more, excluding military households) of poverty-level households (with earnings of $3,743 per year or less). These areas are listed below and keyed to Figure II-6:

Areas with 10%+ Poverty-Level Households

- Upper Palolo, including Palolo Housing
- Waikiki "Jungle"
- Kakaako
- Palama, including Mayor Wright Housing
- Kalihi
- Kalihi, including Kuhio Park Terrace
- Kalihi Valley Housing
- Halawa Housing
- Waianae Coast*
- Wahiawa Town*
- Waialua, Haleiwa Town*
- Kahuku, Laie*
- Waimanalo*

## D. URBAN TRAVEL PATTERNS

Several documents (discussed in Chapter III) have identified the Central Honolulu area as the region most critical to islandwide transportation. It extends from the Pearl City area to Hawaii Kai on a narrow plateau between the Pacific Ocean and the Koolau Range. In its center are the Honolulu central business district (CBD) and other significant urban features.

*Not in Central Honolulu region; data provided for informational purposes only.

## D.1. Street/Highway System

The street and highway network of urbanized Oahu resembles those of many intermediate-sized U.S. metropolitan areas in that primary urban travel corridors radiate from the urban core (see Figure II-1):

- The eastern corridor follows Kalanianaole Highway to Hawaii Kai.
- The northern, trans-Koolau corridor, made up of the existing Pali and Likelike Highways and the proposed H-3 Freeway, serves the Windward region.
- The western corridor consists of the H-1 Freeway and Kamehameha Highway serving the Pearl City area; they split beyond the Pearl City area with the Central Oahu region served by Kamehameha Highway and the new H-2 Freeway, and the Leeward Oahu region by the H-1 Freeway and Farrington Highway.

These three primary corridors all funnel into the relatively narrow east-west movement channel of the Honolulu urban core -- the project corridor. Because this area is sandwiched between the ocean and the Koolau Mountain Range, urban Honolulu has developed into a linear city only one-and-one-half to two miles in width. Within this narrow strip, the bulk of east-west travel movement is served by a single six-lane freeway and four principal urban arterials, fed by a network of minor local streets. Because of the area's dense development, both the State and the City ruled out new major highway facilities; their disruption to communities and adverse environmental impacts would be unacceptable to the residents of the area and this formed the basis for Oahu's Long-Range Transportation Plan which calls for a rapid transit system from Pearl City to Hawaii Kai.

There are several major destination points in the urban Honolulu area, including the CBD, Civic Center, the Waikiki area, and the Hickam-Pearl Harbor military complex; other important points are the University of Hawaii and Honolulu International Airport. These major destination points form a linear corridor pattern. The military complexes occupy the west end of the corridor, followed by the airport, the CBD and Civic Center, Ala Moana Center (a major regional shopping center), and the Waikiki-University area on the corridor's east end.

With existing and committed highways and freeways providing direct routes to Central Honolulu, accessibility from outlying regions along the northern and western primary radial corridors is good with capacity for future auto travel demands adequate. The eastern corridor to Hawaii Kai is overtaxed with Kalanianaole Highway currently being planned for improvements.

Travel on Oahu, as measured by automobile ownership and vehicle miles traveled, has increased approximately 75 percent during the past decade. Proportionally, this is a much greater increase than the 20 percent increase in population.

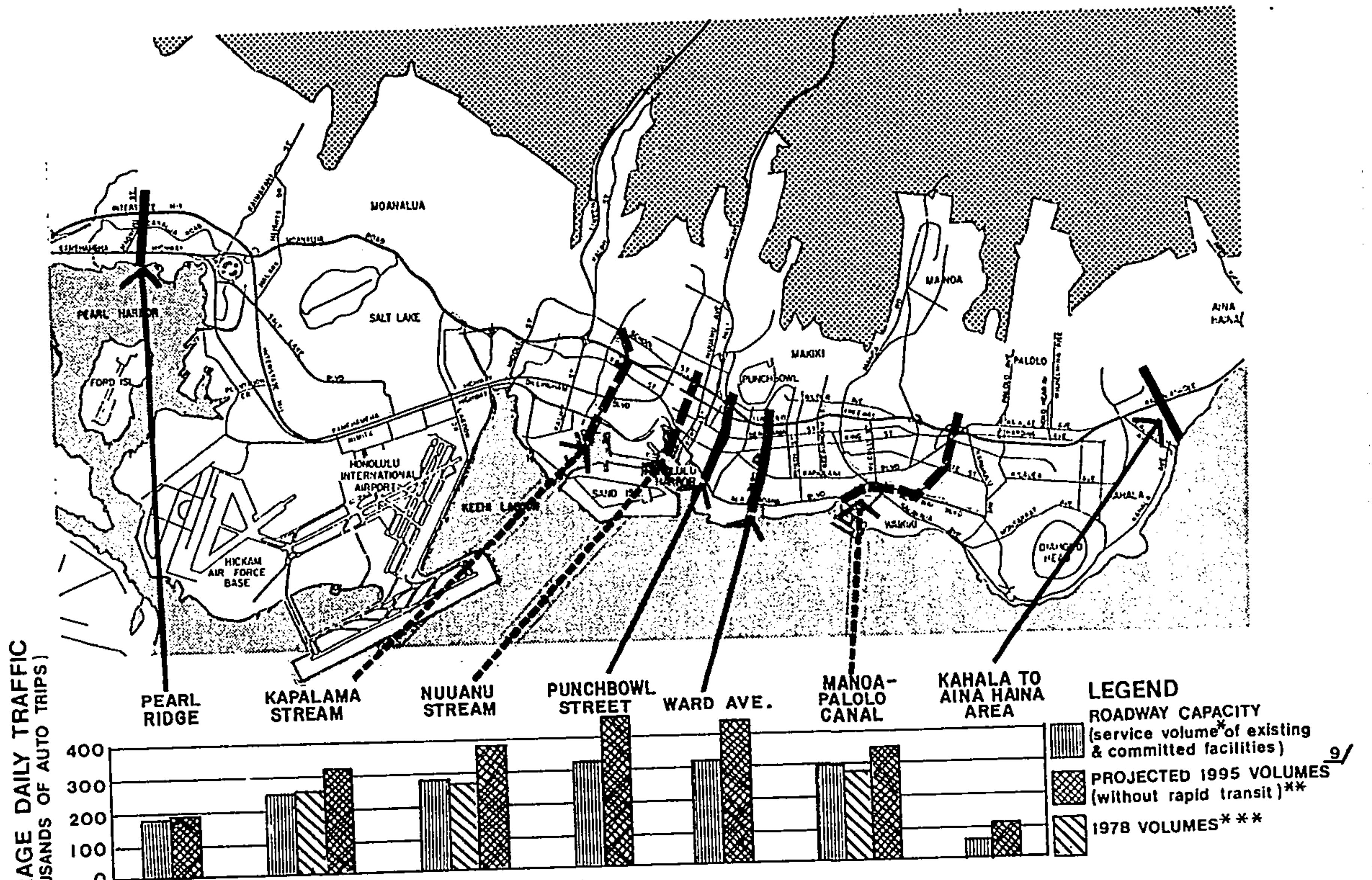
Due to the escalating labor participation rate, work trips have also increased more rapidly than the population. The very rapid increase in overall travel has created a great demand for additional street and highway capacities. The development patterns of urban Oahu and attendant transportation demands are beginning to overtax the principal travel corridors, with major impact on the critical, high-volume corridor in the urban core. Due to concentration of employment and major activity centers in the urban core, an average of 350,000 to 450,000 daily auto trips are projected for this corridor by 1995. No new highways or freeways are contemplated for this urban corridor. Recent studies conducted under the TOPICS[7] and National Transportation Need Study[8] programs forecast a serious transportation capacity deficiency in this corridor.

An analysis of the screenlines on either side of the CBD-Civic Center area indicates a capacity of some 280,000 vehicles per day on the western side and approximately 320,000 on the eastern side, based on a level of service "D" (see Figure II-8). Volumes through these screenlines in 1978 approached or reached capacities. Based on travel demand forecasts[9], traffic volume in 1995 will exceed capacity by an average of approximately 100,000 autos per day. Converting daily auto trips to peak-hour trips would result in approximately 6,000 autos per hour in each direction, the equivalent of a new six-lane freeway carrying 2,000 autos per hour per lane. It is clear from this analysis that congestion is heavy today and will be more severe in the future.

## D.2. Transit

During FY 78-79 the City and County of Honolulu operated a fleet of 350 transit vehicles; of these, an average of 302 were scheduled for service and the balance were spare vehicles. The average fleet age was approximately 9½ years. A few buses are specially equipped to provide hill-climbing service for residential areas located on the slopes of the Koolau Mountains. In the spring of 1980, 74 new standard size buses were added to the fleet. In mid-1980, an additional 10 shorter length hill-climbing models will be in operation. With these new additions and the retirement of some older buses, the bus fleet will total 400 buses.

# PRELIMINARY ROADWAY CAPACITY & VOLUME




* AT LEVEL OF SERVICE D.

** ASSUMES A BASELINE BUS SYSTEM IN OPERATION.

*** SOURCE : "TRAFFIC SUMMARY - 1978," STATE DEPARTMENT OF TRANSPORTATION.

Figure II-8

In June, 1977, through contracted services, the City also initiated operation of specially equipped vans that provide dial-a-ride transit service to handicapped persons. At present, "The Handi-Van" service consists of an expanded fleet of 21 vehicles.

The 302 scheduled vehicles service 30 local routes, and five express routes. Round trip route mileage on all routes totals approximately 1,500 miles. A varying number of extra vehicles are available to supplement regularly scheduled vehicles on heavily loaded routes during peak periods. Three of the five express routes -- Hawaii Kai, Windward, and Wahiawa-Mililani have two subroutes. The Hawaii Kai express buses serve the CBD and the University of Hawaii (U.H.). The Windward express originates from either Kailua or Kaneohe and serves the CBD and the U.H. The Wahiawa-Mililani express transports riders to either U.H. or Pearl Harbor. The fourth express route operates between Waipahu and the CBD. The fifth express route provides service between the park-and-ride facility at the Aloha Stadium and the CBD/U.H. Where feasible, buses travel on exclusive bus lanes or on contra-flow bus lanes. Figure II-9 shows the location of bus routes, headways, and locations of exclusive bus lanes in the Central Honolulu area.

The orientation of service provided by the existing bus system reflects the high travel demands generated within the Central Honolulu region. Twenty of the 30 local routes operate exclusively within the Central Honolulu region. Of the remaining 10 local routes, all but four provide transit service from outlying regions to Central Honolulu. Also, as described earlier, all express routes provide service within or to the Central Honolulu region. Furthermore, 73 percent of the total daily bus mileage operated on the island occurs in the Central Honolulu region. During peak hours, of the total bus fleet operating on the island, some 65 percent operate on routes located entirely in Central Honolulu and another 33 percent operate from outlying areas into Central Honolulu. Only two percent of the peak-hour bus fleet operates wholly outside the Central Honolulu region.

Obsolete maintenance facilities have been the main constraint to the City's further expansion of the bus fleet. The site of the only existing maintenance and storage facilities prior to 1979 is located in the Alapai Street area. In May 1979, the City completed a new bus yard and maintenance facility in Halawa Valley, with excellent highway access to Leeward, Central, and Windward Oahu. This site will serve as the major repair yard for the entire bus transit fleet, as well as provide servicing and storage for 250 buses. A second new facility currently being planned would be located near the Civic Center area and would provide additional shops and service facilities to also accommodate 250 buses.

# Existing Central Honolulu Bus Routes

Preferential Treatment
Local and Express Routes
Buses per Hour (Peak Period)

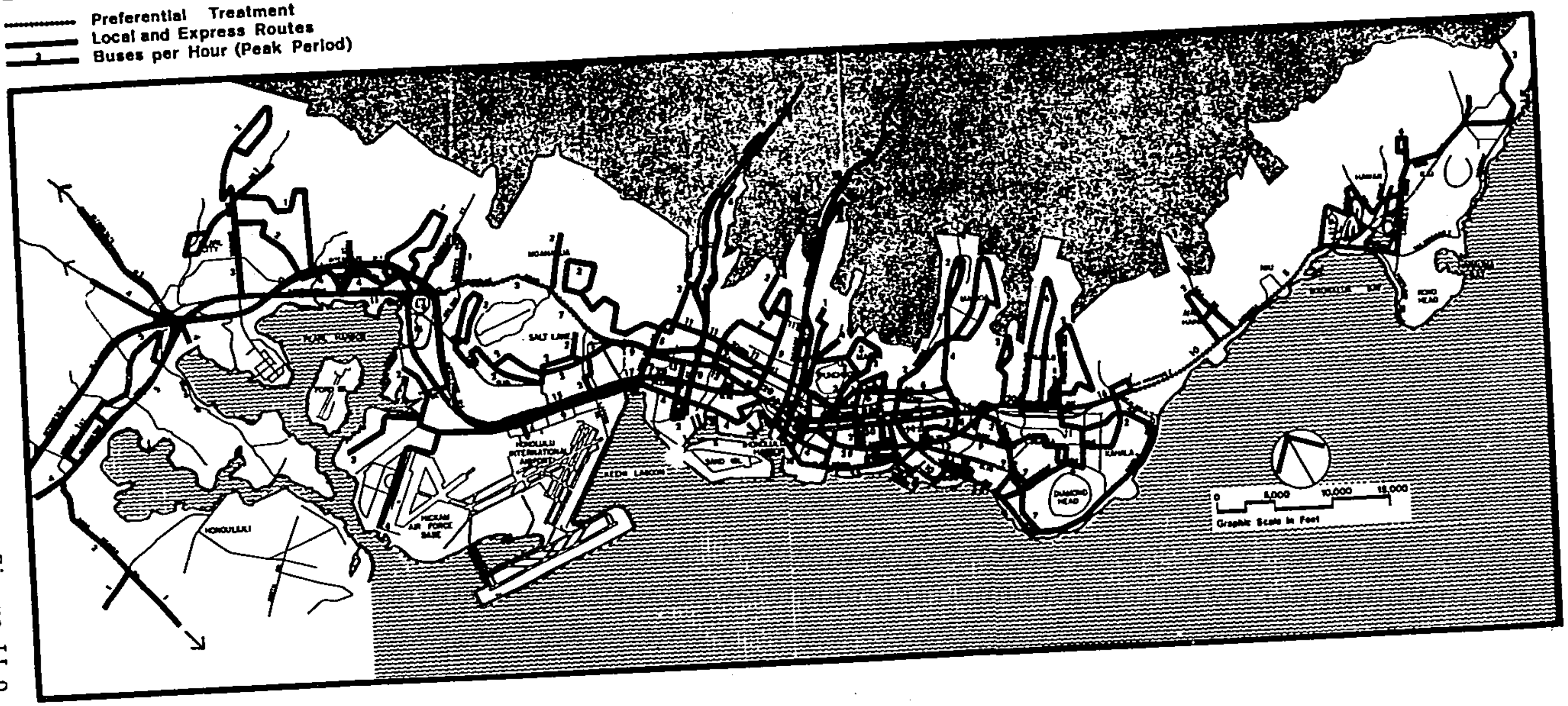



Figure II-9

# III. ANALYSIS OF TRANSIT SYSTEM ALTERNATIVES

The need for an integrated mass transit system on Oahu can be traced to documents composed well over a decade ago. This chapter provides capsule summaries of the most significant of these documents; examines the feasibility of low capital cost alternatives; describes the most viable systems considered and evaluates them in regards to their ability to address transportation goals and objectives. No attempt is made to cover all modes that have been considered at one time or another. Rather, only the candidates that appear most likely to meet islandwide transportation goals in conformance with adopted policies were examined.

In addition to system alternatives, three other alternative evaluations were conducted and are summarized in this chapter. They include alternative alignments and station locations, alternative segment lengths for initial construction, and alternative vehicle system types.

## A. BACKGROUND OF TRANSIT PLANNING STUDIES

### A.1. Historical Perspective

Since World War II, it has been relatively clear that Oahu would require new, high-capacity transportation facilities. As in mainland cities, it was felt in the late 1940's and 1950's that extensive freeway development could relieve congestion that would accompany projected population growth.

Interstate Freeways H-1, H-2 and H-3 eventually became the principal elements in Oahu's highway program. As construction of these facilities progressed in the 1960's, the public grew increasingly aware of their impact magnitude, reinforced by negative response to proposed freeways in various mainland cities. At the same time, population growth was continuing with a corresponding increase in travel demand. In response to this increasing demand, the State and the City, with federal financial support, embarked upon a series of concentrated studies exploring alternatives to an expanded highway system, among them:

- Oahu Transportation Study[10] - 1967
- Preliminary Engineering and Evaluation Program - Phase I[11] - 1972
- Evaluation of Alternative Transportation Systems Study[12] - 1973

- Preliminary Engineering and Evaluation Program - Phase II[13] - 1976

a. Oahu Transportation Study (OTS) - 1967: Drafted in 1967 by the State and the City with federal assistance, the Oahu Transportation Study detailed the parameters of a long-term solution to the island's transportation problems. The study re-examined Oahu's population and employment growth potential and assessed the island's projected transportation deficiencies. OTS concluded that additional transportation capacity would be needed to satisfy transportation demands as early as the 1980's.

Two alternatives were explored as a means of providing that additional capacity: (1) an all-bus system operating in mixed traffic over an expanded freeway system and (2) a fixed guideway system of the "trunkline-feeder" type with the completion of only committed highway improvements. This study concluded that a rapid transit system is cost-effective compared to an all-bus system due to the reduced need for additional highway improvements and because it provides other social, environmental, and community benefits which the all-bus system could not match. While OTS did not explore technology and/or alignments in detail, it did define a viable transit corridor based on travel demands. (That corridor, between Pearl City and Hawaii Kai, has been retained with only slight adjustments through nearly all subsequent transit development reports.)

b. Preliminary Engineering and Evaluation Program - Phase I (PEEP I) - 1972: Additional foundation studies for high-capacity public transit development based on OTS findings began in 1971. By this time, the City and County of Honolulu had initiated the acquisition and consolidation of three independent urban bus companies; major system expansion and modernization were contemplated.

The PEEP I program complemented bus system renovation, focusing on alternative approaches to the development of a fixed guideway system. Modes considered were line-haul/feeder fixed guideway, bus-on-busway, and waterborne systems. (The waterborne system featured offshore trunkline operations in the ocean and canals and/or a feeder bus network for inland connections.) A battery of corridors, route lengths, and alignments were considered, ranging from a 12-mile segment between Halawa and the University of Hawaii to an ultimate "U"-shaped, dual-branch network around most of Oahu's circumference. The PEEP I study defined a fixed guideway rapid transit system running from Pearl City to Hawaii Kai as best meeting the long-range needs of the island. A feeder bus system comprised of local/express services provided access to points beyond the corridor boundaries. PEEP I recommendations differed from those of OTS mainly in endorsing a single, rather than branched, line.

c. Evaluation of Alternative Transportation Systems Study - 1973: This supplementary study compared the fixed guideway and busway alternatives from PEEP I to several busway variations and an automatic rapid transit (ART) network. Significant busway variations included platooning and station bypassing techniques; the small-vehicle ART network consisted of a two-way guideway serving 77 stations along 33 miles. In spite of these additional alternatives, the recommendations from PEEP I were upheld.

d. Preliminary Engineering and Evaluation Program - Phase II (PEEP II) - 1976: After investigations into the feasibility of the ART system concluded that neither it nor the revised busway configurations was preferable to a fixed guideway system, the City and State agreed to proceed with the PEEP II study. The primary objective of PEEP II was to execute more advanced planning and preliminary designs for a fixed guideway system.

Part of PEEP II served to summarize into one document all past planning studies that influenced ongoing design activities. Also, PEEP II explored the feasibility of other less capital-intensive systems such as light rail transit (LRT), which could be progressively upgraded to full grade-separation, as alternatives to fixed guideway implementation. The results of the comparative analysis is summarized in a subsequent section.

## A.2. Need for Improved Mass Transit

The previous chapter described the current and projected conditions of the street/highway system of urban Honolulu which forecasts a serious transportation capacity deficiency in the primary east-west corridor. It also described the existing bus transit system attempting to meet a larger transit demand than that capable of being provided by the current bus fleet. In order to meet the growing travel demand of the area, various improvements to maximize the carrying capacity of existing street/highway system through various transportation system management (TSM) measures have been or are being implemented in Honolulu. Improved mass transit is an important element of this program for providing improved service to meet transit demands as well as a means of increasing the carrying capacity of the existing street/highway system. The following paragraphs describe the measures taken to maximize Honolulu's existing transportation system.

a. Existing Low-Capital Investment Measures: The State of Hawaii and the City and County of Honolulu have long assumed a progressive stance on the issue of modifying existing streets and highways for maximum flow through TSM techniques. Recent improvements to Honolulu circulation include implementation of the following TSM measures:

Improved Signalization: cycle and phasing adjustments in response to traffic volumes.

One-Way Streets: creation of a one-way couplet from two two-way streets to improve flow and allow on-street parking to continue.

Reversible Lanes: increasing peak-hour, peak-direction capacity by assigning the median off-peak lane to contraflow traffic.

On-Street Parking Restrictions: increasing peak-hour street capacity by allowing curb lanes to be used for through traffic.

Longer Peak Commuting Hours: spreading work-trips over a longer time period, decreasing congestion and average commuting time; City/County and State employees currently may choose work hours that vary by as much as three hours.

Segregated Bicycle Rights-of-Way. enhancing safety and easing vehicular flow by eliminating potential cycle-motor vehicle conflicts; encourages alternatives to automobiles for commuting.

High-Occupancy Vehicle (HOV) Priority Treatment: median lanes along several miles of Kalanianaole Highway, Moanalua Highway, and the H-1 Freeway currently available only to vehicles with three or more occupants during peak periods, encourages carpooling and transit use through shorter trip times.

Street Rechannelization: restriping to increase the number of lanes; separating turning maneuvers from through traffic.

In addition, the State of Hawaii is evaluating the feasibility of installing ramp metering and surveillance equipment on the H-1 Freeway. Mainland experiences indicate that such equipment is effective in diverting short trips from freeways to surface streets, resulting in smoother freeway flow, higher average speeds, and reduced emissions from automobiles on freeways.

Although the effectiveness of each of these programs is difficult, if not impossible, to assess quantitatively, the ongoing programs in concert seem to be a qualified success in that they appear to be keeping pace with increases in vehicular traffic. Congestion has not worsened significantly since their implementation. It is also apparent, however, that opportunities for further improvement of this sort may be limited, especially if reduction in auto travel is left to voluntary methods. They could be exhausted in the very near future; congestion will then increase in proportion to travel demand.

b. Bus System Improvements: In FY 78-79 the City's bus fleet totaled 350 buses. With the addition of 84 new buses and the retirement of some older models, by mid-1980, the bus fleet will consist of a total of 400 relatively late model coaches. The City has just completed one and has started on the development of another new bus yard and maintenance facility capable of accommodating up to a total of 500 buses when completed.

Besides the expansion of the bus fleet, the City has also implemented improvements to the flow of buses on the streets and highways such as contra-flow bus lanes on Kalanianaole Highway from Hawaii Kai and on Kalakaua Avenue in Waikiki. Also, as stated earlier, reserved lanes on the Moanalua Highway and the H-1 Freeway (between Aiea and Halawa) are set aside for car pools, including buses, during peak periods.

The City's annual report titled, "Short-Range Bus Plan Update," June 1979, outlines the future plans, implementation program, and cost of the Honolulu bus system. It serves as the most recent document for implementing the short-range transit improvement program in Honolulu.

The plan consists of several phases to be implemented during this period. The first phase involves the expansion and modernization of the fleet in 1980 to a total of 400 vehicles. The second phase will occur with programmed modernization of the bus fleet through 1983 with the purchase of additional vehicles to replace older ones, increasing the fleet to nearly 450 buses.

In addition to the expansion and modernization of the bus fleet, various other complementary improvements and study programs are also planned as follows:

- new bus routes
- the establishment of new preventative maintenance and bus parking facilities in the Civic Center area
- improvement of bus stops including benches, shelters and signs
- Bus System Maintenance and Safety Program - a study to develop maintenance and safety programs and evaluation techniques for the bus fleet, yards, and other facility operations
- Bus System Development Program - a study to provide the City with a continual bus development program geared toward system efficiency and effectiveness. This islandwide program will represent the City's "bus master plan" through the mid-1980's

The City has an enviable record of a highly successful and efficient bus operation. For FY 74-75, approximately 45 million trips were made on the City's transit system consisting of a fleet of some 280 buses. Over 50 million transit trips were made during FY 75-76 and currently nearly 57 million annual transit trips are made in part due to the increase in the fleet size. Transit ridership has increased by 200 percent, since the takeover of the mass transit system in Honolulu by the City in 1971.

Based on the above discussions, it seems clear that in the use of the existing facilities, both the transit system and the street/highway system are being maximized with the improvements already implemented and those scheduled for implementation in the very near future. With the projected growth in travel demand combined with possible limitations on additional improvements remaining, it is inevitable that additional new transportation capacity must be provided. As early as 1967, the OTS pointed out that any new freeway in Central Honolulu would not be acceptable to the community. Today, this view continues to be recognized by public officials and private citizens that Central Honolulu cannot afford such an environmentally disruptive facility as a new freeway, which is reflected in the City's transportation policy statement contained in the new General Plan for Oahu. Thus an extensive evaluation of various alternative transit system concepts was conducted to identify a high level transit system which would fulfill Honolulu's long-range requirements. This evaluation is summarized in the remainder of this chapter.

Based on the City's highly successful bus transit system, various forms of improved bus transit are appropriate alternatives to any low or high capital cost transit alternatives. The expansion of the existing bus system to a fleet of 450 buses will be used as the "baseline" or "no-build" alternative. A higher level bus system incorporating various TSM improvements together with maximum expansion to the bus fleet is designed to provide the optimum bus transit alternative, referred to as the TSM/Expanded Bus system. The two alternatives, "baseline" and TSM/Expanded Bus systems are described in a subsequent section and will be used as the basic low-capital alternatives for assessing all other alternatives.

## A.3. Consideration of Alternative System Concepts

a. PEEP I: Systems studied as a part of the Preliminary Engineering and Evaluation Program - Phase I included fixed guideway, busway and waterborne concepts. The consideration of dual-mode and personal rapid transit (PRT) systems were curtailed after an initial evaluation, based on the fact that both systems were in experimental stages at the time; their application to the Honolulu urban environment would have been based on little or no precedent.

Capsule descriptions and basic performance assessments of the PEEP I fixed guideway, busway and waterborne systems are provided below. Figure III-1 illustrates the alternative line-haul routes. Table III-1 relates each system's projected cost and patronage.

Fixed Guideway: A 22-mile, 20-station system, interfacing with an islandwide network of local and express buses was investigated. Rubber-tired, medium-size vehicles were envisioned. The fixed guideway system enjoyed a high average speed and the best compatibility of the three systems with environmental and community objectives. Originally assumed to provide service comparable to the busway alternative, the fixed guideway system was subsequently found to have higher projected patronage.

Busway: Grade-separated, exclusive rights-of-way in lengths of 19 and 22 miles were considered. Alternative vehicle concepts took into account recent strides in high-capacity, articulated two-unit bus technology. Service levels were assumed to be nearly comparable to the fixed guideway system. The busway's advantage in eliminating certain transfers at line-haul termini was offset by lower average speeds, poorer anticipated schedule reliability, and less favorable environmental and community impacts.

Waterborne: The three waterborne systems, featuring 250-passenger ocean-going vessels on off-shore line-hauls connecting to canal boat and/or bus feeder systems, proved to be less cost-effective than fixed guideway and busway alternatives. Their reliance on feeder systems for penetration into major activity centers made them less attractive to potential patrons. Poor scores were also returned in operating and maintenance costs.

b. Automatic Rapid Transit (ART) System: The City and the State authorized the study of an ART system, to be compared with the busway and fixed guideway alternatives. Being a relatively new concept, there were neither established reference characteristics nor revenue-service operating experiences for ART. Vehicles were envisioned to be 20-passenger (12 seated), trainable, automatically operated cars, needing neither on-board operators nor station attendants. A 33-mile, 77-station network was designed. The flexibility of skip-stop programming was reflected in the fact that all stations were to be off-line; through vehicles would not be detained by accelerating or decelerating vehicles leaving or entering stations.

# Alternative Transit Sytems - PEEP I

Fixed Guideway & Busway Systems Route and Station Locations
Waterborne System Route and Ocean Express Stops

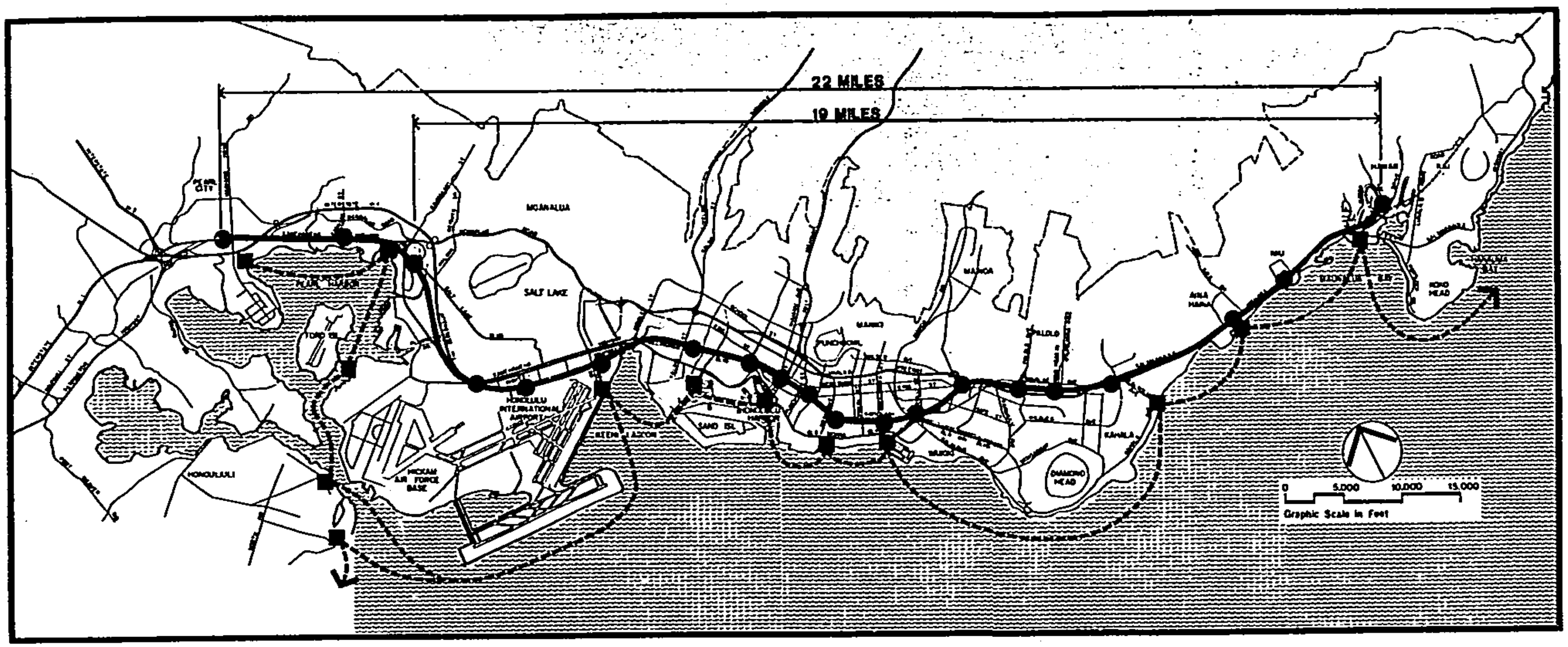



Figure III-1

TABLE III-1 SUMMARY OF COST AND PATRONAGE ANALYSIS - PEEP I 14/

| | FIXED GUIDEWAY | BUSWAY A | BUSWAY B | WATERBORNE 1-A | WATERBORNE 1-B | WATERBORNE 1-C |
|---|---|---|---|---|---|---|
| LINE HAUL LENGTH (MI.) | 22 | 22 | 19 | 22 | 22 | 22 |
| NO. STATIONS | 20 | 20 | 18 | 13 | 13 | 7 |
| DAILY PASSENGER VOLUME | 484,000* | 484,000** | 471,000*** | 484,000** | 226,000* | 185,000* |
| ANNUAL PASS. VOL. (MILLION) | 146.2 | 146.2 | 142.3 | 146.2 | 68.3 | 55.9 |
| FAST LINK VEHICLES | 405 | 458 | 416 | 224 | 75 | 43 |
| CAPITAL COST ($ MILLION) | 577.8 | 537.7 | 483.2 | 935.7 | 377.0 | 244.9 |
| ANNUALIZED CAP. COST ($ MILLION) (30 YRS. @ 4%) | 33.4 | 31.1 | 27.9 | 54.1 | 21.8 | 14.2 |
| ANNUAL O&M ($ MILLION) | | | | | | |
| FAST LINK | 17.0 | 23.6 | 20.4 | 76.6 | 25.4 | 14.6 |
| FEEDER | 19.0 | 19.0 | 20.0 | 16.9 | 8.5 | 7.4 |
| TOTAL | 36.0 | 42.6 | 40.4 | 93.5 | 33.9 | 22.0 |
| TOTAL ANNUAL COST ($ MILLION) | 69.4 | 73.7 | 68.3 | 147.6 | 55.7 | 36.2 |
| COST/PASS. TRIP (¢) | 47.5 | 50.4 | 48.0 | 101.0 | 81.6 | 64.8 |

* BASED ON MODAL-SPLIT ANALYSIS (PEEP I)

** ASSUMED PATRONAGE SAME AS FIXED GUIDEWAY

***PATRONAGE ESTIMATE BASED ON MANUAL DERIVATION

Note: All costs shown are in 1972 dollars.

The entire system would be constructed above-ground on elevated structures. In the downtown Honolulu area where line volumes were high, four mainline tracks plus separate station tracks were required which produced significant visual impact to the area.

Cost of the ART system was estimated to be about 15 percent higher than that of the fixed guideway alternative. The removal of station and vehicle attendants from the fixed guideway system (similar to Lindenwold Line fixed guideway operations in Philadelphia) would widen the gap further. Even with a more extensive network, patronage was only comparable to that of the fixed guideway system.

c. Consideration of Other Alternative Systems:

Light Rail or Streetcar Transit: A Light Rail Transit (LRT) System was examined as a system that can serve short-term needs with modest investment and allow progressive upgrading in response to demand increases. LRT vehicles can be operated on surface streets in either reserved rights-of-way or mixed traffic, thereby eliminating the need for costly tunneling, underground stations, and elevated structures. Its operation essentially represents the state-of-the-art of the time-proven streetcar concept. As such, LRT appears well-suited to incremental implementation, maintaining the flexibility of a bus system in response to changing land use patterns and urban growth, with potentially higher line capacity and lower operating costs. (Hereinafter LRT will be referred to as a "streetcar" system.)

A streetcar network utilizing existing streets was developed to serve high-volume transit routes in urban Honolulu. System design encompassed maximum "people carrying" capacity through the use of large, high-performance light rail vehicles operating in two-car trained units at 90-second minimum headways. For high rider attractiveness and operating efficiency, greater operating speeds were obtained by use of reserved transit lanes, supported by priority treatment such as signal preemption.

Since a streetcar system would occupy two street lanes presently used by automobiles -- in addition to preferential transit measures -- it would have an impact on street capacity resulting in increased traffic congestion. Consequently, a detailed analysis of reciprocal transit and auto impacts was necessary to obtain a balanced operating condition for both modes.

A streetcar network between Middle Street and Kahala was developed and integrated with an island-wide bus system. A modal split analysis was conducted to determine patronage on this system. Figure III-2 shows the 12.2-mile streetcar network considered. Due to the fact that light rail vehicles can attain a slightly higher speed than conventional buses, a modest increase in ridership was achieved. Projected peak-hour demand on the streetcar system indicated that two streetcar routes, each with two-way tracks, would be required through the CBD area (generally between Fort Street Mall and Alapai Street), as shown in Figure III-3.

A volume-to-capacity analysis was conducted at critical screenline locations to determine the relationship of projected demand to available capacity. Table III-2 shows that the 1990 volume/capacity ratio for level of service "E" exceeds 1.0 at the Punchbowl Street and Ward Avenue screenlines. However, in 1990 the streetcar system would have surplus capacity available to accommodate more transit riders than the estimated demand based on the modal split analysis. Assuming that additional motorists could be diverted to transit than that projected due to capacity constraints of the street and highway network, it was found that both the transit and highway network just east of the CBD area would be at their maximum capacity in 1990. However, there would be insufficient transportation capacity to accommodate any increase in demand beyond 1990.

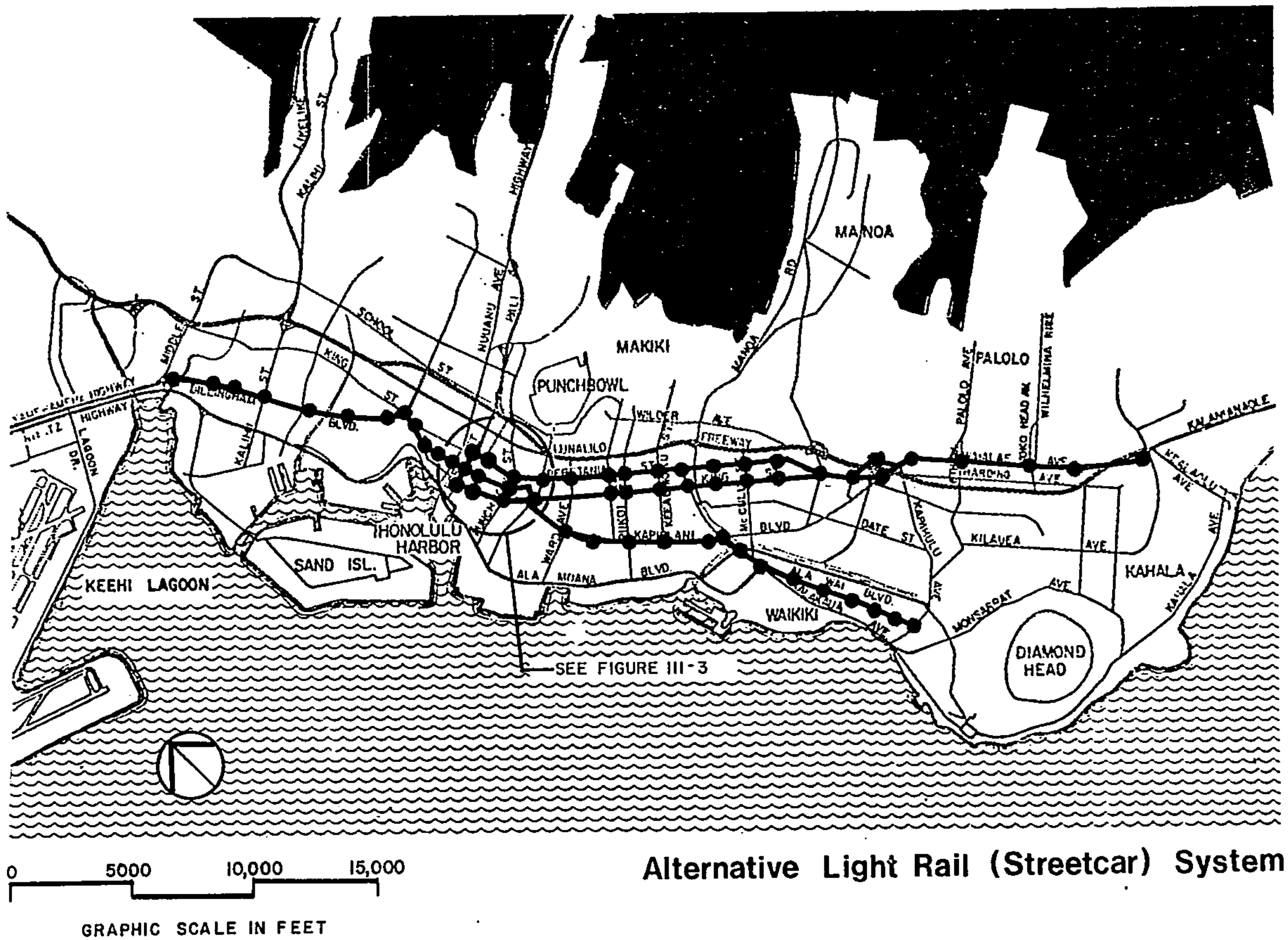
TABLE III-2

1990 HIGHWAY SCREENLINE CAPACITY ANALYSIS
WITH A STREETCAR SYSTEM IN OPERATION

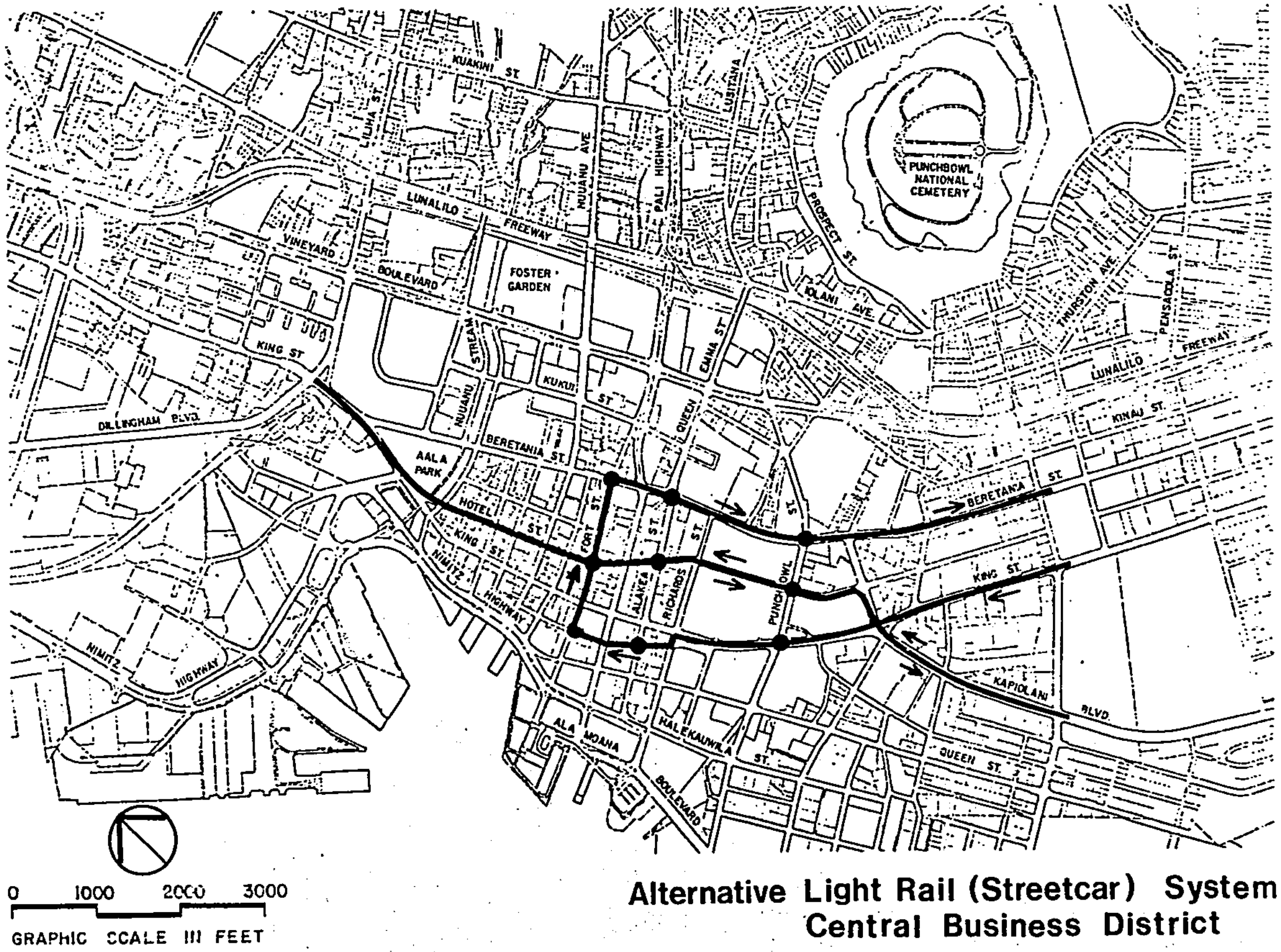
(Capacity at Level of Service E)

| Screenline Locations | Daily Volume[9] | Equiv.Daily Capacity* | V/C |
|---|---|---|---|
| Kapalama Canal | 271,200 | 284,200 | 0.95 |
| Nuuanu Canal | 315,500 | 323,800 | 0.97 |
| Punchbowl Street | 379,400 | 353,900 | 1.07 |
| Ward Avenue | 361,000 | 323,600 | 1.12 |

*The equivalent daily capacity is derived from hourly capacities through a procedure that is essentially the inverse of developing the peak hour, peak direction traffic volumes from daily volumes. Therefore, the volume-to-capacity relationship (or V/C ratio) that compares daily volumes to daily capacity reflects similar conditions that would exist during the peak hour in the peak travel direction.




**Alternative Light Rail (Streetcar) System**




## Alternative Light Rail (Streetcar) System
## Central Business District

Figure III-3

DPM/Bus System: An elevated Downtown People-Mover (DPM) offers to solve CBD circulation problems that plague most surface systems by providing grade-separated circulation and distribution in the downtown/civic center area. DPM terminals on either side of the CBD would be served by a comprehensive feeder bus network. Inasmuch as heavy bus operations would be moved from the center of the CBD to its periphery (where street capacities may not be so restrictive), the DPM might in essence "buy time," allowing postponement of line-haul rapid transit system investment. DPM vehicles are relatively small, operate at maximum speeds of 30 to 35 miles per hour, and are fully automated for driverless operation.

Two DPM system layouts were considered for the Honolulu CBD (Figures III-4A and B). Concept "A" is a simple shuttle, consisting of a single, bi-directional guideway along Hotel Street. Concept "B" is a longer bi-directional loop system on Beretania Street, Dillingham Boulevard, Nimitz Highway, Queen Street, South Street and Alapai Street. Both concepts include a large bus interface facility at each end.

DPM system capacity per track ranges from 5,000 to 10,000 passengers per hour. Concept "A" would therefore have a maximum capacity of 10,000 passengers per hour; Concept "B", 20,000 passengers per hour. Being grade-separated, the aerial DPM guideway would have little or no impact on street capacity. Thus, unacceptable downtown V/C relationships that have plagued other low-capital systems would not be a problem for the DPM/bus system. Instead, critical V/C situations are likely to be encountered beyond the bus-DPM interface points, where buses provide line-haul service.

Whether using reserved or mixed-traffic lanes on existing streets, the number of buses needed to meet projected line-haul travel demand stands to have a significant impact on street capacity available for automobiles. Table III-3 indicates V/C ratios at critical locations and confirms that the critical link in the system is not the DPM segment, but rather the line-haul bus segments. As with the TSM/Expanded Bus system, available street and highway capacity would be exceeded by 1990.

Trolley Bus System: Trolley bus performance closely resembles that of conventional buses. Vehicles are bus-sized and are able to maneuver similarly on city streets. The primary difference is the substitution of electrical propulsion (via overhead catenary lines) for conventional diesel engines. Recent concepts in articulated coaches, offering increased capacity with less-than-commensurate increases in operational cost, have been applied to both trolley and diesel-powered buses.

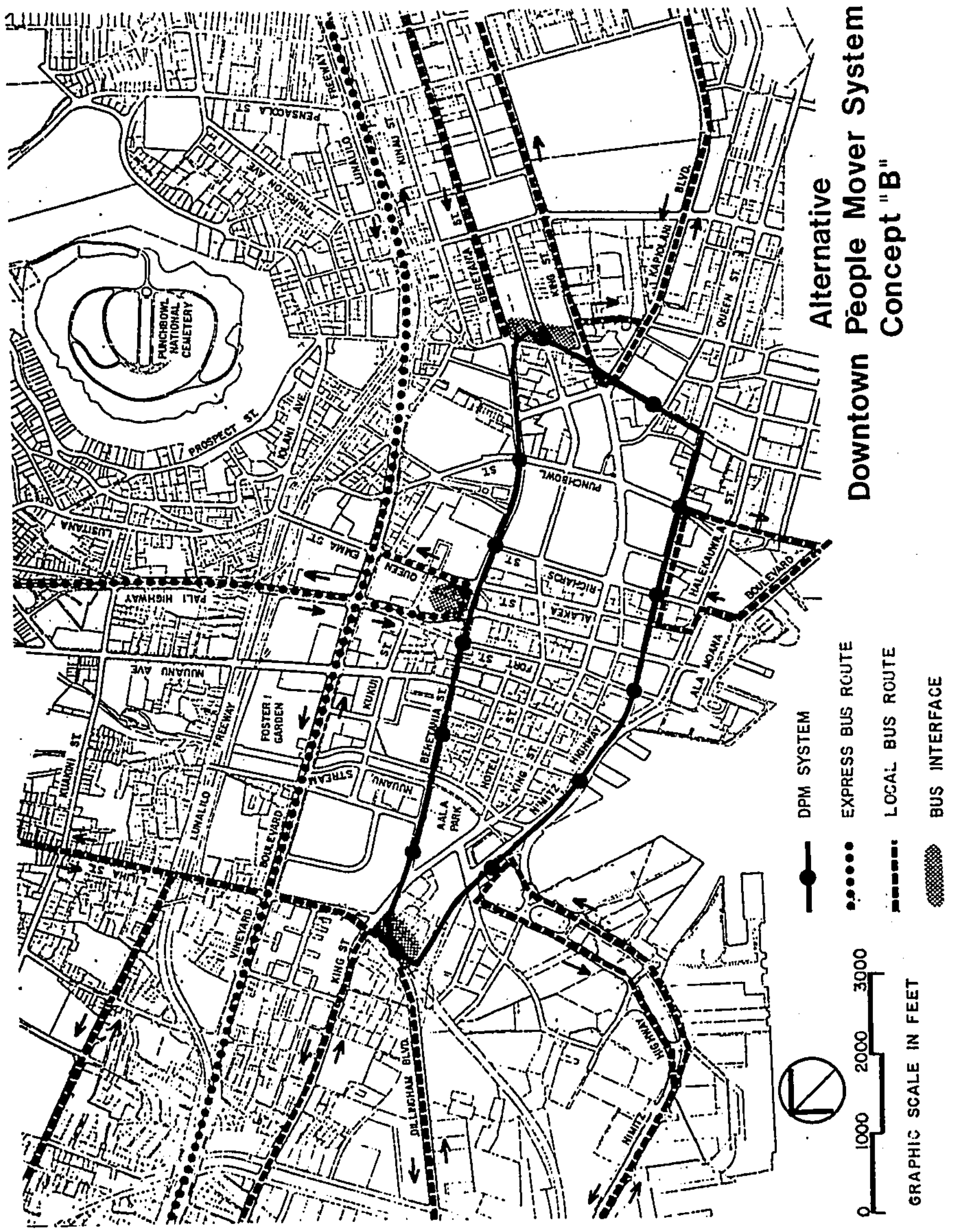



Figure III-4B

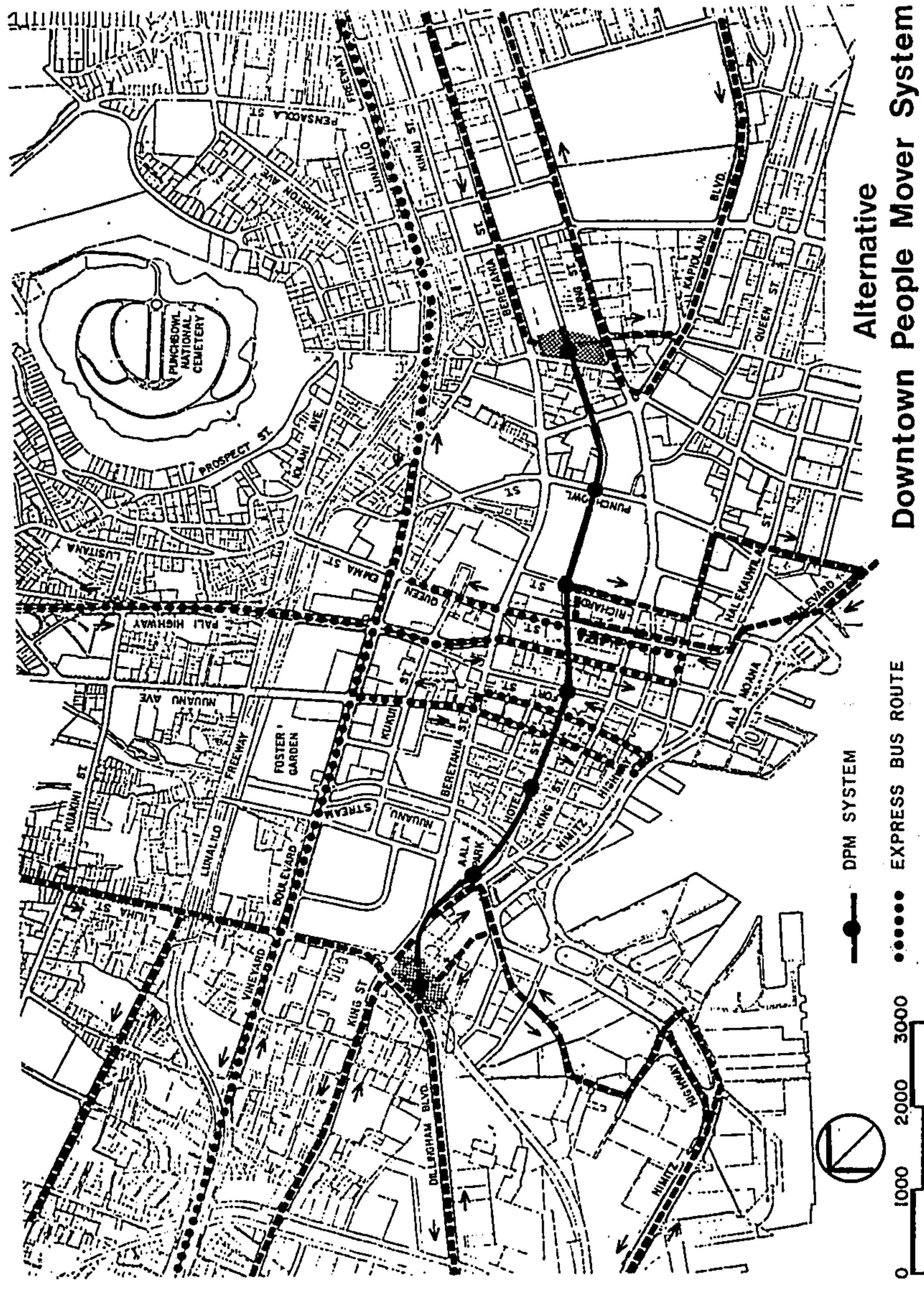



Figure III-4A

TABLE III-3 HIGHWAY SCREENLINE CAPACITY ANALYSIS WITH A DPM / BUS SYSTEM IN OPERATION (Capacity @ Level of Service E)

| Screenline Locations | 1985 | | | 1990 | | |
|---|---|---|---|---|---|---|
| | Daily Volume [9/] | Equiv. Daily Capacity * | V/C | Daily Volume [9/] | Equiv. Daily Capacity * | V/C |
| Kapalama Canal | 251,800 | 284,200 | 0.89 | 275,000 | 284,200 | 0.97 |
| Ward Avenue | 333,500 | 340,000 | 0.98 | 368,400 | 340,000 | 1.08 |

*The equivalent daily capacity is derived from hourly capacities through a procedure that is essentially the inverse of developing the peak hour, peak direction traffic volumes from daily volumes. Therefore, the volume-to-capacity relationship (or V/C ratio) that compares daily volumes to daily capacity reflects similar conditions that would exist during the peak hour in the peak travel direction.

Trolley bus systems enjoyed widespread application in many American cities until the last two decades, when many systems were replaced by fleets of conventional diesel buses. However, several jurisdictions retain trolley service in central business districts and along high demand corridors. Among the advantages of trolley buses: lower noise and air pollution levels than those of conventional buses and better hill-climbing ability. However, trolleys also entail considerable losses in routing flexibility, being dependent on overhead lines for power which also creates visual impact.

In assessing the appropriateness of trolley bus service to Central Honolulu, no advantage would be accrued over the TSM/Expanded Bus alternative in terms of volume-capacity relationships on existing streets. Moreover, capital costs (owing to electrification of existing bus routes and service yards, establishment of separate maintenance and storage facilities, as well as vehicle acquisition), the visual intrusion of overhead wires, and loss of routing flexibility combine to make the trolley bus alternative less than comparable to the TSM/Expanded Bus System as a low-capital solution for Honolulu.

d. <u>Summary of Alternative Concepts</u>: One group of line-haul transit concepts studied for meeting long-range transportation needs of the area consisted of the fixed guideway, busway, waterborne, and automatic rapid transit systems. These concepts feature exclusive, grade-separated facilities, with the exception of the waterborne system, to provide sufficient capacity to meet long-range transportation needs. The waterborne system, of course, would not require any land facilities other than docking and maintenance facilities, and can provide the needed capacity by the size of the fleet. Studies have shown that the fixed guideway system compares favorably to the other systems considered in this group.

Studies were also conducted for a second group of concepts which provides limited or no grade-separated facilities by utilizing existing streets and highways. This group features the TSM/Expanded Bus, Streetcar, Trolley Bus, and Downtown People-Mover (DPM)/Bus systems. With the exception of the DPM/Bus system, which is limited to the downtown area only and served by buses beyond, these systems utilize existing roadways with no grade-separated facilities. This reduces available roadway capacity for remaining automobiles and the absence of grade separation prevents the attainment of high operating speeds for reasons of safety and minimizing impacts on automobile traffic.

The four systems considered were found to increase the "people carrying" capability of existing streets and highways more than the baseline bus system, referred to earlier in this chapter, thus addressing travel demands for some years, but not necessarily those projected for 1995 and beyond. The investigation pointed out that total automobile and transit capacity on existing streets and highways is nearly the same for all four systems in this group and does not meet the long-range transportation needs of Honolulu. However, the TSM/Expanded Bus alternative entails the least capital cost and, in light of its other equivalent performance, was determined to be the preferred system in this group.

Although the studies found that a fixed guideway system would be a better solution to Honolulu's long-range transportation needs than a 22- or 19-mile busway system, a shorter length busway, minimum of seven miles, was thought to be a more viable alternative by utilizing exclusive bus-lanes on existing streets/highways outside the urban core. Also, due to the studies conducted under the second group of alternatives which found that only a fully grade-separated facility through Honolulu's urban core would provide sufficient additional transportation capacity to meet the long-range demands of the area, it was felt that the flexibility of the LRT system to operate both in mixed traffic and grade-separated modes should be further explored.

## B. EVALUATION OF TRANSIT SYSTEM ALTERNATIVES (IN THE LONG-TERM)

This section deals with five transit system alternatives:

- Baseline Bus ("no-build")
- TSM/Expanded Bus
- Busway
- LRT
- Fixed Guideway

The Baseline Bus ("no-build") and TSM/Expanded Bus systems, both non-grade-separated, were introduced in the previous section. The Baseline Bus ("no-build") system, as its name implies, serves primarily as a baseline in assessing the magnitude of improvements provided by more viable systems. (Benefits and costs, for example, can only be quantified and effectively compared in perspective with a "baseline," or "no-build," situation.) The TSM/Expanded Bus system is included in this section inasmuch as it represents the most viable low-capital, non-grade-separated alternative.

Previous sections have established the need for additional transportation capacity in the primary east-west corridor of urban Honolulu. Based on limited street/highway capacities and the current policy not to expand existing highway facilities in Central Honolulu, a transit system fully grade-separated in the urban core would be capable of satisfying long-range regional travel demands. Based on analyses also summarized in previous sections, three fully grade-separated alternative transit systems were selected for detailed analysis: busway, LRT, and fixed guideway. Included in this section are descriptions of the three grade-separated alternatives and a summary of the comparative evaluation process conducted during Phase II of the Preliminary Engineering and Evaluation Program (PEEP II).[15]

## B.1. Descriptions of Non-Grade-Separated Alternatives

a. Baseline Bus ("no-build") System: A 1980 bus system representing the continuation of standard bus service based on existing operating policies and assuming implementation of the City's Short-Range Bus Plan for Oahu (March 1978), Phase I, was assumed. Accomplishments in Phase I include:

- new bus routes
- establishment of new preventative maintenance and bus parking facilities at Halawa and in the Civic Center area
- bus stop improvements including new benches, shelters and signs
- priority bus treatment on major highways
- installation of special electronic equipment to monitor and improve service
- park-and-ride facilities in suburban areas
- implementation of a major route/schedule public information program

The baseline system assumes nominal fleet growth to 450 coaches in order to provide service to meet future year transit demand.

An estimated 65 million trips would be made on the baseline system in 1980, based on anticipation of increased transit demand due to the slightly better service afforded by the larger fleet. This represents over nine percent of total projected person-trips on Oahu, compared to less than eight percent today.

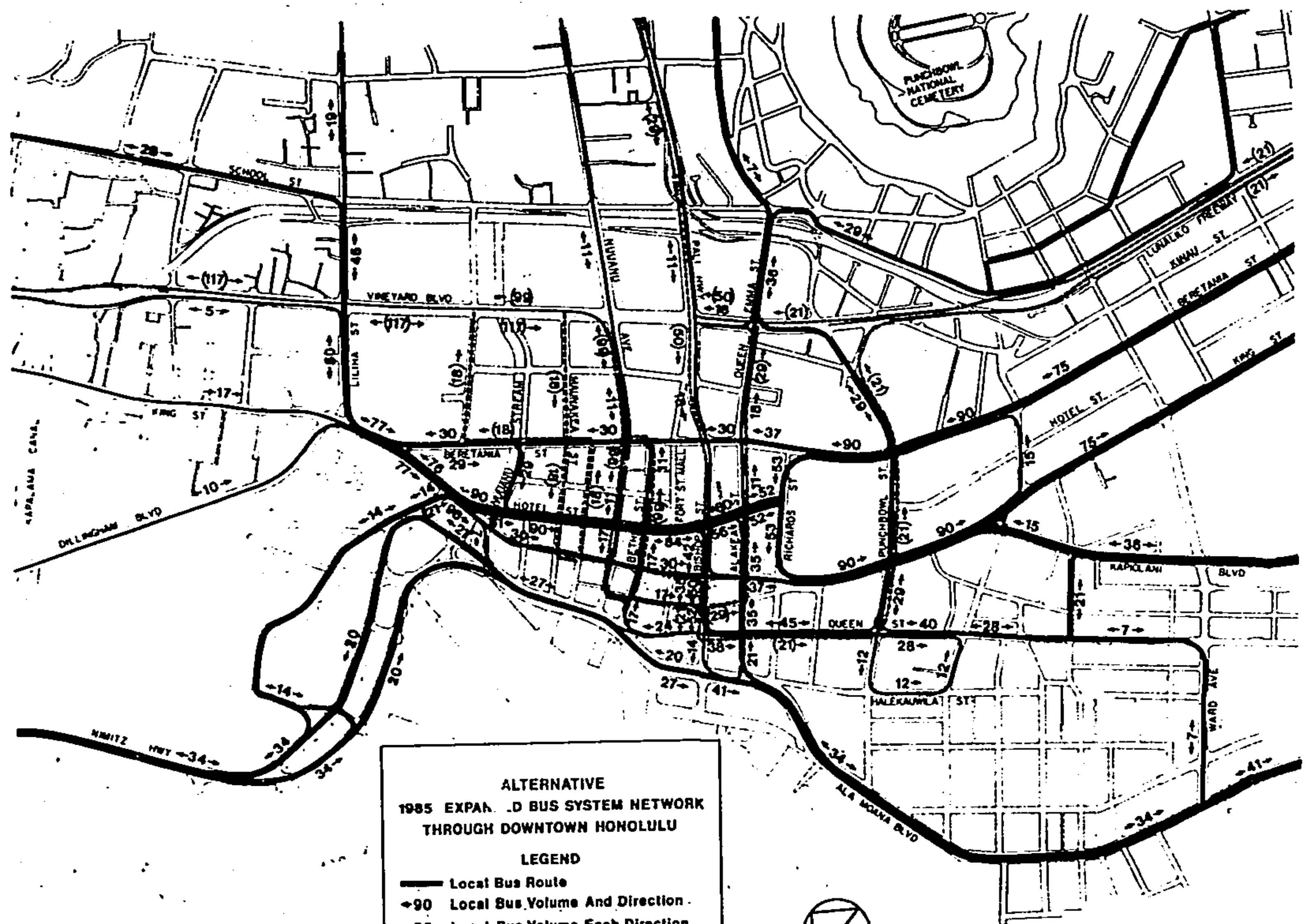
One of the main constraints to further expansion of the baseline bus system is slow operating speed in mixed traffic, which diminishes passenger attraction and increases operating cost. Also, the operation of more buses would pre-empt additional lanes, reducing the roadway capacity for automobiles. Significantly increasing the bus fleet would thus pose capacity problems that would affect both automobile and bus circulation, with attendant costs (or disbenefits) to the travelling public due to heavier congestion on streets.

b. TSM/Expanded Bus System: The TSM/Expanded Bus system includes various TSM programs to provide buses with preferential treatment. A vastly expanded transit bus system would operate on existing streets and freeways modified for most expeditious service and highest volume. Acknowledging several studies (particularly OTS) that advised against construction of new freeways on environmental grounds, the TSM/Expanded Bus network was assumed to have only existing and committed street/highway rights-of-way at its disposal.

Modal split analyses were conducted to determine potential demand on the TSM/Expanded Bus network. Analyses indicated that approximately 70 million passenger-trips could be attracted to the system in 1980, requiring some 500 buses. That demand could increase to 110 million passenger-trips in 1995, requiring over 900 buses, assuming that the roadways are capable of accommodating this volume of buses. Forty local routes and 14 express routes were to cover 705 one-way route-miles. In 1995, nearly 200 buses would pass through critical points in the Honolulu CBD in each direction during the peak-hour, requiring the assignment of at least two lanes, out of an average of 15 available lanes, in each direction to buses only.

Nearly one-half of all local bus routes, or a total of 18 routes, directly serve the CBD-Civic Center area in the east-west direction and 13 of the 14 express bus routes also serve the CBD-Civic Center area from both north-south and east-west directions. The number of local and express buses required to operate in downtown Honolulu are sufficiently large to require careful and detailed analysis of street patterns and capacities as shown in Figures III-5 and III-6.

The two primary east-west streets serving the CBD-Civic Center area are King Street and Beretania Street both one-way streets and together forming a one-way couplet. In the CBD-Civic Center area, both King Street and Beretania Street have a maximum of six lanes either existing or planned. For purposes of this analysis, it was assumed that all planned




**ALTERNATIVE**
**1985 EXPAN. .D BUS SYSTEM NETWORK THROUGH DOWNTOWN HONOLULU**

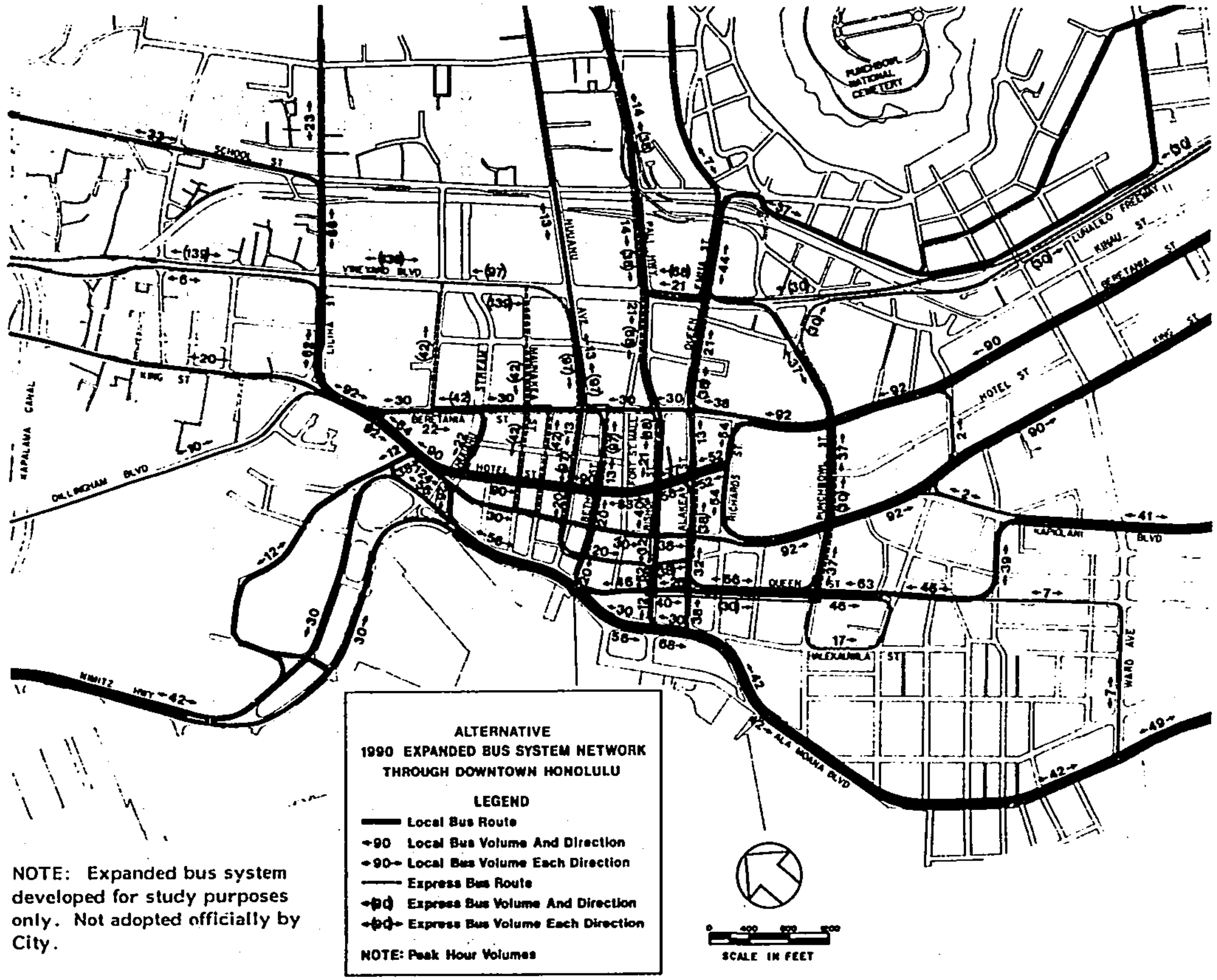
**LEGEND**

- Local Bus Route
- ←90 Local Bus Volume And Direction
- ←90→ Local Bus Volume Each Direction
- Express Bus Route
- ←(90) Express Bus Volume And Direction
- ←(90)→ Express Bus Volume Each Direction

NOTE: Peak Hour Volumes

NOTE. Expanded bus system developed for study purposes only. Not adopted officially by City.

Figure III 5




NOTE: Expanded bus system developed for study purposes only. Not adopted officially by City.

Figure III-6

street widening along King and Beretania Streets would be constructed and the planned number of lanes available.

Currently, the buses serve the Civic Center area on Beretania Street and King Street and the CBD on Hotel Street which is a two-way street. Hotel Street is master-planned to be converted into a pedestrian mall by eliminating all forms of vehicular traffic including buses. However, for purposes of this analysis, it is assumed that Hotel Street could be converted into a bus mall by modifying it to have a 24-foot roadway and a 13-foot sidewalk on either side. With the estimated number of buses per hour operating through the CBD area, the maximum use of Hotel Street is mandatory to achieve any reasonable level of transit service without seriously restraining auto travel through the area.

In the Civic Center area, the buses would necessarily have to operate on King Street and Beretania Street since there are no other streets of required width or location to adequately serve the area. With the estimated volumes, reserved curb bus lanes would be required with either normal flow or contra-flow operation.

The total number of express buses entering the CBD-Civic Center area is too large to be accommodated on a single street. Therefore, the primary routes used by the express buses would be divided between two streets -- Nuuanu Avenue and Bishop Street -- for entering the CBD from the north and Bethel Street and Alakea Street for the reverse movement as shown in Figures III-5 and III-6. The volume of buses on each route would be large enough to require - curb bus lane to be reserved on all of the four streets. To serve the Civic Center directly, some of the buses on the Bishop-Alakea route could utilize Punchbowl Street. This route on Punchbowl Street with buses flowing in the northeast direction would require a contra-flow curb bus lane since the flow of traffic is in the southwest direction.

Table III-4 shows the total peak hour bus volumes at critical links of the major bus route streets. The bus volumes reflect the combined local and express buses and are given for the four time periods between 1980 and 1995. These volumes represent a significant effect on the CBD streets in terms of reduced roadway capacity for automobiles. Approximately 90 buses per hour operating on a downtown street will effectively eliminate a lane from auto use and 50 buses per hour will reduce the effective auto-carrying capacity of a lane by approximately 50 percent. Thus the reduction in effective auto-carrying capacity of downtown streets due to increased volume of buses under the TSM/Expanded Bus alternative will be a major contributing factor toward increased congestion.

## TABLE III-4

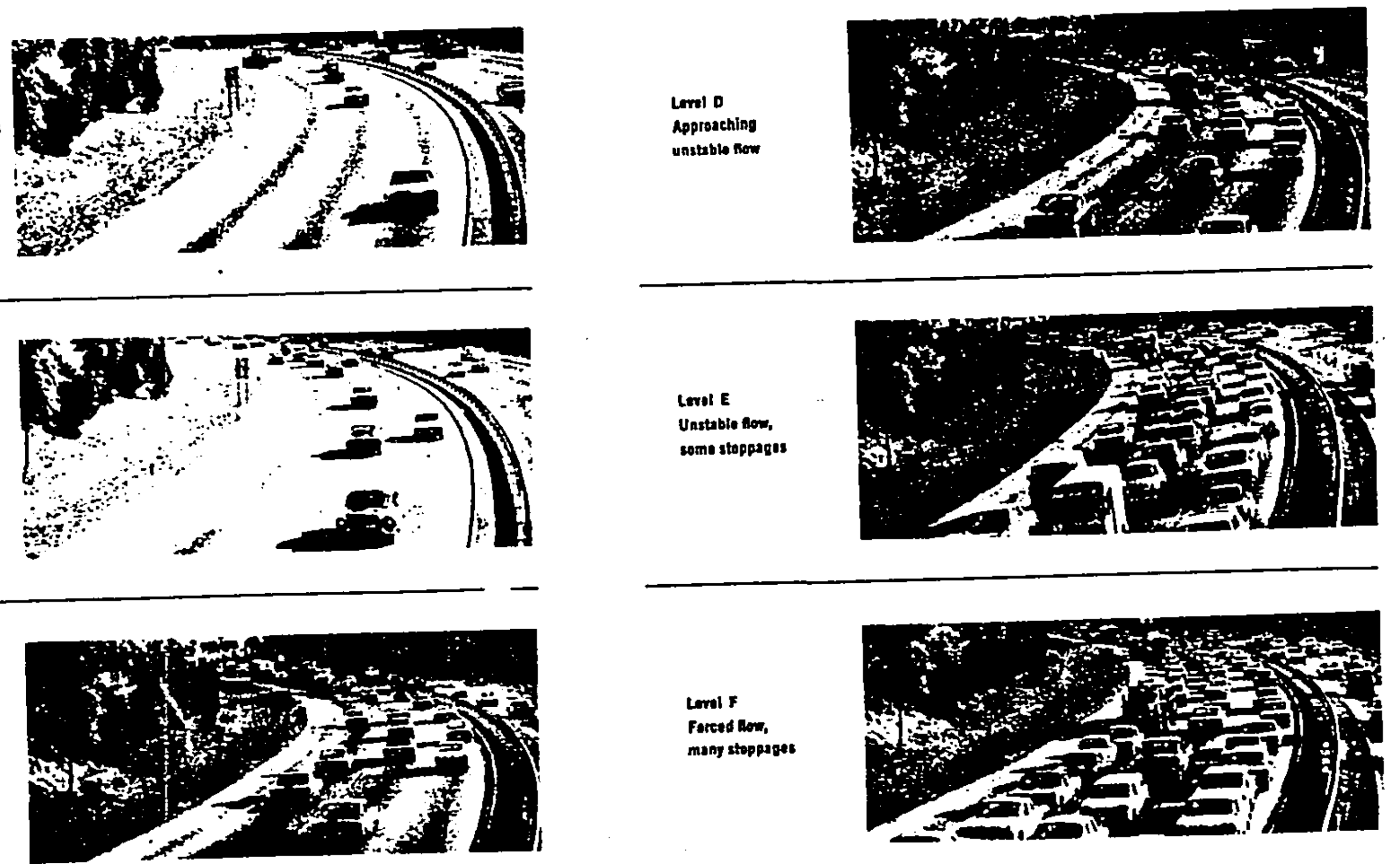
## TOTAL PEAK HOUR BUS VOLUMES AT CRITICAL LINKS

| | Buses/Hour in Peak Direction | | | |
|---|---|---|---|---|
| | 1980 | 1985 | 1990 | 1995 |
| Beretania Street | 92 | 90 | 92 | 106 |
| Hotel Street | 90 | 90 | 90 | 90 |
| King Street | 92 | 90 | 92 | 106 |
| Merchant Street | 15(+94) | 17(+99) | 20(+97) | 22(+96) |
| Queen Street | 21(+13) | 45(+21) | 66(+30) | 74(+38) |
| Ala Moana/Nimitz | 27 | 41 | 68 | 87 |
| Nuuanu Avenue | 15(+94) | 17(+99) | 20(+97) | 22(+96) |
| Bethel Street | 15(+94) | 17(+99) | 20(+97) | 22(+96) |
| Bishop Street | 38(+34) | 42(+50) | 40(+68) | 29(+84) |
| Alakea Street | 33(+21) | 35(+29) | 32(+38) | 19(+46) |
| Richards Street | 57 | 53 | 54 | 66 |
| Punchbowl Street | 21(+13) | 29(+21) | 37(+30) | 45(+30) |

NOTE: Numbers in parentheses denotes the number of express buses operating on the street at the critical link.

In order to assess the extent to which automobile traffic would be affected by TSM/Expanded Bus system operations in and adjacent to the CBD-Civic Center area, "screenlines" were established at critical points along the transit corridor. At these screenlines, volume-to-capacity (V/C) relationships were projected for 1980 through 1995 in five-year increments. (Street performance is normally cited as a function of roadway "level of service," or traffic condition, and is defined in Figure III-7.)

# ROADWAY LEVELS OF SERVICE



Level A
Free flow, no restrictions on maneuvering or operating speed

Level B
Stable flow, few restrictions

Level C
Stable flow, more restrictions

Level D
Approaching unstable flow

Level E
Unstable flow, some stoppages

Level F
Forced flow, many stoppages

Figure III-7

Figure III-8 shows the location of the above-mentioned critical "screenlines" and Table III-5 shows the volume/capacity relationship for the "baseline" system in 1985 and the TSM/Expanded Bus system in 1985 and 1990. It can be interpreted as showing the highway network approaching capacity as early as 1985 and exceeding capacity in 1990, using level of service "E" (unstable flow with frequent stoppages) as the yardstick. Thus, the TSM/Expanded Bus system would fall short of meeting 1995 travel demands and hence would not be capable of meeting the long-range transportation needs of Honolulu.

The foregoing discussions indicate that neither the Baseline Bus nor TSM/Expanded Bus systems using existing facilities was found to be capable of providing the needed capacity in 1995 to meet projected long-range travel demands. The analyses point out that sufficient roadway capacity does not exist in the critical travel corridor of urban Honolulu to meet long-range travel needs even if these facilities were optimized for mass transit use. In short, the long-range travel needs can only be satisfied by providing additional capacity over that existing today.

## B.2. Descriptions of Grade-Separated Alternatives

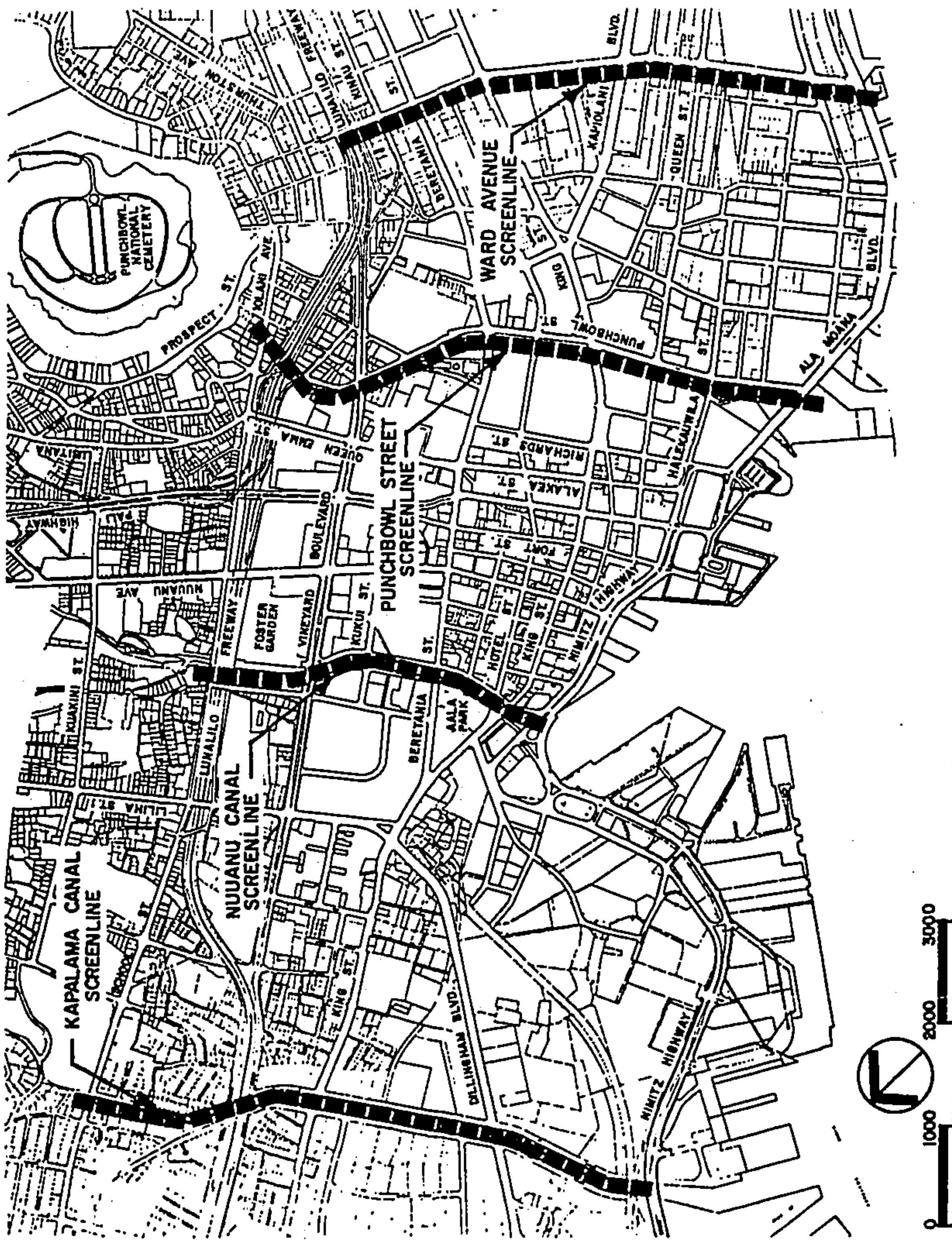
Busway, LRT, and fixed guideway systems in lengths of 7, 14, 23, and 28 miles were considered.[15] Not all modes lend themselves to all lengths, however; only the most feasible mode/length combinations were evaluated to identify the optimum length for each system.

Previous analyses reinforced each other in certain findings that had pertinence to the design of any viable transit system in urban Honolulu. Thus, it was evident that, to be shown in their best light, all alternative systems would share the following basic characteristics: Transit Corridor, Route and Station Location, and Service Levels.

Transit Corridor: All routes are contained within the primary urban travel demand corridor (described in Section II.D.1), a relatively narrow band through the Central Honolulu area (Figure III-9). Location of transit systems along this corridor promised to attract the highest patronage possible by providing direct service to nearly all major activity centers and many high-density residential areas on Oahu.

Corridor segments are defined as follows:

1. Pearl City to Aloha Stadium;
   H-1 Freeway to Pearl Harbor




**CRITICAL CORRIDOR SCREENLINE LOCATIONS**

Figure III-8

TABLE III-5

HIGHWAY SCREENLINE CAPACITY ANALYSIS

(Capacity at Level of Service E)

| Screenline Locations | Baseline Bus 1985 Daily[9] Volume | Baseline Bus 1985 Equiv. Daily Capacity* | Baseline Bus 1985 V/C | TSM/Expanded Bus 1985 Daily[9] Volume | TSM/Expanded Bus 1985 Equiv. Daily Capacity* | TSM/Expanded Bus 1985 V/C | TSM/Expanded Bus 1990 Daily[9] Volume | TSM/Expanded Bus 1990 Equiv. Daily Capacity* | TSM/Expanded Bus 1990 V/C |
|---|---|---|---|---|---|---|---|---|---|
| Kapalama Canal | 266,400 | 284,200 | 0.94 | 251,800 | 284,200 | 0.89 | 275,000 | 284,200 | 0.97 |
| Nuuanu Canal | 308,200 | 323,800 | 0.95 | 290,800 | 323,800 | 0.90 | 318,900 | 323,800 | 0.98 |
| Punchbowl Street | 365,700 | 361,200 | 1.01 | 347,800 | 353,900 | 0.98 | 388,700 | 353,900 | 1.10 |
| Ward Avenue | 352,400 | 351,100 | 1.00 | 333,500 | 340,000 | 0.98 | 368,400 | 340,000 | 1.08 |

*The equivalent daily capacity is derived from hourly capacities through a procedure that is essentially the inverse of developing the peak hour, peak direction traffic volumes from daily volumes. Therefore, the volume-to-capacity relationship (or V/C ratio) that compares daily volumes to daily capacity reflects similar conditions that would exist during the peak hour in the peak travel direction.

## Transit Corridor Segments

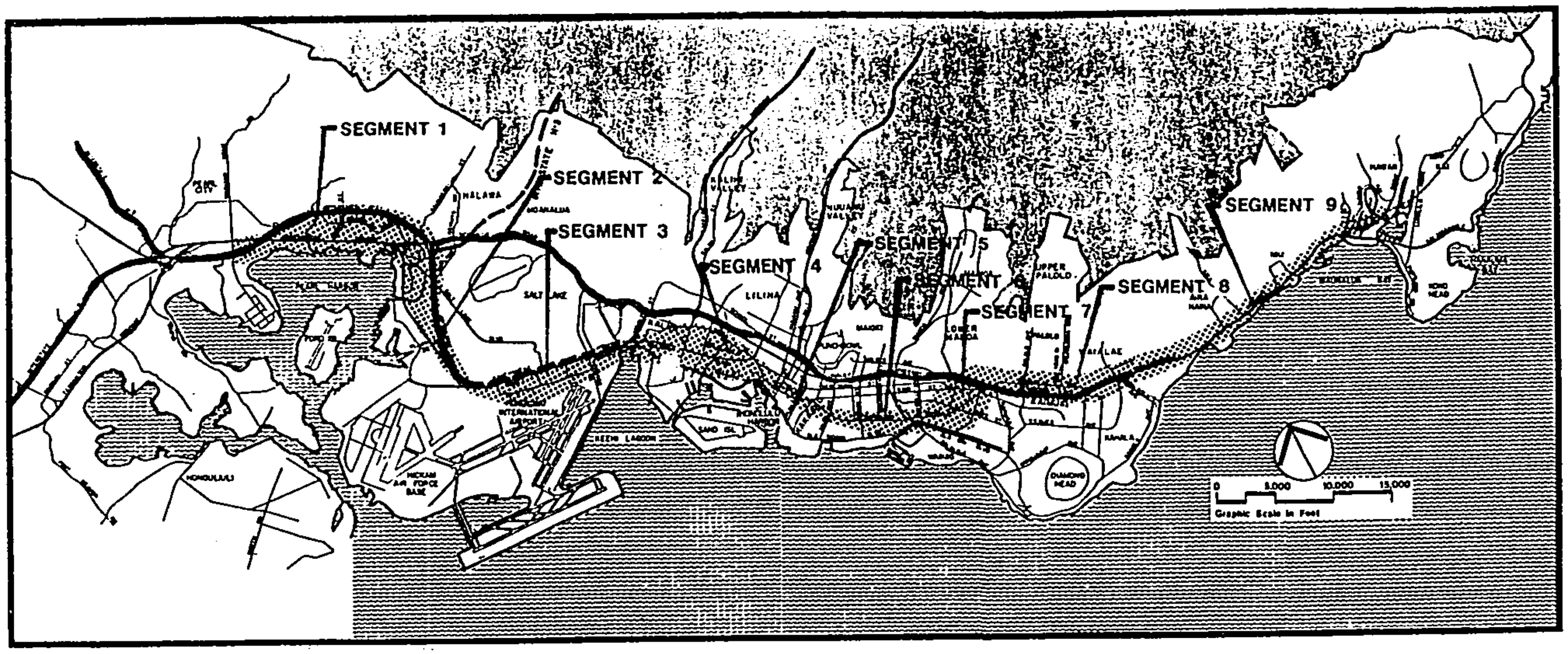



Figure III-9

2. Aloha Stadium to Pearl Harbor Interchange; H-1 Freeway to Kamehameha Highway

3. Pearl Harbor Interchange to Middle Street; H-1 Freeway to Honolulu International Airport

4. Middle Street to Iwilei; King Street to Nimitz Highway/Oahu Railroad and Land rights-of-way

5. Iwilei to Civic Center; King Street to Beretania Street

6. Civic Center to McCully Street; Makaloa Street to Waimanu/Kona Streets

7. McCully Street to Kapahulu Avenue; Ala Wai/Manoa-Palolo Drainage Canals to Isenberg Street/University of Hawaii Quarry

8. Kapahulu Avenue to Kilauea Avenue; Waialae Avenue to H-1 Freeway

9. Kilauea Avenue to Hawaii Kai; Kalanianaole Highway

Route and Station Locations: Routes and station locations reflect each system's unique operating characteristics and an effort to present each system in a form that would produce optimal service and minimal community impact. All routes are located in the transit corridor described above.

Within the corridor's central seven-mile segment (segments four through seven in Figure III-9), each system would run on exclusive rights-of-way provided in the form of new, grade-separated aerial or subway structures. Beyond this central segment, alternative system routes vary from mixed-traffic operations on existing streets to continuation of exclusive, grade-separated rights-of-way.

All alternative systems were designed to integrate with an island-wide feeder bus network. In an effort to provide comparable service levels for all systems within the central seven-mile segment, interface with feeder buses was generally provided near the following locations:

| | |
|---|---|
| Keehi Lagoon | Ward Avenue |
| Kalihi | Ala Moana |
| Iwilei | Kalakaua Avenue |
| CBD-Fort Street | Date Street |
| Civic Center | University of Hawaii Campus |

In addition to providing transfers to feeder buses, transit stations located in these areas would provide direct access to areas of high employment concentration (generators of high travel demand) and several high-density residential districts.

Service Levels: In conjunction with system routes and station locations, feeder bus networks were designed to accommodate comparable service areas for all systems. Service frequency was also assumed to be equal for all alternatives, ensuring that consistent service levels would be maintained through alternative system analyses.

Summary of Assumptions and Parameters: Basic assumptions regarding system operational characteristics and vehicle specifications are summarized in Table III-6.

In the following paragraphs, each of the three alternatives is described in terms of route lengths, operational features, and physical characteristics.

a. Busway: Only one busway system was evaluated: a seven-mile, grade-separated system running on exclusive rights-of-way between Keehi Lagoon and the University (Figure III-10). PEEP I investigations had determined that longer busway lengths were less cost-effective, given the availability of freeway lanes for express bus operations; they were rejected from further consideration. Instead, express bus service to points beyond the seven-mile route would be provided on existing and committed highways, using combinations of mixed-traffic and reserved/high-occupancy vehicle lanes. To the west, express routes would follow the H-1 Freeway to Pearl City and points beyond, with connections to Windward, Leeward, and Central Oahu. To the east, express routes would continue from the University on mixed-traffic H-1 Freeway lanes and, beyond the freeway terminus, on reversible, exclusive Kalanianaole Highway lanes to Hawaii Kai. Beyond Hawaii Kai, certain express routes continue to either Kalama Valley or Waimanalo.

Within the central, seven-mile segment, different busway operational techniques were investigated, including single file concepts -- platooning and random operations -- and a flexible, station-bypass concept. The flexible concept was preferred because of its capacity, unconstrained busway embarkation capability, adaptability to express operations, and reliability. The flexible bypass capability requires that acceleration and deceleration lanes be provided at each stop. Between Kalihi and Waikiki, where stops are frequent, the busway would essentially be a four-lane, grade-separated structure. Portions of the busway beyond these points to the busway termini could be narrower, still allowing sufficient room for disabled vehicles.

TABLE III-6
SUMMARY OF DESIGN ASSUMPTIONS

| Design Item | Busway | LRT | Fixed Guideway |
|---|---|---|---|
| **Vehicle Operating Characteristics:** | | | |
| Maximum speed | 50 mph | 50 mph | 50 mph |
| Acceleration rate | 2.0 mphps | 3.0 mphps | 3.0 mphps |
| Deceleration rate | 1.5 mphps | 2.6 mphps | 2.6 mphps |
| **Frequency on Line-Haul Segment:** | | | |
| Peak hour | 12 sec.* | 2 min. | 2 min. |
| Base | 40 sec.* | 4 min. | 4 min. |
| Night | 2 min.* | 4 min. | 4 min. |
| **Average Station Dwell Time** | 30 sec. | 20 sec. | 20 sec. |
| **Vehicle Capacity/ Area Per Passenger:** | | | |
| Seated load | 53 | 68 | 36 |
| Design load | 61/4.57 $ft^2$ | 100/4.57 $ft^2$ | 72/4.57 $ft^2$ |
| Crush load | 92/2.99 $ft^2$ | 154/2.99 $ft^2$ | 110/2.99 $ft^2$ |
| **Train Length:** | | | |
| Minimum | 1 | 1 | 2 |
| Maximum | 1 | 8** | 10 |
| **Special Features:** | | | |
| On-line coupling and decoupling trained vehicles | -- | Yes | No |
| Vehicle operating on non-exclusive & non-grade separated right-of-way | Yes | Yes | No |
| Short turn radius for street operation | Yes | Yes | No |

*Frequency at maximum point on busway -- includes local and express buses entering busway which do not stop at all stations.

**Assumes modest redesign of limiting factors will allow training more than present four car limit.

# Busway Transit System

RAPID TRANSIT STATIONS

1. Keehi Lagoon
2. Kalihi
3. Iwilei
4. Fort Street
5. Civic Center
6. Ward Avenue
7. Ala Moana
8. Waikiki
9. Date Street
10. University

● Stations
▬ Busway
●●●●●● Express Bus Route

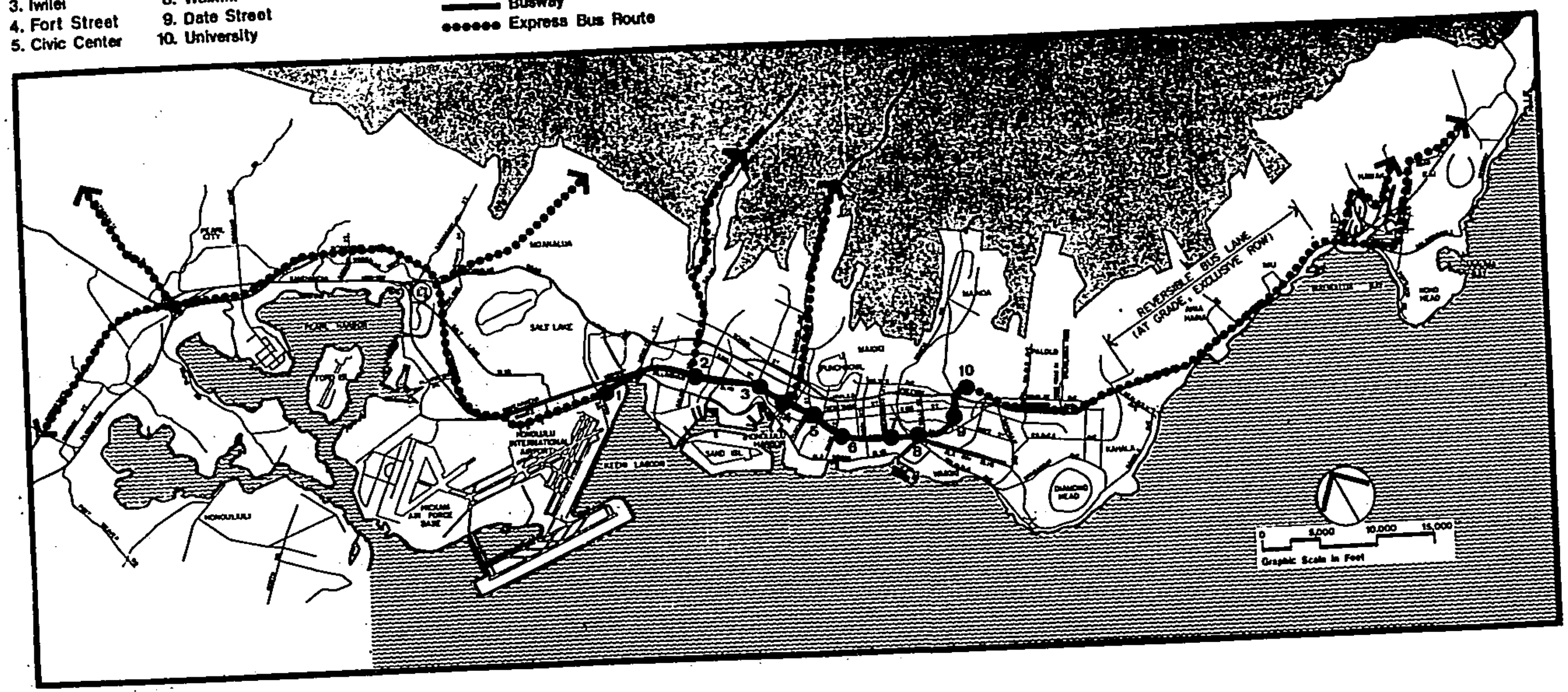



Figure III-10

b. LRT: Light Rail Transit (LRT) has lately been the subject of wide interest, due primarily to its inherent flexibility. Aerial electrification (via catenary lines) permits operation in mixed rights-of-way, as well as on exclusive aerial structures or in subways. Articulation (two-unit vehicle) permits the negotiation of short-radius turns, allowing operation on city streets. The vehicle may be operated as a single unit or coupled into trains of two cars or more. Propulsion and control systems are relatively simple, known commodities.

One will recall that an LRT or streetcar system was among the low-capital systems considered in Section III.A.3.c. The LRT systems considered here, however, resemble an application of light rail transit vehicles that has become known as "light rail rapid transit" (LRRT). LRRT differs from LRT by incorporating many elements associated with fixed guideway technology, including substantial portions of grade-separated right-of-way and in-station (rather than on-vehicle) fare collection to facilitate rapid boarding and alighting. Of the four LRT systems evaluated in PEEP II, the 7-, 14- and 23-mile systems are essentially LRRT systems. The 28-mile system adds to 23 miles of grade-separated, exclusive right-of-way five miles of at-grade, mixed-traffic operation similar to that of the low-capital LRT alternative.

Features of the four PEEP II LRT systems are described below and keyed to Figure III-11:

7-Mile System: as with all PEEP alternative systems, operates on a grade-separated guideway between Keehi Lagoon and the University.

14-Mile System: adds seven miles of grade-separated guideway to the east and west of the seven-mile system, offering exclusive rights-of-way between Halawa and Kahala.

23-Mile System: east of the 14-mile system, adds approximately six miles of at-grade, exclusive right-of-way along the Kalanianaole Highway to Hawaii Kai; west of the 14-mile system, adds approximately three miles of at-grade, exclusive right-of-way along the Kamehameha Highway.

28-Mile System: supplements the 23-mile system with at-grade, mixed-traffic LRT operations, replacing feeder bus routes at three points -- one on Kalakaua Avenue in Waikiki between the Ala Wai Canal and Kapiolani Park, the others at Hawaii Kai, serving the east and west sides of Kuapa Pond, respectively.

# Light Rail Transit System

## RAPID TRANSIT STATIONS

1. Pearl City
2. Waimalu
3. Pearl Ridge
4. Halawa
5. Pearl Harbor
6. Airport
7. Keehi Lagoon
8. Kalihi
9. Iwilei
10. Fort Street
11. Civic Center
12. Ward Avenue
13. Ala Moana
14. Waikiki
15. Date Street
16. University
17. Sixth Avenue
18. Koko Head Avenue
19. Kahala
20. Walalae Iki
21. Aina Haina
22. Niu
23. Kuliouou
24. Hawaii Kai

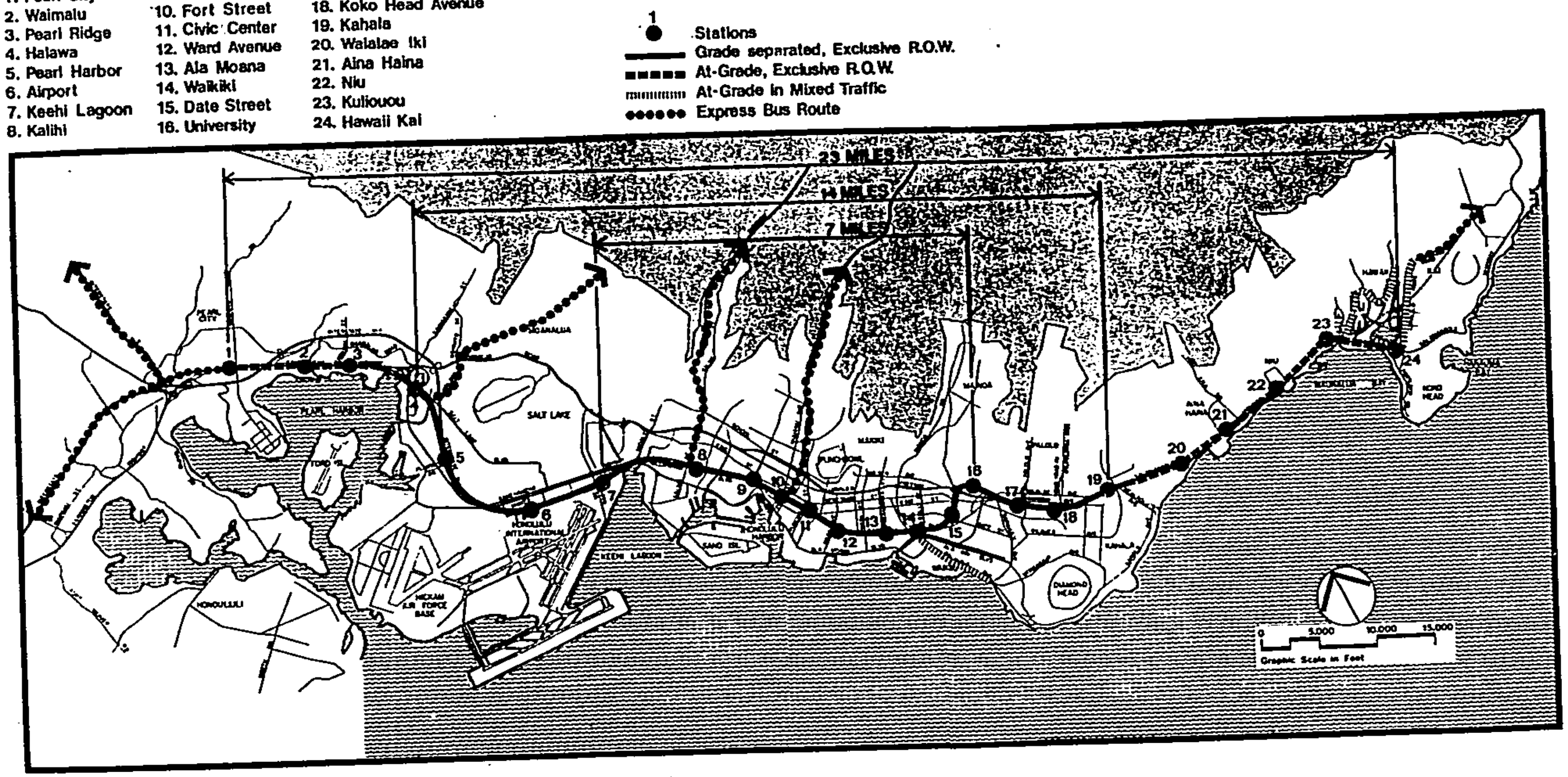



Figure III-11

Each system exploits LRT vehicle flexibility differently. For example, the number of cars operating in consists varies in proportion to passenger demand, instead of running all vehicles over the entire route. The 28-mile system features three branch lines, maintaining consistent headways throughout the system and minimizing unused capacity.

Aerial structures would consist of precast, prestressed concrete girders supported on single reinforced concrete columns. Catenary lines would be supported by a "T" support at the center of the 23-foot wide guideway. Subways could be constructed by cut-and-cover technique, ventilation provided by the "piston" effect of moving vehicles, supplemented by emergency exhaust fans in vent shafts. Exclusive at-grade segments would use conventional tie-and-ballast construction in a minimum 24-foot right-of-way, flanked by traffic barriers except at major street intersections. Mixed traffic segments would use tie-and-ballast construction flush with the roadway, with catenary lines suspended from curbside poles.

All stations would be equipped with automated fare collection and money-changing facilities. Platform lengths (or curbed passenger islands for mixed-traffic operations) correspond to the maximum train length encountered at each portion of the line.

LRT trains would be manually operated, supplemented with automatic protection systems. Radio communication systems in vehicles, stations, and a central control were envisioned.

c. Fixed Guideway Rapid Transit: Fixed guideway transit features grade-separated, trained vehicles operating on exclusive rights-of-way. Three fixed guideway system lengths were examined in PEEP II (Figure III-12).

> 7-Mile System: as with all PEEP II alternative systems, operates on a grade-separated guideway between Keehi Lagoon and the University.
>
> 14-Mile System: as with the 14-mile LRT system, adds seven miles of grade-separated guideway to the east and west of the seven-mile system, offering exclusive rights-of-way between Halawa and Kahala.
>
> 23-Mile System: includes additional guideway in H-1 Freeway rights-of-way between Pearl City and Halawa and along the Kalanianaole Highway between Kahala and Hawaii Kai.

# Fixed Guideway Transit System

RAPID TRANSIT STATIONS

1. Pearl City
2. Pearl Ridge
3. Halawa
4. Pearl Harbor
5. Airport
6. Keehi Lagoon
7. Kalihi
8. Iwilei
9. Fort Street
10. Civic Center
11. Ward Avenue
12. Ala Moana
13. Waikiki
14. Date Street
15. University
16. Sixth Avenue
17. Koko Head Avenue
18. Kahala
19. Aina Haina
20. Niu
21. Hawaii Kai

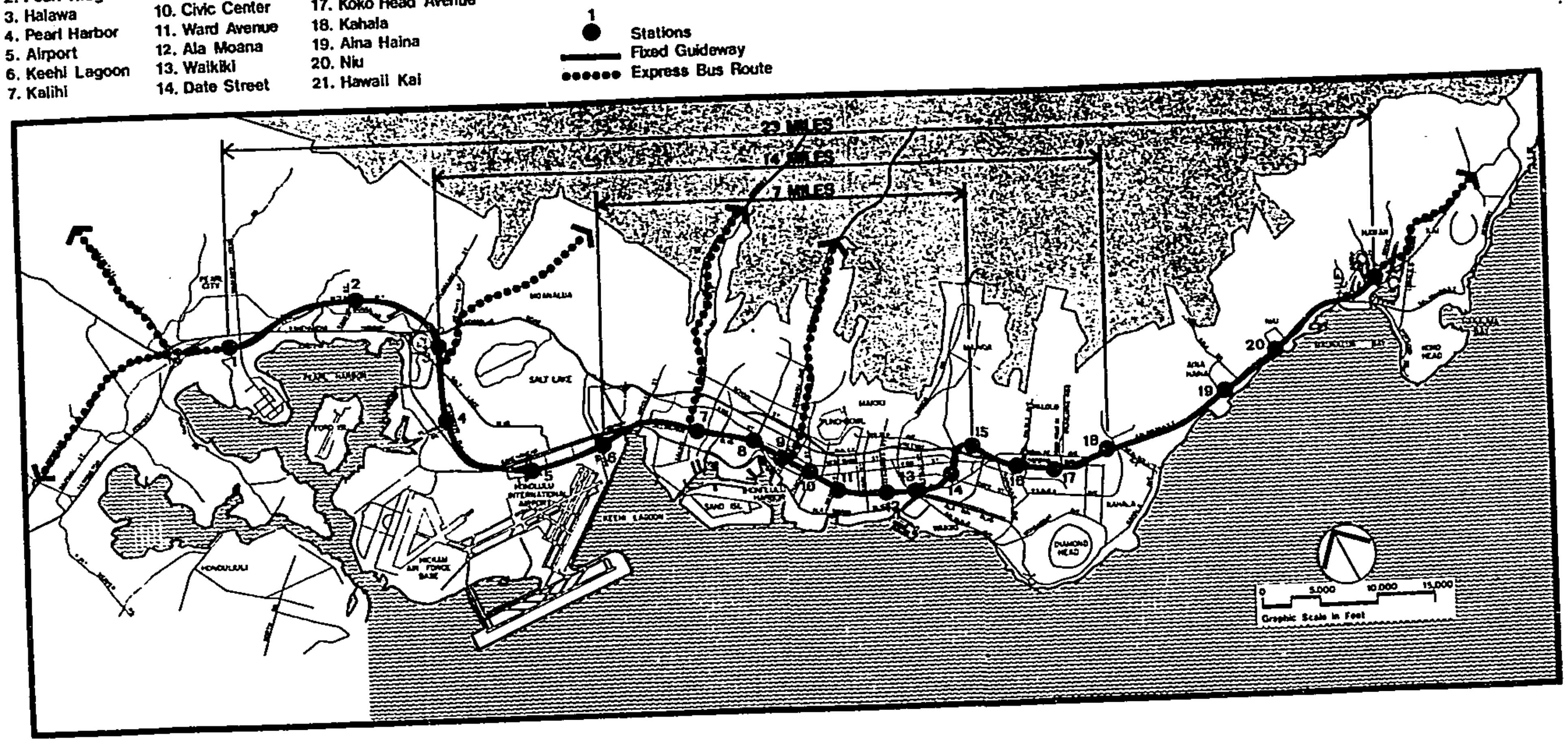



Figure III-12

station by-pass capability, requiring a four-track guideway, was rejected since it did not produce significant travel time savings. Similarly, branch lines were rejected due to high cost and operational problems. The fixed guideway vehicles would operate in trains over the entire length of the system.

Physical characteristics of the aerial fixed guideway segments are similar to those for LRT, except that there would be no overhead catenary line. Stations were designed to conform to train lengths of some 400 feet. Park-and-ride lots would be provided at the Pearl City and Hawaii Kai terminal stations for the 23-mile system; existing parking facilities at the Aloha Stadium were assumed to be available to users of the 14- and 23-mile systems.

As with other systems, stations and vehicles would be equipped with communication systems, connected to a central monitoring post, and each station would include provisions for automatic ticketing. The fixed guideway system would feature an automatic train protection system to maintain maximum safety.

d. Comparative Evaluation of Alternatives: The selection of the "best" transit system among the three viable grade-separated alternatives is a particularly complicated process that involves simultaneous consideration of policies, design, cost (both construction and operation), service, and impacts. All of these factors are interrelated; slight differences in right-of-way requirements, for example, could account for alignment deviations that necessitate consideration of a host of impacts. For these reasons, the analysis described below attempted to distinguish even small differences among alternatives. Data were generated to indicate each system's performance in the following areas (Table III-7):

- projected patronage, based on sequential travel forecasting
- estimated capital cost (including right-of-way acquisition and relocation expenses, construction, and purchase of transit vehicles and equipment) and operating cost (total maintenance cost of facilities and equipment), based on 1975 Honolulu unit prices, including a 10 percent contingency factor for all costs and a 13 percent administration/engineering cost
- operational characteristics

TABLE III-7: SUMMARY OF ANALYTICAL RESULTS

| SYSTEM | TRAVEL CHARACTERISTICS | | | | | | OPERATING CHARACTERISTICS | | | | COST | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Total Daily Transit Trips | Mode Split (Total) % | Daily Trips on Gwy. | % Pk. Hr. Work Trips By Transit | Avg. Trip Length (Mi.) | Avg. Trip Time (Min.) | Vehicles Required (With Spares) | | Vehicle Miles Operated Daily | | Total Capital Cost ($1,000) | Annual Operating Cost ($1,000) |
| | | | | | | | Gwy. | Feeder | Gwy. | Feeder | | |
| 7-Mi. Busway | 456,250 | 13.8 | 288,200 | 42.4 | 7.31 | 36.3 | 179 | 752 | 30,308 | 121,408 | 414,411 | 49,510 |
| LRT | | | | | | | | | | | | |
| 28 Mile | 474,520 | 14.4 | 358,750 | 44.6 | 7.22 | 32.4 | 410 | 443 | 79,515 | 71,645 | 712,289 | 47,660 |
| 23 Mile | 474,520 | 14.4 | 353,700 | 44.6 | 7.21 | 32.3 | 325 | 477 | 75,530 | 75,910 | 646,537 | 46,320 |
| 14 Mile | 473,300 | 14.3 | 306,900 | 44.2 | 7.26 | 33.7 | 198 | 580 | 45,840 | 94,260 | 529,321 | 44,310 |
| 7 Mile | 459,300 | 13.9 | 277,300 | 42.8 | 7.19 | 35.2 | 109 | 774 | 23,580 | 124,605 | 406,808 | 50,170 |
| Fixed Guideway | | | | | | | | | | | | |
| 23 Mile | 490,000 | 14.8 | 332,600 | 46.0 | 7.50 | 31.6 | 421 | 493 | 111,495 | 78,390 | 647,900 | 46,940 |
| 14 Mile | 473,300 | 14.3 | 306,900 | 44.2 | 7.26 | 33.7 | 264 | 580 | 64,225 | 94,260 | 517,318 | 43,890 |
| 7 Mile | 459,300 | 13.9 | 277,300 | 42.8 | 7.19 | 35.2 | 161 | 774 | 34,335 | 124,605 | 398,676 | 50,070 |

Note: All costs shown are in 1975 dollars.

The three alternative transit systems were then analyzed in groups, according to their lengths, regarding their ability to meet regional goals and objectives that included:

- Oahu General Plan (1964) transportation goals
- Oahu Transportation Study (OTS) transportation goals
- PEEP I and PEEP II transit development objectives

Nearly all goals and objectives overlap somewhat. Their similarities, pertinent evaluative factors (or criteria for assessing performance), and system characteristics that have bearing on these goals and objectives (i.e., route location, system type, and system length) are noted in Table III-8.

(1) Methodology of Comparison: Evaluative factors are essentially areas of analysis for which there are specific, usually quantifiable, measures. Certain evaluative factors that do not permit quantitative analysis (e.g., visual intrusion) are measured qualitatively. The performance of each system will be plotted on a comparative matrix. Following a discussion of specific evaluative factors and measures and their bearing on transportation goals and objectives. From this matrix, relative rankings will be assigned for each system for each evaluative factor.

(2) Evaluative Factors and Measures:

- Objective 1 - Improve accessibility by serving and inter-connecting existing and future urbanized areas of Oahu. This objective will be satisfied by the provision of improved transit service to all areas of the island and to all segments of its population. Evaluative factors include:

Availability and Coverage: accessibility to transit at both ends of the trip for all residents (coverage) and frequency of service (availability)

Trip Time: door-to-door trip time, expressed as a system average in minutes

Service Reliability: the assurance of completing a trip within a scheduled time; includes vehicle reliability against in-service failures, schedule reliability against missed connections at transfer points, schedule adherence in terms of arrival/departure time consistency

# TABLE III-8: GOALS, OBJECTIVES AND CRITERIA

| Transportation Goals Oahu General Plan | Transportation Goals Oahu Transportation Study | Transit Development Objectives PEEP I and II | Transit Development Criteria for Alternatives Analysis | Applicable Criteria for Specific Alternative Analysis: Route Location | System Type | System Length |
|---|---|---|---|---|---|---|
| 1. Provide transportation facilities to enable travel from any point in the region to any other point within reasonable travel time by one or more modes | 1. *Provide transportation facilities for ease of movement throughout Oahu; and provide a variety of modes of travel which will best serve the different requirements of the community | 1. Improve accessibility by servi- - and interconnecting existi g and future urbanized areas of Oahu | a. Availability & coverage<br>b. Average trip time<br>c. Service reliability<br>d. Rider convenience<br>e. Rider comfort | —<br>✓<br>—<br>✓<br>✓ | ✓<br>✓<br>✓<br>✓<br>✓ | ✓<br>✓<br>✓<br>✓<br>✓ |
| 2. A transportation system which will provide the greatest efficiency and service to the community with the least overall expenditure of resources | 2. Provide a balanced transportation system which will result in optimum service with the least public expenditure | 2. *Provide a balanced transportation system of transit and highways | a. System patronage<br>b. System capacity | ✓<br>✓ | ✓<br>✓ | ✓<br>✓ |
| | | 3. *Minimize expenditure of resources and disruption to community | a. Consumption of land<br>b. Displacement of residents<br>c. Displacement of businesses<br>d. Reduction of comm. amenities<br>e. Disruption to future dvlpmt.<br>f. Disruption to local circulation<br>g. Disruption - constr. activity<br>h. Savings in energy<br>i. Technical risk | —<br>✓<br>✓<br>✓<br>✓<br>✓<br>—<br>—<br>— | ✓<br>✓<br>✓<br>✓<br>✓<br>✓<br>✓<br>✓<br>✓ | ✓<br>✓<br>✓<br>✓<br>✓<br>✓<br>✓<br>✓<br>✓ |
| 3. A transportation system to be designed as an integral part of and complementary to land use policies | 3. Integration of the transportation system with land use | 4. Support land use and development policies | a. Support regional development<br>b. Support comm. development | ✓<br>✓ | ✓<br>✓ | ✓<br>✓ |
| 4. *Preserve and maintain significant historic sites, scenery and natural assets of Oahu | 4. Preserve Oahu's beauty and amenities | 5. Preserve environment | a. Reduction air pollution<br>b. Noise level<br>c. Visual intrusion<br>d. Vistas<br>e. Historic sites | ✓<br>✓<br>✓<br>✓<br>✓ | ✓<br>✓<br>✓<br>✓<br>✓ | ✓<br>✓<br>✓<br>✓<br>✓ |
| 5. Safety | 5. Safety | 6. Safety | a. Reduce accident exposure<br>b. Security | —<br>— | ✓<br>✓ | ✓<br>✓ |
| 6. **Provide a transportation system which will provide the greatest efficiency and service to the community with the least overall cost | 6. **Provide a balanced transportation system which will result in optimum service at the least cost to the public | 7. Provide the most economical system which best meets all other objectives | a. Total annual cost<br>b. Cost per trip<br>c. Benefit-cost ratio | ✓<br>—<br>— | ✓<br>✓<br>✓ | ✓<br>✓<br>— |
| *Stated as one of the general goals<br>**Stated separately from 2 to differentiate between expenditure of resources and least cost | *Combines Goals 1 & 3 of OTS<br>**Stated separately from 2 to differentiate between expenditure of resources and least cost | *Goal 2 stated as two separate objectives | | | | |

Rider Convenience: the perceived ease in using the vehicle and system; includes number of transfers, fare collection ease (through automatic, in-station facilities), ease in boarding and alighting, waiting area characteristics

Rider Comfort: overall ride quality, climate control, noise level, vibration, jerk rate, etc.

- Objective 2 - Provide a balanced transportation system of transit and highways. This objective is directed at offering a high quality transit service that will attract ridership sufficient to minimize the need for additional highways in the Honolulu urban area. Evaluative factors include:

Annual System Patronage: the ability to attract riders

System Capacity: the ability to accommodate maximum projected patronage within prescribed loading standards

- Objective 3 - Minimize expenditure of resources and disruption to the community. Evaluative factors include:

Consumption of Land: number of acres required for rights-of-way (excluding existing street and freeway rights-of-way) to implement the system and its ancillary facilities, including stations and vehicle storage areas

Displacement of Residents: number of residential dwelling units taken

Displacement of Businesses: number of business establishments taken

Reduction of Community Amenities: the use (if any) of existing public facilities such as parks to support transit system operation

Disruption of Future Development: the relative usability of adjacent land for its intended purpose after development of the transit system

Disruption of Local Circulation: street closures or reduction in street capacity as a result of transit system implementation

Disruption from Construction Activities: short-term local impacts, including traffic disruption, dust, noise, reduced access to street frontage, etc.

Savings in Energy Consumption: net energy savings (if any) resulting from diversion of motorists to transit, expressed in millions of gallons of fuel

Technical Risk: the degree to which any combination of vehicle system and operating concept may assure workability

- Objective 4 - Support land use and development policy. This objective is met if transit system development directs regional growth and development according to accepted City/County and State policies. Evaluative factors include:

Support of Regional Development: the extent to which the transit system contributes to regional planning goals

Support of Community Development: the extent to which the transit system supports neighborhood or community planning goals, particularly near stations and in communities with strong identities

- Objective 5 - Preserve environment. Evaluative factors include:

Reduction in Air Pollution: the net reduction in pollutants resulting from motorist diversion to transit, less the air pollution contributed by the transit system itself; expressed in tons of pollutants (aggregated)

Noise Level: the amount of noise produced by transit vehicles in operation at a distance of 5[illegible] feet, expressed in decibels (dBA)

Visual Intrusion: the size or mass of transit structures adding "clutter" to existing views; it is assumed that all structures would be sensitively designed in harmony with surrounding developments in order to minimize intrusion

Preservation of Vistas: a function of the vertical alignment and mass of transit facilities

Preservation of Historic and Scenic Sites: a function of route location with respect to identified historic and/or scenic places

- Objective 6 - Safety. This objective addresses the safety of transit users (i.e., on-board accidents, boarding and alighting accidents) and non-users (i.e., pedestrian and vehicular conflicts with transit system). Evaluative factors include:

Accident Exposure: the extent of transit rights-of-way exclusivity and operational characteristics (e.g., jerk rate contributing to falls on-board by standing passengers)

Security: the personal well-being of transit patrons while riding in or waiting for transit vehicles

- Objective 7 - Provide the most economical system which best meets all other objectives. This objective deals with overall cost effectiveness and financial burdens of the system. Evaluative factors include:

Total Annual Cost: includes total capital, operating, and maintenance costs associated with construction and operation of the system, expressed in millions of dollars (operating costs based on 1995 system operations, including maintenance of transit facilities; capital costs annualized over a 30-year period at interest rates of four and ten percent to determine if different rates would influence the relative ranking of alternatives)*

Cost Per Trip: cost effectiveness, relating total annual cost to patronage

Benefit-Cost Ratio: economic effectiveness in terms of public benefits accruing from expenditure of public funds; only user and non-user travel benefits included in an effort to be conservative and avoid inclusion of simple transfer benefits

(3) Evaluation of Grade-Separated Alternatives: The performance of each grade-separated transit system, according to the evaluative factors and measures defined above, is plotted on a comparison matrix in Table III-9. Performance ratings expressed in verbal or ranking forms indicate that measures were qualitative, rather than quantitative.

*It should be noted that differing interest rates did not alter relative rankings. However, within LRT and fixed guideway systems, the lowest cost per passenger trip value shifted from the 14-mile systems to the 7-mile systems at the ten percent interest level, reflecting the impact of higher construction cost.

TABLE III-9: COMPARISON MATRIX FOR ALTERNATIVE SYSTEMS

| | Short 7-Mile Length | | | Medium 14-Mile Length | | Long 23 & 28 Mile Length | | |
|---|---|---|---|---|---|---|---|---|
| | Busway | LRT | Fixed Guideway | LRT | Fixed Guide. | 23-Mile LRT | 28-Mile LRT | 23-Mile F.G. |
| **OBJECTIVE 1** | | | | | | | | |
| a. Availability & coverage | Same | Same | Same | Same | Same | Same | Same | Same |
| b. Avg. trip time (min.) | 36.3 | 35.2 | 35.2 | 33.7 | 33.7 | 32.3 | 32.4 | 31.6 |
| c. Service reliability | (2) | (1) | (1) | Same | Same | (2) | (2) | (1) |
| d. Rider convenience | (1) | (2) | (2) | Same | Same | (2) | (1) | (2) |
| e. Rider comfort | (2) | (1) | (1) | Same | Same | Same | Same | Same |
| **OBJECTIVE 2** | | | | | | | | |
| a. System patronage (million) | 137.8 | 138.7 | 138.7 | 142.9 | 142.9 | 143.3 | 143.3 | 148.0 |
| b. System capacity | * | Same | Same | Same | Same | Same | Same | Same |
| **OBJECTIVE 3** | | | | | | | | |
| a. Consumption of land (acres) | 42 | 21 | 20 | 23 | 22 | 36 | 36 | 32 |
| b. Displacement of residents (units) | 233 | 152 | 148 | 166 | 162 | 179 | 179 | 167 |
| c. Displacement of businesses (units) | 257 | 168 | 164 | 187 | 183 | 194 | 194 | 184 |
| d. Reduction of community amenities | Same | Same | Same | Same | Same | Same | Same | Same |
| e. Disruption to future dvlpmt. | Same | Same | Same | Same | Same | Same | Same | Same |
| f. Disruption to local circulation | Same | Same | Same | Same | Same | (2) | (3) | (1) |
| g. Disruption from constr. activities | Same | Same | Same | Same | Same | (1) | (2) | (1) |
| h. Savings in energy (million gal/yr.) | 10.0 | 8.5 | 8.9 | 8.5 | 9.4 | 5.0 | 4.8 | 8.5 |
| i. Technical risk | (3) | (1) | (2) | (1) | (2) | (1) | (1) | (2) |
| **OBJECTIVE 4** | | | | | | | | |
| a. Support regional dvlpmt. | Same | Same | Same | Same | Same | Same | Same | Same |
| b. Support comm. dvlpmt. | Same | Same | Same | Same | Same | Same | Same | Same |
| **OBJECTIVE 5** | | | | | | | | |
| a. Reduction Air pollution (tons/yr.) | 2,970 | 3,240 | 3,260 | 4,110 | 4,150 | 4,120 | 4,140 | 4,930 |
| b. Noise level (dBA) | 86-88 | 77-81 | 77 | 77-81 | 77 | 77-81 | 77-81 | 77 |
| c. Visual intrusion | (3) | (2) | (1) | (2) | (1) | (2) | (2) | (1) |
| d. Vistas | (2) | (3) | (1) | (2) | (1) | (1) | (1) | (2) |
| e. Historic sites | Same | Same | Same | Same | Same | Same | Same | Same |
| **OBJECTIVE 6** | | | | | | | | |
| a. Reduce accident exposure | Same | Same | Same | Same | Same | (2) | (2) | (1) |
| b. Security | Same | Same | Same | Same | Same | Same | Same | Same |

| **OBJECTIVE 7** | Busway | | LRT (7-Mile) | | Fixed Guideway (7-Mile) | | LRT (14-Mile) | | Fixed Guide. (14-Mile) | | 23-Mile LRT | | 28-Mile LRT | | 23-Mile F.G. | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Interest Rates | 4% | 10% | 4% | 10% | 4% | 10% | 4% | 10% | 4% | 10% | 4% | 10% | 4% | 10% | 4% | 10% |
| a. Total annual cost ($ Million) | 77.43 | 96.90 | 76.98 | 96.17 | 76.41 | 95.21 | 77.38 | 102.60 | 76.26 | 101.01 | 85.73 | 116.66 | 90.73 | 124.84 | 86.51 | 117.48 |
| b. Cost per trip | 56.2¢ | 70.3¢ | 55.5¢ | 69.3¢ | 55.1¢ | 68.6¢ | 54.1¢ | 71.8¢ | 53.4¢ | 70.7¢ | 59.8¢ | 81.4¢ | 63.3¢ | 87.1¢ | 58.5¢ | 79.4¢ |
| c. Benefit-cost ratio | 2.24 | 1.50 | 2.28 | 1.55 | 2.31 | 1.58 | 2.40 | 1.47 | 2.47 | 1.51 | 2.06 | 1.24 | 1.87 | 1.13 | 2.19 | 1.32 |

All costs shown are in 1975 dollars.

Note: Numbers in parenthesis (1) show ranking of alternatives based on how well they met the objective
*Practical capacity for busways are unknown and assumed to be less than for guided systems

TABLE III-10: SUMMARY OF RANKINGS
(COMPARISON OF GRADE-SEPARATED ALTERNATIVES FOR VARIOUS SYSTEM LENGTHS)

| | 7-Mile Bus. | 7-Mile LRT | 7-Mile FG | 14-Mile LRT | 14-Mile FG | 23 Mi. LRT | 28 Mi. LRT | 23 Mi. FG |
|---|---|---|---|---|---|---|---|---|
| **OBJECTIVE 1** | | | | | | | | |
| a. Availability & coverage | - | - | - | - | - | - | - | - |
| b. Avg. trip time (min.) | 2 | 1 | 1 | - | - | 2 | 3 | 1 |
| c. Service reliability | 2 | 1 | 1 | - | - | 2 | 2 | 1 |
| d. Rider convenience (transfers per trip) | 1 | 2 | 2 | - | - | 2 | 1 | 2 |
| e. Rider comfort | 2 | 1 | 1 | - | - | - | - | - |
| **OBJECTIVE 2** | | | | | | | | |
| a. System patronage | 2 | 1 | 1 | - | - | 2 | 2 | 1 |
| b. System capacity | 2 | 1 | 1 | - | - | - | - | - |
| **OBJECTIVE 3** | | | | | | | | |
| a. Consumption of land (acres) | 3 | 2 | 1 | 2 | 1 | 2 | 2 | 1 |
| b. Displacement of residents (units) | 3 | 2 | 1 | 2 | 1 | 2 | 2 | 1 |
| c. Displacement of businesses (units) | 3 | 2 | 1 | 2 | 1 | 2 | 2 | 1 |
| d. Reduction of community amenities | - | - | - | - | - | - | - | - |
| e. Disruption to future dvlpmt. | - | - | - | - | - | - | - | - |
| f. Disruption to local circulation | - | - | - | - | - | 2 | 3 | 1 |
| g. Disruption from constr. activities | - | - | - | - | - | 1 | 2 | 1 |
| h. Savings in energy (million gal/yr.) | 1 | 3 | 2 | 2 | 1 | 2 | 3 | 1 |
| i. Technical risk | 3 | 1 | 2 | 1 | 2 | 1 | 1 | 2 |
| **OBJECTIVE 4** | | | | | | | | |
| a. Support regional dvlpmt. | - | - | - | - | - | - | - | - |
| b. Support comm. dvlpmt. | - | - | - | - | - | - | - | - |
| **OBJECTIVE 5** | | | | | | | | |
| a. Reduction Air pollution (tons/yr.) | 3 | 2 | 1 | 2 | 1 | 3 | 2 | 1 |
| b. Noise level (dBA) | 3 | 2 | 1 | 2 | 1 | 2 | 2 | 1 |
| c. Visual intrusion | 3 | 2 | 1 | 2 | 1 | 2 | 2 | 1 |
| d. Vistas | 2 | 3 | 1 | 2 | 1 | 1 | 1 | 2 |
| e. Historic sites | - | - | - | - | - | - | - | - |
| **OBJECTIVE 6** | | | | | | | | |
| a. Reduce accident exposure | - | - | - | - | - | 2 | 2 | 1 |
| b. Security | - | - | - | - | - | - | - | - |
| **OBJECTIVE 7** | | | | | | | | |
| a. Total annual cost | 3 | 2 | 1 | 2 | 1 | 1 | 3 | 2 |
| b. Cost per trip | 3 | 2 | 1 | 2 | 1 | 2 | 3 | 1 |
| c. Benefit-cost ratio | 3 | 2 | 1 | 2 | 1 | 2 | 3 | 1 |
| No. of Firsts | 2 | 6 | 15 | 1 | 11 | 4 | 3 | 15 |
| No. of Seconds | 6 | 10 | 3 | 11 | 1 | 14 | 10 | 4 |
| No. of Thirds | 10 | 2 | 0 | 0 | 0 | 1 | 6 | 0 |

The performance of each system was ranked according to data presented in the matrix. The numbers of relative first, second, and third rankings for each alternative were computed. These findings are presented in Table III-10. Interpretation of alternative analysis findings led to the following conclusions regarding the more viable grade-separated systems:

Busway: Although it would provide a reasonable level of service, the busway system served local and regional objectives less effectively than all the other systems. Primary drawbacks included the labor intensity inherent in individually-operated vehicles, high degree of community disruption, unfavorable environmental impacts compared to electrically-powered systems, and, most importantly, less system capacity than the other alternatives. The busway system provided no cost advantage.

LRT: LRT competed closely with the fixed guideway alternative and was found to be only slightly inferior overall. Differences were noted in service, community disruption, and environmental preservation factors. Tipping the tables further against LRT was the visual intrusion of its overhead catenary lines, particularly in above-grade portions of the route.

Fixed Guideway: The fixed guideway system was selected as the best grade-separated alternative, based on a 30-year period bracketing the year 1995. It promises to meet regional transportation goals and objectives, conforming to adopted policies. The fixed ~uideway system received more "first" rankings than other alternative systems. Though total capital and operating cost for a 23-mile system slightly exceeds that for LRT, it would be offset by higher patronage attracted to the system by its greater speed -- hence, its lower cost per trip.

## B.3. Summary of Alternative Transit Systems Evaluation

Previous sections have presented the analyses and discussions of the TSM/Expanded Bus system as the best of the non-grade-separated alternatives and the three grade-separated alternatives consisting of the Busway, the LRT, and the Fixed Guideway systems with the latter found to be the best of this group. Although the TSM/Expanded Bus system offers an attractive alternative to the grade-separated systems in terms of lower capital investment and minimum displacements, it would not provide comparable service characteristics and thus results in lower diversion to transit.

These very attributes of lower capital investment and minimum displacements are the result of operating the system on existing roadways in joint use with other vehicles. Although the operation of buses on roadways can increase the carrying capacity of the roadway itself, this increase was found to be insufficient to meet the projected growth in travel demand with the existing and planned roadway system. Thus it was concluded that the TSM/Expanded Bus system would not meet the long-range travel needs of the area.

Each of the three grade-separated alternatives operates on its exclusive rights-of-way and hence has little or no effect on the capacity of the existing and planned roadway system. Based on the evaluation, it was found that all three systems were viable and the difference between them was very slight (see Table III-9). The major factors leading to the rejection of the Busway system were its limited system capacity, greater visual impact, and higher dislocation.

The LRT and Fixed Guideway systems are basically identical up to the 14-mile length and only differ with the longer lengths with the LRT system having some routes that are not grade-separated. For both of these systems, it was found that the 14-mile length was the most cost-effective for initial construction. Consequently, the comparative evaluation was basically in the vehicle system itself, with the LRT vehicles featuring articulated body with overhead power pickup associated with non-grade-separated operation. The Fixed Guideway system featuring fully grade-separated operation was found to be generally superior for most evaluative factors considered.

In comparing the longer lengths, the evaluation also indicated that the Fixed Guideway would be the preferred alternative. The Fixed Guideway system's fully grade-separated feature provides higher service characteristics and hence greater diversion to transit. This results in the higher comparative ranking of the Fixed Guideway over the LRT system for most evaluative factors considered as shown in Tables III-9 and 10.

## C. NEAR-TERM IMPLEMENTATION ANALYSIS

### C.1. Comparative Evaluation

Previous sections of this chapter have investigated the relative attributes of several low-capital and grade-separated transit system alternatives. From a battery of alternatives, two were selected as representing the best low-capital and grade-separated alternatives: the

TSM/Expanded Bus system (described in Section III.B.1.b) and the 14-mile Fixed Guideway/Feeder Bus system (described in Section III.B.2.c). In earlier discussions, certain limitations inherent in the TSM/Expanded Bus system -- specifically, its reliance on limited street/highway capacity for rights-of-way -- were shown to limit the system's ability to meet long-term demands. In contrast, the grade-separated fixed guideway system was found to meet critical 1995 demands and those of years beyond.

Acknowledging the superiority of the Fixed Guideway system in the long term, this section investigates the feasibility of implementation of the low-capital system in the near term, conceivably allowing expenditures for the Fixed Guideway system to be postponed. The short-term feasibility comparison assesses 1985 and 1990 performance (preceding the long-term target year of 1995 by five and ten years) of the TSM/Expanded Bus and Fixed Guideway systems in terms of compatibility with street/highway capacities (measured in volume/capacity ratios) and overall regional benefit/cost relationships. These quantitative assessments will be followed by a dual-path qualitative evaluation of the ability of the two systems to meet regional transportation objectives (described in Table III-8) -- an issue as pertinent in the short term as in the long term.

a. Volume-to-Capacity Analysis

Corridor screenlines, generally coinciding with streets or geographical features (e.g., streams) cutting across the transportation corridor, were defined. The relationship between projected traffic demand on streets and highways crossing each screenline and the roadway capacity available were then examined.

Street/highway capacities, as determined by the Oahu Transportation Planning Program (OTPP, until recently the official regional planning body for the Island), are based on particular "levels of service." There are generally considered to be six levels of service (Figure III-7). For planning purposes, roadway performance representing service volumes at either Level of Service "C" (for rural situations) or "D" (for urban situations) are used in order to provide adequate capacity to accommodate future demand beyond the planning year. Level of Service "E" denotes unstable flow with stoppages, as illustrated in Figure III-7, and represents the approximate maximum capacity of the roadway.

Of the numerous screenlines established along the transportation corridor between Pearl City and Hawaii Kai, a few in and near downtown Honolulu were identified as being critical to the street/highway network in Central Honolulu (Figure III-8). These critical screenlines were scrutinized by determining and comparing screenline capacities (the sum of the service volumes for all major streets and highways crossing them) and projected vehicular volumes (Table III-5).

The screenline analyses indicated that by 1985, with a TSM/Expanded Bus system in operation, the total traffic demand through the critical screenlines (especially those east of the CBD) would be near capacity for Level of Service "E." By 1990, screenline capacities would be exceeded by approximately 10 percent. Operation of a fixed guideway system, however, would reduce traffic demand due to its greater diversion to transit such that projected traffic volumes would be lower than with TSM/Expanded Bus alternative.

Under the TSM/Expanded Bus alternative, not only would resulting conditions affect the operation of vehicular traffic on streets and highways; the number of buses required to carry projected volumes of transit riders would increase over time and further aggravate traffic conditions on streets and highways. An alternative that produces a situation where street/highway capacity is exceeded by total travel demand by 1990 clearly falls short of meeting the region's critical long-range transportation needs.

b. Benefit/Cost Analysis

Even though volume-to-capacity analyses determined that the TSM/Expanded Bus alternative physically would fall short of meeting 1990 demands, it was nevertheless compared to the fixed guideway alternative in a benefit/cost analysis, based on a "baseline" bus system reference.* Costs and benefits were calculated for one-year periods in 1985 and 1990.

*Investigations of low-capital alternative systems included evaluation of a "baseline" bus system, an obvious candidate for consideration in the short term (described in Section III.B.1). However, one will recall that the baseline bus system was found to result in intolerably heavy street and highway congestion, verging on being severely overloaded prior to 1985. The system was consequently eliminated from further consideration, except as a "baseline" with which to assess more attractive low-capital and grade-separated alternatives.

The fixed guideway system was found to be about the same as the TSM/Expanded Bus system in terms of benefit-to-cost in 1985, and distinctly higher in 1990, its much greater patronage (with attendant motorist diversion savings) and lower operation and maintenance costs more than offsetting its higher capital cost.[15] Furthermore, capital costs for the TSM/Expanded Bus alternative included only expenditures for new buses, not costs for developing special bus lanes. Also, time savings to continuing motorists and commercial vehicles were not included; were they to be, the scales would have tipped further toward the fixed guideway system. It is interesting to note that, even given its capital intensity, the fixed guideway alternative is shown to be cost-effective when compared to the low-capital TSM/Expanded Bus alternative and the "no-build" baseline bus alternative in the short term. Predictably, as time goes on, the fixed guideway investment would yield benefits increasingly more commensurate with cost, as indicated by the 1990 benefit/cost projections.

c. <u>Qualitative Short-Term Evaluation</u>

Earlier investigations into the long-term performance of grade-separated alternatives translated regional transportation objectives into evaluative factors and measures (Section III.B.2.d). The same criteria can be applied to the performance of the TSM/Expanded Bus and fixed guideway systems in the short term. Two approaches were employed:

<u>Approach A</u>: Assessment of performance at a specific point in time (e.g., 1985), with no assurance of eventual fixed guideway implementation.

<u>Approach B</u>: Acknowledging the superiority of the fixed guideway system and assuming its eventual implementation, determining how soon the fixed guideway system would be needed.

The performance of the TSM/Expanded Bus and fixed guideway systems are presented in Table III-11, based on Approaches A and B, respectively. Assessments related to a few evaluative factors yielded different results for each approach. Examples are reduction of community amenities, disruption of future development, and disruption from construction activities. It is evident that no construction (i.e., bus system) entails no construction impact and no major change to existing conditions. Therefore, without the assumption of eventual fixed guideway construction (Approach A), the TSM/Expanded Bus system is preferable from these standpoints. However, assuming that the fixed guideway system would be built eventually, resource expenditure and disruptive impacts would only worsen with the passage of time, thus favoring early fixed guideway implementation.

TABLE III-11: COMPARATIVE EVALUATION MATRIX

(NEAR-TERM TRANSIT SYSTEMS EVALUATION)

| Evaluation Factors | Approach A | | | Approach B | | |
|---|---|---|---|---|---|---|
| | Baseline | TSM | 14-Mi. Fixed Gwy. | Baseline | TSM | 14-Mi. Fixed Gwy. |
| **OBJECTIVE 1** | | | | | | |
| a. Availability & coverage* | (2) | (1) | (1) | (2) | (1) | (1) |
| b. Avg. trip time (min.) | 40.7 | 40.1 | 33.7 | 40.7 | 40.1 | 33.7 |
| c. Service reliability* | (3) | (2) | (1) | (3) | (2) | (1) |
| d. Rider convenience* | (2) | (2) | (1) | (2) | (2) | (1) |
| e. Rider comfort* | (2) | (2) | (1) | (2) | (2) | (1) |
| **OBJECTIVE 2** | | | | | | |
| a. System patronage-1985 (million/yr.) | 64.7 | 83.6 | 102.4 | 64.7 | 83.6 | 102.4 |
| b. System capacity* | (3) | (2) | (1) | (3) | (2) | (1) |
| **OBJECTIVE 3** | | | | | | |
| a. Consumption of land (acres) | - | 3 | 22 | - | 3 | 22 |
| b. Displacement of residents (units) | - | - | 162 | - | - | 162 |
| c. Displacement of businesses (units) | - | 2 | 183 | - | 2 | 183 |
| d. Reduction of community amenities* | (1) | (1) | (2) | (2) | (2) | (1) |
| e. Disruption of future development* | (1) | (1) | (2) | (2) | (2) | (1) |
| f. Disruption of local circulation* | (3) | (2) | (1) | (3) | (2) | (1) |
| g. Disruption from constr. activities* | (1) | (1) | (2) | (2) | (2) | (1) |
| h. Savings in energy (million gal./yr.) | - | 0.9 | 4.5 | - | 0.9 | 4.5 |
| i. Technical risk* | (1) | (1) | (2) | (1) | (1) | (2) |
| **OBJECTIVE 4** | | | | | | |
| a. Support regional development* | (2) | (2) | (1) | (2) | (2) | (1) |
| b. Support comm. development* | (2) | (2) | (1) | (2) | (2) | (1) |
| **OBJECTIVE 5** | | | | | | |
| a. Reduction Air pollution (tons/yr.) | - | 220 | 2260 | - | 220 | 2260 |
| b. Noise level (dBA) | 86-88 | 86-88 | 77 | 86-88 | 86-88 | 77 |
| c. Visual intrusion* | (1) | (1) | (2) | (2) | (2) | (1) |
| d. Vistas* | (1) | (1) | (2) | (2) | (2) | (1) |
| e. Historic sites* | (1) | (1) | (2) | (2) | (2) | (1) |
| **OBJECTIVE 6** | | | | | | |
| a. Reduce accident exposure* | (3) | (2) | (1) | (3) | (2) | (1) |
| b. Security* | (2) | (2) | (1) | (2) | (2) | (1) |
| **OBJECTIVE 7** | | | | | | |
| a. Total annual cost**-1985 ($ Million) | 32.9 | 45.0 | 66.2 | 32.9 | 45.0 | 66.2 |
| b. Total annual cost per trip ($) | 0.508 | 0.538 | 0.647 | 0.508 | 0.538 | 0.647 |
| c. Benefit-cost ratio*** | - | 1.12 | 1.13 | - | 1.12 | 1.13 |

* For comparative measures, alternatives are ranked in the order of how well they met the objective.
** All costs based on constant 1975 dollars and interest rate of 7%.
*** Based on constant 1975 dollars.

TABLE III-12: SUMMARY OF RANKING

(NEAR-TERM TRANSIT SYSTEMS EVALUATION)

| EVALUATION FACTORS | Approach A | | | Approach B | | |
|---|---|---|---|---|---|---|
| | Baseline | TSM | 14-Mi. Fixed Gwy. | Baseline | TSM | 14-Mi. Fixed Gwy. |
| **OBJECTIVE 1** | | | | | | |
| a. Availability & coverage | 2 | 1 | 1 | 2 | 1 | 1 |
| b. Avg. trip time | 3 | 2 | 1 | 3 | 2 | 1 |
| c. Service reliability | 3 | 2 | 1 | 3 | 2 | 1 |
| d. Rider convenience | 2 | 2 | 1 | 2 | 2 | 1 |
| e. Rider comfort | 2 | 2 | 1 | 2 | 2 | 1 |
| **OBJECTIVE 2** | | | | | | |
| a. System patronage | 3 | 2 | 1 | 3 | 2 | 1 |
| b. System capacity | 3 | 2 | 1 | 3 | 2 | 1 |
| **OBJECTIVE 3** | | | | | | |
| a. Consumption of land | 1 | 2 | 3 | 1 | 2 | 3 |
| b. Displacement of residents | 1 | 1 | 2 | 1 | 1 | 2 |
| c. Displacement of businesses | 1 | 2 | 3 | 1 | 2 | 3 |
| d. Reduction of community amenities | 1 | 1 | 2 | 2 | 2 | 1 |
| e. Disruption of future development | 1 | 1 | 2 | 2 | 2 | 1 |
| f. Disruption of local circulation | 3 | 2 | 1 | 3 | 2 | 1 |
| g. Disruption from constr. activities | 1 | 1 | 2 | 2 | 2 | 1 |
| h. Savings in energy | 3 | 2 | 1 | 3 | 2 | 1 |
| i. Technical risk | 1 | 1 | 2 | 1 | 1 | 2 |
| **OBJECTIVE 4** | | | | | | |
| a. Support regional development | 2 | 2 | 1 | 2 | 2 | 1 |
| b. Support comm. development | 2 | 2 | 1 | 2 | 2 | 1 |
| **OBJECTIVE 5** | | | | | | |
| a. Reduction Air pollution | 3 | 2 | 1 | 3 | 2 | 1 |
| b. Noise level | 2 | 2 | 1 | 2 | 2 | 1 |
| c. Visual intrusion | 1 | 1 | 2 | 2 | 2 | 1 |
| d. Vistas | 1 | 1 | 2 | 2 | 2 | 1 |
| e. Historic sites | 1 | 1 | 2 | 2 | 2 | 1 |
| **OBJECTIVE 6** | | | | | | |
| a. Reduce accident exposure | 3 | 2 | 1 | 3 | 2 | 1 |
| b. Security | 2 | 2 | 1 | 2 | 2 | 1 |
| **OBJECTIVE 7** | | | | | | |
| a. Total annual cost | 1 | 2 | 3 | 1 | 2 | 3 |
| b. Total annual cost per trip | 1 | 2 | 3 | 1 | 2 | 3 |
| c. Benefit-cost ratio | – | 2 | 1 | – | 2 | 1 |
| No. of Firsts | 12 | 9 | 16 | 6 | 3 | 22 |
| No. of Seconds | 7 | 19 | 8 | 13 | 25 | 2 |
| No. of Thirds | 8 | 0 | 4 | 8 | 0 | 4 |

Relative rankings are sumarized in Table III-12 for Approaches A and B, respectively. As in the preceding quantitative analyses, the fixed guideway system emerged slightly ahead of the TSM/Expanded Bus system in terms of its contribution to regional transportation goals by 1985; however, assuming that it will be built eventually, early implementation would be preferable to postponed implementation.

## C.2. Summary of Findings and Conclusions

The alternatives described in the preceding pages were analyzed over a period of several years. More explicit system descriptions are available in a number of technical documents and are summarized in the "Analysis of Transit Alternatives" report prepared in April, 1976. These analyses considered long-term projections in the evaluation and selection of grade-separated systems and supplementing them with the consideration of incremental development, based on demands projected within 15 years, and the support of various Transportation System Management (TSM) techniques for maximum regional benefit.

The near-term comparative analysis discussed above showed the 14-mile fixed guideway system to have a slight advantage over an all-bus system as early as 1985. Table III-13 summarizes the quantitative data used in this near-term evaluation for 1985. By 1990, the advantages of the fixed guideway system increase, reflected in the comparison of the benefit/cost (B/C) ratios for both systems: the 14-mile fixed guideway system had a B/C ratio of 1.29 in 1990, compared to the TSM/Expanded Bus System's B/C ratio of 1.03. This near-term analysis shows that the construction of an initial segment of a fixed guideway system would be justified to be operational within the time period of 1985 and 1990.

## D. ALTERNATIVE ALIGNMENTS AND STATION LOCATIONS

The primary travel demand corridor (as defined in Section III.B.2 and illustrated in Figure III-9) was identified in relationship to major population and employment centers in Central Honolulu. Its identification was an early step in the rapid transit development process and involved research into land use planning, zoning ordinances, traffic data, existing and planned transportation networks, development plans and studies, economic, population, and demographic projections, and other pertinent material.[16] The proposed

TABLE III-13: COMPARISON OF ALTERNATIVE SYSTEMS FOR 1985
(Patronage, Environmental Factors, Costs & Benefits)

| | Baseline | TSM/Expanded Bus. | 14-Mi. Fixed Gwy. |
|---|---|---|---|
| **Patronage** | | | |
| Annual (Million) | 64.72 | 83.65 | 102.36 |
| Daily | 214,300 | 277,000 | 338,950 |
| **Environmental Factors** | | | |
| Air Pollution 1/ (Reduction in tons) | - | 220 | 2260 |
| Fuel 1/ (Million gallons saved) | - | 0.9 | 4.5 |
| ROW & Relocation | | | |
| -Land Area (Acres) | - | 3 | 22 |
| -Residential (Units) | - | - | 162 |
| -Business (Units) | - | 2 | 183 |
| **Costs ($ Million)** | | | |
| Total Capital | 29.25 | 46.41 | 441.3 |
| Annual Capital 2/ | 4.16 | 6.27 | 35.16 |
| Annual O & M 3/ | 28.71 | 38.70 | 31.07 |
| Total Annual Costs | 32.87 | 44.97 | 66.23 |
| **Benefits ($ Million)** | | | |
| Annual Benefits 4/ | - | 13.55 | 37.63 |
| **Benefit/Cost 5/** | | | |
| Net Annual Costs 6/ | - | 12.10 | 33.36 |
| Net Annual Benefits | - | 13.55 | 37.63 |
| B/C Ratio | - | 1.12 | 1.13 |

Note: All costs & benefits in constant 1975 dollars.

1/ Reduction in air pollutants & savings in fuel for the various alternative systems are relative to the Baseline System.

2/ Estimated total capital cost annualized at 7% interest rate.

3/ Estimated annual O & M cost for the year 1985.

4/ Estimated annual benefits for the year 1985. Benefits shown are actual net benefits or marginal benefits relative to the Baseline System.

5/ Benefit/Cost analysis based on 1985 Annual Costs & Benefits.

6/ Net Annual Costs = Total Annual Costs for each alternative system less Total Annual Costs for Baseline System.

transit system and virtually all seriously considered alternatives were located in this corridor. However, the selection of a specific alignment and the location of stations within the corridor entailed several levels of analysis and numerous screenings, balancing service to population and employment centers with other issues, including the island's development potential (the possibility that population and/or employment concentrations may shift, perhaps as a result of rapid transit system implementation), relocation and other environmental factors, and cost. The process of selecting a specific alignment and station locations has been the subject of numerous documents and continued throughout Phases I and II of the Preliminary Engineering and Evaluation Program.[17]

D.1. Criteria

Evaluation criteria (Table III-14) included both "tangible" and "intangible" elements. Tangible elements were associated with cost, including such factors as capital cost, right-of-way acquisition, and loss of property taxes. Intangible elements included such factors as community disruption, environmental qualities, service convenience, and comfort.

Alternate routes were, first, ranked relative to each other in terms of how well each factor in the evaluation criteria were met. Next a weighted rating system was applied which assigned relative values to the tangible and intangible elements. This rating system was intended to provide a balance between the purely economic factor of cost and the more intrinsic element of community value, which may be associated with transportation and accessibility.

The sum of all tangible factors was considered to weigh the same as the sum of intangible factors in the evaluation process. The tangible factors related easily to each other in that cost was the common measurement. However, a further evaluation of relative weight was necessary within the group of intangible factors. This evaluation was accomplished by a computer program that measured the sensitivity of each evaluation factor to changes in their relative weights or values. Also figuring in the establishment of criteria were opinions expressed in several hundred meetings by various governmental agencies, private organizations, and Honolulu area citizens. Relative weights for intangible factors are noted in Table III-15.

## TABLE III-14
### ROUTE EVALUATION FACTORS

| TRANSIT DEVELOPMENT OBJECTIVE | ROUTE PLANNING EVALUATION FACTORS |
|---|---|
| **OBJECTIVE 1** | |
| a. Availability & coverage | - NA* (same as 2.a.) |
| b. Travel time | - Length of line |
| c. Service reliability | - NA |
| d. Rider convenience | - Station site & accessibility |
| e. Rider comfort | - Curvature & grade<br>- Passenger acceptability |
| **OBJECTIVE 2** | |
| a. System patronage | - Service to origins<br>- Service to destinations |
| b. System Capacity | - System line extendability<br>- System carrying capacity |
| **OBJECTIVE 3** | |
| a. Consumption of land | - NA (same as 3.a. and b.) |
| b. Displacement of residents | - Displacement of residents |
| c. Displacement of businesses | - Displacement of businesses |
| d. Reduction of comm. amenities | - Physical identify of community |
| e. Disruption to future dvlpmt. | - Character of adjacent property |
| f. Disruption to local circulation | - Local traffic impact<br>- Constraints to freeway<br>- Constraints to arterial streets |
| g. Disruption from const. activities | - NA (same as 3.f.) |
| h. Consumption of energy | - NA (same as 1.a.) |
| i. Technical risks | - NA |
| **OBJECTIVE 4** | |
| a. Support regional dvlpmt. | - Enhance dvlpmt. potential<br>- Reinforce present plan |
| b. Support comm. dvlpmt. | - Relation to comm. planning goals<br>- Urban design potential |
| **OBJECTIVE 5** | |
| a. Air pollution | - Air pollution |
| b. Noise level | - Noise |
| c. Visual intrusion | - Natural beauty |
| d. Vistas | - Natural beauty |
| e. Historic sites | - Urban environmental quality |
| **OBJECTIVE 6** | |
| a. Reduction in accident exposure | - NA |
| b. Security | - NA |
| **OBJECTIVE 7** | |
| a. Total Cost | - Construction cost<br>- ROW acquisition cost<br>- Tax losses |
| b. Cost per ride | - NA |
| c. Benefit-cost ratio | - NA |

* NA - Not Applied

TABLE III-15

WEIGHTING OF INTANGIBLE FACTORS IN PEEP I ROUTE PLANNING

| Factors | Total Weight |
|---|---|
| I. SERVICE* | 40 |
| 4. Service to Origins | |
| a. Population Centers | |
| b. Concentrations of Labor Force | |
| c. Low-Income Areas | |
| 5. Service to Destinations | |
| a. Employment | |
| b. Business/Shopping | |
| c. Institutional/Cultural | |
| d. Recreation | |
| II. IMPACT | 48 |
| 6. Local Impact | |
| a. Relation to Community Planning Goals | |
| b. Urban Design Potential | |
| c. Relocation of Resident | |
| d. Relocation of Businesses | |
| e. Effect upon Physical Identity of Community | |
| f. Effect upon Character of Adjacent Property | |
| g. Local Traffic Impact | |
| 7. Corridor Impact | |
| a. Enhances Development Potential | |
| b. Reinforces Present Planning Goals | |
| 8. Environmental Aspects | |
| a. Noise Levels | |
| b. Air Pollution | |
| c. Retention of Natural Beauty | |
| d. Retention of Urban Environment Quality | |
| III. DESIGN | 8 |
| 9. Physical Design | |
| a. Curvature and Grades | |
| b. Station Sites and Accessibility | |
| c. Length of Line | |
| d. Passenger Acceptability | |
| 10. Transit System Expansion Capability | |
| a. Extensions | |
| b. Carrying Capacity | |
| IV. CONSTRAINTS | 4 |
| 11. Constraints to Transportation | |
| a. Freeways | |
| b. Arterial Streets | |
| Total for Intangible Factors | 100 |

*The value for service to destination and origin was calculated differently for each segment based on the characteristics specific to those areas.

Station location selection criteria were similar to those for route selection, but emphasized the following factors: service to the area, impact on adjacent properties, access to arterial and local streets, interface with feeder bus routes, parking availability (where appropriate), physical constraints to users (e.g., handicapped, elderly), compliance with civil engineering design criteria (e.g., curves, grades) and optimum station spacing standards (averaging one mile, less in the urban core, more in outlying areas).

## D.2. Selection of Preferred Route Alignment and Station Locations

The number of candidates and levels of screening -- encompassing several years of increasingly detailed analysis -- preclude a full account in these pages. Persons interested in specific phases of this selection program are urged to consult references 16 and 17 listed in the back of this document. Community input played an invaluable role in the selection of the preferred route and station locations. Every segment of the preferred route has been closely coordinated with communities and their inputs incorporated in the planning process. The community and public agency involvement program spanned approximately six years and entailed hundreds of community meetings.

Table III-16, accompanied with Figure III-13, describes in summary form the route alignment and station locations that were analyzed in the final screening phase. Throughout the evaluation process, nine segments that embrace the ultimate 23-mile system were considered, anticipating eventual expansion of the line initially constructed. The 14-mile segment includes segments two through eight. Evaluation criteria remained fairly consistent throughout the selection process.

In Table III-16, the preferred transit route alignment and station locations for the 14-mile segment are designated by a bullet. The following paragraphs briefly describe the key factors that accounted for the selection of the preferred alignment.

Segment 2: The preferred alignment in the median of the H-1 Freeway entailed lower costs, fewer adverse impacts, and better station locations from the standpoint of bus interfacing than alternative alignments. The Kamehameha Highway alternative with the guideway alignment located along the west side of the highway right-of-way, would encroach into the Pearl Harbor/Hickam military lands and produce noise and visual intrusion to the military housing areas located adjacent to the highway. The H-1 Freeway alternative with the guideway alignment located on the west side of the freeway

TABLE III-16: RAPID TRANSIT ALTERNATIVE ROUTE ALIGNMENTS AND STATION LOCATIONS

| Corridor | Alternative | Route Alignment | Route Configuration | Station Location | Station Configuration |
|---|---|---|---|---|---|
| Segment 2 - Halawa/Pearl Harbor (Aloha Stadium to Elliot Street) | •H-1 Freeway [2A] | Median of H-1 Freeway | Transit at grade with roadway | Halawa - H-1 Freeway at Halawa Heights Road<br>Pearl Harbor - H-1 Freeway north of new Radford Drive | Aerial<br>Aerial |
| | Kamehameha Highway [2B] | Along Kamehameha Highway on west side and then along south side of Nimitz Highway | Aerial | Halawa - Relocated Salt Lake Boulevard and Kamehameha Highway<br>Pearl Harbor - Nimitz Highway at Valkenburg Street | Aerial<br>Aerial |
| | H-1 Freeway [2C] | Cross stadium parking area and along H-1 on west side and then along south side | Aerial at stadium, at grade along H-1, then aerial | Halawa - Stadium site at relocated Salt Lake Boulevard<br>Pearl Harbor - Nimitz Highway at Valkenburgh Street | Aerial |
| | H-1 Freeway/ Salt Lake Boulevard [2D] | Median of H-1 Freeway and Salt Lake Boulevard | Aerial | Halawa - H-1 Freeway at Halawa Heights Road<br>Pearl Harbor - Salt Lake Boulevard at Bougainville Road | Aerial<br>Aerial |

• Proposed location
[2A] used to identify alignment on Figure III-13

| Corridor | Alternative | Route Alignment | Route Configuration | Station Location | Station Configuration |
|---|---|---|---|---|---|
| Segment 3 - International Airport (Elliot Street to Kechi Lagoon) | •Aolele Street [3A] | From H-1 Freeway median to airport terminal, then following Aolele Street through northern edge of Kechi Lagoon Park | Aerial | International Airport - North of proposed parking garage | Aerial |
| | | | | Kechi Lagoon - Lagoon Drive and Aolele Street | Aerial |
| | H-1 Freeway [3B] | Median of H-1 Freeway | At grade with H-1 | International Airport - Proposed H-1 Freeway near Rodgers Boulevard | Aerial |
| | | | | Kechi Lagoon - Proposed H-1 Freeway at Lagoon Drive | Aerial |
| | Aolele/Koapaka Streets [3C] | From Nimitz Highway and Elliot Street to airport terminal; Aolele Street then Koapaka Street at Lagoon Drive and through northern edge of Kechi Lagoon Park | Aerial | International Airport - North of existing parking garage | Aerial |
| | | | | Kechi Lagoon - Lagoon Drive and Koapaka Street | Aerial |
| | Salt Lake Boulevard/ Mokumoa Street [3D] | Median of Salt Lake Boulevard and Mokumoa Street, then along eastern edge of Moanalua Stream and through Keehi Lagoon Interchange | Aerial, except for a short segment subway under military housing from just west of Peltier Avenue to Puuloa Road | Salt Lake - Salt Lake Boulevard and Ala Lilikoi Street | Aerial |
| | | | | Mapunapuna - Mokumoa Street and Puuloa Road | Aerial |

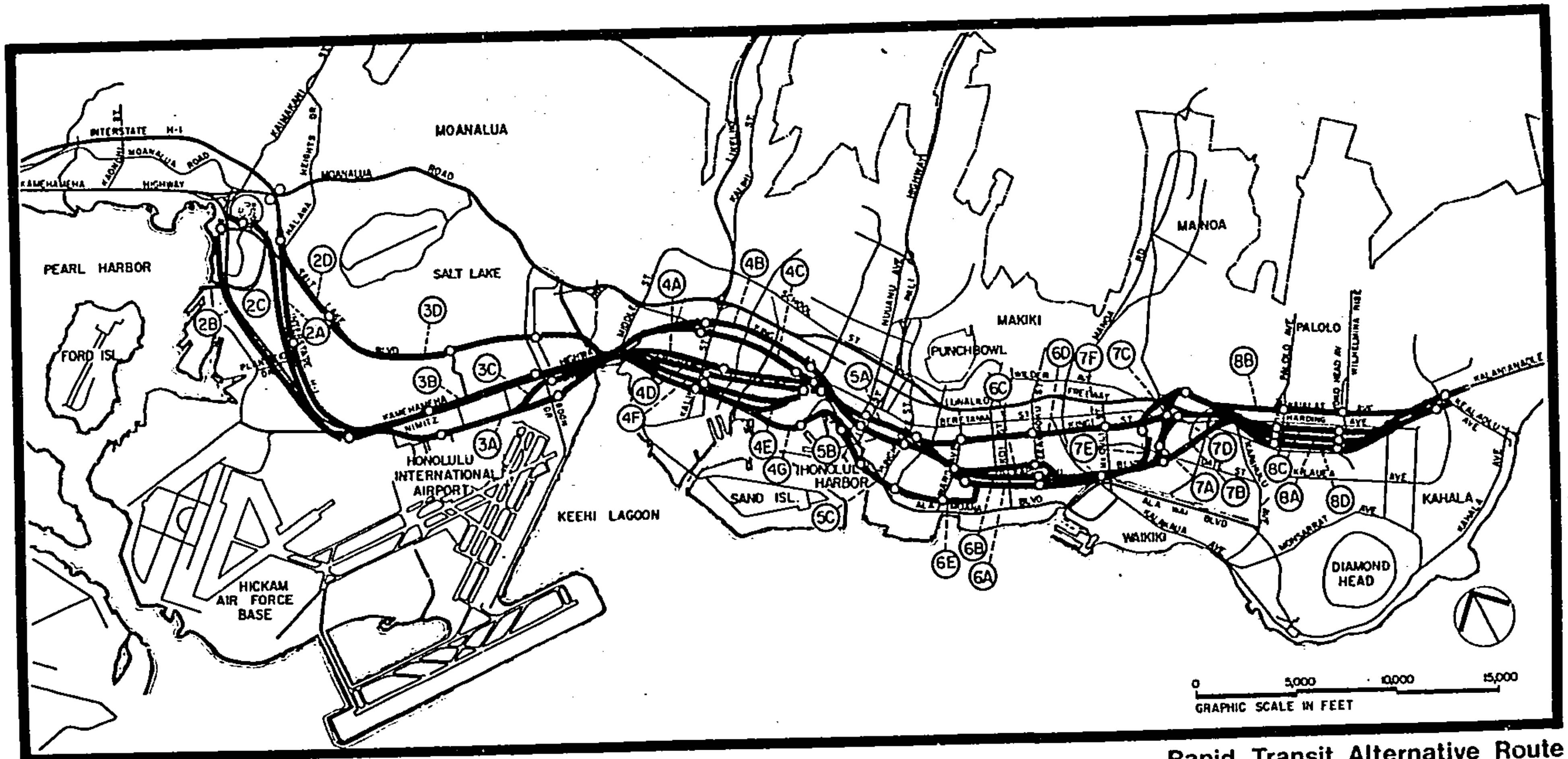
| Corridor | Alternative | Route Alignment | Route Configuration | Station Location | Station Configuration |
|---|---|---|---|---|---|
| Segment 4 - Kalihi/Palama (Middle Street to River Street) | •Dillingham Blvd. (median) [4A] | Median of Dillingham Boulevard | Aerial then Subway before Iwilei Station | Kalihi - Dillingham Blvd., east of McNeill Street<br>Iwilei - Between King Street and Dillingham Blvd. and Kaamahu Place | Aerial<br>Subway |
| | King Street [4B] | Along North King Street | Aerial to Kalihi Stream, Subway along King Street | Kalihi - King Street between Kalihi Street & Mokauea St.<br>Liliha - West of Liliha Street on King Street | Subway<br>Subway |
| | Alokele Street [4C] | Along Alokele Street south of King Street | Aerial to Kalihi Stream, Subway through residential, Aerial across Kapalama Canal, Subway through Iwilei | Kalihi - East of Mokauea Street at Alokele Street<br>Liliha - West of Dillingham Boulevard at Akepo Lane | Subway<br>Aerial |
| | Dillingham Boulevard [4D] | Along south side of Dillingham Boulevard on private R.O.W. | Aerial to Dole Cannery, Subway through Iwilei | Kalihi - Dillingham Boulevard between Kalihi St. & McNeill St.<br>Iwilei - Between King St. & Dillingham Blvd. and Kaamahu Place | Aerial<br>Subway |
| | Nimitz Highway [4E] | Follow Nimitz Highway to Kapalama Canal, then OR&L RR R.O.W. | Aerial, then Subway through Iwilei | Kalihi - Kalihi Street & Nimitz Highway<br>Iwilei - Just west of King Street and Iwilei Road intersection | Aerial<br>Subway |
| | OR&L R.O.W. [4F] | Follow Oahu Railway & Land Co. RR R.O.W. | Aerial, then Subway through Iwilei | Kalihi - East of Kalihi Street at Hart Street<br>Iwilei - Just west of King Street and Iwilei Road intersection | Aerial<br>Subway |
| | Nimitz Highway [4G] | Median of Nimitz Highway to just west of Pacific Street, then along northern edge of Nimitz Highway inbound lanes | Aerial | Kalihi - Kalihi Street & Nimitz Highway<br>Iwilei - Pacific Street & Nimitz Highway | Aerial<br>Aerial |

| Corridor | Alternative | Route Alignment | Route Configuration | Station Location | Station Configuration |
|---|---|---|---|---|---|
| Segment 5 - Chinatown, Downtown, Civic Center (River Street to Alapai Street) | •Hotel Street [5A] | Follow Hotel Street through Chinatown, downtown, and Civic Center | Subway | Fort Street - Fort Street/Nuuanu Avenue at Hotel Street | Subway |
| | | | | Civic Center - Just west of Kapiolani Boulevard Extension & King Street | Subway |
| | King Street [5B] | Follow King Street to Punchbowl Street, then onto Kapiolani Boulevard | Subway | Fort Street - Fort Street/Nuuanu Avenue at King Street | Subway |
| | | | | Civic Center - Punchbowl Street and King Street | Subway |
| | Nimitz Highway/ Ala Moana Boulevard/ Auahi Street [5C] | Follow southern edge of Nimitz Highway and Ala Moana Boulevard, then into the middle of Auahi Street | At-grade and Aerial in Auahi Street | Smith Street - South of Nimitz Highway | At-grade |
| | | | | Aloha Tower - Just south of Hawaiian Electric Co. Power Plant | At-grade |
| | | | | South Street - Auahi Street at South Street | Aerial |
| Segment 6 - Kakaako/Ala Moana (Alapai Street to Atkinson Drive) | •Waimanu/Kona Street [6A] | South of Kapiolani Boulevard along Waimanu Street and Kona Street | Subway to Dreier Street, then Aerial | Ward Avenue - Ward Avenue and Waimanu-Street | Aerial |
| | | | | Ala Moana - Keeaumoku and Kona Streets | Aerial |
| | Kapiolani [6B] | Follow Kapiolani Boulevard | Subway | Ward Avenue - Ward Avenue & Kapiolani Boulevard | Subway |
| | | | | Ala Moana - Keeaumoku Street and Kapiolani Boulevard | Subway |
| | Makaloa Street [6C] | Follow Kapiolani to McKinley High School then along Makaloa, then cross to Kona Street | Subway to McKinley High School, then Aerial | Ward Avenue - Ward Avenue and Kapiolani Boulevard | Subway |
| | | | | Ala Moana - Keeaumoku Street at Makaloa Street | Aerial |
| | King Street [6D] | Follow center line of King Street | Subway to Archer Lane, then Aerial | Ward Avenue - Ward Avenue and King Street | Aerial |
| | | | | Keeaumoku Street - Keeaumoku Street and King Street | Aerial |
| | Auahi Street [6E] | Middle of Auahi Street, then along Kamakee Street into Kona Street | Aerial | Ward Avenue - Ward Avenue and Auahi Street | Aerial |
| | | | | Ala Moana - Keeaumoku and Kona Sts. | Aerial |

| Corridor | Alternative | Route Alignment | Route Configuration | Station Location | Station Configuration |
|---|---|---|---|---|---|
| Segment 7 - Moiliili/ University (Atkinson Drive to Kapahulu Ave) | •MB - Kapiolani/ University with Date and UH Quarry Stations [7A] | Middle of Kapiolani, middle of University Avenue past Freeway, easterly through UH & then along Waialae Road | Aerial | Waikiki - Between Kalakaua Avenue & McCully Street, north of Ala Wai Canal | Aerial |
| | | | | Date Street - University Avenue and Date Street | Aerial |
| | | | | University - UH Quarry | Aerial |
| | A - Kapiolani Boulevard [7B] | Middle of Kapiolani Boulevard to H-1 Freeway at Kapahulu Avenue | Aerial | Waikiki - Between Kalakaua Ave. and McCully Street, north of Ala Wai Canal | Aerial |
| | | | | Kapiolani - On Kapiolani Blvd. between University & Date | Aerial |
| | $B_1$ - Kapiolani/ University/Old Waialae Road [7C] | Middle of Kapiolani, middle of University Avenue past Freeway, easterly through UH and then along Waialae Road | Aerial | Waikiki - Between Kalakaua Ave. and McCully Street north of Ala Wai Canal | Aerial |
| | | | | University - University Avenue between King Street & H-1 Freeway | Aerial |
| | $B_2$ - Kapiolani/ University/South of H-1 [7D] | Same as $B_1$ but turns east at King Street then over and into the median of H-1 | Aerial | Waikiki - Between Kalakaua Ave. and McCully Street north of Ala Wai Canal | Aerial |
| | | | | University - Between King Street and H-1 east of University Ave. | Aerial |
| | C - Isenberg/ UH/Old Waialae Road [7E] | Kapiolani to Isenberg, north to King Street, northeast to UH then east along Waialae Road | Aerial | Waikiki - Between Kalakaua Ave. and McCully Street north of Ala Wai Canal | Aerial |
| | | | | Isenberg Street - South of King St. on Isenberg Street | Aerial |
| | | | | University - On UH property east of Varsity Circle | Aerial |
| | King St./ University/ Old Waialae Road [7F] | Middle of King Street, then northeasterly across Beretania Street, Kaialiu Street, University Avenue, H-1 Freeway, then southeasterly through UH and along Old Waialae Road | Aerial | McCully Street - McCully and King Sts. | Aerial |
| | | | | University - UH Quarry | Aerial |

NOTE: Five other routes were evaluated in PEEP I and rejected prior to the evaluation of the above five in PEEP II. These were Manoa-Palolo Drainage Canal, Ala Wai Canal/University Avenue (subway), Kapiolani/University (subway), Kapiolani/University (aerial), and a private right-of-way across Coolidge and Hausten Streets.

| Corridor | Alternative | Route Alignment | Route Configuration | Station Location | Station Configuration |
|---|---|---|---|---|---|
| Segment 8 - Kaimuki/Kahala (Kapahulu Avenue to Kahala Mall) | •Middle of Lunalilo Freeway (At Grade) [8A] | Middle of Freeway | At-grade | 6th Avenue - On Freeway west of 6th Avenue | At-grade |
| | | | | Koko Head - On Freeway west of Koko Head Avenue | At-grade |
| | | | | Kahala - Kahala Mall on Freeway near Kilauea Avenue | At-grade |
| | Waialae Avenue [8B] | Along Waialae Avenue | Subway in Waialae Avenue and then Aerial over the Freeway to Kahala Mall | 6th Avenue - 6th Avenue & Waialae Avenue | Subway |
| | | | | Koko Head - Koko Head Avenue and Waialae Avenue | Subway |
| | | | | Kahala - Kahala Mall at Kilauea Avenue | Aerial |
| | North of Lunalilo Freeway [8C] | Private R.O.W. along northern edge of Freeway and crosses. Freeway near Waialae Avenue to Kahala Mall | Aerial with a small portion in Subway under Koko Head Avenue | 6th Avenue - 6th Avenue & Lunalilo Freeway (north) | Aerial |
| | | | | Koko Head - Koko Head Avenue & Lunalilo Freeway (north) | Subway |
| | | | | Kahala - Kahala Mall at Kilauea Avenue (south) | Aerial |
| | Median of Lunalilo Freeway (Aerial) [8A] | Median of Freeway | Aerial | 6th Avenue - Above Lunalilo Freeway east of 6th Avenue | Aerial |
| | | | | Koko Head - Koko Head Avenue at Lunalilo Freeway | Aerial |
| | | | | Kahala - Kilauea Avenue at Freeway | Aerial |
| | South of Lunalilo Freeway [8D] | Private R.O.W. south of Freeway | Aerial | 6th Avenue - 6th Avenue and Lunalilo Freeway (south) | Aerial |
| | | | | Koko Head - Koko Head Avenue & Freeway (south) | Aerial |
| | | | | Kahala - Kahala Mall at Kilauea Avenue (south) | Aerial |




**Rapid Transit Alternative Route Alignments and Station Locations**

LEGEND

ALTERNATIVE ALIGNMENT

STATION LOCATION

2A ALIGNMENT IDENTIFICATION (SEE TABLE III-16)

Figure III-13

but within the freeway right-of-way would create greater noise and visual intrusion to adjacent military housing areas and result in higher cost than the preferred alignment.

Segment 3: The preferred route for this segment follows Aolele Street from the Airport to Lagoon Drive and then the northerly boundary of Keehi Lagoon Park to Middle Street. Two other basic route alternatives considered were the H-1 Freeway and the Salt Lake Boulevard. The key feature of the H-1 Freeway route, which is proposed to displace the planned carpool lanes, is that it places the Airport Station approximately one-half mile from the Airport terminal. This distance was concluded to be too great for easy walking between the station and Airport terminal and thus diminish the service attractiveness to this important activity center. Also, there would be some negative impacts to the traffic on H-1 due to the loss of the carpool lanes.

The Salt Lake Boulevard alternative would provide direct transit service to the high density residential complex in the Salt Lake area but would place the transit line far removed from the Airport. This alternative was dismissed in favor of providing direct service to the Airport.

The Aolele/Koapaka Street alternative is a variation of the preferred route alignment at the easterly end of the segment. This alignment places the guideway near the H-1 Freeway in order to minimize encroachment on Keehi Lagoon Park. This alignment was dismissed due to extensive private right-of-way requirements and attendant dislocation of existing businesses.

Segment 4: Through the Kalihi-Palama area, the Dillingham Boulevard alternative was identified as the preferred alignment. The alternative routes following King Street and Alokele Street resulted in substantially larger numbers of residential relocation as well as being considerably more costly than the preferred alignment. The Nimitz Highway and the OR&L R.O.W. route alternatives were comparable in cost but less desirable in serving the Kalihi residents than the preferred alignment. The preferred alignment on Dillingham Boulevard was concluded to provide the best balance of service between residential and employment areas.

Segment 5: The downtown Honolulu area encompassing Chinatown, CBD and Civic Center represents the single largest employment concentration on Oahu and hence is the primary destination for transit users. The transit stations must be centrally located to provide convenient walking access to as many people as possible in this highly important service area. Thus, from the alternatives considered, Hotel Street was selected as the preferred route primarily due to its central location.

The King Street alternative, which is fairly close to Hotel Street, was considered to also be centrally located but it is one of the major streets serving the downtown area. Traffic disruption during construction would be significant with attendant increase in construction cost to minimize this impact. More importantly, King Street being a major vehicular street with narrow sidewalks, it would not be as desirable as Hotel Street for convenient pedestrian access to the CBD transit station. An east-west pedestrian mall on Hotel Street, as currently planned, and the existing north-south Fort Street mall provides an ideal pedestrian access to the rapid transit station on Hotel Street serving the CBD which would be superior to any station locations on King Street.

The Nimitz Highway alignment would place the transit line away from the centroid of the downtown service area with greater reliance placed on feeder bus for access to stations. The placing of a large number of buses on the limited and congested streets of the downtown area would increase traffic congestion causing additional degradation of the downtown environment.

Segment 6: Three basic route alternatives were considered in this segment -- King Street, Kapiolani Boulevard, and Auahi Street. The King Street route would directly serve the medium and high density residential area north of the street and strip commercial development along the street. The Kapiolani Boulevard route would directly serve the existing Ala Moana Shopping Complex, the Holiday Mart apartment complex, the high density apartment area in Moiliili, and the Kakaako area currently under planning study for major redevelopment. Auahi Street, the most southerly of the three route alternatives, would directly serve the southerly portion of the Kakaako area as well as the other areas described above for the Kapiolani Boulevard alternative.

The Kapiolani route was found to serve more people, both residents and workers, than either of the two other alternatives. This route also provided an opportunity to locate the guideway either one block north (Makaloa Street) or one block south (Waimanu/Kona Streets) of Kapiolani Boulevard, with the latter location selected as the preferred alignment due to lower cost and lesser environmental impact than the Makaloa Street alignment.

Segment 7: Following the selection of the Waimanu/Kona Streets alignment for the previous segment, the transit line would traverse the Moiliili community as it continues in the easterly direction towards the Waialae/Kahala area. Direct service to major activity centers including the University of Hawaii Manoa Campus was one of the primary objectives in system planning. A large number of alternative routes were considered in order to minimize adverse impacts to this highly developed community. One alternative route considered, the Kapiolani Boulevard route to H-1 Freeway, would bypass the University of Hawaii Manoa Campus, but nevertheless was considered due to its potentially lower cost and lesser impacts than the alternatives that would serve the campus.

After leaving the Waikiki Station, five different alternative alignments to the University of Hawaii campus were analyzed and the Kapiolani Boulevard-University Avenue alignment was found to create lesser environmental impacts and fewer number of dislocation of residents than the other four alternatives. In evaluating the Kapiolani Boulevard-University Avenue alignment serving the University of Hawaii campus against the Kapiolani Boulevard to H-1 Freeway alignment which bypasses the University of Hawaii campus, it was concluded that the route providing direct service to the campus would be highly desirable and was selected as the preferred route.

Segment 8: Two basic alternative routes were considered for this most easterly segment of the 14-mile system -- Waialae Avenue and the H-1 (Lunalilo) Freeway.

The Kaimuki area through which Segment 8 traverses is an older but stable residential community developed at the turn of the century. The extension of the streetcar line on Waialae Avenue encouraged the development of the existing strip commercial activities including the Kaimuki business district located between 11th Avenue and Koko Head Avenue. The construction of the H-1 Freeway divided the community and the development of the Kahala Mall Shopping Center has had an impact on the Kaimuki business district. However, the area remains as a well preserved neighborhood unit with predominantly single-family dwellings, many of which are original structures of the area. Numerous small businesses remain along Waialae Avenue together with several public and private schools and a park.

Waialae Avenue is a 4- to 6- lane arterial and is the only major surface street that parallels the freeway. It is heavily travelled since it is the primary access road to the ridge and valley communities of St. Louis Heights, Palolo Valley and Wilhelmina Rise.

As part of the initial route planning study, it was determined with the community that any alignment using Waialae Avenue would have to be underground. Aerial structures along this street would have a significant impact on traffic especially on the 4-lane portion, and also it would have a significant impact on the character of this older community. Consequently, it was concluded that, although costly, the only viable alternative would be to place the transit facilities underground in Waialae Avenue, providing two underground stations, one near 6th Avenue and one near Koko Head Avenue.

The Waialae Avenue route would cost approximately $34 million in 1978 dollars or $46 million in escalated dollars more than the H-1 Freeway route. This added cost is due primarily to the higher cost of underground construction for both the guideway structure and stations.

Because of strong community objections to the Waialae Avenue routing, particularly from Kaimuki Neighborhood Board No. 4, and the significantly increased construction costs, this alternative was dismissed in favor of the H-1 Freeway route.

Various alternative alignments were considered along the H-1 Freeway route. These included the alignments both north and south of the freeway right-of-way, the alignment in the median of the freeway on aerial structures and the alignment in the middle of the freeway with at-grade configuration. The first two alignments located on the edge and outside of the freeway right-of-way would result in dislocation of over 100 residential units and were therefore dismissed from further consideration. The alternative with the alignment in the freeway median using aerial structures would create both visual and noise impact such that it was considered to be less favorable than the preferred alignment which places the guideway at the same level as the existing roadway. Although the preferred alignment would have a slightly higher cost due to the required widening of the freeway, it was selected on the basis of its lesser noise and visual impacts on the community.

## D.3. Auxiliary Facilities

For the yard and shop facility, numerous alternative sites were initially identified, however, many of them were dismissed due to their distant location from the initial segment of the transit system, i.e., sites at Pearl City, Hawaii Kai, and Sand Island. Another alternative identified was the possible use of the Oahu State Prison site, predicated on its removal elsewhere by the State. However, most recent events indicate that the prison would remain at its present site, therefore this location was also dismissed. Of the three remaining alternative sites, both the Makalapa Crater and Mapunapuna Industrial Tract sites, owned by the State and/or the Federal government and previously vacant, were found to be planned or currently under construction for full development with various State and Federal facilities and hence they would be too costly and result in major disruptions if acquired for transit use. Thus, the Keehi Lagoon site was found to be the only feasible location for the yard and shop facility in terms of available area and minimum community disruption.

## E. ALTERNATIVE SEGMENT LENGTHS FOR INITIAL CONSTRUCTION

This section examines five alternative segment lengths: 7, 8, 10, 12, and 14 miles. The detailed analysis from which this examination is derived can be found in the "Analysis of Transit Alternatives" document,[15] Chapter VIII and is supplemented with additional analyses including a 10-mile segment length and terminal access evaluation.

The analysis assumed that construction of any segment length would take five to six years, with revenue service commencing in the mid-1980's. Operational projections through 1995 were considered. All alternative segment lengths were supported by thoroughly-developed station access strategies and feeder bus networks, both of which played major roles in modal split and trip assignment models.

### E.1. Alternative Segment Length Descriptions

The five alternative segment lengths evaluated are illustrated in Figure III-14 and described below:

| Segment Length (actual) | West Terminus | East Terminus |
|---|---|---|
| "7 miles" (7.3) | Keehi Lagoon Dr. | University |
| "8 miles" (8.4) | Airport | University |
| "10 miles" (9.9) | Keehi Lagoon Dr. | Kahala |
| "12 miles" (11.5) | Halawa | University |
| "14 miles" (13.9) | Halawa | Kahala |

Feeder bus systems were designed to provide coverage and transit availability that were essentially equal for all segment lengths. However, each of the alternate terminal stations have unique characteristics, capabilities and limitations which must also be taken into consideration.

The listing of the alternate segment lengths suggests that three additional sites might be considered as guideway terminal candidates. However, the Airport Station could be characterized as simply an extension of the line for airport access since all of the terminal-related ground transportation interface would be provided at the prior stop, Keehi Lagoon Station. Following are brief descriptions of the

# Alternative Segment Lengths

## RAPID TRANSIT STATIONS

1. Halawa
2. Pearl Harbor
3. Airport
4. Keehi Lagoon
5. Kalihi
6. Iwilei
7. Fort Street
8. Civic Center
9. Ward Avenue
10. Ala Moana
11. Waikiki
12. Date Street
13. University
14. 6th. Avenue
15. Koko Head Avenue
16. Kahala

- ● Stations
- ▬▬ Aerial
- ┃┃┃┃┃ At-Grade
- ■■■■■ Underground
- ●●●●●● Express Buses in Exclusive Bus Lane
- OOOOO Express Buses in Reserved Bus Lanes or Mixed Traffic

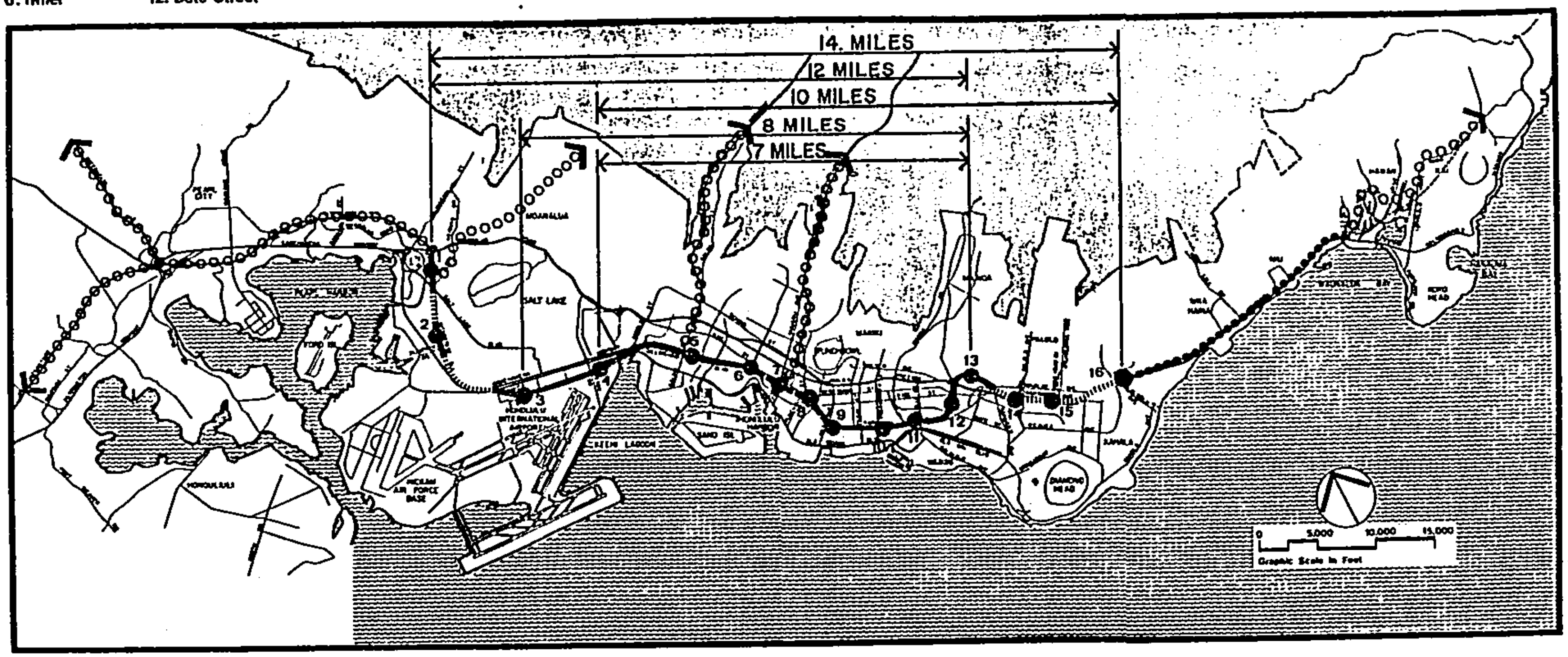



FIGURE III-14

functional characteristics and operational modifications of the two primary terminal alternatives, Keehi Lagoon and University Stations.

Keehi Lagoon Station Terminal Alternative: The Keehi Lagoon Station would be the principal center of guideway terminal activity as the western terminus for the 7-, 8- and 10-mile systems. As a non-terminal, the station is visualized as being primarily a transfer point between local feeder bus routes and the guideway. The location, adjacent to an industrial area on one side and the Keehi Lagoon Park on the other, would indicate limited use by pedestrian access other than for recreational activity.

Terminal use of the station would dramatically increase the activity level at the station by introducing the extensive express bus interface capability required to extend the guideway influence to the western areas of population concentration. The express buses would be required to travel Nimitz Highway to-and-from the Pearl Harbor Interchange where freeway service would be provided to the outlying areas. Additional private right-of-way of some 30,000 sq. ft. must be acquired to provide additional bus loading and unloading facilities (see Figure IV-10).

The potential for development of a park-and-ride capability exists near the site on lands presently owned by the State. Since the station is ewa of the major downtown traffic congestion areas, this could become a valuable asset.

University Station Terminal Alternative: The University Station has been proposed as a possible guideway termination point for first-stage construction and would define one end of the 7-, 8- and 12-mile guideway segments. Location of the terminal station on the University grounds necessitates the stipulation that only express bus services be added to the University-related pedestrian services which would otherwise be provided. Express buses would be utilized to continue the high-level public transit service capability from the University Station to outlying suburban areas in East Oahu; but all other bus routes that were proposed to interface at the 6th Avenue, Koko Head and Kahala Stations of the longer first-phase guideway facility would be restructured and extended to the Date Street Station. No facilities for private auto accessibility would be provided at the University Station.

With respect to operational area necessary for the guideway terminal at the University Station, the express bus interface will require not only additional space to accommodate the bus loading and alighting facilities, but also a reservoir area for the short-duration storage of the bus fleet required for transition from the off-peak level of service to the peak-period demand-responsive condition. A bi-directional exclusive use roadway utilizing the future guideway structure would be developed to facilitate the express bus movements between the station interface area and the H-1 (Lunalilo) Freeway median. On reaching the freeway grade-level, the busway would be transitioned to-or-from the existing freeway lanes and would result in bus operations merging into and operating with the freeway traffic over a portion of the H-1 Freeway. Easterly of Kahala the express service would be facilitated by a unidirectional busway that is currently under development by the State DOT in the median of the Kalanianaole Highway.

## E.2. Cost-Effectiveness Analysis

Cost-effectiveness studies were conducted for alternative segment lengths in 1985 and 1990. Costs are extrapolated, based on constant 1975 dollars,and do not include the four percent Hawaii State excise tax; thus, figures in this analysis may not match in all cases implementation costs that appear in other analyses; however, relative findings within this study remain valid.

A summary of annual capital and operation/maintenance costs for the fixed guideway only is provided in Table III-17. As would be expected, longer guideway lengths -- and the resultant improved transit service -- would attract increasing numbers of patrons. At the same time, since longer guideways are more capital intensive and provide longer trips, the cost per ride would tend to be higher than for shorter guideways. Thus, cost per passenger-mile, rather than cost per ride, was a prime determinant of cost-effectiveness. An analysis of the relationship between projected service (as measured in passenger-miles) and fixed guideway total annual cost showed the 14-mile fixed guideway to be more cost-effective than shorter-length increments by 1985.

TABLE III-17

FIXED GUIDEWAY ONLY
TOTAL ANNUAL COST ANALYSIS

| | 1965 | | | | | 1990 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 7-Mi. | 8-Mi. | 10-Mi. | 12-Mi. | 14-Mi. | 7-Mi. | 8-Mi. | 10-Mi. | 12-Mi. | 14-Mi. |
| TOTAL ANNUAL COST* | | | | | | | | | | |
| Total Annual Capital Cost**(Million) | $27.96 | $29.36 | $31.94 | $32.53 | $36.48 | $30.30 | $31.52 | $34.47 | $34.97 | $38.74 |
| Total Annual O&M Cost (Million) | $ 9.39 | $ 9.90 | $10.55 | $11.37 | $12.53 | $10.08 | $10.63 | $11.41 | $12.41 | $13.74 |
| Total Annual Cost (Million) | $37.35 | $39.26 | $42.49 | $43.90 | $49.01 | $40.38 | $42.15 | $45.88 | $47.38 | $52.48 |
| Annual Patronage (Million) | 58.47 | 59.22 | 63.12 | 64.08 | 68.72 | 71.47 | 72.37 | 76.86 | 79.03 | 84.41 |
| Total Annual Cost/Ride | $0.639 | $0.663 | $0.673 | $0.685 | $0.713 | $0.565 | $0.582 | $0.597 | $0.600 | $0.622 |
| Average Trip Length (Mile) | 2.56 | 2.59 | 3.02 | 3.33 | 3.63 | 2.60 | 2.63 | 3.09 | 3.42 | 3.73 |
| Total Annual Cost/Pass. Mile | $0.250 | $0.256 | $0.223 | $0.206 | $0.196 | $0.217 | $0.221 | $0.193 | $0.175 | $0.167 |

*All costs in 1975 dollars.
**Annualized at 7% interest rate.

Tc tal annual cost analysis findings, taking into consideration both fixed guideway and feeder bus elements, also offer an indication of greater cost-effectiveness if the entire 14-mile system were to be the initial increment of construction, rather than the "core" seven-mile or other intermediate lengths. This owes largely to the fact that total annual cost per ride for combined bus/fixed guideway is lower with the 14-mile fixed guideway system by 1990 (Table III-18) although the difference between it and the "core" 7-mile length cost/ride is small -- $0.016.

TABLE III-18

TOTAL ANNUAL COST ANALYSIS

| | 1985 | | | | | 1990 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 7-Mi. | 8-Mi. | 10-Mi. | 12-Mi. | 14-Mi. | 7-Mi. | 8-Mi. | 10-Mi. | 12-Mi. | 14-Mi. |
| TOTAL ANNUAL COST* | | | | | | | | | | |
| Total Annual Capital Cost** (Million) | $27.96 | $29.36 | $31.94 | $32.53 | $36.48 | $30.30 | $31.52 | $34.47 | $34.97 | $38.74 |
| Total Annual O&M Cost (Million) | $34.69 | $34.05 | $33.75 | $32.01 | $31.07 | $42.38 | $41.39 | $41.03 | $38.83 | $37.48 |
| Total Annual Cost (Million) | $62.65 | $63.41 | $65.69 | $64.54 | $67.55 | $72.68 | $72.91 | $75.50 | $73.80 | $76.22 |
| Annual Patronage (Million) | 95.31 | 96.04 | 99.14 | 98.54 | 102.36 | 117.40 | 118.28 | 122.10 | 121.63 | 126.33 |
| Total Annual Cost/Ride | $0.657 | $0.660 | $0.663 | $0.655 | $0.660 | $0.619 | $0.616 | $0.618 | $0.607 | $0.603 |

*All costs in 1975 dollars.
**Annualized at 7% interest rate.

The analysis described in the paragraphs above took into account the costs of providing projected levels of service, measured in cost per passenger-miles and cost per ride. Also considered in the evaluation were the benefits accrued to both transit users and non-users by implementation of the various lengths (e.g., time savings, auto operating, parking and insurance savings, and reduction in traffic fatalities). All of the alternatives proved to have a benefit/cost ratio greater than 1.0 and can be considered to be sound economic investments. The 14-mile length was found to provide the highest benefit-cost ratio by 1990, as summarized in Table III-19, although the differences between the 8-, 10-, 12- and 14-mile lengths are very small.

TABLE III-19

BENEFIT-COST RATIO

| | 1985 | | | | | 1990 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 7-Mi. | 8-Mi. | 10-Mi. | 12-Mi. | 14-Mi. | 7-Mi. | 8-Mi. | 10-Mi. | 12-Mi. | 14-Mi. |
| BENEFIT/COST RATIO | 1.05 | 1.06 | 1.09 | 1.10 | 1.09 | 1.19 | 1.23 | 1.25 | 1.28 | 1.29 |

## E.3. Transportation Goals and Objectives

Alternative initial guideway lengths were evaluated in somewhat the same manner as alternative systems (Section III.B). The degrees to which alternative segment lengths would promote regional transportation objectives were the criteria. However, not all the evaluative factors previously considered were appropriate to this analysis. Pertinent factors are identified in Table III-20, which presents rankings for each of the five initial segment lengths, as well as certain key data. It bears repeating that this evaluation and rankings take into account only short-term impacts. If one considers that the 14-mile system will eventually be built, regardless of the length of initial construction, several of the rankings would shift to favor the 14-mile system over shorter lengths. Reasons for this, also noted in the explanations of individual objectives and associated evaluative factors, are the more severe impacts of postponed construction in view of the inevitable development that would occur between the time of initial construction and system expansion.

Objective 1 - Improved Service: Transit availability and coverage are essentially the same for all lengths. Travel time, service reliability, rider convenience, and rider comfort would all improve with increased length due to higher average speeds, better equipment and schedule reliability, fewer transfers, and greater comfort on the fixed guideway system (rather than on buses). Consequently, the longer systems better meet this objective.

Objective 2 - Balanced Transportation: To achieve balanced transportation objectives, greater transit usage must be obtained and system patronage increases with length due to the superiority of fixed guideway service over that of buses. The fixed guideway system has comparable capacity for all lengths.

Objective 3 - Minimal Expenditure of Resources: Land consumption and displacement of residents and businesses are proportional to system length. However, when a short system is eventually extended, ultimate impacts may be greater due to development occurring in the ensuing years. Differences among alternatives are relatively small and of short duration. Disruption of future development and the use of adjacent properties (Factor "e") would be affected by alternative terminal stations. The western terminus of the 7- and 10-mile segment at Keehi Lagoon requires the acquisition of additional industrial properties to accommodate feeder buses. The eight-mile segment would also have interface with buses at Keehi Lagoon in order to reduce the number of

TABLE III-20: ALTERNATIVE SEGMENT LENGTH EVALUATION MATRIX (1990)

| | 7-Mile | 8-Mile | 10-Mile | 12-Mile | 14-Mile |
|---|---|---|---|---|---|
| **OBJECTIVE 1** | | | | | |
| a. Availability & coverage | Same | Same | Same | Same | Same |
| b. Avg. trip time (min.) | 35.2 | 35.2 | 34.0 | 34.5 | 33.7 |
| c. Service reliability* | 5 | 4 | 3 | 2 | 1 |
| d. Rider convenience* | 5 | 4 | 3 | 2 | 1 |
| e. Rider comfort* | 5 | 4 | 3 | 2 | 1 |
| **OBJECTIVE 2** | | | | | |
| a. System patronage-Avg. weekday (thousand) | 388.7 | 391.7 | 404.3 | 402.6 | 418.2 |
| b. System capacity* | Same | Same | Same | Same | Same |
| **OBJECTIVE 3** | | | | | |
| a. Consumption of land (acres) | 21 | 21 | 22 | 21 | 22 |
| b. Displacement of residents (units) | 162 | 162 | 162 | 162 | 162 |
| c. Displacement of businesses (units) | 171 | 171 | 183 | 171 | 183 |
| d. Reduction of community amenities | Same | Same | Same | Same | Same |
| e. Disruption to future dvlpmt.* | 4 | 4 | 2 | 3 | 1 |
| f. Disruption to local circulation* | 4 | 4 | 2 | 3 | 1 |
| g. Disruption from constr. activities | 1 | 2 | 3 | 4 | 5 |
| h. Savings in energy (million gal/yr.) | 9.8 | 9.9 | 10.6 | 10.8 | 11.4 |
| i. Technical risk | Same | Same | Same | Same | Same |
| **OBJECTIVE 4** | | | | | |
| a. Support regional dvlpmt. | Same | Same | Same | Same | Same |
| b. Support comm. dvlpmt.* | 5 | 4 | 2 | 3 | 1 |
| **OBJECTIVE 5** | | | | | |
| a. Reduction Air pollution (tons/yr.) | 3,400 | 3,530 | 3,840 | 4,000 | 4,420 |
| b. Noise level* | 5 | 4 | 3 | 2 | 1 |
| c. Visual intrusion | Same | Same | Same | Same | Same |
| d. Vistas | Same | Same | Same | Same | Same |
| e. Historic sites | Same | Same | Same | Same | Same |
| **OBJECTIVE 6** | | | | | |
| a. Reduce accident exposure* | 5 | 4 | 3 | 2 | 1 |
| b. Security | Same | Same | Same | Same | Same |
| **OBJECTIVE 7** | | | | | |
| a. Total annual cost**- ($ Million) | 72.7 | 72.9 | 75.5 | 73.8 | 76.2 |
| b. Total Annual Cost Per Trip ($) | 0.619 | 0.616 | 0.618 | 0.607 | 0.603 |
| c. Benefit-cost ratio*** | 1.19 | 1.23 | 1.25 | 1.28 | 1.29 |

*For comparative measures, alternatives are ranked in the order of how well they met the objective.

**All costs based on constant 1975 dollars and interest rate of 7%.

***Based on constant 1975 dollars.

buses at the Airport terminus. The acquisition of additional industrial property for terminal facilities does not conflict significantly with the area's future development potential; nevertheless, the Halawa terminal used by the 12- and 14-mile systems avoids the problem completely. Significant impacts would be felt at the University, the eastern terminus of the 7-, 8-, and 12-mile segments. The station, proposed to occupy a site near the campus' southern boundary in an area presently used for automobile parking, is master planned for an athletic field. Station and guideway structures can be accommodated without seriously impairing the planned development, but expansion of the station for bus facilities would have serious impact on the site's development potential. Consequently, only express buses would have interface with this terminal; local buses would be routed to the next station at Date Street, entailing longer transit times for patrons and increased impacts in the vicinity of the Date Street Station.

Disruption of local circulation (Factor "f") as an element of comparison is affected by the location of the terminal station, since all guideway alignment and configurations utilized are identical for each alternate. Shorter segments required that local and express buses travel greater distances to interface with the guideway, generally in areas of greater congestion. Therefore, the longer systems better meet this objective than shorter systems relative to impact of buses on local circulation. Similarly, the longer 12- or 14-mile segment lengths, both using Aloha Stadium as a western terminus, would produce less auto traffic impact at both the Airport and Keehi Lagoon (western terminus for the 7-, 8-, and 10-mile segments, respectively).

The constraints at the eastern terminus (University Station) for the 7-, 8-, and 12-mile lengths have been previously described with regard to disruption of future campus development and limitations on bus access and interface facilities. These constraints would shift the local circulation interaction to the Date Street Station where a doubling of the local bus activity and increases in kiss/ride demand could severely impact the traffic service capabilities of the surrounding streets. The Kahala terminus for the 10- and 14-mile segments would also entail some impact on local circulation as the result of the express bus use of the surface street and the freeway ramps for off-peak direction of travel to or from Hawaii Kai. However, the longer guideway length would reduce the number of local buses interfacing at the Date Street Station from outlying service areas as the result of the three additional stations.

Disruption by construction activity (Factor "g") is smaller for shorter systems. Energy savings (Factor "h") are best achieved by the 14-mile system and are progressively smaller with diminishing system length. Technical risk (Factor "i") would be identical for all alternative lengths.

Objective 4 - Conformance with Land Use Policies: The Honolulu General Plan, adopted in 1977, calls for a transportation system on Oahu that would "enable people and goods to move safely, efficiently, and at a reasonable cost." To achieve this, the role of public transportation is that of providing "travel to and from work, and travel within Central Honolulu." A mass transit and feeder bus system was suggested for the corridor between Pearl City and Hawaii Kai, supplemented by limited highway improvements. Within this broad planning framework, mass transit systems that cover a greater portion of this Pearl City-to-Hawaii Kai corridor can be seen as better meeting adopted regional planning policies for Central Honolulu.

When considering the effects on communities of alternative segment lengths for initial construction, rapid transit terminal stations are most likely to have development impact (described in greater detail in Section V.B.4). However, the cases in which such new development would be most likely to occur are those in which terminals are placed in areas that are "ripe" for redevelopment (i.e., a decaying downtown or commercial center). In such cases, the extension of a transit system to an area in need of increased business and investment activity could be seen as having positive community development implications. This is not the case in Honolulu. The alternative western terminal sites -- the Aloha Stadium, Airport, and Keehi Lagoon Stations -- are all by and large zoned for development that would tend to evolve irrespective of transit: military, airport-related, or industrial land use. The selection of any of these sites would not be expected to produce measurable impacts in the intensity or type of land use.

The situation on the eastern end of the line is similar. The area around the University of Hawaii is presently used for medium-density housing. Making new large-scale development a remote possibility is the station site's difficult access, necessitating travel on small, generally dead-end streets. The vicinity of the Kahala terminus, on the other hand, is now intensely used for a variety of purposes: a large, regional shopping center, high- and medium-density housing, educational and recreational facilities, and a cemetery. The area is economically sound and indications are that this situation would continue with or without the presence of a transit terminal, at least in the foreseeable future.

The Kaimuki area is also well established, lying between the alternative University and Kahala eastern terminal sites. Conceivably, extension of the eastern end of the transit system to Kahala could have some development impact on the Kaimuki area. Development in the vicinity of the Sixth Avenue Station is largely residential, with only occasional parcels devoted to semi-public, church, and school uses -- all low-density and neighborhood-oriented. The Koko Head Station vicinity features similar uses south (makai) of the H-1 Freeway. The north (mauka) side of the freeway hosts a mixture of land uses, including commercial functions (the Kaimuki business district). It is likely that the foreseeable development impacts of a nearby guideway system station would be primarily reflected in these commercial areas.

A detailed station impact study has been conducted in close coordination with the preparation of the Development Plans which is scheduled for completion in 1980-81. The study analyzed the potential of various station areas for compatible developments.

<u>Objective 5 - Preserve the Environment</u>: Reduction in levels of air pollution and noise would be achieved more by longer than shorter guideway lengths, as buses and cars would be replaced by quieter, non-polluting, electrically-propelled vehicles. Differences in visual intrusion and disruption of vistas would be relatively insignificant, due to types of adjacent development and the location of the guideway increments in existing freeway rights-of-way. Historic sites are not affected by system length.

<u>Objective 6 - Safety and Security</u>: Reduction in accident exposure varies in proportion to system length, as exclusive, grade-separated routes offer a wide safety margin over mixed traffic operations. Security would not be affected by system length.

<u>Objective 7 - Economy</u>: Economic factors and relative levels of cost-effectiveness were the subject of the previous section.

## E.4. Summary of Alternative Lengths Evaluation

As indicated in Table III-20, the evaluations show that all alternative lengths are economically feasible, with benefit/cost ratios ranging from 1.06 to 1.10 for 1985 and from 1.19 to 1.29 for 1990. Although the cost-effectiveness of the alternative lengths was found to be generally better with the shorter lengths for 1985 but improved with increasing length by 1990, it should be noted that the differences between the 8-mile and the 14-mile segments are small, 0.03 in 1985 and 0.06 in 1990. The increasing cost effectiveness is due to the greater attractiveness of fixed guideway service over that of buses and the increased efficiency of fixed guideway system at higher volumes.

The major differences between the various system lengths appears in terminal locations. On the western end, the terminal location at Aloha Stadium would provide better bus interface capabilities than at the Keehi Lagoon terminal and also would have available the use of the existing stadium park-and-ride facility. At the eastern end, terminals could be located at either University or Kahala. Adequate bus interface facilities can be provided at Kahala for both express and feeder buses.

The University terminal location has limited bus interface space, which will necessitate the diversion of local feeder buses to the Date Street Station with express buses terminating at the University Station.

Other differences between the alternative system lengths, other than total capital and operating costs, are relatively small.

Aside from the fact that all alternative lengths being considered for a fixed guideway system are economically feasible, other factors have been considered in reaching a decision on system length. At this time, an 8-mile system with terminals at Honolulu International Airport and the University, nine intermediate stations and a supporting feeder bus system has been selected. The primary considerations in this selection were:

- Costs: Total capital costs for the 8-mile system would be nearly $250 million, less than that for the 14-mile system, assuming start of construction is early 1983.

- Community Objections: There has been strong community objection to the terminus of a longer system in the Kahala neighborhood, due to impact on local street systems and competition between transit patrons and shoppers for existing parking spaces in the Kahala shopping district.

- Right-of-Way Agreements: In order to construct a 14-mile system with a western terminal at Halawa and an eastern terminal at Kahala, agreement must be reached between the State and the City for co-location of transit and vehicular facilities in the H-1 corridor between Halawa and the Airport and between the University and Kahala. To date, such agreement has not been reached, necessitating a western terminal at the Airport, and the eastern terminal at the University.

- Transportation Needs: Provide needed additional transportation capacity to the congested urban core of Honolulu, as a minimum, between Middle Street and Kapiolani Interchange.

- Service: Service to a major activity center such as the Honolulu International Airport by a transportation facility is vital to the community.

## F. ALTERNATIVE VEHICLE SYSTEM TYPES

The 7- to 14-mile fixed guideway system comprises approximately 1.7 miles of subway or underground construction with the remainder to be above ground, either in aerial structure or at-grade configuration. Much of the alignment will traverse areas extremely sensitive to noise and visual intrusion.

In utilizing above ground configurations, choices in horizontal alignments are quite limited including radii of curves in order to minimize right-of-way acquisition and dislocation of residents and businesses. Also, the proposed vertical alignments or gradients matching the route topography are somewhat more severe than 3-4 percent normally found in most rapid transit systems. Maximum sustained grades of 5 percent and short segment grades of up to 8 percent will be encountered in the system.

The relatively short system length combined with short average station spacing and trip length will influence the type and operation of the vehicle system to be selected for Honolulu. Additionally, cost considerations and the island's tropical climate influenced the selection of a predominantly above-ground guideway configuration which will place greater importance on environmental impacts from system operation. Two types of transit cars are under consideration for Honolulu, the conventional heavy rail vehicle system and the rubber-tired vehicle system.[19]

### F.1. Vehicle System Types

A rapid transit system with the guideway located in its own exclusive rights-of-way and entirely grade-separated demands a high performance vehicle system with a high degree of operating safety and reliability. The most common type of vehicle system providing this level of service uses steel-wheeled vehicles referred to as the conventional heavy rail vehicle system. Two of the newest rapid transit systems in the U.S., the Atlanta (MARTA) and Washington, D.C. (WMATA) systems, utilize the most modern version of the conventional heavy rail system with a high degree of automation. The heavy rail system, as the name implies, utilizes flanged steel wheels which support and guide the vehicle on steel rail tracks. The high speed vehicle operates under either manual or automatic control.

Some of the newer rapid transit systems including those operating in Montreal, Mexico City, and Sapporo (Japan), utilize rubber-tired vehicles. This type of vehicle runs on a concrete roadway which is usually treated with a special running surface to obtain smooth riding quality. The vehicles employ small rubber-tired guide wheels mounted horizontally on each bogie frame to engage the guide rail located in the center or on each side of the roadway.

## F.2. Physical and Performance Characteristics

### a. Dimensions and Weight

Recent trends toward larger vehicles for new rapid transit systems and the emphasis for standardization of transit cars have resulted in 75-ft. length as the most common size for conventional heavy rail vehicles in the U.S. Rubber-tired vehicles do not have a commonly recognized standard dimension other than the fact that weight restriction due to tire loading precludes car sizes comparable to the heavy rail systems. Although the steel-wheeled vehicle is heavier in terms of total weight, the unit weight per linear foot of car length or square foot of floor area is approximately the same for both vehicles studied.

For comparing the types of vehicles, the most modern and efficient system of each type was selected, namely the WMATA cars for the steel-wheeled system and the Sapporo cars for the rubber-tired system.

| | WMATA (Steel Wheel) | Sapporo (Rubber Wheel) |
|---|---|---|
| Length | 75' - 0" | 59' - 0" |
| Width | 10' - 2" | 10' - 1" |
| Height | 10' - 10" | 12' - 10" |
| Weight | 72,500# | 59,000# |
| WGT/LF | 970# | 1,000# |
| WGT/SF | 95# | 99# |

### b. Guidance and Switching

The principal difference between the two vehicle types is in the support and guidance of the vehicle. As previously stated, conventional heavy rail vehicles utilize flanged steel wheels running on steel rails for both support and guidance. Unlike the steel-wheeled vehicle system, the use of rubber-tired vehicles for rapid transit systems is relatively new and in service only in foreign countries.

Another key factor associated with the rubber-tired system is its switching device. Because rubber-tired vehicles are more difficult to switch, the switching device is necessarily larger and more cumbersome to operate than the steel-wheeled switching device. Consequently the rubber-tired vehicle switches use large switching angles with small radii curves which reduce the train operating speed through the switch, and consequently the operating time by up to five seconds.

c. Wheel Adhesion

High performance in vehicle systems entail rapid acceleration and deceleration combined with high speed capability which can only be attained with proper wheel adhesion. The difference in adhesion values between the two types of wheel is the key feature which distinguishes the design and performance characteristics of each vehicle system.

Basically, a rubber-wheel system has higher adhesion values and can travel along a vertical grade at a higher speed than a steel-wheel system. In order to minimize the visual and structural barrier of the transition from the elevated or at-grade guideway to the underground segment of the proposed system, vertical gradient will be as much as 8 percent compared to the usual 3 or 4 percent gradient utilized in most rapid transit systems. Although either rubber- or steel-wheeled vehicles can negotiate the gradient proposed, the steel-wheeled vehicles may have to operate at a lower speed on this portion of the system.

d. Maximum Operating Speeds

Modern steel-wheeled rapid transit vehicles operate at maximum speeds of 70-75 mph where station spacing is more than one mile. With station spacing of between one-half to three-quarter miles maximum operating speed would be between 50-60 mph. Steel-wheeled vehicles with appropriately sized propulsion motors can attain maximum desired operating speeds for optimum high performance rapid transit service.

Rubber-tired vehicles are normally operated at lower speeds of up to 50 mph depending on station spacing. Tire loading restrictions limit both weight and speed of the vehicle and therefore, rubber-tired vehicles are used where high speeds are not required due to close station spacing.

## F.3. Safety and Environmental Features

a. Safety Considerations

Most modern rapid transit systems are provided with an automatic train protection system to maintain safe separation distance between trains and protect against over-speed in areas where speed restrictions exist. Both steel-wheeled and rubber-tired systems are currently employing modern automatic train protection systems with equal results. The application of automatic train protection techniques to achieve maximum safety operation is not affected by the type of wheels used on the vehicle.

b. Noise and Vibration

The noise from a steel-wheeled vehicle system is primarily caused by the wheel rolling on the rail, with loudness being a function of speed and condition of the wheel and rail contact surfaces. A well maintained system where wheels are ground to remove flat spots and rails are ground when they become rough has a wayside noise level only slightly higher than that of a rubber-tired system. If the steel-wheeled system is not properly maintained, the wayside noise level can rise dramatically and be highly disruptive to a noise sensitive community.

The rubber-tired vehicle noise is predominantly from the rolling of the wheels on the roadway. The rolling noise level loudness is a function of vehicle speed, type of tire, and roughness of the roadway surface. Assuming an average condition for tires and roadway surface, the noise level from rubber-tired vehicles is estimated to be 3-4 dBA less than the steel-wheeled vehicle at comparable speeds. If low noise tires are used on smooth roadway surface, the wayside level could be substantially less than from a steel-wheeled system not properly maintained.

Perhaps the most annoying type of rail noise is the wheel squeal as the vehicle goes around a sharp curve. A vehicle with conventional steel wheels is known to squeal when the curve is less than 500-700 ft. radius. With the use of resilient (rubber dampened) wheels, the wheel squeal will occur only if the curve is less than 200-250 ft. radius. Wheel squeals can be virtually eliminated by using curve radii larger than the above for the two types of wheels. The only squeal that will remain is when the car is going through a switch which has a relatively small radius curve.

F.4. Cost Comparison

The cost of the two vehicle types are quite comparable depending on the train length selected for the system. Since the car lengths are different, 75 ft. for the steel-wheeled vehicle and 59 ft. for the rubber-tired vehicle, a 6-car steel-wheeled train of 450-ft. length would be nearly equivalent to an eight-car rubber-tired train of 472-ft. length.

Depending on the maximum design volume required for the system, either a seven-car or eight-car rubber-tired train and a six-car steel-wheeled train would be capable of providing the necessary capacity. In terms of total present worth capital and operating costs, a seven-car rubber-tired system is approximately equal to a six-car steel-wheeled system, but an eight-car rubber-tired system is slightly greater. In short, the steel-wheeled system may generally be considered as being slightly less costly than the rubber-tired system on an equivalent basis due to less energy consumption and less cost to procure and maintain fewer number of cars.

## F.5. Summary of Findings and Conclusions

As shown in the comparison matrix below, overall the two systems are quite similar. However, because of the greater ease in obtaining the steel-wheeled vehicles since they are domestically manufactured and because of somewhat lower costs and greater energy savings, the steel-wheeled vehicle has been selected for the rapid transit system.

### COMPARISON MATRIX

| | Steel | Rubber |
|---|---|---|
| Cost | Better | --- |
| Service Availability | Same | Same |
| Schedule Dependability | --- | Better |
| Safety (derailment) | --- | Better |
| Noise Impact | --- | Better |
| Social Impact | Same | Same |
| Energy Conservation Policy | Better | --- |
| Vehicle Procurement (potential bidding competition) | Better | --- |
| Program Scheduling | Better | --- |

## IV. DESCRIPTION OF THE PROPOSED ACTION

Based on analyses of various alternatives summarized in Chapter III, the proposed transit system is an integrated fixed guideway/feeder bus system, using conventional rail technology, with an initial construction length of 8.4 miles. The system's proposed alignment and station locations have also been identified with community input playing a vital role in the evaluation and selection process. The proposed guideway location and station locations for the entire initial system length has been determined and described below.

### A. GENERAL DESCRIPTION OF THE PROPOSED TRANSIT SYSTEM

#### A.1. Integrated Fixed Guideway/Feeder Bus Concept

The proposed rapid transit system consists of an integrated fixed guideway/feeder bus network with initial development of the fixed guideway of 8.4 miles running between the Honolulu International Airport and the University of Hawaii. The proposed fixed guideway system would provide high-capacity service along the most heavily traveled corridor in Central Honolulu, where existing transportation capacity is limited and automobile traffic is becoming increasingly more congested each year.

Central to the effective operation of the fixed guideway is an islandwide feeder bus service. Bus service is currently provided to virtually all of Oahu. Implementation of the fixed guideway system would improve transit service to areas well beyond its termini as buses normally assigned to inner city service, along the transit corridor, can be reassigned to expand service coverage or provide more frequent service on other existing routes. In addition, that portion of each transit trip made by guideway could reduce travel time significantly from that provided by the existing bus system.

#### A.2. Fixed Guideway Rapid Transit Component

The fixed guideway system entails 11 stations. The route along which these stations, as proposed, is illustrated in Figure IV-1. The following discussion offers a general description of the proposed route.

The fixed guideway will be routed in subway, and aerial configurations through a travel corridor which connects the

# Fixed Guideway System

**RAPID TRANSIT STATIONS**

1. Airport
2. Keehi Lagoon
3. Kalihi
4. Iwilei
5. Fort Street
6. Civic Center
7. Ward Avenue
8. Ala Moana
9. Waikiki
10. Date Street
11. University

LEGEND

- 1● STATIONS
- AERIAL
- UNDERGROUND

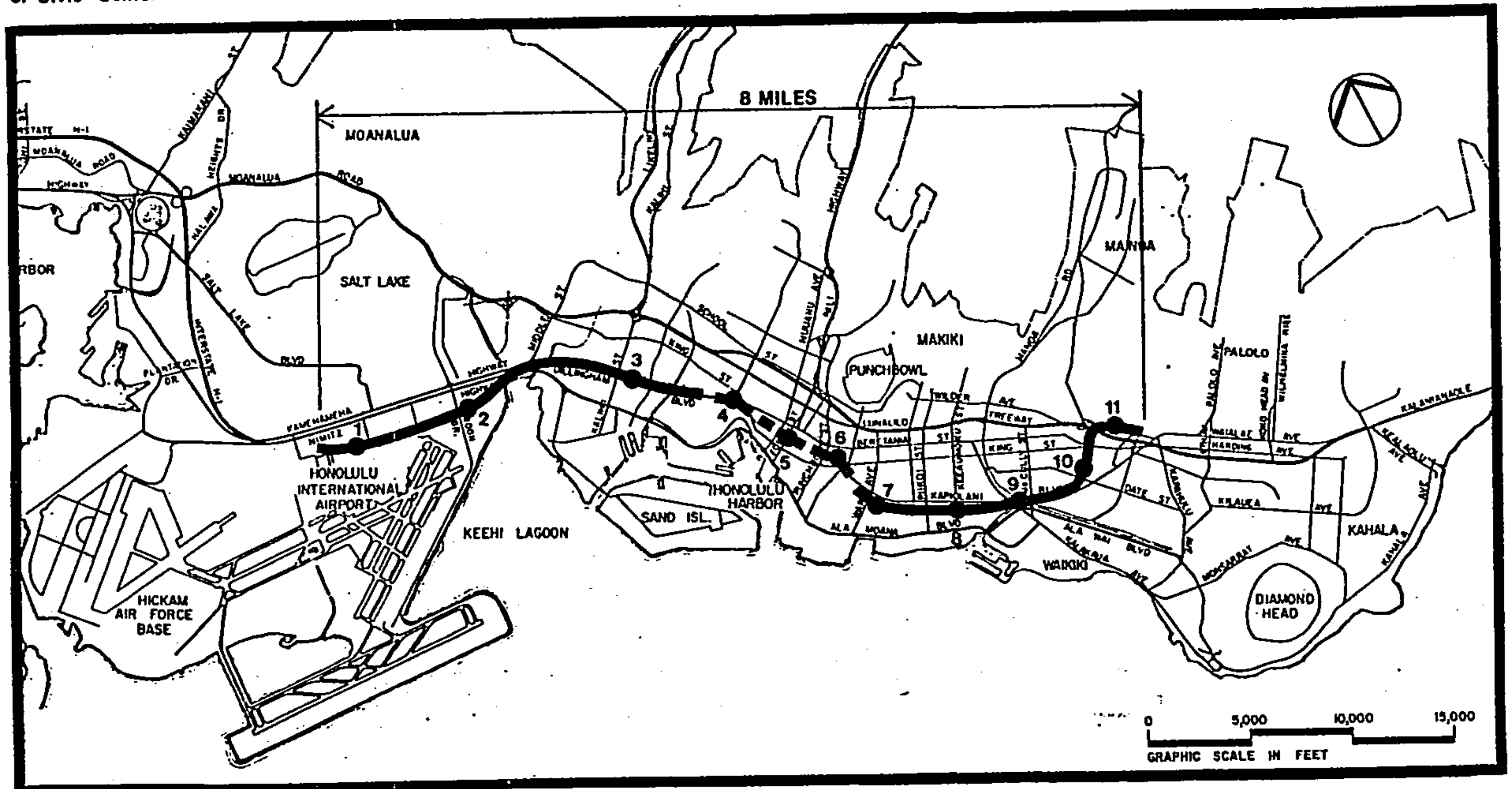



FIGURE IV-1

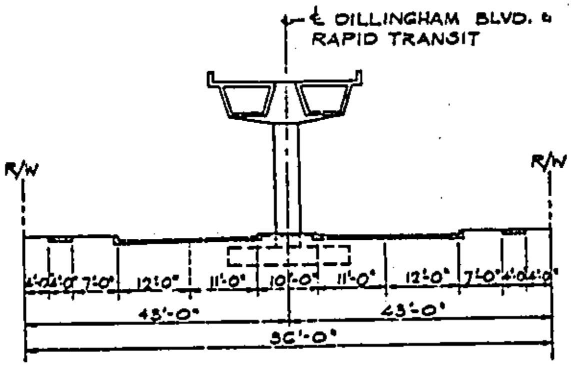
major activity centers of Honolulu. Beginning at the Honolulu International Airport (although the actual western terminal of the system would be at Keehi Lagoon) where crossovers will be provided to turn back trains, the route extends through the airport area and follows Aolele Street, lying between the airport and the industrial developments to the north, in an aerial configuration to Keehi Lagoon Drive. The area traversed is in commercial (such as automobile dealership) and light industrial uses. The route then follows the northern boundary of Keehi Lagoon Park and crosses Nimitz Highway, near Middle Street, to Dillingham Boulevard.

The route follows Dillingham Boulevard, through the Kalihi area with its mixed residential, commercial, and industrial uses, with the aerial guideway structures located in the street right-of-way (see Figure IV-2). West of the intersection of Dillingham Boulevard and King Street, the guideway changes from an aerial to an underground configuration. Through the CBD and the Civic Center, the guideway is underground below Hotel Street, which is planned for conversion to a pedestrian mall (see Figure IV-2). The route in underground configuration, enters Kapiolani Boulevard, passes Cooke Street, and proceeds in a southeasterly direction, changing to an aerial configuration west of Ward Avenue near Waimanu Street.

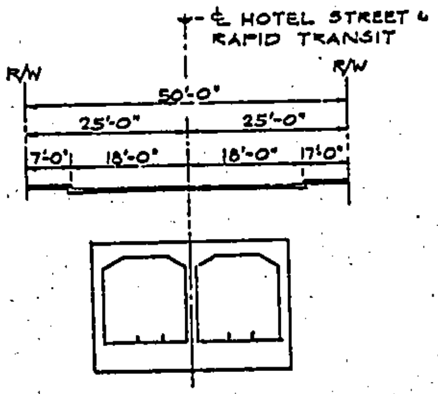
Through the Kakaako area, which is in predominantly light industrial use, the route crosses Ward Avenue in an aerial configuration, follows Waimanu Street, enters and follows Kona Street, and then proceeds to Kalakaua Avenue. East of Kalakaua Avenue, the route crosses over McCully Street and enters Kapiolani Boulevard to University Avenue, traversing a high density apartment area. It proceeds north on University Avenue, crosses over the H-1 Freeway, and then proceeds east along the southern boundary of the University of Hawaii-Manoa Campus to Old Waialae Road, terminating at this location with tail tracks and cross-over provided for turning back trains.

Additionally, a bi-directional exclusive use busway utilizing the future guideway structure would be developed to facilitate express bus movements between the University Station interface area and the H-1 (Lunalilo) Freeway median. On reaching the freeway grade-level, the busway would be transitioned to or from the existing freeway lanes and would result in bus operations merging into and operating with the freeway traffic over a portion of the H-1 Freeway.

The 8-mile fixed guideway system includes 11 stations, with terminal stations at Keehi Lagoon and the University. This provides for an average station spacing of less than one mile which allows an average system speed of approximately




KALIHI/PALAMA SEGMENT




CBD/CIVIC CENTER SEGMENT

# TYPICAL SECTIONS

FIGURE IV-2

30 mph. In the central core area, stations are spaced at smaller intervals to facilitate convenient foot access to major destination areas. The plan and profile drawings, Figures IV-5 through IV-8 placed at the end of this section, illustrate the general route alignment of the proposed system.

Park-and-ride facilities may be made available near the Keehi Lagoon Station if suitable siting can be arranged. In addition, most other stations are to provide limited kiss-and-ride (drop-off and pick-up) provisions corresponding to anticipated modes of access and station volumes. Bicycle storage facilities are also planned to be provided at stations. Stations are to be located at the following sites (starting from the system's western end) and are illustrated by accompanying site plans (Figures IV-9 through IV-19 placed at end of this section).

1. Airport
2. Keehi Lagoon (serving the Salt Lake residential area and nearby industrial areas)
3. Kalihi (serving adjacent residential, industrial, and commercial areas)
4. Iwilei (serving housing areas north of King Street, Honolulu Community College, and an industrial area to the south)
5. Fort Street (in the heart of the CBD, anticipated to be the most heavily-used station in the system)
6. Civic Center (providing access to City, State, and Federal agencies and nearby industrial and commercial areas)
7. Ward Avenue (serving Blaisdell Memorial Center, Kakaako industrial and commercial areas, and Kapiolani Community College)
8. Ala Moana (integrated with the existing Ala Moana Shopping Center parking lot, providing immediate access to Oahu's largest regional shopping center and serving nearby Kapiolani business and residential districts)
9. Waikiki (providing interface with buses and taxis serving the Oahu resort and entertainment center and surrounding residential areas)
10. Date Street (serving the growing high-density residential population of Moiliili)

11. University (providing direct access to the University of Hawaii and nearby residential and commercial districts)

Each station has been sited in relationship to traffic patterns, the physical character of the area, and convenient bus interface. In addition, all stations will include provisions for the elderly and handicapped. The Iwilei and Waikiki Stations will incorporate pedestrian overpasses over King Street and Kalakaua Avenue, respectively, to avoid conflict between transit patrons and street traffic.

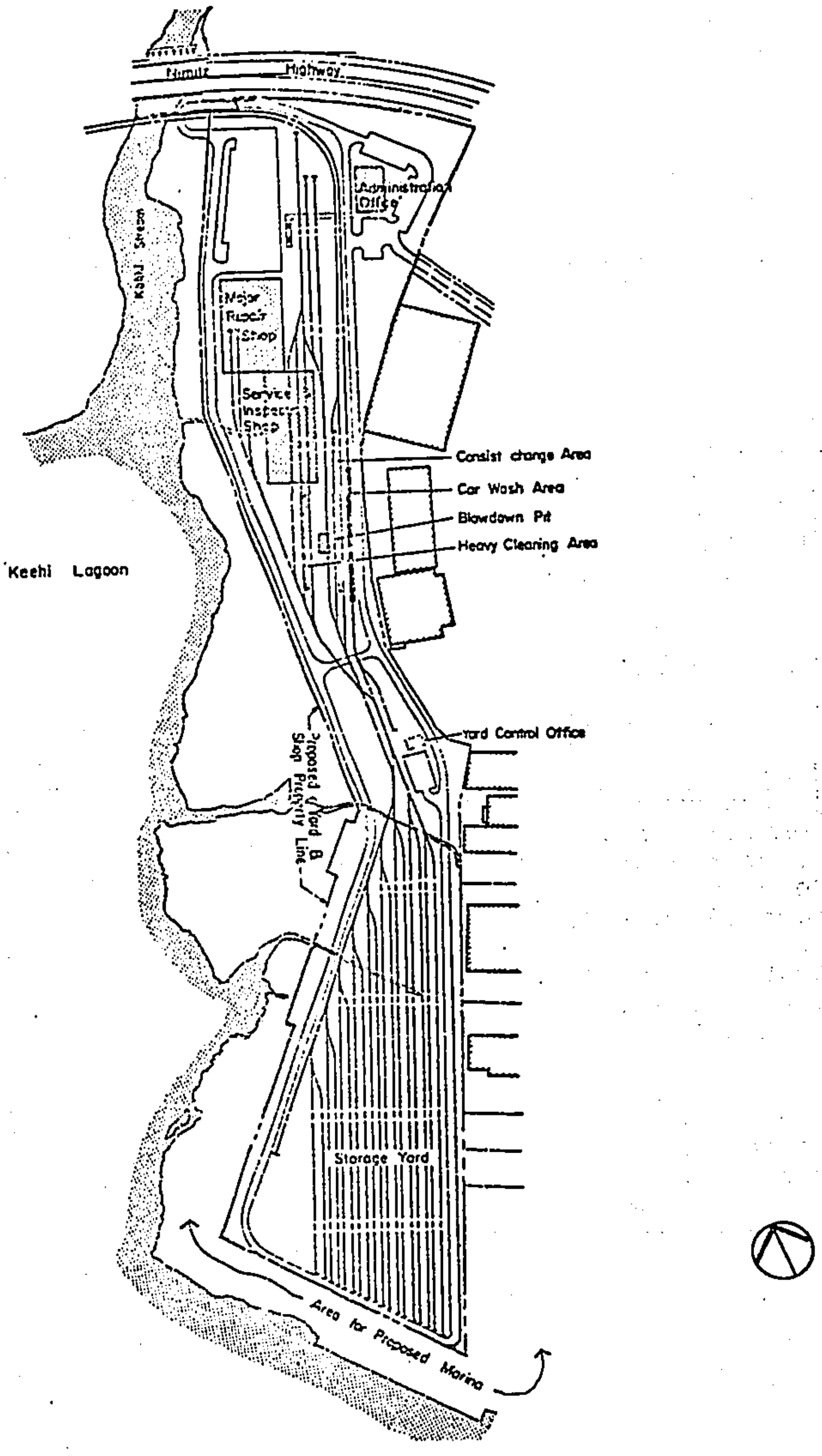
Yard and shops are to occupy a 30-acre site adjacent to the guideway at the mouth of Kalihi Stream, on the eastern shore of Keehi Lagoon. Facilities will offer complete vehicle repair, service, and inspection capabilities, as well as the ability to accommodate the number of vehicles required to meet 1995 projected patronage. The site will contain transfer tracks, storage tracks, office building, service and inspection building, major repair building, and ancillary facilities. A preliminary scheme for yard and shops layout is provided in Figure IV-3.

The vehicles, guideway and stations are designed to minimize visual intrusion, noise, vibration, and air pollution. The 75-foot steel-wheeled fixed guideway vehicle was selected for the rapid transit system and will be electrically-propelled and operated under a proven automatic train protection system. Vehicles can carry from 72 to 180 passengers per car, are trainable, and can operate at speeds of 50 miles per hour or more. They can operate safely and reliably at a minimum headway of two minutes or less, depending on station dwell time, with the use of an automatic train protection system.

Vehicles, stations, yard and shops, and central control will be interconnected with a voice communication system consisting of telephone, two-way radio, and public address systems. A closed-circuit television system will monitor station activities that are outside the station agent's immediate view. An automatic fare collection system will be used to gain access to the transit system. Power will be purchased from the Hawaiian Electric Company, Inc., converted to D.C. (direct current) power and supplied to the vehicles by means of a third rail at 600 volts D.C. or greater.

## A.3. Feeder Bus Component

A feeder bus system consisting of express, local, and shuttle buses will be provided to carry people both to and from the guideway stations and to provide public transportation




Yard and Shops Layout Scheme

FIGURE IV-3

in areas not served directly by the fixed guideway system. Interface with the guideway system will be facilitated by off-street bus parking at many stations. Adequate provisions will be made for bus queuing and safe merging with street traffic. The feeder bus network for the 8-mile fixed guideway system is illustrated in Figure IV-4.

A network of 77 bus routes operating over more than 700 route miles was designed to accommodate the estimated number of bus passengers. Of these routes, 60 are local or shuttle routes and the remaining 17 are express routes. The development of bus networks took into account anticipated passenger volumes, differences between peak-hour and off-peak requirements, average vehicle speed (depending on type of service), and load factors (which also vary with type of service).

Based on the City's Short-Range Bus Plan Update, June 1979, which includes construction of new maintenance and storage facilities, 84 new buses will be procured to bring the existing fleet up to 400 buses by mid-1980. All short-range improvements are being implemented to be compatible with the long-range fixed guideway plan.

## A.4. Transit Patronage

Based on the modal split model computer runs made as part of this program, the total daily patronage in 1995 for the 8-mile rail system, including the feeder buses, was projected to be nearly 460,000 passengers or 13[illegible] million passengers per year.[18] This ridership volume is the result of using the official State Department of Planning and Economic Development (DPED) population and employment forecasts adopted in 1971 by the State and City for all long-range transportation planning on Oahu. More recently, the State DPED developed the Series II-F forecasts which lowered the total population from 924,000 to 886,000 and employment from 515,000 to 472,000 for the year 1995.

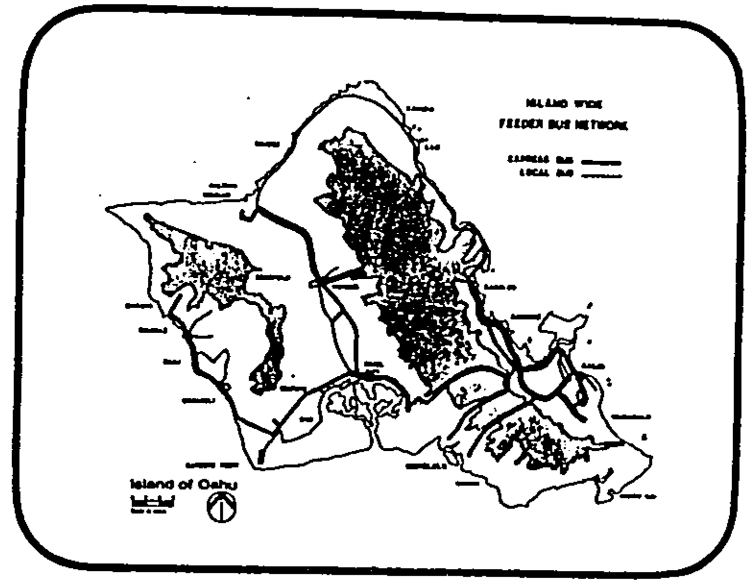
In 1978, the Oahu Metropolitan Planning Organization (OMPO) adopted the Series II-F forecasts for all long-range transportation planning on Oahu. For the past several years, the City Department of General Planning has been in the process of preparing the detailed Development Plans (DPs) which would serve as the basis for determining population and employment distributions. In November 1981, the DPs for the Primary Urban Center and Ewa areas were officially adopted. The other six DPs were vetoed by the Mayor and are presently being revised. Until all of the DPs are adopted, the official distribution of population and employment cannot be developed which is required as input to the travel forecast models. Consequently, new computer runs based on these new developments cannot be made to update transit ridership estimates at this time.

# Urban Feeder Bus Network Map

FEEDER BUS
EXPRESS BUS

RAPID TRANSIT STATIONS

1. Airport
2. Keehi Lagoon
3. Kalihi
4. Iwilei
5. Fort Street
6. Civic Center
7. Ward Avenue
8. Ala Moana
9. Waikiki
10. Date Street
11. University



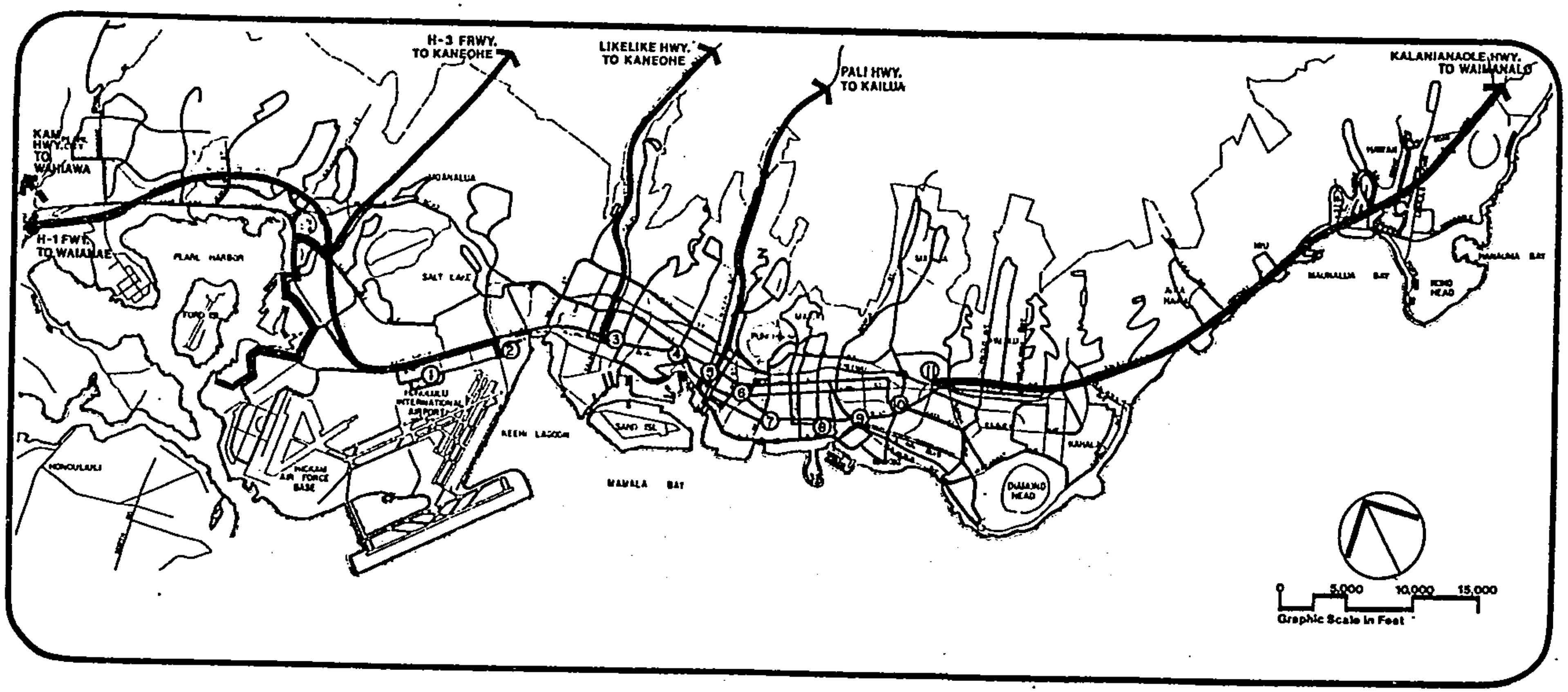




FIGURE IV

Due to the fact that total population and employment forecasts have been reduced by 4 percent for population and 9 percent for employment from the previous forecasts, an analysis of the impact of these reductions was conducted. It was found that the patronage could reduce by approximately 7 percent for the 1990 volume and 11 percent for the 1995 volume. Thus the revised 1990 and 1995 daily ridership volumes are estimated to be 360,000 and 413,000, respectively.

Despite many years of research, transportation demand modeling remains more of an art than a science. Even though acceptable techniques are used in the transportation planning process, it is still possible to project ridership levels with substantial variances. Difficulties in making any long-term forecasting is well known, especially since people's values, attitudes and behavior do not remain constant over time. Consequently, the above ridership estimates should be viewed as the most probable volumes to be expected with a potential for ten to fifteen percent (±10-15%) variation. Therefore, in the financial study[20] conducted for the program, the above revised volumes were reduced to 310,000 and 368,000 for 1990 and 1995, respectively, to reflect a conservative approach in making financial forecasts. It should, however, be pointed out that if fuel shortage and consequent increase in gas prices should occur, ridership could far exceed the revised volumes given in the previous paragraph.

## A.5. System Operations

The fixed guideway system is anticipated to eventually be operated up to 20 hours per day, from 5:00 a.m. to 1:00 a.m., seven days a week. There should be a sufficient number of seats for all passengers in off-peak periods; peak-period service is planned to meet demand volumes with all seats filled, plus a substantial number of standees -- less than a "crush" load situation.

Headways in early years of operation are planned to be as low as three minutes during peak periods and six minutes or more during off-peak periods. As demand increases, headways can be reduced to two minutes during peak periods. In periods of low demand, train consists will be reduced accordingly, with minimum consists of two cars.

The number of transit cars required will depend on the size of the vehicles finally selected. To meet the projected 1990 demand, the 8-mile guideway system would require approximately 84 75-foot vehicles. In 1995, approximately 105 75-foot vehicles would be required. To support the 8-mile guideway system, some 600 feeder buses would be required in 1990 and increasing to over 700 buses by 1995.

## A.6. Capital and Operating and Maintenance Cost Estimates

### a. Capital Cost Estimate

Costs for the selected 8-mile system are shown in Table IV-1. It is estimated that the total project will take up to six years of which some five years will be in actual construction. With wages and prices increasing annually due to inflation, cost projections are developed to reflect a specific project start date and an assumed rate of inflation. Similarly, the operating and maintenance (O&M) costs are developed for specific years to reflect varying ridership volumes and also cost escalation.

The preliminary cost estimates shown in Table IV-1 are escalated costs based on assumed start of construction in early 1983 and an escalation rate of 8 percent per year. With the construction of the project estimated to take approximately six years including final testing and check-out, revenue service is expected to begin in 1989.

In the capital costs are included construction of facilities, equipment procurement, administration and engineering, rights-of-way and relocation, City expenses, contingency allowance, and State excise tax. Purchase of feeder buses are not included since the number required should nearly match the existing bus fleet at the beginning of revenue service.

The preliminary capital cost estimate for the 8-mile guideway system is $870 million based on the above-mentioned construction start date and escalation rate. It should be pointed out that the cost of any long-term construction project is susceptible to change due to delays or change in inflation rate. For example, a one-year delay in construction start could increase the cost by over $70 million.

### b. Operating and Maintenance Cost and Revenue Estimates

The annual operating and maintenance cost for the 8-mile fixed guideway system and the supporting feeder buses is estimated at over $70 million in 1980 dollars. This amount is based on the system carrying some 110 million riders which is projected to occur in 1990. For purposes of comparison, the current (FY 80) City bus operation is projected to cost some $35 million with a fleet of 350 buses carrying in excess of 57 million passengers.

TABLE IV-1

PRELIMINARY CAPITAL COST ESTIMATE
(dollars in million)

| | Escalated Dollar* |
|---|---|
| CONSTRUCTION | |
| Guideway | 239.6 |
| Stations | 131.1 |
| Yard and Shop | 19.7 |
| Subtotal | 390.4 |
| EQUIPMENT AND PROCUREMENT | |
| Control and Communications | 42.9 |
| Traction Power | 34.6 |
| Vehicle | 105.9 |
| Subtotal | 183.4 |
| ADMINISTRATION AND ENGINEERING | |
| Design | 38.7 |
| Construction | 35.9 |
| Subtotal | 74.6 |
| RIGHT-OF-WAY AND RELOCATION | 104.2 |
| CITY EXPENSES | |
| Administration | 8.5 |
| Pre-Operating Cost | 14.9 |
| Subtotal | 23.4 |
| PROGRAM RESERVE (contingency) | 64.8 |
| STATE TAX | 28.5 |
| GRAND TOTAL | 869.3 |

*Costs escalated at 8 percent per year based on assumed start of construction in early 1983.

Table IV-2 shows the O&M costs in 1980 dollars for the 8-mile fixed guideway system and its required feeder buses. Also shown are the projected revenues at current fare structure and the anticipated deficit. Both the O&M cost and revenue estimates are based on the revised transit ridership volumes of 360,000 and 413,000 for 1990 and 1995 respectively previously given in Section A.4.

TABLE IV-2

ANNUAL OPERATING & MAINTENANCE COSTS AND REVENUES FOR 8-MILE SYSTEM

(dollars in million)

| | 1990 | 1995 |
|---|---|---|
| Constant 1980 Dollar | | |
| Fixed Guideway | 17.6 | 21.7 |
| Feeder Bus | 53.6 | 64.0 |
| Total O&M Cost | 71.2 | 85.7 |
| Fare Revenue* | 39.0 | 44.8 |
| Deficit | 32.2 | 40.9 |

*Assume current fare structure.

## A.7. Financial Program

A study[20] of a proposed financial program including projections and estimates of costs, revenues and funding requirements was made to provide a comprehensive and objective information base to aid in selecting the funding source or sources for the program. The study explored various alternative revenue sources and focused on three feasible financing plans covering a mix of revenue options to finance the proposed transit project.

The financial program considers the total program costs including capital and operating expenses. Capital costs considered include both the initial capital outlay for the 8-mile rail system and the future capital replacement and improvement costs required for both bus and rail components up to the year 2000. Relative to funding requirements, Federal assistance for capital grants at 80 percent level and an estimated operating assistance of future allocations were considered. Currently, the Urban Mass Transportation Administration policy is to defer participation in the construction of new fixed guideway systems at least until the National economy improves. If no Federal funds are available, the program will be deferred. Fare box revenues were also included considering current fare structure in developing revenue projections. The financial program also assumes that the State will share in one-half the local share of the capital costs.

The proposed financial program covers three basic alternative financing plans as outlined below.

a) Plan A. This plan proposes the development of a State/County surface transportation fund financed through a special excise tax on fuel (variable wholesale gasoline tax) combined with a dedicated surface transportation general excise tax. This plan is designed to replace the current per gallon taxes with a unified special excise tax on fuel and to authorize the State to levy a .25 percent additional rate in the general excise tax to cover additional bus/rail operating and maintenance and City and County debt service costs resulting from the program.

b) Plan B. This plan proposes the restructuring of the Ci y and County tax structure to finance the additional 8-mile bus-rail annual funding requirement by raising the per gallon fuel tax by 9¢/gallon and implementing an automobile ownership tax of approximately $57 per vehicle.

c) Plan C. This plan proposes to finance the additional 8-mile bus-rail annual funding requirement through increased property tax requiring a general real property tax increase of approximately $2.86 per $1,000 of assessed valuation.

In the financing of the proposed program, the study stresses the need for a dedicated revenue source for funding capital investment and subsidy requirements that is both dependable and inflation-sensitive. The City and County of Honolulu is continuing to work towards finalizing the financing plan including the selection of the funding source or sources for implementing the proposed transit system.

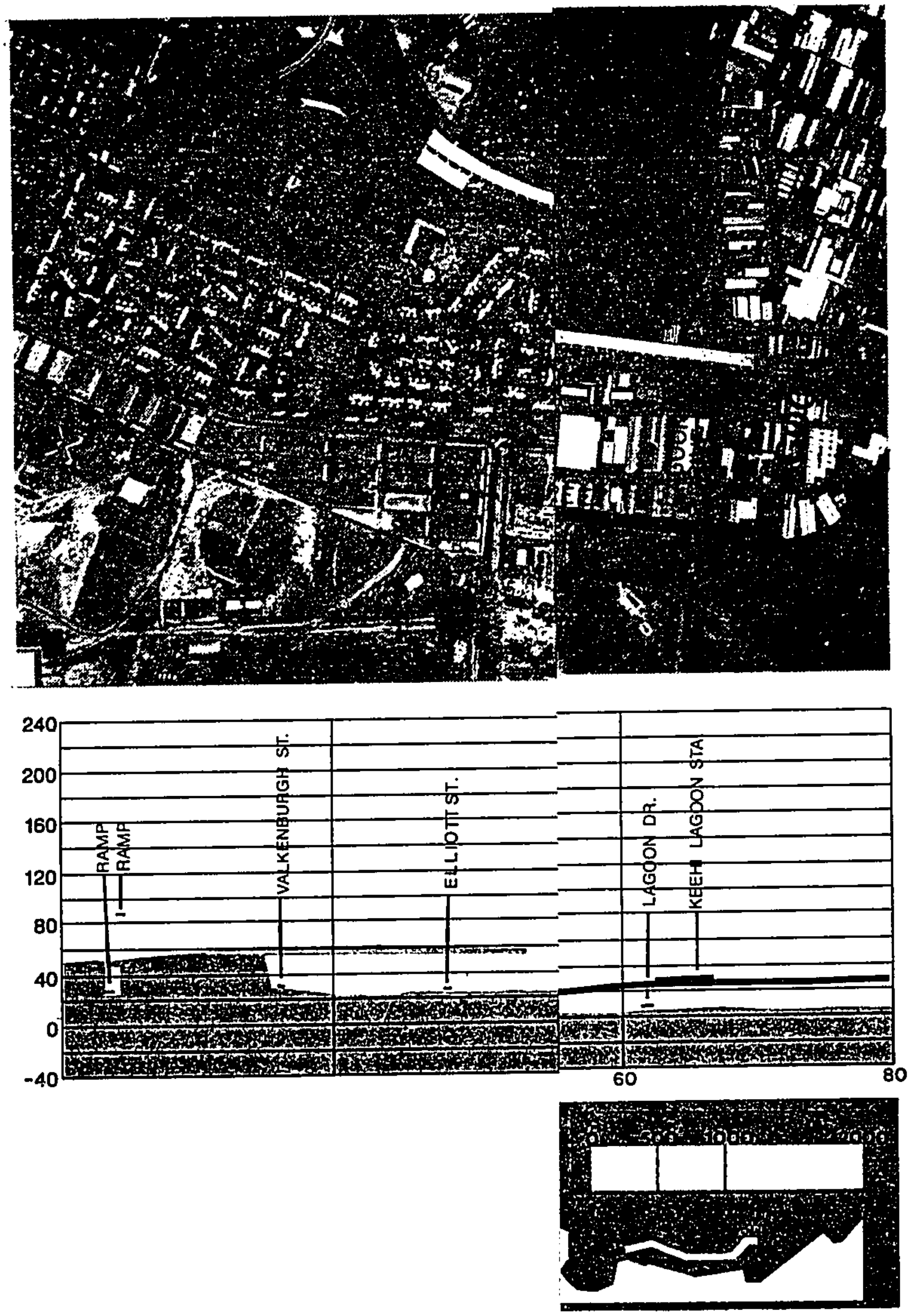
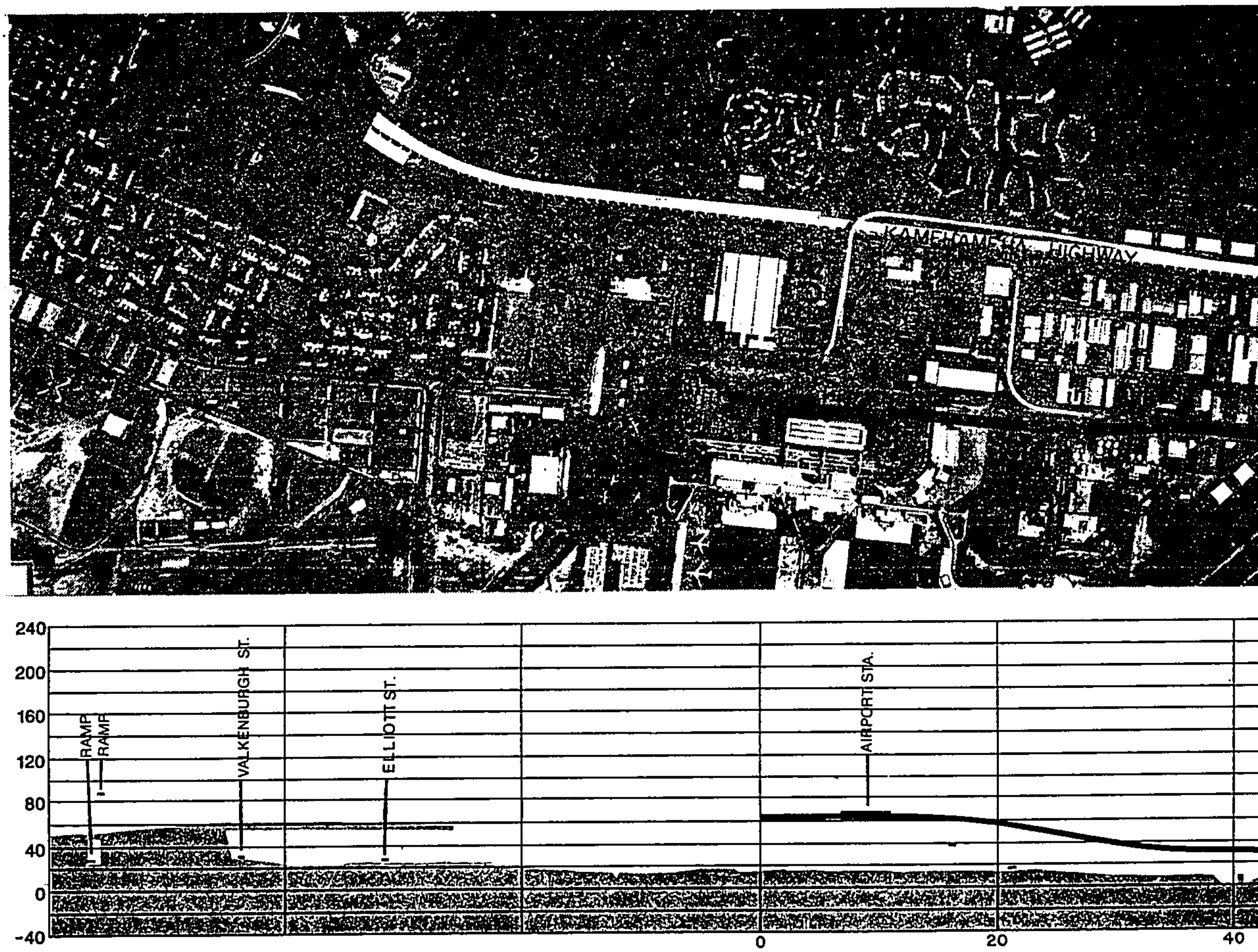

240
200
160
120
80
40
0
-40
RAMP
RAMP
VALKENBURGH ST.
ELLIOTT ST.
LAGOON DR.
KEEHI LAGOON STA
60
80

FIGURE IV-5

RECEIVED AS FOLLOWS




# PLAN AND PROFILE

Pearl Harbor-Airport

RECEIVED AS FOLLOWS

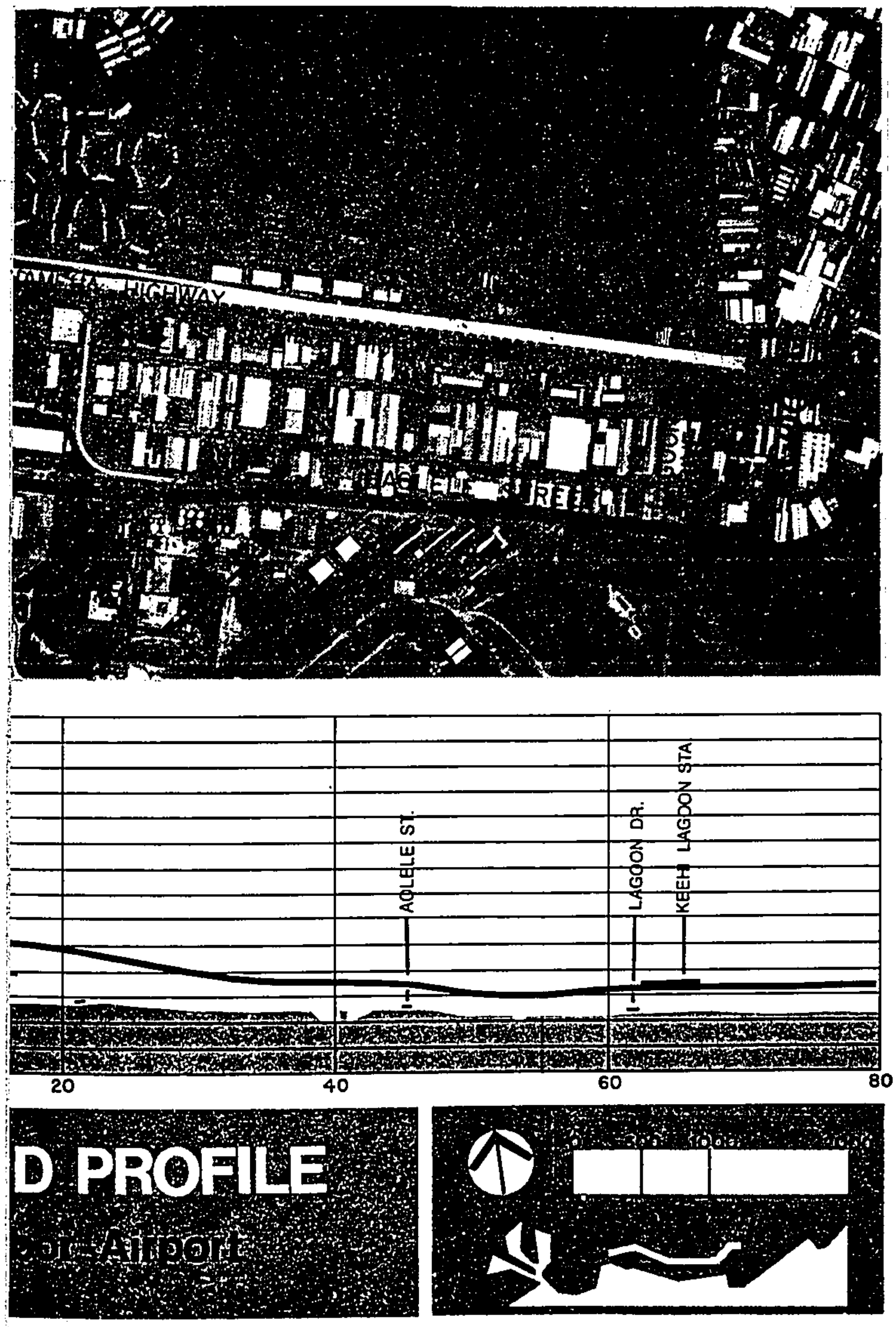
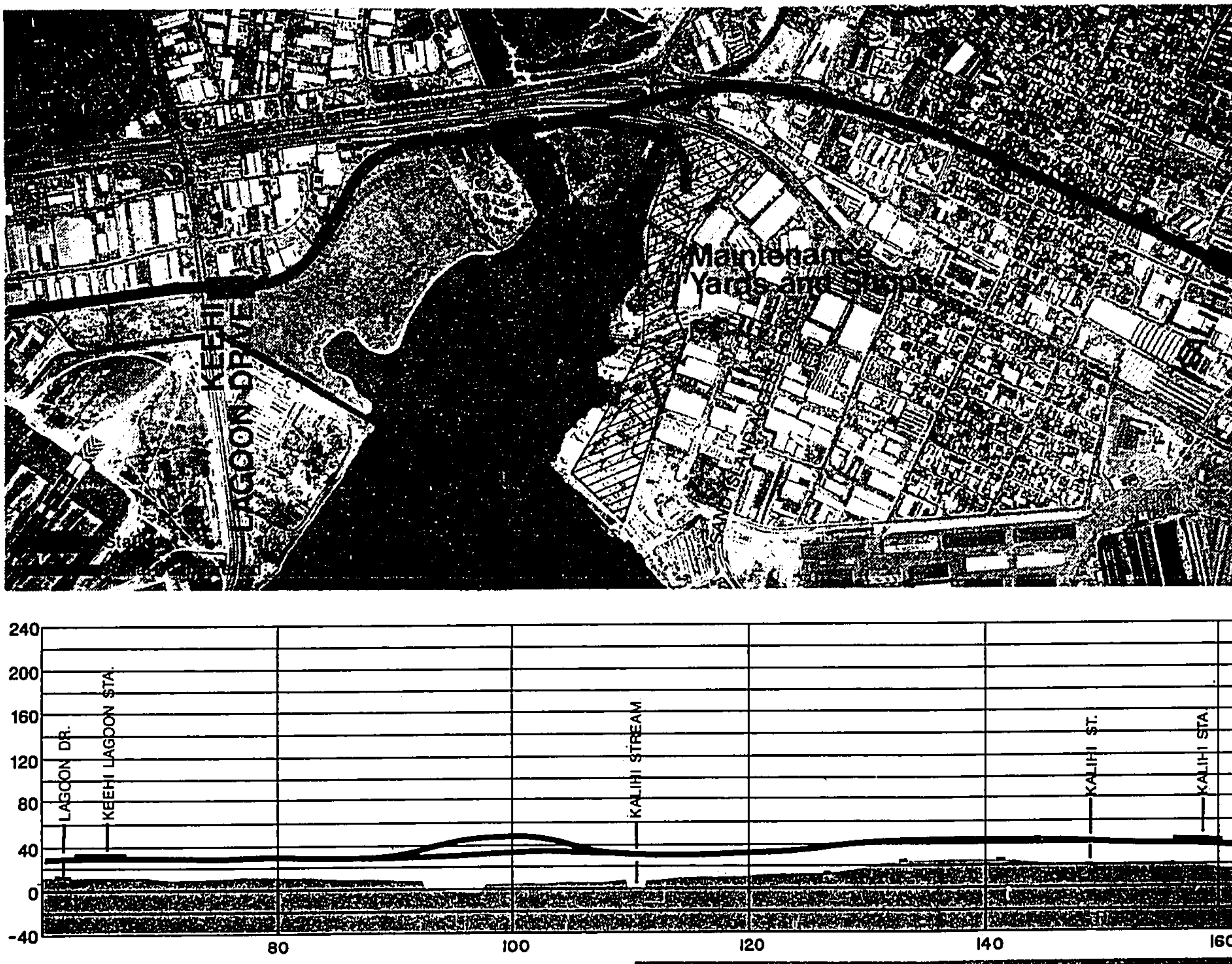



FIGURE IV-5

RECEIVED AS FOLLOWS




# PLAN AND PROFILE

## Keehi Lagoon-Kalihi

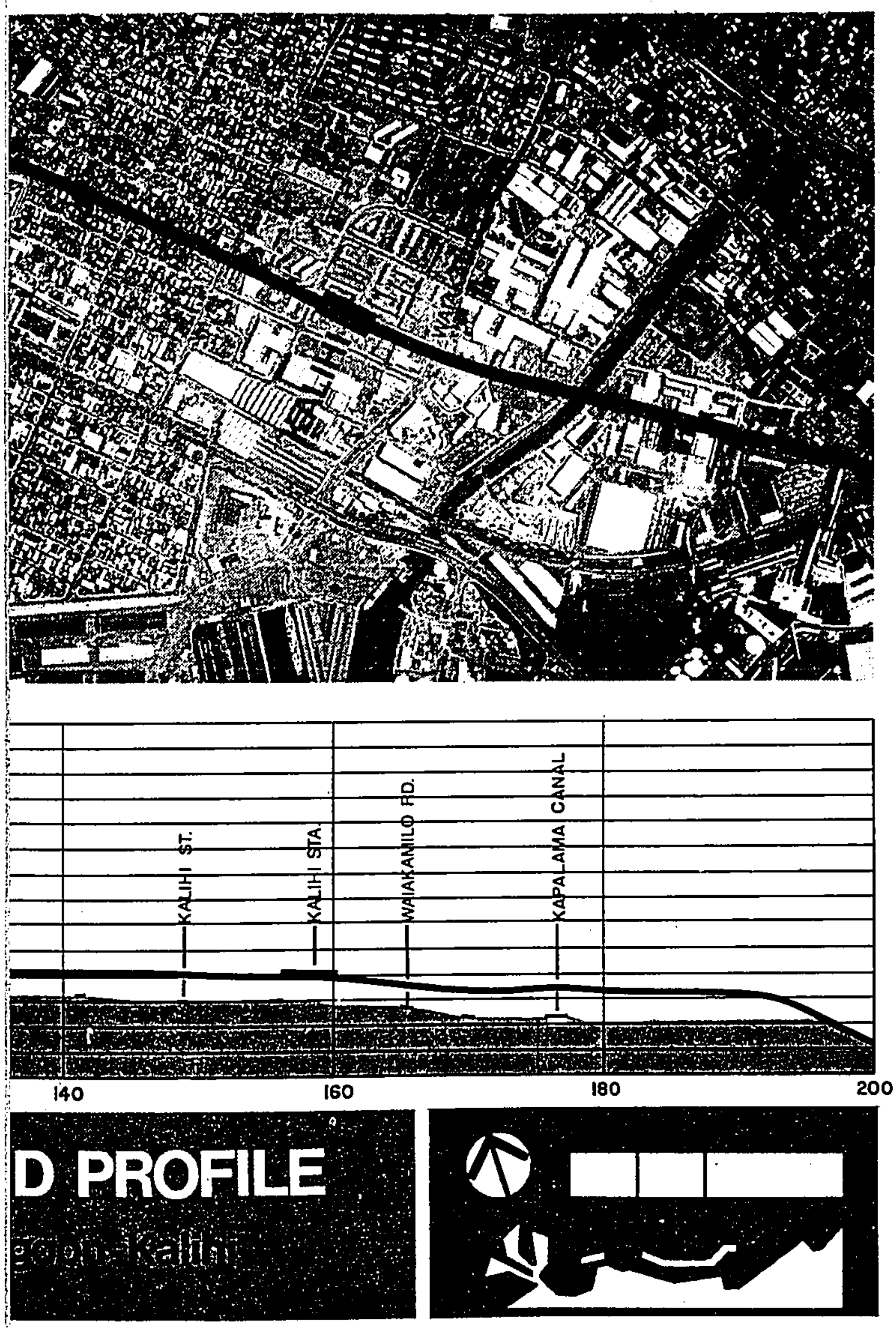
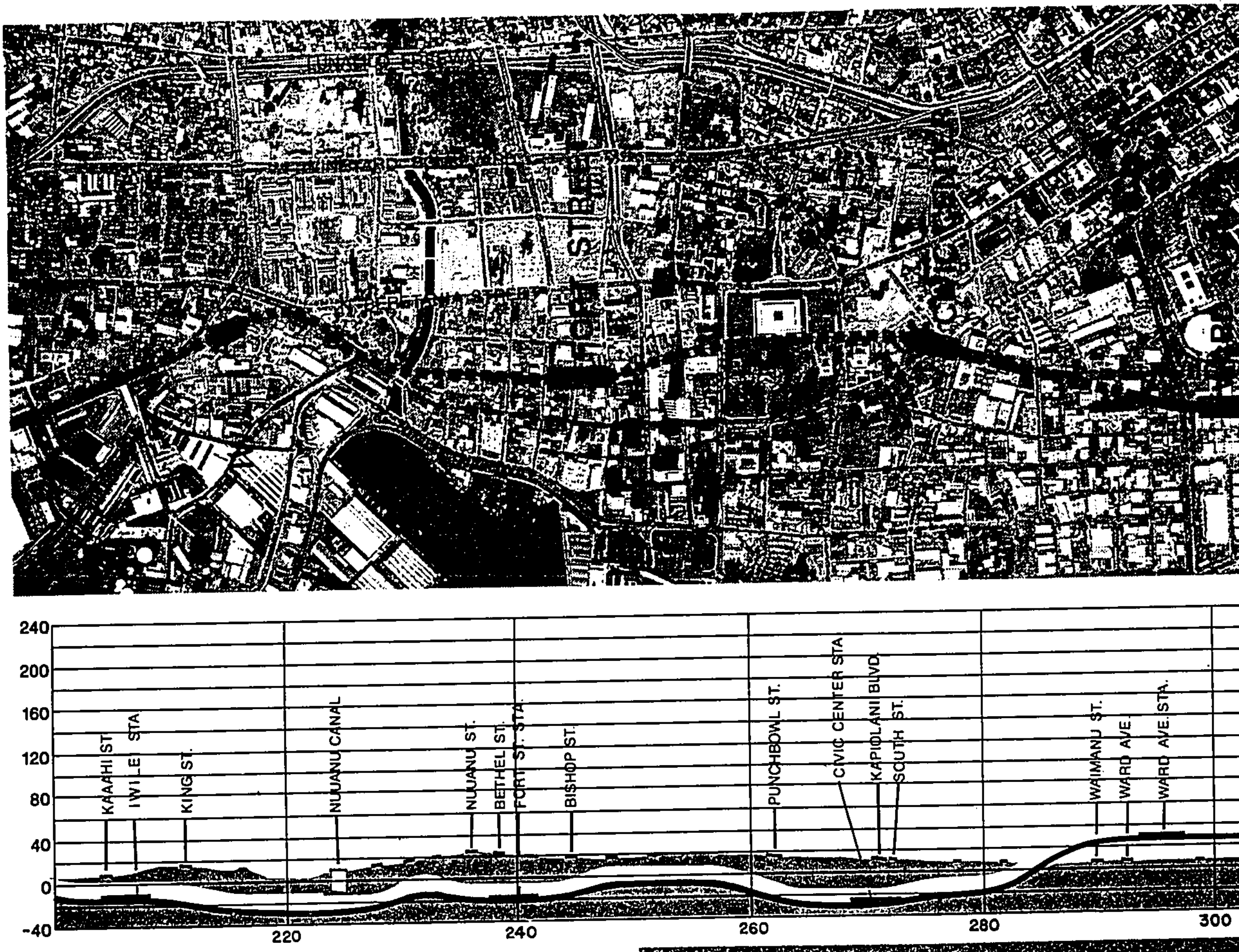

KALIHI ST.
KALIHI STA.
WAIAKAMILO RD.
KAPALAMA CANAL
140
160
180
200
D PROFILE

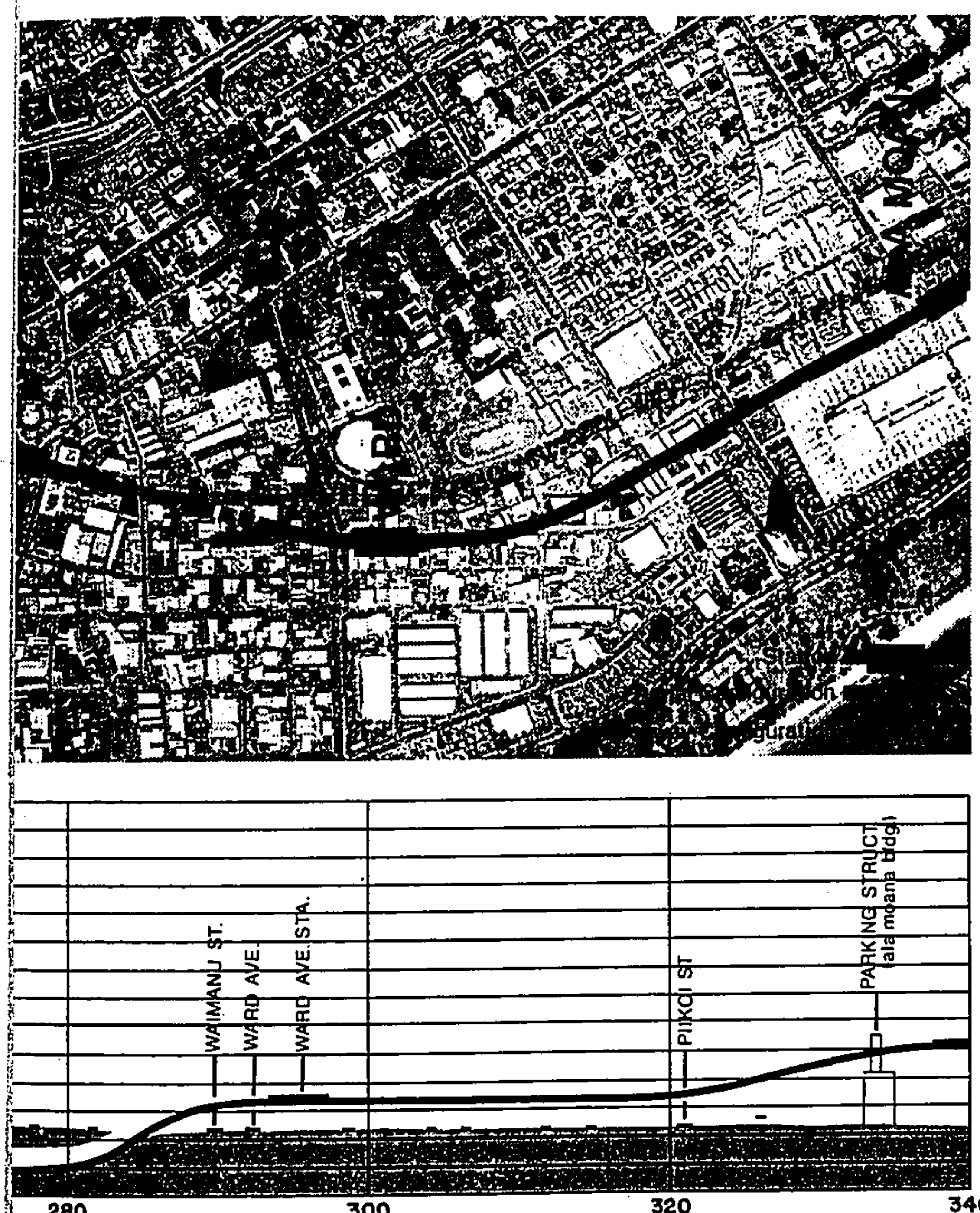
FIGURE IV-6

RECEIVED AS FOLLOWS




PLAN AND PROFILE

Downtown-Civic Center




D PROFILE

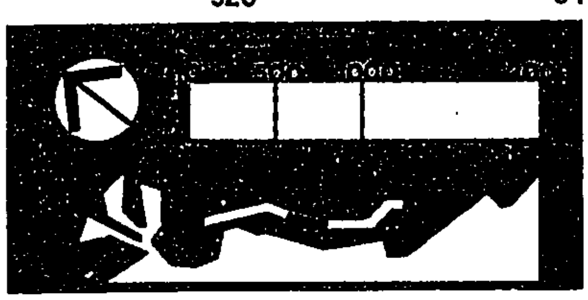
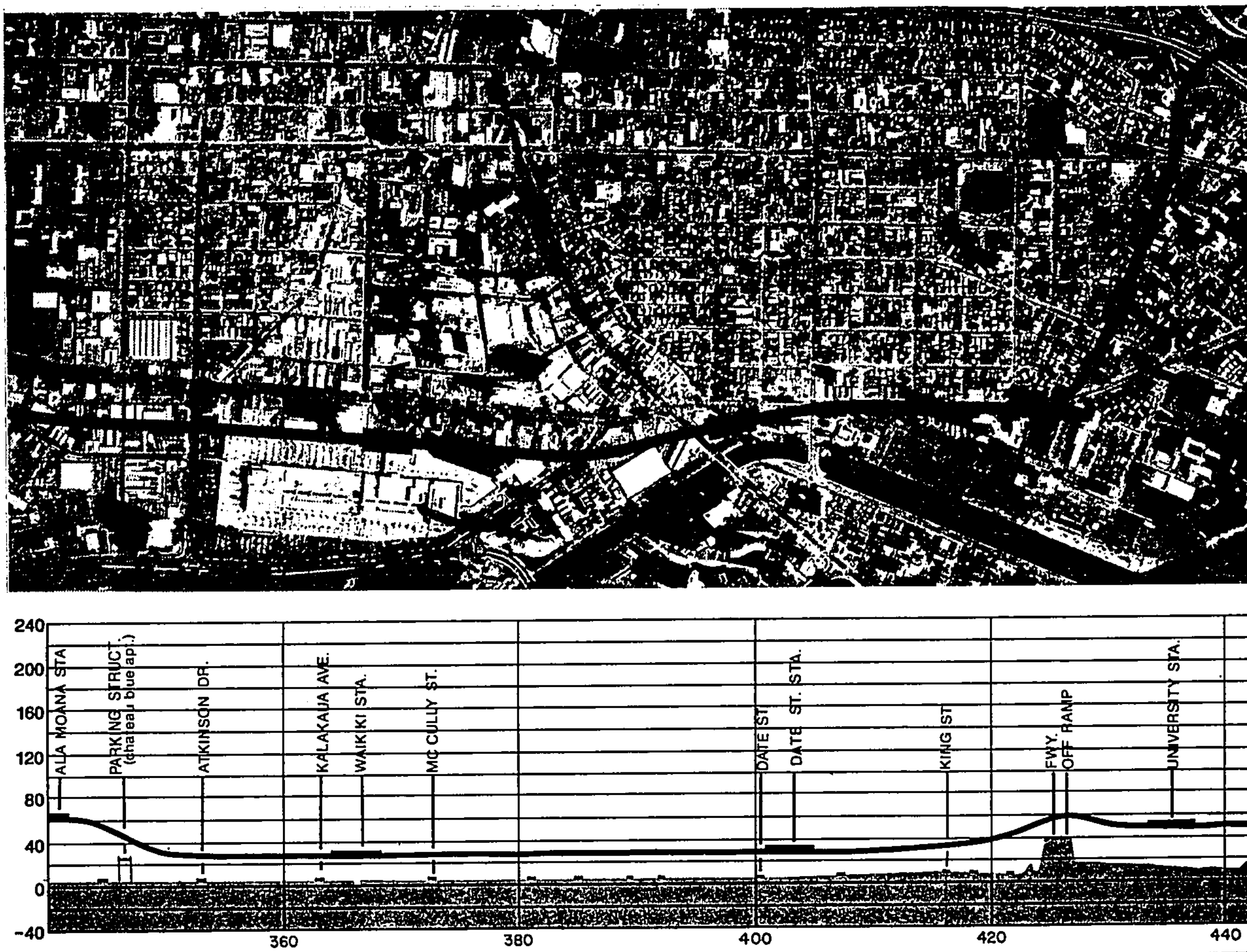


FIGURE IV-7

RECEIVED AS FOLLOWS




# PLAN AND PROFILE

Ala Moana-Waikiki-Universi

RECEIVED AS FOLLOWS

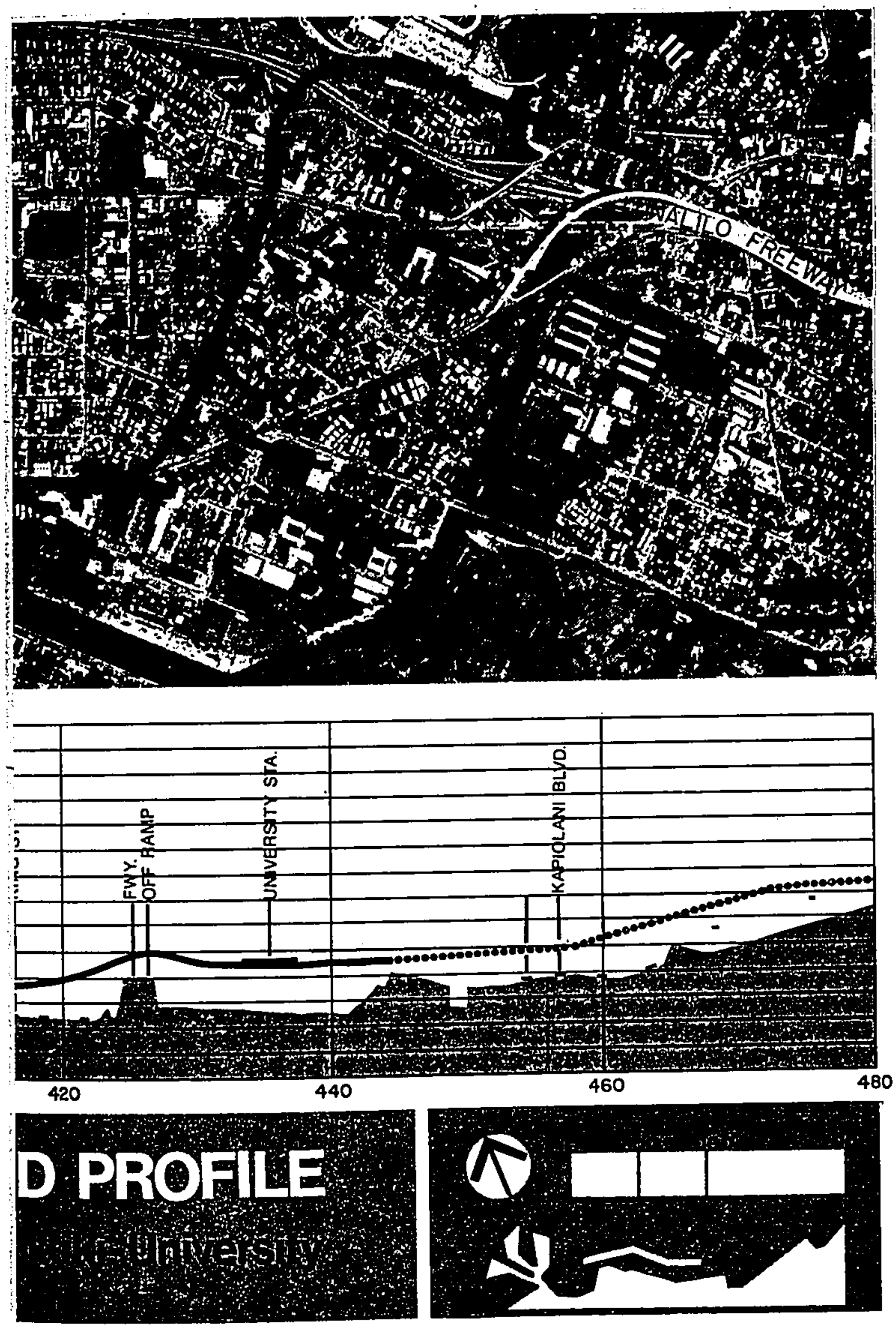
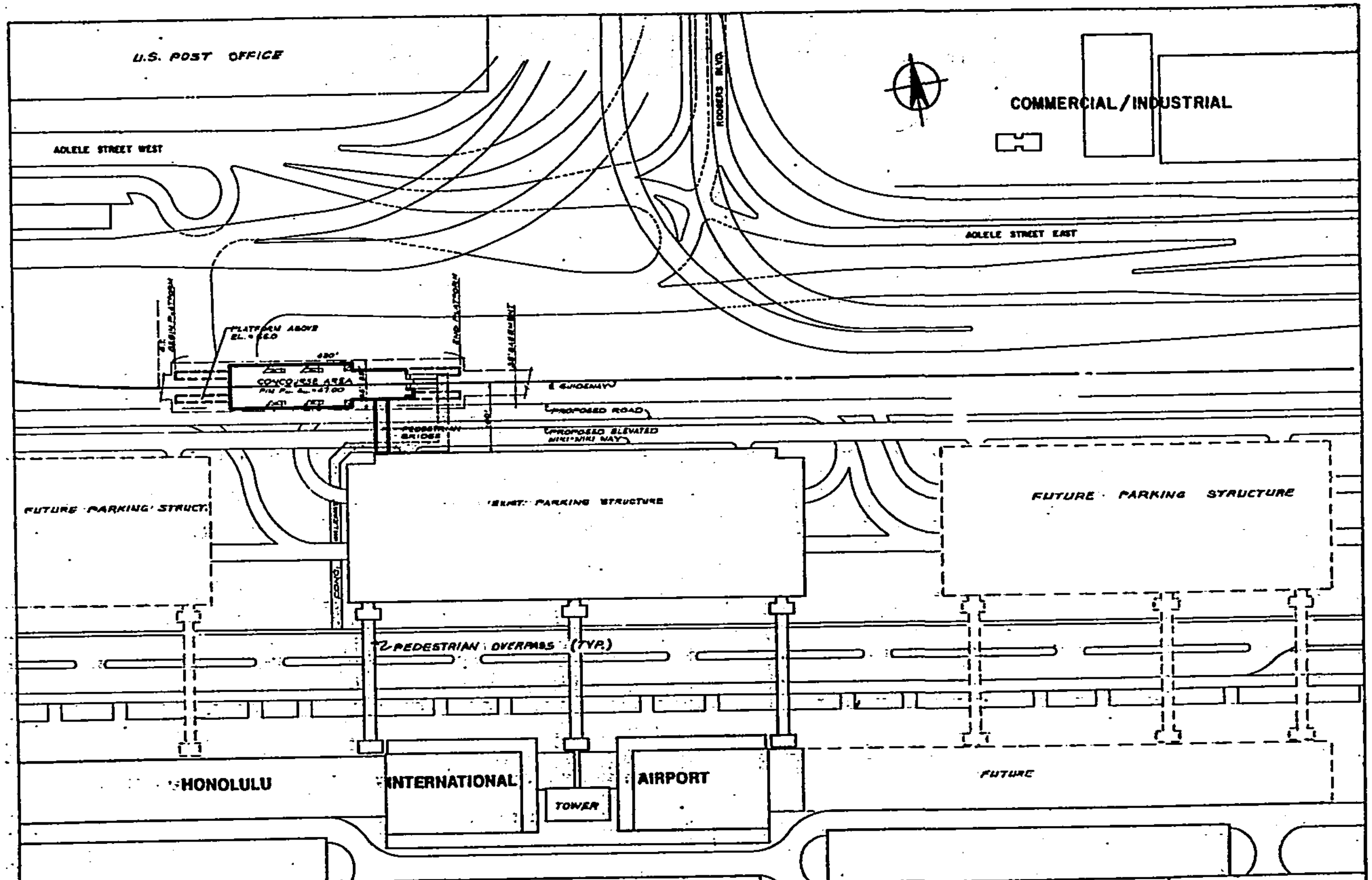


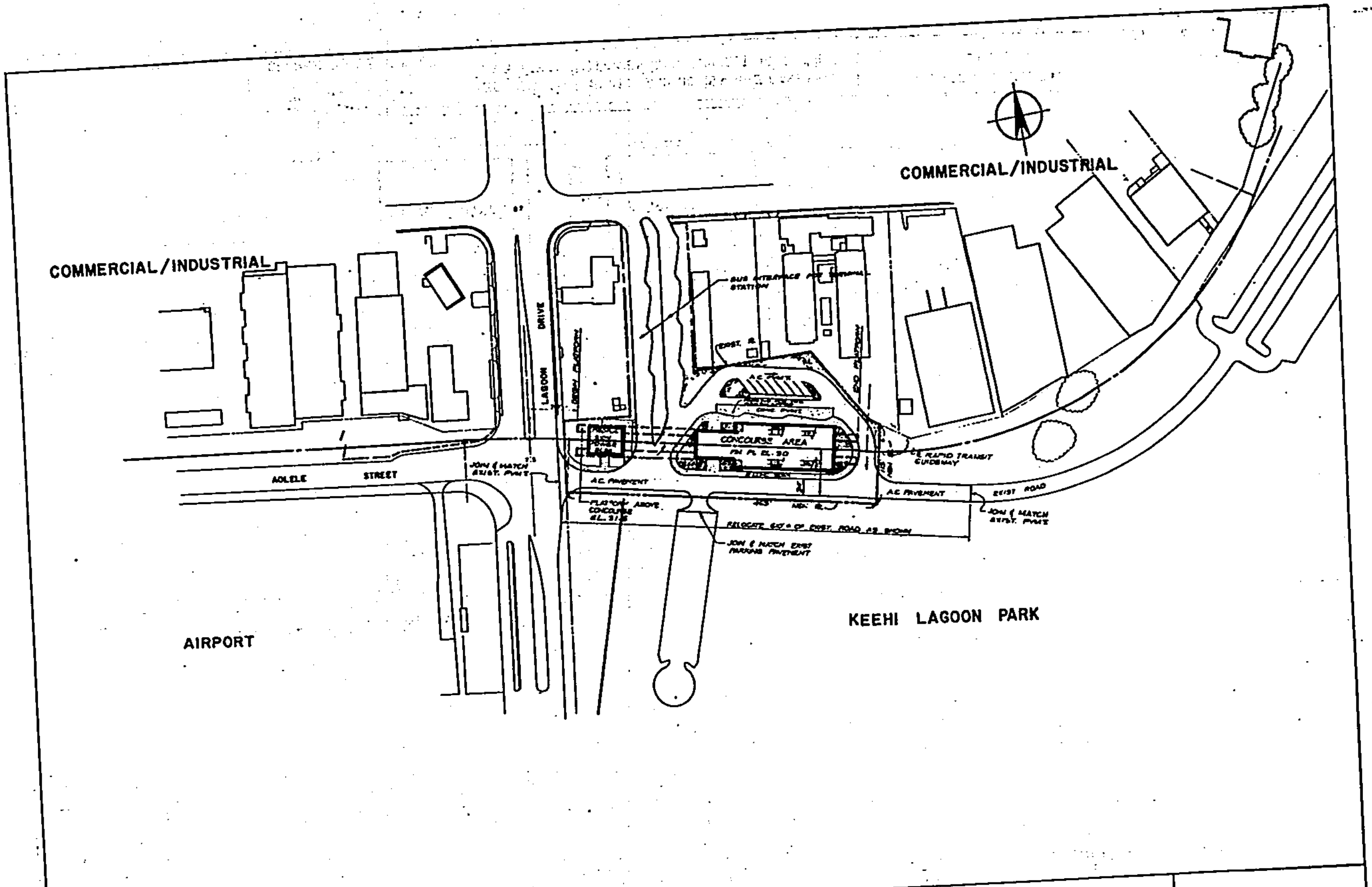

FIGURE IV-8




STATION SITE PLANS AND DESIGN ARE BASED ON PRELIMINARY STUDIES AND SUBJECT TO CHANGE.

AIRPORT STATION
Site Plan

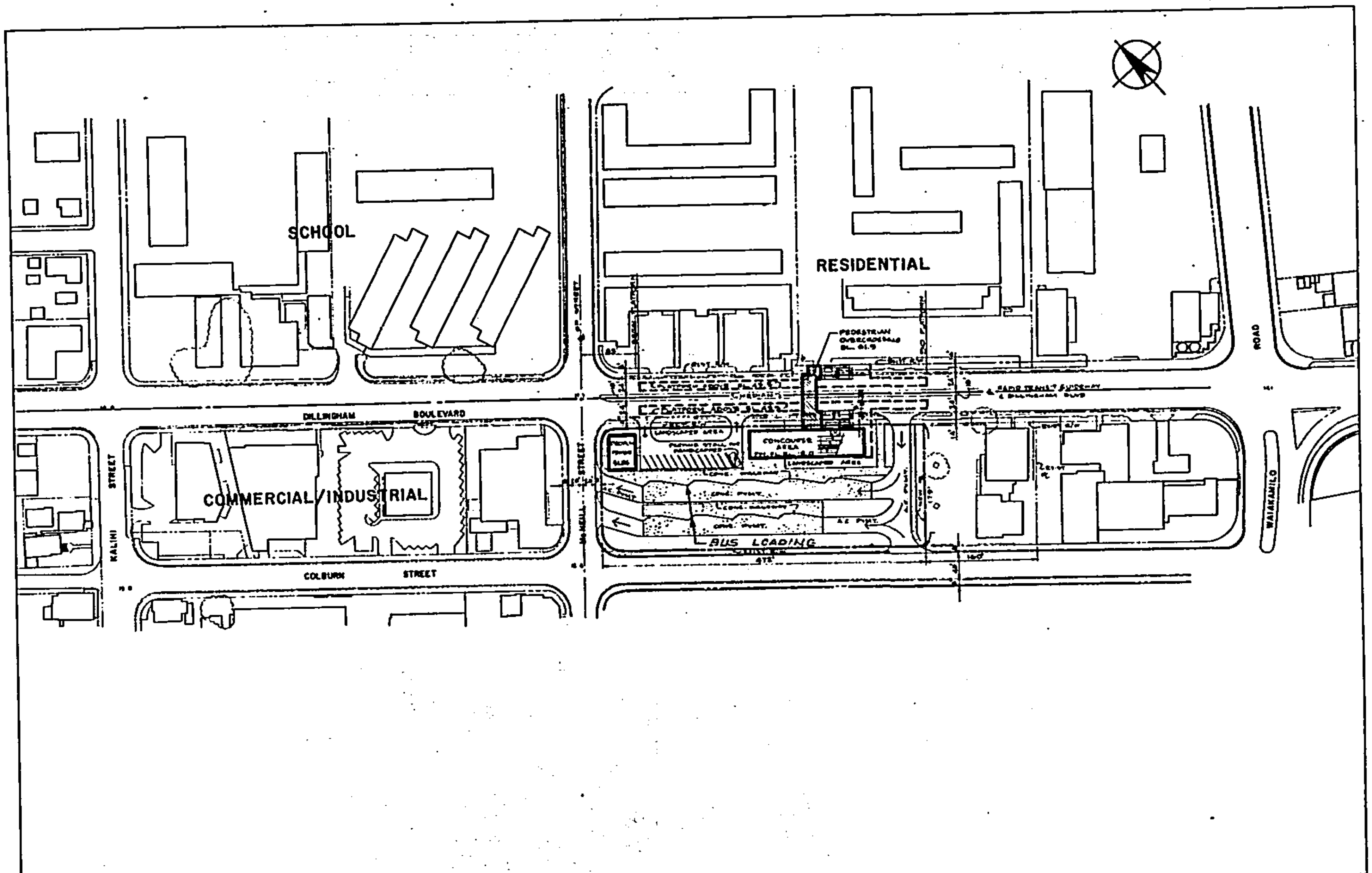
FIGURE IV-9



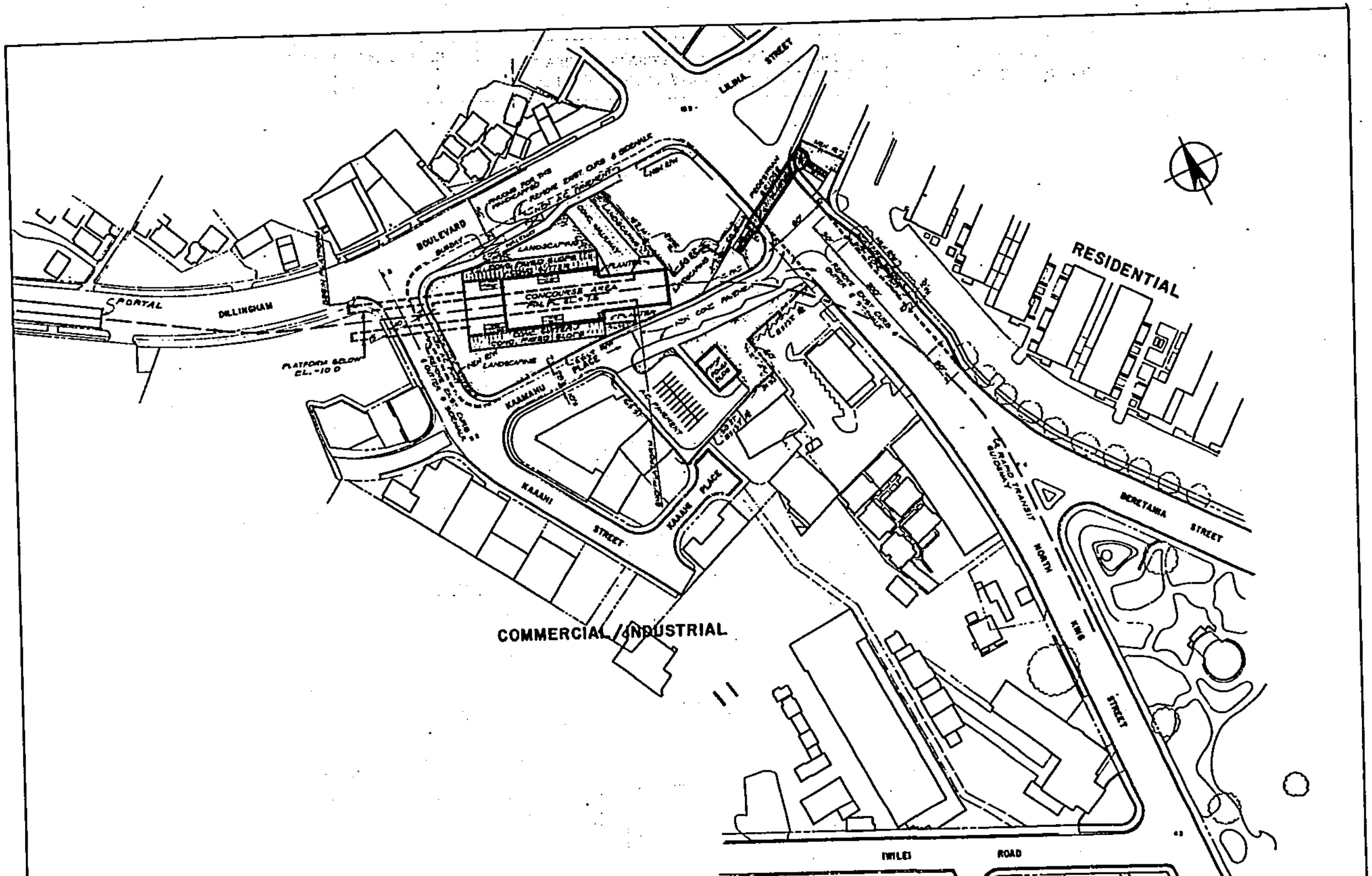

STATION SITE PLANS AND DESIGN ARE BASED ON PRELIMINARY STUDIES AND SUBJECT TO CHANGE.

KEEHI LAGOON STATION
Site Plan

FIGURE IV-10



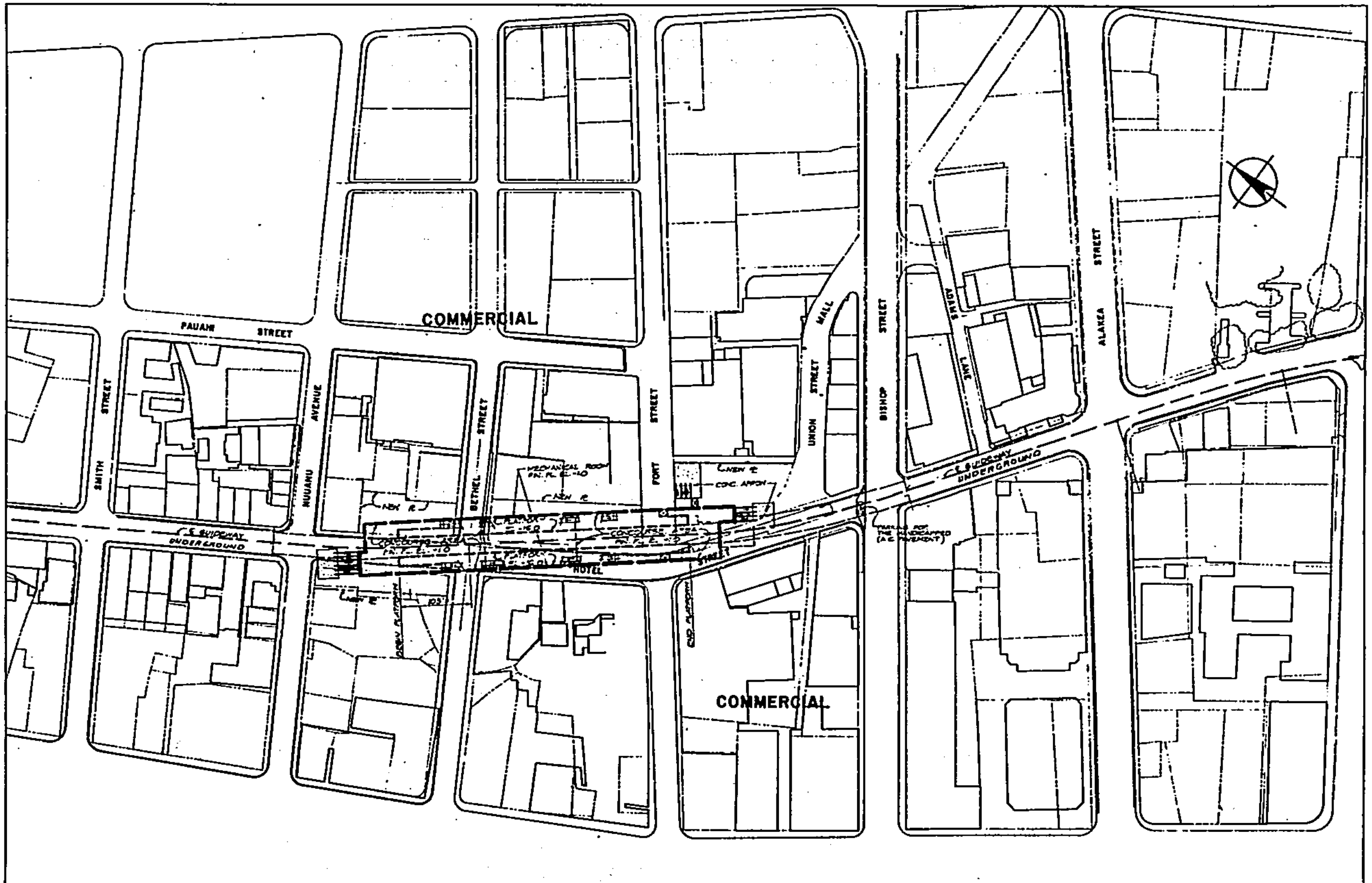

| | | | | |
|---|---|---|---|---|
| | 0 50 100 150 200<br>GRAPHIC SCALE IN FEET | STATION SITE PLANS AND DESIGN ARE BASED ON PRELIMINARY STUDIES AND SUBJECT TO CHANGE. | KALIHI STATION<br>Site Plan | FIGURE IV-11 |




STATION SITE PLANS AND DESIGN ARE BASED ON PRELIMINARY STUDIES AND SUBJECT TO CHANGE.

IWILEI STATION
Site Plan

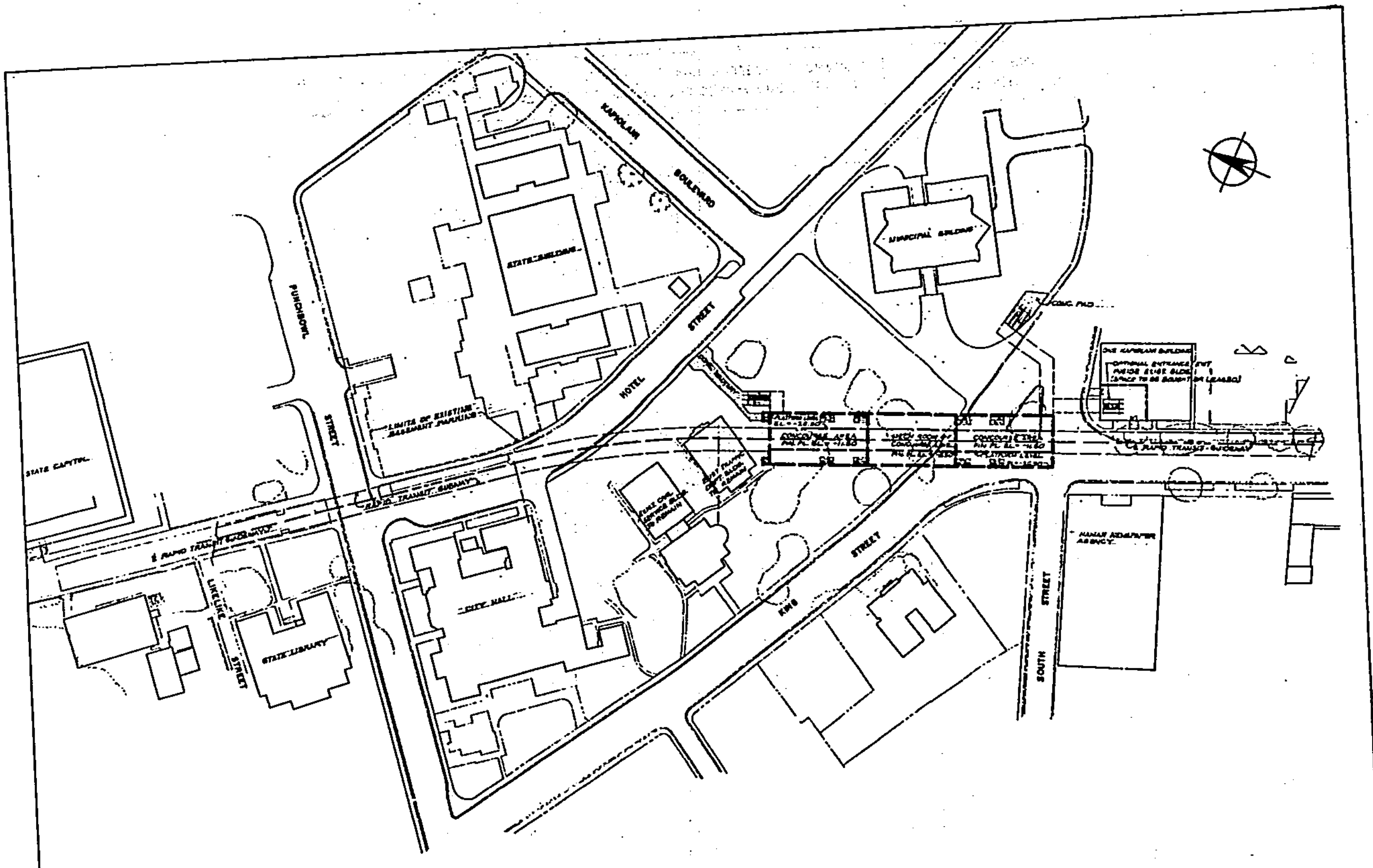
FIGURE IV-12




STATION SITE PLANS AND DESIGN ARE BASED ON PRELIMINARY STUDIES AND SUBJECT TO CHANGE.

FORT STREET STATION
Site Plan

FIGURE IV-13

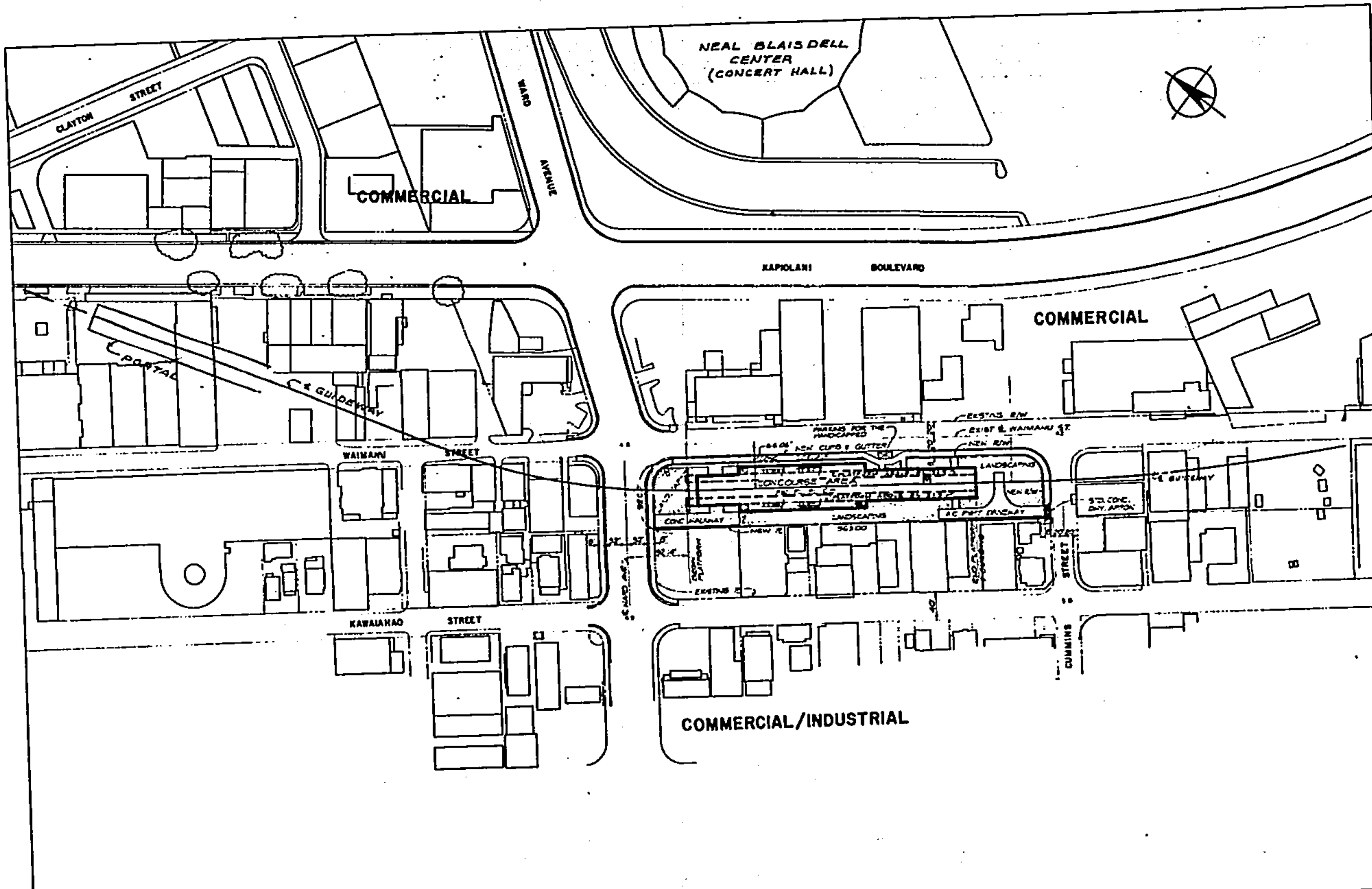



GRAPHIC SCALE IN FEET

STATION SITE PLANS AND DESIGN ARE BASED ON PRELIMINARY STUDIES AND SUBJECT TO CHANGE.

CIVIC CENTER STATION
Site Plan

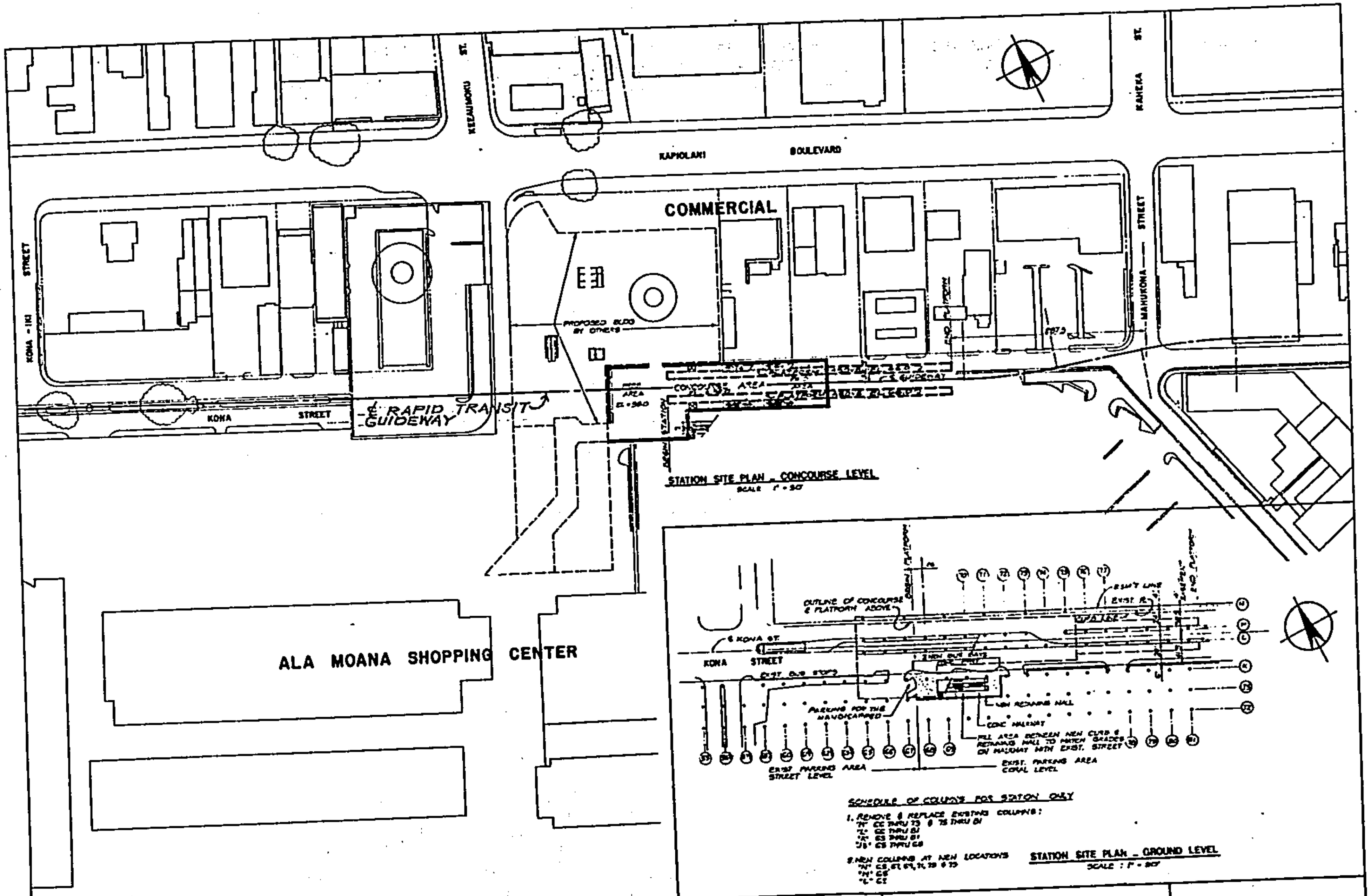
FIGURE IV-14




STATION SITE PLANS AND DESIGN ARE BASED ON PRELIMINARY STUDIES AND SUBJECT TO CHANGE.

WARD AVENUE STATION
Site Plan

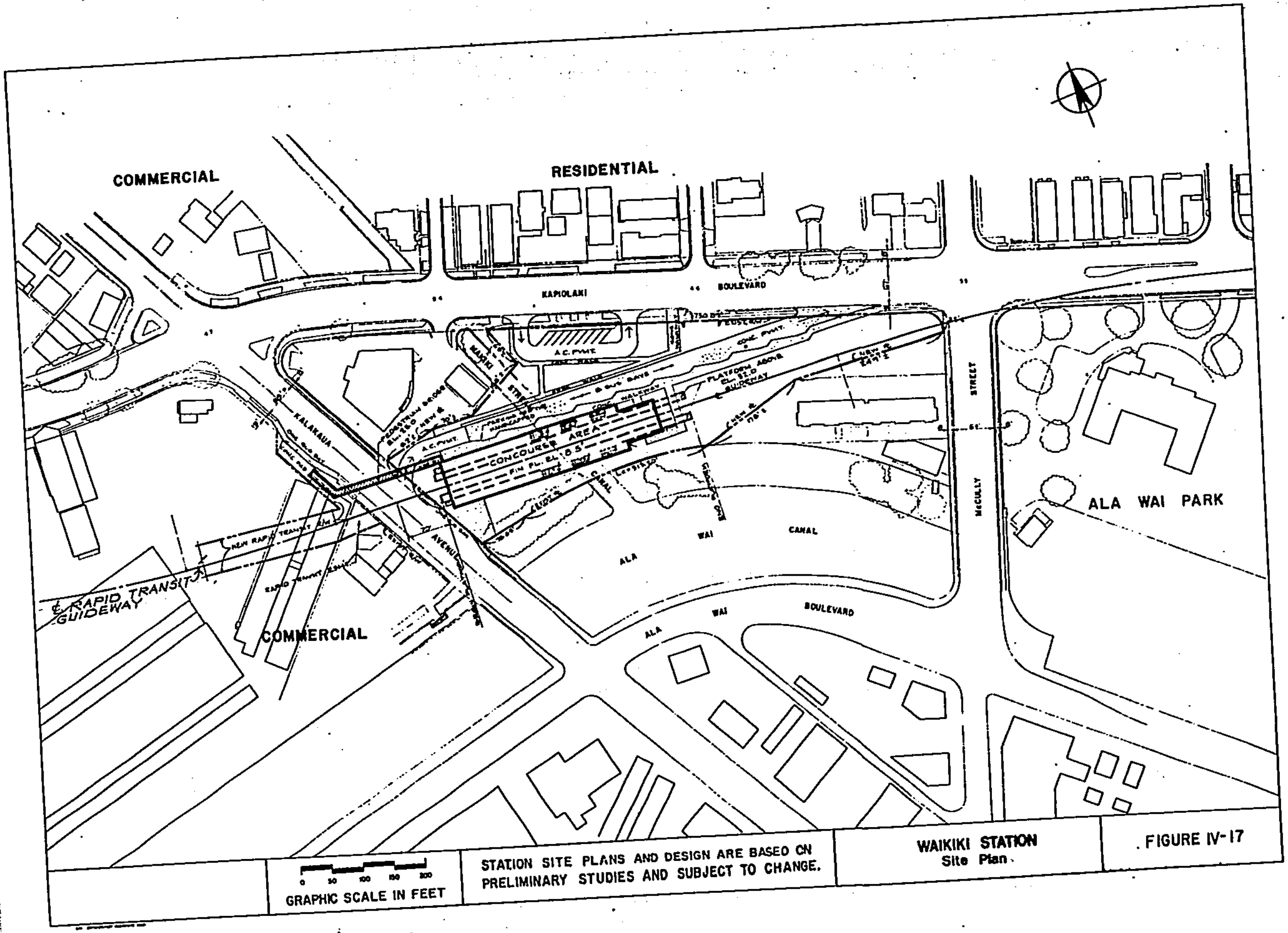
FIGURE IV-15




STATION SITE PLANS AND DESIGN ARE BASED ON PRELIMINARY STUDIES AND SUBJECT TO CHANGE.

ALA MOANA STATION
Site Plan

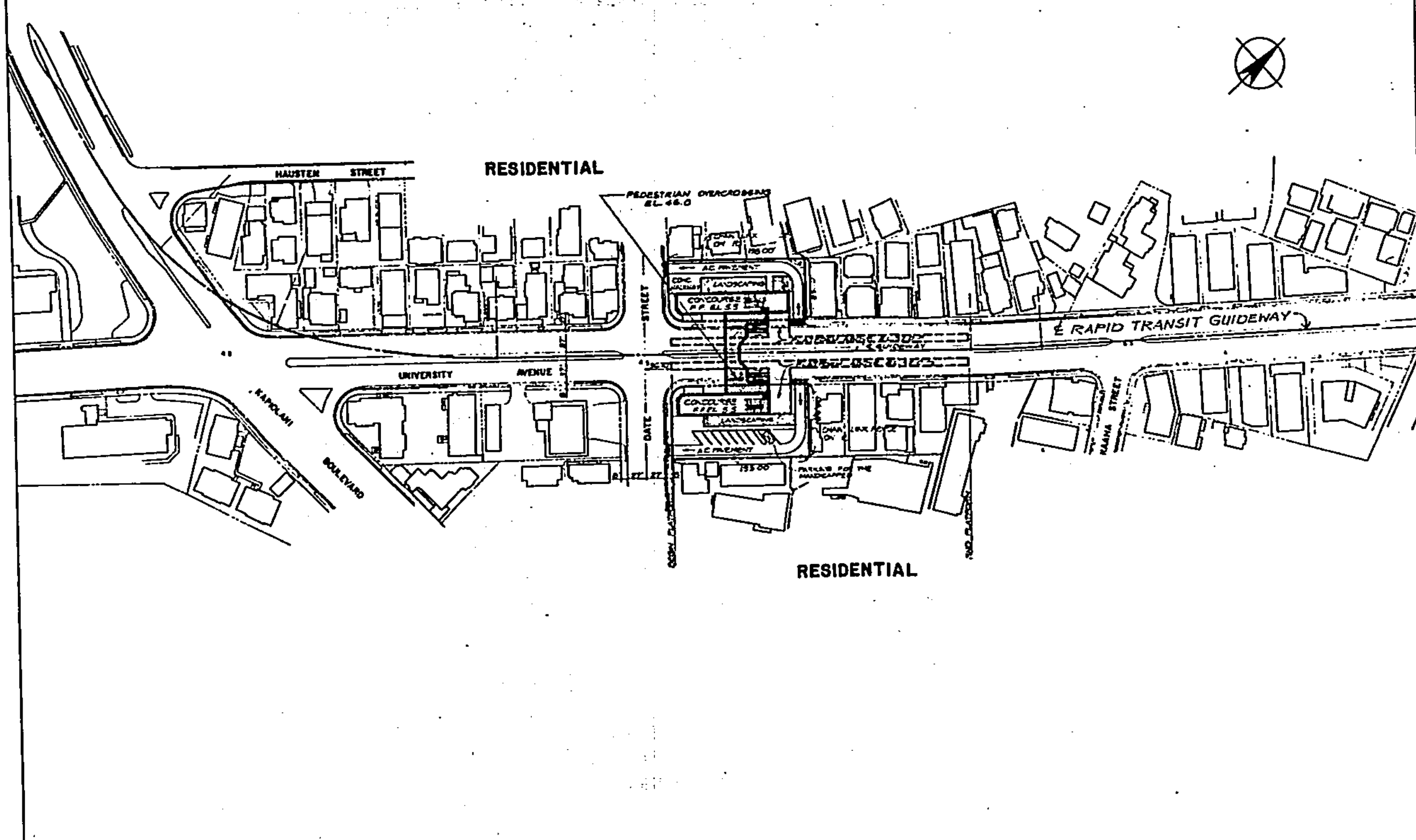
FIGURE IV-16



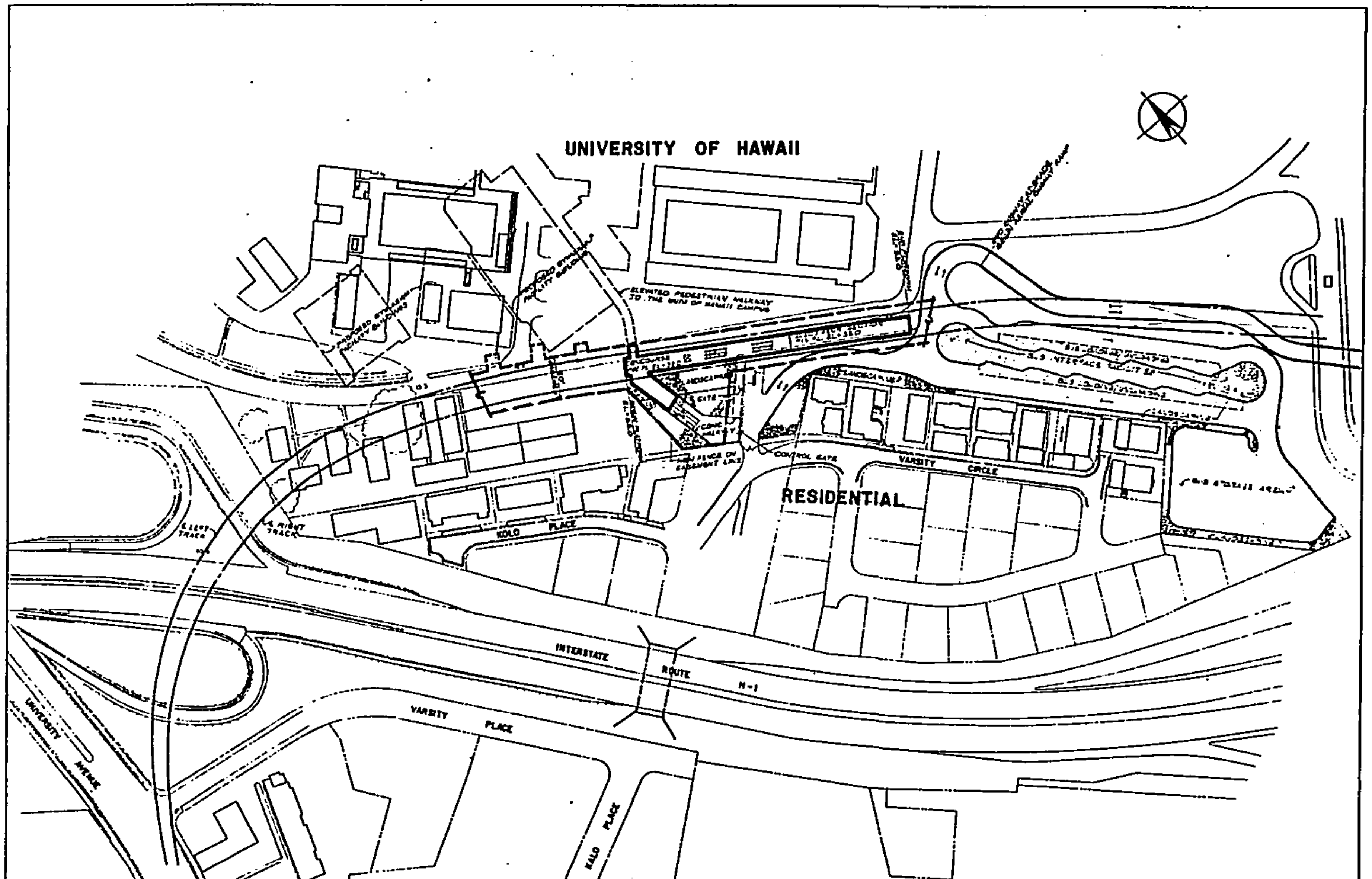

STATION SITE PLANS AND DESIGN ARE BASED ON PRELIMINARY STUDIES AND SUBJECT TO CHANGE.

WAIKIKI STATION
Site Plan.

FIGURE IV-17




| GRAPHIC SCALE IN FEET (0, 50, 100, 150, 200) | STATION SITE PLANS AND DESIGN ARE BASED ON PRELIMINARY STUDIES AND SUBJECT TO CHANGE. | DATE STREET STATION Site Plan | FIGURE IV-18 |
|---|---|---|---|




GRAPHIC SCALE IN FEET

STATION SITE PLANS AND DESIGN ARE BASED ON PRELIMINARY STUDIES AND SUBJECT TO CHANGE.

UNIVERSITY STATION
Site Plan

FIGURE IV-19

## V. PROBABLE ENVIRONMENTAL IMPACTS OF THE PROPOSED ACTION

This chapter examines the probable environmental impacts that may result if the proposed transit system is adopted over the baseline (no action) bus plan. The proposed transit system has been described in the previous chapter as a fixed guideway system, supported by an islandwide network of local-express feeder buses, with an initial segment of 8 miles. Chapter III also described in detail the alternative segment lengths considered for the initial stage of construction.

The examination of probable impacts will address the 8-mile fixed guideway system that has been selected for the initial stage of construction.

### A. NATURAL ENVIRONMENT IMPACTS

#### A.1. Air Quality

##### a. General

The impact of the 8-mile fixed guideway/feeder bus system on the air quality of the island of Oahu was analyzed for regional and local effects. This analysis considered the projected magnitude of the island-wide reduction of future automobile usage and the resulting reduction of pollutant emissions, the increase in power requirements to operate the rapid transit system, and any increase in automobile and bus traffic in the vicinity of the rapid transit stations. The analysis is divided into two sections, first, a discussion of the regional impacts and second, the localized effects of the system. Generally, both analyses were conducted by comparing the differences in pollutant emissions with and without the proposed system in 1995. The baseline system, which reflects the condition without the fixed guideway system, is the continuation of the existing bus system only slightly modified to accommodate increased patronage (Baseline Bus System from Chapter III).

##### b. Regional Impact

The regional impact of the proposed transit system was analyzed on the basis of the total emission of primary pollutants directly associated with the preferred system as compared to the baseline system. To accomplish this, several types of base data were required. These included:

- Emission factors for hydrocarbons (HC), carbon monoxide (CO), oxides of nitrogen ($NO_x$), sulfur dioxide ($SO_2$), and particulates for automobiles, buses, and the power plant.

- Travel characteristics of the baseline and 8-mile fixed guideway/feeder bus systems including vehicle miles traveled (VMT) by buses and automobiles.

- Segregation of VMT information into the six U.S. Environmental Protection Agency (EPA) airshed areas for the island.

Since this analysis is only concerned with the planning year of 1995, and the difference between the baseline and proposed systems, a prerequisite to the analysis is the determination of appropriate projected motor vehicle emission factors for each of the pollutants of concern. These factors were determined using emission data from EPA publications entitled "Compilation of Air Pollutant Emission Factors, Supplement No. 5, Appendix D", dated December 1975, and "Mobile Source Emission Factors For Low-Altitude Areas Only", dated March 1978. Also, only VMT associated with automobiles and buses is considered in the analysis since commercial trips, i.e., light-duty and heavy-duty trucks, are assumed to be the same with either the baseline or fixed guideway systems. The projected emission factors for autos (light-duty vehicles) and buses (diesel) utilized in the analysis are summarized in Table V-1.

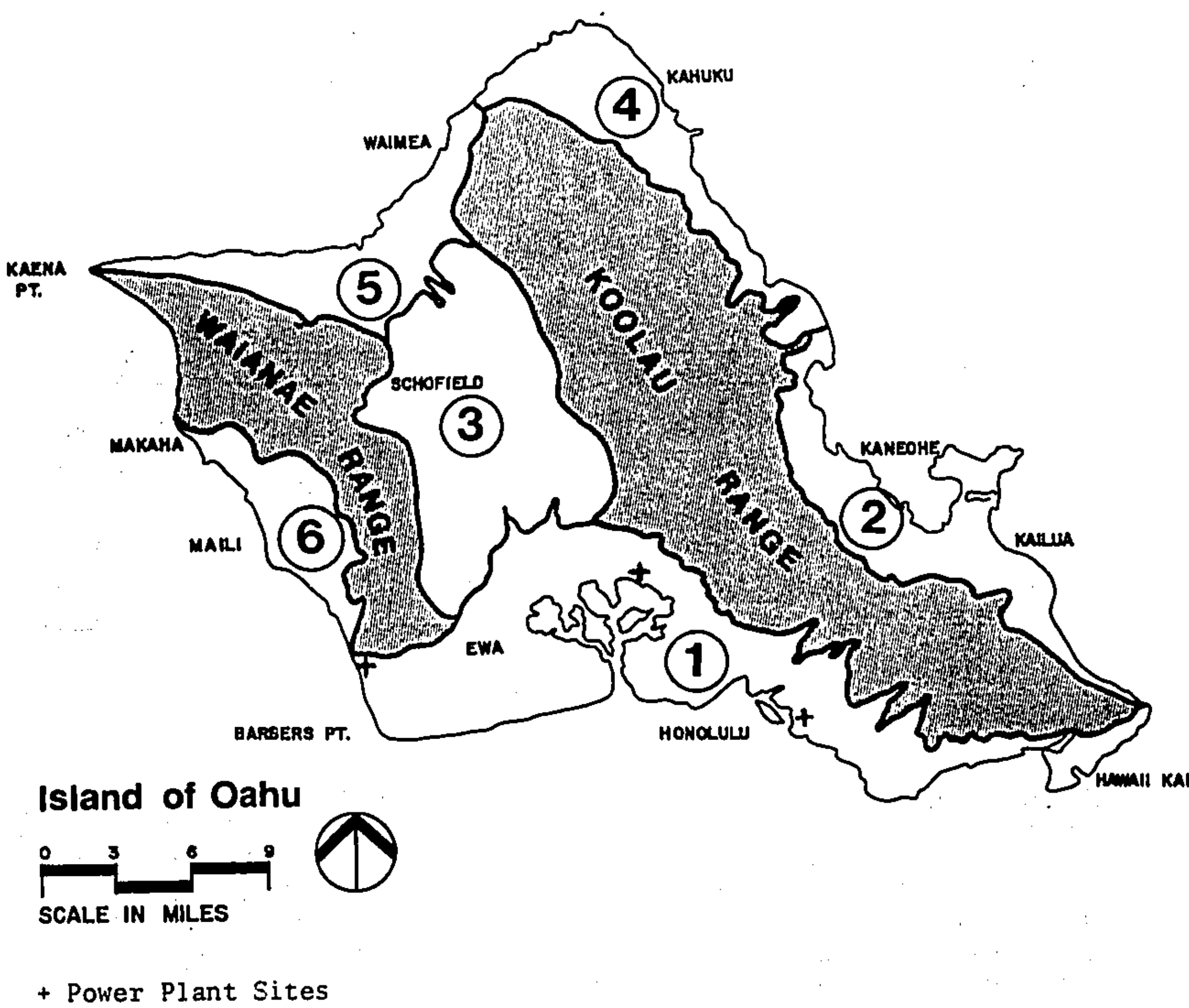
TABLE V-1

EMISSION FACTORS (GRAMS/MILE)*

| | Auto | Bus |
|---|---|---|
| CO | 13.3 | 27.0 |
| HC | 1.5 | 2.9 |
| $NO_x$ | 1.6 | 6.0 |
| PART. | 0.3 | 1.7 |
| $SO_2$ | 0.1 | 2.8 |

*Based on national average conditions as defined in the aforementioned EPA publications and average route speed of approximately 20 mph.

The EPA has established boundaries on Oahu for six airshed areas. The six areas are shown in Figure V-1 and generally




**AIRSHED AREAS ON OAHU**

FIGURE V-1

conform to Central Honolulu, Kailua-Kaneohe, Central Oahu, Windward Oahu, the North Shore, and Leeward Oahu. A seventh area was added to cover the trans-Koolau corridor comprising the Pali and Likelike Highways and the proposed H-3 Freeway. The analysis of the regional air quality impacts included the stratification of this data by airshed area.

The projected VMT by automobiles and buses for both the 8-mile fixed guideway and the baseline systems were calculated for each airshed area. The VMT figures are summarized in Table V-2.

TABLE V-2

COMPARISON OF DAILY VEHICLE MILES TRAVELED - 1995

| AIRSHED | 8-Mi Fixed Guideway AUTO | 8-Mi Fixed Guideway BUS | Baseline AUTO | Baseline BUS |
|---|---|---|---|---|
| 1 | 6,668,000 | 82,000 | 7,500,000 | 55,100 |
| 2 | 922,000 | 14,000 | 1,003,000 | 6,300 |
| 3 | 568,000 | 5,400 | 616,000 | 2,100 |
| 4 | 140,000 | 1,900 | 147,000 | 1,700 |
| 5 | 163,000 | 1,400 | 173,000 | 700 |
| 6 | 282,000 | 3,400 | 308,000 | 2,900 |
| Trans-Koolau | 505,000 | 11,200 | 561,000 | 4,600 |
| TOTAL | 9,248,000 | 119,300 | 10,308,000 | 73,400 |

Utilizing the factors provided in Table V-1, the air quality impact of the 8-mile fixed guideway can be seen in Table V-3. The proposed system would effect a decrease in the emission of all pollutants except for sulfur dioxide ($SO_2$) on an island-wide basis. The increase in $SO_2$ is primarily the result of additional power consumption required to run the electrically powered fixed guideway trains.

Assuming that automotive emissions would decline in a similar percentage to the decline in vehicle miles traveled, the potential decrease of all pollutants is estimated to be over 8 percent on an island-wide basis and about 9 percent reduction in the Central Honolulu airshed. These estimates are based on a further assumption that the total number of trips would remain the same with or without the proposed action and hence do not include induced automobile trips which could occur with the proposed action and thus reduce the percent decline in total emissions.

TABLE V-3

COMPARISON OF POLLUTION EMISSION IN 1995
(TONS/YR.)

| | CO | HC | $NO_x$ | PART. | $SO_2$ | TOTAL |
|---|---|---|---|---|---|---|
| **ISLAND WIDE** | | | | | | |
| BASELINE: | | | | | | |
| Auto | 45,238 | 5,042 | 5,350 | 1,020 | 340 | 56,990 |
| Buses | 656 | 70 | 144 | 41 | 68 | 979 |
| F.G. | - | - | - | - | - | - |
| | 45,894 | 5,112 | 5,494 | 1,061 | 408 | 57,969 |
| 8-MI. F.G.: | | | | | | |
| Auto | 40,599 | 4,524 | 4,801 | 915 | 305 | 51,144 |
| Buses | 1,067 | 115 | 236 | 68 | 111 | 1,597 |
| F.G. | - | - | 119 | 7 | 140 | 266 |
| | 41,666 | 4,639 | 5,156 | 990 | 556 | 53,007 |
| DIFFERENCE: | -4,228 | -473 | -338 | -71 | +148 | -4,962 |
| **CEN. HNL. AIRSHED** | | | | | | |
| BASELINE: | | | | | | |
| Auto | 32,918 | 3,668 | 3,893 | 743 | 248 | 41,470 |
| Buses | 492 | 53 | 108 | 31 | 51 | 735 |
| F.G. | - | - | - | - | - | - |
| | 33,410 | 3,721 | 4,001 | 774 | 299 | 42,205 |
| 8-MI. F.G.: | | | | | | |
| Auto | 29,260 | 3,260 | 3,460 | 660 | 220 | 36,860 |
| Buses | 733 | 79 | 162 | 47 | 76 | 1,097 |
| F.G. | - | - | 119 | 7 | 140 | 266 |
| | 29,993 | 3,339 | 3,741 | 714 | 436 | 38,223 |
| DIFFERENCE: | -3,417 | -382 | -260 | -60 | +137 | -3,982 |

The impact of the additional power requirement caused by the fixed guideway system was analyzed. On Oahu, there are three power generating plants located in downtown Honolulu, north of Pearl Harbor in Waiau, and in Kahe on the Leeward Coast. The first two plants located in Central Honolulu are operating at capacity with no future plans for expansion. Therefore, it is assumed that any new power demand would be supplied from the third plant at Kahe which has adequate capacity to meet future transit demand. Accordingly, any impact on air quality from additional power generation would occur in the Leeward area, near the Kahe plant. Table V-4 shows the estimated emission factors and the emission quantities in 1995 for generating the power required by the 8-mile fixed guideway system based on low sulfur fuel.

TABLE V-4

ANNUAL POWER PLANT EMISSION FOR FIXED GUIDEWAY IN 1995
(TONS/YEAR)

| | Emission Factors | Emission Quantity |
|---|---|---|
| $NO_x$ | 1.44 gms/KWH | 119 tons/year |
| PART. | 0.09 gms/KWH | 7 tons/year |
| $SO_2$ | 1.69 gms/KWH | 140 tons/year |

The critical pollutant in Central Honolulu, is carbon monoxide. It is estimated that a reduction of over 3,000 tons in 1995 would be realized with the fixed guideway system as shown in Table V-3. This figure is conservative based on the fact that the emission factors used for both the baseline and the 8-mile transit systems are based on an average trip speed of approximately 20 mph for auto travel. As an example, if the average auto speed were reduced by 3 mph for the baseline system due to greater congestion, the CO emission would increase by some 12 percent or from 13.3 to 14.9 gms/mile. The result of this reduction in average travel speed would increase the total CO emission in Central Honolulu by some 400 tons per year. Thus, the reduction in CO in Central Honolulu could potentially be nearly 4,000 tons by the proposed action or approximately a 12 percent reduction in CO emitted by autos and buses, if induced automobile trips are not considered.

Oahu has thus far been free from serious or large-scale air pollution problems due to a minimum of heavy industrial complexes and power plant centers. However, the State has adopted ambient air quality standards that are more stringent than national standards (see Table I-3), and has developed an Implementation Plan with control strategies that are intended to preserve and improve the present air quality as shown in Table II-2. Any reduction in pollution emissions will thus help in maintaining and enhancing Oahu's ambient air quality.

c. Local Impact

On Oahu, most air pollution problems are of a localized nature. For example, in downtown Honolulu, the State standard for carbon monoxide concentration has been exceeded a number of times although still below the national standard. Thus the localized impact of the 8-mile fixed guideway system was analyzed for potential effects at the various station locations. An inventory was made to determine the projected increase in automobile and bus traffic in the immediate vicinity of each station which can be directly attributed to the rapid transit station. The projected increases were based on an analysis of the mode of arrival and departure of passengers at each station. The mode of arrival and departure analysis segregated arrivals and departures into five modes: walk, bus, express bus, kiss-and-ride, and park-and-ride. Utilizing this information, the auto and bus traffic attributable to the rapid transit system at each station was tabulated. This data was then analyzed to identify the more critical stations in terms of potential local impact upon air quality. The following five stations were chosen for more detailed analysis as potentially the most extreme cases of impact. The remaining six stations would have less of an impact upon the air quality in the respective local areas. The transit-related vehicular traffic at each of these stations are summarized in Table V-5.

TABLE V-5

VEHICULAR ACTIVITY GENERATED BY FIXED GUIDEWAY
(1995 PEAK HOUR VOLUME)

| Station | Automobile (VPH) | Bus (VPH) |
|---|---|---|
| Keehi Lagoon | 800 | 142 |
| Kalihi | 440 | 87 |
| Fort Street | 230 | 130 |
| Waikiki | 390 | 128 |
| Date Street | 270 | 109 |

T e methodology used in the analysis was to delineate an area roughly equal to one-half mile by one-half mile square around each of the five stations identified above. This created an impact area for which all traffic activity within one-quarter mile of the station would be considered. The projected traffic for 1995 within this impact area was determined for each station. The peak-hour traffic projections for the 8-mile fixed guideway and the baseline system were calculated separately for private automobiles and for trucks and buses. The peak-hour automobile, bus, and truck traffic projections for the baseline and the 8-mile system are summarized for each station in Table V-6.

TABLE V-6

TRAFFIC PROJECTION IN IMPACT AREA OF SELECTED STATIONS
(1995 PEAK HOUR - VPH)

| | Baseline | | 8-Mile Fixed Guideway | | | |
|---|---|---|---|---|---|---|
| Station | Auto | Bus* | Auto | Percent Change | Bus* | Percent Change |
| Keehi Lagoon | 10,241 | 1,678 | 10,019 | - 2.2 | 1,765 | + 5.2 |
| Kalihi | 9,084 | 992 | 8,933 | - 1.7 | 1,043 | + 5.1 |
| Fort Street | 13,094 | 3,915 | 10,793 | -17.6 | 3,871 | - 1.1 |
| Waikiki | 17,086 | 2,170 | 14,953 | -12.5 | 2,236 | + 3.0 |
| Date Street | 10,730 | 1,234 | 9,731 | - 9.3 | 1,263 | + 2.4 |

*Includes commercial vehicle trips as well as bus vehicle trips.

The results of the analysis indicate that at all five stations the peak-hour automobile traffic is projected to generally decrease despite the traffic which is specifically drawn to the area by the rapid transit station. However, the peak-hour bus traffic is projected to increase at all but one of the selected station impact areas studied, Fort Street Station. In the other cases, the increase is approximately 5 percent or less.

To determine the actual net effect that the reduction and/or increase in projected auto and bus traffic would have on the air quality in the station impact area, the following evaluation was made.

Indicated by the Emission Inventory Summary of 1970, prepared by the State of Hawaii Department of Health, motor vehicles accounted for 85 percent of the carbon monoxide (CO) emissions on Oahu. Utilizing the emission factors illustrated in Table V-1, it is estimated that one bus-mile has the equivalent impact of two automobile miles in terms of carbon monoxide emission. Thus, using this ratio the bus traffic could be converted into equivalent automobile traffic and then compared to determine the net change in equivalent vehicular traffic around stations which would then reflect the net change in CO emissions. The equivalent percent change in CO emissions for the selected stations are summarized below:

| | |
|---|---|
| Keehi Lagoon | - 0.3 percent |
| Kalihi | - 0.4 percent |
| Fort Street | -11.4 percent |
| Waikiki | - 9.3 percent |
| Date Street | - 7.1 percent |

The figures shown above indicate that all of the analyzed station areas would have a decrease in equivalent automobile traffic with a fixed guideway system than without. It is especially significant to note that the two most active stations, Fort Street and Waikiki, would experience the largest reduction in vehicular activity, especially since these stations are located in areas with the highest concentration of carbon monoxide. It should be made clear again that the above analyses and findings are based upon the comparison of the conditions that would exist on Oahu, in the year 1995, with and without the 8-mile fixed guideway system in operation. It is not to mean that present levels of vehicular activity would decrease in the future. In fact, vehicular traffic would probably increase in the future. However, this increase would be greater without the fixed guideway system.

Thus, overall, the 8-mile fixed guideway/feeder bus system could have a small but positive impact on the air quality of the region at the local level around station areas. However, it should be pointed out that at a particular intersection near a station, there could be an increase in traffic and hence, a similar increase in localized pollution. In general, air quality near stations should not be notably different from the quality that would prevail without the proposed action.

Although the station area analysis indicated that a general reduction in traffic volumes would occur around transit stations with the proposed transit system than without it, an air quality analysis was performed to determine the CO concentration at a major intersection near one of the transit stations. From a review of various major intersections, the intersection at Kapiolani Boulevard and Kalakaua Avenue was selected for testing due to its high recorded volume of traffic and high observed level of congestion.

The analysis was made using the technique for quantifying hot spot potential contained in the document EPA-450/3-78-033 titled "Carbon Monoxide Hot Spot Guideline, Vol. 1: Technique." In utilizing this approach, the result would lead to a "worst case" condition which could possibly occur by assuming that the "worst case" values for each parameter would occur simultaneously. For example, the highest peak-hour traffic volume is used with the lowest possible wind velocity occurring in the direction that will cause the highest CO concentration at the selected receptor location. The probability of such an occurrence is estimated to be less than once a year.

Maximum one-hour CO concentration was calculated using the above referenced EPA guideline with the resulting value of 11.5 mg/m3 obtained. The maximum eight-hour value was obtained by using 0.7 as the assumed persistence factor and assumed background CO concentration of 1.0 mg/m3 added to the value obtained from the analysis resulting in an eight-hour CO concentration of 9.1 mg/m3. The predicted one-hour and eight-hour values are below the Federal Standards but exceed the State Standards by a small amount (+1.5 mg/m3) for the one-hour concentration and by a larger amount (+4.1 mg/m3) for the eight-hour concentration. This is not surprising since the eight-hour standard is much more difficult to meet than the one-hour standard. However, it should be pointed out that the probability of this level of CO concentration occurring should be less than once each year. Using the most probable wind condition of 3.64 m/s, the one-hour and eight-hour CO concentrations are 4.75 mg/m3 and 4.33 mg/m3, respectively, which are both below the State Standards (10 mg/m3 and 5 mg/m3).

After 1990, the level of CO concentration is expected to decrease as the Federal Motor Vehicle Control Program is fully implemented and its effectiveness increases over time. The proposed rapid transit system will tend to support this decrease by diverting motorists to transit and hence reduce the volume of auto travel as compared to a "no-build" situation. The findings of this analysis is that the proposed action is not likely to have any significant adverse impact on air quality in the transit station area and that the future air quality can be maintained within the Federal Standards.

## A.2. Water and Marine Resources

Discussions in this section deal with the proposed transit system's probable impacts on water quality, aquatic life, wetlands and coastal zones, and flood hazards. In several cases, design decisions that have been made with respect to the compatibility of the system with water and aquatic resources are identified.

### a. Water Quality

Both surface and ground water quality impacts were investigated. Specific concerns were hydrology, sedimentation, and general contamination.

Hydrology: The hydrologic impacts are limited to drainage; analyses relating to floodplains and stream flows are discussed in a later section dealing with flood hazards.

The effects of new facility construction on local area drainage often include: (1) increased peak run-offs due primarily to the introduction of new pavement and other impermeable surface treatments, and (2) a resultant lowering of the ground water table due to prevention of natural recharge beneath paved surfaces. The proposed guideway structures will have little or no hydrologic effect due to the limited surface area required. Stations without extensive park-and-ride facilities -- applicable to nearly all stations -- will not be expected to have an adverse impact on run-off or ground water level. The proposed yard and shop site will be located in an existing industrial area. Large portions of the area now have oiled surfaces for dust control and to facilitate surface drainage. The construction of the yard and shop facilities will alter existing conditions somewhat by increased building and paved areas. However, a good portion of the site will remain unpaved or landscaped and can be gently graded to facilitate percolation and minimize storm run-offs into Keehi Lagoon.

Sedimentation Control: One of the major environmental concerns in the construction and maintenance of the transit system is that of erosion and sedimentation. Any disturbance of the existing land area surface whether it be vegetation, paving or a structure will expose the ground surface to erosion. Damage due to erosion and sedimentation is generally acute during construction and has both long and short-term implications. However, the fixed guideway system will be located in highly urbanized areas which already contribute sediments into the drainage systems; therefore, the system should not contribute toward further degradation.

A more detailed description of erosion and sedimentation control is contained under the section "Construction Impacts."

After construction of the guideway and station facilities, the amount of sediment flowing into streams and bodies of water is not expected to be significantly different from the amount currently being discharged. In fact, the quantity of sediment more likely could be reduced by appropriate site design and maintenance of these facilities by a public agency.

The particular element of the transit system that requires the closest attention during design and construction would be the yard and shops facility. Measures which can be taken to control erosion and sedimentation from this area are described in the following section on "Aquatic Life."

General Contamination: The primary source of potential contaminants are from the yard and shop area where transit cars will be serviced, repaired and stored. Appropriate mitigation measures will be adopted during final design of this facility in consultation with cognizant regulatory agencies. Mitigation measures to accommodate potential problem sources are as follows:

(1) Washwater: Significant quantities of water will be used for many purposes within the yard. The water becomes contaminated with substances such as dirt, litter, oil, grease and disintegrated asphalt. This washwater will be collected, filtered using charcoal filters or other devices to remove pollutants and the filtered washwater will be recycled.

(2) Lubrication Oil Wastes: These wastes originate from the wash area and maintenance shop. The dirty oil drained from these sources will be collected and retained in holding tanks and will be disposed of at off-site locations and will meet City and State requirements. Possibilities for disposal include sale to local oil refineries for oil processing.

(3) Oil Spills: There is always a possibility of accidental spills in the yards and shop area. When possible, oil spills will be diverted immediately to holding tanks located at suitable locations so that these spills can be

held separate and removed quickly for safe disposal before they are allowed to mix with stormwater runoff or percolate into the ground. Other quick remedial measures such as possible use of foams would also be considered. Operating instructions will need to be developed to cover such contingencies.

(4) Storage Tanks: Special precautions are needed in the design of the underground storage tanks, if used, to prevent petroleum products from infiltrating the underground soils. Studies will need to be made as to use of concrete vaults with inspection access so that leaks can be immediately corrected. If above ground storage is used, a paved surface will need to be provided so that leaks or spills can be detected and collected. The design of these facilities will give maximum consideration to the possibility of leaks and spillage.

(5) Spray Paint Wastes from Spray Paint Area: Should it be necessary to have a spray paint operation the overspray paint from the spray paint area of the yard and shop site will be collected to prevent it from affecting the environment or other operations and treated by the available methods of control such as water absorption, carbon absorption and diluted extraction. The contaminated water will be filtered to remove the paint pollutants.

(6) Blowdown Area Waste: The debris and all undesirable material from this area will be collected as solid waste and disposal will be offsite.

b. Aquatic Life

Though the proposed route crosses several streams, the anticipated adverse environmental impacts on aquatic life are expected to be minor. Based on information contained in the Federal Register concerning endangered and threatened wildlife and plants, no endangered species of aquatic life are found in the streams of Central Honolulu. As stated earlier in Section II.A.3, only endemic and indigenous aquatic life are found near shore and in the streams of Central Honolulu. These species are typical of aquatic habitats in other areas of Oahu. Also, the existing water quality of the streams is not pristine because the drainage areas have been developed and modified. Channelization of the streams, existing bridges and other structures have also modified stream flows and affected the aquatic life. In order to prevent further degradation of the water quality and to prevent further disruption of the aquatic life, the location and number of structural supports (when needed) for the transit system will be minimized when crossing streams. All such crossings will require Section 10 and 404 permits from the U.S. Corps of Engineers in coordination with the U.S. Coast Guard and the U.S. Fish and Wildlife Service. During the preparation of this EIS, close coordination with these agencies was conducted and a determination made of no significant problems associated with the proposed stream crossings.

Also, special precautions to minimize any adverse impacts on aquatic life will be taken and enforced by specification in the construction documents for areas of special concern. For the guideway crossings of the Moanalua and Kalihi Streams and the development of the yard and shop site, special precautions to prevent siltation of Keehi Lagoon is important in that it is one of three areas where Nehu is obtained as a baitfish for the tuna fishermen. Although adult Nehu are relatively tolerant to a wide range of water conditions, little is known about their tolerances during the larvae and juvenile stages. Therefore, any change in water quality due to the disturbance of existing sediments during construction of the guideway piers or from turbulence due to the obstruction of stream flow by the piers should be minimized.

The two major streams with outlets into Keehi Lagoon, Moanalua Stream and Kalihi Stream, due to their widths, will require support structures to be located in these streams which will obstruct water movement to some degree. However, bridges already exist and the impact of the proposed structures will not be as great as the effects produced by the existing bridges. Although the magnitude of the impact upon the marine environment is considered to be only minor due to the proposed structures, the number of support structures in the streams should be kept to a minimum.[29]

Precautions which can be taken to minimize silt from entering Keehi Lagoon for the stream crossing segment include use of siltation curtains at the mouth of Moanalua Stream and construction to be undertaken during the non-rainy season. Siltation from the proposed yard and shop site could be controlled by directing storm waters into siltation ponds, redirecting flows into unpaved landscaped areas and grading to lower storm water velocities.

Proper maintenance of the paved areas after construction, sweeping to remove refuse, soil, etc., and appropriate treatment/disposal of chemicals and petroleum products in conformance with applicable regulations, will also aid in preventing potential contaminants from reaching Keehi Lagoon.

In addition, site filling and construction activities, for the yard and shop area, will be set back sufficiently from the water's edge to prevent potential sliding and slumping into the water.

c. Wetlands and Coastal Zones

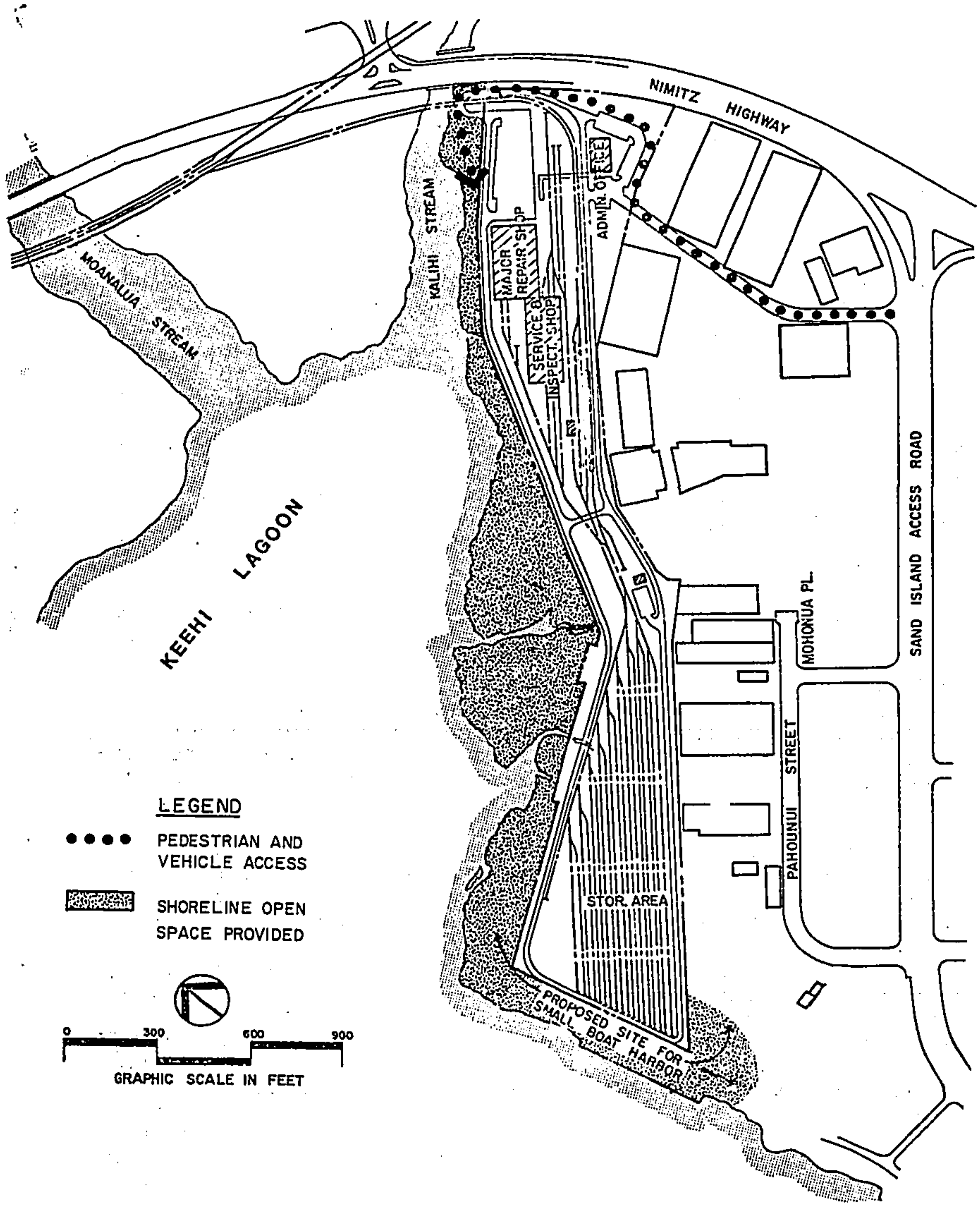
There are no wetlands located in the portion of urban Honolulu traversed by the proposed rapid transit system. However, certain elements of the system will be located adjacent to or in the designated "special management area" of the coastal zone of Oahu. The proposed project will require a public hearing and action by the City Council.

Urban Honolulu is located on the southeasterly coastal plain of the island which is a relatively narrow strip of flat land sloping gently from the leeward slopes of the Koolau Range to the ocean. Major activity centers are mostly located on or near the coastline and with transit to serve these centers, the guideway route would necessarily be near the coastline. Of the various feasible alternative routes studied, as described in Section III.D and as shown in Figure III-13, all routes would have certain portions of the system located in the special management areas at the Airport and in the Keehi Lagoon area. Thus, there are no prudent alternatives that will keep the system entirely out of the special management area.

One of the most significant elements of the system (and the only one in the selected 8-mile system) to be sited in the special management area is the yard and shop facilities on the eastern shore of Keehi Lagoon. This site was selected for its large area, central location, accessibility to the mainline, and minimal relocation and development impacts. As described in Section III.D.3, alternative sites were examined but were found to be lacking in one or more of these features.

A number of agencies were contacted in the site's planning stages, including the City and County of Honolulu, Department of Parks and Recreation, and the State of Hawaii Department of Transportation, Water Transportation Facilities Division. The Water Transportation Facilities Division contemplates developing a small boat harbor and marina just south of the yard and shops site and requested that a 150-foot setback from the shoreline be provided. The Department of Parks and Recreation requested that a 50-foot setback be maintained along the eastern Keehi Lagoon shore to enable development of a waterfront park running continuously from Keehi Lagoon Park (on the western shore of the lagoon) to the new marina. The design of the yard and shops site accommodates these requests (Figure V-2). Access to the strip of open space along the shoreline of the lagoon will be provided as shown in Figure V-2 from Sand Island Access Road around the northern perimeter of the project site.

Though the risk of contaminant discharges from construction and operation of the yard and shop facilities is estimated




**PROPOSED YARD & SHOPS SITE LAYOUT**
**WITH LOCATION OF AVAILABLE ACCESS TO SHORELINE OPEN SPACE**

Figure V-2

as minor, precautions should nevertheless be taken to further reduce such likelihoods. Every precaution will be taken in the design of the facilities, specifications of equipment, and the actual procedures to be used in the operation and maintenance of the facilities and equipment to ensure that no contaminants are discharged into the lagoon.

Certain portions of the guideway and station facilities will be on the border of or will encroach into the special management area including the segment along the northerly boundary of the Airport property along Aolele Street and the segment along Keehi Lagoon Park's northern boundary including the crossing of Moanalua and Kalihi Streams.

The above guideway segments are located either adjacent to freeways, or in aerial configuration traversing developed areas whereby any publicly owned or used beaches, recreation areas, and natural reserves would not be significantly affected in terms of access thereto, alteration to existing land forms or vegetation, quality of water, and scenic or recreational amenities.

d. Floodplains

The proposed action constitutes an "encroachment" as defined by DOT Order 5650.2 "Floodplain Management and Protection", dated April 23, 1979. Approximately one-fifth (9,000 ft.) of the guideway alignment traverse the base floodplain area. The specific limits of the base floodplain are shown in Figure V-3.

The guideway will be an aerial structure throughout the floodplain areas. A minimum clearance of 16.5 feet will be maintained between the bottom of the structure and ground level. This places the base of the guideway structure and the system's stations above the actual water level of the 100-year flood thus minimizing any potential risk.

Urban Honolulu is a densely built-up urban environment without any significant natural areas which benefit from recurring flooding action. As defined in the DOT Order, impacts on the "natural and beneficial floodplain values" are not applicable to the proposed action.

The proposed system will be designed to remain operable in the event of a 100-year flood. Structures providing access to two of the eleven stations are located within the area of inundation. Where practicable, design of the access structures which include stairs, elevators and escalators, will incorporate features designed to reduce effects of water entry. Power distribution rooms, which are required at each station and at the maintenance facility, have been located at ground level; technically, however, these facilities do

## Location of Stream, Floodplain & Special Management Area Crossings

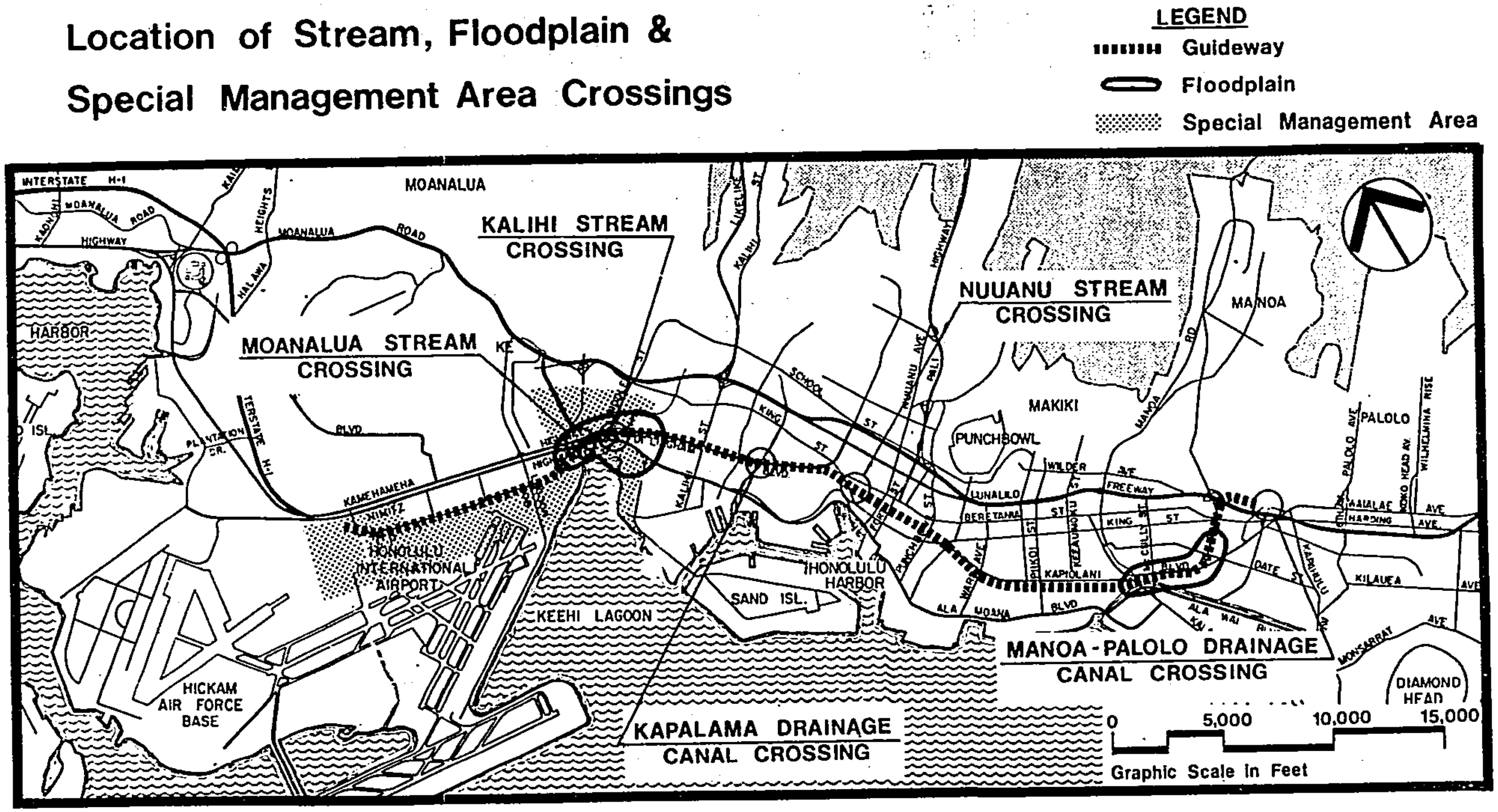



FIGURE V-3

not represent an encroachment on the 100-year floodplain since the floor level of these rooms will be above the flood level elevation. In general, the design of the power distribution rooms will include the appropriate features required to keep the water out, thus minimizing threats to property and the continued operation of the system.

The proposed guideway does not represent a "significant encroachment" as defined by the DOT floodplain Order because it does not result in one or more of the following construction or flood related impacts:

- in the event of a 100-year flood, the proposed system will not contribute to a considerable probability of the loss of human life;
- likely flood related damage associated with the proposed guideway system is not likely to be substantial in cost or extent nor is a 100-year flood likely to cause an interruption in service on or loss of a vital transportation facility;
- there will not be a notable adverse impact on natural and beneficial floodplain values.

It has been determined that the guideway in aerial configuration will not have any significant impact on the floodplains or flood-prone areas that they traverse as defined in the Flood Insurance Rate Map (FIRM). The remaining guideway segments in underground configuration do not come near floodplains. Only transit stations with at-grade concourse levels and/or bus/auto interface may, be affected by the floodplain areas. Two stations of the 8-mile segment fall into this category, identified through consultation with the U.S. Corps of Engineers and study of the FIRM prepared by the U.S. Department of Housing and Urban Development, Fire Insurance Administration. These stations are the Waikiki Station and the Date Street Station (Figure V-3). The proposed yard and shops site is also in a floodplain area. The construction of the transit facilities at these three sites should not alter significantly the existing characteristics of the floodplain area since all sites are currently developed with existing structures and/or paved areas. The determination of no significant impact to the floodplains has also been made by the U.S. Corps of Engineers and documented in their letter of April 9, 1979.

The U.S. Corps of Engineers has recommended that the design of transit facilities situated in floodplains maintain certain minimum safe elevations to minimize impacts of a 100-year storm on the system. These elevations are shown below along with existing average ground elevations.

| Location | Minimum Safe Elevation (Ft. Above M.S.L.) | Average Existing Ground Elevation (Ft. Above M.S.L.) |
|---|---|---|
| Waikiki Station | 8.0 | 4.5 |
| Date Street Station | 10.0 | 5.0 |
| Yard and Shops Site | 6.0 | 3.5 |

Development of the transit system should not contribute to flood hazard in any case. Nevertheless, the project's final design should incorporate measures to control drainage and minimize the potential of flood damages. All applicable state and local ordinances dealing with flood control and drainage should be strictly followed and consultation with such public agencies as the U.S. Corps of Engineers may identify additional means to this end.

The secondary impact of the proposed action relative to incompatible development in the floodplain area is considered to be negligible. The proposed action is known to support high density developments but since the affected area is currently zoned for and already developed into a high density area, the impact will be minimal, if any.

According to the U.S. Geological Survey "Map of Flood-Prone Areas," no portion of the proposed fixed guideway system will be located in an area that could be inundated by a 100-year tsunami.

## A.3. Natural, Ecological, or Scenic Resources

### a. Wildlife and Vegetation

The transit facilities are located entirely in urbanized areas. Areas that are essentially natural in character and which serve as wildlife habitats as shown in Figure II-4, are not directly involved. In fact most of the route is in existing street and highway rights-of-way.

A considerable variety of vegetation which are generally of common type and primarily "landscape" in character occurs within the Honolulu area. Roadside or roadway median vegetation is found throughout the system route and consists of shrubs or trees. The impact of the transit system will be largely short-term in that replanting will restore disturbed areas to as near their original conditions as possible.

Those publicly or privately owned lands, planned to be used for the system facilities, with existing vegetation and trees will be appropriately landscaped. Mature trees would be saved wherever possible, and in some cases they would be replanted in nearby locations when compatible to the overall system landscape plan. Trees that cannot be replanted will be replaced with similar type trees wherever they are compatible with the landscape scheme.

During the construction period, provisions will be made to preserve these resources, within the project area and outside the limits of permanent work performed under the various construction contracts, in their existing condition or will be restored to a natural condition that will not detract from the appearance of the surrounding area. Except in areas marked on the construction drawings to be cleared, it shall be clearly specified that the contractor shall not deface, injure or destroy trees or shrubs nor remove or cut them without approval. Any tree or other landscape features scarred or damaged by the contractor's equipment or operation shall be restored as nearly as possible to its original condition by replacement if necessary.

A survey was conducted to identify major trees and palms within the proposed construction limits of the transit system. The affected plant materials was grouped into three categories:

1. Plant materials recommended for relocation,
2. Plant materials recommended for removal, and
3. Plant materials to remain; however, pruning may be necessary as per present preliminary plans.

Table V-7 lists the quantity, type, and size of plant materials affected under the three categories.

Although none of the plant materials listed are of an endangered species, there are certain large trees of high quality which are recommended for removal. These are:

21 True Kamani (Calophyllum inophyllum) trees located along the makai side of Dillingham Boulevard and

one large Banyan (Ficus retusa) tree located in the University Quarry.

## A.4. Energy Resources

The fixed guideway/feeder bus system is projected to divert many motorists to potential transit users, thus resulting in energy savings. Although the proposed fixed guideway system would consume electric energy and the feeder buses diesel fuel, the net result is that there would be an overall savings in fuel consumption.

If the proposed transit system were not implemented, and assuming the continued use of the existing bus system only

## TABLE V-7 PLANT MATERIALS AFFECTED

RELOCATION:

| QUANTITY | COMMON NAME<br>BOTANICAL NAME | SIZE |
|---|---|---|
| 52 | Coconut<br>Cocos nucifera | 25'-35'<br>overall ht. |
| 7 | Hala<br>Pandanus odoratissimus | 12'-30' ht. |
| 1 | Gold Tree<br>Cybistax donnell-smithii | 6" cal., 15' ht. |
| 5 | Rainbow Shower<br>Cassia javanica x.c.fistula | 6"-8" cal.,<br>15'-20' ht. |
| 34 | Monkeypod<br>Samanea Saman | 15"-36" cal.,<br>20'-30' ht. |
| 1 | True Kamani<br>Calophyllum inophyllum | 12" cal., 20' ht. |
| 2 | Orchid Trees<br>Bauhinia var. | 6" cal., 20' ht. |
| 3 | Singapore Plumeria<br>Plumeria obtsua | 6"-8" cal.,<br>20'-25' ht. |
| 8 | Milo<br>Thespesia populnea | 8"-10" cal.,<br>25'-30' ht. |
| 1 | Sausage Tree | 8" cal.,<br>12' ht. |
| 15 | Wiliwili<br>Erythrina sandwicensis | 6"-8" cal.,<br>20'-25' ht. |
| 10 | Fishtail Plam<br>Caryota urens | 4"-5" cal.,<br>7'-10' ht. |
| 1 | Fiddlewood<br>Citharexylum spinosum | 6" cal., 10' ht. |
| 4 | Banyan - Chinese<br>Ficus retusn | 18"-30" cal.,<br>20'-30' ht. |
| 2 | Kalamona<br>Cassia glauca | 6" cal., 10' ht. |
| 3 | False Olive<br>Elaeodendron orientale | 6"-10" cal.,<br>15' ht. |

REMOVE:

| QUANTITY | COMMON NAME<br>BOTANICAL NAME | SIZE |
|---|---|---|
| 21 | True Kamani<br>Calophyllum inophyllum | 24"-36" cal.,<br>25'-35' ht. |
| 6 | Brassaia<br>Brassaia actinophylla | 6"-12" cal.,<br>15'-25' ht. |
| 1 | Avocado<br>Persea var. | 12" cal., 15' ht. |
| 2 | Pink Tecoma<br>Tabebuia pentaphylla | 6"-10" cal.,<br>20' ht. |
| 1 | Tabebuia var.<br>Tabebuia var. | 8" cal., 20' ht. |
| 1 | Italian Cypress<br>Cypresses sempervirens | 6" cal.,<br>15' ht. |
| 3 | Ohia<br>Metrosideros collina | 8"-12" cal.,<br>15'-20' ht. |
| 1 | Mango<br>Mangifera indica | 18" cal.,<br>30' ht. |
| 3 | African Tulip<br>Spathodea campanulata | 10"-24" cal.,<br>15'-30' ht. |
| 1 | Keawe<br>Prosopia pallida | 30"-36" cal.,<br>40" spr. |
| 1 | Banyan - Chinese<br>Ficus retusa | 48"-60" cal.,<br>40'-60' spr. |
| 4 | Opiuma<br>Pithecellobium dulce | 24"-30" cal.,<br>25'-30' ht. |
| 1 | Singapore Plumeria<br>Plumeria obtusa | 18" cal., 30' ht. |
| 4 | Norfolk Pine<br>Araucaria heterophylla | 6" cal., 20' ht. |

REMAIN:

| QUANTITY | COMMON NAME<br>BOTANICAL NAME | SIZE |
|---|---|---|
| 28 | Monkeypod<br>Samanea saman | 18"-24" cal.,<br>20'-30' ht. |
| 1 | Hala<br>Pandanus odoratissimus | 4"-6" cal., 12' ht. |
| 1 | Keawe<br>Prosopia pallida | 36" cal., 50' spr. |
| 3 | Coconuts<br>Cocos nucifera | 20'-35' overall ht. |
| 1 | Royal Poinciana<br>Delonix regia | 12" cal., 15' ht. |
| 1 | Banyan - Chinese<br>Ficus retusa | 48" cal., 40' spr. |
| 2 | Nara or Narra<br>Pterocarpus indicus | 20"-30" cal.,<br>25'-35' ht. |
| 1 | Mango<br>Mangifera indica | 36" cal., 20' spr. |
| 1 | Tamarix<br>Tamarix aphylla | 24" cal., 30' ht. |
| 1 | Rainbow Shower<br>Cassia javanica x c.fistula | 6" cal., 15' ht. |

Source: Survey by Iwamoto & Associates, Landscape Architects, Oct. 1977 slightly modified to accommodate increased patronage (Baseline Bus System from Chapter III), the savings in gross fuel consumption with the proposed transit system would be approximately 3.6 million gallons of equivalent gasoline, annually, in 1995. Currently, approximately 250 million gallons of fuel are consumed by motor vehicles on Oahu. This amount of fuel savings is the result of the projected number of motorists diverted to transit from the total number of trips estimated to be taken without the rapid transit system (Table V-2). The following tabulation shows the gross energy effects of the proposed action including vehicle maintenance and fuel refining losses.

TABLE V-8

ENERGY SAVINGS

| | Fuel Saved--Diverted Motorists (gasoline) | Addit'l. Fuel--Feeder Buses (diesel) | Fuel for Electric Power--Rail Operations (residual) | Daily Savings |
|---|---|---|---|---|
| Gross Fuel (gals./day) | -46,900 | +13,500 | +18,500 | -14,900 |
| Total Energy ($10^9$ Btu) | - 5.86 | + 1.84 | + 2.52 | - 1.50* |
| Equivalent Gals. Gasoline | -46,900 | +14,700 | +20,200 | -12,000 |

*If 18 percent of auto fuel consumed is included for auto manufacturing and highway construction, the daily savings in energy is $2.36 \times 10^9$ Btu or over $200 \times 10^6$ kwh per year.

In order to realize the above fuel savings, construction and manufacturing energy will be expended for the transit facilities and equipment which is estimated to take up to 3 billion kwh of energy. This amount of energy over the life of the project translates to some 100 million kwh of energy per year. Even in the early years of operation, it is estimated that over 200 million kwh of energy will be saved annually through the proposed action which will give a net positive savings even considering the construction and manufacturing energy. Based on the projected transit ridership estimates, it will take approximately 15 years to recover the energy ex ended for construction and manufacturing of the proposed system. With the anticipated continued growth in transit ridership net energy savings will become substantial beyond the recovery period.

## B. COMMUNITY IMPACTS

### B.1. Noise and Vibration Impacts

Noise and vibration impacts are among the most difficult to evaluate, since they are largely a product of sensitivity. Also, the periodic nature of transit system noise may tend to make a sound annoying that would ordinarily be unobtrusive. Analyses of noise and vibration impacts are based on extensive experience with comparable transit systems in other cities and existing ambient noise levels (measured twice, first in July, 1972 and later in June-July, 1975) at selected key points along the proposed transit route segment evaluated (Figures V-4, V-5 and V-6).[4]

Conventional steel wheel/rail transit systems having modern design features and facilities such as continuously welded rails have low noise characteristics compared to systems utilizing bolted rails. The use of dampened or resilient steel wheels can significantly reduce wheel squeals while negotiating short-radius curves. The steel wheel system also produces noise at a higher frequency which may be more identifiable in the presence of typical community noise which is made up of lower frequency noise produced by rubber-tired motor vehicles.

#### a. Noise & Vibration Standards

The American Public Transit Association (APTA) has made extensive studies on the probable response of people to the noise created by transit system operations. It was found that defining the acceptability of tansient noises from transit operations is difficult and although overall transit noise levels are comparable to some existing community noises, such as street and highway traffic, transit operations can represent a new noise nuisance in the community. Therefore, acceptability guidelines or standards should be carefully applied according to land usage and typical ambient noise levels. In APTA's "Guidelines and Principals for Design of Rapid Transit Facilities", a recommended procedure to be used for design purposes is outlined. The APTA Guidelines contain noise level design goals for five general land use or community area categories and for selected types of buildings or occupancies requiring specific design goals as shown in Table V-9.

# Community Noise Survey Locations

● 1972 Survey Locations
▲ 1975 Survey Locations

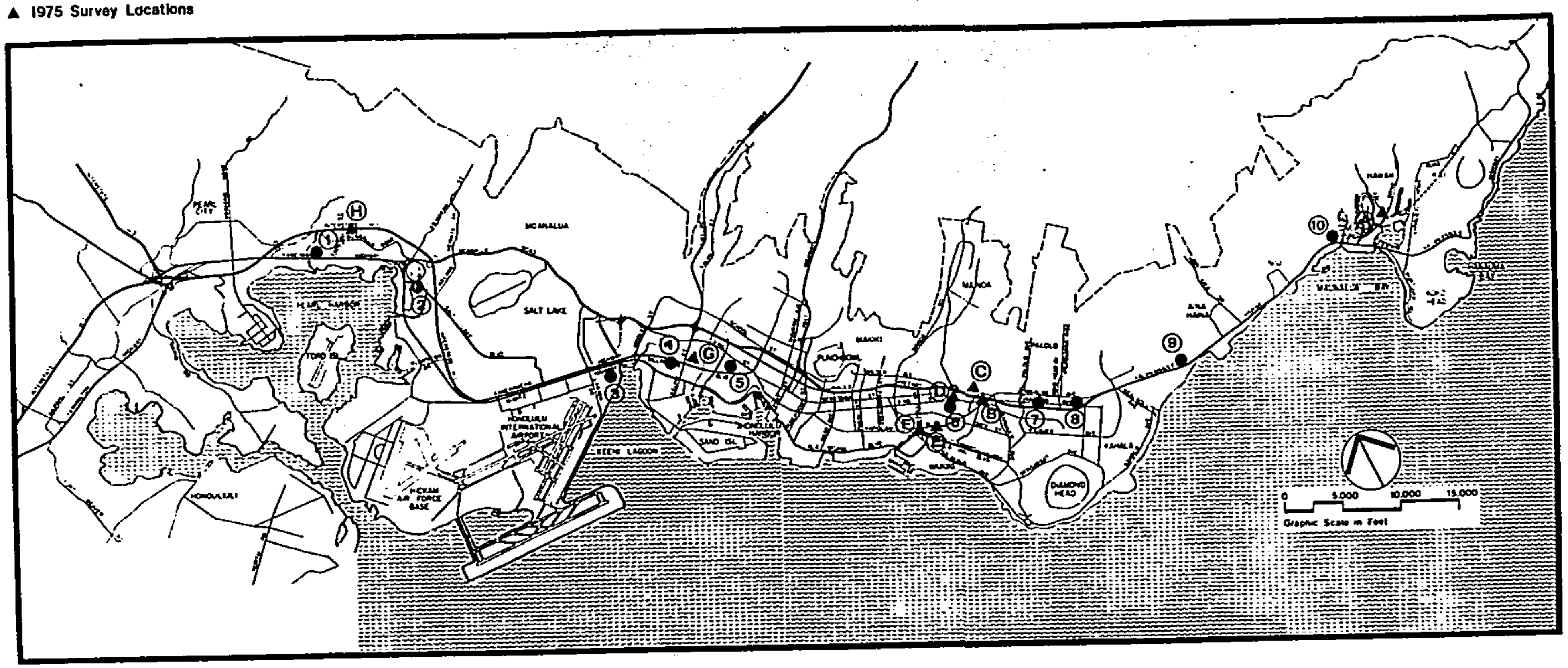
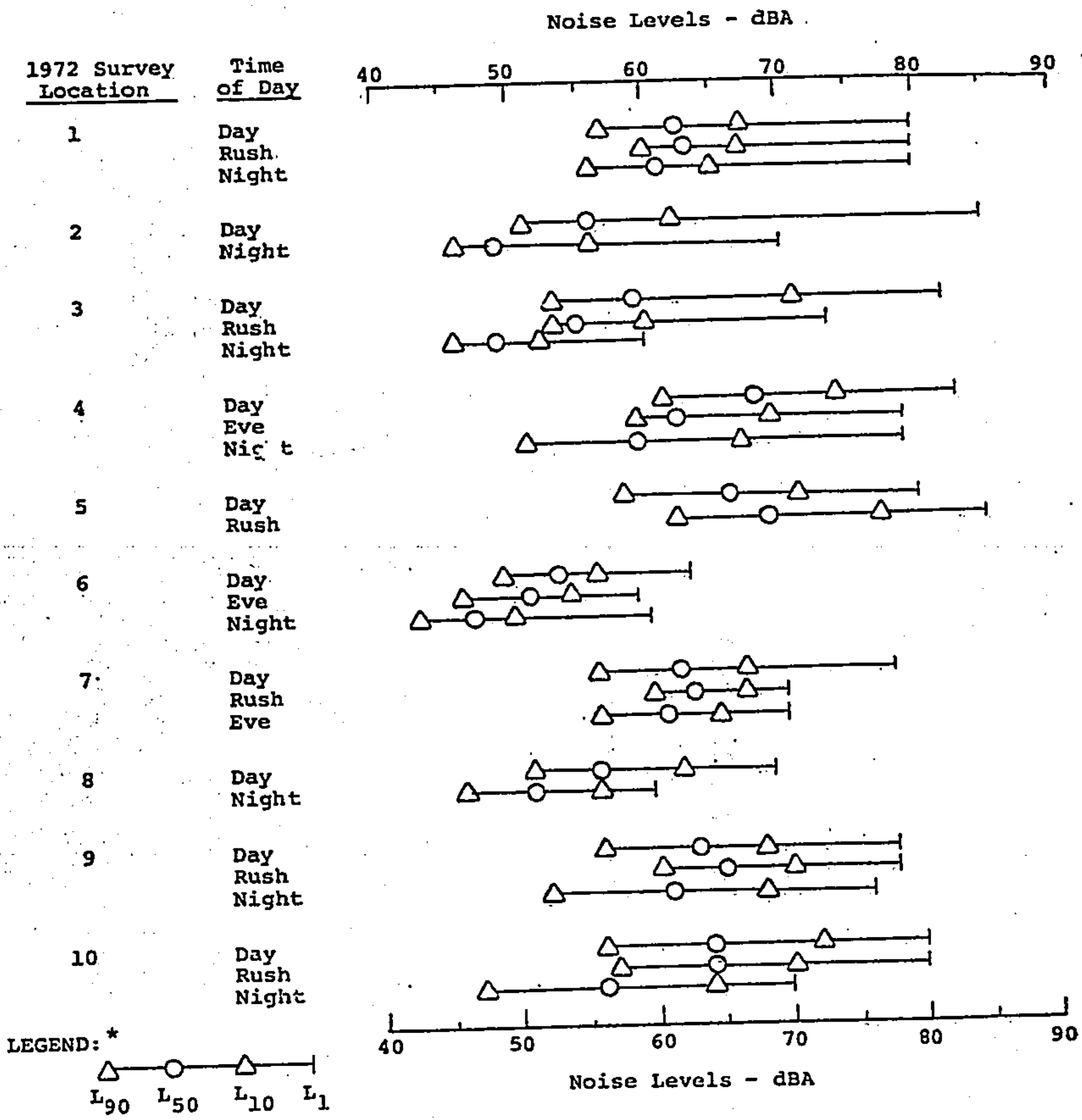


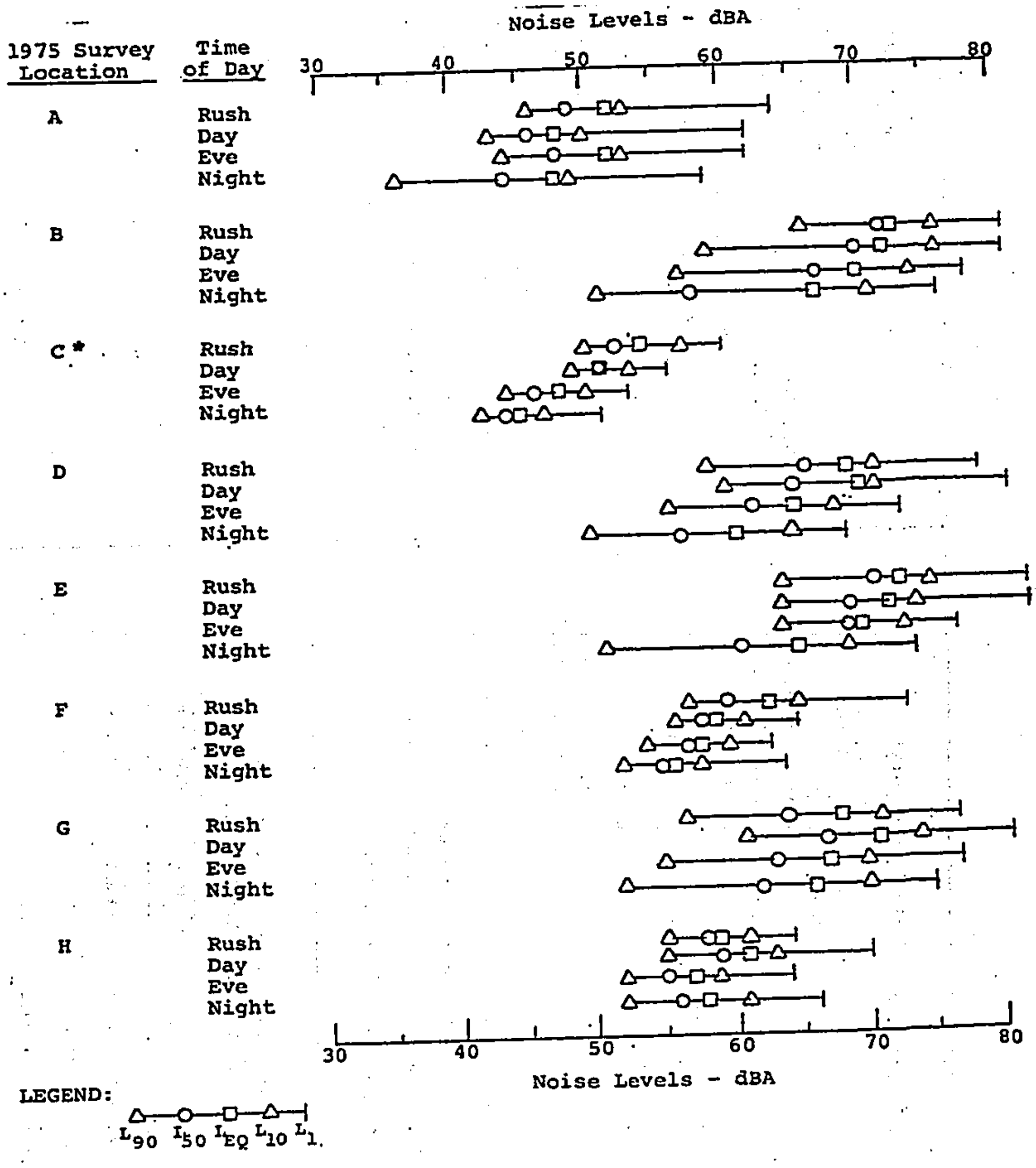

FIGURE V-4

FIGURE V-5
COMMUNITY NOISE LEVELS ALONG THE PROPOSED RAPID TRANSIT SYSTEM ROUTE [4]




* $L_{90}$, $L_{50}$, $L_{10}$, and $L_1$ are A-weighted noise levels exceeded 90, 50, 10, and 1 % of the time, respectively

FIGURE V-6
COMMUNITY NOISE LEVELS ALONG THE PROPOSED RAPID TRANSIT SYSTEM ROUTE[4/]




* This location is shielded by buildings from the freeway.

TABLE V-9

GUIDELINES FOR MAXIMUM NOISE FROM TRAIN OPERATIONS

**AIRBORNE NOISE FROM SURFACE TRAIN OPERATIONS**

| Community Area Category | Single Event Maximum Noise Level Design Goal* — Single Family Dwellings | Multi-Family Dwellings | Commercial Buildings |
|---|---|---|---|
| I Low Density Residential | 70 dBA | 75 dBA | 80 dBA |
| II Average Residential | 75 | 75 | 80 |
| III High Density Residential | 75 | 80 | 85 |
| IV Commercial | 80 | 80 | 85 |
| V Industrial/Highway | 80 | 85 | 85 |

| Building or Occupancy Type | Single Event Maximum Noise Level Design Goal |
|---|---|
| Amphitheatres | 60 dBA |
| "Quiet" Outdoor Recreation Areas | 65 dBA |
| Concert Halls, Radio and TV Studios, Auditoriums | 70 dBA |
| Churches, Theatres, Schools, Hospitals, Museums, Libraries | 75 dBA |

* Applies to nighttime operation

**AIRBORNE NOISE FROM SUBWAY TRAIN OPERATION (FAN & VENT SHAFTS)**

| Community Area Category | Maximum Noise Level Design Goal — Transient Noises | Continuous Noises |
|---|---|---|
| I Low Density Residential | 50 dBA | 40 dBA |
| II Average Residential | 55 | 45 |
| III High Density Residential | 60 | 50 |
| IV Commercial | 65 | 55 |
| V Industrial/Highway | 75 | 65 |

**GROUND-BORNE NOISE FROM SUBWAY TRAIN OPERATIONS**

| Community Area Category | Maximum Single Event Ground-Borne Noise Level Design Goal — Single Family Dwellings | Multi-Family Dwellings | Hotel/Motel Buildings |
|---|---|---|---|
| I Low Density Residential | 30 dBA | 35 dBA | 40 dBA |
| II Average Residential | 35 | 40 | 45 |
| III High Density Residential | 35 | 40 | 45 |
| IV Commercial | 40 | 45 | 50 |
| V Industrial/Highway | 40 | 45 | 55 |

| Type of Building or Room | Ground-borne Passby Noise Design Goal |
|---|---|
| Concert Halls and TV Studios | 25 dBA |
| Auditoriums and Music Rooms | 30 dBA |
| Churches and Theatres | 35 dBA |
| Hospital Sleeping Rooms | 35-40 dBA |
| Courtrooms | 35 dBA |
| Schools and Libraries | 40 dBA |
| University Buildings | 35-40 dBA |
| Offices | 35-45 dBA |
| Commercial Buildings | 45-55 dBA |

**STATION INTERIOR NOISE LEVEL**

| Type of Station | Maximum Noise Level Design Goal |
|---|---|
| Above-Ground Station | 80 - 85 dBA |
| Underground Station | 85 dBA |

Source: American Public Transit Association

The noise level design goals were derived by APTA considering typical ambient noise levels for each community area category and the maximum transit noise levels that should receive community acceptance if they are not exceeded. APTA's typical (average or $L_{50}$) ambient noise levels for each community area category were compared to the community noise level measurements taken along the proposed transit route and they were found to be in close correlation with Honolulu's average ambient noise levels and also found to be generally in the upper range of APTA's levels. Furthermore, the State Department of Health agreed that the use of the APTA Guidelines appeared appropriate as a reference in the development of the noise criteria to assess the impact of the fixed guideway system. Accordingly, the APTA Guidelines were followed in the detailed noise evaluation of the various segments of the transit line discussed in this section.

The use of a single event *maximum* passby noise level has been adopted in the APTA Guidelines rather than any of the "noise exposure level" evaluation schemes. Since transit noise is of short duration, it may appear acceptable on a calculated exposure level basis but, because of the possible large differences between maximum passby levels and average community ambient noise, the train noise may be unacceptable because of its magnitude. Therefore, the APTA Guidelines recommends single event maximum noise levels for transit system facility design.

The primary sources of wayside intrusion or annoyance due to noise and vibration created by a transit facility are:

- Airborne noise from at-grade and aerial train operations.
- Ground-borne noise and vibration from subway operation.
- Airborne noise from fan and vent shaft openings.

The APTA Guidelines shown in Table V-9 also specify noise level design goals for each of the above primary noise sources.

b. Predicted Noise and Vibration Levels of Train Operation

Based on the experience gained from transit operations on the San Francisco Bay Area Rapid Transit System (BART), the Washington Metropolitan Area Transit Authority (WMATA) Metro System and other recently designed rapid transit systems, levels of expected wayside noise and vibration from train operations have been determined to provide a basis for evaluating the expected impact of the transit system on the Honolulu community. Expected airborne noise levels for transit passbys on surface tracks (at-grade or aerial) can be readily predicted, both with and without sound barrier walls, based on data obtained from various operating transit facilities. Table V-10 shows the expected noise levels from surface operations for both ballast and tie roadbed on at-grade segments and concrete roadbed on aerial segments.

TABLE V-10

TYPICAL AIRBORNE NOISE LEVELS FROM SURFACE TRANSIT OPERATIONS 4/
(in dBA at 50 ft. from vehicles)

BALLAST & TIE ROADBED (AT GRADE)

| | No Sound Barrier Wall | | | With Non-Absorptive Sound Barrier Wall | | |
|---|---|---|---|---|---|---|
| Speed (mph) | 2-cars | 4-cars | 6-cars | 2-cars | 4-cars | 6-cars |
| 40 | 77 | 79 | 80 | 72 | 74 | 75 |
| 50 | 79 | 81 | 82 | 74 | 76 | 77 |
| 60 | 81 | 83 | 84 | 76 | 78 | 79 |

CONCRETE ROADBED ON AERIAL STRUCTURE

| | No Sound Barrier Wall | | | With Absorptive Sound Barrier Wall | | |
|---|---|---|---|---|---|---|
| Speed (mph) | 2-cars | 4-cars | 6-cars | 2-cars | 4-cars | 6 cars |
| 40 | 81 | 83 | 84 | 72 | 74 | 75 |
| 50 | 83 | 85 | 86 | 74 | 76 | 77 |
| 60 | 85 | 87 | 88 | 76 | 78 | 79 |

TABLE V-11

TYPICAL GROUND-BORNE NOISE LEVELS[4]/
FROM SUBWAY TRANSIT OPERATIONS

(in dBA for 4-car trains @ 60 mph at various distances)

| | Rigid Inverts With Resilient D.F. Fasteners | Resiliently Supported Ties | Floating Slab Trackbeds |
|---|---|---|---|
| Small Lightweight Buildings at: | | | |
| 15 ft | 48-59 dBA | 41-51 dBA | 36-46 dBA |
| 30 ft | 44-54 | 35-45 | 29-41 |
| 60 ft | 33-43 | 28-38 | 18-30 |
| 100 ft | 23-33 | 19-29 | 8-20 |
| Heavy Masonry Buildings at: | | | |
| 15 ft | 40-50 dBA | 33-43 dBA | 25-37 dBA |
| 30 ft | 34-45 | 27-37 | 20-32 |
| 60 ft | 25-35 | 20-30 | 10-22 |
| 100 ft | 16-26 | 11-21 | 1-13 |

Prediction of the expected sound levels in buildings adjacent to subway portions cannot be done with the precision or confidence associated with the prediction of noise from surface operations. There is, however, a considerable amount of background information available that permits prediction of expected noise level with reasonable confidence. The prediction apply to ground-borne vibration from subway train operation for a system with modern design features, including continuous welded rail, resilient rail fasteners, resilient supported ties, and floating slab trackbeds. Table V-11 shows the expected noise level radiated inside nearby buildings due to building structure vibration.

Another source of noise intrusion from subway operations is airborne noise from fan and vent shaft openings. There is some variation in the noise levels due to variations in the size of fan and vent shafts and due to variations in train speeds and the reverberent conditions in the subway. However, to assist in determining the noise reduction measures necessary to reduce these noise to satisfactory levels, the typical noise levels from train operations and from ventilation fan operations have been determined and shown in Table V-12.

TABLE V-12

TYPICAL AIRBORNE NOISE LEVELS FROM FAN AND VENT SHAFTS[21] OF SUBWAY TRANSIT OPERATION

(at 30 feet from the center of the surface outlet and 5 feet above grade)

| | |
|---|---|
| Fan Shaft Noise without Acoustic Treatment | 62-72 dBA |
| Fan Shaft Fan Noise with Sound Attenuation Treatment in the Shaft | 53-63 dBA |
| Train Noise from Vent Shafts without Acoustic Treatment in Subway or Shaft: | |
| 4-Car Trains -- 60 mph | 79-84 dBA |
| 2-Car Trains -- 50 mph | 72-77 dBA |
| Train Noise from Vent Shafts with Acoustic Treatment in Subway and in Vent Shaft: | |
| 4-Car Trains -- 60 mph | 54-64 dBA |
| 2-Car Trains -- 50 mph | 47-57 dBA |

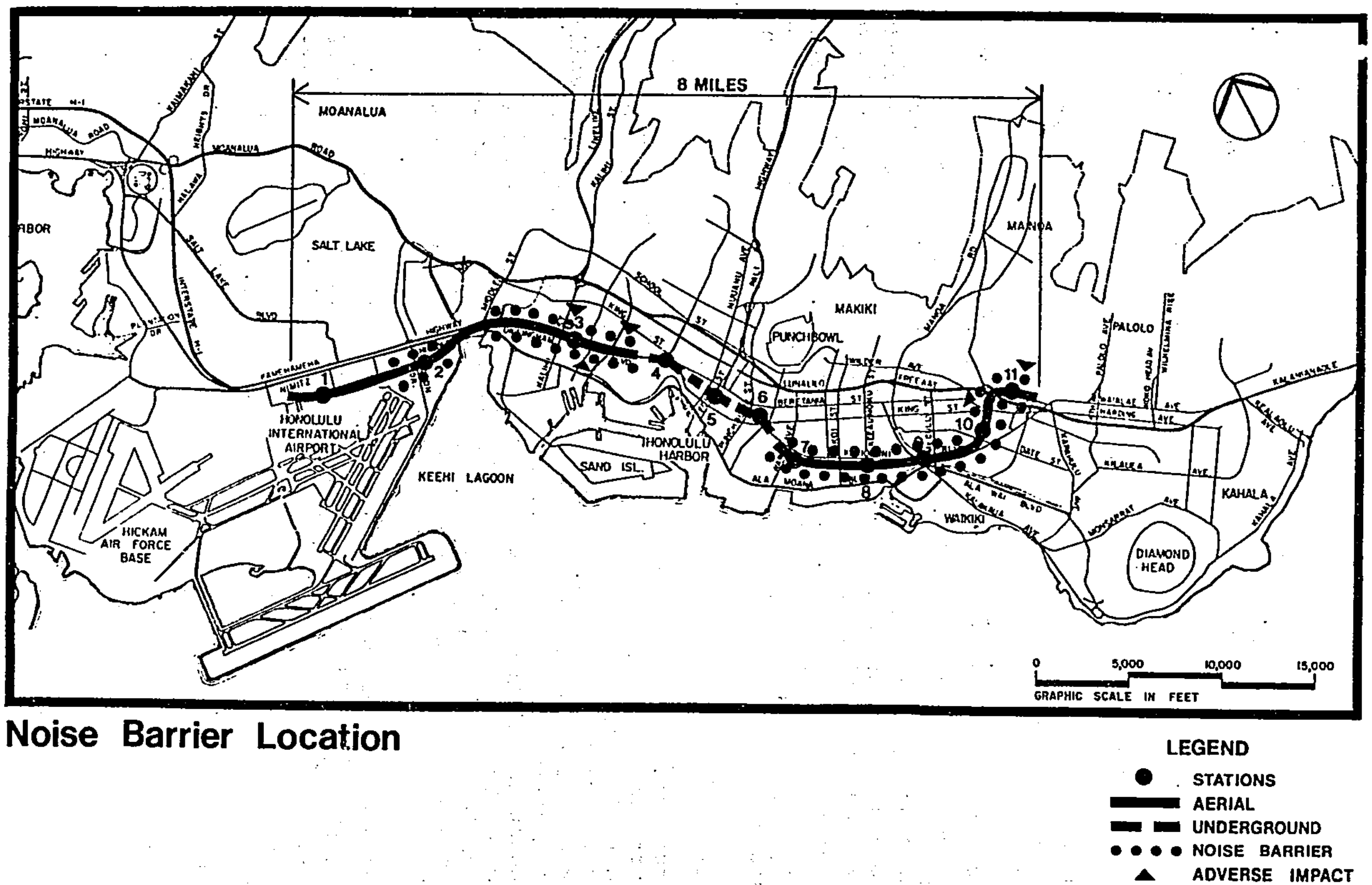
Using general land use categories of the urban area, and their maximum noise level design goals as defined by the APTA Guidelines, each segment of the transit line is analyzed for noise impact relative to the expected noise levels of train operations. Additionally, certain noise sensitive types of buildings or occupancies requiring application of special maximum noise level limits regardless of the community area category in which they are located were identified and the assessment of noise impacts made. A detailed segment by segment description of the noise impact analysis follows. Based on this analysis, areas where mitigating measures would be required by the use of absorptive sound barrier walls are shown in Figure V-7.

In applying the criteria during design or interpreting the potential effect of estimated transit noise levels, it should be noted that a difference in noise level of 1 to 2 dBA is generally not detectible or noticeable and a change of 3 dBA is noticeable. A change of 8 to 10 dBA corresponds to a doubling or halving of subjective noise level and hence is a substantial change. Thus, while it is desirable to achieve the criteria levels, a design which indicates levels of only 1 or 2 dBA greater than the criterion will not be of significant difference from the design goal and will be considered acceptable in this analysis.

Aerial Segment from the Airport to Keehi Lagoon Park

From the existing airport parking structure where the airport station will be located, the transit line proceeds easterly along Aolele Street which is bounded on the north by industrial development and to the south by airport facilities including one of the runways. The community area designation for this portion of the segment would be Industrial/Highway (Category V) and the significance of noise from the transit system reduces due to the generally high level at and near the airport interlaced with future highway viaducts which the guideway structure will cross over.

The airport, highway and industrial complex through which the proposed transit system traverses will potentially have a relatively high ambient noise level when fully developed. Areas containing these types of uses are less sensitive to train passby noise than other urban areas along the transit corridor. Therefore, the transit passby noise is not expected to have any adverse impact on adjacent facilities as currently known. However, if more noise sensitive facilities are known to exist at the time of final design, appropriate lengths of sound barriers would then be provided.




## Noise Barrier Location

FIGURE V-7

A special trackwork consisting of a double cross-over will be installed at the Airport Station and just west of Lagoon Drive. At special trackwork where discontinuity of tracks occurs, the noise level is estimated to increase to an average of 6 dBA over the typical passby noise level to a level of 94 dBA. Sound barrier walls would be provided at this location which will reduce the noise to an acceptable level of 85 dBA.

Aerial Segment from Keehi Lagoon Park through Kalihi

As the transit line crosses Keehi Lagoon Drive, it enters the Keehi Lagoon Park with the line following the northerly boundary of the park. The properties north of the line are in industrial use with a single motel located therein. The line then parallels Nimitz Highway at the location of the future H-1 Freeway Keehi Interchange (Middle Street) and passes just north of the Disabled American Veterans (DAV) facility with its monument and recreation/meeting facility located some 200 feet from the nearest mainline track. Although the ambient noise level is relatively high in this area due to its proximity to the airport and highway, sound barrier walls would be provided to minimize noise intrusion to the park and DAV facilities.

Near the DAV facility, special trackwork will be installed to connect the mainline tracks to the yard and shops. This will require turnouts with switches from the mainline to the yard connector tracks. Where turnouts are located, discontinuity of tracks occur whereby the noise levels would increase by an average of 6 dBA. Thus even with sound barrier walls the train passby noise level of a six-car train would increase to a maximum average of 85 dBA at 50 feet from the train. With a distance of some 200 feet between the DAV facility and the train, this would result in lowering the train passby noise level to about 75 dBA which should be acceptable in the noise environment influenced by the airport and highway.

The Kalihi area along Dillingham Boulevard is predominantly devoted to industrial and commercial uses with a few blocks in residential use at the westerly end of the segment. Dillingham Boulevard with its high volume of automobile and truck traffic has a high ambient noise level. In addition to some residential use, there are the Kalihi Kai Elementary School, New York Technical Institute, and the Honolulu Community College which are classified as special noise sensitive facilities. Although the ambient noise level is high, about 75 dBA for $L_{10}$, sound barrier walls would be required for the entire length of Dillingham Boulevard to minimize any increase to the ambient noise level from the transit operation.

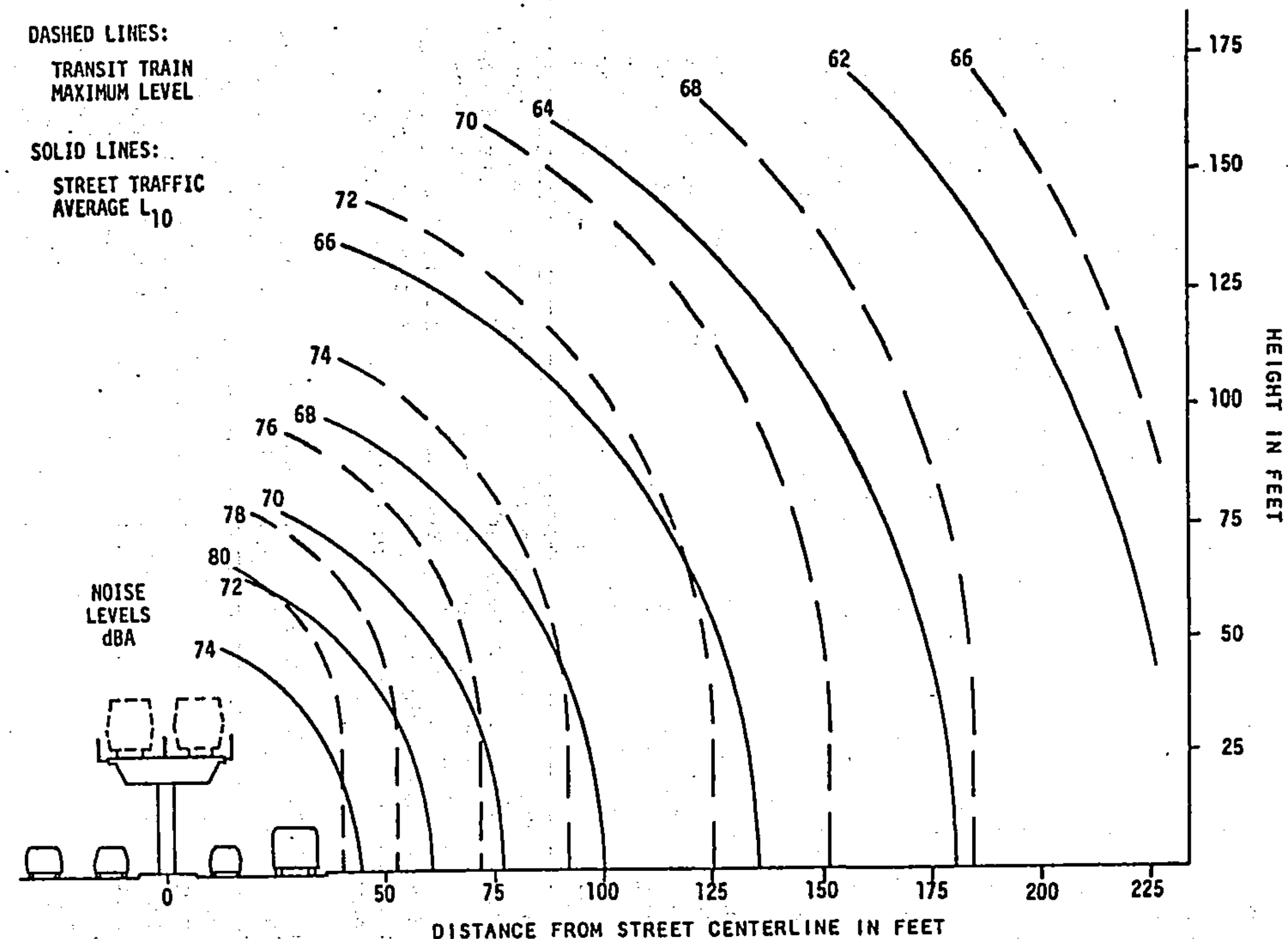
The noise level design goal for single-family dwellings in a community area under Category IV is 80 dBA at night. A two-car train, with sound barrier walls provided, will have a passby noise level of 76 dBA. For schools, the critical period is during daytime when maximum six-car trains will be operating with a passby noise level of 79 dBA, even with the use of sound barrier walls, at the nearest buildings located approximately 50 feet from the track. This will exceed the design goal of 75 dBA for schools by 4 dBA.

Special trackwork consisting of a cross-over will be placed just west of the Kapalama Canal with the resulting increase in noise level by an average of 6 dBA. Using sound barrier walls, the noise levels will be 82 dBA for two-car trains and 85 dBA for six-car trains with the latter meeting the design goal for commercial buildings at this location.

In order to compare the noise levels of transit trains on an aerial structure, with sound barriers, located in the center of a major boulevard to the noise environment due to noise emitted by vehicular traffic, noise contours were developed as shown in Figure V-8. To derive the approximate traffic noise levels, the results from the community noise measurements along Dillingham Boulevard, Kapiolani Boulevard, and University Avenue were averaged and used. Since the $L_{10}$ or 10 percentile noise levels observed are approximately equivalent to the average maximum or average peak levels of noise from vehicles passing by, the vehicular noise contours on Figure V-8 are based on the average measured $L_{10}$ noise levels for the vehicular traffic on the streets. It is important to realize in comparing the data in Figure V-8 that the noise level contours shown for the trains are the maximum noise levels achieved by four-car trains whereas the noise level contours shown for the street traffic are averages. There will be many motor vehicle passbys which are as much as 5 to 10 dBA greater than the average passby noise level. This shows that the addition of the transit trains on aerial guideway would not add significantly to the noise environment along a major boulevard or street.

## Underground/Aerial Segment through Downtown-Civic Center and Kakaako

The Downtown-Civic Center segment is entirely undergound and the area will experience two types of noise; airborne noise emanating from fan and vent shaft openings and ground-borne noise in buildings caused by vibration in the subway structure from train operation. Development in the downtown segment is predominantly commercial where Categoy IV design goals would apply in the CBD area and Category III design goals applying to the Civic Center area where public buildings exist.




NOISE LEVEL CONTOURS 4/

(Estimated Maximum Wayside Noise Levels for 4-Car Steel Wheel Transit Trains on Aerial Structure with Absorptive Sound Barrier Walls and Approximate Contours for the Average Maximum Noise Level for Street Traffic $L_{10}$ )

Figure V-8

Fan and vent shaft openings will occur at each end of stations and also between stations at Nuuanu Stream and Richards Street. Two sources of noise emanating from these openings are from the fan and from the train operation which are required to meet the noise level design goals shown in Table V-9.

The need for acoustical treatment of fan and vent shafts depends on the shape of the vent shafts and the location of the surface opening of the shaft with respect to the nearest residences, businesses or noise sensitive areas. Specific recommendations cannot, therefore, be made without detailed knowledge of each situation. Generally speaking, however, the noise from fan and vent shafts may be controlled by lining some of the wall area of the shaft with sound absorption, as shown in Table V-12. This will usually involve the provision of a two-inch thick layer of glass fiber (covered with a thin plastic film for protection from the weather), or a suitable spray-on acoustical absorption material, extending for several duct widths in each direction from a 90° bend in the duct or covering the ceiling and most of the walls of the fan room. The exact amount of treatment depends entirely on the position of the shaft outlet with respect to the nearby community and the size of duct or number of fans.

Ground-borne vibration caused by train operation is transmitted from the rails to subway structures and then to the soil. The vibration of the ground is converted into sound by radiation off the vibrating interior surfaces of buildings. Under the APTA Guidelines, the allowable ground-borne noise level is 35-45 dBA for office buildings. As shown in Table V-11, for this type of occupancy in small lightweight buildings, floating slab trackbeds would be required. However, only resiliently supported ties would be required when located next to heavy masonry buildings. During final design of the project, detailed subsurface and geologic investigations will be made to determine the exact extent of floating slab construction requirements for this entire subway segment.

The transit line ascends from the subway to aerial structure in the Kakaako area which is predominantly in light industrial use and falls under community area Category V. The maximum noise level design goal is 85 dBA for the type of buildings or occupancies curently existing in this area. The expected transit noise level is 88 dBA without sound barrier walls which is only 3 dBA above the design goal. Since this area is currently under study for major redevelopment, it is possible that the character of the area may change and require lower noise level in the future. Therefore, although sound barrier walls are shown, final determination for installation of sound barrier walls will be made during final design.

As the transit line crosses Piikoi Street, it enters the Ala Moana shopping complex which contains various business and retail establishments. This type of land use would be represented by community area Category IV with a specified noise level design goal of 85 dBA. Due to the close proximity of the transit line to parking structures where pedestrians will abound, sound barrier walls will be provided at locations where adjoining parking area and pedestrian ways are at approximately the same elevation as the tracks.

Special trackwork for a cross-over will be installed west of Piikoi Street resulting in noise level increase of an average of 6 dBA, or to 85 dBA with the use of sound barrier walls. Sound barrier walls will be required at this special trackwork location to minimize noise intrusion.

Aerial Segment from Ala Moana,
through Moiliili, to the University

Upon leaving the Ala Moana Station, the transit line continues along Kona Street and crosses Atkinson Drive and Kalakaua Boulevard to the Waikiki Station. The transit line then enters and is located in the median of Kapiolani Boulevard and University Avenue, crosses the H-1 Freeway, and enters the University of Hawaii Manoa Campus grounds. The land use along both of these streets is high density residential or community area Category III with an ambient noise level of about 75 dBA for $L_{10}$. The maximum noise level design goal is 80 dBA which will require the use of sound barrier walls along the entire length of the transit structure located in these two streets.

After the transit line crosses the H-1 Freeway, it is located along the southerly boundary of the University property near existing and proposed athletic facilities. The nearest facilities are a proposed gymnasium complex and an existing swimming pool and baseball field. One portion of the proposed gymnasium facility, currently under planning and design, will be located only about 20 feet from the track. The closest edge of the pool deck is about 50 feet from the track at the station. The baseball diamond is located over 250 feet from the closest part of the infield to the track. Even with these types of athletic facilities, sound barrier walls would be required to minimize noise intrusion in the area.

To the south of the transit line, medium density residential area exists with an average separation of over 100 feet between the buildings and the track. At the station, the nearest building is approximately 40 feet from the track. With this area located adjacent to the University's athletic area, it would be classified under Category III with a design goal of 80 dBA. This side of the track will also require sound barrier walls to meet the above design goals.

A special trackwork involving turnouts will occur near the station for turning back trains to this location resulting in an average of 6 dBA increase in noise levels. Even with the use of sound barrier walls, the expected noise level would reach 82 dBA under nighttime operation. With the residential buildings set back over 100 feet from the track centerline at the location of this special trackwork, the noise level at the buildings would be approximately 78 dBA which would meet the design goal for the area.

There are several special noise sensitive facilities located adjacent to the transit line on University Avenue. They are the Moiliili Hongwanji Mission Church located south of King Street and the Varsity Theatre and Church of the Crossroads located north of King Street. The noise level design goal for these types of facilities is 75 dBA which can be met with the use of sound barrier walls under normal nighttime transit operation. However, during daytime operation with a maximum six-car train, the expected passby noise level is 79 dBA at 50 feet distance, even with sound barrier walls, thus exceeding the design goal by 4 dBA. Since these buildings are set back more than 50 feet from the track, the train passby noise level will be lower at the buildings. The Varsity Theater located approximately 70 feet from the track would have a lower noise level at the building by 3 dBA to 77 dBA. The Moiliili Hongwanji Mission Church is located about 100 feet from the track and thus the noise level at the structure would reduce to about 75 dBA. The Church of the Crossroad is well over 150 feet from the tracks which should reduce the noise level sufficiently to be below the design goal.

Extending beyond the transit guideway terminating east of the University Station, a busway segment connects the University Station with the H-1 Freeway which generally follows Old Waialae Road before entering the H-1 Freeway. Single and multi-family dwellings line this street which would be classified under community area Category II with a design goal of 75 dBA. This will require the use of sound barrier walls with the expected noise level of up to 80 dBA.

c. Noise Impact at Station

The placement of a transit system station in a community can result in noise impact due to three major sources of noise: transit trains, station mechanical equipment, and buses and autos interfacing at the station. The noise created by people using the transit system stations is a minor source of noise emission to the surrounding area and is not a dominant factor relative to the total noise produced by the station activities.

The primary source of noise in the vicinity of a transit station are trains entering and leaving the station, especially at at-grade or aerial stations. The maximum predicted noise level from transit vehicles in station with acoustically treated walls is 75 dBA at 50 feet, assuming that a full length train enters or leaves at about 40 mph. Thus the maximum noise level from the trains in the station areas will be about 4-5 dBA less than for areas between stations where trains reach speeds of 60 mph. Since nearly all aerial stations are sited in the center of major arterials with already high ambient noise levels, train operations at transit stations would not be expected to perceptibly increase those noise levels. Even stations sited off primary trafficways are immediately adjacent to one or more major streets. In such cases, ambient noise levels generated by transit vehicle should be somewhat comparable to existing traffic noise and increase the $L_{10}$ noise level by some 2-3 dBA at 50 feet, which, as mentioned earlier, is a relatively minor increase in average noise level.

Mechanical and electrical equipment associated with the stations can produce noise, however, the noise from such facilities can be controlled by conventional means. The primary sources of noise will be ventilation fans, cooling tower fans, or other air handling devices and power substations. The noise from such facilities can be reduced to meet Community Noise Regulations by the use of silencers, duct attenuators and by proper enclosures or orientation of the facilities. These regulations restrict allowable noise levels at the property line from a low of 45 dBA in residential areas at night to a high of 70 dBA in industrial areas. In particular, substation transformer noise and cooling fan noise will be attenuated through selection of equipment, and design and placement of the substation structure during final design.

Another potential source of added noise near a transit station is the noise from those buses and automobiles carrying transit riders to and from the transit station. Some general statements can be made about the effect of transit station induced auto traffic as it affects the general traffic noise environment of an area. Most of the transit stations are located in areas where there is a large traffic flow which results in relatively high community noise levels. In fact most of the streets in the transit station area would have traffic volumes approaching or at capacity with or without transit. Furthermore, much of the transit related auto traffic could be traveling the same streets even without transit, therefore the actual increase in traffic would be somewhat less than the estimated number of people arriving or leaving the station by auto.

As an example of potential noise increase due to transit induced auto traffic, assuming traffic speed remains the same, a doubling of the traffic flow rate will result in an increase of $L_{50}$ by about 3 dBA and increase of $L_{10}$ by about 4 dBA. A typical urban street would have a capacity of over 800 vehicles per hour per lane, thus a four-lane street would have over 1,600 vehicles per hour in one direction and a six-lane street over 2,400 vehicles per hour in one direction. In 1995, the largest estimated number of passengers arriving or leaving the stations by auto, other than at the terminal stations, is approximately 500 vehicles per hour at the Kalihi Station. Dillingham Boulevard and Colburn Street would share this number of cars and relating this volume of vehicles to the capacity of these streets, the 500 vehicles would represent some 25 percent of the total traffic volume. The expected increase in the $L_{10}$ noise level would then be approximately 2 dBA.

When large volumes of buses are expected to interface at stations, an increase in the ambient noise could occur due to the concentration of bus traffic flow. On major streets and highways carrying large traffic volumes with normal mix of trucks and buses of approximately 5 percent of total traffic, the ambient noise level is generally high. The addition of station-induced bus traffic flow of 100 buses per hour would only increase the $L_{10}$ noise level by 3-4 dBA which would be noticeable.

Outside of the terminal stations, five stations have less than 50 buses per hour arriving at the station and there should be essentially no noticeable change in the noise environment of the community. Four stations will, however, have more than 50 buses per hour arriving at the station. The Kalihi Station is expected to have approximately 30 local buses and 60 express buses per hour arriving at the station. With Dillingham Boulevard having a high ambient noise level due to existing heavy traffic volumes with high percentage of trucks and buses, the net increase in the number of buses would raise the $L_{10}$ noise level by about 3-4 dBA.

Downtown Honolulu is expected to have some 70 local buses and 60 express buses per hour traveling on major north-south and east-west streets to serve various downtown areas and interface with the Fort Street Station. This projected 1995 volume of buses, to complement the proposed fixed guideway station, would be less than the number of buses expected to be operating on downtown streets without the proposed fixed guideway system. Consequently, the proposed transit system with the guideway portion built underground through the downtown area, would improve the ambient noise condition in the area by reducing the potential number of buses operating in the downtown area if the fixed guideway system were not built.

The Waikiki Station is expected to have nearly 130 local buses per hour with most of those buses arriving from

Waikiki via Kalakaua Avenue and returning via McCully Street. The remaining buses would be operating on Kapiolani Boulevard with this number of buses expected to be less than the number of buses that would be operating without the proposed system. Similarly, the number of buses on Kalakaua Avenue and McCully Street, even without the proposed system, would be high such that any increase in the noise level should be small. The greatest noise impact would occur from the buses operating within the station site, especially to those buildings located adjacent to the station. In order to minimize the noise impact in the very local area near the proposed bus parking and access roadway, sound barrier walls would be required. This will reduce the bus noise exposure to adjacent buildings and the community until the buses travel into the general traffic flows of major streets and highways.

At the Keehi Lagoon Station, which functions as the western terminal, some 80 local buses and 60 express buses per hour will be arriving during the peak hour in 1995.

The express buses interfacing at Keehi Lagoon Station would travel on the H-1 Freeway to the Pearl Harbor Interchange, then on the surface "Nimitz-Kamehameha Highway" frontage road to Keehi Lagoon Drive and then southerly a few blocks to the Keehi Lagoon Station. Local buses would also use Keehi Lagoon Drive and Aolele Street. The major increase in noise level would be on the Keehi Lagoon Drive and at the interface area of the terminal station. The primary impact would be to the motel located adjacent to the terminal parking area. A masonry wall will be required at the property line to minimize noise intrusion to the motel.

At the opposite terminal located at the University, approximately 130 express buses per hour would be arriving from the H-1 Freeway via a special busway facility connecting the H-1 Freeway from approximately the 6th Avenue overpass directly to the bus parking area at the station. The busway alignment would be the same as the fixed guideway alignment between the University Station and the future 6th Avenue Station and would be constructed to accommodate the fixed guideway trains if extended in the future. The noise level along this alignment under bus operations could be about the same or slightly higher than the fixed guideway transit operation with both using sound barrier walls.

The bus operations on the busway may have the same ambient noise levels at the bus parking area which is located adjacent to the residential area south of the University property. A high masonry wall along the property line would be required to reduce the bus noise to 80 dBA or lower.

Since the University Station has limited capacity for bus storage and access, local buses will be routed to the Date Street Station. Total local buses arriving at and departing from this station would be 55 per hour initially increasing to nearly 110 by 1995. The ambient noise level along University Avenue during peak periods would be high due to traffic volumes of 1,500 vehicles per hour. The addition of the feeder buses could be expected to raise the $L_{10}$ noise level by 2-4 dBA.

d. <u>Noise Impacts from Yard and Shops</u>

Noise due to operations of the yard and shops for the proposed transit system is of somewhat different character than the wayside noise due to revenue service operations. Primary noises typically associated with yard and shops operations are wheel squeal on short-radius curves, propulsion systems and car auxiliary equipment (e.g., compressors, blowers, air conditions). At the low operating speeds that vehicles attain in yards, propulsion systems would contribute only slightly to community noise.

Maintenance equipment that might generate noise would be designed and located for minimum intrusion into noise-sensitive areas. In general, activities that might create more noise than the low-speed operation of transit cars would be confined to the interiors of shop buildings and should not transmit noise to adjacent areas. If train speeds of up to 25 miles per hour are permitted on yard tracks, noise levels for long trains could be in the range of 70-71 dBA at 50 feet. However, it is important to note that the proposed yard and shops location is an industrial area near the intersection of three major trafficways. Therefore, it is not expected that noise from the yard and shops would exceed the area's normal background noise.

e. <u>Summary of Noise Impacts</u>

The area that may have adverse noise impacts due to the maximum estimated noise level from the operation exceeding the design goal are shown in Figure V-7 and summarized on the following table:

TABLE V-13

NOISE SENSITIVE AREAS EXCEEDING DESIGN GOALS

| | Design Goal (APTA) | Est'd. Max. Noise Level |
|---|---|---|
| Segment 4 | | |
| (Dillingham Blvd. - Kalihi Area) | | |
| Kalihi Kai Elementary School | 75 dBA | 79 dBA |
| New York Technical Institute | 75 dBA | 79 dBA |
| Honolulu Community College | 75 dBA | 79 dBA |
| Segment 7 | | |
| (Moiliili/University Area) | | |
| Varsity Theatre | 75 dBA | 77 dBA |
| Residences (Old Waialae Road) | 75 dBA | 77 dBA |

Additional measures will be investigated during final design to reduce impact in these areas. Methods that will be considered will include: more effective sound barriers, reduce noise source in the vehicle, improved rail fasteners and roadbed treatment, and possibly, the acoustical treatment of affected facilities. Acoustical consultants will be retained during final design to ensure that effective abatement procedures are utilized to meet the design goals wherever possible.

### B.2. Visual

The visual impacts of any transportation system that covers eight miles and traverses a wide range of land uses are bound to be substantial. The assessment of visual impacts, a highly subjective subject, cannot be accomplished quantitatively; nor can impacts be readily declared "positive" or "negative." Instead, visual impacts are assessed in relation to (1) the visibility of the system, (2) designated view corridors that may be affected by either the guideway or the stations, (3) visual impact of the stations, and (4) the sensitivity and characteristics of potential observers. Less critical but also worthy of note are new visual opportunities the system would allow.

Of the 11 stations now included in the proposed 8-mile transit system eight will be aerial, at the height of the guideway. Three stations serving the downtown area will be underground. Although the exact dimensions of the stations cannot be determined until the engineering phase is complete, the general station configuration would be 450 feet in length, with a guideway/platform width of 50-60 feet, and a ceiling height of 35-40 feet above the ground.

The discussions that follow note existing development along those portions of the transit line that would produce visual impact (i.e., aerial guideway and stations, and station entrances for below-grade portions of the line) and describes the system's impacts in terms of visibility to and the sensitivity of neighborhoods through which it passes. Generally, sensitivity was determined to be highest in residential areas through which the guideway system would pass in aerial configuration. Figures V-9 through V-12 depict the possible appearance of the aerial guideway/stations from different vantage points (before and after the implementation of the system).

The following discussions are keyed to figures V-13 through V-16, which offer graphic representations of existing development along the proposed transit route. Different types of development by land use are identified, such as residential, commercial, etc., as they exist along the transit line. The visibility of the guideway from each side, or the view line, is indicated by an arrow symbol. In certain areas the guideway, although located above ground, is not visible due to other existing structures or the topography obstructing the view line. Where this condition occurs, it is denoted by a view barrier symbol in the figures. Discussion of view corridor and station impacts then is presented.

Aerial Segment from Honolulu International Airport to Keehi Lagoon Park (Figure V-13)

This segment is totally in or adjacent to the airport complex with the passenger terminal and parking structure, maintenance facilities, and fuel storage tanks dominating the area adjacent to the proposed guideway. Another prominent feature of the area are the numerous freeway viaducts, currently under construction, interconnecting with the passenger terminal.

Through the Honolulu International Airport area the guideway would maintain an elevation approximately 45 feet above grade. The guideway would be highly visible to users of the airport and nearby industrial facilities, resembling a freeway "slip ramp" in size and appearance. The sensitivity of potential viewers in this area is considered to be low, owing to the industrial/transportation orientation of the area. In the vicinity of the airport terminal, the elevation of the guideway closely matches that of the airport's pedestrian walkway system that connects the terminal with existing and future parking structures. Its relationship to these structures which, like the guideway structure, feature strong horizontal lines and concrete composition, somewhat subordinates the visual presence of the guideway.

The Airport Station is located between the existing parking structure and freeway viaduct and ramps. By being sandwiched in between these two prominent structures, the station would have little or no visual impact to the area.

As the guideway leaves the airport, it descends to an elevation about 20 feet above that of Aolele Street, which will be slightly relocated alongside the proposed transit alignment near Lagoon Drive. Traffic along Aolele Street is nearly all industrial or airport-bound; development on both sides is typical of an industrial park, many large warehouses devoted to aircraft maintenance and service. This neighborhood is thus estimated to have low sensitivity to the highly visible guideway structure.

The Keehi Lagoon Station will have the industrial development on one side and the Keehi Lagoon Park on the opposite side. The station structure will be equal to or slightly higher than the adjacent industrial buildings but will be highly visible from the park. Landscape treatment along the park side will reduce the visual impact to the park users.

Aerial Segment from Keehi Lagoon Park
through Kalihi (Figure V-14)

In this segment, the route will first traverse an area containing the Keehi Lagoon Park on one side and the back of an industrial tract on the opposite side. Then it parallels the H-1 Freeway viaduct and crosses the Middle Street Interchange with its host of ramps leading to and from Nimitz Highway and Dillingham Boulevard. From there the line enters Dillingham Boulevard, a major arterial with mixed-use developments beginning with heavy industrial, a prison, single-family dwellings interspersed with retail stores, medium height apartment buildings, a shopping center, a community college, and a variety of commercial and light industrial buildings.

The guideway maintains an elevation of some 20 feet above grade as it crosses Lagoon Drive and hugs the northern edge of Keehi Lagoon Park. In this area, the guideway charts a course almost parallel to a park access road and two double-loaded parking lots. The more open, natural park recreation areas are generally visually screened from the guideway by the landscaped parking lots (flanked by trees approximately 25 feet tall). The guideway would be visible to park users, particularly as it ascends to approximately 50 feet above grade to cross Nimitz Highway to Dillingham Boulevard, though construction of the proposed Keehi Interchange might prove to be the visually dominant element. At the same time, the guideway structure would somewhat mask industrial/warehouse buildings of considerable size abutting on the park, as well as partly screen Nimitz Highway traffic movements.

FIGURE V-9a

EXISTING GROUND VIEW OF
KALIHI STATION FROM NORTH

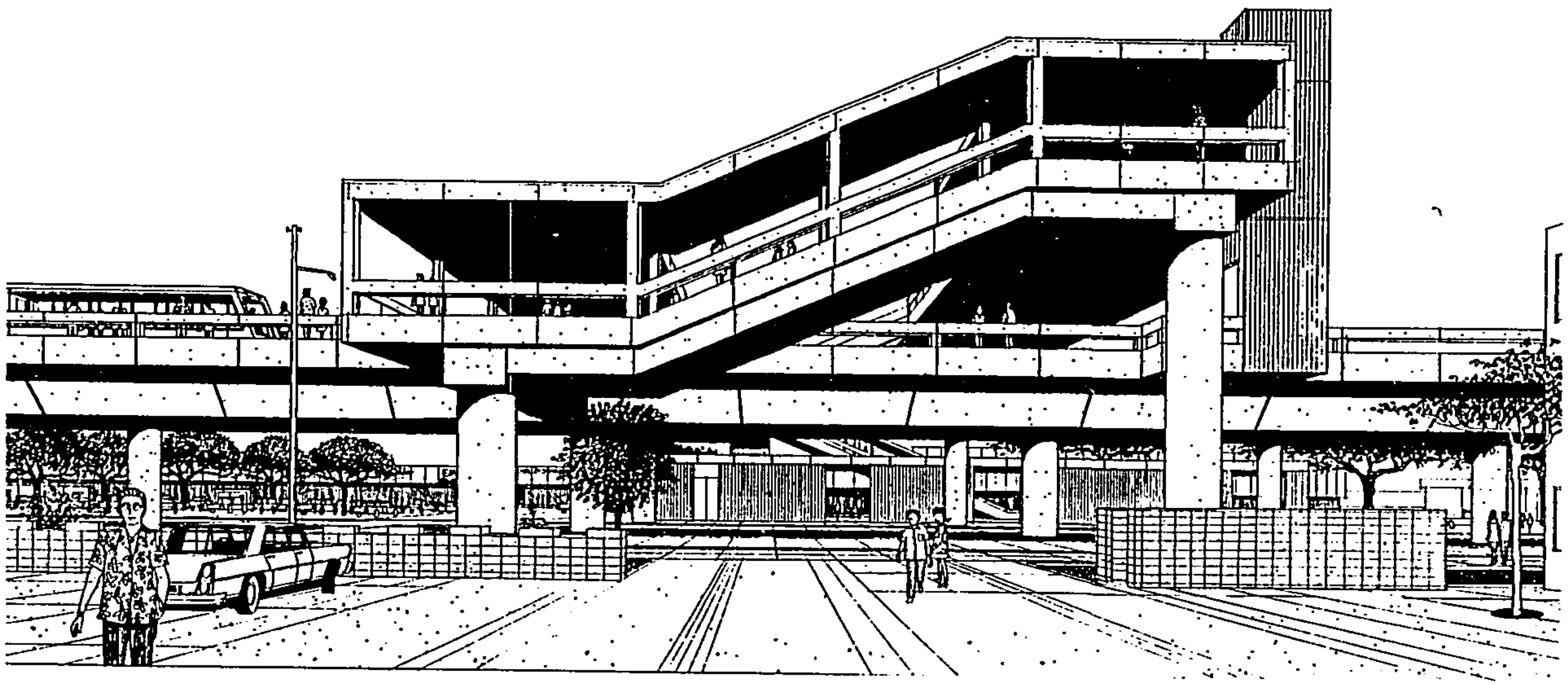


FIGURE V-9b

PROPOSED GROUND VIEW OF
KALIHI STATION FROM NORTH

ARTIST'S RENDERINGS ARE
BASED ON PRELIMINARY STUDIES
AND SUBJECT TO CHANGE.

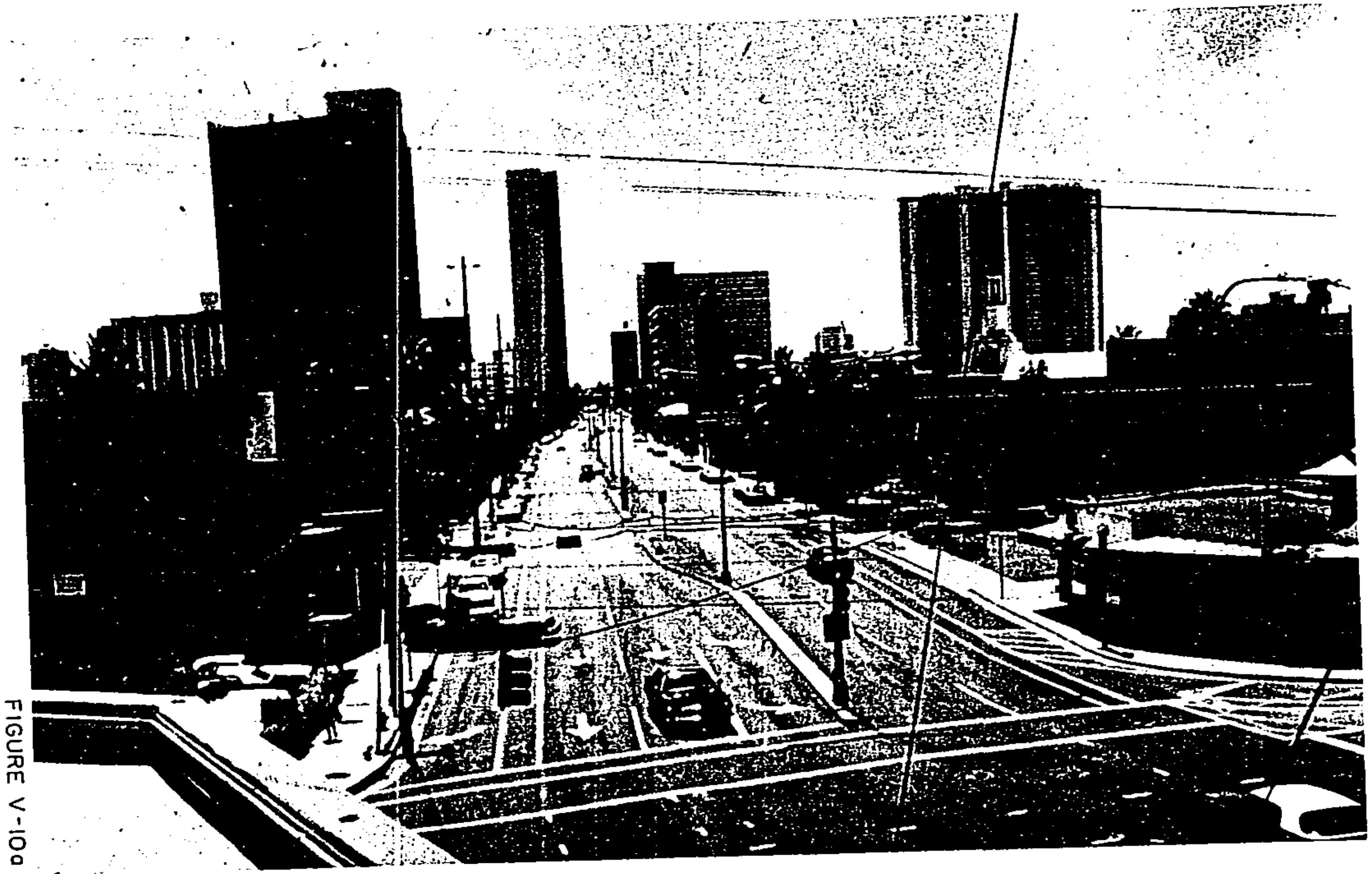
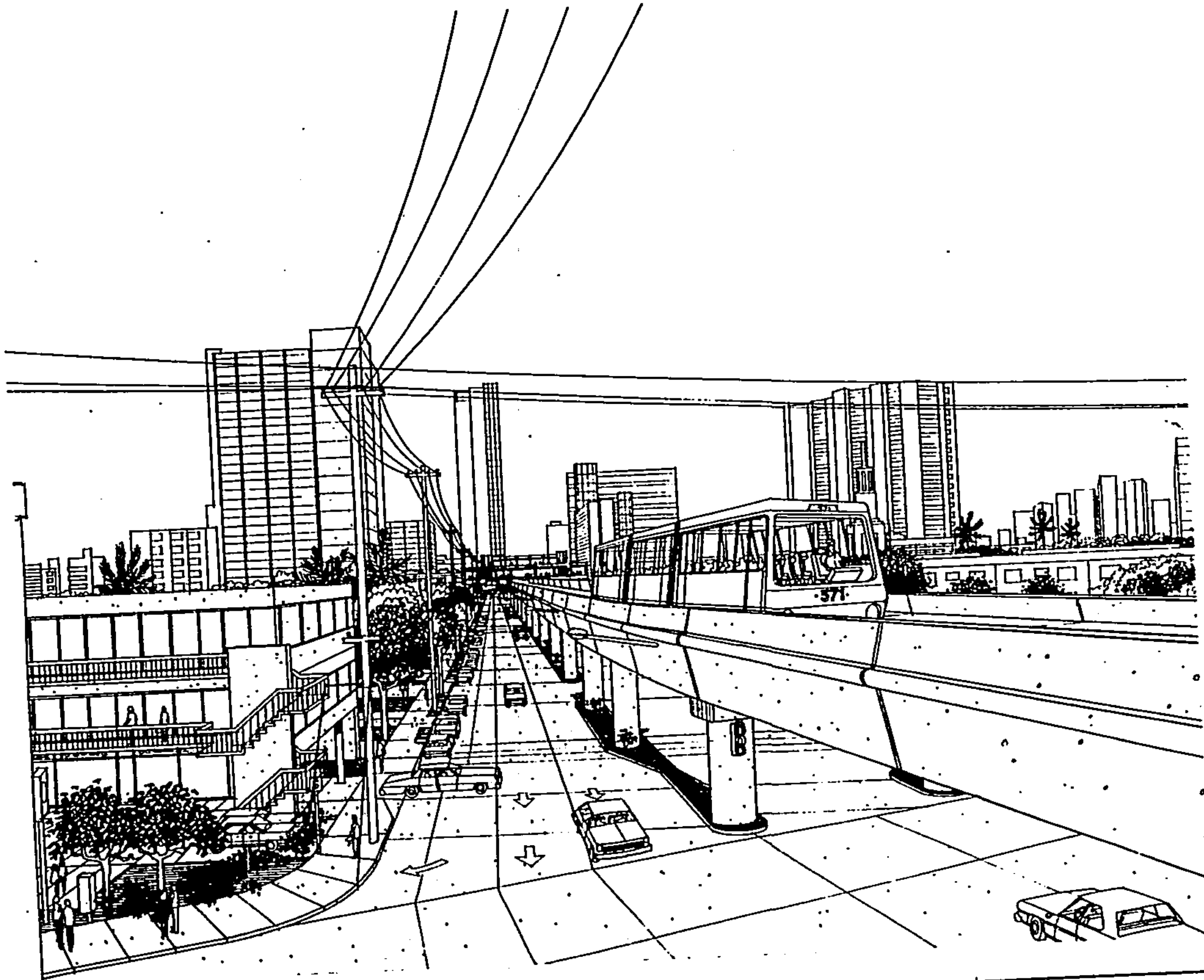


FIGURE V-10a

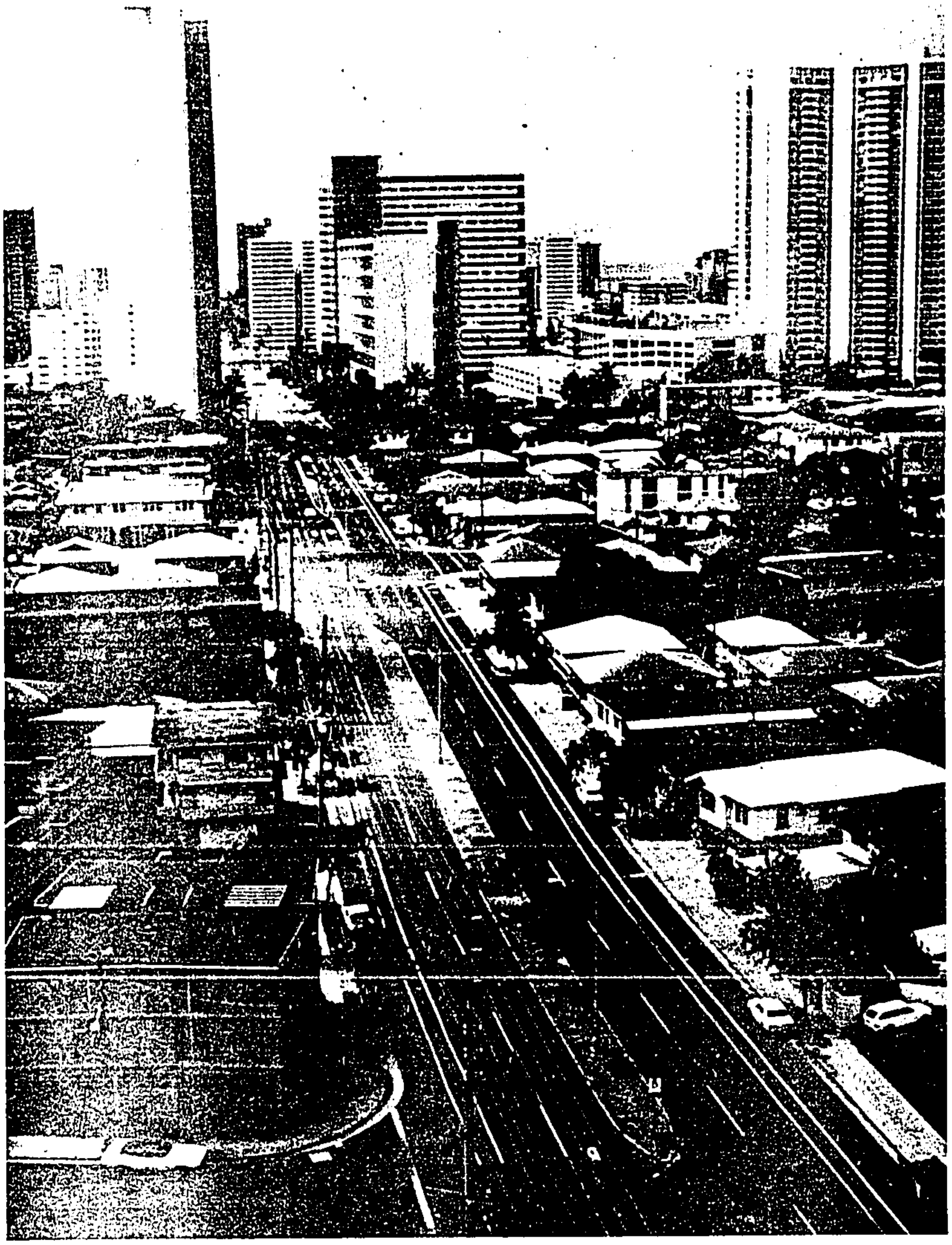
EXISTING VIEW AT GUIDEWAY LEVEL
OF UNIVERSITY AVE. FROM NORTH




PROPOSED VIEW AT GUIDEWAY LEVEL
OF UNIVERSITY AVE. FROM NORTH

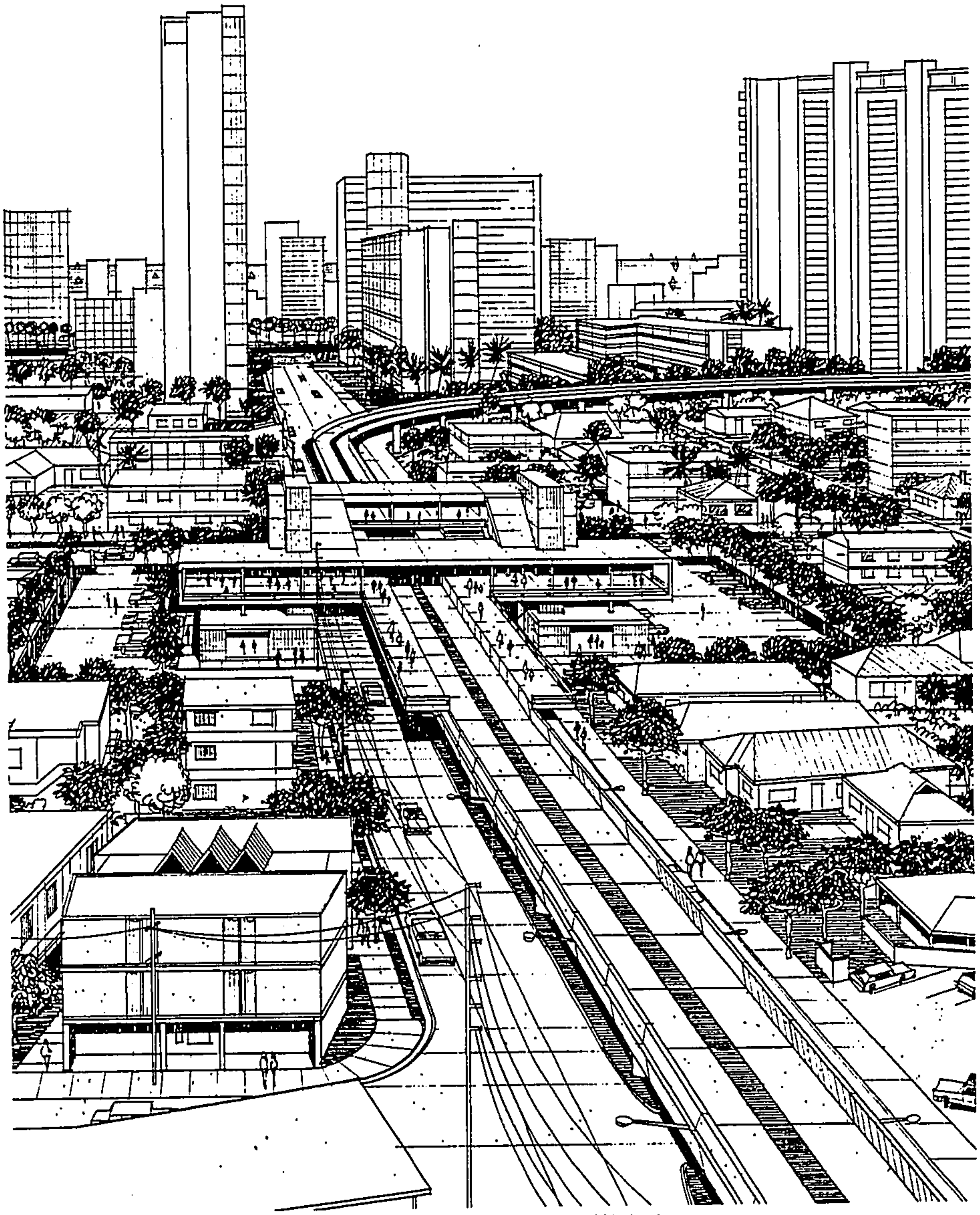
ARTIST'S RENDERINGS ARE
BASED ON PRELIMINARY STUDIES
AND SUBJECT TO CHANGE.

FIGURE V-10b



EXISTING ELEVATED VIEW
OF UNIVERSITY AVE. FROM NORTH

FIGURE V-11a



PROPOSED ELEVATED VIEW
OF UNIVERSITY AVE. FROM NORTH

ARTIST'S RENDERINGS ARE BASED ON PRELIMINARY STUDIES AND SUBJECT TO CHANGE.

FIGURE V-11b

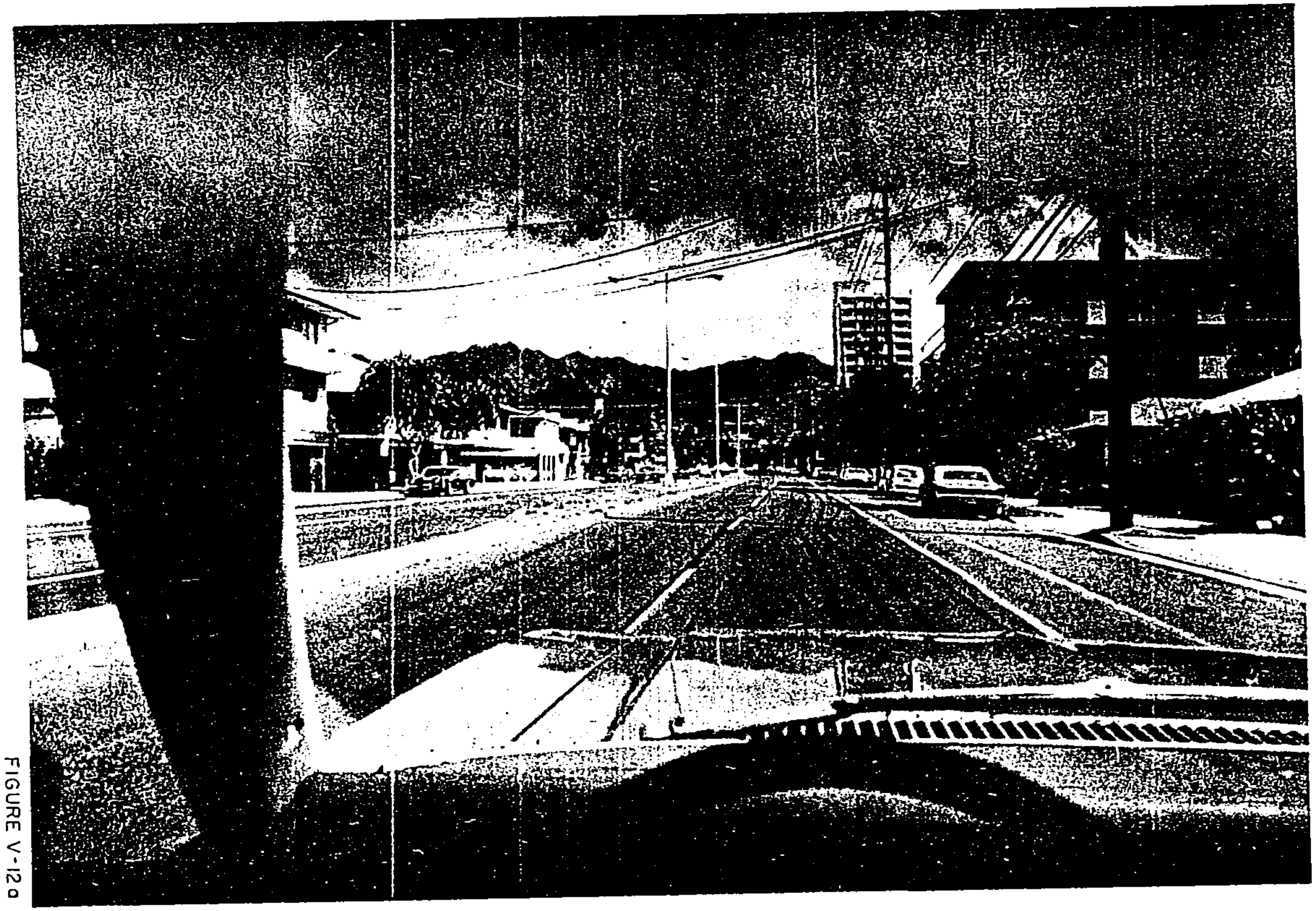


FIGURE V-12a

EXISTING GROUND VIEW OF
UNIVERSITY AVE. FROM SOUTH

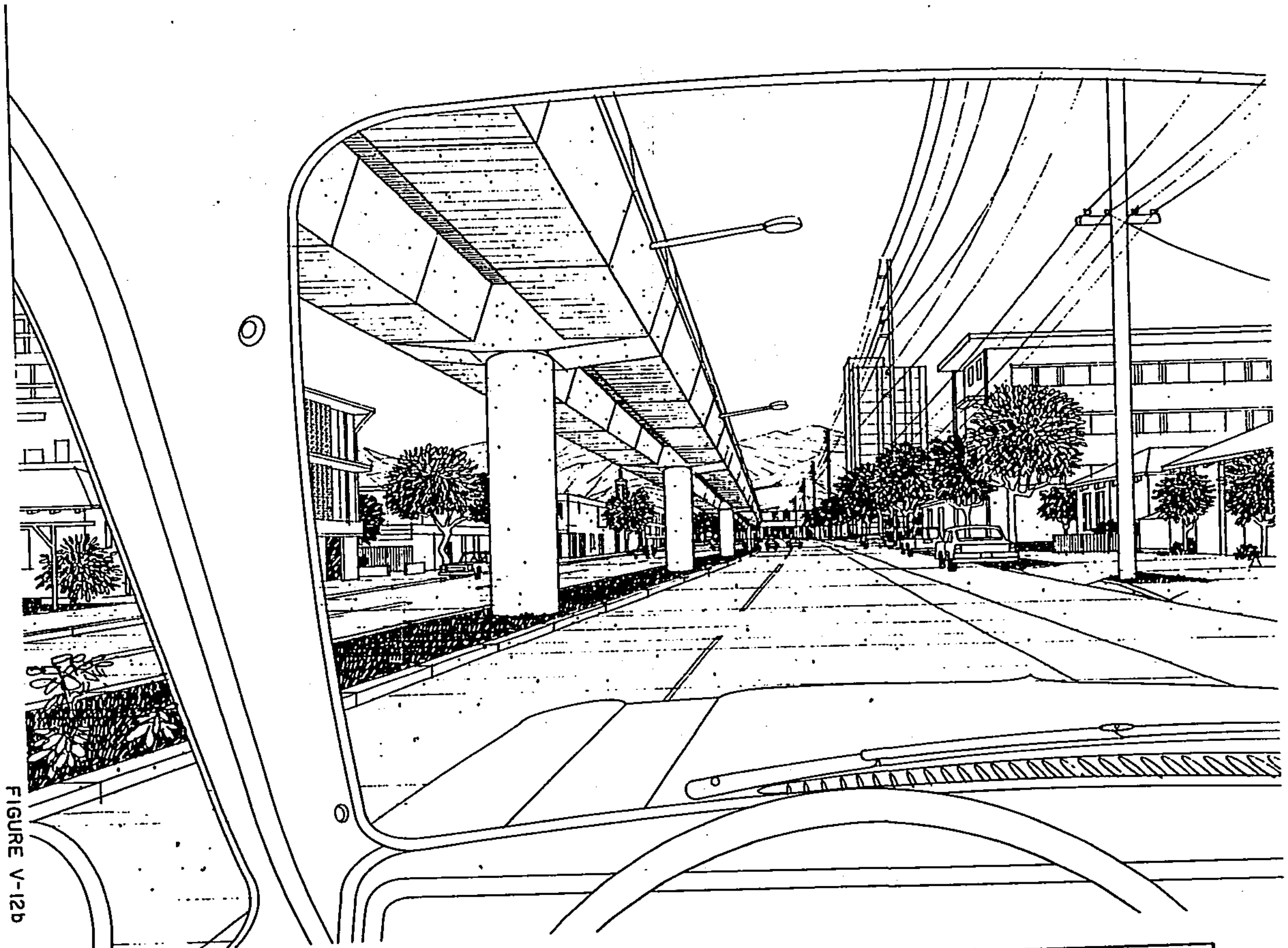


FIGURE V-12b

PROPOSED GROUND VIEW OF
UNIVERSITY AVE. FROM SOUTH

ARTIST'S RENDERINGS ARE BASED ON PRELIMINARY STUDIES AND SUBJECT TO CHANGE.

Since the park is visually oriented toward Keehi Lagoon, the transit system yard and storage site across the lagoon would be apparent. This area at present hosts a number of industrial and harbor-related functions, with randomly-spaced, dark-colored buildings of varying size. While most guideway vehicles will be in service during daylight hours, the yard will nevertheless accommodate a number of vehicles being serviced or, in non-peak hours, stored for peak-hour use. Landscape treatments along the shore side of the service yard could reduce the visual impact of the facilities on park users.

Transit patrons would be offered commanding views of aircraft take-offs and landings, Keehi Lagoon Park vegetation (though not much of it is grassy open area), and the Lagoon itself in this segment. In the airport area and as the guideway crosses over Nimitz Highway near the H-1 Freeway/Middle Street interchange, transit vehicle occupants would observe a wide range of vehicular movements from their aerial perspective.

The transit system's aerial configuration in the median of Dillingham Boulevard is likely to produce a wide variety of visual impacts by virtue of the Kalihi neighborhood's variety of land uses. The guideway maintains an elevation approximately 25 feet above the street right-of-way before descending to an undergound configuration just west (ewa) of King Street.

The westernmost portion of this segment, west (ewa) of Puuhale Street, is devoted to manufacturing and wholesale commercial concerns, with one- to three-story concrete buildings. Sensitivity to the presence of the guideway structure in this area is considered low. Between Puuhale and Kalihi Streets, however, Dillingham Boulevard is lined with older, low-density wood housing. Residents in this area would be highly aware of the aerial transit structures. Houses on the north (mauka) side of Dillingham would be in the shadow of the guideway by mid-afternoon in winter months. It is also possible that residents may feel that their privacy is reduced, despite the screening of mature plantings.

Between Kalihi Street and Kapalama Canal, impacts are less severe, though still substantial, as the guideway passes a school, strip commercial and manufacturing establishments, a shopping center, and a medium-density apartment complex of recent vintage.

The Kalihi Station straddles Dillingham Boulevard between the shopping center and the apartment complex. Though its design remains to be firmly established, one concept (Figure V-9b) calls for a pedestrian overpass above the aerial guideway, entailing a structure about 50 feet tall. While the majority of apartment units are oriented away from the street, the station and related pedestrian activity would be visually prominent. Existing views -- albeit to a sea of cars parked at the shopping center -- would be blocked from upper-floor apartments.

East (diamond head) of Kapalama Canal, as the guideway enters the Iwilei neighborhood, sensitivity to its presence becomes moderate. Strip commercial and industrial facilities and the Honolulu Community College would have views of the aerial system. Most college buildings are oriented inward, rather than toward Dillingham Boulevard, and thus the periodic presence of the transit vehicles should not be particularly disruptive.

Along this highly developed Kalihi route segment, transit patrons would be afforded occasional views of the Koolau mountain range as the guideway passes single-story buildings. Otherwise, views would be unremarkable for frequent transit users.

Underground/Aerial Segment through Downtown-Civic Center and Kakaako (Figure V-15)

Upon leaving the Iwilei area, the system traverses the old part of Downtown Honolulu referred to as Chinatown with its two- to three-story buildings many of which are old and in disrepair. It then traverses the newer part of the CBD and then the Civic Center with both new government facilities as well as some of the most significant historic sites and buildings in the State. It then traverses the Kakaako area, currently in light industrial use with mostly small, old buildings of one to two stories in height. This segment terminates at the Ala Moana Shopping Center, the largest retail center in the State.

As the guideway proceeds through the Iwilei neighborhood, it maintains an elevation approximately 25 feet above the Dillingham Boulevard grade. This area features a mix of industrial and commercial establishments. Observers of the system are expected to have low sensitivity to its visual presence.

Just west (ewa) of the intersection of Dillingham Boulevard with King Street, the guideway descends to grade, penetrates a "portal," and submerges below grade. As the line levels out at about 20 feet below grade, it continues in a southeasterly direction, while Dillingham Boulevard curves to the east (diamond head).

The Iwilei Station is to occupy an open cut on the southwest corner of the Dillingham/King intersection. Inasmuch as this open cut is set well back from street frontages in a newly-created plaza, the station itself would not be highly visible to passers-by not destined for it. However, creation of the plaza and the opening of the station cut require that some existing commercial structures be razed. This will have the effect of "opening up" the Dillingham/King intersection, creating a "vest-pocket" landscaped park.

As the guideway descends from aerial to below-grade configuration, passengers will experience dramatic contrast in light: gradual darkening as the trains descend, sheltered light at the open-cut station, and continued dark as the vehicles proceed through the Honolulu CBD. Interior lights will permit reading to continue as the vehicles negotiate these transitions.

The Fort Street Station is to be completely enclosed, with no visual impact on the downtown area other than at its entrances along Hotel Street. Integration of these entrances with surrounding structures can be accomplished with the use of compatible architectual styles and finishes. The continuation of materials and textures used in the Fort Street Mall might be an appropriate treatment.

The Civic Center Station is also completely enclosed, lying below part of the intersection of King Street with Kapiolani Boulevard. As with Fort Street Station, station entrance materials and architectural treatment will comprise the system's visual impact in this area.

After clearing the King/Kapiolani intersection in an underground alignment, the guideway elevates to an aerial configuration, diagonally traversing the block bounded by Kapiolani Boulevard, Dreier and Waimanu Streets, and Ward Avenue. This will require the razing of several commercial and industrial facilities, typified by two-story, concrete block construction. As with the Iwilei Station, the elimination of structures would create a gap in development along the heavily-traveled Kapiolani Boulevard (though it might later be filled with new construction surrounding the guideway envelope). Since the area is commercially oriented, sensitivity to the system's visual impact is assumed to be low.

The guideway once again aligns itself with the existing street geometry just west (ewa) of Ward Avenue, assuming a position parallel to and just south (makai) of Waimanu Street. In the next few blocks, the guideway maintains an elevation approximately 25 feet above grade.

The Ward Avenue Station occupies the southeast corner of the Ward Avenue/Waimanu Street intersection and will be located in the midst of older one- and two-story industrial buildings. The visual sensitivity of this area to the station structure is considered to be only moderate and reducing in the future when the area is redeveloped.

Continuation of the guideway in the next two blocks, as it gently curves from the south (makai) side of Waimanu Street to the median of Kona Street, necessitates the razing of some commercial and industrial establishments. This, along with the presence of the guideway structure itself, would have significant implications on the character of this area. Presently the area hosts numerous small businesses of a wholesale commercial and manufacturing nature. Buildings are modest, usually older high-bay, one-story or two-story buildings composed of concrete or wood. Parking tends to be chaotic, with frequent blockages by delivery vehicles. As such, Waimanu Street and Kona Street west (ewa) of Piikoi Street resemble alleys more than streets. With the transit system alongside Waimanu Street and some of its businesses removed, the street will appear much broader and may be less congested. The elevated guideway structure will tend to enclose the street on the south, casting afternoon shadows on much of the newly-opened property. Thus the visual impacts on remaining Waimanu Street businesses will be profound. Transit patrons will be offered prominent views of remaining Waimanu Street business facades. Impacts on these enterprises would vary with the degree to which the affected trades rely on exposure for business.

Kona Street is now somewhat more orderly than Waimanu Street, though it caters to similar uses. The introduction of the elevated guideway in its median would widen the roadway, however, cast the entire street in shadow for all or part of the day. Even more than in the case of Waimanu Street, transit pasengers will have "front-row" views of business facades, with similar implications on the affected establishments.

Having crossed Piikoi Street, the guideway elevates gradually to approximately 55 feet above grade, clearing the existing Ala Moana Shopping Center parking decks. The character of Kona Street changes abruptly, modest, backstreet businesses being replaced by high-density shopping and office facilities. The number of persons to whom the guideway system would be exposed increases dramatically, but the bustling nature of the area and number of elements vying for visual attention imply a situation where sensitivity to the transit system's visual impact would be only moderate.

Kona Street east (diamond head) of Piikoi Street is currently inundated with buses, being one of the bus system's primary transfer points and serving a major trip generator as well. It also provides access to the shopping center's parking facilities. The shopping center area's proliferation of parking decks and amount of surface street traffic now makes for a situation that is visually disorienting. The guideway system, by climbing to the top of these parking decks, would offer brighter, more direct access to the shopping center via an open-air parking lot, rather than an enclosed one.

The Ala Moana Station is located adjacent to the shopping center's multi-level parking structure. The station structure will protrude above the top level of the parking structure but the visual sensitivity of this area should be quite low. On the opposite side, generally low-rise structures currently exist but this area is planned to be redeveloped with high-rise buildings which will completely screen the station from the north.

Aerial Segment from Ala Moana, through Moiliili, to the University (Figure V-16)

This segment of the system traverses an area with land uses and transportation facilities that can be described as having a high level of activity. After leaving the Ala Moana Shopping Center, the area transitions into medium to high density residential developments served by Kapiolani Boulevard and University Avenue, two highly traveled and important urban arterials. The H-1 Freeway borders this area to the north, which the transit line crosses, and adjoining it is the University of Hawaii Campus with its over 20,000 students.

As the guideway progresses east (diamond head) from the Ala Moana Station, it descends gradually along Kona Street to an elevation approximately 25 feet above grade, crossing Atkinson Drive and, beyond the present terminus of Kona Street, curving gently through newly-acquired right-of-way toward Kapiolani Boulevard.

Land use in this area is in transition. A large automobile dealership is the most visually prominent establishment, its several buildings and storage yards encompassing all the south (makai) frontage of Kapiolani Boulevard between Atkinson Drive and Kalakaua Avenue. This property has been slated for redevelopment; the razing of existing structure is imminent. Thus new visual elements will not be attributable solely to transit development. Opportunities to integrate future development with the Waikiki Station (e.g., direct access via a pedestrian bridge) might be in keeping with new land uses.

The Waikiki Station, just east of Kalakaua Avenue, is to be a major interface point for feeder buses serving Waikiki.

Nearly all structures in the block bounded by Kalakaua Avenue, Kapiolani Boulevard, McCully Street, and the Ala Wai Canal would be razed to accommodate the guideway and the Waikiki Station. These include a legion post (Veterans of Foreign Wars), several older low-rise apartment houses, and a grocery store. All of these buildings are unremarkable from a visual standpoint, yet their absence would be noticed, particularly in light of this block's juxtaposition with the Ala Wai Canal and numerous high-rise Waikiki apartments and condominiums beyond. Auto occupants on Kapiolani Boulevard as well as guideway passengers would be afforded new views across the canal. Similarly north-facing Waikiki high-rise residents would see a block cleared of development, save the guideway, the Waikiki Station, and two remaining structures: a restaurant that is visually striking (and somewhat a landmark) on the southeast corner of the Kalakaua/Kapiolani intersection and a ten-story residential tower on the west side of McCully Street.

The sensitivity of Waikiki residents to these changes would be considerable; whether or not changes would be considered positive is unknown, though the creation of additional open, green space would be visually continuous with an existing recreational field on the east side of the McCully Street bridge. Some residents of the block's one remaining tower would experience more acute visual impacts, however, as the guideway would sit literally in their front yard. Occupants of some older, low-rise apartments on the north (mauka) side of Kapiolani Boulevard would be less sensitive to the guideway's visual impacts, since most units would view the system from an oblique angle, if at all.

East of McCully Street, the guideway maintains an elevation of about 25 feet above grade in the median of Kapiolani Boulevard. It would be highly visible to residents along both sides of the boulevard, which features medium- and high-density housing. Shadows cast by the aerial structure would be similar to those of the regularly-spaced trees it would replace. The substitution of concrete for natural features would promote a more "urban" character to the boulevard, at the expense of considerable green "relief" provided by the existing trees. The density of the area would tend to compensate for potential feelings of lessened privacy that might be experienced by tenants along this segment.

The guideway would curve gently northward along University Avenue, maintaining its approximate 25-foot elevation. University Avenue is visually more cluttered and less broad than Kapiolani Boulevard, with utility wires strung overhead at frequent intervals and metal streetlight standards occupying the median. Lining both sides of the street are two- and three-story, medium-density apartment buildings. Set back somewhat from the street are occasional taller apartment houses.

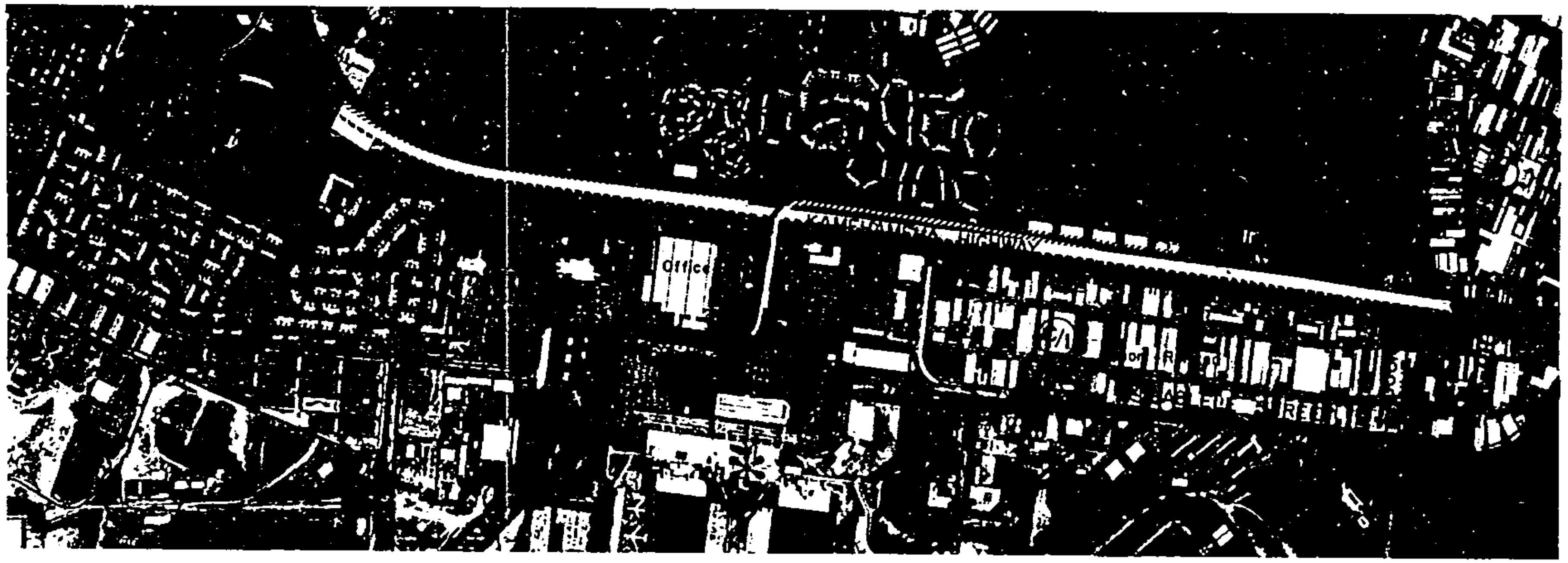
Sensitivity of residents to the visual presence of the guideway would be high. Existing trees along sidewalks would in most cases be retained. Shadows resulting from the guideway's aerial alignment would be more strongly perceived along University Avenue than along Kapiolani Boulevard by virtue of the street's north-south alignment (with shadows bearing a more direct relationship to the sun's movement), narrower right-of-way, and the fact that no shade-producing trees are present. Figures V-10b, 11b and 12b represent the guideway's possible appearance near the Date Street Station.

The Date Street Station will be located on University Avenue, just north of Date Street, and have station access from both sides of the street. The station structure's mass and height will be visually imposing from the street level along University Avenue, especially when viewed from near the station. The visual sensitivity of the general area, when viewed from a distance and from higher elevation, is expected to be only moderate due to the area's development with two- and three-story apartment buildings interspersed with occasional high-rise buildings.

Once the guideway reaches the intersection of University Avenue with King Street, adjacent land use changes from medium-density residential to university-related commercial. Buildings feature indoor pedestrian shopping streets, visually screened outdoor eating areas, and other inward-oriented functions. Thus, visual sensitivity to the guideway would be fairly low.

The guideway gradually ascends north of King Street, leaving the University Avenue median near Varsity Place to arch up and over the H-1 Freeway. It descends in an easterly direction just south (makai) of the University of Hawaii's athletic field and pool facilities.

The University Station would be approximately 40 feet above grade, visible to users of the field, spectators at the pool, and residents of medium-density housing along Varsity Circle, to the south (makai). Plans call for construction of new gymnasium facilities near the athletic field on a site presently occupied by temporary buildings. Depending on its size, this construction could reduce the visual influence of the transit system on outdoor athletic facilities, but the system would still be visible to users of the main campus, on a bluff overlooking the field. Apartment dwellers' sensitivity to the system would be similar to that of residents along University Avenue. Shadows would not be cast on apartments adjacent to the University Station due to the guideway's general east-west alignment, but the height and closeness of the guideway supports would obscure present views across the University quarry to the campus beyond.




**LEGEND**

- View Line
- Activity Center
- View Barrier
- Denotes Zone With Consistent Land Use
- Residential Ⓡ
- Industrial Ⓘ
- Commercial Ⓒ
- Park Ⓟ
- Undeveloped Ⓤ

# Existing Development Along Transit Route

## Pearl Harbor - Airport

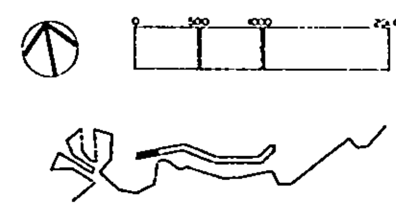
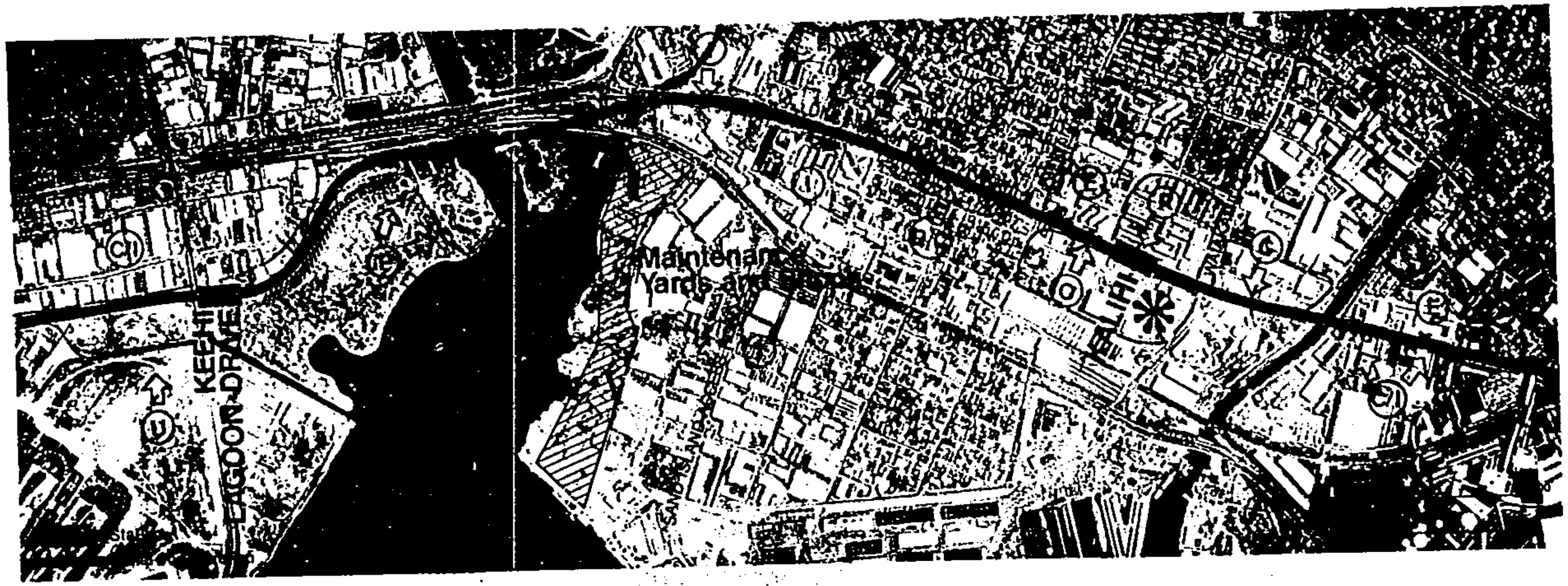



FIGURE V-13




**LEGEND**

| | |
|---|---|
| View Line | ⇦ |
| Activity Center | ✻ |
| View Barrier | ////////// |
| Denotes Zone With Consistent Land Use | ▭ |
| Residential | Ⓡ |
| Industrial | Ⓘ |
| Commercial | Ⓒ |
| Park | Ⓟ |
| Educational | Ⓔ |
| Undeveloped | Ⓤ |

# Existing Development Along Transit Route

## Keehi Lagoon-Kalihi

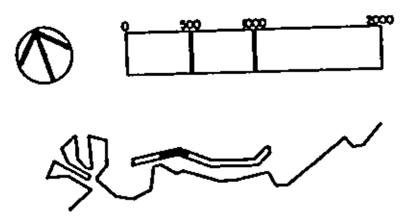



FIGURE V-14

**LEGEND**

| | |
|---|---|
| View Line | ⇦ |
| Activity Center | * |
| Denotes Zone With Consistent Land Use | ⌐ ¬ |
| Residential | Ⓡ |
| Industrial | Ⓘ |
| Commercial | Ⓒ |
| Park | Ⓟ |
| Educational | Ⓔ |

# Existing Development Along Transit Route

## Downtown-Civic Center

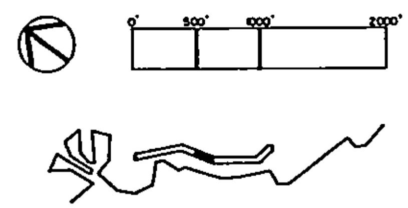
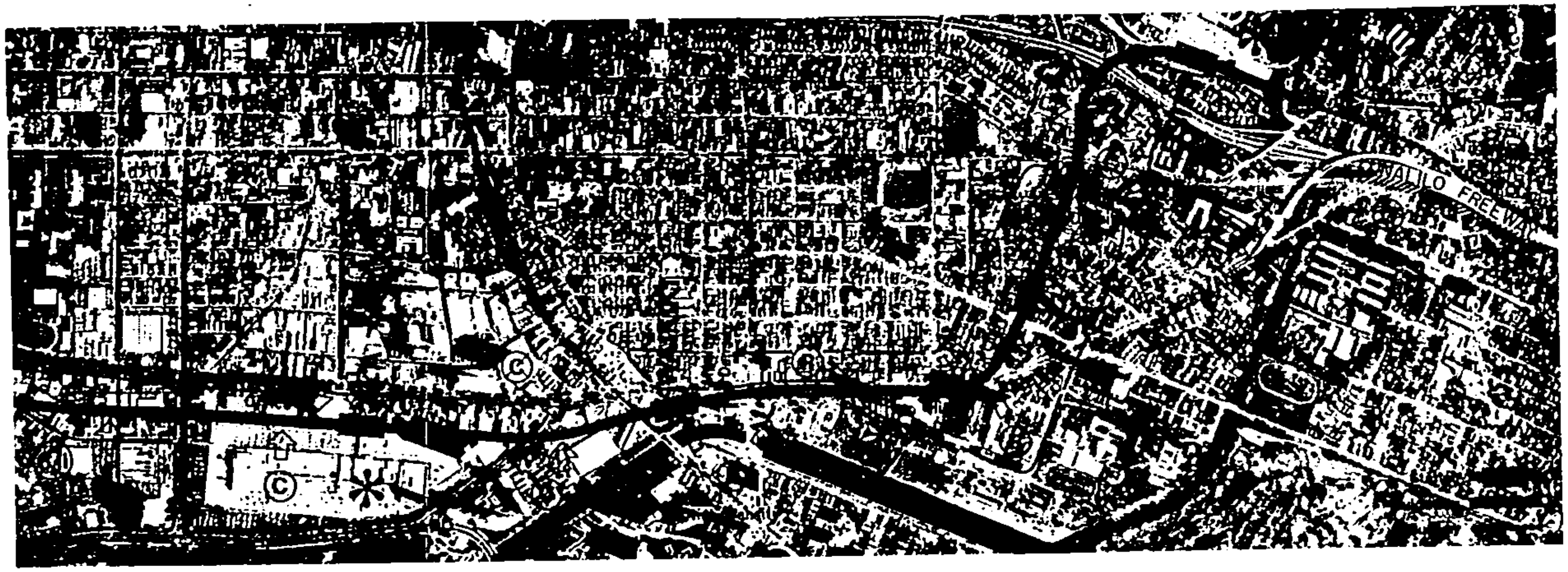



FIGURE V-15




## LEGEND

- View Line
- Activity Center
- View Barrier
- Denotes Zone With Consistent Land Use
- Residential (R)
- Industrial (I)
- Commercial (C)
- Park (P)

# Existing Development Along Transit Route

## Ala Moana-Waikiki-University

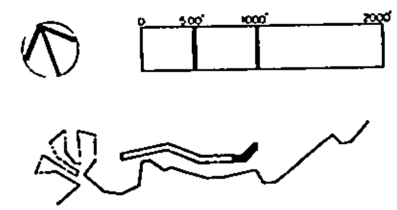



FIGURE V-16

Throughout this segment of the line, views from transit vehicles would cover a wide range, alternating between clusters of low- and high-rise buildings and the more distant views of the Koolau Mountains and Waikiki skyline.

Beyond the University Station and the turn-back tracks, the guideway transforms into a busway with similar structural characteristics. Proceeding easterly from the University property, the busway maintains a relatively flat profile as it crosses Kalele Road, the Manoa-Palolo drainage canal, and hugs the north (mauka) edge of Old Waialae Road. Development in this area consists mainly of well-kept, single-story houses, some of them along Waialae Road subdivided into multiple units. Residents would be highly sensitive to the busways's visual impacts. Those living on Kalei Road, over which the busway passes, would be particularly sensitive. As well as the visual implications of the aerial busway itself, construction would entail the razing of several houses, creating a gap in the otherwise contiguous development. The system would be exposed to residents along both sides of Waialae Road and to automobile occupants. This road experiences high traffic volumes in providing access to the westbound (ewa-bound) H-1 Freeway. While the busway's aerial alignment on the north side of the road would not necessitate the razing of any existing structures (due to generous setbacks), its visual impacts on adjacent residences would have implications on views, privacy, and winter sun penetration -- as along Dillingham Boulevard. Occupants of two four-story apartments on the south (makai) side of Waialae Road would experience less significant visual impacts, as apartments would have only peripheral views of the system. Also viewing this segment of the system would be the occupants of one high-rise structure just south (makai) of the H-1 Freeway and of houses along ridges in St. Louis Heights. The presence of the elevated freeway, composed of materials similar to those of the proposed busway, would tend to reduce the obviousness of the busway structure.

Affect on Designated View Corridors

The urban design portion of the proposed Development Plan Ordinance for the Primary Urban Center of the City and County of Honolulu sets forth the following general guidelines for public views:

- Public views include views along streets and highways, panoramic and dominant landmark views from public places, focal views of natural features, heritage resources, and other landmarks, and view corridors between dominant landmarks. Such public view should be protected by special building heights, setbacks, designs and siting controls under the Comprehensive Zoning Code. These controls should be determined by the particular needs of each view and applied to public streets and to both public and private structures.

- The design and siting of all structures should reflect the need to maintain and enhance available views of significant landmarks. New developments which would block important public views should be prohibited.

- Whenever possible, overhead utility wires and poles which significantly obstruct public views should be relocated or placed underground.

These guidelines are to be incorporated in the design of all functional plans and any implementing mechanism including the Comprehensive Zoning Code (CZC).

There are presently no zoning controls applicable to rapid transit guideways; rather the controls refer to structures (buildings).

The proposed elevated guideway would be located in the center of Dillingham Boulevard (with aerial station at McNeill Street), Kapiolani Boulevard, and University Avenue (with aerial station at Date Street) and would also cross such streets as Ward Avenue, Piikoi Street, McCully Street, etc. At these locations the guideway structures would be at an elevation of approximately 25 feet and would be supported by columns. Although the guideway structure will be affecting the view corridors, the obstruction is quite partial rather than entire. Persons traveling on the guideway will experience no view obstruction, nor will persons living or working on floors of buildings taller than the guideway.

The placement of the guideway support columns and the exact alignment of the guideway itself should be carefully done to preserve as much of the view as possible.

<u>Tailoring System Design to Neighborhood Requirements</u>

The foregoing discussions of probable visual impacts did not always suggest methods by which possible adverse impacts could be mitigated. This is because -- as mentioned in the introduction to this section -- visual impacts are highly subjective and cannot objectively be deemed adverse or positive. In fact, the ultimate design of the transit system, including guideway structures and stations, would be the by-product of meetings among system planners, architects, urban designers, and representatives of the communities through which the system would pass. As a result of these meetings, alternative visual treatments would be explored in search of solutions that would cause the system to blend into, rather than conflict with, its visual environment. Possible means toward achieving this "blend" include:

- Landscape treatments that mask the system or accentuate either its vertical or horizontal members

- Integration of station platforms with neighboring activity centers
- The use of concrete admixtures that tint the material to conform to the tone of existing community elements (e.g., pavement, sidewalks) and/or neighboring buildings
- The use of finish textures and concrete forms that, through shadows and textures, approximate the scale of surrounding elements
- Consistent and identifiable, yet visually discrete, systemwide graphics

## B.3. Circulation Impacts

a. Pedestrians: The fixed guideway system supported by an island-wide express and local feeder bus system will be planned to provide convenient public transit service on buses and/or the fixed guideway trains. The bus and fixed guideway transit services will be coordinated with appropriate interface facilities provided for persons using private cars or buses, or who walk to the system. The current improvements to the existing bus system, including bus shelters and benches, will be incorporated into the fixed guideway's feeder bus system for the convenience of transit users.

Due to their location in the CBD and Civic Center areas, the Fort Street and Civic Center Stations are projected to have the largest number of peak-hour transit-users arriving and leaving the stations by foot. Since these stations would be located in areas which are already highly pedestrian oriented the additional pedestrian traffic generated by the transit stations would have the greatest impact on pedestrian circulation. These stations have been planned to accommodate the anticipated pedestrian traffic by being located in areas where either existing or planned pedestrian-ways are available or can be provided. For example, the Fort Street Station is located at the point where the existing Fort Street Mall and planned Hotel Street Mall meet. The Fort Street Mall will serve as the major north-south pedestrian artery to and from the station while the planned Hotel Street Mall will serve the east-west pedestrian traffic.

Increase in pedestrian movements around every transit station will occur. Pedestrian access to stations will be encouraged by proper planning of facilities since this mode of travel to and from stations is the most efficient and has the least adverse impact on the environment.

Inasmuch as the fixed guideway system is fully grade-separated, impacts on non-transit related pedestrian circulation would be minor. The system will therefore not create a physical barrier and neighborhoods will not be divided.

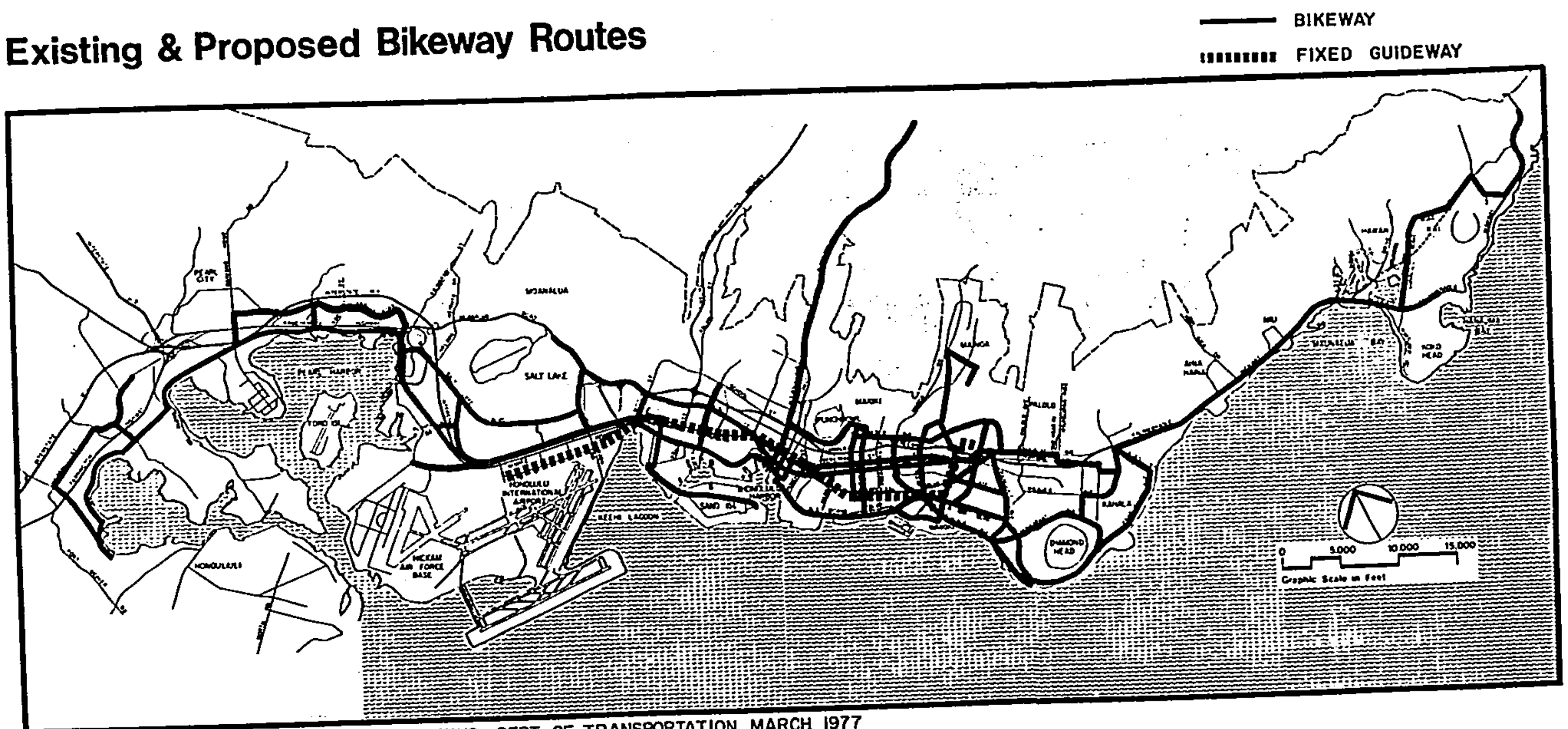
b. Bicycles: The system would have minimal impact on bicyclists, both on rights-of-way shared with other vehicles or bike routes and on bike lanes (Figure V-17). In some cases, the guideway route corresponds to existing and proposed bikeway routes. Such areas include University Avenue, Dillingham Boulevard and the Old Waialae Road. In these areas, the guideway on University Avenue and Dillingham Boulevard and the busway along portions of Old Waialae Road are to occupy the air rights over the median or along the side of the street, with little impact other than that of a visual nature on cyclists. The proposed bicycle route along Hotel Street between the Kapiolani extension and Richards Street would experience no impact from the underground guideway alignment, except during construction. Traffic in the vicinity of the Waikiki Station would entail some impact on bicyclists due to increases in the number of turning maneuvers associated with feeder bus movements and passenger dropoff and pickup operations. The bike lanes on University Avenue at the proposed Date Street Station would be affected by the increased number of buses pulling in and out of the station.

c. Vehicular Traffic: The overall impact of the rapid transit system on vehicular traffic would be a net reduction in demand for use of the street and highway system by the number of motorists diverted to transit. Although the diversion of these motorists to potential transit users will effect a reduction in future demand levels along some of today's most congested travel corridors, forecasts of future travel demand indicate that traffic volumes, overall, are likely to increase with little, if any, improvement over today's conditions.

There are, however, some traffic impacts expected on existing street and highway facilities due to the transit facility. These impacts relate primarily to those segments of the arterials and local streets modified to accommodate the transit facility, and in some cases on the local streets which provide access to transit stations.

Traffic Impact on Urban Streets Utilized to Accommodate Transit Facilities: In an effort to minimize a major impact on the communities through which the proposed transit system traverses, namely, the number of relocations required along the route, portions of the proposed fixed guideway alignment, where feasible, were located in the middle of existing streets, in either an aerial or underground configuration. There will be no long-term traffic impact on streets in

# Existing & Proposed Bikeway Routes




SOURCE: STATEWIDE MASTER PLAN FOR BIKEWAYS, DEPT. OF TRANSPORTATION, MARCH 1977

FIGURE V-17

which the proposed system would be located in an underground configuration. However, some vehicular access to businesses along Hotel Street may be curtailed with the implementation of the Hotel Street pedestrian mall.

With the aerial configuration, the guideway would be supported on columns located in either existing or proposed raised medians in the roadway. The street facilities in which this situation would occur include:

- Kamehameha Highway-Dillingham Boulevard, between the Keehi Lagoon and Iwilei Stations,
- Kona Street, between Hopaka Street and the Ala Moana Station,
- Kapiolani Boulevard and University Avenue, between the Waikiki and University Stations.

Existing raised medians wide enough to accommodate the guideway support columns are found in the portion of Kona Street adjacent to the Ala Moana Shopping Center, in Kapiolani Boulevard and generally, along the entire length of University Avenue.

On all of the streets in which the aerial guideway structure will be located, the existing through traffic lanes will be maintained. The impact on traffic operations would be limited to the elimination of left-turn movements at some minor streets and the mid-block left-turn restrictions associated with introducing raised medians where these do not currently exist, e.g., Dillingham Boulevard and Kona Street, west of Piikoi Street.

Key intersections with major left-turn movements were identified for special design treatment which would allow the retention of left-turn pockets. In a few cases, "straddle bent" structures spanning the entire width of the roadway are proposed as a means of retaining the existing left-turn pocket. This would require that only small parcels of private property, acquired by either fee or easement, would be necessary to facilitate the bent columns where sufficient area between the curb and property line is not available. Other methods for providing left-turn movements include widening the roadway by acquiring additional right-of-way necessary for left-turn pockets or the use of split-phase signalization.

<u>Traffic Impact Around Stations</u>: Accessibility to the proposed fixed guideway system is one of the most important factors in determining station location. Access by all modes including buses, automobiles, and walking were analyzed relative to existing streets in siting the stations and planning the egress and ingress facilities. In analyzing the street system and the traffic pattern thereon, it

was generally found that most streets would be at or near capacity during peak periods. In order to minimize traffic impact due to transit stations, one of the key planning considerations was to emphasize feeder buses as the primary mode of arrival and to minimize automobile use by limiting park-and-ride facilities except at the Keehi Lagoon Station where the potential for development of a park-and-ride capability exists near the site on lands presently owned by the State (airport property).

Recognizing that even without park-and-ride facilities, automobiles would be used to drop-off and pick-up transit patrons, kiss-and-ride facilities are provided at nearly all stations. The primary purpose for providing kiss-and-ride facilities is to provide off-street stopping and short-term parking in order to minimize traffic disruption on streets around stations.

By planning the proposed system to encourage the use of bus and walking as the primary modes of arrival, less than 10 percent of the total peak-hour transit patronage is expected to arrive at and depart from the transit stations by automobile. Furthermore, most high activity on-line stations can expect a considerably lower auto attraction. Table V-14 indicates the percentage of transit patrons arriving and departing at each station by mode.

Table V-14

MODE OF ACCESS TO AND FROM STATIONS DURING 1995 PEAK HOUR

| STATION | MODE (Percent) WALK | BUS | CARS |
|---|---|---|---|
| Airport | 95 | 5 | 0 |
| Keehi Lagoon | 2 | 94 | 4 |
| Kalihi | 33 | 60 | 7 |
| Iwilei | 41 | 51 | 8 |
| Fort Street | 74 | 24 | 2 |
| Civic Center | 90 | 8 | 2 |
| Ward Avenue | 92 | 6 | 2 |
| Ala Moana | 57 | 36 | 7 |
| Waikiki | 29 | 68 | 3 |
| Date | 20 | 74 | 6 |
| University | 23 | 77 | 0 |

While there is little doubt that peak-period traffic congestion will develop in the vicinity of many of the transit stations, an analysis of selected stations with higher than average bus and automobile traffic as the expected modes of access indicates that this volume of transit-related vehicular traffic generated around stations would generally be a small proportion of the total volume, between 3 to 11 percent, and therefore, should have little additional impact on local traffic conditions (see Section V.A.1.c. on Air Quality, Local Impact). Moreover, the automobile traffic volume attributed to kiss-and-ride transit patrons is generally significantly less than the total transit patrons arriving by walking or feeder buses which could imply reduced automobile traffic on certain streets with transit as compared to conditions without transit. These studies suggest that congestion encountered will be more closely allied with increased local travel than with the transit influence. However, since they are terminal stations of the 8-mile fixed guideway system, the Keehi Lagoon and University Stations will receive a greater proportion of transit-induced vehicular traffic than on-line stations. Thus, these stations and the traffic generated by them are discussed in more detail in the following paragraphs.

The termination of the rapid transit line at the Keehi Lagoon Station or at the Airport will make Keehi Lagoon Station the major auto and bus interface point since the Airport Station will be restricted to primarily pedestrian access only with some minor bus interface. Keehi Lagoon Station is expected to have some 400 passengers per hour being dropped-off and picked-up by automobile. This volume of traffic coming mostly from the north will require a left-turn movement into the station area at the intersection of Keehi Lagoon Drive and Aolele Street. In addition, a park-and-ride facility for approximately 500 cars may be provided on Airport property at the southwest corner of Keehi Lagoon Drive and Aolele Street. Between 300-400 cars out of the total 500 cars could be entering or leaving the parking lot during the maximum one-hour peak period. Since it is anticipated that the traffic volume on Keehi Lagoon Drive would be substantially below its capacity once the H-1 Freeway viaduct is completed by diverting much of the airport bound traffic currently using Keehi Lagoon Drive and Aolele Street, these streets should be capable of accommodating the total transit-induced auto traffic volume of some 700-800 cars per hour. To the 22 buses per hour interfacing at Keehi Lagoon as an on-line station, an additional 120-130 local and express buses per hour will be accommodated as a terminal station. This volume of buses will be added to the previously described transit-induced auto traffic volume which Keehi Lagoon Drive and Aolele Street should be able to accommodate.

Since no park-and-ride facility is planned at the University Station, no significant change in auto traffic is anticipated with this station serving as a terminal station. An increase in traffic will be due to express buses interfacing at the University Station and additional local buses at the Date Street Station. As previously described, the express buses interfacing at the University Station would arrive and depart via a separate busway facility and hence should not impact the local traffic.

With restricted surface street access to the University Station, local buses serving the areas beyond this terminus would interface at the Date Street Station. With the terminus at the University Station, total local buses arriving at and departing from the Date Street Station would be 55 per hour initially and increasing to 110 by 1995. Assuming that University Avenue during peak periods would be carrying the maximum traffic volume of 1,500 vehicles per hour or more in one direction, the additional buses in the traffic stream would represent less than 5 percent of the total traffic. However, the major problem at this station is in trying to accommodate up to a total of 110 buses per hour, or 55 buses per hour in each direction, on University Avenue. Even though the buses will stop off the main traffic stream, the frequent pulling-out of buses will cause interruption of traffic flow at the station area. Also impacted would be the bike lanes along University Avenue, as the buses would be crossing them when arriving and departing from the station.

In order to accommodate this number of buses, the existing parking lanes would be used which will preclude future on-street parking. With the removal of existing apartment buildings at the station, the reduction of on-street parking should not cause additional pressures elsewhere. Also, the placement of the transit station in this neighborhood could somewhat reduce auto ownership and hence further reduce the need for on-street parking.

Also, increases in kiss-and-ride demands could occur at the Date Street Station. This increase in vehicular traffic around the station would create similar impacts as the buses through added volume and disruption to traffic flow near the station.

## B.4. Land Use and Urban Development

A transportation system can be a development tool or a growth management tool or simply another means of mobility for an area's residents. The recent trend in transportation and land use planning is to utilize any new system to implement a community's goals and objectives, basically saying "what else can we provide besides increased mobility as we build a new freeway -- or rapid transit line -- or ferry terminal?"

To these ends, the City and County of Honolulu has adopted in its General Plan the following objectives and policies which may be considered as guidance in assessing the possible effects of a rapid transit system:

## Population:

**Objective C**

To establish a pattern of population distribution that will allow the people of Oahu to live and work in harmony.

**Policy 1**

Facilitate the full development of the primary urban center.

## Economic Activity:

**Objective G**

To bring about orderly economic growth on Oahu.

**Policy 1**

Direct economic activity primarily to Honolulu, Aiea, and Pearl City; and, secondarily, to Ewa.

## Physical Development and Urban Design:

**Objective B**

To develop Honolulu (Waialae-Kahala to Halawa), Aiea, and Pearl City as the Island's primary urban center.

**Policy 1**

Stimulate development in the primary urban center by means of the City and County's capital-improvement program.

The purpose of this policy direction is to insure that the "underdeveloped portions of this area be developed to appropriate densities prior to allowing large-scale development in areas outside the primary urban center."[30]

The area referenced is in Honolulu from Waialae-Kahala to Halawa, as well as Aiea and Pearl City, which represents the most densely populated part of the Island.

Further, it is felt that sections of the primary urban center that already have adequate public utilities are where development emphasis should be placed, especially in the Kakaako area -- mixed uses including residential development. Recent consultant reports[31] to the City indicate that under current zoning, the Fort Street area has 5.6 million square feet of non-residential floor space available for future development to the year 2000, with projections indicating that if current trends continue, there will be a demand for some 5 million square feet in this area. Potential supplies of non-residential floor area in the Ward Avenue Station area and the Ala Moana Station area, again under current zoning, are also substantial, indicating that just in the areas within easy walking distance of these three stations alone, the potential for realizing the policies of the General Plan certainly exist.

The construction of a rapid transit line serving downtown and the immediately adjacent areas, with extensions into residential areas also within the primary urban center (supported by a feeder bus system) directly supports the continued development of the center by providing quick, convenient access. Additionally, by providing an alternative to the private commute vehicle, congestion problems could be eased and parking requirements of the Comprehensive Zoning Code (CZC) reduced, lowering construction costs and making this area more attractive to private developers.

The provision of a rapid transit line does not insure that such development will occur, and certainly does not insure that attractive and desirable development will occur. But it can be argued that the City should take an active role in providing incentives and controls that can affect use and activities, densities, urban design and circulation around the transit stations, both to minimize potential negative affects and to take full advantage of any development that may be stimulated by the new transit system. For instance, by creating special design districts around the stations, the City can develop an ordinance which would provide for land use and design controls suitable and specially tailored for the particular characteristics and opportunities of each station's environment.

Such action by the city would be in support of another physical development and urban design objective:

Objective A

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

Policy 1

Plan for the construction of new public facilities and utilities in the various parts of the Island according to the following order of priority: first, in the primary urban center; second, in Ewa; and third, in the urban-fringe and rural areas; and

Policy 5

Encourage the clustering of developments to reduce the cost of providing utilities and other public services.

It should also support an important transportation objective:

Objective D

To maintain transportation and utility systems which will help Oahu continue to be a desirable place to live and visit.

Policy 2

Use the transportation and utility systems as a means of guiding growth and the pattern of land use on Oahu.

The formulation of objectives and goals is just the first step in the process that ends in physical manifestations that impact the community. In recognition of the fact that in the past Honolulu general planning and final physical form had very little to do with one another, a two-tier planning process was mandated by the City Charter in 1977. This revised process involved the preparation and adoption of a General Plan, some of whose objectives and policies were mentioned above. The second step is the preparation of Development Plans, which translate the broad brush General Plan guidelines into firm specifications for "the desired sequence, patterns and characteristics of future development." It is in these more specific plans that the transit system will become a development tool.

As input for the development plans, analysis of land use around proposed rapid transit station sites was done in order to determine general potential for land use change specifically in terms of development. The City's consultant assessed availability of development land, attractiveness of the area for development, demand in the area for development, public land use policies and neighborhood attitudes favorable to development, and other new nearby development activity.[32]

The consultants found that the Ala Moana, Fort Street, Waikiki and Ward Avenue Stations on the proposed 8-mile alignment had the most potential for land use change measured by the criteria listed above. In general, the type of development would be non-residential: retail, consumer services; business and professional services; commerce; manufacturing, etc. The Ala Moana Station area was identified as having a very high potential for residential development. Although demand for residential development was good and public land use policy favorable for residential development around the Date Street and University Stations, availability of developable land is very low, lessening the potential for significant amounts of new residential units.

Other kinds of potential change that might be expected, based upon experience in mainland cities that have introduced transit systems much like that proposed for Honolulu are summarized below:

Residential Areas Near Transit Stations: Convenient access to a transit system is generally considered desirable by residents. Those living within a quarter mile of the transit stations would enjoy the highest convenience -- though being immediately adjacent to a station may be perceived as somewhat of a drawback due to activity levels in the station's vicinity. The "premium" people are willing to pay to live near convenient transit generally diminishes with increased distance from transit stations.

Commercial Areas Near Transit Stations: Direct transit service may have a positive impact on business revenues. At the same time, store rents may increase, along with a tendency toward more concentrated, higher-density shopping clusters. The net result may, over time, be reflected in changes in commercial offerings. For example, shopping centers that presently cater to automobile access may find a reorientation toward pedestrian access to be desirable. Rapid transit service to other business centers, eliminating the need for long drives, may also attract suburban business interests to downtown commercial districts, reversing a 25-year trend.

Industrial Areas Near Transit Stations: Transit is likely to have minimal impact on industrial areas, other than providing service to employees. This is often misconstrued as a "compatible" relationship, but in reality is merely a lack of discord; transit lines most often pass through industrial areas as the only means of serving more densely-developed residential and commercial areas.

Open and Recreational Areas Near Transit Stations: Transit can have a significant impact in making open and recreational land more accessible to the public. Increased use of public parks is generally thought to be desirable, the only exceptions to date being wilderness refuges suffering from inundations of people. It is reasonable to expect that Keehi Lagoon Park would be more heavily used as a result of direct guideway service. The visual and auditory characteristics of a transit system may, however, be thought of as disruptive to park activities and ambiance.

Educational Institutions Near Transit Stations: The impacts of a transit system on nearby educational institutions vary with institution characteristics and guideway configuration. In general, transit service to any type of college or university is considered desirable, promoting local activity and aiding access to other areas, while its proximity to elementary schools is generally felt to embrace negative impacts: distraction and confusion. Both situations are encountered along the proposed Honolulu transit system route; however, it should be pointed out that guideway service in the vicinity of elementary schools would only be introduced along routes presently served by buses, which entail similar negative impacts as well as a lower pedestrian safety factor.

Island Development: Implementation of the proposed transit system would not be likely to have a major effect on island-wide development patterns. Influences that have caused development to occur in such places as Windward Oahu will continue; these areas would be served by more comprehensive bus service than has been previously available. Rather, development impacts described in the introduction to this section would probably be felt only along the transit corridor.

Central business districts nationwide have been experiencing an erosion of middle-class residential uses and attendant increases in crime. The result is often a downtown area that is deserted after dark, catering increasingly to daytime business needs only -- and even they are being attracted to the lower land cost and lack of congestion in suburbs. Only through a battery of incentives, often including improved transit services, has this trend been arrested or partially reversed in mainland cities.

Downtown Honolulu has not suffered in this respect to the same degree as similarly-sized or even some smaller mainland cities. This is partly attributable to different land use patterns -- the fact that Central Honolulu is developed in a narrow "strip" between mountains and ocean -- and a unique socio-cultural mix for which there is no clear-cut means to distinguish the "haves" from the "have-nots". Therefore, implementation of the proposed transit system cannot be expected to "turn downtown around," since it remains a viable business center with a good supply of close-in housing. Better transit service and the preclusion of otherwise intolerable traffic levels may be effective, however, in warding off future erosion of demand for downtown housing and may provide an impetus for increased multi-use development, consisting of a mix of residential and employment opportunities.

Impact of Terminals:

The development surrounding the Keehi Lagoon Terminal Station is primarily in industrial use to the north and airport and park use to the south. With the current use expected to remain, there should be no significant impact.

Furthermore, the limitation on building height imposed by the runway glide path would deter any redevelopment to their higher density uses. Little or no impact on present and future land use and urban development policies is expected by virtue of locating a terminal station at Keehi Lagoon.

The University Terminal Station would be located on the southern boundary of the University of Hawaii's quarry area. The station site area is presently occupied by some temporary facilities and automobile parking. The quarry area is master planned for athletic facilities and fields. Station and guideway structures can be accommodated without seriously impairing the planned development, but expansion of the station for bus facilities could have some impact on the site's development potential. Consequently, only express buses would interface at this terminal to reduce the impact. However, in either case as a terminal or on-line station, the direct rapid transit service provided the University will enhance overall campus development and environment by reducing the need for parking facilities.

Just south of the station is a fully developed medium-density residential area. The impact of the University Station as an on-line station or as a terminal station should not change the influence of transit on development in this area.

### B.5. Public Facilities

A survey was conducted to identify various public facilities along the transit corridor which may be affected by the fixed guideway system. These facilities included:

- churches,
- schools (pre-schools - Universities/colleges),
- hospitals,
- theatres, auditoriums, arenas,
- libraries,
- fire, police and other public emergency facilities.

No public facilities will be displaced by the construction of the transit system. Also accessibility to these facilities will not be hampered by the fixed guideway system. However, there may be some noise and/or vibration impact on certain facilities as discussed in Section V.B.1.

## C. SOCIAL IMPACTS

### C.1. Displacement

Displacements necessitated by fixed guideway system implementation entail significant impacts, regardless of the number of persons and businesses that must move. It is ironic, yet inevitable, that a certain number of homes and businesses be uprooted in an effort to benefit the region. Particular attention was paid throughout the transit system development program to minimize the number of displacements; significant reductions in this number were achieved during the PEEP II phase.

This section considers the number, locations, and characteristics of displaced residents and business concerns, as well as identifies the program that would assist the occupants of displaced buildings. These programs and their application to the specific needs of displaced persons and businesses in Honolulu have been compiled and documented in "Relocation Plan, Honolulu Rapid Transit System, Preliminary Engineering and Evaluation Program, Phase II."[22]

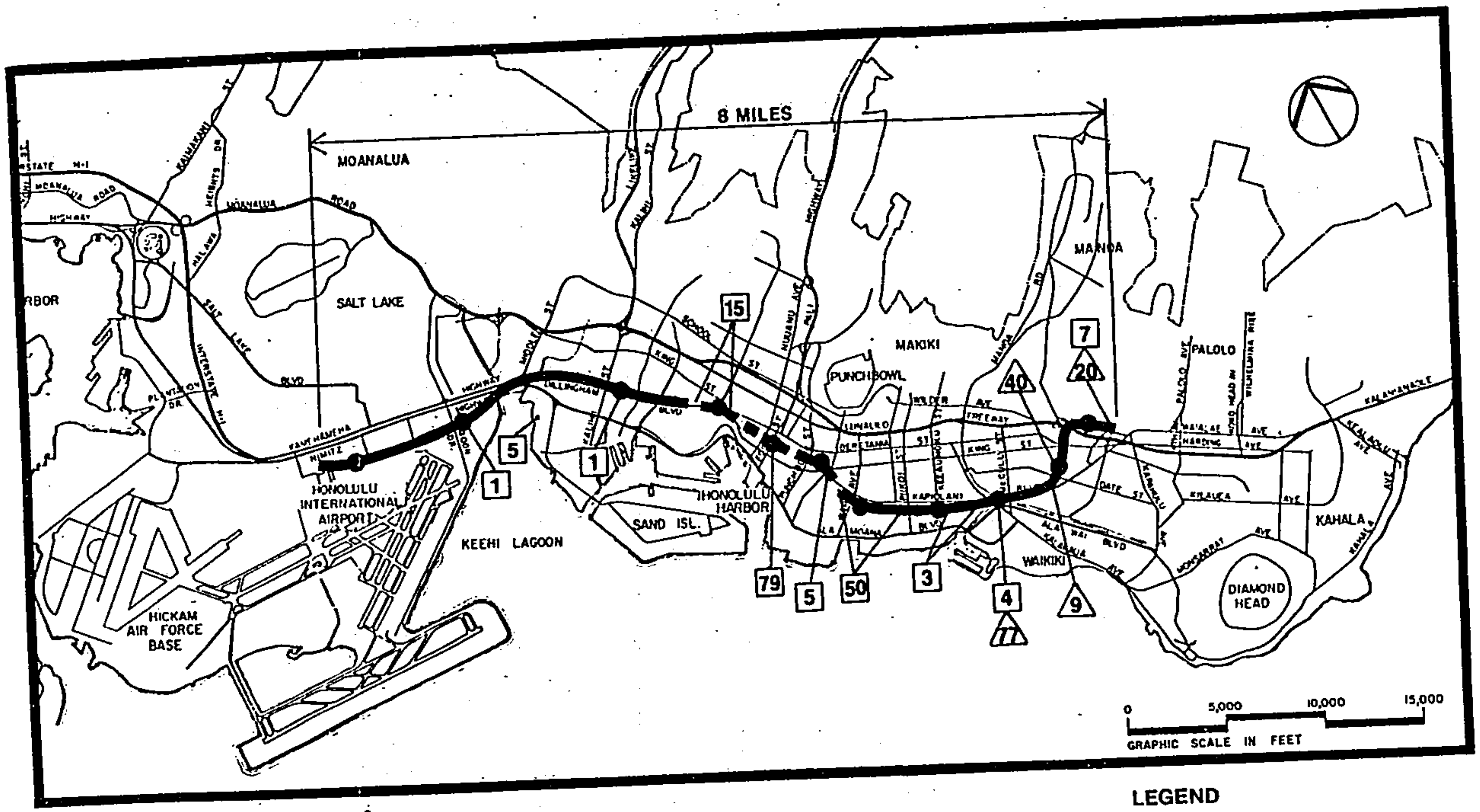
Due to continuing refinement of the alignment, and because exact station plans have not been established for many of the stations, some changes in the number of both residential and business dislocations exist and will continue to occur. Based on the alignment and station locations developed under PEEP II and used in the development of the "Relocation Plan" document (1975), a total of 162 residential units and 183 non-residential units were affected with the 14-mile fixed guideway system. However, as stated previously, these number of residential and non-residential units to be affected by the transit system, are preliminary estimates only and may change during final design.

Residential Displacement: The 8-mile fixed guideway system (including the busway to the University Station) would entail the removal of 146 dwelling units, representing 307 persons. Figure V-18 indicates the locations of these residential units, as well as those of businesses that would be removed (to be discussed later). Most of the affected dwelling units are in the McCully-Moiliili area at the proposed Waikiki and Date Street Station sites. The remaining dwelling units are located at the corner of Kapiolani Boulevard and University Avenue and along Old Waialae Road.

A survey of some 140 affected households was conducted in 1975. Besides the potential changes noted previously, there undoubtedly will be some changes in the composition of affected households in the ensuing years (i.e., families moving out of and into affected buildings). However, it is felt that the demographic patterns will generally remain representative of conditions today. Those 140 households consisted of 71 families, 58 individuals, and 11 groups of two or more unrelated individuals. At that time, a total of 332 persons would have been displaced by the implementation of an 8-mile transit system, based on occupancy rates revealed in the survey. Approximately 20 percent of the affected persons at that time were elderly. Median monthly household income was $663. Nearly half of the affected households spent more than 25 percent of their monthly income on rent.

An examination of the Honolulu housing market indicated that most of the displaced households should be able to find comparable replacement housing on the private market. Although vacancy rates are constantly in flux and vary widely with season, a surplus of available sale and rental units was found to exist at that time. The apartment vacancy rate was estimated at about 4.3 percent. In addition, there have been many authorizations for the construction of both sale and rental multiple-unit dwellings. While prices of units presently on the market are high, they are matched by the high value of dwelling units that would be taken -- for which the owners would, of course, be fairly compensated.

However, the cost of being uprooted from a residence entails more than a building's replacement value. Therefore, a number of subsidies have been established by both Federal and City agencies to aid in relocation. Federal subsidies under Section 8, Lower Income Housing Assistance Program, created under the Housing and Community Development Act of 1974, would provide most of the assistance for rental households that cannot obtain comparable housing within their




**Dislocation Impact**

LEGEND

- ● STATIONS
- AERIAL
- UNDERGROUND
- △ RESIDENTIAL DISLOCATION
- □ NON-RESIDENTIAL DISLOCATION

FIGURE V-18

financial means, even with the maximum Replacement Housing Payment. The City Department of Housing and Community Development, when designated a public housing agency under this program, will obtain and commit funds for the affected households. As an additional measure, such households would receive priority treatment in the allocation of public-subsidized and City-sponsored housing projects.

An additional "backup" would be the City's construction of new, low-rise, multi-family rental housing on a site in the McCully-Moiliili area to accommodate people displaced in the course of transit system implementation. Section 8 funds would be sought in the event that tenants need supplemental assistance.

For those who cannot be suitably rehoused by this battery of programs, rapid transit project funds could be used to acquire accommodations. The use of Federal project funds to provide this "last resort" housing is authorized under Section 206 of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970.

Non-Residential Displacements: At the time of the survey, 169 business facilities and one non-profit institution were found to be displaced by implementation of an 8-mile transit system. Of this number of businesses affected, 161 were occupied and, of these, 72 were involved with retail sales and service and 41 were offices (located primarily in the downtown and Kakaako-Ala Moana areas).

Also being displaced would be 11 wholesalers, 33 industrial firms, and two warehouses (primarily in the Kalihi-Palama and Kakaako areas). The non-profit institution affected is a Japanese Shinto Shrine, situated among multi-family residential units near the proposed Waikiki Station site.

As shown in Figure V-18, the largest number of business dislocations occurs at the Fort Street Station site. The next largest number occurs in the Kakaako area for the guideway right-of-way and the Ward Avenue Station site. A number of businesses are also affected at the Iwilei Station site with the remainder scattered throughout the system.

Survey interviews determined that approximately 75 percent of the affected businesses planned to relocate if displaced; 25 businesses indicated that they would liquidate; and 17 were undecided. Based on general market information on presently available business space, only about half of the displaced businesses wanting to relocate would stand a reasonable chance of finding suitable replacement space at an affordable price in a comparable location. The problem was generally related to cost, rather than availability. If the indicated number of businesses were to be liquidated, between 300 to 600 workers would be affected.

Experience of other large urban areas indicates that displacement usually has a negative impact on marginal types of businesses, which are generally smaller operations requiring the least investment in equipment. Many will discontinue business because of problems in finding a viable new location. Some owners of marginal businesses will change occupations, either purchasing another business or being employed elsewhere.

Unlike displaced households, uprooted businesses do not have at their disposal an array of government subsidy programs for displacement assistance, with the exception of loans available from the Small Business Administration. Morever, even if substantial relocation assistance were not required, Federal law does not require such relocation to take place prior to displacement. The assumption is apparently that businesses enjoy the option of being compensated for liquidation, while households do not.

In view of this situation, the Rapid Transit Program would approach the relocation of displaced businesses and the nonprofit organization in one of the following ways:

- Compensation for actual moving expenses, the loss of property, and the cost of seeking replacement facilities

- Alternate payment based on annual net earnings, in the event that establishments have no other outlets that contribute materially to the displaced owner's income and displacement would entail substantial losses in patronage.

An information program specially oriented to displacement and related issues would be conducted. This program would inform citizens about the project, relocation policies and resources, available benefits, and other types of assistance available to dislocated businesses and households. The designated public housing agency for the program will assist businesses, similar to affected households, in finding suitable replacement space or location to continue their business.

## C.2. Accessibility to the Transit Dependent

Section II.C.2. introduced various elements of the Central Honolulu transit-dependent population. In general, the proposed transit system is not expected to have a profound effect on transit-dependent mobility.

Certain improvements in system accessibility over the present bus system would be accrued to the elderly and handicapped. The high steps and narrow aisles of contemporary transit buses are difficult for the elderly and handicapped to negotiate -- and cannot accommodate those in wheelchairs at all. Transit bus design may improve somewhat in the 1980's, when requirements for lower floors and wider doors go into effect, but it will be some time before entire bus fleets incorporate these changes; and wheelchair provisions will almost certainly be reserved only for specially designed vehicles.

Stations for the proposed rapid transit system would be designed according to standards that would increase safety and convenience for the elderly and handicapped. Access would be facilitated by specially designed drop-off, pick-up, and parking areas; consistent, negotiable slopes would be maintained on ramps; elevators would be provided; and vehicles would have doors and special interior spaces that could accommodate wheelchairs.

Figures II-6 and II-7 showed the primary activity centers for the elderly and handicapped, as well as most residential areas with high concentrations of elderly, to be in areas of Central Honolulu that could be directly served by the preferred transit route. However, many elderly people may continue to use buses because of their more specialized, block-by-block service that may entail shorter walks. Those members of the elderly population who presently use cabs may find that the accessibility of the fixed guideway transit system -- and its free fare -- enables them to take shorter cab rides to and from transit stations only in cases where either the origin or destination is at some distance from transit.

Most non-ambulatory people would most likely use modes other than the rapid transit system, not because of system inadequacies or design insensitivities, but rather because transportation to and from transit stops represents a tremendous -- and sometimes insurmountable -- challenge. For these people, a variety of special "para-transit" (low-cost, easily implementable) services are available, including the dial-a-ride Handi-Van program operated by the City and County of Honolulu and several similar programs operated by a number of private and quasi-public service organizations. These services differ from conventional public transportation in that they offer curb-to-curb transportation and are dispatched on an as-needed basis to the primary activity centers of the groups to which they cater (e.g., hospitals, rehabilitation centers). Limited para-transit services are also available to certain segments of the school-age population through agencies associated with such programs as the "head start" educational program.

Many low-income individuals and people with limited automobile access throughout Oahu would be offered more comprehensive bus service, with many express feeder buses connecting with rapid transit terminal stations. Thus, to some extent these elements of the transit-dependent population would benefit from the proposed fixed guideway/feeder bus system.

## C.3. Transit Induced Developments

The implementation of the proposed fixed guideway system is expected to induce certain changes in land use and density around some of the stations[31]. No major changes in basic land use, such as from residential to commercial or industrial, is expected since most station areas with the greatest potential for change currently have similar uses in all or part of the area most likely to be affected. Based on current and proposed land use policies and zoning ordinances, there are no low density residential areas expected to be changed to high density developments due to the proposed action. Therefore, no major social impacts are anticipated due to potential land use changes.

Certain increase in density of commercial and residential areas is expected to be induced by the proposed action. This will result in greater concentration of people with attendant social impacts. One of the primary impacts would be the higher level of congestion in pedestrian and automobile traffic to be encountered by those individuals who will not be using the transit system in their daily activities while others using the transit system will benefit from increased mobility. The increase in population through higher density commercial and residential developments should make it possible for a wider variety of shopping, dining, entertainment and recreational activities to exist within the area. Ready access to such activities would result in social benefits to the majority of the people.

## C.4. Potential for Community Disruption

Major transportation projects, especially highways, are known to create a physical barrier in communities through which they traverse. Such barriers are created when existing vehicular and pedestrian circulation is restricted except at new crossings, thus oftentimes splitting or dividing a homogeneous neighborhood.

The proposed transit system traverses two established communities - the Kalihi and Moiliili areas - in an aerial configuration with the guideway alignment located in the center of existing major thoroughfares. In both communities, due to the aerial configuration of the guideway, impact on local circulation patterns will not be significantly affected and hence the accessibility between residential areas and community facilities would not be reduced. There will be no existing street cut offs and no physical barriers created by the guideway to restrict normal vehicular and pedestrian movements in the areas to divide or disrupt these established communities.

## D. ECONOMIC IMPACTS

The economic impacts of the proposed transit system include the short- and long-term costs associated with right-of-way acquisition, employment fluctuations, and the indirect economic impacts accrued to Honolulu citizens and visitors, both users and non-users of the system.

### D.1. Right-of-Way Acquisition and Tax Loss

Real properties totalling approximately $50 million in fair market value will be acquired to build the system. Based on the current tax roll, this represents in excess of $20 million in taxable assessed value which is approximately one-quarter percent of the total assessed value on Oahu. Using current tax rates, property tax loss would amount to slightly in excess of $300,000 annually. This impact is expected to be short-term, however; probable increases in land value of property adjacent to the transit system and the construction of replacement housing and business facilities are expected to offset this short-term loss in the long term.

In addition to the short-term loss of property taxes, the acquisition or change in use of real property would be considered an economic loss. Replacement costs entail the use of scarce resources such as money, land, labor, and construction materials. At the same time, if economic benefits were to result from changes in land use, long-term impacts could be interpreted as positive.

### D.2. Employment Impact

Construction of the transit system would, of course, bring about increased employment in the construction industry. This short-term impact may be perceived as either positive or adverse, depending on the state of the industry at the time of construction; if the industry is highly active, the need for additional labor, materials, and equipment could place critical demands on the industry, resulting either in higher construction cost or long-term purchase of equipment and labor that would, upon project completion, face possible stagnation.

The implementation of the fixed guideway system would entail the acquisition of property on which business establishments currently exist. As stated earlier, based on interviews of affected businesses conducted in 1975, 25 businesses indicated that they would liquidate if displaced. The liquidation of these businesses may involve some 300-600 employees, based on data obtained during the interviews.

However, the long-term employment impact would likely be positive as a result of improved accessibility to jobs resulting in improved labor force mobility and hence increased availability of workers. A possible secondary impact may be the stimulation of private investment in new building construction along the transit corridor.

## D.3. Economic Benefits

Economic benefits likely to accrue to the Honolulu region from implementation of the proposed transit system include savings in time for both users and non-users, reduction or elimination of vehicle operating, insurance, parking, and ownership costs, and reductions in injuries and fatalities resulting from automobile accidents.

Most people diverted from private automobiles to rapid transit would realize work-trip time savings, avoiding traffic congestion by virtue of the system's grade separation. Similar benefits would be enjoyed by former bus riders. The removal of diverted motorists from arterials and freeways would not be likely to reduce congestion to levels below those of today; however, congestion levels with the fixed guideway system in operation would be somewhat lower than if the fixed guideway were not built (see discussion on baseline bus system in Section III.B.1). Thus, even some non-users would experience a time-savings benefit in relation to a "no-build" situation.

Overall projected vehicle-miles traveled on Oahu streets and highways are estimated to decrease through implementation of the system. This entails savings in costs associated with automobile operation, maintenance, parking, and insurance -- with slight secondary benefit in terms of road longevity and a probable postponed need for major roadway repairs. Insurance savings warrant further discussion. The insurance industry typically imposes a 15 percent surcharge on an automobile's insurance premium if the vehicle is used regularly for work-trips. The service of the proposed transit system may enable many households to eliminate a second or third car -- or in some cases the first car -- with resultant savings.

The costs associated with injuries and deaths resulting from automobile accidents are immeasurable, the loss of potential income being the only factor that has been known to be quantified in the course of subsequent litigations. Reductions in traffic levels below what they would be if the transit system were not built would have positive implications on motorist and community safety and should be considered a positive project impact in terms of much more than its economic benefit.

## D.4. Impact on Other Capital Improvement Programs

The City's 1980-85 capital budget anticipates borrowing less than $10 million annually to finance capital improvement projects (CIP's). Based on the assumption that:

- the City and State will equally share in the capital funding of the transit system,
- the City limits its borrowing to $10 million annually for the CIP's,
- general fund revenues grow at an annual rate of 9 percent,
- other general fund expenditures do not grow faster than general fund revenues, and
- projected net deficits of the proposed rapid transit system are funded under one of the proposed alternative financing plans (see Section IV.A.7.), then

the budgeted CIP's and the proposed Honolulu Program of Waste Energy Recovery (HPOWER) should not be affected by the proposed transit system. However, if it is assumed that actual City borrowings average $20 million or more annually, based on past 1973-78 borrowings, to finance future CIP's, the City may have difficulty financing both the HPOWER and the transit system without affecting its credit rating.

The State has a general obligation bond limit whereby such bonds may only be issued provided they do not result in debt service charges exceeding 20 percent of the average of general fund revenues in the past three fiscal years, and not exceeding 18.5 percent of revenues after July 1, 1982. In addition, the Constitutional Convention (Con-Con) amendments provide that State surpluses running more than 5 percent for two consecutive years must be refunded to taxpayers.

Based on the State of Hawaii Department of Budget and Finance's best current estimate of the State's Projected Debt Service Limit and Projected Total Debt Service to the year 1984, projected total debt service may exceed the debt service limit in future years. Thus, given the State's currently planned schedule of bond issues and strict adherence to the Con-Con amendments, general obligation bond funding for the proposed transit system would potentially displace funding for currently planned State CIP appropriations (actual legislative appropriations for fiscal year 1980-81 were below those recommended in the Governor's budget).

It is premature to determine whether the State will truly face difficulty in financing the proposed transit system.

First, the Legislature must act on the constitutional mandates; then, the effect on competing State projects must be determined. The impact of the proposed transit system on future State CIP appropriations can only be determined after the State's total response to the Con-Con amendments has been decided.

## E. CONSTRUCTION IMPACTS

Construction impacts differ from operational impacts in two important ways: first, they are all short-term; second, they are all adverse. Rather than place these temporary, adverse impacts in perspective with probable contributions the proposed transit system will make to the Honolulu region (an issue covered in Chapter VII), this section instead emphasizes measures that could reduce the severity of construction impacts in the areas of noise and vibration, air quality, water quality, vehicular and pedestrian circulation, physical effects on adjacent structures, spoils disposal, and business losses.

### E.1. Noise and Vibration

The construction of a rapid transit system in a built-up area, as with any large project, involves the use of machines and procedures which typically cause high noise and vibration levels in the vicinity of the construction site. Construction activities with such potential include demolition, clearing, grading, excavation, pile driving, drilling, the handling and placement of materials, erection, and finish work. It is also possible that blasting may be necessary for rock excavation at certain locations.

#### a. Noise

Existing Oahu noise emission standards for public work construction restrict the hours of the day that loud or disturbing construction activities can be conducted. The State of Hawaii Department of Health "Community Noise Control for Oahu" regulations state that all construction activities in excess of allowable noise levels, measured at or beyond the property line require a permit and be restricted to between 7:00 a.m. and 6:00 p.m. and prohibited on Sundays and holidays. In cases where construction noise exceeds 95 dBA at or beyond the construction property line, activities would be restricted to between 9:00 a.m. and 5:30 p.m. All combustion by powered equipment is required to have appropriate mufflers to minimize noise. Construction activities falling into the above categories would require permits issued by the Department of Health.

Considerable progress has been made recently in reducing and controlling construction noise through equipment modifications. An effective method to assure noise control and minimum acoustic impact is the inclusion of noise limit specifications in construction contracts. The final design phase of this program should include a thorough investigation of the noise limits that can practically be achieved with modern construction equipment and techniques in an effort to mitigate construction noise impacts.

### b. Ground-Borne Vibration

Ground-borne vibration is traditionally associated with such construction activities as blasting and pile driving, as well as supportive activities such as movements of vehicles and excavation machinery. Some vibration impact may be experienced in nearby buildings. Levels of vibration in the normal movement of vehicles including graders, loaders, dozers, scrapers, and trucks are generally of the same order of magnitude as the vibration caused by heavy vehicles running on streets. Therefore, it is expected that normal vehicle movements at transit construction sites would not generate sufficient ground-borne vibration to result in significant impact.

Blasting, drilling, and excavation procedures can result in ground-borne vibration levels that may be perceptible in adjacent communities. The amplitudes of vibration from such activities are limited for safety reasons by procedural techniques. For example, time delay charges reduce the maximum amplitude of the ground-borne vibration generated by blasting to a level well below that which could cause structural damage to adjacent facilities. Impact pile drivers, while generating considerable noise and vibration, maintain vibration levels which also are well below the intensity that would cause structural damage to adjacent facilities. Ground vibration from these construction activities will be monitored to maintain the vibration levels at 2 inch/sec. or less in the vicinity of existing structures.

### c. Techniques to Minimize Construction Noise and Vibration Impacts

Noise generated at a construction site may be reduced with the continuous development of quieter equipment and by adhering to the following procedural guidelines:

- Replacement of traditional operations and techniques with less noisy ones (e.g., use of drilled piles or vibratory pile drivers instead of impact pile drivers, welding instead of riveting, off-site instead of on-site concrete mixing, use of prefabricated instead of site-assembled structures)

- Selection of the quietest among alternative pieces of equipment (e.g., electric- instead of diesel-powered equipment, hydraulic squeeze tools instead of pneumatic impact tools)
- Scheduling equipment operations to maintain low average noise levels, programming noisiest operations to coincide with times of highest ambient noise levels
- Turning off idling equipment
- Locating noisy equipment as far as possible from site boundaries and noise-sensitive areas
- Providing enclosures for stationary equipment and barriers around particularly noisy areas

After selection of the quieter construction techniques, equipment should be examined for noise-generating characteristics and its potential for further noise reduction. If new equipment is being purchased, the manufacturer should be required to specify the level of noise produced. The quietest equipment should be selected. Older equipment should be examined to determine if the noise it generates can be attenuated by feasible means.

The most important factor in reducing the ground-borne vibration from construction activities is the selection of construction techniques. The use of drilled piles or vibratory pile drivers can completely eliminate impact pile driving as a source of ground-borne vibration. The use of tunnel boring machines, rather than blasting, can considerably reduce the ground-borne vibration due to tunneling. Where blasting is necessary for technical or economic reasons, the use of delayed charge techniques can considerably reduce and control ground-borne vibration levels.

Most other types of construction activities do not cause significant ground vibration. For those that do, activities should be located far from nearby-buildings whenever possible. Ground-borne vibration attenuates rapidly with distance in soil and, by appropriate selection of locations for construction yards, gravel dumps, muck train terminals, etc., the possibility of ground-borne vibration impact can be minimized.

## E.2. Air Quality

The immediate short-term impact of the proposed action on air quality would be moderate local increases in pollution levels due to construction activities. Construction activities will produce dust and diesel fumes from increased truck traffic, generators, bulldozers, etc. Furthermore, the operation of heavy equipment would create traffic congestion and an attendant increase in emissions from slow-moving and idling automobiles. These short-term adverse impacts would be minimized through strict observance of the pollution control measures (described below) and traffic control measures (described in the subsequent section).

The following pollution control measures and procedures will be followed as required for all construction contracts:

From the Public Health Regulations of the Department of Health, State of Hawaii, Chapter 43, "Air Pollution Control":

1) Section 9. Control of Motor Vehicles

   a) No gasoline-powered motor vehicle shall be operated which emits visible smoke while moving upon streets, roads, and highways.

   b) No diesel-powered motor vehicle shall be operated which emits visible smoke for a period of more than five (5) consecutive seconds while upon streets, roads, and highways.

   c) No person shall cause, suffer or allow to keep any engine in operation while the motor vehicle is stationary at a loading zone, parking or servicing area, route terminal or other off-street areas, except:

      (1) During adjustment or repairing of such engine at a garage or similar place of repair.

      (2) During operation of ready-mix trucks, cranes, hoists, and certain bulk carriers or other auxiliary equipment built onto the vehicle or equipment that require power take-off from the engine, provided that there is no visible discharge of smoke and the equipment is being used and operated for the purposes as originally designed and intended.

2) Section 10. Fugitive Dust

a) No person shall cause or permit any materials to be handled, transported, or stored; or a building, its appurtenances, or a road to be constructed, altered, repaired or demolished without taking reasonable precautions, as approved by the Department, to prevent particulate matter from becoming airborne. Examples of some reasonable precautions are:

(1) Use, where possible, of water or chemicals for control of dust in the demolition of existing buildings or structures, construction operations, the grading of roads or the clearing of land.

(2) Application of asphalt, oil, water or suitable chemicals on roads, materials stockpiles, and other surfaces which can give rise to airborne dusts.

(3) Installation and use of hoods, fans, and fabric filters to enclose and vent the handling of dusty materials. Adequate containment methods shall be employed during sandblasting or other similar operations.

(4) Covering at all times when in motion, open-bodied trucks transporting materials likely to give rise to airborne dusts.

b) No person shall:

(1) Cause or permit the discharge of visible emissions of fugitive dust beyond the lot line of the property on which the emissions originate; or

(2) Cause or permit to be emitted into the atmosphere any dust from any source in such a manner that the ground level concentrations at a point selected by the Department exceeds:

(aa) 150 micrograms per cubic meter above upwind concentrations. Samples shall be obtained by using a high volume air sampler or other equivalent method for a 12-hour period; or (bb) A fallout of 3.0 grams of dust per square meter above upwind concentrations for any 14-day period. Dustfall samples shall be obtained by using fallout jars of eight inches in diameter and 12 inches in depth or any larger jars of equivalent proportions;

provided that this subsection shall not apply to persons who can demonstrate to the Director that best practical operation or treatment is being implemented.

## E.3. Water Quality

Transit construction entails certain operations that would disturb the ground cover, with both short- and long-term implications. These operations include clearing, grading, excavation, filling, and de-watering. A rigid erosion and sediment control program should be required in construction contracts.

Sedimentation can be controlled during clearing, grading, excavation, and filling operations in the following manner:

- Saving existing vegetation wherever possible
- Reducing the area of disturbance
- Covering soils with mulch or vegetation to reduce to a minimum the exposure of bare soil
- Installation of permanent vegetation immediately following construction
- Installation of permanent storm drains, roads, and parking lots as early as possible
- Trapping sediments in on-site basins

The de-watering of trench excavations in corralline deposits may cause fine materials in suspension to be pumped. Such materials may remain in suspension in bodies of water for a period of time long enough to be highly visible. Suspended materials are difficult or impossible to trap or settle in a basin. To minimize the amounts of suspended solids in de-watering discharges, a wellpoint system with suitable filter materials around the pump intake may be necessary. If this is infeasible, waters pumped from trench excavations may be recharged back into the ground, rather than released to bodies of water. Determination of the better technique should be made during the program's final design phase.

Another construction activity requiring special attention is the crossing of Nuuanu Stream with an underground box structure. It is envisioned that the box structure would be constructed by blocking off one-half of the stream with sheet piling or cofferdam such that the area can be de-watered and excavation and concrete pouring done in dry condition. This process would then be repeated for the other one-half of the stream. The construction should take place during low stream flow such that the anticipated flows are low enough to be handled with one-half of the stream temporarily blocked. Driving of sheet piling and excavation should be carefully performed to minimize disturbance and flow of sediments into the harbor.

The following pollution control measures and procedures should be followed during construction:

a. From the Public Health Regulations of the Department of Health, State of Hawaii, Chapter 37, "Water Pollution Control, Section 2, Standards of Water Quality":

> "It is the public policy of this State to conserve the waters of the State, and to provide that no waste be discharged into any waters of this State without first being given the degree of treatment necessary to protect the legitimate beneficial uses of such waters; and to provide for the prevention, abatement and control of new and existing water pollution; and to cooperate with the federal government in carrying out these objectives.
>
> ". . . Any industrial, public or private project or development which could constitute a new source of pollution or an increased source of pollution will be required, as part of the initial project design to provide the highest and best degree of water treatment practicable under existing technology."

b. From the General Provisions of construction Contracts of the City and County of Honolulu on "Water Pollution":

> "The Contractor shall not pollute water resources including streams and drainage systems with fuel, oils, bituminous materials, calcium chloride, acids, construction wastes, wash waters or other harmful materials. Surface drainage from cuts and fills whether or not completed, and from borrow and waste disposal areas shall, if turbidity producing materials are present, be held in suitable sedimentation ponds or shall be graded to control erosion to meet acceptable limits. Objectionable construction discharges shall be processed, filtered,

ponded or otherwise treated prior to their discharge into a waterway or drainage system. Disposal of any material, garbage, oil, grease, chemicals, trash, and other similar materials on areas adjacent to streams or drainage systems shall be subject to the approval of the Officer-in-Charge".

## E.4. Vehicular and Pedestrian Circulation

Nearly 60 percent of the 8-mile fixed guideway system is routed in existing streets and highways. Construction of the guideway system may require the temporary closing of some traffic lanes, with a short-term impact on vehicles, including bicycles using these facilities. Most of these trafficways are wide enough to accommodate through traffic, local traffic, and emergency vehicles while construction is under way. Decisions regarding the number of lanes that would remain open lie with either the City and County Department of Transportation Services or the State of Hawaii Department of Transportation. No roadway will be closed without authorization and all detours will be appropriately designed to safely accommodate autos, bicycles and/or pedestrians subject to the approval of these agencies.

Through the CBD/Civic Center area, the guideway would be in underground configuration beneath Hotel Street. It is assumed that plans to convert Hotel Street into a pedestrian mall will be concurrently done with transit construction; thus the entire roadway width would be used for construction, though existing sidewalk areas would be maintained to provide adequate pedestrian access to businesses. Arrangements for emergency vehicles must be made with the Honolulu Fire and Police Departments and buses currently using Hotel Street will be rerouted to other streets including King and Beretania Streets.

In order to mitigate circulation impacts, prevent accidents, and maintain personal and property safety, the following measures have been proposed.

- Free access to water meters, water valves, and abutting private properties; fire hydrants readily accessible to the Fire Department at all times
- Installation of traffic bridges or steel plates to maintain access to all streets, roads, lanes, alleys, driveways, and garages
- Maintenance of existing pedestrian walkways and bikeways or provision of alternate pedestrian routes; passage between walkways and bikeways at intersections

- Separate safe crossing provisions for both vehicles and pedestrians in cases where substructure excavations cross street intersections; pedestrian crossings to be equipped with handrails

- Installation or preservation of all signs, lights, flares, barricades, and other facilities required for the protection, convenience, and safety of public traffic; all to conform to requirements specified in the "State of Hawaii Rules and Regulations Governing the Use of Traffic Control Devices at Work Sites on or Adjacent to Public Streets and Highways", and the U.S. Federal Highway Administration "Manual on Uniform Traffic Control Devices for Streets and Highways, Part VI - Traffic Controls for Highway Construction and Maintenance Operations," 1971

- Notices to the motoring public pertaining to the restriction of vehicular traffic and any road closures near work areas, to be published at least three consecutive days prior to imposition of restrictions in a Honolulu daily newspaper of general circulation

## E.5. Physical Effects on Adjacent Structures

Construction of the guideway's underground segment through the CBD may entail some physical impact on adjacent structures, requiring some structural underpinning. Building setbacks and foundation types vary and, owing to the age of many structures, might in some cases only be determined in the course of construction. Therefore, the amount and type of underpinning will be determined on an individual basis. Typical methods include driven or drilled friction and foundation piles under existing foundations. These supports would be stronger than the buildings' original foundations to ensure that structures would not be disturbed in the course of construction.

Some ground settlement adjacent to trench excavation may be caused by excessive lateral movements of the sides and heaves of the bottom of excavations, as well as by construction vibration and de-watering.[33] Settlement would be significantly influenced by the affected structure's foundation type, depth, and bearing strata. In areas underlain with corralline materials, settlement is expected to be small and to have no structural effect on buildings, provided that suitable excavation, shoring, and bracing techniques are employed. A detailed evaluation of each potentially affected structure is recommended for the final engineering phase.

In general, corralline material is found from the Nuuanu Stream to the east end of the underground segment. The area adjacent to the Nuuanu Stream is underlain with soft clays and silts, which, with a combination of excavation and de-watering, could experience significant settlements. Settlements due to excavation are caused by lateral movement of the excavation walls and bottom heave due to stress release. Carefully planned and implemented excavation, shoring, and bracing could minimize settlements. Settlements due to de-watering the silt and clay materials are caused by the increased weight of the de-watered material (due to removal of the buoyant force), which consequently increases the load in these compressible materials, causing them to consolidate. A combination of deep cut-off sheet piling and recharging the ground water outside the excavation could minimize the effects of de-watering.

## E.6. Spoils Disposal

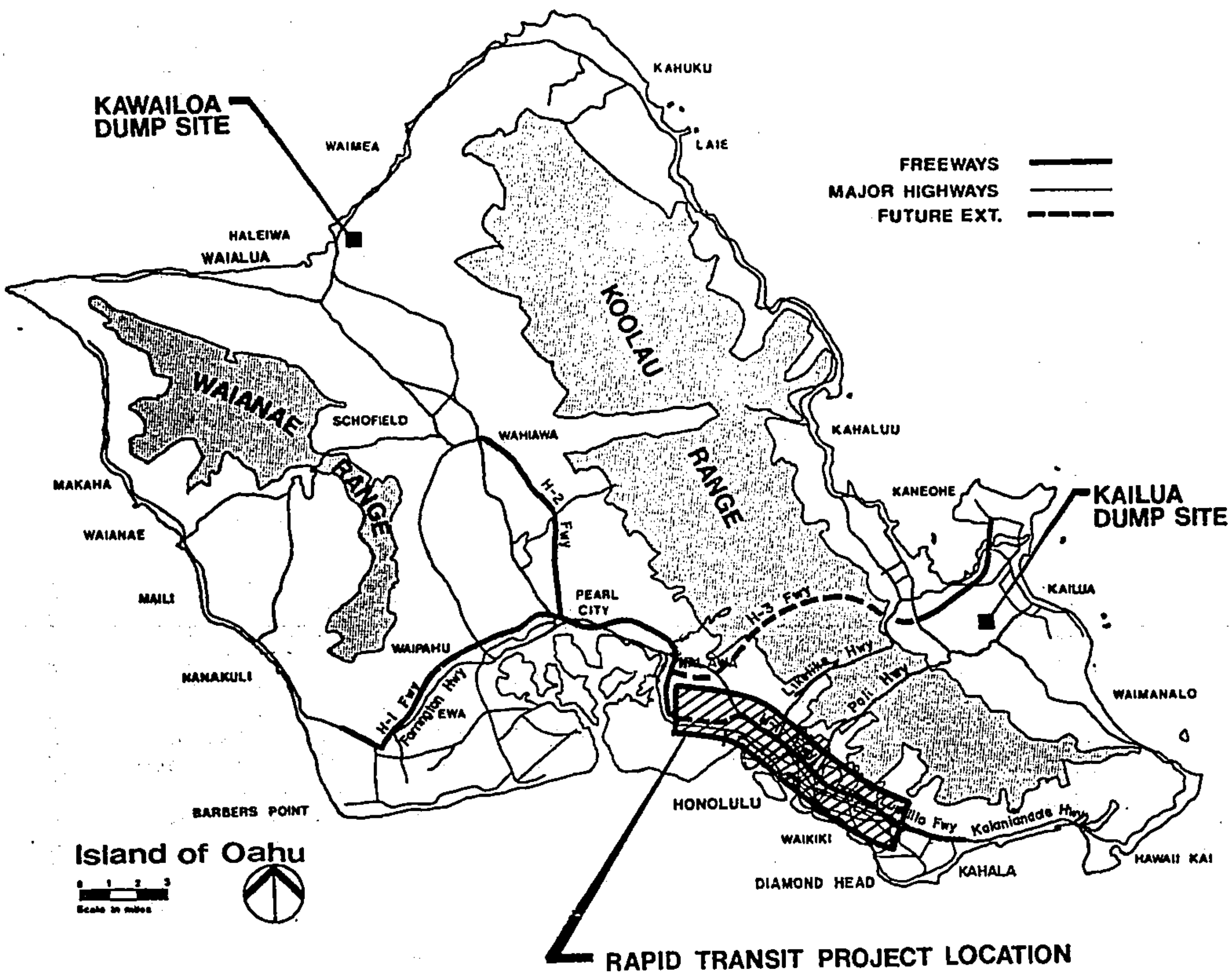
An estimated 300,000 cubic yards of material will be cleared and excavated in the course of transit system construction. Of these, about half the clean soil and rock would be used for backfill. Over two-thirds of the remaining 150,000 cubic yards would be used to fill the yard and shop site; 50,000 cubic yards of spoils considered to be unsuitable as fill material would be disposed of at sanitary land fill sites certified by the State Department of Health. The City of Honolulu presently operates two such sites (Figure V-19) for disposal of construction wastes and is in the process of selecting a third major site in the near future. The nearest site is in Kailua which is about 10 miles from the Honolulu CBD. Strict controls prevent any form of environmental pollution in the course of spoils disposal. All pertinent ordinances, including those applying to grading, would be followed in disposing spoils at either City-owned or private sanitary land fill site locations approved by the City and the State.

## E.7. Temporary Disruptions to Utility Services

Although all utility services will be maintained, there will be temporary disruptions, normally of short duration, to make new connections or to isolate a segment of a system to conduct certain construction work and maintain workers' safety. In all cases, any service disruptions will be temporary, with affected occupants to be notified of the day and approximate time of the disruption.

## E.8. Impact on Existing Wells

A number of private wells exist along the underground segment of the proposed transit system. These shallow wells




# EXISTING SPOILS DISPOSAL SITES

FIGURE V-19

are generally 60-100 feet deep with two active wells located within 100 feet and the others beyond 100 feet from the rapid transit line. Borings taken along the line indicate hard coralline materials down to 30-40 feet deep underlain by a relatively stiff alluvial silt deposit. Experience with excavation in the coralline material indicates relatively small amount of ground water infiltration and therefore any impact on these shallow wells is expected to be minimal. However, a monitoring program will be established during construction and if any interference to the wells is expected, mitigative measures such as injection wells will be employed.

## E.9. Business Losses Due to Construction Activities

There are likely to be short-term adverse impacts on businesses adjacent to certain segments of the proposed transit route. The construction of any major transportation facility involves the short-term disruption of views, accessibility, and parking, as well as increased noise, dust, and other environmental distractions. These may translate into reduced business revenues, particularly in the cut-and-cover section of the line as it traverses the Honolulu CBD. Pedestrian circulation would be maintained, although there would be some limitations on current levels of movement in the form of barricades, decking over trenches, presence of construction equipment, and change in bus routes. These factors may result in loss of revenue for some businesses (although certain businesses, such as those that cater to the lunch trade, may experience increased revenues due to the presence of construction crews). The long-term adverse impact of construction activities would be expected to befall only those businesses that are marginal today and those that rely on high visibility/accessibility and "impulse" shopping motivation. It is expected that most presently stable businesses would enjoy a long-term economic benefit from the presence of the transit system, in that their offerings would be made more apparent to transit patrons as they travel to and from transit stations.

The primary impact area is along Hotel Street between River and Richards Streets. Cut-and-cover construction normally requires that on-street parking be eliminated which is one of the primary causes of economic impact to businesses. Since on-street parking is currently prohibited at all times on Hotel Street, this will not be a factor. As previously stated, any form of construction activities could have an effect on business with the magnitude of impact related to the level of disruption to pedestrian circulation which will vary with the type of business and its dependence on pedestrian visibility. In view of this potential impact on business during construction, consideration of alternative methods of underground construction is described.

Various methods of underground construction are available depending on subsurface conditions and available width of rights-of-way. Where rock sub-surface conditions exist, a single horse-shoe tunnel is commonly used such as in Montreal and Washington, D.C. With highly competent rock, twin-bore tunnels utilizing rock boring machines are economical methods of construction. For materials other than rock, twin-bore tunnels utilizing shields are common both in dry and wet conditions.

The sub-surface conditions existing under Hotel Street vary with approximately 10 feet of alluvial deposits or fill consisting of loose sand and soft silts and clays. Below this lèvel is generally found 30 feet or more of coralline materials underlain by a relatively stiff alluvial silt deposit. The corraline materials usually occur in very erratic conditions with frequent voids or cavities filled with soft sands and silts which makes tunneling extremely difficult and expensive. The use of boring machines or shields requires the equipment to be adapted to a particular type of material in order to achieve any degree of efficiency. Since it is nearly impossible to extricate this equipment once tunneling is started, the frequent and unpredictable change in the material would preclude its use.

An additional consideration in the use of twin-bore tunnels is the width of the existing Hotel Street right-of-way. The outside bore diameter of the tunnel bore will be between 18 to 19 feet with at least one tunnel diameter space required between the bores. This results in the out-to-out dimension of the twin-bore tunnels to be 54 feet to 58 feet, a width exceeding the available 50 feet right-of-way. With existing foundations of buildings located on or near the right-of-way lines, the outside edge of the tunnels would be under building foundations.

A single horse-shoe tunnel was considered but in view of possible large holes or cavities in the coral stratum filled with soft sands or silts, a potential for dangerous cave-ins exist. Furthermore, blasting of coral may be required which could cause damages to adjacent structures.

The cut-and-cover method would be the most economical with the least physical impact to adjacent properties. With open trench construction, a large tractor with a ripping tooth or a large backhoe is capable of excavating coral without blasting. Thus, any form of tunneling methods would not be suitable with the subsurface conditions and the right-of-way width available on Hotel Street.

## VI. (SECTION 4(f)) STATEMENTS AND HISTORIC PROPERTIES (SECTION 106) DETERMINATIONS

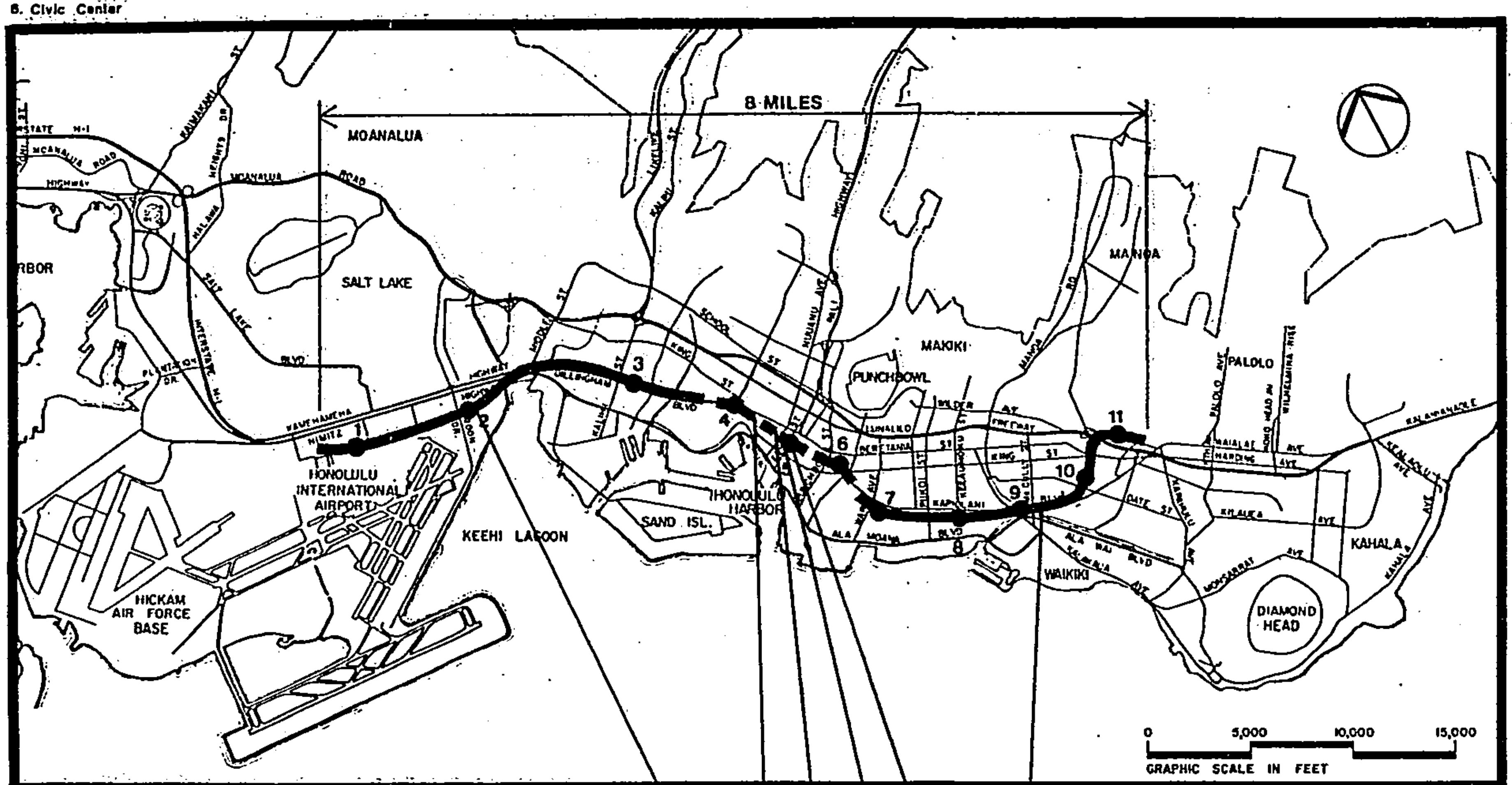
This chapter assesses the impact of the project on affected parklands and historic properties and specifies protective measures that would be taken where these lands are adversely affected. This discussion is treated separately from the main chapter on environmental impacts because it is responding to the specific requirements of certain Federal laws. These laws recognize the significant public values residing in certain open space areas and historic and cultural resources.

Section 4(f) of the Department of Transportation Act of 1966 declares a national policy that special effort be made to preserve the natural beauty of the countryside, public park and recreation lands, wildlife and waterfowl refuges, and historic sites. Section 4(f) permits the Secretary of Transportation to approve a project which requires the use of publicly-owned land from a park, recreation area, or wildlife refuge of national, state, or local significance, or any land from a historic site of national, state, or local significance only if the following determinations have been made: (1) there is no feasible and prudent alternative to the use of such land; and (2) all possible planning has been undertaken to minimize harm to the 4(f) land(s) resulting from such use. These determinations with supporting documentation are set forth in a 4(f) statement. This is a self-contained document, but for projects requiring an EIS, the 4(f) statement is included in the EIS.

Section 106 of the National Historic Preservation Act of 1966, as amended, requires that a Federal agency take into account the effect of a federally assisted project on any district, site, building, structure, or object listed in the National Register of Historic Places prior to the approval of the expenditure of any Federal funds on the project. The Advisory Council on Historic Preservation, created by the Act, has established procedures that set forth certain steps for Federal agencies to follow to meet the requirements of the Act and of Executive Order 11593, May 13, 1971, "Protection and Enhancement of the Cultural Environment", which extended the procedures to be followed to properties eligible for the National Register of Historic Places.

### A. USE OF PARKLANDS AND HISTORIC PROPERTIES (Section 4(f) Statements)

The location for the proposed fixed guideway system through urban Honolulu would use land from three significant parks, the Keehi Lagoon Beach Park, Aala International Park and the Ala Wai Park Field and Playground. The general location of these parks are shown in Figure VI-1. The U.S. Department of Interior has reviewed the draft Section 4(f) Statements




General Location of Section 4(f) Parkland Takings and Eligible Historic Buildings

FIGURE VI-1

prepared for these parklands, and via letter dated October 3, 1979 concluded that there appears to be no feasible or prudent alternative to these takings. (A copy of this letter is on file at the Honolulu Department of Transportation Services.)

The proposed system would also adversely affect the Robinson Building, the McCorriston Building and the Hotel Street Sidewalk Elements, all identified as eligible for the National Register. These three historic resources are located on Hotel Street and the Office of the Secretary, U.S. Department of Interior has agreed that there are no feasible or prudent alternatives to avoid these takings. Various other historic properties which are included or determined eligible for inclusion in the National Register have been identified and it was determined that no adverse effect would be encountered and are discussed under Section B of this chapter.

## A.1. Keehi Lagoon Beach Park

### a. Description and Significance of Affected Property

This approximately 70-acre park is located on the shore of Keehi Lagoon on the southern side of the Island of Oahu, adjacent to the Honolulu International Airport. The park is bounded on the north by Nimitz Highway and some industrial developments, on the south by the Lagoon and the airport property, on the west by Lagoon Drive and on the east by the Veterans of Foreign Wars Memorial property. The entrance to the park is on Lagoon Drive and the access road through the park is an extension of Aolele Street. Keehi Lagoon Park is located in an area which is primarily industrial. The primary access to the park is via the automobile (see Figure VI-2).

The park is well maintained and offers a wide assortment of active and passive recreational facilities for all age groups. Existing facilities include four softball fields, one baseball field, 12 tennis courts (some with bleachers), two comfort stations, one maintenance building, a tot lot with playground-type equipment, a model boat basin with breakwater in Keehi Lagoon, walkways, an area set aside for a Hawaii Little League Baseball Stadium and two separate parking areas. One area has 50 parking stalls and the other has 435 stalls.

People do not ordinarily swim in the Lagoon, adjacent to the park, but in areas further out toward the ocean, the Lagoon is frequently used by small speed boats and for some water-skiing. The park is often used by groups of school children who arrive in buses to picnic and is occasionally used at lunch time by the workers from the industrial areas adjacent to the park. The park is primarily used by numerous social softball leagues on the island mainly during the later afternoon on weekdays, after work, and on weekends. The tennis courts are also quite heavily used.

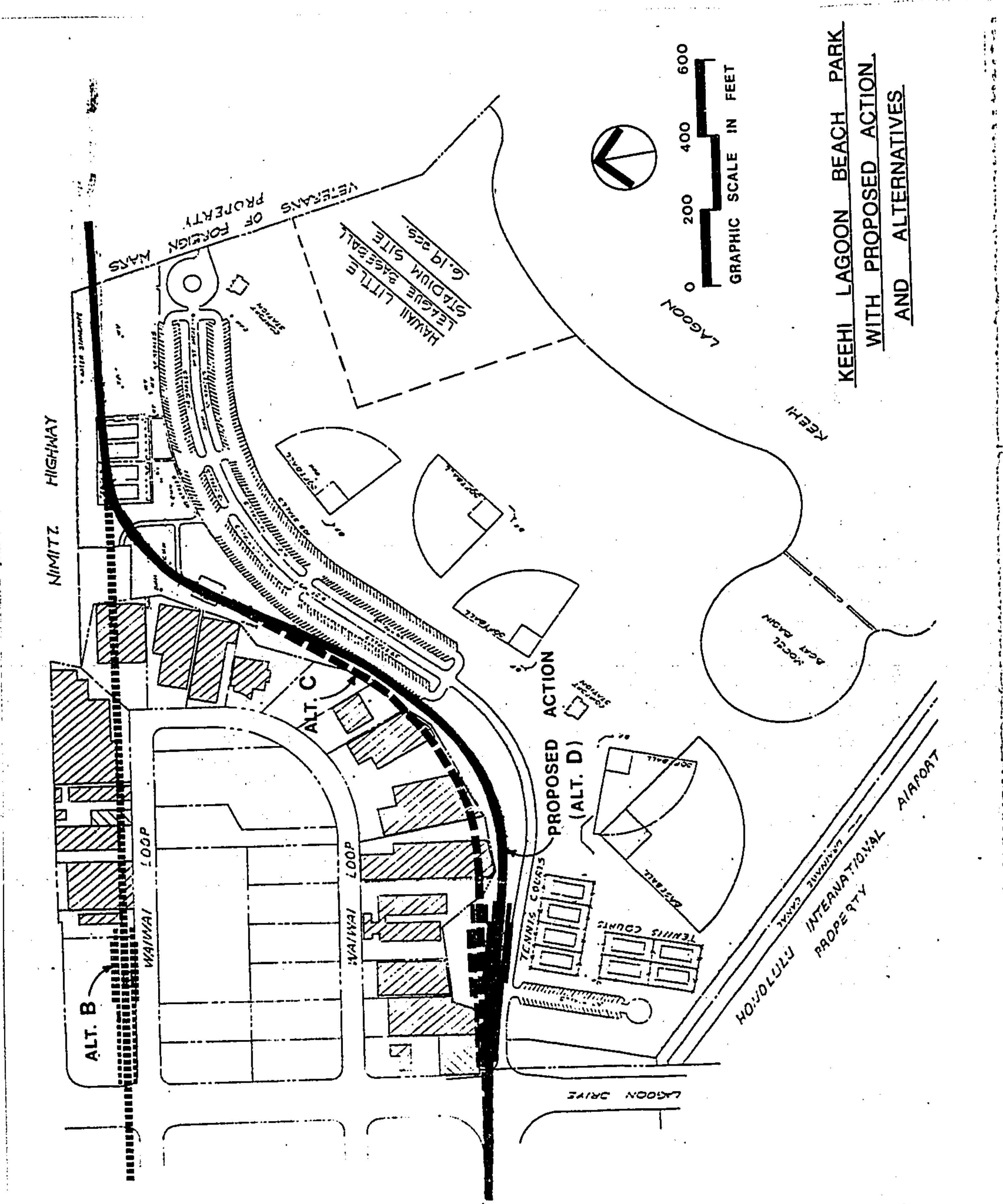

KEEHI LAGOON BEACH PARK
WITH PROPOSED ACTION
AND ALTERNATIVES
0 200 400 600
GRAPHIC SCALE IN FEET
NIMITZ HIGHWAY
VETERANS OF FOREIGN WARS PROPERTY
HAWAII LITTLE LEAGUE BASEBALL STADIUM SITE
6.19 acs.
KEEHI LAGOON
MODEL BOAT BASIN
ALT. B
ALT. C
PROPOSED ACTION
(ALT. D)
WAIWAI LOOP
WAIWAI LOOP
LAGOON DRIVE
TENNIS COURTS
TENNIS COURTS
HONOLULU INTERNATIONAL AIRPORT PROPERTY

FIGURE VI-2

Due to its isolation from residential areas the park is not extensively utilitzed. It mainly serves park users who arrive by car. Furthermore, because Keehi Lagoon is located under the flight path of one of the main runways at the Honolulu International Airport, night lights are prohibited in the park, therefore, the park is used only during daylight. The park land is owned by the State of Hawaii and is operated and maintained by the City and County of Honolulu, Department of Parks and Recreation under Executive Order Number 1561.

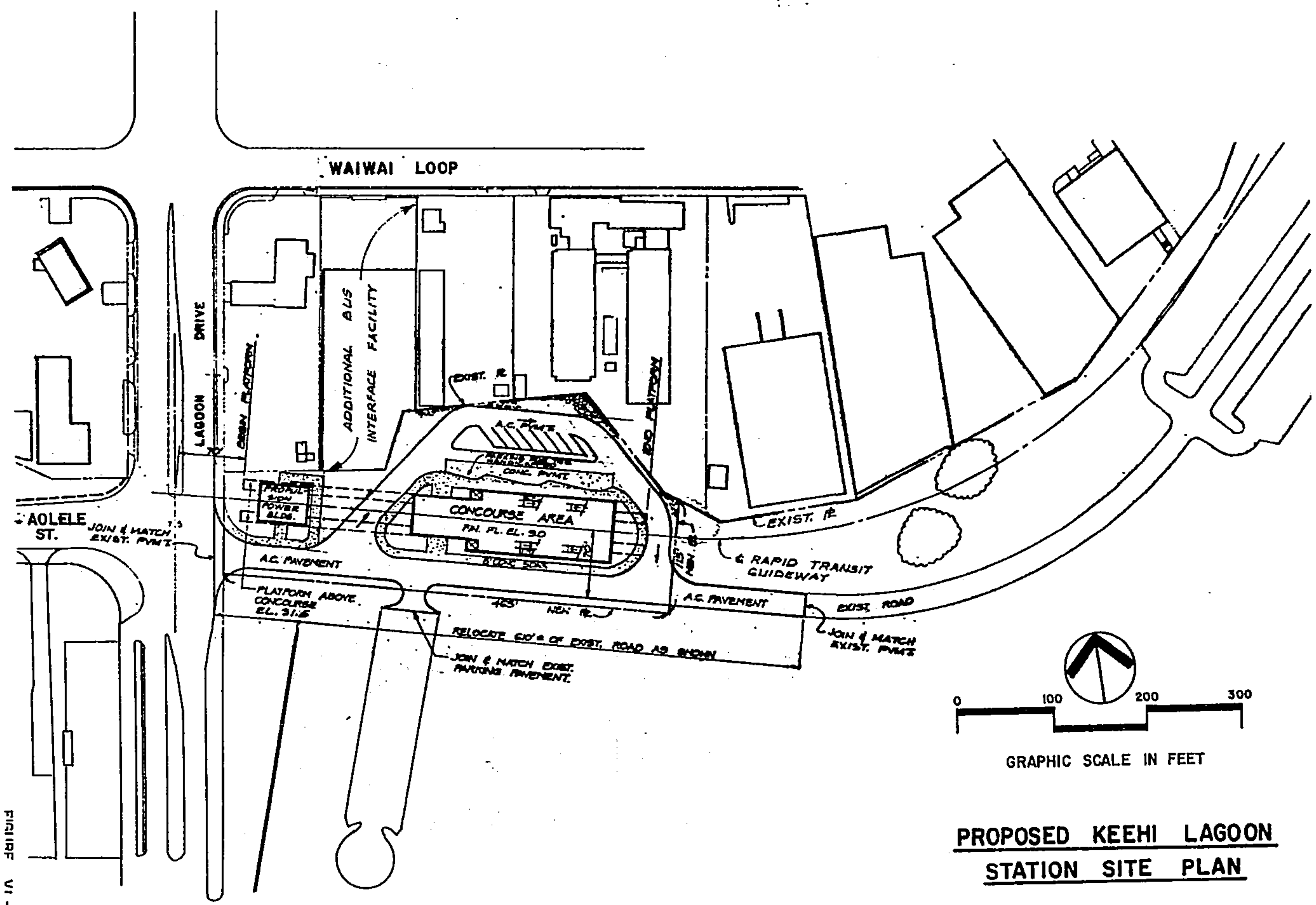
b. Proposed Use

Implementation of the proposed system would require the permanent use of 1.7 acres of land for a transit station and up to 1,000 sq. ft. of land for guideway support columns spaced at approximately 80 ft. on centers. Some two acres of easement would also be required for construction and maintenance of the aerial guideway with the ground surface retained for park use. The proposed system would also require the removal of four existing tennis courts.

The proposed alignment would provide convenient access to and from the proposed yard and shop site located on the opposite side of the Lagoon from the park. A transit station is proposed to be located in the park area. This station would not only serve the park directly but also the adjacent industrial areas, and the residential areas located north of the station in the Salt Lake and Tripler Army Hospital areas through a feeder bus system. The proposed station is located in the northwest corner of the park, just east of Lagoon Drive near the entrance to the park. The proposed alignment and station location for the fixed guideway system through the Keehi Lagoon Park is shown in Figure VI-2.

The proposed guideway structure and station platform are in an aerial configuration with an at-grade station concourse for entrance into the transit station. The station area would also consist of minimum bus and auto (kiss-and-ride) interface facilities (see Figure VI-3). The aerial guideway structure would be located some 15 feet above the ground to maintain clearance over Lagoon Drive and still meet aerial clearance required by the airport's runway flight path. This 15 feet clearance from grade would be maintained through the park to provide for use of area under the guideway for proper landscaping and possible park use.

The proposed alignment through the park is located adjacent to the northern property line of the park, on a thin strip of park land located between the access road through the




**PROPOSED KEEHI LAGOON STATION SITE PLAN**

FIGURE VI - 3

park and its northern boundary. The tot lot and four existing tennis courts are located in this area and will be affected. This alignment would not encroach into any of the adjacent industrial properties. To accomplish this alignment, minimum radius curves were utilized which would somewhat restrict system operating speed but it would minimize the impact to the park.

It is pointed out that this Keehi Lagoon Station located in the park area would be or function as a terminal station if the 7-mile, 8-mile, or 10-mile rapid transit system length is constructed as the initial phase. In this event, the second parcel of land east of Lagoon Drive would be acquired for additional bus interface facilities as shown in Figure VI-3.

c. Alternatives

During the preliminary engineering and evaluation program for the proposed transit system numerous alternative system route alignments were developed and analyzed for the segment of the transit corridor between the Pearl Harbor-Hickam Military Complex and the Kalihi-Palama area. This segment includes one of the major destination areas in urban Honolulu, namely, the Honolulu International Airport. Four route alternatives in this segment of the proposed fixed guideway system were identified and are shown in Figure VI-4. The more detailed evaluation of the alternatives and the reasons for selecting the preferred route are presented in the reports entitled, "Route Planning Study, Honolulu Rapid Transit Project, Preliminary Engineering and Evaluation Program, Phase I (PEEP I),"[16] and "Feasibility Study of the H-1 Freeway Route for Fixed Guideway System, Honolulu Rapid Transit Project, Preliminary Engineering and Evaluation Program, Phase II (PEEP II)"[17] and are summarized in the following sections.

Comparative studies[23] were also made on another route alternative which involved an alignment located in an entirely different corridor, along Salt Lake Boulevard (see Figure VI-4). The Salt Lake Boulevard route alternative would provide direct transit service to the high density residential developments in the Salt Lake area, however, it would be far removed from the Honolulu International Airport. This alternative was dismissed in favor of those alternatives providing more direct service to the airport which would result in greater regional benefits by virtue of having higher transit usage and less social and environmental impacts on the community.

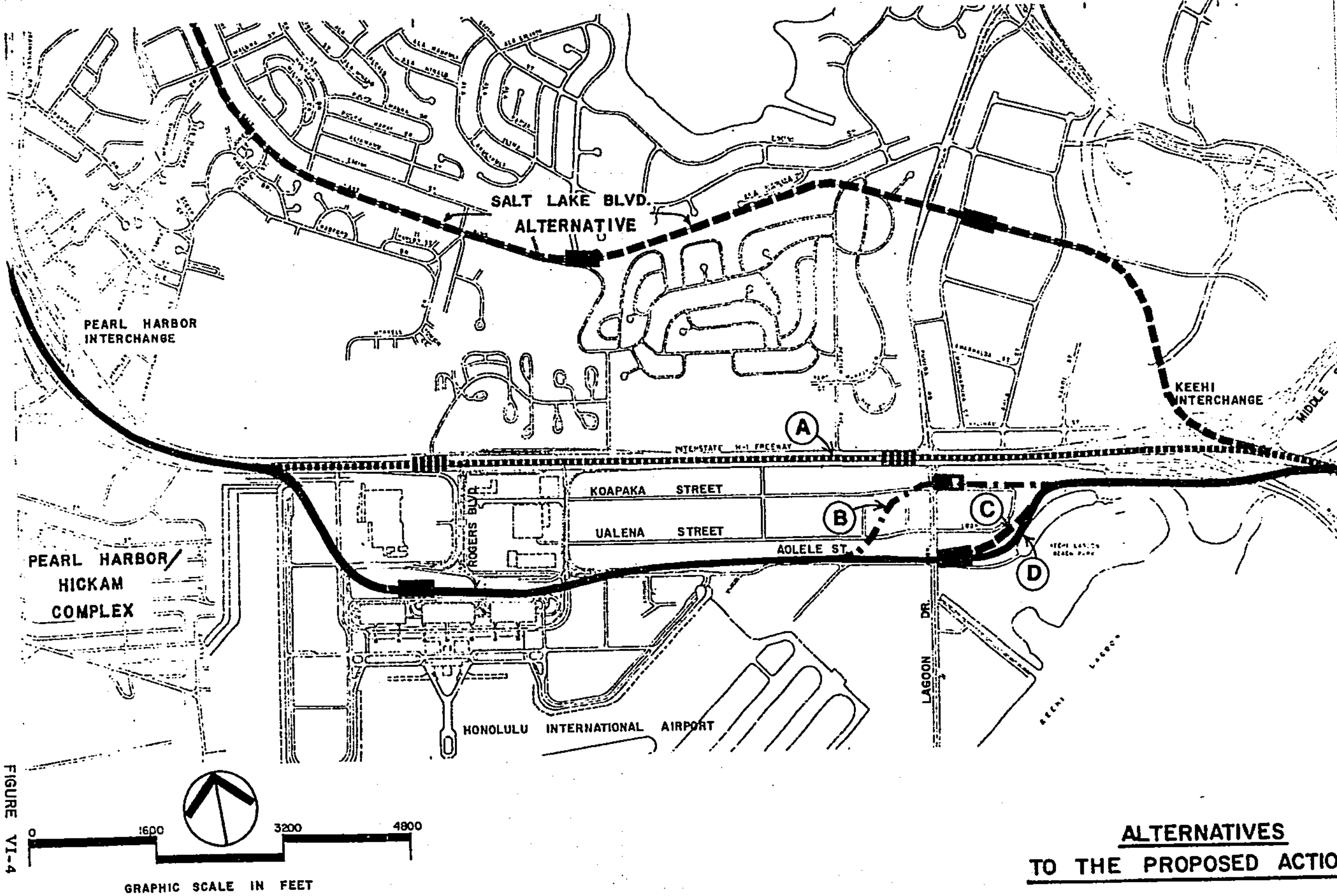



FIGURE VI-4

ALTERNATIVES
TO THE PROPOSED ACTION

Description of Alternative Routes Studied: West of the Honolulu International Airport (HIA), the proposed transit alignment would be located generally at-grade, on the two existing inside lanes of the Interstate H-1 Freeway. East of the HIA, through the Kalihi-Palama area, the transit alignment in aerial configuration would be located in the middle of Dillingham Boulevard. These alignment locations were also based on detailed evaluations of various alternative alignments with the final selection based on engineering and design, social, visual, economic, and environmental factors, similar to those used in the evaluation of alternative alignments for this segment of the transit system.

The two basic routes identified for this segment of the transit corridor were the H-1 Freeway (Route A) and the Aolele Street location with its three alternative alignments (Routes B, C, & D), all as shown in Figure VI-4 and described hereinafter:

Route A - The use of the two inside lanes on the Interstate H-1 Freeway, with stations located at the airport just west of Rodgers Boulevard and another on the west side of Puuloa Road-Lagoon Drive.

Route B - The alignment would leave the H-1 Freeway just easterly of the Pearl Harbor Interchange in an aerial configuration and enter the airport property near Elliott Street and place a station on the northern edge of the existing parking structure facility for the airport. After leaving the Airport Station, the alignment would remain aerial and be located along the northern side of Aolele Street, between the street and the northern boundary of the airport property. Before crossing Lagoon Drive, the alignment shifts over to the northern edge of Koapaka Street, cutting across numerous private industrial properties, and remaining adjacent to Koapaka Street in its own right-of-way until it enters the northern edge of Keehi Lagoon Park, after which it crosses Nimitz Highway adjacent to the proposed Keehi Interchange, into Dillingham Boulevard. Another aerial station would be located on the eastern side of Lagoon Drive on Koapaka Street.

Route C - This alignment would be similar to that described in Route B but instead of shifting to Koapaka Street, the alignment would continue on

Aolele Street, locate an aerial station on the east side of Lagoon Drive, then cut across private industrial properties between Keehi Lagoon Park and Waiwai Loop in an aerial configuration, then traverse the northern edge of the Keehi Lagoon Park, cross Nimitz Highway and enter into Dillingham Boulevard.

Route D - A refinement of Route C, this alternative utilizes smaller radius curves for the transit alignment after leaving the Keehi Lagoon Station to maintain the alignment wholly in the park property adjacent to its northerly boundary.

In the evaluation of the above alternatives, the objectives were to determine which alternative would best fulfill the overall needs of the proposed action by providing the greatest accessibility to the system with minimum adverse impacts to the community and minimum use of park and recreational land. A discussion of the comparative analysis conducted is presented next.

Discussion of Alternative Route Evaluation: A comparative summary of the number of relocations and capital cost required for each alternative route evaluated is presented in Table VI-1. Additionally, there were many other non-quantifiable factors which led to the selection of the preferred route through this segment of the fixed guideway system.

Direct service to major activity centers such as a major airport would be one of the most important factors to consider in selecting a route. With a station located within easy walking distance to the airport terminal, alternative routes B, C, & D would all provide excellent service to the transit riders in terms of reduced overall travel time and convenient access to and from the system. Not only would this benefit work trips, but it would also make the system more attractive for use by air passengers.

Alternative A, with the stations and guideway located in the middle of the H-1 Freeway, would cause slightly less noise impact to the surrounding area and would not impinge into any parkland but would create an additional traffic impact on the circulation roadway at the airport due to the large number of shuttle buses required to transport transit riders destined for the airport from the rapid transit station in the middle of the freeway. As shown in Table VI-1, the capital cost for Alternative A is less than any of the other alternatives. However, the additionally long-term cost of operating the shuttle buses would substantially reduce this difference in total cost.

TABLE VI-1: COMPARATIVE SUMMARY - ALTERNATIVE ROUTE EVALUATION

| Basic Route | Alternative Route | Dislocation | | | Capital Cost* ($million) | | | | Parkland Affected (Acres) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Business | | Residential | | | | | | | |
| | | No. Unit | No. Empl. | No. Unit | Constr. Cost | ROW Cost | Total Cost | %Diff. From Route D | Parkland Taking | Parkland Easement | Total Parkland Affected |
| H-1 Fwy | A | 1 | 10 | 0 | 20.1 | 1.5 | 21.6 | -29% | 0 | 0 | 0 |
| Aolele St. | B | 8 | 140 | 0 | 30.6 | 5.8 | 36.4 | +19% | 0 | 0.6 | 0.6 |
| | C | 6 | 60 | 0 | 30.5 | 3.0 | 33.5 | +10% | 1.7 | 1.0 | 2.7 |
| | D | 0 | 0 | 0 | 30.5 | 0 | 30.5 | - | 1.7 | 2.0 | 3.7 |

* Costs in 1974 dollars

For all alternative alignments, provision for a special spur line was considered whereby all special HIA-Waikiki transfer service[17] trains could switch off the mainline and stop at a separate terminal station provided exclusively for air passengers. If this special HIA to Waikiki transfer service were to be provided, Alternate A would require up to one-half mile of additional guideway structure to be constructed. The cost of this additional length of guideway would more than offset any differences in total cost between Alternative A and the other alternatives.

Based on the above evaluaton, it was concluded that Alternative A would not provide the desired level of service to the Honolulu International Airport and therefore ruled out from further consideration. This conclusion was strongly supported by both City and State officials.

The three alternative alignments representing the basic Aolele Street routes, i.e., Routes B, C, & D, would impinge on the parkland in varying degrees with Route B representing the least parkland usage. However, Route B, or any combination of Routes A & B, would result in the greatest loss of valuable industrial land and the most severe business dislocations (see Figure VI-2 and Table VI-1). Route C would result in greater parkland usage than Alternative B but less than Route D. Route C would result in parkland taking of some 1.7 acres for the station area and one acre of parkland easement for accommodating the aerial guideway structures. Route D would also require the same amount of parkland taking for the station area but would require two acres of parkland easement for its guideway structures. Table VI-1 shows in tabular form the amount of parkland taking and/or easement for each alternative route. The amount of parkland taking for the station area, under Routes C and D represents 2.4 percent of this 70-acre park.

Although all three of the alternatives would impact the park to some degree, only one alternative, Route D, would not require any privately-owned industrial properties to be acquired for the transit right-of-way. In urbanized Honolulu, the availability of developable land is highly constrained by the unusual configuration of the mountains and the sea. As a result, there is a critical shortage of available industrial and commercial lands which are convenient to market areas, transportation facilities, and the general labor market. In a study[24] conducted to determine the availability of industrial land for those businesses that would need relocation due to the transit system, it was found that land for both light and heavy industrial use is very "scarce" and "extremely limited" within urban Honolulu. In the future there will be additional demand for industrial lands within this area and any reduction of existing industrial lands would only increase the scarcity of such lands.

In addition to the foregoing conclusion that industrial land is scarce and the importance of its preservation, the evaluation of the alternative routes took into consideration the relative impact on the functional use of the park. The alternative routes were discussed with the City's Department of Parks and Recreation and it was the opinion of this department that the impact on the park from any of the alternatives could be mitigated so that the effects would not be adverse. Relative to Routes C & D, the park officials' opinion was that the parkland taking for the station area would not be critical since the odd-shaped configuration of this area of the park was not and could not be effectively utilized. Also, the access road isolates this area from the rest of the park.

The impact of the guideway occupying the parkland would require the relocation of the tennis courts under all three alternatives. Only Route D affects the tot lot which contains only a few pieces of equipment. The primary difference between the alternatives is the amount of land occupied by the guideway structure. This land, generally lying between the property line and the access road or parking lot, is only infrequently used. The park officials felt that by making certain adjustments to the park layout the use of this particular area for transit would not affect the overall utility of the park. The park officials also felt that these adjustments could be worked out during the final design. Furthermore, a large state park, portions of which are already developed, is planned on Sand Island only a short distance away. The assessment of the impact caused by the proposed action on the park and its use is discussed in more detail in the following section.

d. Mitigation

The primary impact of the proposed alignment through Keehi Lagoon Park is the permanent use of 1.7 acres of parkland for the transit station which represents 2.4 percent of the total park area, and the acquiring of 2.0 acres of easement for the aerial guideway structure. The construction of the transit station would require a slight realignment in the park's access road connection to Lagoon Drive, southerly of its existing location. Also the construction of the guideway structure would require the relocation of four existing tennis courts. The tot lot may also be relocated. A few small trees, located at the proposed station site, would need replanting elsewhere in the park or utilized as part of the station site landscaping.

The area to be acquired for the proposed transit station is located in the northwest corner of the park, adjacent to Lagoon Drive, between the access road and the private industrial properties located north of the park (see Figure VI-3). The affected area, lying between the park access road and the northern boundary, is an isolated area not used for any active park function. The ground is turfed with several trees but due to its isolated location, odd shape of the area, and proximity to industrial facilities, it is one area that is not frequently used even for passive park functions. Therefore, the use of this area of the park for the transit station should not have any significant effect on the overall use of the park.

Discussion held with representatives of the Department of Parks and Recreation, City and County of Honolulu, indicated that the fixed guideway would not decrease the amenity of the park or constrain certain existing or planned park activities or facilities. Due to the relocation of some of the existing facilities in the park, it was felt by the Parks Department that a new master plan for the park could be developed to incorporate the fixed guideway system. The existing access road and parking facility would be incorporated under the fixed guideway structure, thereby providing a larger contiguous area of parkland. It was agreed that the relocation of the tot lot would have minimal impact since its current location adjacent to the park access road creates a hazardous situation and that a more suitable alternative location could be easily found. The use of the land of the existing tennis courts would be mitigated by relocating them to another location. In summary, the location of the fixed guideway facilities would not reduce the utility of the park and replanning of the access road and parking area would provide for a larger contiguous park area.

The aerial configuration of the fixed guideway alignment through the park would cause definite visual impact. The guideway structure would be visible and depending on the location of the individual, the visual impact on the park users would be unavoidable. To minimize the visual impact, special attention in the design of the structure, the landscaping, and any modifications to the park activity areas would all be closely coordinated and sensitively done.

As the proposed alignment through Keehi Lagoon Park would create some additional noise, noise barriers would be installed on the guideway structure to minimize this adverse impact. The rapid transit system is not expected to have any adverse impacts on the maintenance of safe conditions in the park. The aerial way structure and station would be located close to the northern perimeter of the park and along the park's access road which already bisects the park. The transit easements below the way structure would be properly landscaped with consideration given to comments by the Department of Parks and Recreation, who have indicated that this area would be suitable for continued passive recreational uses, once the transit structures are constructed.

Vehicular access to the park would be somewhat impacted by the autos and buses interfacing at the transit station. The transit related vehicles would share with the parks users the only vehicular entrance into the park to interface at the Keehi Lagoon Station. The greater conflict with park users would basically occur during the weekday p.m. peak period at which time, as indicated earlier, some social softball leagues on the island utilize the park facilities. This condition would become more severe with the implementation of shorter initial system lengths of 7 miles, 8 miles, or 10 miles. As pointed out earlier, associated with these alternative initial system lengths is the termination of the rapid transit line at the Keehi Lagoon Station or at the Airport Station which will make the Keehi Lagoon Station a major auto and bus interface point since the Airport Station will be restricted to primarily pedestrian access only, with some bus interface. The amount of traffic that could be attracted to a terminal station at Keehi Lagoon was discussed earlier in Chapter V. Although it is expected that the surface streets leading into the station, namely Lagoon Drive and Aolele Street, would be able to accommodate this additional traffic, this additional traffic volume, especially during the p.m. peak period could cause some inconvenience to the park users arriving by automobile. However, safe and ready access to the park would be maintained by signalizing the intersection and planning and designing the access road to accommodate the increased traffic.

There would be adverse impacts on noise, air and visual quality during construction of the guideway facilities which would temporarily decrease the amenity of the park but would not restrict the continued use of its facilities. Applicable rules and regulations would be strictly enforced including the construction of appropriate barricades and fences to restrict construction activities to designated areas. The greatest demand for use of the park comes from tennis players. The four tennis courts which would be affected would be relocated prior to construction of the fixed guideway structures. This would eliminate any disruption to the use of the tennis facilities during construction of the proposed transit system.

It should also be pointed out, as noted earlier, extensive additional recreational facilities have been master planned on Sand Island by the State Parks Division of the Department of Land and Natural Resources, State of Hawaii. A total of 140 acres of land area is currently planned to be used for recreational purposes on Sand Island, with an additional 40 acres in land bank for future park purposes. Proposed facilities include picnic tables and benches, comfort stations, overnight camping facilities, bikeways, fishing and maintenance facilities, and park lighting. Also, as a result of the implementation of the new City sewage treatment plant at Sand Island, the quality of the water off-shore has improved to a point where beach and water activities can be provided. Plans also call for the expansion of facilities for fishery research. Sand Island facilities will also serve essentially the same community as do those of Keehi Lagoon Park.

e. Coordination

In planning the proposed fixed guideway system, continuous coordination was maintained with the City Department of Parks and Recreation, the local agency having jurisdiction over the affected parkland. After having reviewed the proposed action and its effects on the parkland, the Department of Parks and Recreation did not request the replacement of the land required by the proposed system. The following statement was contained in their letter to the Department of Transportation Services: "The impact on the Keehi Lagoon Beach Park will be significant; however, your proposal for adjustments to the park is acceptable and the effects will not be adverse."

The U.S. Department of the Interior in their letter to UMTA (79/702), dated October 3, 1979, concurred with the proposed alignment and that there appears to be no feasible or prudent alternatives to the taking of this parkland.

f. Determination

Based upon the above documentation, there are no feasible or prudent alternatives to the use of Keehi Lagoon Beach Park, a 4(f) property, for the proposed action. In addition, all possible planning has been done to minimize harm to this property.

## A.2. Aala International Park

### a. Description and Significance of Property

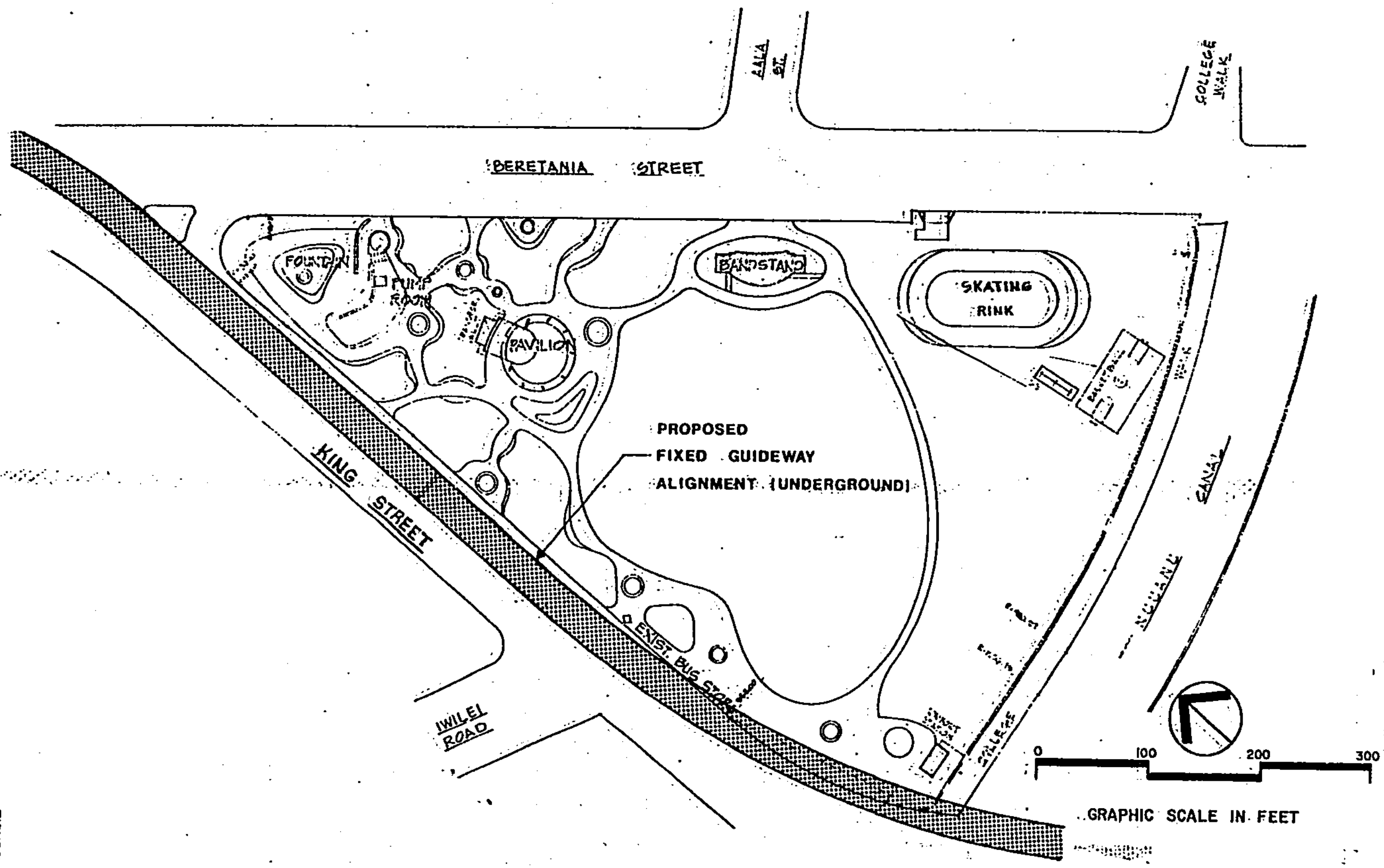
Aala International Park is a 6.7-acre triangularly shaped and well maintained park located at the intersection of Beretania and King Streets in downtown Honolulu (see Figure VI-5). This park is also located on the northern banks of the Nuuanu Canal across from a portion of the Central Business District (CBD) known as Chinatown. The area surrounding the park is densely developed with residential, commercial and light industrial uses.

Over the past several years, major improvements to park facilities and landscaping have been made by the Department of Parks and Recreation, City and County of Honolulu. The park is heavily utilized throughout the day and evening hours, particularly by the elderly and the youth of the surrounding residential areas. Aala Park is also used for outreach social service programs for the elderly and the poor by the Honolulu Community Action Program (HCAP) and the Catholic Social Services. Regularly, the Department of Parks and Recreation sponsors cultural and recreational events in the park.

Existing park facilities include a pavilion with comfort station, a bandstand, a fountain with pump room, walkways, benches and tables (see Figure VI-5). There is an old and dilapidated comfort station located in the southwest corner of the park which is being maintained primarily because it is heavily used by residents of nearby tenements who do not have adequate plumbing facilities. Some additional facilities, including a basketball court, some swings and a skating rink, are located in the southeastern corner of the park, at the intersection of Beretania Street and the Canal. Some of these facilities will be eventually removed to make way for the future expansion and modernization of the park and its facilities.

A majority of the people visiting the park congregate along the western edge of the park fronting on King Street primarily because most of the shade trees and park benches and tables are located there and also due to a major bus stop located on King Street which generates much pedestrian traffic through the park. It is estimated by the Parks Department that some 1,500 people or more utilize the park daily.

The Department of Parks and Recreation plans to expand the facilities of Aala Park with the construction of two new comfort stations, new basketball and volleyball courts, a sumo wrestling ring, additional walkways and landscaping,




AALA INTERNATIONAL PARK

FIGURE VI-5

and improvements to the park lighting system. The Department of Parks and Recreation also plans to retain a program manager to develop and coordinate the various social services, cultural and recreational programs at Aala Park. The design and planning of Aala Park are being closely coordinated with the Kalihi-Palama community organization and the Chinatown Renewal Project with its plan to create a pedestrian mall on nearby Hotel Street.

Approximately one-half of Aala Park (northern half) is owned by the City and County of Honolulu and the other half is owned by the State of Hawaii. But the operation and maintenance of the park is the direct responsibility of the Department of Parks and Recreation, City and County of Honolulu.

b. Proposed Use

The implementation of the proposed system will require the temporary construction use of some 3,000 sq. ft. of land along King Street to install the subway structure. A permanent use of the parkland for tunnel exhaust vent amounting to some 300-400 sq. ft. in area may be required if a vent structure can be appropriately integrated with the existing comfort station structure.

The Iwilei Station would be located in the southwest corner of the intersection of Dillingham Boulevard and King Street in an underground configuration. In response to requests from residents of the adjacent communities for a station with good accessibility and high visibility, for security purposes, the station would be located close to the intersection of these two streets. The section of the proposed transit alignment between Iwilei Station and Hotel Street entails a sharp reverse curve to enter Hotel Street from King Street. The alignment in King Street would be generally located along the right-of-way line adjacent to the park property and then would actually cross the right-of-way line into the park property as it approaches Nuuanu Canal.

From the Iwilei Station to the Nuuanu Canal, where the alignment enters Hotel Street, construction of the underground guideway structure in King Street and along Aala Park will utilize a conventional cut-and-cover method, with the excavation covered with decking to maintain traffic flow on King Street. The portion of the line in the park property would require the temporary use of the land during construction.

c. Alternatives

During the fixed guideway system preliminary engineering and evaluation program, the Dillingham Boulevard Corridor was selected by both residents of the community and transit planners over a number of other alternative corridors as the preferred location for the guideway alignment through the residential and industrial Kalihi-Palama area. Through the important downtown Honolulu area all feasible alternative routes were examined including routes along Nimitz Highway/ Ala Moana Boulevard, King Street, Hotel Street and Beretania Street. Some of these routes would avoid the use of any parklands of the Aala Park. However, based on a detailed evaluation of these routes, the Hotel Street route was found to provide the superior location for the transit line and station to serve the important CBD area.

For the segment of the fixed guideway system that affects Aala Park, two basic alignment alternatives with three different locations for the Iwilei Station were considered during the Preliminary Engineering and Evaluation Program for the proposed transit program. Evaluation of these alignment alternatives in terms of the overall purposes of the proposed rapid transit system reveals that the preferred alignment is along King Street with the Iwilei Station located at the intersection of Dillingham Boulevard and King Street which provides the best transit service, optimizes safety and security for the potential transit riders from the neighboring communities, minimizes relocation and has no significant long-term impact on the park.

Alternative sites for the Iwilei Station which serves the Kalihi-Palama area and portions of the CBD, were the basic determinants of the two alternative alignment locations. Three alternative station locations and their associated guideway alignments were identified and evaluated and are described below (see Figure VI-6).

<u>Alternative A</u> - This alternative is located underground and is bordered by Dillingham Boulevard, Kaaahi Street, Kaamahu Place, and King Street. The station is generally oriented in an east-west direction. Utilizing a minimum radius curve, the guideway alignment after leaving the station would traverse under the King and Beretania Streets intersection, then along King Street on the southwestern edge of Aala Park, across Nuuanu Canal, and into Hotel Street.

<u>Alternative B</u> - This station would be located, in an aerial configuration, adjacent to and parallel on the southwestern side of Kaaahi Street, just southeast of the Hawaiian Electric Company (HECO) Iwilei power substation. The guideway alignment would continue in a southeasterly direction in an aerial configuration until it portals underground just before crossing Iwilei Road and continues underground across King Street and the Nuuanu Canal into Hotel Street.

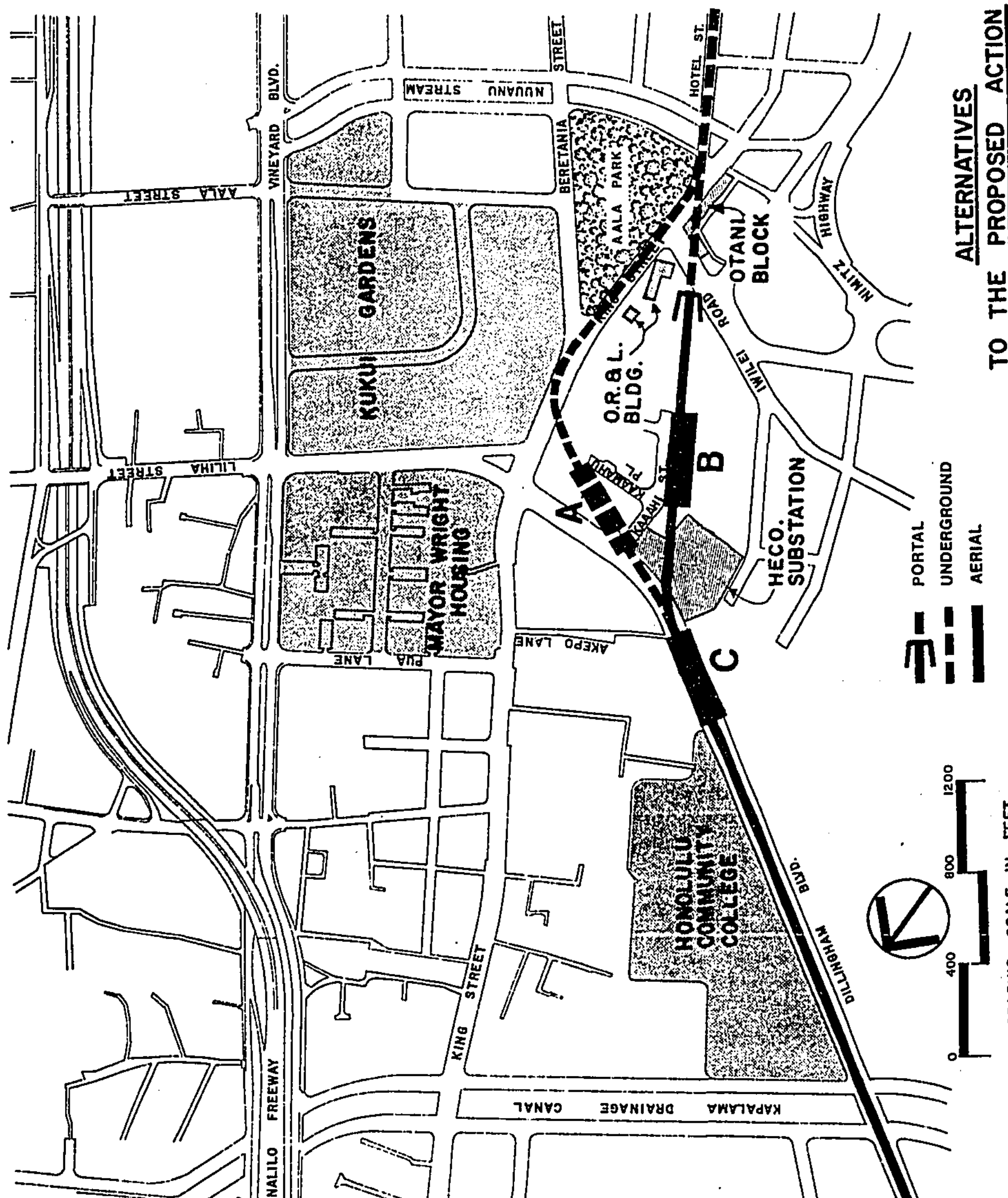

ALTERNATIVES
TO THE PROPOSED ACTION
LUNALILO FREEWAY
VINEYARD BLVD.
BERETANIA STREET
NUUANU STREAM
AALA STREET
LILIHA STREET
KING STREET
HOTEL ST.
KUKUI GARDENS
MAYOR WRIGHT HOUSING
PUA LANE
AKEPO LANE
AALA PARK
O.R.&L. BLDG.
OTANI BLOCK
HECO. SUBSTATION
IWILEI ROAD
NIMITZ HIGHWAY
KAAAHI PL.
KAAAHI ST.
HONOLULU COMMUNITY COLLEGE
DILLINGHAM BLVD.
KAPALAMA DRAINAGE CANAL
A
B
C
PORTAL
UNDERGROUND
AERIAL
0
400
800
1200
GRAPHIC SCALE IN FEET

FIGURE VI-6

Alternative C - This station would be located in the middle of Dillingham Boulevard, just westerly of Akepo Lane, in an aerial configuration. The guideway alignment into Hotel Street would be the same as the alignment associated with Alternative B, discussed previously.

The results of the comparative evaluation conducted on these three alternative routes are summarized in Table VI-2. Alternative A requires the least numbers of dislocation but would cost approximately $10 million more than either Alternative B or C due to its greater length of underground construction.

Table VI-2

SUMMARY OF ALTERNATIVE ROUTE EVALUATION

| Alternative Route | Dislocation (units) | | Capital Cost ($ million)* | | |
|---|---|---|---|---|---|
| | Residential | Business | Constr. | R.O.W. | Total |
| A | 0 | 16 | 18.0 | 6.0 | 24.0 |
| B | 13 | 47 | 8.5 | 5.5 | 14.0 |
| C | 13 | 43 | 9.0 | 5.0 | 14.0 |

*Costs in 1975 dollar.

Of the three alternative station locations, Alternative A is the closest to and provides the best service to the Kukui Gardens (low and moderate income) housing development and Mayor Wright (public) housing and reasonable service to the Honolulu Community College. This station location would be visible and close to Dillingham Boulevard and King Street, two heavily used arterials in urban Honolulu. Although underground, security at this station as currently planned is excellent since the station entrance and concourse area will be at-grade and the platform itself will be open to the sky. Bus and auto (kiss-and-ride) interface at this station location is also good due to its location close to Dillingham Boulevard and King Street.

In addition to having the least dislocation impacts and a superior station location, Alternative A does not adversely affect any historic site. The guideway and portal structure of Alternatives B and C would have adverse visual impacts on the OR&L Building, a property determined eligible for the National Register (see subsection B.10.a, page VI-49, for the description of the OR&L Building). Mitigation of this adverse visual impact would require the guideway and station structures to be placed underground. This would negate the cost advantage of Alternatives B and C, while still requiring higher dislocation impacts. There would be little or no impact on Aala Park with Alternatives B and C since the guideway structure would be totally within the King Street right-of-way before entering Hotel Street.

Although costing more than the other alternatives and using minimal amounts of parkland, Alternative A was found to create the least amount of adverse effects and provide the best service quality due to its superior station location. This alternative was strongly endorsed by representatives of neighboring communities and therefore selected as the proposed station location and route alignment through the Iwilei area.

d. Mitigation

The only adverse impact of the proposed fixed guideway system on Aala Park would be temporary and occur only during the construction period. A small area located in the southwest corner of the park adjacent to King Street and the Nuuanu Canal would be required for a temporary period to construct the underground guideway structure. The encroachment into the parkland varies from the property line to a maximum of approximately 20 feet over a length of some 300 feet. The total affected area would be in the neighborhood of 3,000 sq. ft., or slightly in excess of 1 percent of the total parkland area. The comfort station may have to be relocated, temporarily. A permanent tunnel exhaust vent may be located at the same southwest corner of the park. In lieu of an exhaust vent, with openings at ground level, it is proposed that the vent be integrated with the comfort station structure to exhaust the tunnel air at a higher elevation.

To minimize the impact which may be caused by the construction of the underground guideway structure, adherence to applicable noise and air quality regulations and appropriate requirements would be stipulated in the construction specifications to minimize the nuisance of construction noise and dust to the park and its users. There would be no permanent adverse noise, air, visual or other adverse environmental impacts on Aala Park caused by the fixed guideway system operations with the system placed underground. Temporary removal of the existing sidewalk along King Street would result in short-term inconvenience to park users. However, access to the park, from the Iwilei Road area via King Street, would be maintained through temporary walkways as requested by the City's Department of Parks and Recreation. Existing improvements, including any trees and ground cover, would be replaced after completion of construction.

e. Coordination

In planning the proposed fixed guideway system, continuous coordination was maintained with the City Department of Parks and Recreation, the local agency having jurisdiction over the affected parkland. After having reviewed the proposed action and its effects on the parkland, the Department of Parks and Recreation did not request the replacement of land proposed to be used for the transit system. The following statement was received: "The impact on the Aala International Park will be insignificant and there will be no adverse effects due to this project."

Due to a subsequent realignment of this segment of the route, the following statement was received from the City's Department of Parks and Recreation on April 11, 1979:

> "We have reviewed the amendments to Chapter VI, Parklands, Section 4(f) of the Environmental Impact Statement and have no objections to your proposals. However, in the case of the transit alignment adjacent to Aala International Park, we recommend that pedestrian access to the park from the Iwilei Road area via King Street be maintained during the construction period."

The U.S. Department of the Interior in their letter to UMTA (79/702), dated October 3, 1979, also concurred with this finding that the temporary construction impacts are not serious.

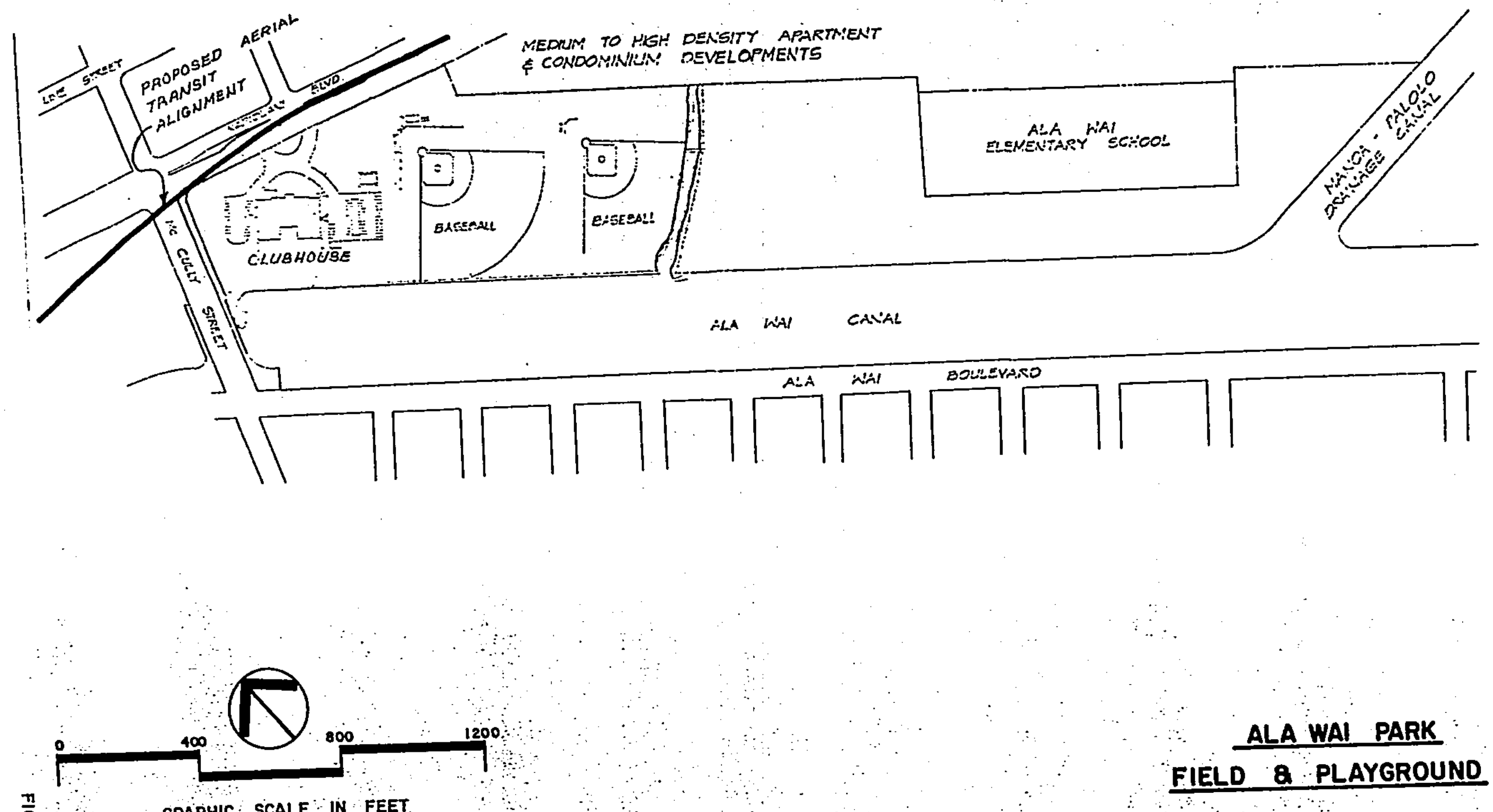
f. Determination

Based upon the above documentation, there are no feasible or prudent alternatives to the use of Aala International Park, a 4(f) property, for the proposed action. In addition, all possible planning has been done to minimize harm to this property.

A.3. Ala Wai Park

a. Description and Significance of Property

Ala Wai Park is a 29-acre park located at the southeast corner of Kapiolani Boulevard and McCully Street intersection. The park is sited on the bank of the Ala Wai Canal which is its southern boundary. On its northern boundary is Kapiolani Boulevard, a number of medium to high density apartment and condominium developments, and the Ala Wai Elementary School. McCully Street and the Manoa-Palolo Drainage Canal form the park's western and eastern boundaries, respectively (see Figure VI-7).



PROPOSED AERIAL TRANSIT ALIGNMENT
MEDIUM TO HIGH DENSITY APARTMENT
& CONDOMINIUM DEVELOPMENTS
ALA WAI ELEMENTARY SCHOOL
MANOA - PALOLO DRAINAGE CANAL
BASEBALL
BASEBALL
CLUBHOUSE
Mc CULLY STREET
ALA WAI CANAL
ALA WAI BOULEVARD
0
400
800
1200
GRAPHIC SCALE IN FEET
ALA WAI PARK
FIELD & PLAYGROUND


FIGURE VI-7

Ala Wai Park is an attractive and well-cared for park which is carefully planned to provide a variety of recreational activities for people from all over Honolulu. One of its most distinctive features is its dramatic unobstructed view of Diamond Head. The park is divided into two areas by a small stream which empties into the Ala Wai Canal. To the southeast of the stream is the Ala Wai Playground and to the northwest is the Ala Wai Field. Facilities at the Ala Wai Field include a clubhouse with administrative offices for the park manager and the District Supervisor of the Department of Parks and Recreation, an Arts and Crafts Center, club rooms for two canoe and one kayak associations, a patio and lounge, two baseball fields, children's playground apparatus, a comfort station and two parking lots which can accommodate some 100 cars. Ala Wai Playground contains a comfort station and pavilion, two softball fields, basketball and volleyball courts, children's playground apparatus and picknicking facilities. Ala Wai Canal is used for outrigger canoe races and team practice and the clubhouse serves as the headquarters for these boating clubs. Organized activities at the Ala Wai include arts and crafts classes and workshops, community ballroom dances and various entertainment events. The park is also used as the recreational facility for the Ala Wai Elementary School. The park is used as a community facility by the residents of Moiliili and McCully and by persons from throughout the urban area who participate in its many activities. It is very accessible both for persons who arrive by car and for pedestrians. Approximately 400 to 500 persons use the park daily. At the present time the park's Citizen Advisory Council is preparing a master plan for the park which could include expansion of the clubhouse and more ball fields. Night lights have been installed in the park.

Other nearby recreational facilities include the Ala Wai Golf Course, which is located southeast of the Manoa-Palolo Drainage Canal and on the banks of the Ala Wai Canal. The nearby highrise condominiums all have their own private recreational facilities.

Ala Wai Park is in an area which is prone to flooding but has never experienced any problems. At high tide the water in the canal is high but no real flooding occurs.

The parkland is owned by the State of Hawaii and is operated and maintained by the City and County Department of Parks and Recreation, through an executive order.

b. Proposed Use

The implementation of the proposed system would require the permanent use of up to 150 sq. ft. of land for the guideway support columns and some 3,000 sq. ft. of land for temporary construction use during the installation of the foundations for the support columns.

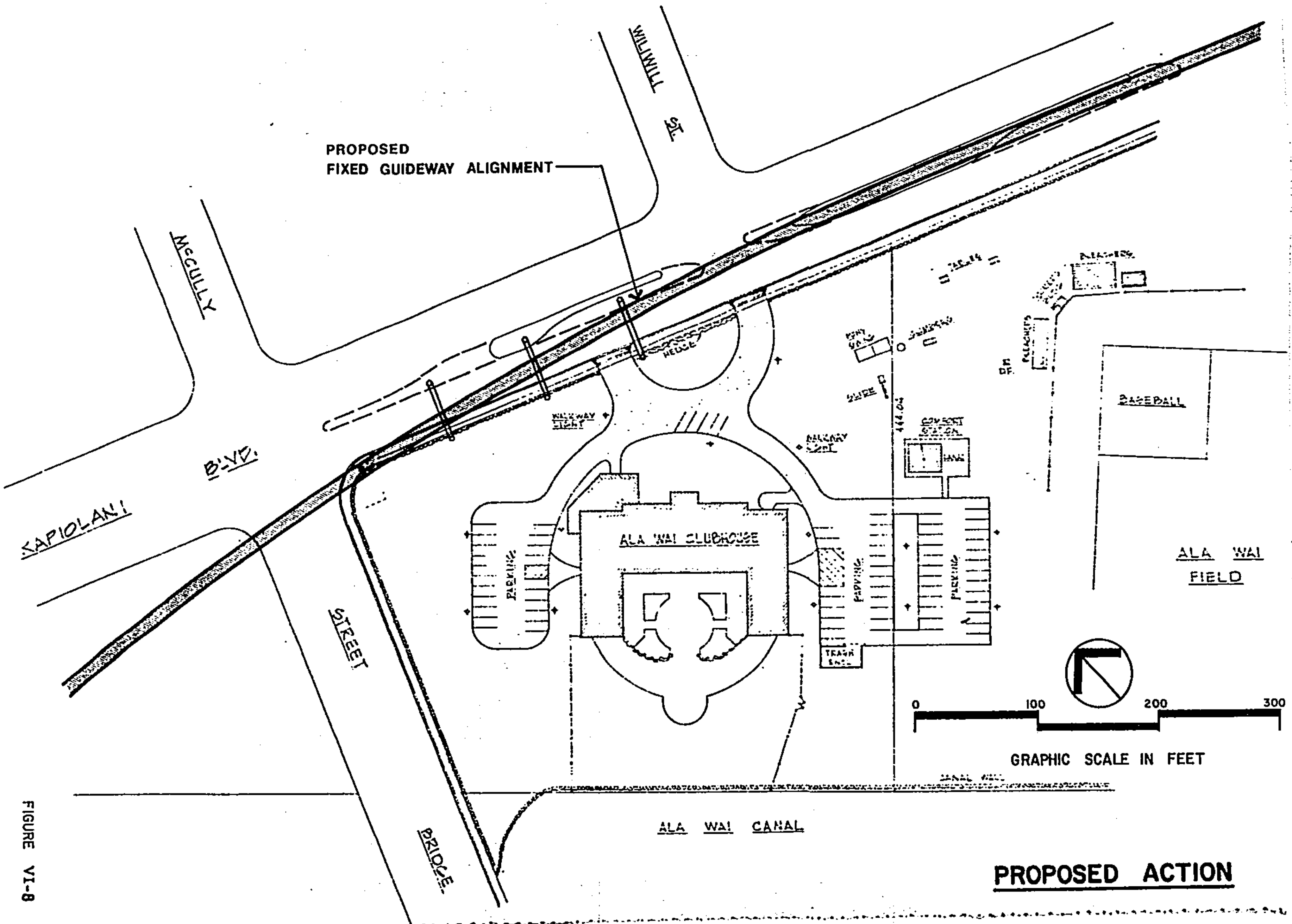
The proposed guideway alignment which just clips the northwest corner of Ala Wai Park is included in the segment of the proposed fixed guideway system referred to as the Moiliili-University Segment. In order to enter the median of Kapiolani Boulevard from the proposed Waikiki Station, the proposed alignment crosses McCully Street and traverses over a very small portion of the northwest corner of Ala Wai Park (see Figure IV-8). Three supporting bent structures and one single column will be required to support the guideway as it passes over the edge of Ala Wai Park. All of the support columns will be totally or partially located in the park property.

c. Alternatives

During the preliminary engineering and evaluation program (PEEP) of the proposed transit program, it was determined that a station located on the block bordered by Kalakaua Avenue, Kapiolani Boulevard, McCully Street, and the Ala Wai Canal, just west of the Ala Wai Park, would best serve the highly important Waikiki area and interface with the fixed guideway system at the Waikiki Station.

To serve the densely populated communities of McCully and Moiliili and also the University of Hawaii Manoa Campus, two basic transit corridors were studied. The first corridor was the Kapiolani Boulevard Corridor with its various alternative alignments and the second corridor was the King Street Corridor (see Figure III-13). The alternative alignments considered in the Kapiolani Boulevard Corridor all have a common alignment for the crossing of McCully Street. Due to its superior service characteristics, although costing more (by some $12 million), the Kapiolani Boulevard Corridor was selected as the preferred location for the fixed guideway over the King Street Corridor.

To enter the middle of Kapiolani Boulevard from the Waikiki Station, the fixed guideway would necessarily cross the eastbound lanes of Kapiolani Boulevard. This crossing could be accomplished either west or east of McCully Street and would require the use of bent structures, straddling over Kapiolani Boulevard. If this crossing is located east of McCully Street, as shown in Figure VI-8, one single column structure and three bent structures would be required with their supporting columns located along the northern perimeter of the Ala Wai Park and also in the center of the existing median in Kapiolani Boulevard.




## PROPOSED ACTION

FIGURE VI-8

If the Kapiolani Boulevard crossing is made west of McCully Street, bent support structures would be required as identified by Alternative B in Figure VI-9. Since there is no median in Kapiolani Boulevard at this location, the bent structures would have to span the entire roadway width or one-half of the roadway by creating a new median.

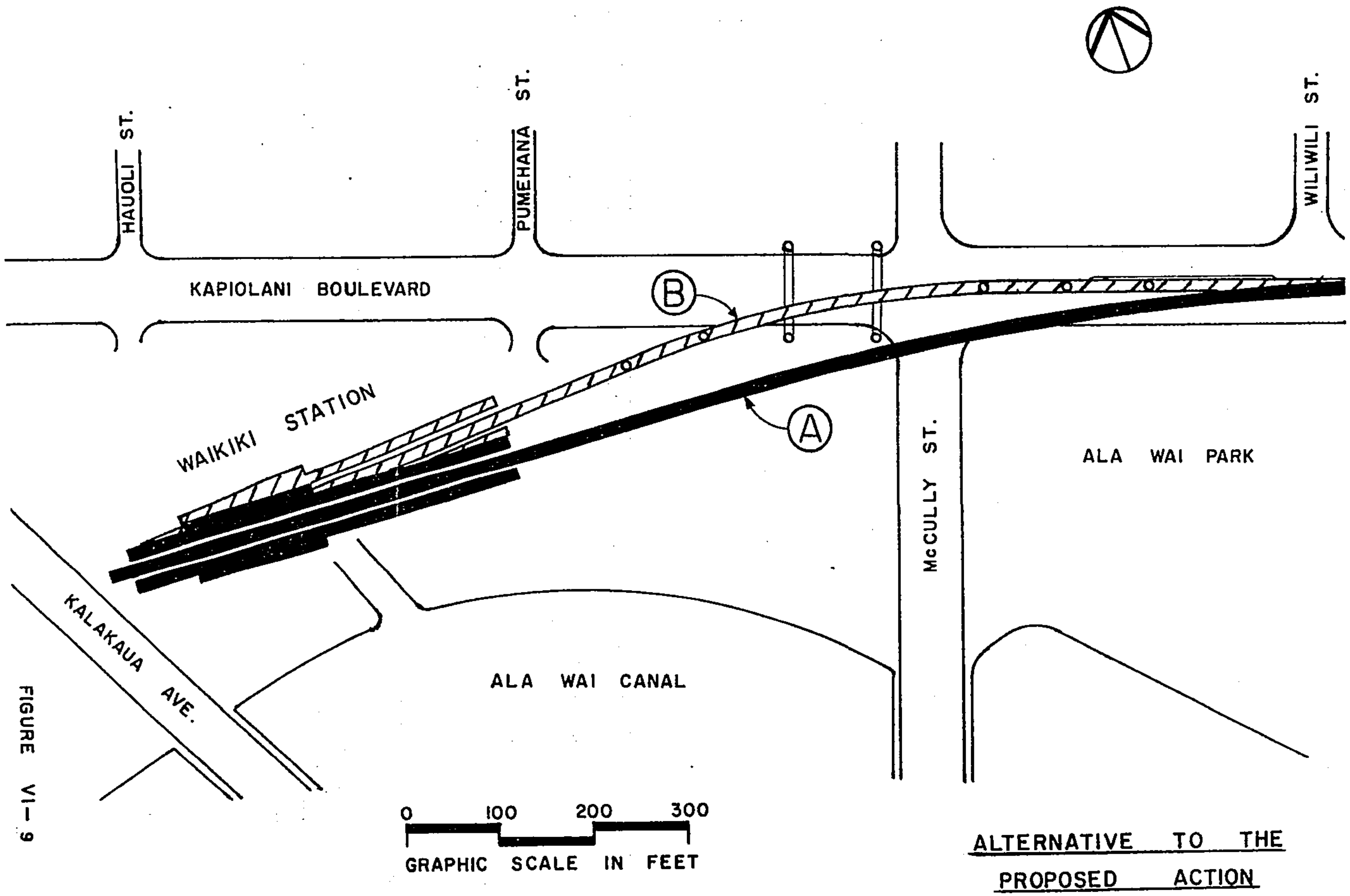
In the latter case, the existing left-turn pocket will have to be replaced by widening the entire roadway. On the east side of McCully Street, a single support column would be located in the center of the roadway which is currently a left-turn pocket. With the support column being 5-6 feet in diameter plus two-foot clearance on either side, a space of 9-10 feet in width is required to accommodate the column. In order to retain the left-turn pocket at this location, the roadway will require widening by approximately 5 feet on each side. This would mean that a strip of parkland would have to be acquired under this alternative alignment.

The results of the comparative evaluation between the two alternative alignments are as follows:

- Alternative B is more costly by some $100,000.
- Alternative B would remove the left-turn lane and hence lower the capacity of the street unless the laneage is replaced.
- Alternative B creates greater visual impact at the intersection with long-span bent structures.
- Alternative B alignment results in smaller radius curve which will lower operating speed.
- Alternative B will require five feet of parkland to be acquired in order to maintain existing roadway laneage while Alternative A requires only an easement.

d. Mitigation

The proposed alignment would take no parkland which is now used or which is proposed to be used for recreation facilities. The major impact of the action on parklands would be the location of approximately four columns about 5-6 feet in diameter or square, which would support the aerial tracks of the fixed guideway system. These columns would be located along the right-of-way line of Kapiolani Boulevard, a busy six-lane roadway with a 90-foot right-of-way. One large existing banyan tree located on the northwest corner of the park, whose branches would interfere with the guideway, would need trimming. The existing lava rock wall on the property line will be restored to its original condition after construction of the support foundations is completed.




ALTERNATIVE TO THE PROPOSED ACTION

FIGURE VI-9

All of the park's recreational facilities are centrally placed within the park area and discussions with staff members of the Department of Parks and Recreation indicate that activities would not be affected by placement of the guideway at the edge of the park. In noise sensitive areas, such as a park, although Ala Wai Park is located next to Kapiolani Boulevard which is a heavily used urban arterial with high ambient noise levels, sound barriers would be installed on the guideway structure to minimize any noise intrusion to the park. Furthermore, the aerial configuration of the guideway would have a visual impact on park users, depending upon the location of the individual. But with special attention given to the design of the structure to make it simple and functionally suitable in alignment profile, scale and form, and with the use of adequate and appropriate landscaping, the visual impact to the park users can be minimized.

Any adverse impacts which may occur would be during construction. However, these impacts would be only temporary and are not expected to disrupt existing use of the park. Appropriate measures would be taken to provide for the safety of park users during construction and for the protection of park property and vegetation. Full access to the park would be maintained throughout the construction period. Noise and air pollution control regulations would be strictly enforced during the construction period to minimize any adverse effects to the park users.

e. Coordination

In planning the proposed fixed guideway system, continuous coordination was maintained with the City Department of Parks and Recreation, the local agency having jurisdiction over the affected parkland. After reviewing the proposed action and its effects on the parkland, the Department of Parks and Recreation stated: "The impact on the Ala Wai Park (Clubhouse) will be insignificant and there will be no adverse effects due to this project." This conclusion was concurred with by the U.S. Department of the Interior in their letter to UMTA (79/702), dated October 3, 1979.

f. Determination

Based upon the above documentation, there are no feasible or prudent alternatives to the use of Ala Wai Park, a 4(f) property, for the proposed action. In addition, all possible planning has been done to minimize harm to this property.

## A.4. The Robinson Building

### a. Description and Significance of Affected Property

The Robinson Building has been determined eligible for inclusion into the National Register. It is a brick structure with some concrete detailing. Its facade on Hotel Street is divided into a regular series of bays at the second floor by articulated pilasters. The pilaster shafts are divided into three segments, the middle one of which has a rusticated pattern with the upper and lower segments given a fluted pattern.

The pilasters have a foliated capital upon which sits a small cornice. Above the cornice sits a row of brackets which support a larger, more decorated cornice (see Figure VI-10).

The second floor treatment on the other side is much different. To the back and on the side facing Bijou Lane, the walls are unpainted brick with few openings. On the Bethel Street side there is a series of regularly spaced windows with a projected keystone as on the Hotel Street side. This side, however, is stuccoed, has no pilasters, cornice and no banding which connects the window sills.

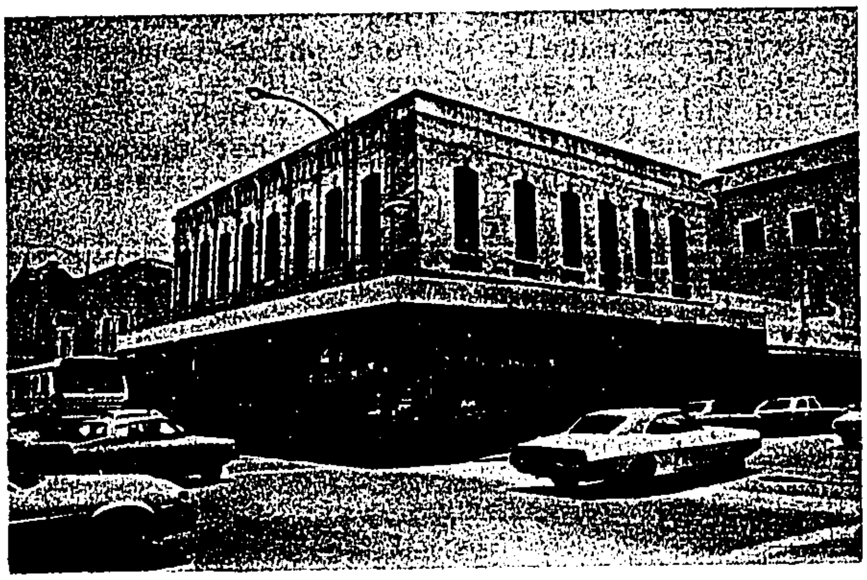
The reason for the difference by these two "public" facades: When the Robinson Building was originally built Bethel Street ended on the south side of Hotel Street. The Robinson Building extended about 30 feet farther than it does now. When Bethel Street was extended from Hotel to Pauahi in 1923, that 30 feet was removed (one structural bay) and the new Bethel Street facade crudely fixed up to imitate its Hotel Street brother.

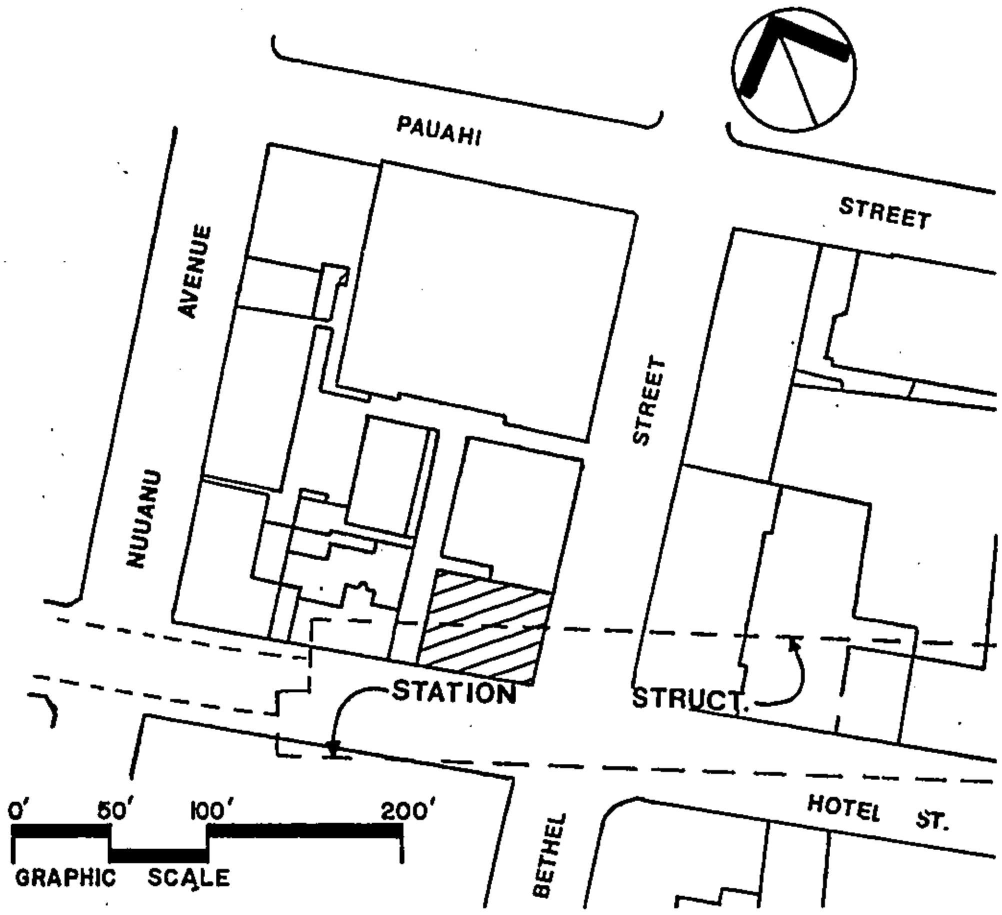
The first and second floors are separated by an awning. The building has always had an awning but the present one is of fairly recent vintage. Also, the first floor is a heavily remodeled collection of 1960's storefronts.

Despite the fact that a bay was removed and the first story facade altered, the building is considered to be an architecturally significant structure as it retains its second-story integrity. The applied ornamentation on the upper story perpetuates in masonry the cast iron facade which was so popular in the west during the late nineteenth century.

### b. Proposed Use

The implementation of the proposed action would include provision of an underground transit station between Nuuanu






ROBINSON BLDG.

FIGURE VI-10

Avenue and Bishop Street to serve the CBD. The station platform would be approximately 450 feet long with the total structure, including ventilation structures at each end, being approximately 600 feet long. The width of the station structure is approximately 70 feet which is much wider than the existing 50-foot right-of-way of Hotel Street. To further compound this problem, there is a bend in the Hotel Street alignment which results in further encroachment of the station structure into private properties on the north side of the street (see Figure VI-11).

Under the proposed alignment and station location, the Robinson Building is situated directly above and would conflict with the construction of the station structure. Furthermore, with Hotel Street having a relatively narrow width of 50 feet, more space at the station is required to efficiently disperse the large volume of transit patrons using this station.

c. Alternatives

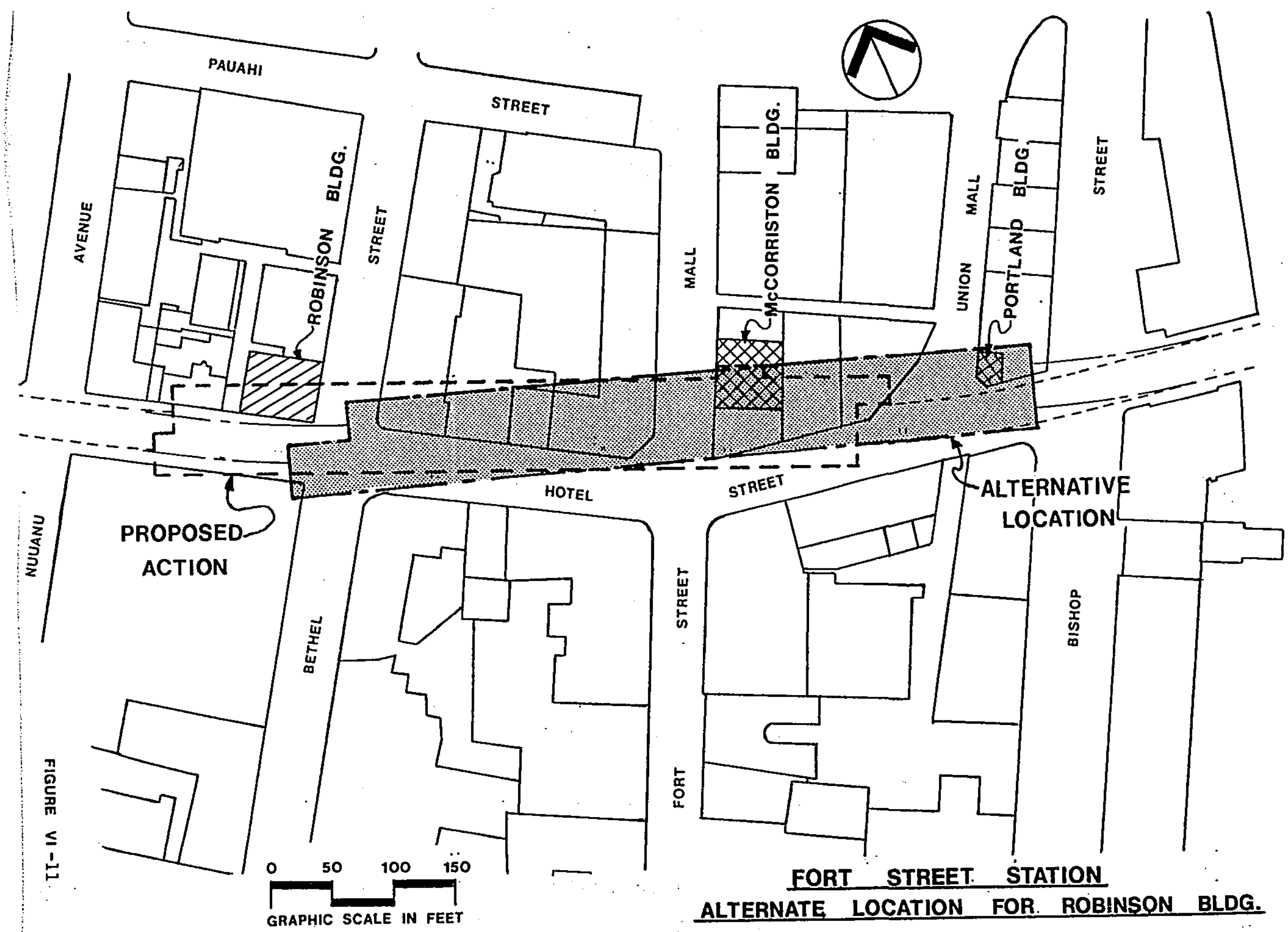
The two alternative alignments considered as feasible and prudent locations for the proposed fixed guideway system were Hotel Street and King Street with Hotel Street selected as the preferred alignment. However, the King Street alignment would avoid any adverse effect on the Robinson Building.

It should be pointed out that both Hotel Street and King Street have properties fronting them that are listed in or determined eligible for the National Register and subject to adverse effects from the proposed action. In fact, even the other alternatives considered and discarded, (i.e., the Beretania Street and Nimitz Highway/Ala Moana Boulevard routes) would have adverse effects on certain historic properties. Thus, the selection of any alternative route through downtown Honolulu may not completely avoid some adverse effects.

An alternative of relocating the station was studied and it was found that if the station structure was moved west of Nuuanu Avenue, there would be a conflict with and result in adverse effects to the Chinatown Historic District. If the station was moved to the east to clear the Robinson Building, there would be a conflict with and result in adverse effects to the Portland and McCorriston Buildings, both of which are determined eligible for inclusion in the National Register (see Figure VI-11).

d. Mitigation

To mitigate the proposed action, the City will document the Robinson Building prior to demolition so that there will be a permanent record of its existence. The City will first




**FORT STREET STATION**

**ALTERNATE LOCATION FOR ROBINSON BLDG.**

FIGURE VI-11

contact the National Architectural and Engineering Record (NAER) of the Heritage Conservation and Recreation Service, U.S. Department of the Interior, to determine the level of required documentation. Demolition will not proceed until the documentation has been approved by NAER.

e. Coordination

In planning the proposed fixed guideway system, continuous coordination was maintained with the Hawaii State Historic Preservation Officer (SHPO) in evaluating the affected properties. Based on this coordination and upon application of the criteria of adverse effect (36 CFR, Section 800.3), the proposed action would result in the "destruction or alteration of all or part of the project" (Section 800.3(b)(1)), UMTA has determined that there would be adverse effect on the Robinson Building.

The SHPO has made a determination that this property could be used for the proposed transit system provided that appropriate mitigative measures are taken as stipulated in the attached Memorandum of Agreement.

The U.S. Department of the Interior in their letter to UMTA (79/702), dated October 3, 1979, concurs with the finding that there are no feasible or prudent alternatives to avoid this taking.

f. Determination

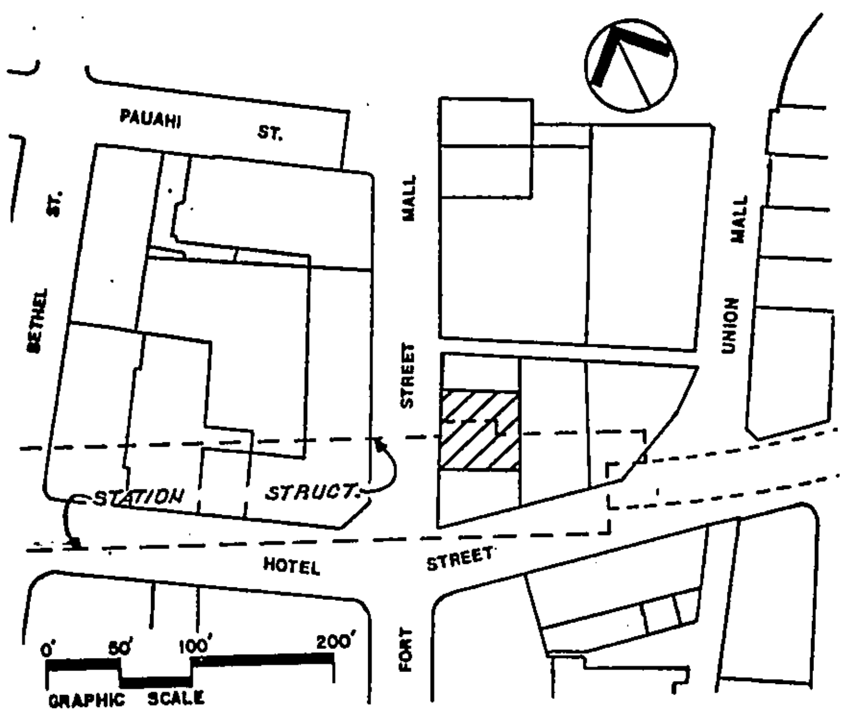
Based upon the above documentation, there are no feasible or prudent alternatives to the removal of the Robinson Building, a historic property under Section 4(f) of the DOT Act of 1966, for the proposed action. In addition, all possible planning has been done to minimize harm to this property.

A.5. The McCorriston Building

a. Description and Significance of Affected Property

The McCorriston Building has been determined eligible for inclusion into the National Register. It was built in 1914 and its stucco Fort Street elevation is done in a modified Classical Revival style. Its first floor has been, in 1973 and 1977, heavily remodeled. Above the first floor is a metal awning. Above the awning is a facade very slightly altered (see Figure VI-12).

A horizontal band of four pairs of 1/1 light double hung windows are spaced by stylized flat columns. The entablature above the windows has a small architrave, a wide




**McCORRISTON BLDG.**
**FIGURE VI -12**

frieze with the name McCorriston in relief, and is capped with cornice with large spaced dentils. Above the entablature is a fairly flat gable end with a circular attic vent above which is the date "1914".

The McCorriston Building is a pleasantly proportioned example of a small commercial building in early 20th century Honolulu. In a highly diverse downtown streetscape, this building contributes another distinctive architectural form to the area.

b. Proposed Use

The implementation of the proposed action would include provision of an underground transit station between Nuuanu Avenue and Bishop Street to serve the CBD (see Figure VI-13).

Under the proposed alignment and station location, the McCorriston Building is situated directly above and would conflict with the construction of the station structure. Furthermore, with Hotel Street having a relatively narrow width of 50 feet, more space at the station is required to efficiently disperse the large volume of transit patrons using this station.

c. Alternatives

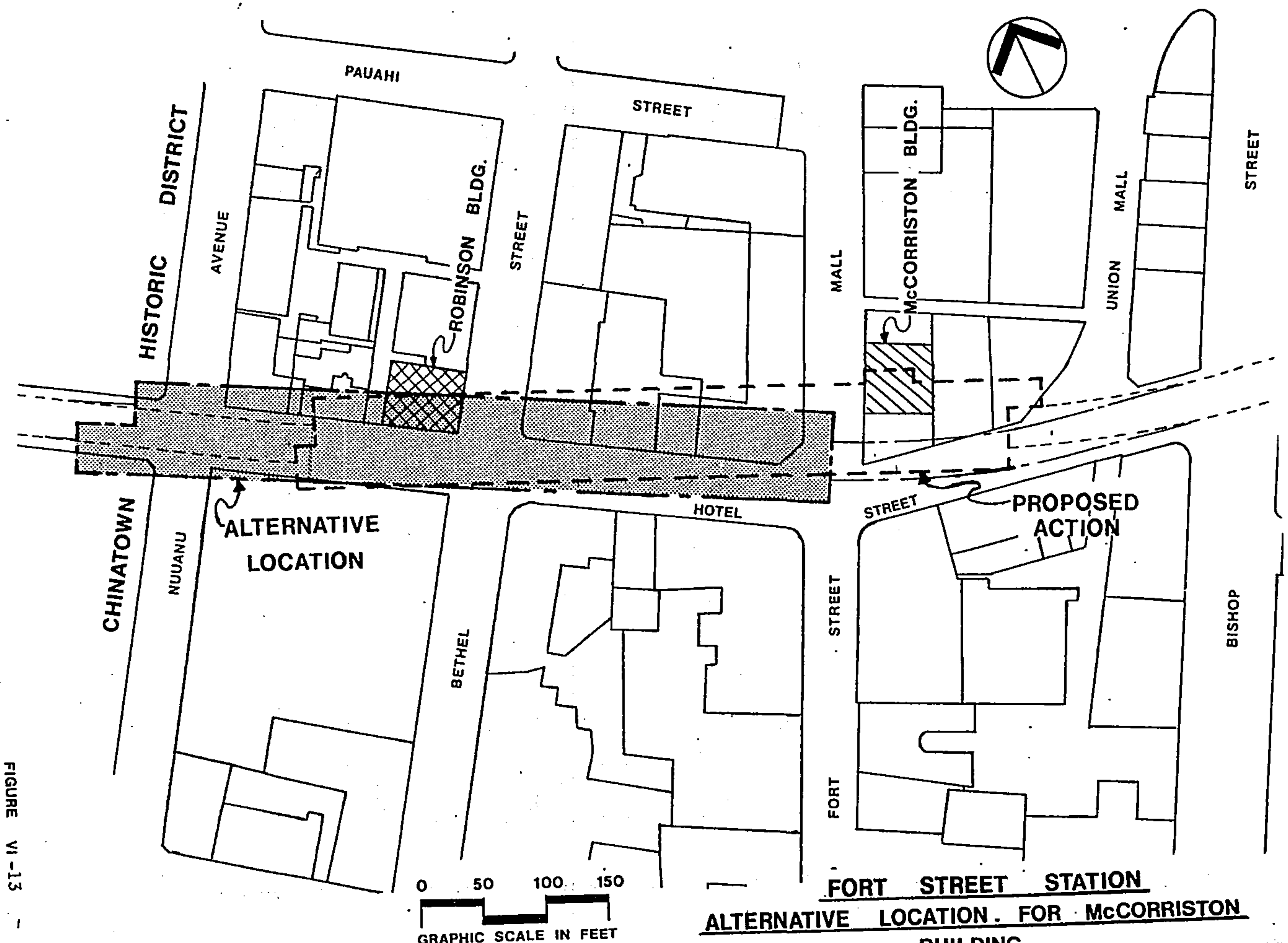
The two alternative alignments considered as feasible and prudent locations for the proposed fixed guideway system were Hotel Street and King Street with Hotel Street selected as the preferred alignment. However, the King Street alignment would avoid any adverse effect on the McCorriston Building.

It should be pointed out that both Hotel Street and King Street have properties fronting them that are listed in or determined eligible for the National Register and subject to adverse effects from the proposed action. In fact, even the other alternatives considered and discarded (i.e., the Beretania Street and Nimitz Highway/Ala Moana Boulevard routes) would have adverse effects on certain historic properties. Thus, the selection of any alternative route through downtown Honolulu may not completely avoid some adverse effects.

An alternative of relocating the station was studied and it was found that if the station structure was moved to the west to clear the McCorriston Building, there would be a conflict with and result in adverse effects to the Chinatown Historic District and the Robinson Building (see Figure VI-13.)

d. Mitigation

To mitigate the proposed action, the City will document the McCorriston Building prior to demolition so that there will




**FORT STREET STATION**

**ALTERNATIVE LOCATION FOR McCORRISTON BUILDING**

FIGURE VI-13

be a permanent record of its existence. The City will first contact the National Achitectural and Engineering Record (NAER) of the Heritage Conservation and Recreation Service, U.S. Department of the Interior, to determine the level of required documentation. Demolition will not proceed until the documentation has been approved by NAER.

e. Coordination

In planning the proposed fixed guideway system, continuous coordination was maintained with the Hawaii State Historic Preservation Officer (SHPO) in evaluating the affected properties. Based on this coordination and upon application of the criteria of adverse effect (36 CFR, Section 800.3), the proposed action would result in the "destruction or alteration of all or part of the project" (Section 800.3(b)(1)), UMTA has determined that there would be adverse effect on the McCorriston Building.

The SHPO has made a determination that this property could be used for the proposed transit system provided that appropriate mitigative measures are taken as stipulated in the attached Memorandum of Agreement.

The U.S. Department of the Interior in their letter to UMTA (79/702), dated October 3, 1979, concurs with the finding that there are no feasible or prudent alternatives to avoid this taking.

f. Determination

Based upon the above documentation, there are no feasible or prudent alternatives to the removal of the McCorriston Building, a historic property under Section 4(f) of the DOT Act of 1966, for the proposed action. In addition, all possible planning has been done to minimize harm to this property.

A.6. Hotel Street Sidewalk Elements

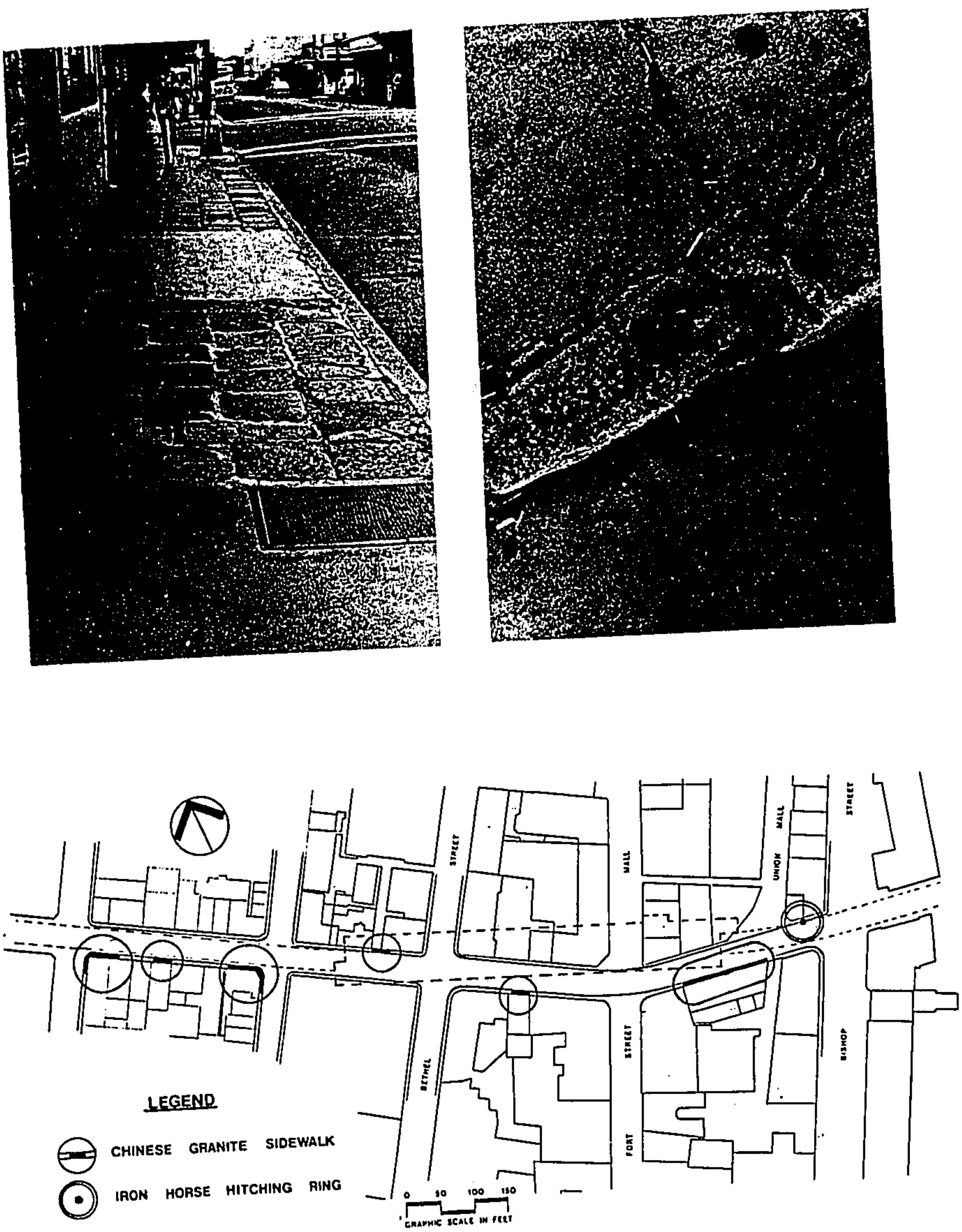
a. Description and Significance of Affected Property

The Hotel Street Sidewalk Elements have been determined eligible for inclusion into the National Register. On Hotel Street, through the Chinatown Historic District and easterly thereof to Bishop Street, the sidewalks contain the following:

(1) Sections of Chinese granite paving appearing intermittently at locations shown on Figure VI-14.

(2) Lava stone curbing along both sides of the street.

(3) Iron horse hitching ring located in the curb in front of the Portland Building.




HOTEL STREET SIDEWALK ELEMENTS

FIGURE VI-14

The significance of these elements is that they are all part of the Chinatown environment and they represent materials used in constructing sidewalks in the early 1900's.

b. Proposed Use

Through downtown Honolulu, the proposed fixed guideway system would be placed underground with the alignment following Hotel Street. The alignment has been established to fit the guideway structure within the existing public right-of-way as much as possible to minimize conflicts with existing properties. The underground placement of the guideway eliminates most of the serious environmental impacts associated with the aerial guideway configuration. However, even underground facilities could potentially affect adjoining properties due to construction activities and operation of the system.

The construction of underground facilities on Hotel Street would be done by the cut-and-cover method, i.e., open trench excavation performed from the ground surface. The subway structure would be approximately 35 feet wide and 20 feet high with the excavation depth varying from 30 feet to 40 feet. With a 50-foot right-of-way width and the subway structure occupying approximately 35 feet of it, the space remaining between the structure and the right-of-way line would be less than 8 feet on each side. This would place the excavation line at or beyond the curb line and thus require the temporary removal of the curb and portions of the sidewalk for construction of the subway structure.

c. Alternatives

The two alternative alignments considered as feasible and prudent locations for the proposed fixed guideway system were Hotel Street and King Street with Hotel Street selected as the preferred alignment. However, the King Street alignment would avoid any adverse effect on the Hotel Street Sidewalk Elements.

It should be pointed out that both Hotel Street and King Street have properties fronting them that are listed in or determined eligible for the National Register and subject to adverse effects from the proposed action. In fact, even the other alternatives considered and discarded (i.e., the Beretania Street and Nimitz Highway/Ala Moana Boulevard routes) would have adverse effects on certain historic properties. Thus, the selection of any alternative route through downtown Honolulu may not completely avoid some adverse effects.

d. Mitigation

To mitigate the proposed action, the City will temporarily remove and store the elements during construction and then restore them in a manner satisfactory to SHPO.

e. Coordination

In planning the proposed fixed guideway system, continuous coordination was maintained with the Hawaii State Historic Preservation Officer (SHPO) in evaluating the affected properties. Based on this coordination and upon application of the criteria of adverse effect (36 CFR, Section 800.3), the proposed action would result in the "destruction or alteration of all or part of the project" (Section 800.3(b)(1)), UMTA has determined that there would be adverse effect on the Hotel Street Sidewalk Elements.

The SHPO has made a determination that this property could be used for the proposed transit system provided that appropriate mitigative measures are taken as stipulated in the attached Memorandum of Agreement.

The U.S. Department of the Interior in their letter to UMTA (79/702), dated October 3, 1979, concurs with the finding that there are no feasible or prudent alternatives to avoid this taking.

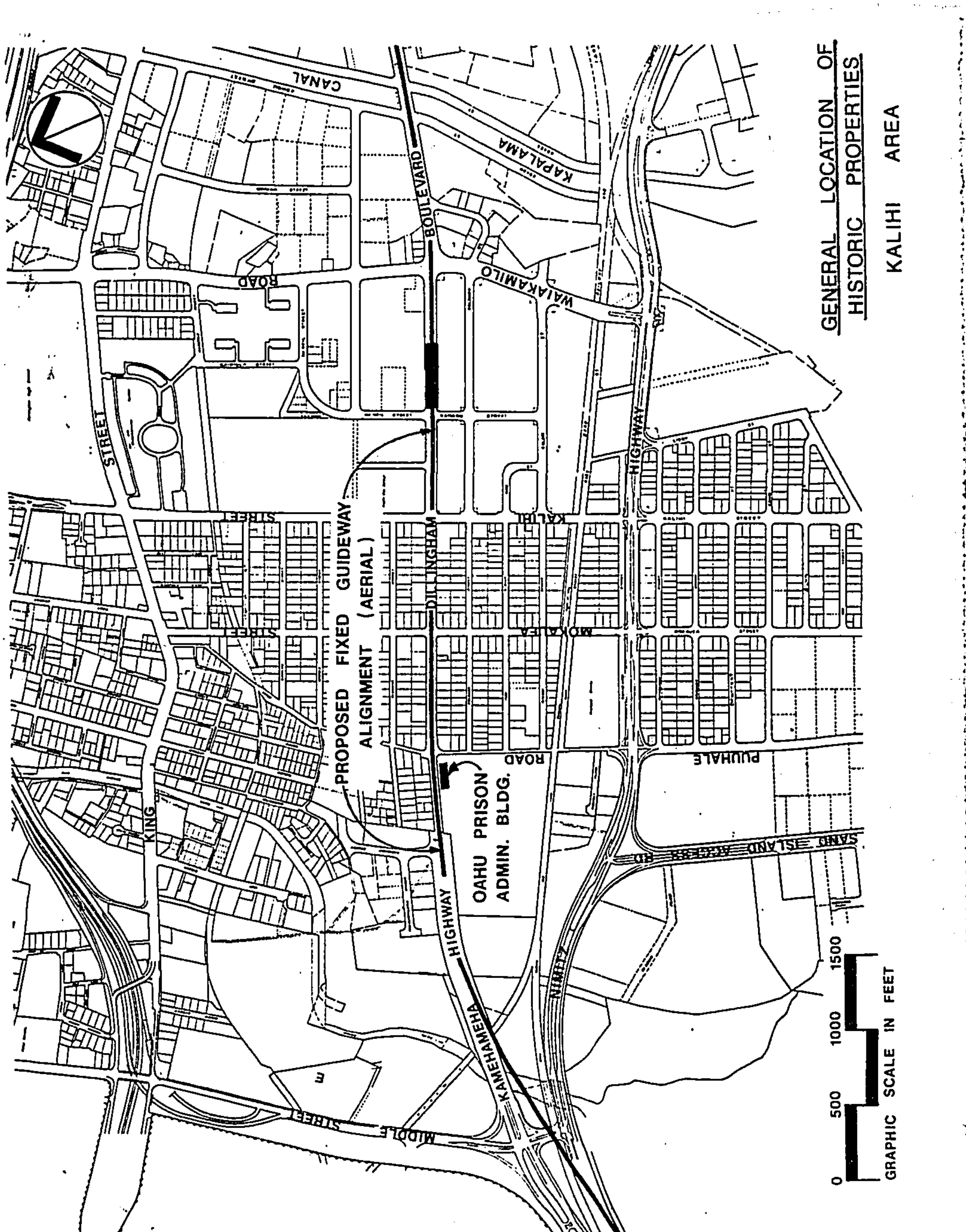
f. Determination

Based upon the above documentation, there are no feasible or prudent alternatives to the temporary removal of the Hotel Street Sidewalk Elements, historic properties under Section 4(f) of the DOT Act of 1966, for the proposed action. In addition, all possible planning has been done to minimize harm to this property and it has been concluded that this can be mitigated by eventual replacement after construction.

B. HISTORIC PROPERTIES (Section 106) DETERMINATIONS

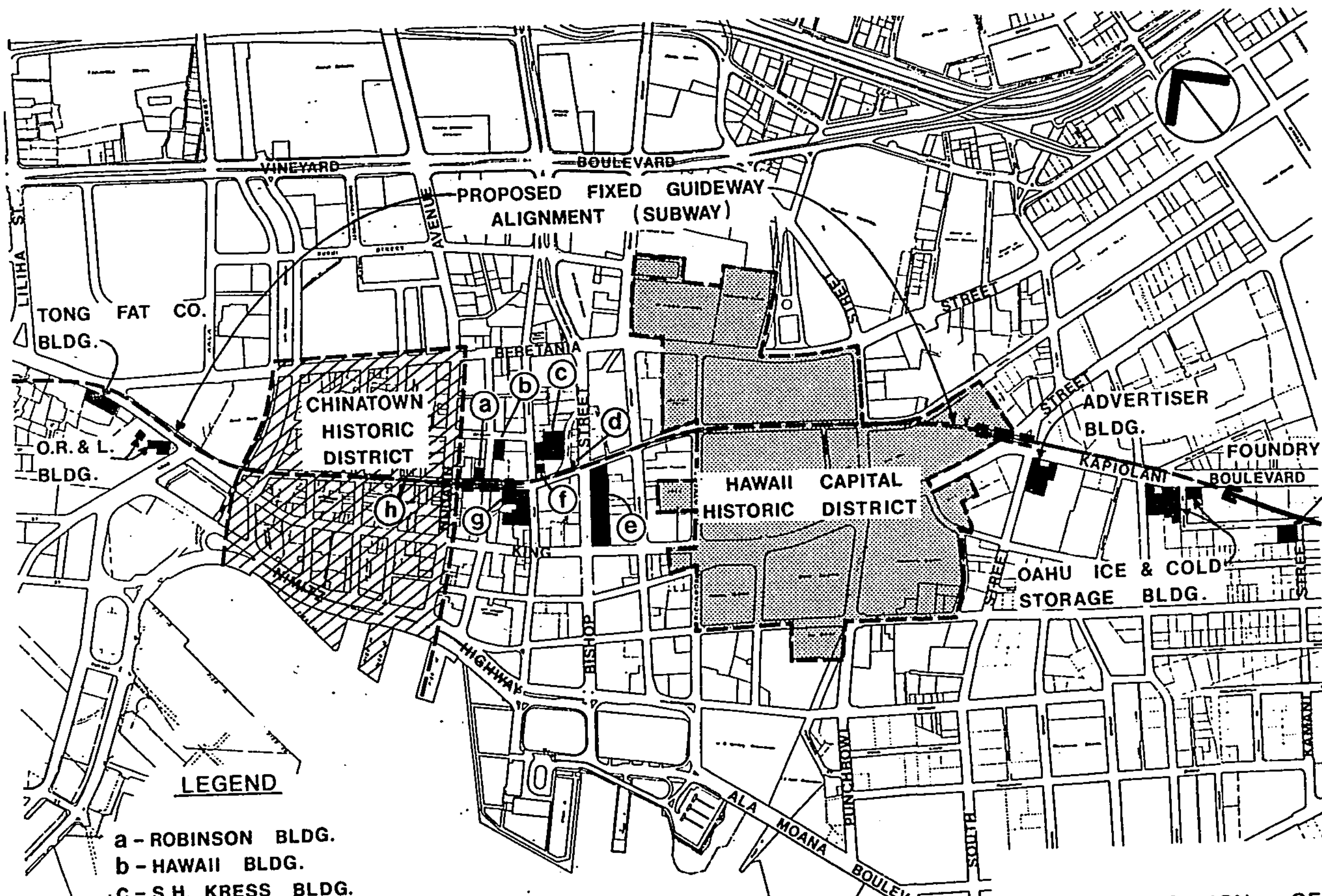
Various historic properties which are included or determined eligible for inclusion in the National Register of Historic Places have been identified and analyzed for effect by the proposed fixed guideway system.[25,26] Two historic properties; the Chinatown Historic District and the Hawaii Capital Historic District are listed in the National Register while 16 properties have been determined eligible. The general location of these properties are shown in Figures VI-15, 16 and 17.

These properties have been evaluated, in coordination with the State Historic Preservation Officer (SHPO), for potential effects from the proposed action. Studies of alternative alignments that would avoid adverse effects and



GENERAL LOCATION OF HISTORIC PROPERTIES
KALIHI AREA
PROPOSED FIXED GUIDEWAY ALIGNMENT (AERIAL)
OAHU PRISON ADMIN. BLDG.
CANAL
KAPALAMA
DILLINGHAM BOULEVARD
WAIAKAMILO ROAD
KING STREET
KALIHI STREET
MOKAUEA STREET
PUUHALE ROAD
SAND ISLAND ACCESS RD
KAMEHAMEHA HIGHWAY
NIMITZ HIGHWAY
MIDDLE STREET
GRAPHIC SCALE IN FEET
0
500
1000
1500


FIGURE VI-15



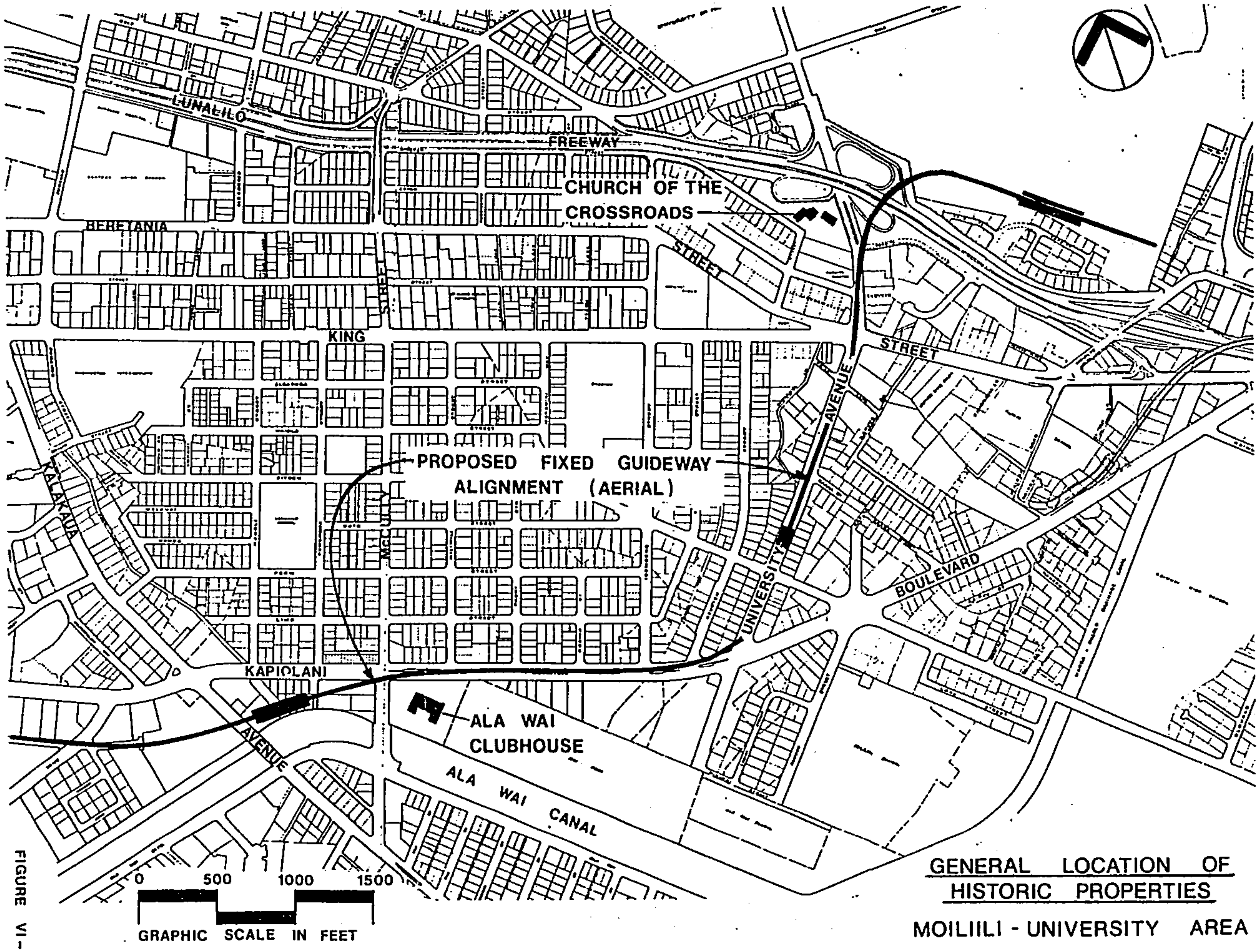

## LEGEND

a - ROBINSON BLDG.
b - HAWAII BLDG.
c - S.H. KRESS BLDG.
d - PORTLAND BLDG.
e - ALEXANDER YOUNG HOTEL BLDG.
f - McCORRISTON BLDG.
g - JAMES CAMPBELL BLDG.
h - HOTEL ST. SIDEWALK

0 500 1000 1500
GRAPHIC SCALE IN FEET

GENERAL LOCATION OF HISTORIC PROPERTIES
DOWNTOWN-KAKAAKO AREA

FIGURE VI-16




GENERAL LOCATION OF HISTORIC PROPERTIES

MOILIILI - UNIVERSITY AREA

FIGURE VI-17

alternatives that would mitigate adverse effects were conducted for each property. It was determined that two (2) properties (Robinson and McCorriston Buildings) would require demolition and thus be adversely affected, one property (Hotel Street Elements) which would also be adversely affected, would be temporarily moved during construction, and fifteen (15) properties will not be adversely affected.

The three properties to be adversely affected due to their required use by the proposed fixed guideway system are fully covered by the 4(f) statements contained in Section VI.A.4, A.5 and A.6, and as documented (preliminary case report) in the Draft EIS plus the mitigative measures contained in the attached Memorandum of Agreement.

Of the fifteen (15) properties determined not to be adversely affected twelve (12) properties required mitigative measures to ensure no adverse effects. This has been coordinated with SHPO as described in the attached Memorandum of Agreement. (Note: The Otani Block, a property determined eligible for the National Register, was demolished by the owner in May, 1980, hence would not fall under Section 106 requirements.)

Regarding the three (3) remaining properties determined also not to be adversely affected, the Oahu Prison Administration Building, the Brass Foundry Building, and the Church of the Crossroads, SHPO has concluded that whatever effects might occur would not be adverse as contained in the letter to the City, dated February 22, 1980. Due to the proximity of the guideway structure to the Oahu Prison Administration Building, photographs of this building will be taken prior to construction of the guideway.

## B.1. Chinatown Historic District

### a. Description and Significance of Affected Property

Honolulu's Chinatown area is designated as a National Historic District and is also listed in the Hawaii State Register of Historic Places. This 15-block community located in downtown Honolulu is generally bounded by Nuuanu Avenue, River Street, Nimitz Highway and Beretania Street (see Figure VI-16). A large proportion of the buildings and the numerous small land parcels are owned by persons who live in Chinatown. The area is characterized by mixed residential, commercial and entertainment uses.

Chinatown is an ethnic center which was first settled by the Chinese over 100 years ago. It was the earliest ethnic community in Honolulu and it still retains a most distinctive cultural environment. Many of its merchants are

Chinese, but its resident population has shifted to include a variety of ethnic groups, the largest of which is the Filipinos. Since the 1860's, Chinatown has supported a variety of activities and functions, including Chinese dry goods, food shops, restaurants, open markets and retail stalls, a Chinese speaking theatre and dramatic society. This unique and vital ethnic community is Chinatown's greatest resource.

Despite several disastrous fires which completely razed Chinatown and continuous new construction in the downtown areas adjacent to Chinatown, Chinatown proper has remained intact with a distinctive architectural character. Chinatown buildings which are considered to be of historical significance were constructed in the first decade of the 20th century, after the Chinatown fire in January, 1900. These buildings are primarily simple, two- and three-story structures of common materials, similar examples of which are found in most American cities today. The majority of buildings have commercial uses on the ground floor and living quarters on the upper floors. This double usage is reflected on the exterior. The street facade of the lower floor usually consists of a recessed double doored entry with large "store-front" windows on either side.

When the buildings of Chinatown are analyzed individually, it is difficult to determine their true value. They are well proportioned buildings with excellent masonry work, many are distinguished by corbelled brick cornices, articulated brick arches for windows and doorways and rusticated bluestone facades. While these descriptions are technically correct, they reveal only a small portion of the true value of Chinatown. Its real value is its unique and irreplaceable environment and the special life styles which are allowed to live within it.

b. Inapplicability of the Criteria of Adverse Effect

Through downtown Honolulu, which includes the entire Chinatown Historic District, the proposed fixed guideway system would be placed underground with the alignment following Hotel Street. The alignment has been established to fit the guideway structure within the existing public right-of-way as much as possible to minimize conflicts with existing properties. The underground placement of the guideway eliminates most of the serious environmental impacts associated with above-ground construction of the guideway. However, even underground facilities could potentially affect adjoining properties due to construction activities and operation of the system.

The construction of underground facilities on Hotel Street would be done by the cut-and-cover method, i.e., open trench excavation performed from the ground surface. The subway structure would be approximately 34 feet wide and 20 feet high with the excavation depth varying from 30 feet to 40 feet. With a 50-foot right-of-way width and the subway structure occupying approximately 34 feet of it, the space remaining between the structure and the right-of-way line would be an average of 8 feet on each side. In performing the excavation and its related work, the adjacent buildings and structures can be adequately protected during construction to prevent any deterioration or destruction of the property. Upon applying the criteria of adverse effect, the proposed action is found to have no adverse effect on the Chinatown Historic District.

The operation of an underground transit system produces ground-borne noise and vibration in adjacent buildings. Usually the vibration levels are below the threshold of perception to mechanical motion but the vibration transmitted to a building structure could generate a low-pitched rumbling noise that is audible. In applying the criteria of adverse effect, the proposed action is found to have no adverse effect by taking appropriate mitigative measures to reduce ground vibrations.

### c. Coordination and Consultation with the State Historic Preservation Officer

The opinion of the State Historic Preservation Officer regarding the effect of the proposed action on the Chinatown Historic District is contained in the attached Memorandum of Agreement. The State Historic Preservation Officer has agreed to certain design and construction considerations to satisfactorily mitigate the impact of the rapid transit system on the Chinatown Historic District.

### d. Determination of Effect

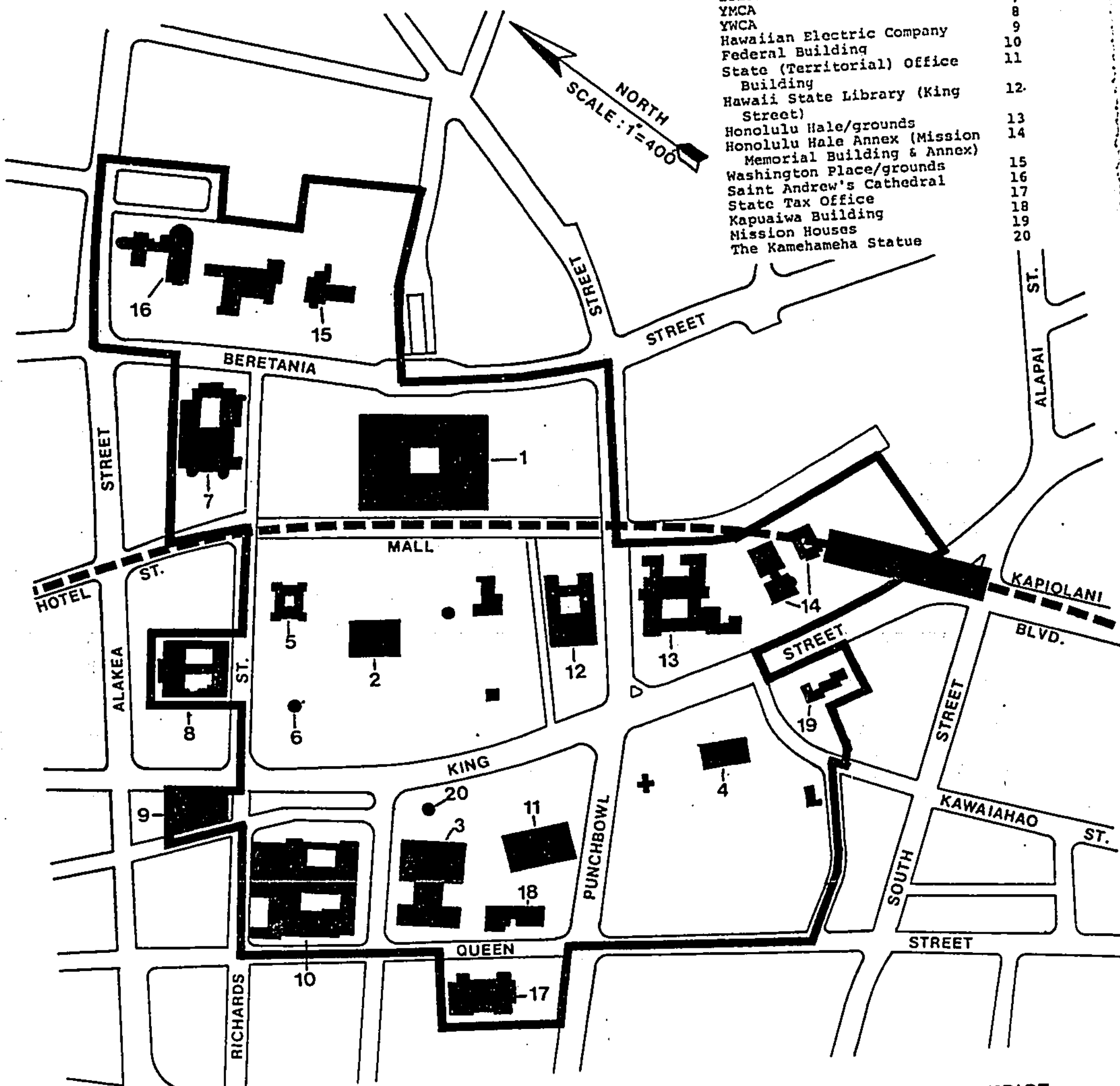
Upon applying the Criteria of Effect and Criteria of Adverse Effect (36 CFR, Section 800.3), and in consultation with the State Historic Preservation Officer, UMTA has determined that the proposed action will have "no adverse effect" on the aforementioned historic property.

## B.2. Hawaii Capital Historic District

### a. Description and Significance of Affected Property

The State Department of Land and Natural Resources (DLNR), Historic Sites Section conducted research and prepared documents for the nomination of the Hawaii Capital Historic District to the Hawaii and National Registers of Historic Places. The Hawaii Capital Historic District is included on both the Hawaii and National Registers of Historic Places. According to the documents prepared by the DLNR, the Hawaii Capital District is an area that defines the central nexus of Honolulu, and whose boundaries are as shown in Figure VI-18.

| Building | Building # |
|---|---|
| State Capitol/grounds | 1 |
| Iolani Palace/grounds | 2 |
| Aliiolani Hale | 3 |
| Kawaiahao Church/grounds | 4 |
| Iolani Barracks | 5 |
| Iolani Palace Bandstand | 6 |
| YMCA | 7 |
| YWCA | 8 |
| Hawaiian Electric Company | 9 |
| Federal Building | 10 |
| State (Territorial) Office Building | 11 |
| Hawaii State Library (King Street) | 12 |
| Honolulu Hale/grounds | 13 |
| Honolulu Hale Annex (Mission Memorial Building & Annex) | 14 |
| Washington Place/grounds | 15 |
| Saint Andrew's Cathedral | 16 |
| State Tax Office | 17 |
| Kapuaiwa Building | 18 |
| Mission Houses | 19 |
| The Kamehameha Statue | 20 |




CAPITAL HISTORIC DISTRICT

FIGURE VI-18

Historically, the Capital Historic District was proposed for inclusion on the National Register of Historic Places because of its significance in association with events that have made a significant contribution to the broad patterns of Hawaiian history; and because of its association with the lives of persons significant in Hawaii's past. Also, the early centralization of all levels of government in Honolulu has resulted in an extraordinary concentration of public and private architecture reflecting the social and political evolution of the people of Hawaii. The Capital District and its present environs are an invaluable natural and cultural asset to the people of Hawaii.

The District encompasses some 57 acres of land of which over 80 percent is in open space. Located adjacent to a dense downtown Honolulu area, it offers a park-like relief from its high-rise structures and crowded sidewalks.

The focal point of the District is the Iolani Palace, the royal residence of the last two rulers of the Kingdom of Hawaii. It is the most important surviving symbol of the days of the Hawaiian monarchs and its exotic architecture is symbolic of the tastes, cultural aspirations and sophistication of the Hawaiian rulers. Iolani Palace was the seat of government under the Provisional Government of Hawaii, the Republic of Hawaii and the Territory of Hawaii. It was the site of the formal transfer of the Hawaiian Islands to the United States. The history of the palace is rich with events which are centered primarily on the transfer of the Hawaiian Islands from independence to involvement with the United States.

The style of the ornate two story palace has been variously described as "American composite", "American Florentine" or "French rococo". The palace is built of brick, faced with cement, trimmed with concrete block, and is ornamented by six towers. With the interior and exterior restoration just completed, Iolani Palace is again open to the public.

The beautifully landscaped and well maintained grounds of the Palace are also of historical importance. A feature of the grounds is the delightfully elegant bandstand which is in the southwest portion of the square. It was first built directly in front of the King Street entrance to the Palace as the shelter for the coronation of King Kalakaua and Queen Kapiolani in 1883 and later moved to its present location. Another feature of the grounds is the site of the royal tomb, where most of Hawaii's monarchs were buried until 1865, when all the royal coffins were removed to the Royal Mausoleum in Nuuanu Valley. The importance of Iolani Palace and grounds is related not as much to age but to its special position in the heritage of the Hawaiian people and in the history of statehood.

The District covers an area generally between Beretania Street and Queen Street in the north-south direction. The proposed fixed guideway system is located in Hotel Street before leaving it to enter Kapiolani Boulevard. The structures and grounds adjacent to the proposed alignment are shown in Figure VI-18 and include the following:

- Armed Services YMCA
- Iolani Barracks
- Iolani Palace
- Kana'ina Building (Old Archives Building)
- State Capital
- Hawaii State Library
- Honolulu Hale
- Honolulu Hale Annex (Mission Memorial Building and Auditorium)
- Honolulu Hale Annex (Mission Memorial Annex)

b. Inapplicability of the Criteria of Adverse Effect

Through downtown Honolulu, which includes the entire Capital Historic District, the proposed fixed guideway system would be placed underground with the alignment following Hotel Street. The alignment has been established to fit the guideway structure within the existing public right-of-way as much as possible to minimize conflicts with existing properties. The underground placement of the guideway eliminates most of the serious environmental impacts associated with above-ground construction of the guideway. However, even underground facilities could potentially affect adjoining properties due to construction activities and operation of the system.

The construction of underground facilities on Hotel Street would be done by the cut-and-cover method, i.e., open trench excavation performed from the ground surface. The subway structure would be approximately 34 feet wide and 20 feet high with the excavation depth varying from 30 feet to 40 feet. With a 50-foot right-of-way width and the subway structure occupying approximately 34 feet of it, the space remaining between the structure and the right-of-way line would be an average of 8 feet on each side. In performing the excavation and its related work, the adjacent buildings and structures can be adequately protected during construction to prevent any deterioration or destruction of the property. Upon applying the criteria of adverse effect, the proposed action is found to have no adverse effect on the Capitol Historic District.

The operation of an underground transit system produces ground-borne noise and vibration in adjacent buildings. Usually the vibration levels are below the threshold of perception to mechanical motion but the vibration transmitted to a building structure could generate a low pitched rumbling noise that is audible. There would also be airborne noise emanating from the fan and vent shaft opening located near the station. In applying the criteria of adverse effect, the proposed action is found to have no adverse effect by taking appropriate mitigative measures to reduce ground vibrations and airborne noise.

c. Coordination and Consultation with the State Historic Preservation Officer

The opinion of the State Historic Preservation Officer regarding the effect of the proposed action on the Capitol Historic District is contained in the attached Memorandum of Agreement. The State Historic Preservation Officer has agreed to certain design and construction considerations to satisfactorily mitigate the impact of the rapid transit system on the Capitol Historic District.

d. Determination of Effect

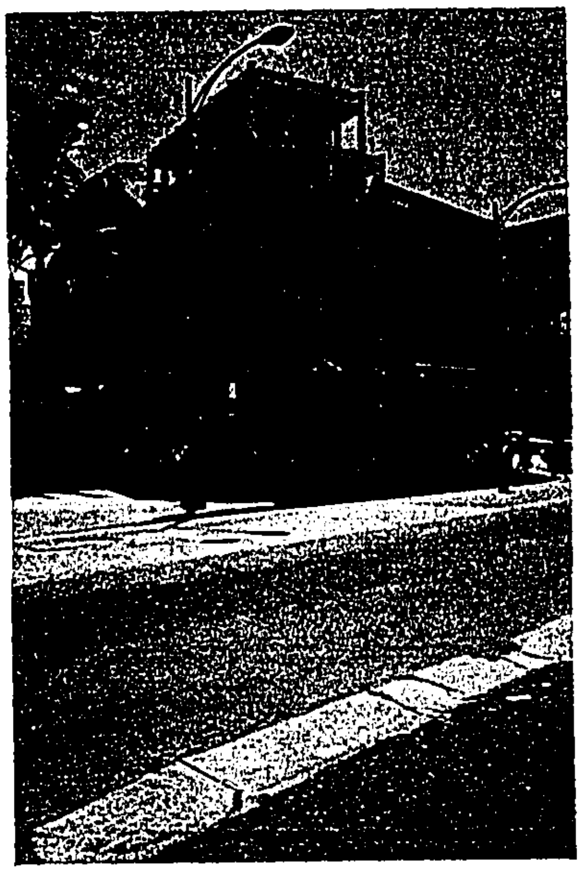
Upon applying the Criteria of Effect and Criteria of Adverse Effect (36 CFR, Section 800.3), and in consultation with the State Historic Preservation Officer, UMTA has determined that the proposed action will have "no adverse effect" on the aforementioned historic property.

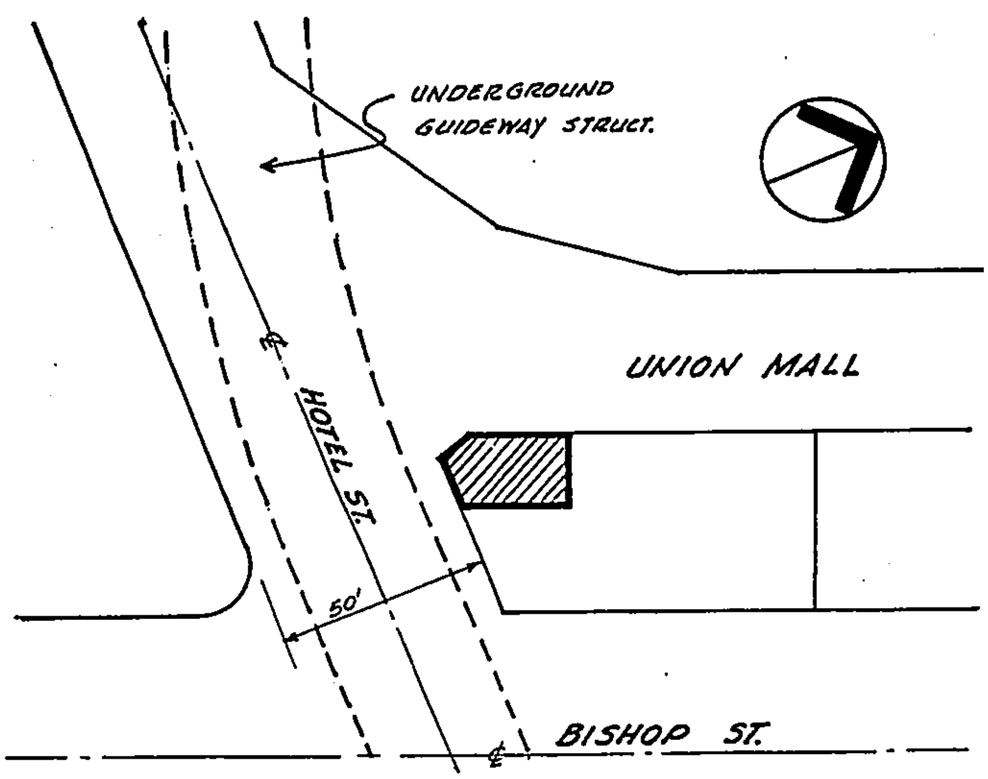
B.3. The Portland Building

a. Description and Significance of Affected Property

The Portland Building was determined eligible by the Keeper of the National Register on January 24, 1979. It is a small building of five sides located at the corner of Union Mall and Hotel Street and surrounded on its north and east sides by the Oregon Building. It is built of stuccoed masonry and sits on a stone foundation. It has a full basement and two floors above ground. The present awning is a fairly modern replacement, but Fire Maps do indicate that it has always had one (see Figure VI-19).

The style can be described as early Beaux Arts and has a fanciful treatment from the second floor to the parapet. The four large round arched window openings have 1/1 light double hung windows with a solid panel at the arch. The extradosed arches "sit" on a cornice which runs the perimeter of the building at the archway springer height. At the four exposed corners of the building a round pilaster begins at that cornice form. Above the extrados of the arches is a corbel table and above that, the parapet. The parapet rises at each corner to meet the pilaster and at the entry corner it has The Portland sign in relief within a triangular arch which extends above the parapet.






**PORTLAND BLDG.**

**FIGURE VI - 19**

This relatively small building has a very distinctive appearance which results in an impact which belies its size. The building has retained its original integrity with very little exterior changes. The scale and detail of the structure are particularly important because the building is on a prominent corner and fronts the extremely busy Union Mall (see Figure VI-19).

b. Inapplicability of the Criteria of Adverse Effect

Through downtown Honolulu, where the Portland Building is located, the proposed fixed guideway system would be placed underground with the alignment following Hotel Street. The alignment has been established to fit the guideway structure within the existing public right-of-way as much as possible to minimize conflicts with existing properties. The underground placement of the guideway eliminates most of the serious environmental impacts associated with the aerial guideway configuration. However, even underground facilities could potentially affect adjoining properties due to construction activities and operation of the system.

The construction of underground facilities on Hotel Street would be done by the cut-and-cover method, i.e., open trench excavation performed from the ground surface. The subway structure would be approximately 34 feet wide and 20 feet high with the excavation depth varying from 30 feet to 40 feet. With a 50-foot right-of-way width and the subway structure occupying approximately 34 feet of it, the space remaining between the structure and the right-of-way line would be an average of 8 feet on each side. In performing the excavation and its related work, the adjacent buildings and structures can be adequately protected during construction to prevent any deterioration or destruction of the property. Upon applying the criteria of adverse effect, the proposed action is found to have no adverse effect on the Portland Building.

The operation of an underground transit system produces ground-borne noise and vibration in adjacent buildings. Usually the vibration levels are below the threshold of perception to mechanical motion but the vibration transmitted to a building structure could generate a low pitched rumbling noise that is audible. There would also be airborne noise emanating from the fan and vent shaft opening located near the Fort Street Station. In applying the criteria of adverse effect, the proposed action is found to have no adverse effect by taking appropriate mitigative measures to reduce ground vibration and airborne noise.

c. Coordination and Consultation with the State Historic Preservation Officer

The opinion of the State Historic Preservation Officer regarding the effect of the proposed action on the Portland

Building is contained in the attached Memorandum of Agreement. The State Historic Preservation Officer has agreed to certain design and construction considerations to satisfactorily mitigate the impact of the rapid transit system on the Portland Building.

d. Determination of Effect

Upon applying the Criteria of Effect and Criteria of Adverse Effect (36 CFR, Section 800.3), and in consultation with the State Historic Preservation Officer, UMTA has determined that the proposed action will have "no adverse effect" on the aforementioned historic property.

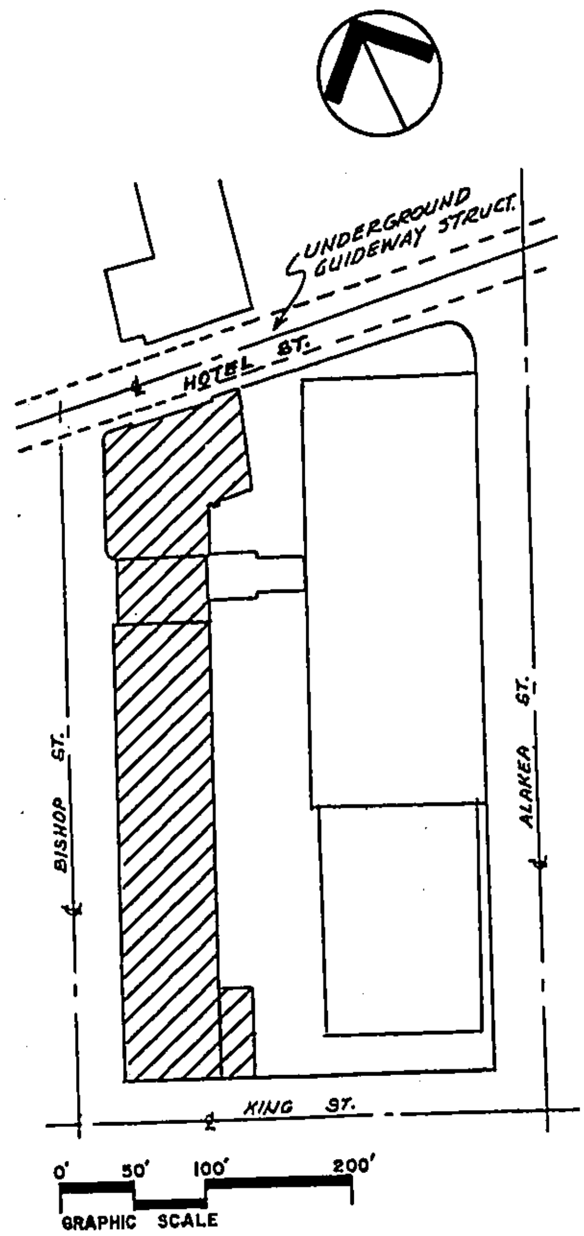
B.4. The Alexander Young Hotel Building

a. Description and Significance of Affected Property

The Alexander Young Hotel Building was determined eligible by the Keeper of the National Register on January 24, 1979. This building is a large block-long steel framed building with Hotel, Bishop and King Street facades of Colusa Sandstone and the rear facade of painted brick. It is Late Renaissance in style, five stories in height along most of Bishop Street and six stories high at the King and Hotel Street ends. These building ends are the most ornate. Round arches 1 1/2 stories high establish the building base. The building "shaft" is three stories tall and is defined above by a cornice which continues around the street elevations of the building (see Figure VI-20).

The building ends are five bays wide on Bishop Street and projects beyond the central section. The three center bays of those ends form a recess three stories tall and have two partially engaged fluted columns topped with composite capitals. The three second floor windows are topped with triangular or rounded pediments (frontons). All other window openings are topped with a flat cornice. All windows are wood framed double hung windows with a 1/1 light.

At the turn of the century the Alexander Young Hotel Building was by far the largest and grandest building in downtown Honolulu and the largest hotel of the Pacific. It was an expression of Honolulu as the tourist center of Hawaii and was developed, along with the Royal Hawaiian Hotel (downtown) and Moana (Waikiki) by Young, who has been called the "Father of the Hotel Industry" in Hawaii. The building has played an important part in the history of Hawaii as well as Honolulu. It became a social center of dinners, dances, benefits and the like. This activity intensified when the roof garden was opened in 1934. For the formal opening the Hotel invited the famous Jay Whidden orchestra and the Earl and Josephine Leach dance team.




**ALEXANDER YOUNG HOTEL BLDG.**

**FIGURE VI-20**

Portions of the building were taken over by the military for two significant periods of time. The first time, the Army took over the second floor and used it as its headquarters until Fort Shafter was completed in 1917. In 1941 most of the 5th and 6th floors were occupied by 250 people under Lt. Col. Theodore Wyman, Jr., U.S. District Engineer. Government use of the building was not abandoned until 1947.

The Alexander Young Hotel Building has undergone a major functional change since originally constructed. Initially, primarily a hotel with 192 rooms, the building was gradually converted to office use as the importance of Waikiki as a tourist center increased. The ground floor has continued to be used for commercial activities.

The building is by far the largest, finest and most intact example of Late Renaissance architecture in Hawaii. It serves as a conceptual landmark in downtown Honolulu in an area that has seen many new and taller office buildings spring up around it. Its mass and detail keep it from being visually dominated by the taller structures. Although the interior has undergone dozens of alterations to adapt the building to office use, the exterior of the building has been altered relatively little.

b. Inapplicability of the Criteria of Adverse Effect

Through downtown Honolulu, where the Alexander Young Building is located, the proposed fixed guideway system would be placed underground with the alignment following Hotel Street. The alignment has been established to fit the guideway structure within the existing public right-of-way as much as possible to minimize conflicts with existing properties. The underground placement of the guideway eliminates most of the serious environmental impacts associated with the aerial guideway configuration. However, even underground facilities could potentially affect adjoining properties due to construction activities and operation of the system.

The construction of underground facilities on Hotel Street would be done by the cut-and-cover method, i.e., open trench excavation performed from the ground surface. The subway structure would be approximately 34 feet wide and 20 feet high with the excavation depth varying from 30 feet to 40 feet. With a 50-foot right-of-way width and the subway structure occupying approximately 34 feet of it, the space remaining between the structure and the right-of-way line would be an average of 8 feet on each side. In performing the excavation and its related work, the adjacent buildings and structures can be adequately protected during construction to prevent any deterioration or destruction of the property. Upon applying the criteria of adverse effect, the proposed action is found to have no adverse effect on the Alexander Young Building.

The operation of an underground transit system produces ground-borne noise and vibration in adjacent buildings. Usually the vibration levels are below the threshold of perception to mechanical motion but the vibration transmitted to a building structure could generate a low pitched rumbling noise that is audible. There would also be airborne noise emanating from the fan and vent shaft opening located near the Fort Street Station. In applying the criteria of adverse effect, the proposed action is found to have no adverse effect by taking appropriate mitigative measures to reduce ground vibration and airborne noise.

c. Coordination and Consultation with the State Historic Preservation Officer

The opinion of the State Historic Preservation Officer regarding the effect of the proposed action on the Alexander Young Hotel Building is contained in the attached Memorandum of Agreement. The State Historic Preservation Officer has agreed to certain design and construction considerations to satisfactorily mitigate the impact of the rapid transit system on the Alexander Young Hotel Building.

d. Determination of Effect

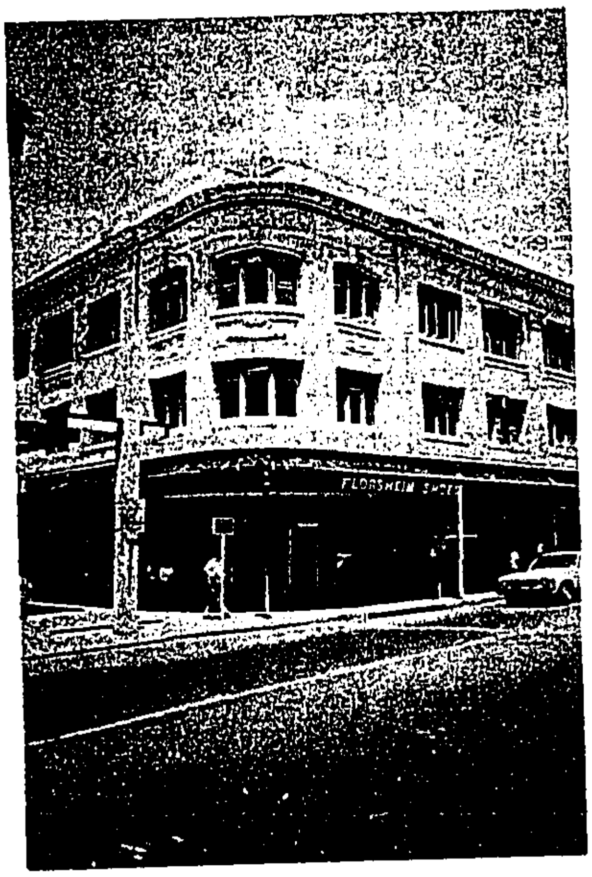
Upon applying the Criteria of Effect and Criteria of Adverse Effect (36 CFR, Section 800.3), and in consultation with the State Historic Preservation Officer, UMTA has determined that the proposed action will have "no adverse effect" on the aforementioned historic property.

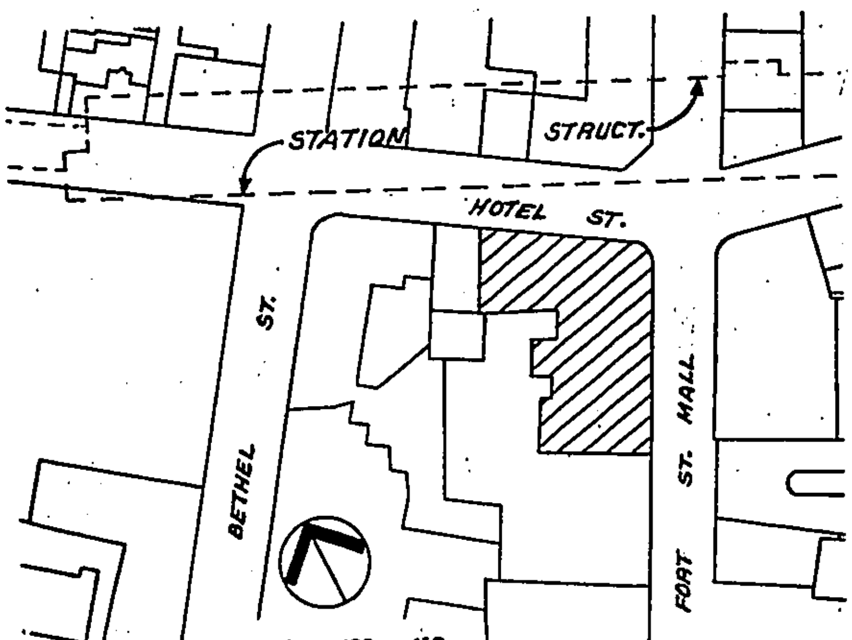
B.5. The J. Campbell Building

a. Description and Significance of Affected Property

The Campbell Building has been determined eligible for inclusion into the National Register. It was built in 1917 of concrete. It has a fairly regular street facade with about 115 feet fronting on Hotel Street and 100 feet fronting on Fort Street. Its south side abuts an adjacent building while its west side has a very irregular outline (see Figure VI-21).

The three-story building has been altered through the years and is composed of 1950's and 1960's storefronts at present. There are three entrances from the sidewalk, with the main office entry being at mid-elevation on Hotel Street. A newer canopy runs the length of the street facades. Above the canopy is a cornice and above the cornice are two floors of regularly spaced window openings each typically filled with two pairs of wood framed casement windows over which






JAMES CAMPBELL BLDG.
FIGURE VI -21

are four small awning windows. The windows are deeply recessed and those over the main entry are flanked by pilasters topped with Ionic capitals.

Above the windows is a simple classical entablature with an architrave, frieze and a strong dentilled cornice. The parapet above the cornice is capped with a projecting band and is unadorned except for a small round arch at the Hotel/Fort corner under which is a flying eagle in high relief.

The three-window bays around the curved street corner are adorned at the spandrel between the second and third floor. The third floor windows have a very flat semi-elliptical arch. Several window bays at the south end of the building on Fort Street have been covered over with a flat plastered facing.

The architectural significance of this building is that its proportions are good, its scale is similar to that common of buildings throughout this section of downtown Honolulu and of Chinatown, and its upper two stories and cornice line remain intact and contain excellent examples of applied ornamentation.

b. Inapplicability of the Criteria of Adverse Effect

Through downtown Honolulu, where the J. Campbell Building is located, the proposed fixed guideway system would be placed underground with the alignment following Hotel Street. The alignment has been established to fit the guideway structure within the existing public right-of-way as much as possible to minimize conflicts with existing properties. The underground placement of the guideway eliminates most of the serious environmental impacts associated with the aerial guideway configuration. However, even underground facilities could potentially affect adjoining properties due to construction activities and operation of the system.

The construction of underground facilities on Hotel Street would be done by the cut-and-cover method, i.e., open trench excavation performed from the ground surface. The subway structure would be approximately 34 feet wide and 20 feet high with the excavation depth varying from 30 feet to 40 feet. The station structure would have an overall length of approximately 600 feet and width of 70 feet. In performing the excavation and its related work, the adjacent buildings and structures can be adequately protected during construction to prevent any deterioration or destruction of the property. Upon applying the criteria of adverse effect, the proposed action is found to have no adverse effect on the J. Campbell Building.

The operation of an underground transit system produces ground-borne noise and vibration in adjacent buildings.

Usually the vibration levels are below the threshold of perception to mechanical motion but the vibration transmitted to a building structure could generate a low pitched rumbling noise that is audible. There would also be airborne noise emanating from the fan and vent shaft opening located near the Fort Street Station. In applying the criteria of adverse effect, the proposed action is found to have no adverse effect by taking appropriate mitigative measures to reduce ground vibration and airborne noise.

c. Coordination and Consultation with the State Historic Preservation Officer

The opinion of the State Historic Preservation Officer regarding the effect of the proposed action on the J. Campbell Building is contained in the attached Memorandum of Agreement. The State Historic Preservation Officer has agreed to certain design and construction considerations to satisfactorily mitigate the impact of the rapid transit system on the Campbell Building.

d. Determination of Effect

Upon applying the Criteria of Effect and Criteria of Adverse Effect (36 CFR, Section 800.3), and in consultation with the State Historic Preservation Officer, UMTA has determined that the proposed action will have "no adverse effect" on the aforementioned historic property.

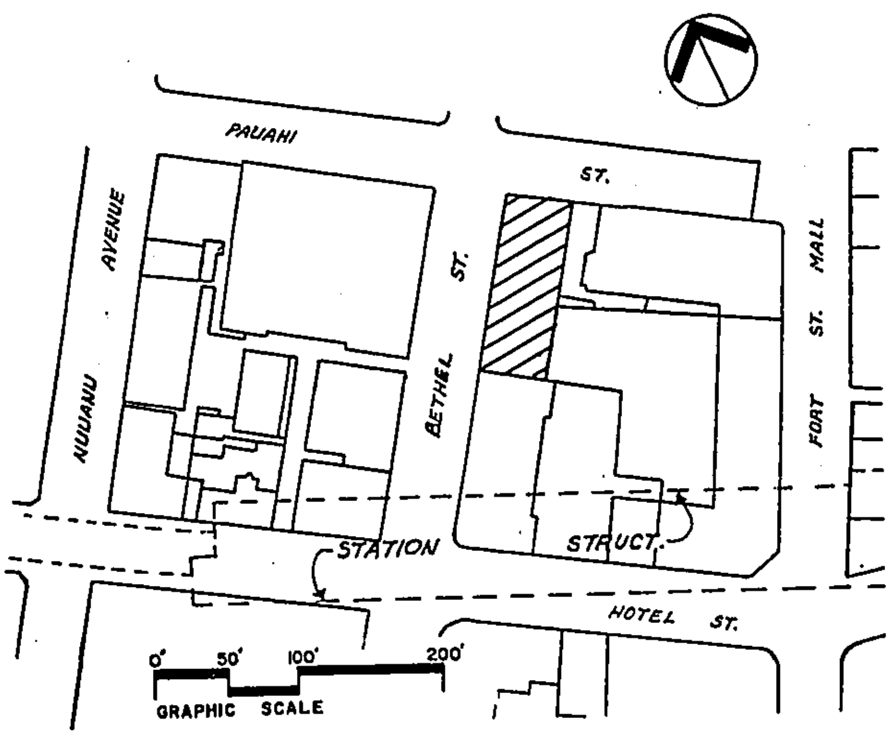
B.6. The Hawaii Building

a. Description and Significance of Affected Property

The Hawaii Building has been determined eligible for inclusion into the National Register. It has a concrete frame structure which is clearly expressed on the exterior face of the building. First floor storefronts and the second floor rusticated concrete block, as well as the rusticated concrete block parapet are all expressed as infill panels within that frame. The concrete blocks are rusticated to look like stone (see Figure VI-22).

The building was constructed between 1924 and 1926, after Bethel Street was extended from Hotel Street to Pauahi Street. Its frame is regular except for two closely spaced columns centered on the Bethel Street elevation and which serve to announce the main second floor entry. Above these columns is a 19 HAWAII BUILDING 24 sign cast into a band topped with a small cornice which runs the length of the street elevations.

The second floor has window openings with paired wood-frame casement windows above which are a pair of small awning




**HAWAII BLDG.**

**FIGURE VI - 22**

windows. Six of these awning windows have been removed to allow for room air conditioners.

Over the first floor is a typical canopy (replaced in 1949) above which are strips of vent windows and below which is a series of storefronts, all of which are a result of 1950's and 1960's remodelings.

The building shares characteristics with buildings in the nearby Chinatown Historic District: scale, awnings, first floor storefronts with high vent windows. It is alone on the east side of Bethel Street with respect to its age and scale, as the other buildings are of considerably more recent vintage.

b. Inapplicability of the Criteria of Adverse Effect

Through downtown Honolulu, where the Hawaii Building is located, the proposed fixed guideway system would be placed underground with the alignment following Hotel Street. The alignment has been established to fit the guideway structure within the existing public right-of-way as much as possible to minimize conflicts with existing properties. The underground placement of the guideway eliminates most of the serious environmental impacts associated with the aerial guideway configuration. However, even underground facilities could potentially affect adjoining properties due to construction activities and operation of the system.

The construction of underground facilities on Hotel Street would be done by the cut-and-cover method, i.e., open trench excavation performed from the ground surface. The subway structure would be approximately 34 feet wide and 20 feet high with the excavation depth varying from 30 feet to 40 feet. The station structure would be approximately 600 feet long and 70 feet wide. In performing the excavation and its related work, the adjacent buildings and structures can be adequately protected during construction to prevent any deterioration or destruction of the property. Upon applying the criteria of adverse effect, the proposed action is found to have no adverse effect on the Hawaii Building.

c. Coordination and Consultation with the State Historic Preservation Officer

The opinion of the State Historic Preservation Officer regarding the effect of the proposed action on the Hawaii Building is contained in the attached Memorandum of Agreement. The State Historic Preservation

Officer has agreed to certain design and construction considerations to satisfactorily mitigate the impact of the rapid transit system on the Hawaii Building.

### d. Determination of Effect

Upon applying the Criteria of Effect and Criteria of Adverse Effect (36 CFR, Section 800.3), and in consultation with the State Historic Preservation Officer, UMTA has determined that the proposed action will have "no adverse effect" on the aforementioned historic property.

## B.7. The S.H. Kress Company Building

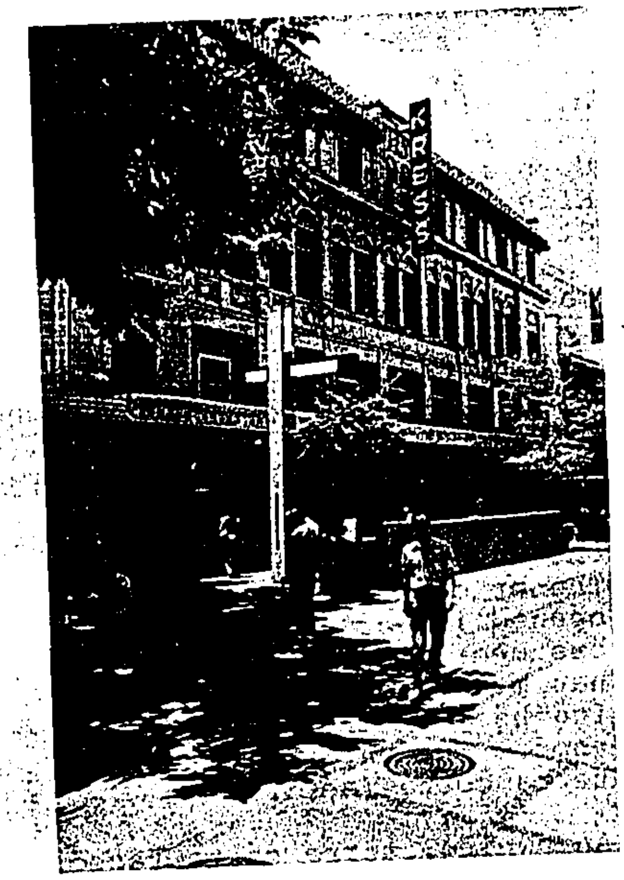
### a. Description and Significance of Affected Property

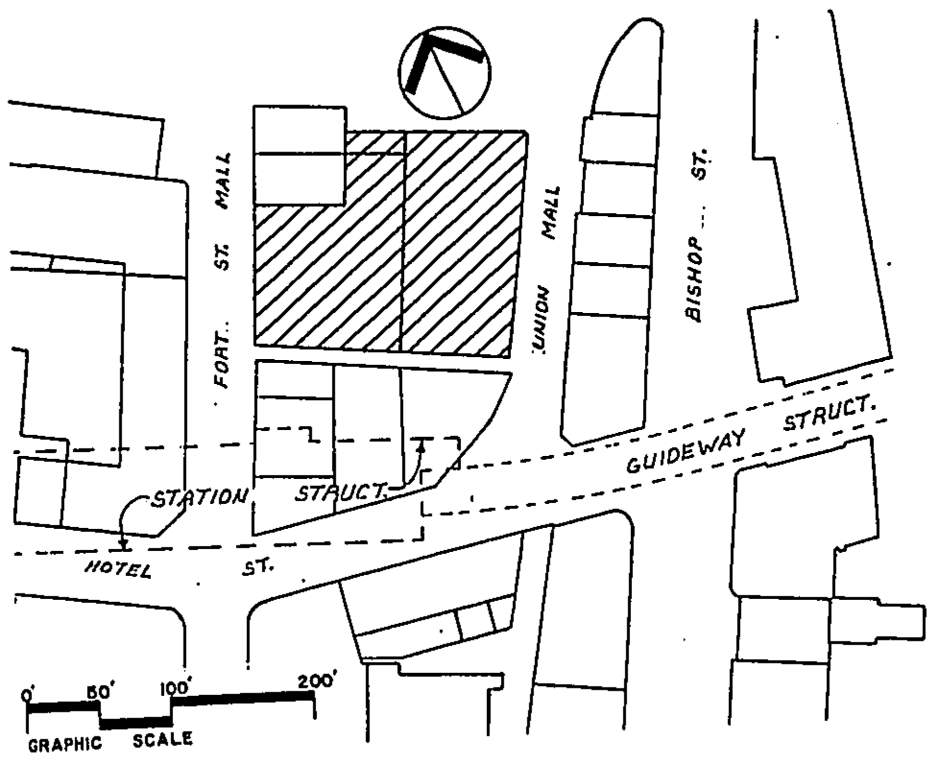
The S.H. Kress Company Building was determined eligible by the Keeper of the National Register on January 24, 1979. The original section of the building was built in 1930 and opened in early 1931. It was two stories tall with a full basement; the first floor having a very high ceiling. It has modern glass storefronts with marble bases. The building has a steel frame structure with concrete floors and roof. The entire facade on Fort Street was covered with terra cotta (see Figure VI-23).

An awning, terra cotta faced, runs the length of the Fort Street elevation. Above the awning are large metal frame projected windows with multiple lights. These windows are separated by flat pilasters atop of which there is a frieze with the S.H. Kress & Company sign. The second floor windows are 4/4 double hung set in round arched pairs between pilasters. The second floor windows at the sides of the east elevation have small metal railed balconies. A bracketed cornice sits atop the pilasters.

The store was such a financial success that plans for additions were being made less than one year later. About 1932 a partial third floor with a clay tile mansard roof was added to the Fort Street side of the building. In October 1935 a large addition to Kress was opened. It stood on the site of the former Walter's Building and extended the store to Union Mall. This addition is two stories tall and like all the exteriors, terra cotta faced.

The building is an early example of the 5, 10 and 25 cent store; a forerunner of the modern department store. It is also an excellent example of corporate commercial architecture. It is one of the few completely terra-cotta faced buildings in the City and County of Honolulu and, with the Alexander & Baldwin Building, the largest terra-cotta building in the State of Hawaii.




**S. H. KRESS BLDG.**

FIGURE VI-23

Its detail and size make it a visually strong building on Fort Street Mall. It is one of the largest retail outlets on Fort Street Mall and serves as one of the retail anchors for the Mall.

b. Inapplicability of the Criteria of Adverse Effect

Through downtown Honolulu, where the S.H. Kress Company Building is located, the proposed fixed guideway system would be placed underground with the alignment following Hotel Street. The alignment has been established to fit the guideway structure within the existing public right-of-way as much as possible to minimize conflicts with existing properties. The underground placement of the guideway eliminates most of the serious environmental impacts associated with the aerial guideway configuration. However, even underground facilities could potentially affect adjoining properties due to construction activities and operation of the system.

The construction of underground facilities on Hotel Street would be done by the cut-and-cover method, i.e., open trench excavation performed from the ground surface. The subway structure will be approximately 34 feet wide and 20 feet high with the excavation depth varying from 30 feet to 40 feet. The station structure would be approximately 600 feet long and 70 feet wide. In performing the excavation and its related work, the adjacent buildings and structures can be adequately protected during construction to prevent any deterioration or destruction of the property. Upon applying the criteria of adverse effect, the proposed action is found to have no adverse effect on the S. H. Kress Building.

The station area requires space for entrance facilities with sufficient back-up area to accommodate the large number of expected transit users. Consequently, some existing buildings will be removed to provide the necessary space which could alter the existing environment of the area. In applying the criteria of adverse effect, the proposed action is found to have no adverse effect by taking appropriate mitigative measures to soften any adverse visual impacts.

c. Coordination and Consultation with the State Historic Preservation Officer

The opinion of the State Historic Preservation Officer regarding the effect of the proposed action on the S. H. Kress Building is contained in the attached Memorandum of Agreement. The State Historic Preservation Officer has agreed to certain design and construction considerations to satisfactorily mitigate the impact of the rapid transit system on the Kress Building.

d. Determination of Effect

Upon applying the Criteria of Effect and Criteria of Adverse Effect (36 CFR, Section 800.3), and in consultation with the State Historic Preservation Officer, UMTA has determined that the proposed action will have "no adverse effect" on the aforementioned historic property.

B.8. The Advertiser Building

a. Description and Significance of Affected Property

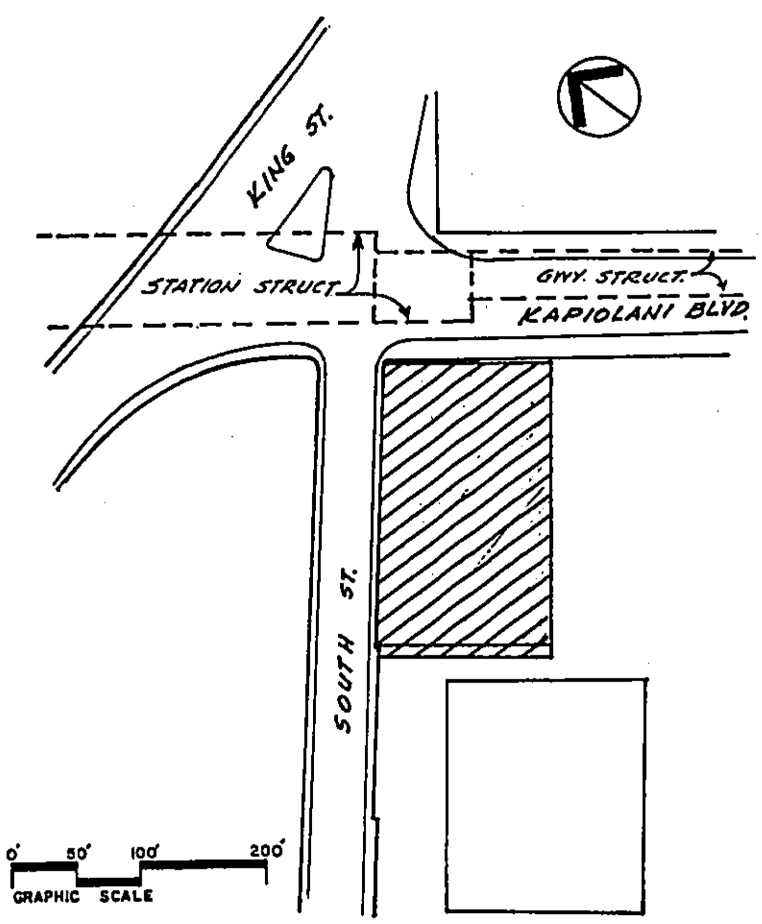
The Advertiser Building has been determined to be eligible by the Keeper of the National Register on January 24, 1979. The original Advertiser Building was built in 1930 of stuccoed concrete. It is three stories tall with a red clay tile hip and valley roof. It was originally built in an "L" shape with its two legs of seven bays each facing South Street and Kapiolani Boulevard. The legs are three bays deep (see Figure VI-24).

The building has some Renaissance Revival influences notably in its three central bays on Kapiolani Boulevard. A tile stair with curved railings sweeping its four risers leads to the entry which is flanked by two-story, square-fluted pilasters with Ionic Capitals. Above the first floor metal framed entry door is a round arched window opening.

All window openings are fitted with multi-pane industrial type windows with a fixed bottom and top row of lights with awning windows between. The window openings are large and well proportioned. Above the second floor windows is a simple entablature with a modest dentilled cornice. The third floor window openings are not as high and each structural bay is divided in two by a thin classic column behind which is the true structural column.

With the exception of the entry, the interiors have been altered extensively. The large entry has a quarry tile floor with a pair of tiled stairs with concrete rail and balusters which flank a semi-elliptical arched opening to a wood parquet floored art gallery. The stairs join above that opening at the second floor and continue to the third in one straight flight of steps.

The entry has octagonal columns which are capped with a Hawaiian version of a Corinthian column capital; complete with stylized acanthus leaves and pineapples. Girders and beams at the entry ceiling are decorated with a painted pattern which is very geometric and appears almost American Indian influenced except for the fact that the diamond shaped decorations incorporate stylized poi pounders and feathered capes.




**ADVERTISER BLDG.**

**FIGURE VI -24**

Major additions have been made to the back of the building, especially a very large addition in 1956.

The building is the corporate symbol of the Advertiser, the oldest newspaper still being published in Hawaii, started in 1856. The Advertiser introduced many modern printing techniques to Hawaii and when constructed had a fully modern printing plant, radio station and newspaper operation.

The building is in a visually prominent location at the intersection of the major thoroughfares of King Street and Kapiolani Boulevard. It is visually connected to the capital district and its scale and detailing are important to that corner of the district. The exterior and entry are in superbly maintained and virtually unaltered condition. Many alterations were made to the interiors of the newspaper complex in the late 1960's and early 1970's.

b. Inapplicability of the Criteria of Adverse Effect

Through downtown Honolulu the proposed fixed guideway system would be placed underground with the alignment following Hotel Street and Kapiolani Boulevard for a short distance. The alignment has been established to fit the guideway structure within the existing public right-of-way as much as possible to minimize conflicts with existing properties. The underground placement of the guideway eliminates most of the serious environmental impacts associated with the aerial guideway configuration. However, even underground facilities could potentially affect adjoining properties due to construction activities and operation of the system.

The construction of underground facilities on Hotel Street would be done by the cut-and-cover method, i.e., open trench excavation performed from the ground surface. The subway structure would be approximately 34 feet wide and 20 feet high with the excavation depth varying from 30 feet to 40 feet. The Civic Center Station would be approximately 600 feet long including the ventilation structures and 70 feet wide. The Kapiolani Boulevard right-of-way width is 100 feet which is adequate to accommodate the underground transit facilities. In performing the excavation and its related work, the adjacent buildings and structures can be adequately protected during construction to prevent any deterioration or destruction of the property. Upon applying the criteria of adverse effect, the proposed action is found to have no adverse effect on the Advertiser Building.

The operation of an underground transit system produces ground-borne noise and vibration in adjacent buildings. Usually the vibration levels are below the threshold of perception to mechanical motion but the vibration transmitted to a building structure could generate a low pitched rumbling noise that is audible. There would also be airborne noise emanating from the fan and vent shaft openings located at the ends of the Civic Center Station. In applying the criteria of adverse effect, the proposed action is found to have no adverse effect by taking appropriate mitigative measures to reduce ground vibration and airborne noise.

c. Coordination and Consultation with the State Historic Preservation Officer

The opinion of the State Historic Preservation Officer regarding the effect of the proposed action on the Advertiser Building is contained in the attached Memorandum of Agreement. The State Historic Preservation Officer has agreed to certain design and construction considerations to satisfactorily mitigate the impact of the rapid transit system on the Advertiser Building.

d. Determination of Effect

Upon applying the Criteria of Effect and Criteria of Adverse Effect (36 CFR, Section 800.3), and in consultation with the State Historic Preservation Officer, UMTA has determined that the proposed action will have "no adverse effect" on the aforementioned historic property.

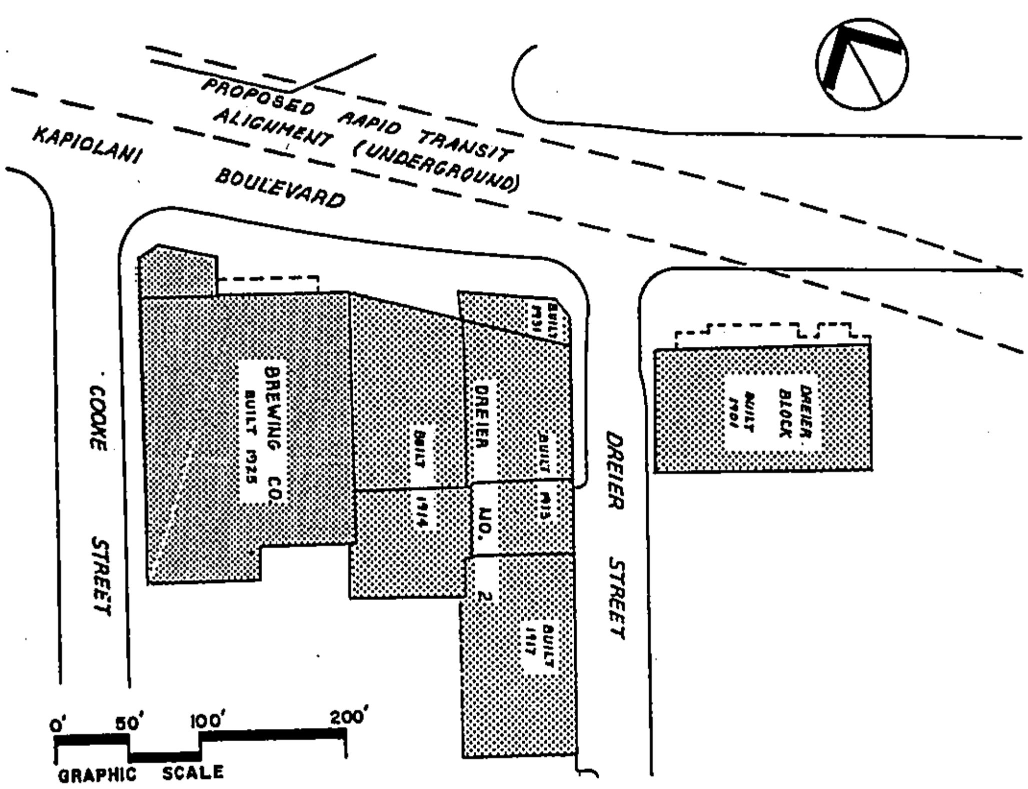
B.9. Oahu Ice and Cold Storage Company Building

a. Description and Significance of Affected Property

The Oahu Ice and Cold Storage Company Building has been determined eligible by the Keeper of the National Register on January 24, 1979. The first of these three buildings was Dreier Block. Built in 1901, it is stuccoed masonry with three bays. Each bay is marked by a stepped parapet on the Kapiolani Boulevard and south sides which hide the three trussed split gables behind. The building is metal roofed. Each stepped parapet is punctured by a round, louvered attic vent. The building was used for cold storage and ice manufacturing (see Figure VI-25).

In 1913 the first portions of Dreier No. 2 were opened and the total capacity of the Oahu Ice and Electric Company, as it was then called, was increased to 65 tons of ice and 100,000 cubic feet of storage space. This section, and the additions to it made in 1914, 1917, and 1919 were all of stuccoed masonry and 1 1/2 stories in height. In 1931, shortly after Hustace Street was widened and became Kapiolani Boulevard, a small two-story office wing with plate glass windows was added.

In 1920 the name of the firm was changed to Oahu Ice and Cold Storage Company. About 1925 a large three-story reinforced concrete addition, designed by Gardner and Lindberg of Chicago, was added adjacent to Dreier No. 2. A fourth




**OAHU ICE & COLD STORAGE BLDGS.**

FIGURE VI – 25

floor was added to the building and opened in 1942. This building has vertical, flat unadorned pilasters with flat recessed panels. The perimeter of the building has a parapet with two openings per structural bay.

By 1933 the Oahu Ice and Cold Storage Company was owned by the Hawaii Brewing Corporation. By 1934, with its new buildings to the south side of the Brewing Company building, it was producing Primo Beer. The entire brewing complex, consisting of buildings on the east side of Cooke Street and west of Dreier No. 2, was owned by the Hawaii Brewing Corporation until 1962. In the late '60's and '70's numerous remodelings, largely of the interiors, were done to turn the building into a retail and office complex.

Before artificial refrigeration was introduced, ice was obtained from the rivers of Maine, stored in sawdust, and shipped around the Horn. For any significant quantities of meat, poultry, fruits or vegetables to be imported, dependable cold storage space was essential. The company of August Dreier, Ltd. filled that need and grew as the city and its imports grew. It was integral in the building of our import-dependent foodstuffs market.

Dreier No. 2 was the most significant of the three main buildings. It is large, was in use as an ice and cold storage plant the longest and clearly shows its growth as an expression of its architecture. The Dreier Block was the first of the cold storage buildings but by 1927 it was used for auto work and general storage. The Brewing Company building was the latest and largest addition.

These buildings are examples of early 20th century industrial buildings. The 30-year spread of construction shows some changes in style and materials of construction of this building type. The exteriors have changed very little but the interiors of the Dreier Block and Brewing Company sections are heavily altered while Dreier No. 2 is relatively unaltered on the interior.

b. Inapplicability of the Criteria of Adverse Effect

Through downtown Honolulu the proposed fixed guideway system would be placed underground with the alignment following Hotel Street and Kapiolani Boulevard for a short distance before it turns off into private properties where the portal is located. The alignment has been established to fit the guideway structure within the existing public right-of-way as much as possible to minimize conflicts with existing properties. The underground placement of the guideway eliminates most of the serious environmental impacts associated with the aerial guideway configuration. However, even underground facilities could potentially affect adjoining properties due to construction activities and operation of the system.

The construction of underground facilities in Kapiolani Boulevard would be done by the cut-and-cover method, i.e., open trench excavation performed from the ground surface. The subway structure would be approximately 34 feet wide and 20 feet high with the excavation depth varying from 30 feet to 40 feet. With a 100-foot right-of-way width, the clearance between the excavation and the nearest building is approximately 20 feet. In performing the excavation and its related work, the adjacent buildings and structures can be adequately protected during construction to prevent any deterioration or destruction of the property. Upon applying the criteria of adverse effect, the proposed action is found to have no adverse effect on the Oahu Ice and Cold Storage Company Building.

The operation of an underground transit system produces ground-borne noise and vibration in adjacent buildings. Usually the vibration levels are below the threshold of perception to mechanical motion but the vibration transmitted to a building structure could generate a low pitched rumbling noise that is audible. In applying the criteria of adverse effect, the proposed action is found to have no adverse effect by taking appropriate mitigative measures to reduce ground vibration.

c. Coordination and Consultation with the State Historic Preservation Officer

The opinion of the State Historic Preservation Officer regarding the effect of the proposed action on the Oahu Ice and Cold Storage Company Building is contained in the attached Memorandum of Agreement. The State Historic Preservation Officer has agreed to certain design and construction considerations to satisfactorily mitigate the impact of the rapid transit system on the Oahu Ice and Cold Storage Building.

d. Determination of Effect

Upon applying the Criteria of Effect and Criteria of Adverse Effect (36 CFR, Section 800.3), and in consultation with the State Historic Preservation Officer, UMTA has determined that the proposed action will have "no adverse effect" on the aforementioned historic property.

B.10. Otani Block

a. Description and Significance of Affected Property

The Otani Block has been determined eligible by the Keeper of the National Register on January 24, 1979. The Otani Block comprises the main, block-long building on King Street and the "extension" on Iwilei Road. They are brick structures with the street facades of the King Street building arcade which runs the entire perimeter of the building. The continuous arcade is capped by a projected band at the parapet. The archway springers are emphasized by a similar projected band. The bases of the arch columns are projected. The arcade floor is composed of brick set in a herringbone pattern. The flat plaster ceiling is broken at the arch columns by an exposed wood beam which is "supported" at its ends by small conical corbels. The arcade has been blocked up at the west end and six arches down on the north and south sides (see Figure VI-27).

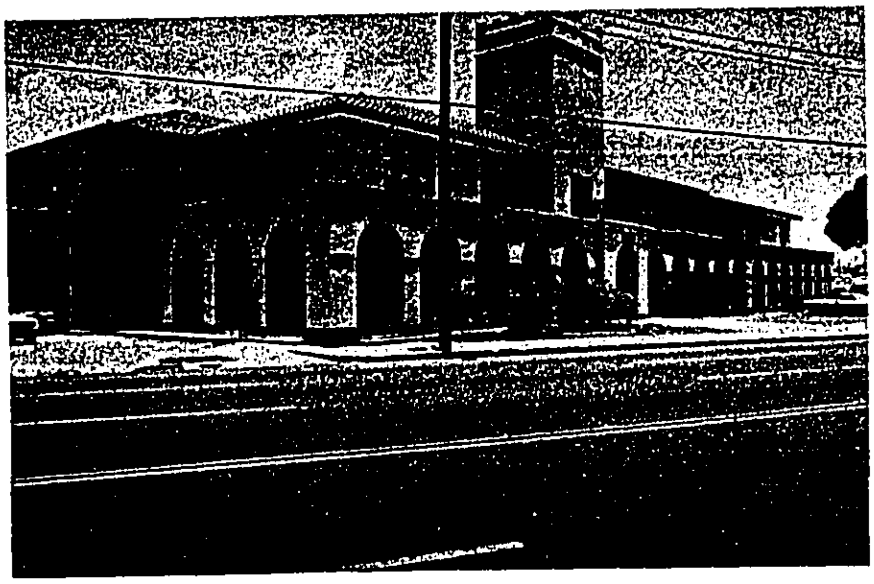
At the east end of the terminal is a porte cochere and prominent on the north side of the building is a four-sided clock tower with a crenellated parapet. Its intersecting hip roof is covered with red clay tile which overhangs the second floor wall line by about three feet. Soffits are plastered. Windows are wood framed 1/1 light double hung, usually grouped in pairs or threes.

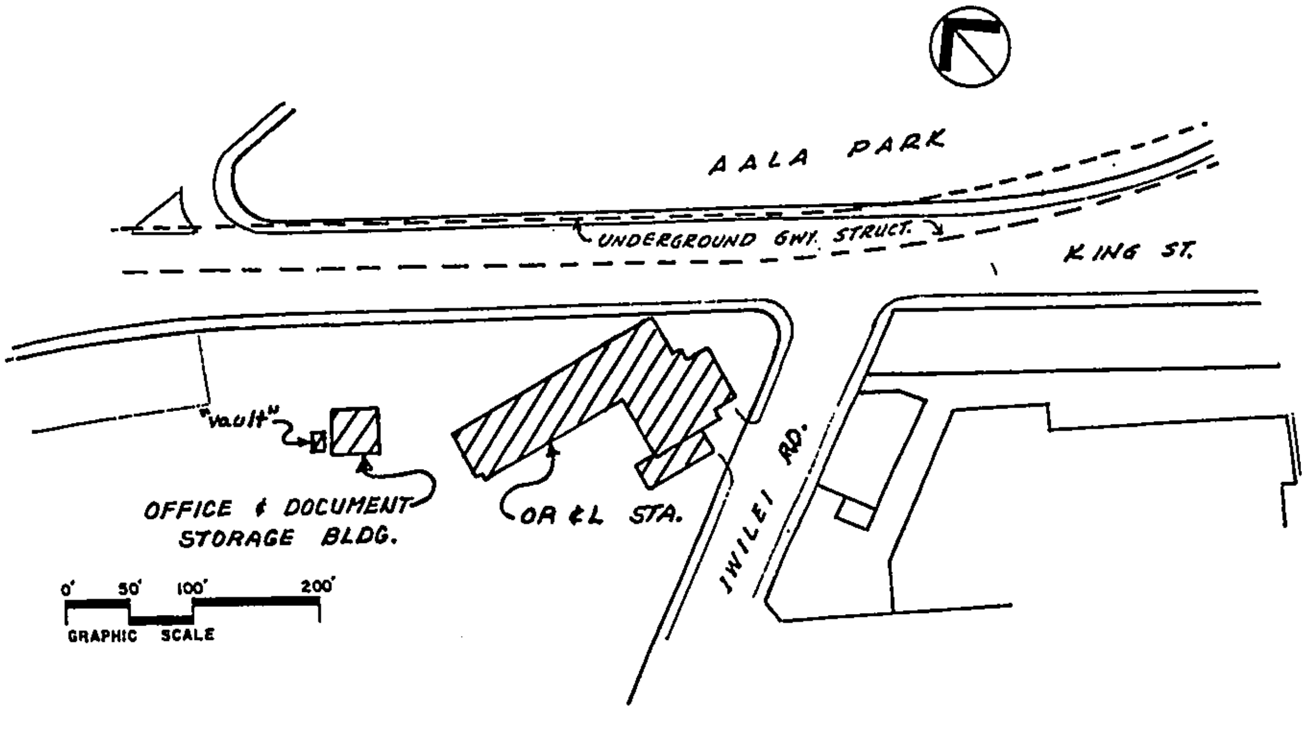
The Office & Document Storage Building was built in 1914 of reinforced concrete. It is of a stark Georgian Revival style with a heavy cornice on three sides and heavy pediment gable end on the gable end over the entry on the east side. The rear gable end is unadorned; the cornice extends about one foot beyond the end wall and stops; there is no pediment. The raking cornice and horizontal cornice of the front pediment are deep and strongly simple. The tympanum is flat and unadorned.

The second floor was originally used for offices. On the east and north faces are a series of regularly spaced windows now covered with awnings and filled with glass jalousies. The south wall has three openings; a small two light awning window toward the rear (west) side; a single jalousie window and a jalousie window door pair. The door leads to the top of a concrete bracket supported ledge.

The front entry is reached by walking up three concrete steps and through a doorway flanked by two pilasters with enlarged bases, the tops of which align with the top of a three-foot high water table which runs around the north, east and south side of the building. The pilasters are topped with a heavy pediment, the cornices of which are so heavy as to leave only a very small tympanum. To the right of the entry door in the small foyer is a straight flight of stairs which leads to the second floor.

Sometime between 1919 and 1927 (based on Fire Maps) a small building, labeled as a "vault" on the maps, was installed. It is separated from the Office & Documents Building by about 2 1/2 feet and is constructed of reinforced concrete poured with rough board formwork. The openings are small slit vents and on the south side, a boarded up doorway.






**OR & L STATION**

**FIGURE VI - 27**

b. Inapplicability of the Criteria of Adverse Effect

From the west portal located in Dillingham Boulevard, the alignment curves into King Street and then enters Hotel Street, all in an underground configuration. The alignment has been established to fit the guideway structure within the existing public right-of-way as much as possible to minimize conflicts with existing developed properties. The underground placement of the guideway facilities generally eliminates most of the serious environmental impacts associated with the aerial guideway configuration. However, even underground construction could potentially affect adjoining properties due to construction activities and operation of the system.

The construction of underground facilities on King Street would be done by the cut-and-cover method, i.e., open trench excavation performed from ground surface. The subway structure would be approximately 34 feet wide and 20 feet high with the excavation depth varying from 30 feet to 40 feet. With a 70-foot right-of-way and the subway structure occupying approximately 34 feet of it and located near the park, some 40 feet exists between the subway structure and the building. In performing the excavation and its related work, the adjacent buildings and structures can be adequately protected during construction to prevent any deterioration or destruction of the property. Upon applying the criteria of adverse effect, the proposed action is found to have no adverse effect on the OR & L Station and Office and Document Storage Building.

c. Coordination and Consultation with the State Historic Preservation Officer

The opinion of the State Historic Preservation Officer regarding the effect of the proposed action on the OR & L Station and Office Document Storage Building is contained in the attached Memorandum of Agreement. The State Historic Preservation Officer has agreed to certain design and construction considerations to satisfactorily mitigate the impact of the rapid transit system on the OR & L Station Buildings.

d. Determination of Effect

Upon applying the Criteria of Effect and Criteria of Adverse Effect (36 CFR, Section 800.3), and in consultation with the State Historic Preservation Officer, UMTA has determined that the proposed action will have "no adverse effect" on the aforementioned historic property.

## B.11. The Tong Fat Company Building

### a. Description and Significance of Affected Property

The Tong Fat Company Building has been determined eligible for inclusion into the National Register. It is a two-story building with its parapet declaring that name at mid-block of this 198-foot long building. Its second floor has a series of evenly spaced wood 1/1 double hung windows. Window heads and jambs are flat and the sills project very slightly (see Figure VI-28).

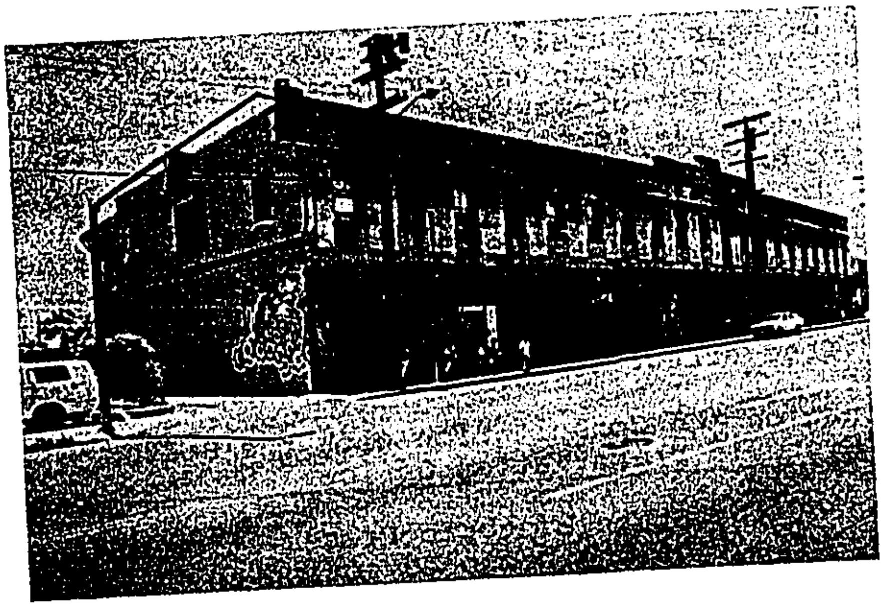
Above the windows, on the King Street elevation only, runs a continuous and very modest cornice. The building face above the cornice has a total of 10 small rectangular vent openings, the Tong Fat Company sign in relief, and a projected rectangular plaster shape. The parapet is capped and straight except for two steps it takes to emphasize and allow room for the Tong Fat sign at the middle of the King Street facade.

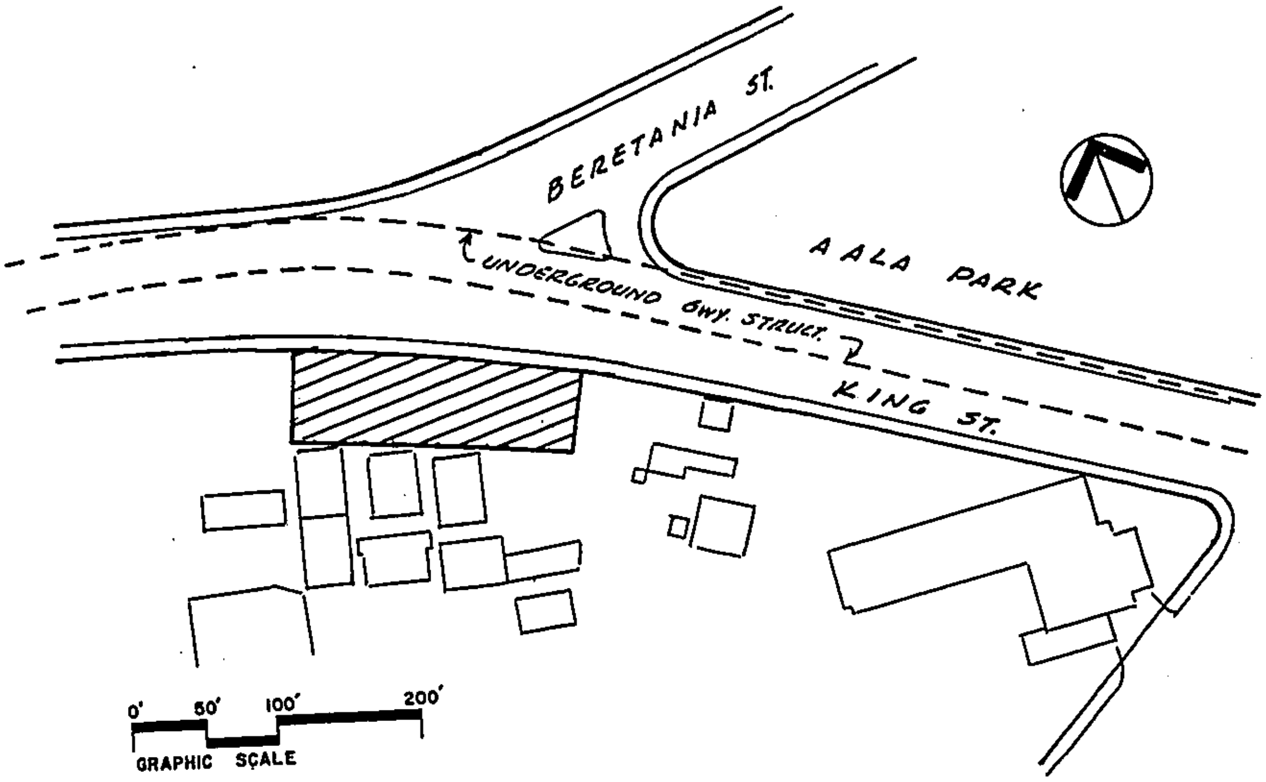
Separating the first from the second floor is an awning replaced in 1951. The first floor consists of a variety of materials at present. The basic storefront modulation has been retained, but glass has been replaced by wood, concrete block and signs in different forms, textures and colors. The storefronts usually have a single door and are spaced about 20 feet on center. Just below the awning is a continuous band of ventilating windows broken only by the columns at 20 feet on center. The back of the building has a full length corridor at the second floor to which all living units have access.

The Tong Fat Building, taken as a part of the group including the OR & L Station, contributes enormously to the ambiance of the neighborhood. Architecturally the structures create a significant and readily recognized commercial complex which centers around the OR & L depot. The structures provide a uniform and harmonious backdrop for Aala Park.

### b. Inapplicability of the Criteria of Adverse Effect

From the west portal located on Dillingham Boulevard, the alignment curves into King Street and then enters Hotel Street, all in an underground configuration. The alignment has been established to fit the guideway structure within the existing public right-of-way as much as possible to minimize conflicts with existing developed properties. The underground placement of the guideway facilities generally eliminates most of the serious environmental impacts associated with the aerial guideway configuration. However, even underground construction could potentially affect adjoining properties due to construction activities and operation of the system.






TONG FAT CO. BLDG.

FIGURE VI - 28

The construction of underground facilities on King Street would be done by the cut-and-cover method, i.e., open trench excavation performed from ground surface. The subway structure would be approximately 34 feet wide and 20 feet high with the excavation depth varying from 30 feet to 40 feet. With a 70-foot right-of-way and the subway structure occupying approximately 34 feet of it and located near the park, some 40 feet exists between the subway structure and the building. In performing the excavation and its related work, the adjacent buildings and structures can be adequately protected during construction to prevent any deterioration or destruction of the property. Upon applying the criteria of adverse effect, the proposed action is found to have no adverse effect on the Tong Fat Company Building.

c. Coordination and Consultation with the State Historic Preservation Officer

The opinion of the State Historic Preservation Officer regarding the effect of the proposed action on the Tong Fat Company Building is contained in the attached Memorandum of Agreement. The State Historic Preservation Officer has agreed to certain design and construction considerations to satisfactorily mitigate the impact of the rapid transit system on the Tong Fat Building.

d. Determination of Effect

Upon applying the Criteria of Effect and Criteria of Adverse Effect (36 CFR, Section 800.3), and in consultation with the State Historic Preservation Officer, UMTA has determined that the proposed action will have "no adverse effect" on the aforementioned historic property.

B.12. The Ala Wai Park Clubhouse

a. Description and Significance of Affected Property

The Ala Wai Clubhouse has been determined eligible for inclusion into the National Register. It is situated on a 3.5-acre parcel, which was the first developed section of Ala Wai park. It was constructed in 1937 as a clubhouse for the rowing clubs. During the Second World War, it was used by the Navy as an officers' club. In 1951 the Navy turned the property over to the City and County Parks Department, which converted the structure into a community clubhouse. Between 1965 and 1968, Kapiolani College occupied the building as a food preparation school.

A rock wall encloses the park on the street sides. The wall dates from 1937, although the McCully Street side was rebuilt in the 1960's following a road widening. A hipped roof comfort station of modern, hollow tile construction is located east of the clubhouse parking area, but does not detract from the building or its setting (see Figure VI-29).

The Clubhouse structure is a one-story, painted brick building with a cedar shake shingle hipped roof. The low pitched roof with its overhanging eaves and exposed rafters, dominates the structure. The pavilion (U) shaped building faces the Ala Wai Canal and features a large central open space which may be used as a ballroom. This area is completely open on the south side and flows into a lanai (patio- courtyard). A three-foot high iron balustrade separates the open space from the lanai. The lanai is partially roofed with corrugated iron on the north side and the east wing. A scallop shaped brick wall separates the lanai from the canoe landing area.

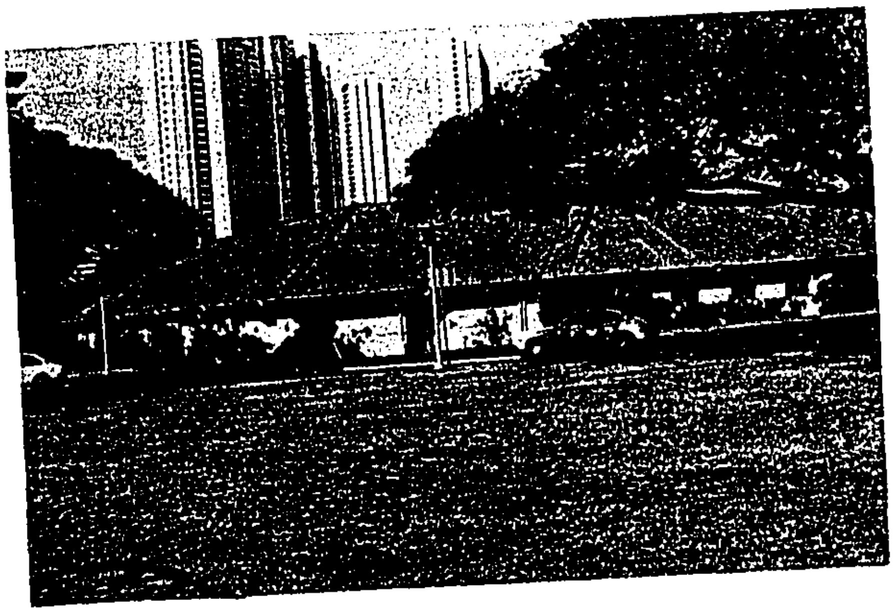
The two wings are enclosed and contain office, storage and kitchen spaces. Hallways bisect the wings and provide access to the open center space from the surrounding paved parking lots. The only addition is a kitchen built by the Navy during World War II on the northwest side. It is in keeping with the scale and style of the original structure.

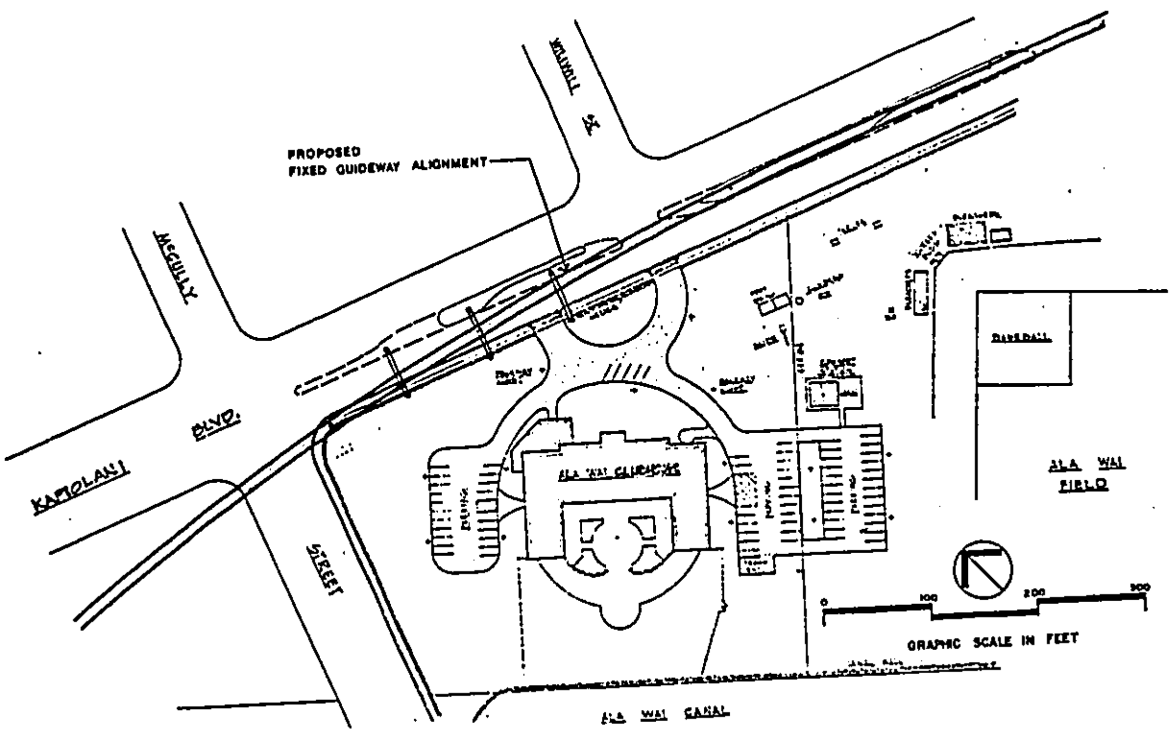
The building has strong associations with rowing, the history of which goes far back into island tradition. The sport was in imminent danger of dying out but with the construction of a clubhouse, an immediate revival of interest in the sport was felt. The building is important to the community as a center for rowing activities on the Ala Wai Canal. The building further functions as a setting for such social gatherings as private parties, receptions, etc. Although not 50 years old, the building is representative of park commission architecture of the period and one of the major buildings erected by this commission in the thirties.

b. Inapplicability of the Criteria of Adverse Effect

The proposed guideway alignment which just clips the northwest corner of Ala Wai Park is included in the segment of the proposed fixed guideway system referred to throughout the rapid transit planning, engineering and environmental studies as the Moiliili-University Segment. This segment follows Kapiolani Boulevard and University Avenue and enters the southern portion of the University of Hawaii campus (see Figure IV-8).

In order to enter the median of Kapiolani Boulevard from the proposed Waikiki Station, the proposed alignment crosses McCully Street and traverses over a very small portion of the northwest corner of Ala Wai Park (see Figure VI-8). An easement of some 1,000 sq. ft. and the permanent use of some 75 sq. ft. are required for the four columns supporting the






**ALA WAI CLUBHOUSE**

**FIGURE VI -29**

guideway. No additional easement or property acquisition will be necessary since the column structures are located along the northern perimeter of the park adjacent to Kapiolani Boulevard. Approximately three supporting bent structures and one single column would be required to support the guideway as it passes over the edge of Ala Wai Park. Each of the bent structures would have a column in park property, while the single column would be located in the sidewalk area of Kapiolani Boulevard, outside of park property. In order to construct these four support columns with their foundations, the existing lava rock wall would have to be temporarily removed and then reconstructed to its original condition after construction is completed.

The guideway structure is located approximately 150 feet, on the average, from the clubhouse structure and there is a row of trees that would screen the guideway from the clubhouse. It is recognized that an aerial guideway system would have some impact on the area traversed, the degree of impact dependent on the type of character of the development existing in the area. Also the proximity of the structure to the guideway would influence the degree of impact. The actual appearance of the Clubhouse would not be altered. Perception of the building would be affected from some angles due to the proposed columns. The existing trees are currently obstructing some view angles so that the introduction of these columns will not result in a major impact to the property.

c. Coordination and Consultation with the State Historic Preservation Officer

The opinion of the State Historic Preservation Officer regarding the effect of the proposed action on the Ala Wai Park Clubhouse is contained in the attached Memorandum of Agreement. The State Historic Preservation Officer has agreed to certain design and construction considerations to satisfactorily mitigate the impact of the rapid transit system on the Ala Wai Park Clubhouse.

d. Determination of Effect

Upon applying the Criteria of Effect and Criteria of Adverse Effect (36 CFR, Section 800.3), and in consultation with the State Historic Preservation Officer, UMTA has determined that the proposed action will have "no adverse effect" on the aforementioned historic property.

B.13. Oahu Prison Administration Building

a. Description and Significance of Affected Property

The Oahu Prison Administration Building has been determined eligible for inclusion into the National Register. The prison walls, dormitory, laundry, auditorium and administration building were all built in 1917, according to tax records. The administration building, which fronts Dillingham Boulevard is of primary concern here. It is a starkly simple building which shows Classical Revival influences (see Figure VI-30).

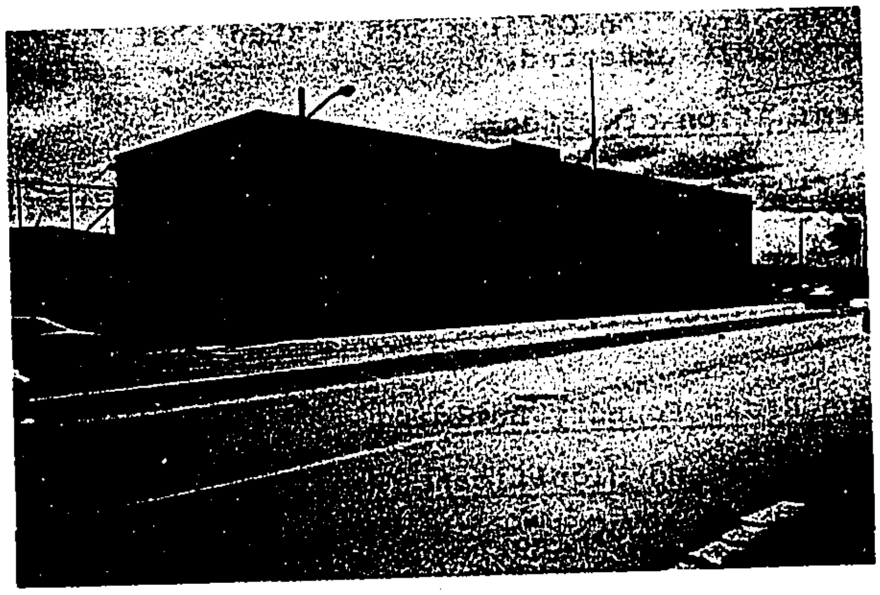
Its long facade, along Dillingham Boulevard, is divided into regular bays by pilasters. Within each bay of the two-story building is a large window at the first floor and a small, almost square window at the second. All windows are barred and covered with expanded metal lath. The center bay has a larger and decoratively barred window at the second floor and a door opening at the first floor. The door opening has two pilasters on either side topped by a cornice. A series of six steps rise to the door from the sidewalk below.

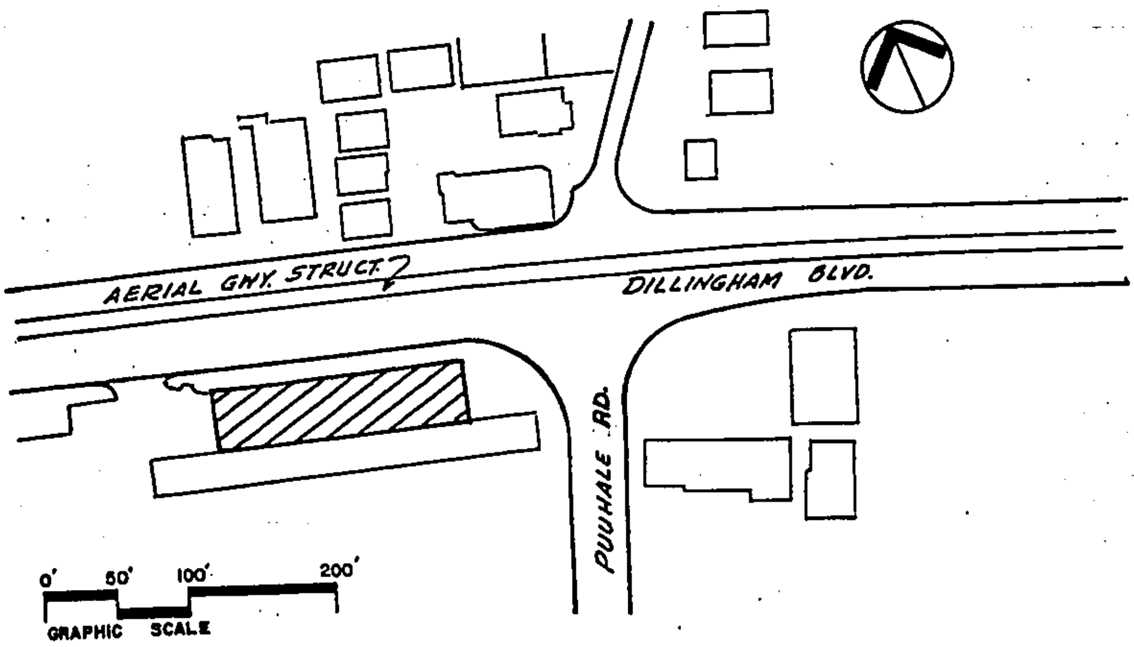
The formal treatment of the exterior is further expressed by the water table base upon which sit the pilaster "columns". The pilasters end at a simple cornice which runs the entire perimeter of the building, and above which is a simple parapet. A single flagpole rises above the center bay. The entire building is of reinforced concrete painted a light green.

This structure is significant as an example of turn of the century prison architecture. When constructed in 1917 it was considered to be a icon of the evolving conception of prisons as humane institutions. The Neo-classical revival style, of which this structure is a modest example, became the preferred style, replacing of the formerly popular Gothic revival style with associations with dark, dank dungeons. The structure gains further significance as an example of the work of Ripley & Davis, one of the more prominent firms operating in Honolulu during this period.

b. Inapplicability of the Criteria of Adverse Effect

Through the Kalihi area, the proposed fixed guideway system is supported on aerial structures and located in the center of Dillingham Boulevard. Dillingham Boulevard is a major arterial carrying a high volume of vehicular traffic with a high percentage of trucks. The development along this arterial is primarily industrial with a sprinkling of residential dwellings in the vicinity of the Oahu State Prison. It is recognized that an aerial guideway system would have some impact on the area it traverses, but upon applying the criteria of adverse effect, the proposed action is considered to have no adverse effect on the Oahu Prison Administration Building.






OAHU PRISON ADMIN. BLDG.
FIGURE VI -30

c. Coordination and Consultation with the State Historic Preservation Officer

In the attached letter dated February 22, 1980, the State Historic Preservation Officer has stated that this property is not adversely affected.

d. Determination of Effect

Upon applying the Criteria of Effect and Criteria of Adverse Effect (36 CFR, Section 800.3), and in consultation with the State Historic Preservation Officer, UMTA has determined that the proposed action will have "no adverse effect" on the aforementioned historic property.

B.14. The Brass Foundry Building

a. Description and Significance of Affected Property

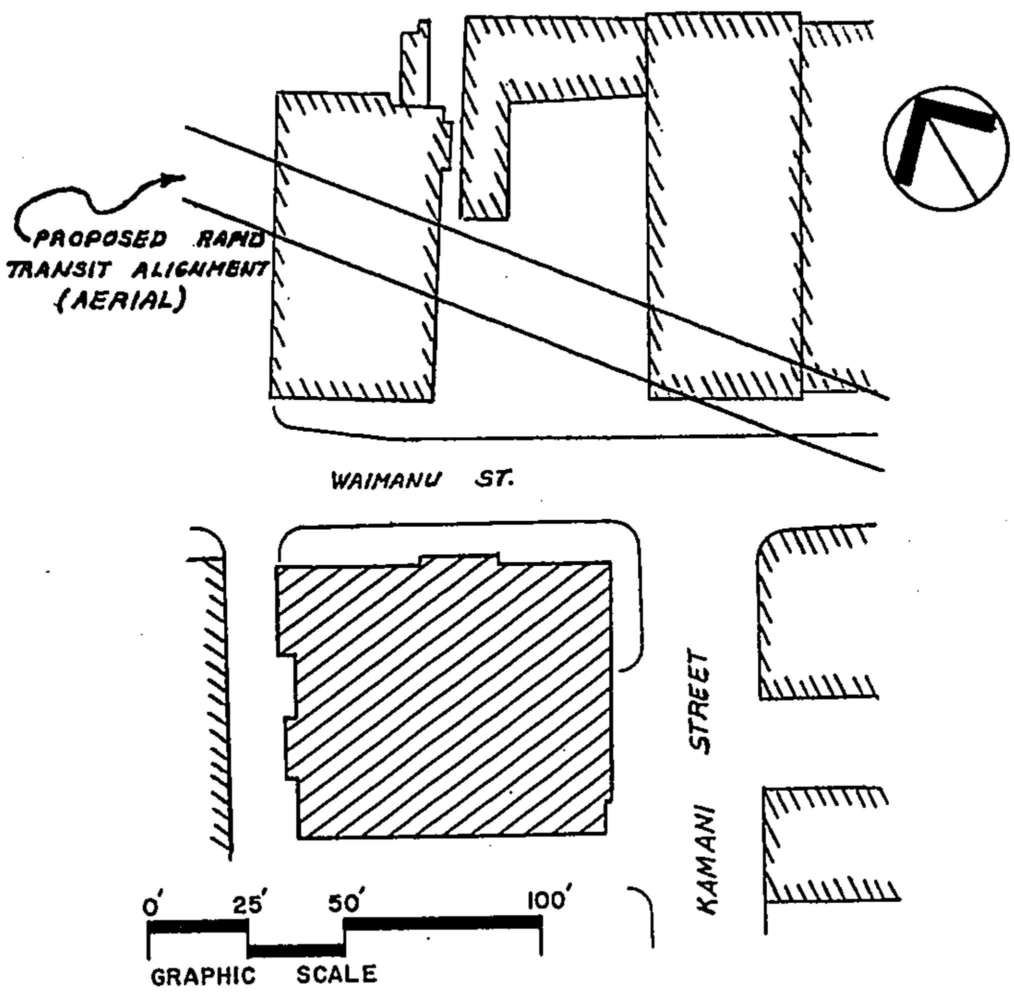
The Brass Foundry Building has been determined eligible by the Keeper of the National Register on January 24, 1979. It is a steel framed building with a high split gable roof over one floor with a mezzanine at its southeasterly side. Its roof and walls are corrugated steel. Windows are fixed and awning metal sash industrial types. The floor at grade is brick set on earth (see Figure VI-31).

The building is set back about 10 feet on both street facades. It is also free standing from its industrial and warehouse neighbors. There is an iron exhaust stack near the east corner which is part of an old smelter below.

Original equipment of the Foundry is still present on the site. The small gantry crane still hangs over the main space. Equipment includes winches, wooden casting patterns, casting equipment, and other foundry equipment of unidentified uses.

The Foundry was the first building in that block and typical of the small industrial use which, in conjunction with housing, that the area has been used for in the 20th century. Important in historical significance is the fact that much of the original equipment is still scattered around the site. It will be an illustration of a small foundry operation and a light industrial operation which seems to be integral with Kakaako's history.

The building itself is not distinctive architecturally. It is a typical small industrial building of which there are few of its age and which are as intact.




BRASS FOUNDRY BLDG.
FIGURE VI -31

b. Inapplicability of the Criteria of Adverse Effect

The proposed fixed guideway system traverses this area on aerial structures and crosses Waimanu Street on a diagonal near Kamani Street which is adjacent to the Brass Foundry Building. As part of the Kakaako area, the land use is light industrial made up of old warehouse buildings of varying size and shape. The streets are narrow and disorderly and frequently used by trucks servicing the various industries.

It is recognized that an aerial guideway system would have some impact on the area that it traverses, but upon applying the criteria of adverse effect, the proposed action is considered to have no adverse effect on the Brass Foundry Building.

c. Coordination and Consultation with the State Historic Preservation Officer

In the attached letter dated February 22, 1980, the State Historic Preservation Officer has stated that this property is not adversely affected.

d. Determination of Effect

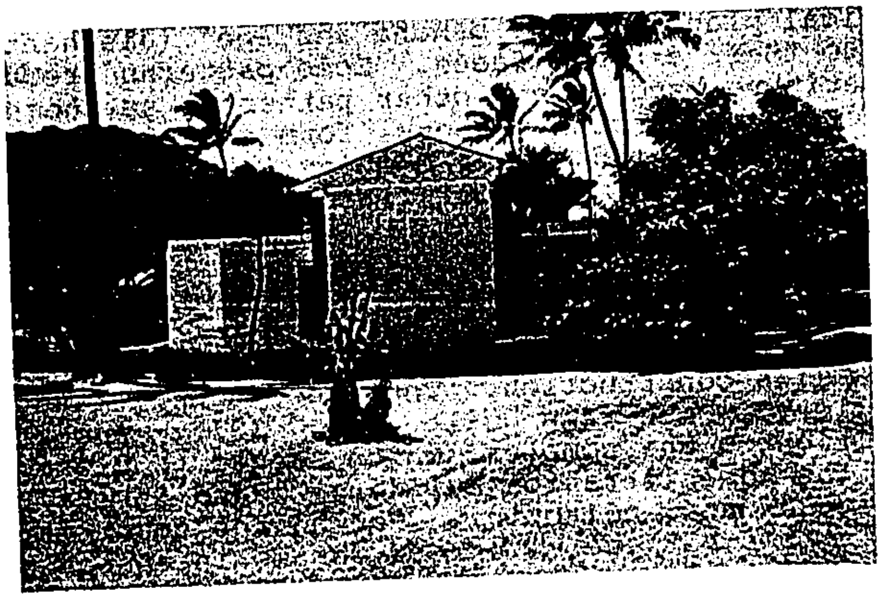
Upon applying the Criteria of Effect and Criteria of Adverse Effect (36 CFR, Section 800.3), and in consultation with the State Historic Preservation Officer, UMTA has determined that the proposed action will have "no adverse effect" on the aforementioned historic property.

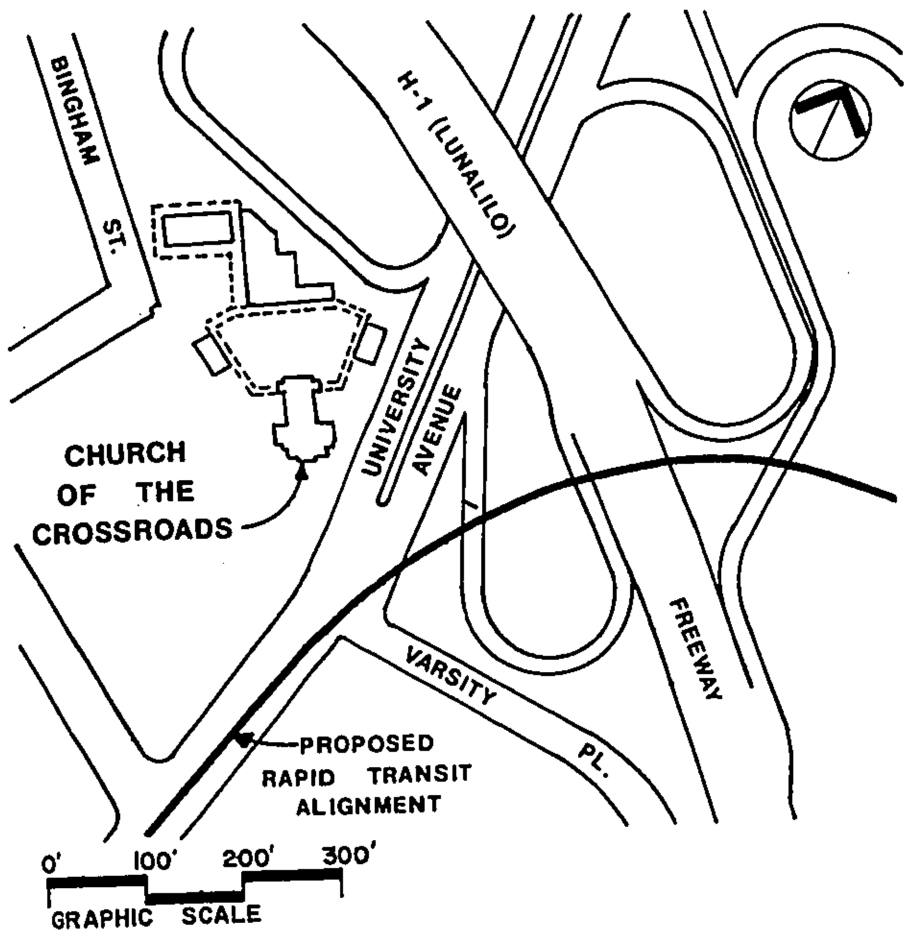
B.15. The Church of the Crossroads

a. Description and Significance of Affected Property

The Church of the Crossroads has been determined eligible by the Keeper of the National Register on January 24, 1979. The site has six buildings on it, four of which are interconnected around a grassy open court by a continuous hipped pergola with conscious references to the Summer Palace outside of Peiping. The sanctuary was built in 1934 of stuccoed reinforced concrete walls, smooth concrete floors, and an exposed heavy timbered hip roof (see Figure VI-32).

Patterned concrete blocks, dyed a light green, are used in vertical panels at corners and at the center of the concrete shaft of a small music tower on the east side of the sanctuary. The square tower is topped with a small hip roof which in turn topped by a copper finial.






CHURCH OF THE CROSSROADS
FIGURE VI -32

The concrete blocks have reliefs of geometric forms and stylized tropical plants -- the banana and ape' (elephant ear) -- cast into their exposed faces. Some patterns are used to form a repetitive banding and other patterns, as those at either side of the sanctuary doors, form a single plant image. All exposed wood in the complex is stained or treated with lye and lime. Most finish wood is given this latter treatment.

Two small buildings on the east and southwest legs of the pergola are nearly identical and done with a decided Japanese influence with sliding shoji doors, low roof lines and a stick-like construction. These now house classrooms and art gallery. Both were built around 1937. A more recent addition to the complex, which served to close the court, was the Administration Building, added in 1957. It houses a kitchen and auditorium. Facing the court is a vented gable roof but the main roof is two intersecting hip roofs.

First services of the church were held in 1922. From its initial organization, the Crossroads has emphasized community interaction and being multi-racial, attempted to eliminate distinctions between members and non-members.

The architecture draws from many sources in a constant allusion to the diverse ethnic, religious and social backgrounds that make up the world, and in microcosm, Hawaii. The complex of buildings superbly integrates these diverse allusions to Eastern, Hawaiian and Western Art Deco and architectural forms and motifs into a sensitively scaled and detailed grouping rarely equalled elsewhere in the State of Hawaii. Its integration of art forms and architecture is excellent. Carvings by local artists Margaret Blasingame and Fritz Abplanalp are well interwoven with the overall design.

The Crossroads has been very active in the community from its beginning. Besides its own community oriented functions it also provides space for programs like the John Howard Association, the 3-M Community Council, Hawaii Potters Guild, Zero Population Growth, Youth Action and many others. Physically, the church occupies a prominent spot on University Avenue. It has sufficient open space around it not to be obscured by other buildings. Its trees and plantings come at the edge of a relatively barren commercial area.

b. Inapplicability of the Criteria of Adverse Effect

The proposed fixed guideway system supported on aerial structures would be located in University Avenue and cross over the H-1 Freeway before turning into the University of Hawaii

Manoa Campus grounds. As the guideway alignment leaves University Avenue, it turns in the easterly direction. On the west side of University Avenue, and south of the H-1 Freeway nestles the Church of the Crossroads site. The area is basically in commercial use with heavy traffic on both University Avenue and the H-1 Freeway.

Although it is recognized that an aerial guideway system would have some impact on the area it traverses, the degree of impact depends on the sensitivity of the area. With the guideway located some 150 feet away from the closest building on the property, and considering the close proximity of the property to the Freeway and the busy University Avenue, the impact is considered to be minimal. Upon applying the criteria of adverse effect, the proposed action is found to have no adverse effect on the Church of the Crossroads property.

c. Coordination and Consultation with the State Historic Preservation Officer

In the attached letter dated February 22, 1980, the State Historic Preservation Officer has stated that this property is not adversely affected.

d. Determination of Effect

Upon applying the Criteria of Effect and Criteria of Adverse Effect (36 CFR, Section 800.3), and in consultation with the State Historic Preservation Officer, UMTA has determined that the proposed action will have "no adverse effect" on the aforementioned historic property.

**Advisory Council On Historic Preservation**

1522 K Street, NW
Washington, DC 20005

# MEMORANDUM OF AGREEMENT

WHEREAS, the Urban Mass Transportation Administration, Department of Transportation (UMTA), has received a grant application from the City and County of Honolulu, Hawaii, for capital assistance for a fixed guideway mass transit system; and,

WHEREAS, UMTA, in consultation with the Hawaii State Historic Preservation Officer (SHPO), has determined that this undertaking as proposed may have an adverse effect on Chinatown and Capitol Historic Districts, plus properties on King Street, properties included in or determined eligible for the National Register of Historic Places; and,

WHEREAS, pursuant to Section 106 of the National Historic Preservation Act of 1966 (16 U.S.C. Sec. 470f, as amended, 90 Stat. 1320) UMTA has requested the comments of the Advisory Council on Historic Preservation (Council) in accordance with the Council's regulations, "Protection of Historic and Cultural Properties" (36 CFR Part 800); and,

WHEREAS, representatives of the Council, UMTA, and the Hawaii SHPO have consulted and reviewed the undertaking to consider feasible and prudent alternatives to avoid or satisfactorily mitigate the adverse effect;

NOW, THEREFORE, if the finding made pursuant to Section 4(f) of the Department of Transportation Act (49 U.S.C. 1653(f)) is to proceed with the Honolulu Area Rapid Transit proposed fixed guideway mass transit system, it is mutually agreed that implementation of the undertaking in accordance with the following stipulations will satisfactorily mitigate any adverse effect on the above-mentioned properties.

## Stipulations

UMTA will ensure that the following measures are carried out.

1. The Department of Transportation Services, City and County of Honolulu (City), may demolish the Robinson and the McCorriston Buildings and use these sites for construction of the proposed rapid transit system. Prior to said demolition, the City will document these two structures so that there will be a permanent record of their existence. The National Architectural and Engineering Record (NAER) of the Heritage Conservation and Recreation Service, U.S. Department of the Interior, (Mr. Douglas Griffin, Pacific Southwest Region, P.O. Box 36062, San Francisco, California 94102) will first be contacted to determine the level of required documentation. This documentation must be approved by NAER prior to demolition.

2. The Hotel Street sidewalk elements, which include the granite paving stones, curbing stones, and iron horse hitching ring, may be temporarily removed during construction of the proposed project. Following construction, they will be either replaced at their original locations or replaced by consolidation into one continguous area, in a manner acceptable to the Hawaii SHPO.

To ensure no adverse effect on 12 additional historic properties, the following steps will be taken.

3. The lava rock wall surrounding the Ala Wai Clubhouse may be temporarily removed during construction. The rocks will be carefully removed to minimize breakage; then correctly replaced in order to reconstruct the wall as nearly as possible to its original condition.

4. In the vicinity of the buildings listed below,

   1. The Chinatown Historic District
   2. The Alexander Young Hotel Building
   3. The J. Campbell Building
   4. The Oahu Ice and Cold Storage Company Building
   5. The Portland Building
   6. The Advertiser Building
   7. The Hawaii Building
   8. The OR & L Station, and Office and Document Storage Building
   9. The Tong Fat Company Building
   10. The Hawaii Capitol Historic District
   11. The S. H. Kress Building

   the following measures, where appropriate, will be undertaken during the construction and operation of the proposed rapid transit system:

   a. Drilled piles or vibratory pile drivers will be used, as needed, to minimize ground vibrations. If driving piles are necessary, predrilling will be done to minimize ground vibration.

   b. Adequate trench shoring and bracing will be used during excavations in order to prevent ground settlement. Such actions will be monitored before, during and after construction.

   c. Appropriate steps will be taken during trench dewatering to prevent settlement. These may include groundwater recharging, pressure grouting, and/or underpinning. Such actions will be monitored before, during and after construction.

   d. Resilient track fasteners or floating slab trackbeds will be used, where needed, to reduce ground-borne vibrations.

   e. An archeologist, meeting the standards set by the Secretary of the Interior (Appendix C, Proposed Guidelines 36 CFR Part 66, Federal Register, Volume 42, No. 19, January 28, 1977) and acceptable to the Hawaii SHPO, will be hired and retained during the excavation of the subway sections. Should archeological resources discovered be determined to be eligible for inclusion in the National Register of Historic Places, the City will follow the provisions of the Council regulations dealing with resources discovered during construction (36 CFR 800.7 (a)).

5. In the vicinity of the Portland and the Advertiser Buildings, the fan and vent shaft openings will be acoustically treated, as needed, with sound-absorptive material, and located in a position sympathetic to historical integrity of these buildings.

6. In the Hawaii Capitol Historic District, adequate and properly-placed underpinnings will be used to protect the foundation of the Municipal Library Building. Backfill will be compacted to minimize floor slab cracks.

7. In the vicinity of the S.H. Kress Building, where several nearby buildings will be demolished to make way for the proposed Fort Street Station, the design of the station environs will include measures to soften the visual impact of exposing one wall of the Kress Building. Sensitive landscaping, the design and installation of mall furnishings and/or appropriate refinishing of the wall itself will be undertaken.

8. Failure to carry out the terms of this Agreement requires that UMTA again request the Council's comments in accordance with 36 CFR Part 800. If UMTA cannot carry out the terms of the Agreement, it will not take or sanction any action or make any irreversible commitment that would result in an adverse effect with respect to National Register or eligible properties covered by the Agreement or would foreclose the Council's considerations of modifications or alternatives to the proposed project that could avoid or mitigate the adverse effect until the commenting process has been completed.

9. If a signatory determines that the terms of the Memorandum of Agreement cannot be met or believes a change is necessary, the signatory will immediately request the consulting parties to consider an amendment of Agreement. Amendments will be executed in the same manner as the original Agreement.

Robert Garvey July 13, 1981 (date)
Executive Director
Advisory Council on Historic Preservation

Edward R Fleischman (date) August 12, 1981
Urban Mass Transportation
Adminsitration

Concur: Roy Parker (date) 7-27-81
City and County of Honolulu

for [signature] (date) 8/4/81
Hawaii State Historic Preservation Officer

[signature: Alexander Aldrich] (date) 8/19/81
Chairman
Advisory Council on Historic Preservation

RT 3180-630

RECEIVED

30 MAR 3 A 9:05

TRANSPORTATION SERVICES

GEORGE R. ARIYOSHI
GOVERNOR OF HAWAII

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
P. O. BOX 621
HONOLULU, HAWAII 96809

SUSUMU ONO, CHAIRMAN
BOARD OF LAND & NATURAL RESOURCES

EDGAR A. HAMASU
DEPUTY TO THE CHAIRMAN

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

February 22, 1980

Mr. Akira Fujita, Acting Director
Department of Transportation Services
City and County of Honolulu
650 South King Street
Honolulu, Hawaii 96813

Dear Mr. Fujita:

On December 11, 1979, members of my staff and I toured the proposed HART route with representatives from your office and UMTA.

In the course of the inspection, we paid particular attention to those structures which the Advisory Council feared might be adversely impacted upon--the Oahu Prison Administration Building, the Brass Foundary Building, and the Church of the Crossroads. With regard to the last two mentioned buildings, the guiderail will be sufficiently distant from them as to not have an adverse impact. With regard to the Oahu Prison Administration Building the urban setting which surrounds it, including numerous new prison structures, has changed the contex of the structure to such an extent that the addition of the guideway will not further detract from its environment. However, certain view planes will be permanently destroyed, and UMTA with the concurrence of your staff, has suggested that your department have a professional photographer document these views prior to construction.

Sincerely yours,

Susumu Ono

Susumu Ono
State Historic Preservation
Officer

# VII. PROBABLE ADVERSE ENVIRONMENTAL EFFECTS WHICH CANNOT BE AVOIDED

Both short-term and long-term unavoidable adverse environmental impacts will occur as a result of the proposed action. The short-term impacts are those associated with construction activities and are generally localized around construction sites. Although there are Federal and local rules and regulations controlling virtually all construction activities, there will, nevertheless, be a certain amount of short-term unavoidable impacts that will occur including dislocation of residents and businesses.

Long-term impacts will occur as a result of system implementation including system operation. The presence of above-ground guideway and station structures are sources of visual impact to the communities in which they are located. The presence of a station in certain areas could cause pressure for redevelopment to higher density population or activity centers. In addition, transit system operation will generate noise, it may increase traffic congestion and aggravate parking problems near stations, and would increase pedestrian traffic around station areas.

These impacts, plus others, are identified and discussed in detail in Chapter V and the more significant unavoidable impacts summarized in this chapter.

## A. NATURAL ENVIRONMENT IMPACTS

### A.1. Air Quality

Air quality around construction sites is expected to be temporarily degraded by fugitive dust from excavation activities and exhaust emissions from construction equipment and unavoidable traffic disruption. The long-term impact on air quality is favorable on a regional basis and generally favorable on a local level (1/2-mile area around stations). However, at a particular intersection or location immediately adjacent to a station, there could be slight increases in exhaust emission due to higher concentration of autos and buses with, rather than without, the transit station, however the CO concentrations are not expected to exceed the Federal CO standards and under the most probable conditions, will not exceed the State standards.

### A.2. Water Quality

The probable unavoidable impact on water quality would be from construction activities causing siltation of streams and other bodies of water. Through rigid control measures and enforcement of existing regulations, siltation from construction activities could be controlled to minimize any long-term impact on water quality and aquatic life.

The extent of the probable impact is expected to be some short-term discoloration of water due to discharge of sediments. No long-term water pollution problems are anticipated from solid or liquid waste disposal due to system operation by adhering to applicable rules and regulations.

### A.3. Vegetation

Removal of bushes, shrubs, and grass will be unavoidable at construction sites. Trees will also be affected and even though careful studies have been conducted, some major trees will be affected as more fully described in Chapter V. However, any trees requiring removal will, wherever possible, be transplanted to a nearby location.

## B. COMMUNITY IMPACTS

### B.1. Noise & Vibration Impact

Although noise during construction will be monitored and controlled as to intensity and time of day, increase in ambient noise level is unavoidable. Noise from transit system operation, especially on aerial guideway segments, will be mitigated by the use of sound barrier walls which would generally reduce train passby noise to "normally acceptable" levels. However, depending on the noise sensitivity of the adjacent land uses, the predicted noise level could exceed the desired goal. This excess in most instances would range between "not being detectible or noticeable" to "noticeable."

### B.2. Visual Impact

With some 80 percent of the system guideway located above ground, visual impact is unavoidable with the magnitude of impact varying with the sensitivity of the traversed area. Residential areas are considered to be the most sensitive and the segments of the system on Dillingham Boulevard, Kapiolani Boulevard and University Avenue would fall in this category. Although visual impact can be softened by sensitively designing the structures and by landscaping, any new facility of this magnitude could produce unfavorable visual effects of varying degree merely by its presence.

### B.3. Circulation Impacts

Circulation impacts cover three types of movement: pedestrian, bicycles, and vehicles. Pedestrian movement will generally increase at every station area with the largest increase expected to occur at major activity centers, especially in the CBD. The pedestrian circulation impact will be in the form of higher congestion levels primarily on sidewalks in the CBD area where relatively narrow sidewalks exist.

Increased volumes of vehicular traffic will affect the convenience and safety of bicycles using the same roadway. The existing bike lanes on University Avenue will be impacted; particularly around the Date Street Station where feeder buses and autos will frequently cross the bike lanes. Also, bicyclists near the Waikiki Station will be impacted by interfacing vehicles.

Vehicular traffic circulation will be affected during construction due to construction activities taking place in the roadway. This will cause reduction in the number of lanes or obstruction of normal operating conditions. In other areas, temporary road detours will be required for autos and buses, causing inconvenience and greater congestion. Although motor vehicle travel will be reduced on the regional scale and generally in the local level (1/2-mile area around the station) due to the diversion of motorists to transit, ingress and egress to transit stations will add traffic to certain access roads, thus causing or adding to congestion. An additional traffic related impact will be the increase in demand for on-street parking around stations. Although parking restrictions can be imposed to preclude all-day parking by other than local residents, the impact would cause some degree of inconvenience to local residents.

### B.4. Land Use and Urban Development Impact

The primary impact on land use and development caused by improved accessibility to transit is the increased demand for housing and commercial/business facilities near transit stations. This increased demand may result in pressure for redevelopment toward increased density. Whether or not increased density will occur is contingent on many factors, foremost of which is the zoning policy. Therefore, the impact is the potential for change in land use or densities around transit stations.

## C. SOCIAL IMPACT

Dislocation of a certain number of residents and businesses is the unavoidable social impact resulting from the proposed action. In instances where families and businesses are dislocated, varying degrees of emotional strain and moving inconvenience would occur. The number of dislocation is estimated to involve some 150 residential units and 170 businesses.

## D. ECONOMIC IMPACTS

### D.1. Private Land Take and Tax Loss

The total land requirement for the proposed action amounts to some 60 acres of which 25 acres are privately owned properties. The taking of these privately owned properties are mostly improved and would affect approximately 150 residential units and 170 businesses.

The total fair market value of land and improvements is estimated at about $50 million and the current assessed valuation amounts to some $20 million. The taking of these private (taxable) lands will result in a property tax loss of over $300,000 per year. This loss could be considered as short-term impact with the displacees absorbing available housing units and business spaces thus creating demand for additional taxable properties to replace those taken.

### D.2. Employment Impact

The taking of private land would affect some 170 businesses of which up to 25 indicated that they may liquidate if displaced. The liquidation of these businesses could affect some 300 to 600 employees.

### D.3. Business Impact Due to Construction Activities

Businesses adjacent to construction sites may experience losses in revenue due to increase traffic congestion and restricted access. Restricted access could apply to either vehicular or pedestrian access with similar impact on businesses. Businesses along Hotel Street may be affected the most due to the proposed underground construction activities.

## E. MISCELLANEOUS CONSTRUCTION IMPACT

### E.1. Spoil Disposal and Debris Disposal

Construction activities will result in generation of spoils and debris requiring disposal. The collection and hauling of these materials will contribute to various impacts on the natural environment and community as well as adding to the ever-increasing volume of solid wastes that are becoming more difficult to dispose year by year.

## E.2. Utility Relocation

Both aerial and underground guideway construction will require relocation of utilities which will result in temporary disruption of utility service. Although service disruptions will be scheduled to occur at non-critical demand periods, temporary disruption of various utility services will occur.

## E.3. Disruption of Access and Services

Temporary disruption of vehicular access to residential and business properties will occur when streets must be closed to conduct certain construction activities. Although the time and duration of these closures will be controlled to minimize the impact, certain streets will be temporarily closed during the construction period.

# VIII. THE RELATIONSHIP BETWEEN SHORT-TERM USES OF MAN'S ENVIRONMENT AND THE MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

The previous chapter presented a summary of probable adverse environmental effects that cannot be avoided. This chapter discusses the extent to which the proposed action involves trade-offs between those short-term environmental losses and potential long-term gains.

## A. SHORT-TERM USE OF MAN'S ENVIRONMENT

Any project of the magnitude proposed will produce a wide variety of short-term impacts during construction as well as longer term impacts from system implementation and operation. Some of the more noteworthy adverse impacts that are considered as short-term use of man's environment are summarized below.

- Construction generated noise, air pollution, traffic congestion and business losses.
- Taking of private lands resulting in dislocation of residents and businesses, and tax losses.
- Creation of visual impact in communities where the guideway is located above ground.
- Creation of noise and vibration impacts to properties and facilities adjacent to the guideway from train operation.
- Creation of some traffic congestion and possible increase in air pollution in localized areas.
- Cost of the project.

## B. MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

### B.1. Travel Benefits

With improved transportation facilities and services provided by the proposed rapid transit system operating on exclusive, grade-separated right-of-way and supported by a network of feeder buses, the resulting potential travel and travel-related benefits considered relevant to the maintenance and enhancement of long-term productivity are as follows:

- Create an alternative travel mode to achieve a better transportation system balance.
- Improve accessibility to jobs, services and recreation.
- Provide improved mobility for the young, the old, and the handicapped.
- Reduction in auto travel resulting from those motorists diverted to transit.
- Reduce the space demands of other transportation components.
- Aid in preserving the quality of air.
- Aid in utilizing energy more efficiently.
- Decrease noise levels in corridors where bus volumes are reduced.
- Reduce private and public capital expenditure for parking facilities.
- Permit policy-makers to take various regulatory actions relative to auto-disincentive programs.

## B.2. Regional Benefits

Recognizing that any other form of transportation system with comparable capabilities would create as much, if not more, adverse environmental impacts, Oahu's transportation needs should be viewed in the broader context of total long-range social, economic, and environmental goals and objectives. The General Plan of Honolulu, adopted in 1977, is the official policy document for the long-range development of the City. Transportation is one of many areas of concern addressed in the General Plan and its objectives and policies are aimed towards continued improvements to meet the mobility needs of the people and promoting the use of public transportation as a means of moving people quickly and efficiently in the urban area and of conserving energy. Transportation, especially mass transit, is also cited as having a secondary, but important, function to be used as a means of guiding growth and the pattern of land use on Oahu.

Population growth and distribution is given prominence in the General Plan due to Oahu's limited land resource. The key element of this area of concern is to ensure quality growth through a desired distribution pattern of concentrated population growth in selected areas. In order to achieve this development pattern, the General Plan contains a policy calling for the use of capital improvement programs, and citing a mass transit system as means of stimulating development.

Transportation has little or no influence upon increasing or decreasing total population growth, or the long-range economic activity on Oahu. Mass transit can, however, be used as one of the tools in managing urban growth to achieve desired pattern of development. The General Plan of Honolulu identifies the existing urbanized area from Pearl City to Waialae-Kahala as the "primary urban area" to be fully developed as first order of priority followed by a gradual development of outlying Ewa into a secondary urban area. The intent of this policy is to maximize the development of existing urbanized areas through appropriate development of underdeveloped properties, redevelopment of the Kakaako area, preservation and restoration of existing structures, and more intensive development around future mass transit stops.

The reorientation from past emphasis on new growth and creation of new infra-structure in outlying areas toward reinvestment and rehabilitation of existing urban areas so that they may continue to be livable and prosperous is crucial to Oahu's future. Its success, through management of urban growth as proposed in the General Plan, will require the use of every available planning tool including mass transit. To whatever degree the proposed transit project, supported by appropriate zoning policies and development incentives, is instrumental in the successful management of this growth, it will strengthen the City's commitment to a future considered to be both desirable and attainable in the following areas as cited in the General Plan.

- Help preserve agricultural land and open space.
- Help discourage urban sprawl and scatteration in outer urban fringes and rural areas of Oahu.
- Permit gradual and phased development of Ewa to help maintain the viability of the sugar industry.
- Help maintain the existing diversity of living environments, including a "rural atmosphere" in certain parts of Oahu.
- Help provide the people of Oahu with a choice of living environments which are reasonably close to employment, recreation, and commercial centers.
- Help reduce new infra-structure costs by maximizing the use of available capacities in existing public facilities.

- Strengthen the tax base of Honolulu by stimulating improvements to or redevelopment of existing aging structures in the urban core.

- Help preserve the environment by reducing air and noise pollution through shorter travel distance and also help in energy conservation.

The first part of this chapter summarizes the probable adverse environmental effects which cannot be avoided and the potential travel and travel-related benefits to accrue to the island resulting from implementing the proposed system. Since a large sum of public funds is required in such an undertaking, the role of the proposed system in the broader context of the long-range strategy of promoting the general welfare and prosperity of the people of Oahu is also addressed. The General Plan of Honolulu, adopted in early 1977, explicitly states the vital role of mass transit in attaining the desired urban growth and development pattern described in the objective and policy statements of this document.

## IX. IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

The construction and operation of the proposed project would involve the irretrievable commitment of certain natural and fiscal resources. Major resource commitments include land, money, construction materials, manpower, and energy. The impacts of using these resources should, however, be weighed against the benefits accruing to the residents of Oahu and the consequences resulting from taking no action at all which have been discussed in previous chapters.

### A. LAND

A substantial portion of the proposed project will be constructed within existing street and highway rights-of-way or on publicly owned lands. The taking of privately owned lands will, however, be required at station locations and certain sections along the alignment. Although the joint use of existing rights-of-way is a commitment of a resource which is scarce or becoming scarce, it is somewhat mitigated by increased utilization of lands already committed to transportation use in lieu of using existing private lands. The taking of private lands is a major commitment of scarce resources, amounting to some 25 acres, and the resulting tax losses.

### B. MONEY

The capital committed to the construction of the system will be irrevocably committed. Although this commitment is large, its value as a public service to the area will accrue from expanded employment opportunities, increased mobility for the transit dependent, and user and nonuser benefits through savings in both travel time and money.

### C. CONSTRUCTION MATERIALS

Construction materials such as concrete, lumber, and steel consumed in the construction of the system is a natural resource that is irretrievably committed. Concrete aggregates and cement are produced locally and represent a local commitment. Other materials such as steel, lumber, aluminum and copper, are produced in other areas of the country or world. Although they are not necessarily in plentiful supply, their consumption will be over an extended period of time which should have little effect on the overall availability.

## D. LABOR

Labor expended in the design and construction of the system cannot be recovered. Benefits will, however, accrue to the area at large and particularly to the construction industry which has suffered from recent construction cutbacks. The duration of employment and the crafts utilized will vary depending upon the construction schedule, staging and types of construction involved.

## E. ENERGY

Energy consumed during construction and system operation will be an irretrievable commitment of resources. Energy for construction will be a combination of electrical energy and energy derived from petroleum products while that used for system operation will be principally electrical energy produced by the Hawaiian Electric Company.

## REFERENCES


1. Data Book, 1979, Statistical Abstract, State DPED.
2. Population Summary for Hawaii, 1972, Statistical Report 87, Jan. 7, 1972, State DPED.
3. Revised Population and Economic Projections 1975-2000, March 1, 1978, State DPED.
4. Noise and Vibration Characteristics, Honolulu Rapid Transit System, Dec. 1977, by Wilson, Ihrig & Associates, Inc.
5. Unpublished Output data from Land-Use Model for 1980 and 1995, Oahu Transportation Planning Program, 1972.
6. Provisions for the Elderly and Handicapped for Fixed Guideway System, Honolulu Rapid Transit System, PEEP II, May 1974, DMJM.
7. TOPICS STUDY, Feb. 1971, Traffic Dept., City and County of Honolulu.
8. Highway Functional Classification and Needs Study, State of Hawaii 1970-1975, Dec. 1971, Dept. of Transportation, State of Hawaii.
9. Unpublished output data from Highway Assignment Model, Rapid Transit Planning Program, 1975, City and County of Honolulu.
10. Oahu Transportation Study, Volumes I, II, & III, 1967, State of Hawaii and City and County of Honolulu.
11. Honolulu Rapid Transit System, Preliminary Engineering Evaluation Program, Final Report, December 1972, DMJM.
12. Evaluation of Alternative Transportation Systems for the Pearl City - Hawaii Kai Corridor, Mar. 1973, Alan M. Voorhees & Associates, Inc.
13. Honolulu Rapid Transit System, Preliminary Engineering & Evaluation Program, Phase II, Final Report, Nov. 1976, DMJM.
14. Draft Environmental Impact Report, Honolulu Rapid Transit & Preliminary Engineering Evaluation Program, Vol. I, II, & III, Sept. 1972 Mass Transit Division, Dept. of Traffic, City and County of Honolulu.
15. Analysis of Transit Alternatives, Honolulu Rapid Transit Project, April 1976, DMJM.

16. Route Planning Study, Honolulu Rapid Transit Project, Vol. 1, 2, 3, March 1972, DMJM.

17. Alternative Route Evaluations conducted in PEEP II contained in following reports:

    a. Feasibility Study of the H-1 Freeway Route of Fixed Guideway System, March 1974, DMJM.

    b. Study of Alternative Alignments in the Dillingham Blvd. Corridor, April 1974, DMJM.

    c. Study of Alternative Routes in the Moiliili/University Avenue, March 1974, DMJM.

    d. Feasibility Study of the Lunalilo Freeway Route for Fixed Guideway System - Kapiolani Interchange to Kalanianaole Highway, May 1974, DMJM.

18. Patronage and Revenue Estimates, November 1974, Alan M. Voorhees & Associates, Inc.

19. Comparative Evaluation of Vehicle System, June 1978, DMJM.

20. Proposed Financial Program for the Honolulu Bus/Rail Transportation System, February 1980, Ernst & Whinney in association with Robert J. Harmon & Associates, Inc.

21. Noise and Vibration Design Criteria and Recommendations, Baltimore Region Rapid Transit System, Feb. 1974, Wilson, Ihrig, & Assoc. Inc.

22. Relocation Plan, Honolulu Rapid Transit System, June 1975, Surveys and Marketing Services, Inc.

23. Study of the Salt Lake Blvd. Alignment, Honolulu Area Rapid Transit System, March 1978, DMJM.

24. Preliminary Market Study, June 1972, Bay K.C. Yee & Co.

25. Historic Sites Survey for H.A.R.T. - Oct. 13, 1977, Fox Associates.

26. Honolulu Area Rapid Transit Historic Sites Survey, Vol. I & II, Nov. 27, 1978, Charles R. Sutton & Assoc., Inc.

27. Interim Report - Long Range Transit Plan, March 1972, DMJM.

28. Fixed Guideway Operational Concepts, July 1974, DMJM.

29. The Environmental Impact of Proposed Construction Within Aiea Bay and Keehi Lagoon, 1972, Oceanic Institute.

30. General Plan, City and County of Honolulu, A Reference Report Summarizing the Basis for the Objectives and Policies, January 1978.

31. Land Use Study Around Rapid Transit Stations, Task B, C & D; January 1979, May 1979 & December 1979, respectively; Belt, Collins & Associates.

32. Land Use Projections, Selected Station Impact Areas, July 1978, Belt, Collins & Associates, Inc. by Hastings, Martin, Hallstrom & Chew, Ltd.

33. Preliminary Subsurface Investigation Proposed Honolulu Rapid Transit System Underground Section, September 1974, Dames & Moore.