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DEPARTMENT OF TRANSPORTATION
869 PUNCHBOWL STREET
HONOLULU, HAWAII 96813

IN REPLY REFER TO:

November 16, 1989

HAR-EP 1957

Dr. Marvin T. Miura, Director
Office of Environmental Quality Control
Kekuanaoa Building
465 South King Street, Room 104
Honolulu, Hawaii 96813

Dear Dr. Miura:

Negative Declaration - Container Yard
Improvements at Fort Armstrong

In accordance with Chapter 343-5 (c), Hawaii Revised Statutes, we are notifying you that we will not require an Environmental Impact Statement for the subject project. We have enclosed a Negative Declaration on the proposal and a completed OEQC Form 89-01 for publication in the OEQC Bulletin. Also enclosed are detailed reports on Noise Impacts Analysis, Air Quality Analysis, and Traffic Impact Assessment.

Should you have any questions on the action, please contact Mr. Howard Miura of our Harbors Division at 548-2559.

Very truly yours,

Edward Y. Hirata
Director of Transportation

Enclosures

1990-11-23-OA-FEA

FILE COPY

# NEGATIVE DECLARATION

for

* Fort Armstrong
Container Yard Improvements

at

Pier I, Honolulu* Harbor, Oahu

October 1989

# Negative Declaration

| | |
|---|---|
| PROJECT: | FORT ARMSTRONG CONTAINER YARD IMPROVEMENTS |
| LOCATION: | KAKAAKO, HONOLULU DISTRICT<br>CITY AND COUNTY OF HONOLULU<br>Tax Map Key: 2-1-15:9 |
| APPLICANT: | AMERICAN PRESIDENT LINES, LTD.<br>1800 HARRISON STREET<br>OAKLAND, CALIFORNIA 94612 |
| APPROVING AGENCY | STATE DEPARTMENT OF TRANSPORTATION, HARBORS DIVISION |
| CONSULTANT: | KENNEDY/JENKS/CHILTON<br>1164 BISHOP STREET, SUITE 1400<br>HONOLULU, HAWAII 96813<br>(808) 524 0594<br>CONTACT PERSON:<br>HENRY SUMIDA |

TABLE OF CONTENTS


| | | Page |
|---|---|---|
| CHAPTER I | Description of the Proposed Action | |
| | General Description | 1 |
| | Frequency of Service | 1 |
| | Vessels | 1 |
| | Cargo | 2 |
| | Terminal Operations | 2 |
| | Social and Economic Characteristics | 2 |
| | Environmental Characteristics | 3 |
| CHAPTER II | Description of the Affected Environment | |
| | Physical Characteristics | 5 |
| | Social and Economic Characteristics | 7 |
| Chapter III | Probable Impacts of the Proposed Action and Mitigation Measures | |
| | Probable Impacts and Mitigation Measures11 | |
| Chapter IV | Alternatives to the Proposed Action | |
| | Project Alternatives | 15 |
| | Site Alternatives | 15 |
| | No Action Alternative | 15 |
| Chapter V | Determination | 17 |
| Chapter VI | Findings and Reasons Supporting Determination | 19 |
| Chapter VII | Agencies, Organizations and Individuals Consulted | |
| | Consulted Parties | 21 |
| | Preparers | 22 |
| References | | 23 |

## Figures


| | |
|---|---|
| Figure 1 | Project Area |
| Figure 2 | Existing Site Plan |
| Figure 3 | Proposed Site Plan |
| Figure 4 | Gantry Crane Elevations |

# CHAPTER I

# DESCRIPTION OF THE PROPOSED ACTION

## General Description

American President Lines, Ltd. (APL) proposes to improve the cargo loading and unloading facilities of Pier 1 at Fort Armstrong. (The location of Fort Armstrong and existing and proposed facilities are shown in Figures 1 through 4.) Two gantry cranes, each 100' wide and 130' tall, white with black engine houses, will be installed along approximately 800' of the wharf. The existing waterside rail will be replaced and a new grade beam and rail constructed 100 feet inland of the waterside rail. Existing rail foundations will not be affected. The cranes will be similar to those previously used for loading and unloading containers at Pier 1 by Matson Navigation before its operations were moved to Sand Island in 1981. The main difference between the two operations is that the APL cranes will be diesel-powered rather than electric, the rails will be 100' apart rather than 32' and APL will have only two gantry cranes where Matson had four (*Ampersand*,1981).

In addition to the crane rails, new construction will include segmenting and remodeling of a portion of the existing Container Freight Station #2, tower, and office building as indicated in Figure 3. The utilities will be relocated and the fender system extended three feet seaward. The yard will be restriped for use by chassis as opposed to straddle carriers. Ten hustlers (yard tractors), two fork lifts for stacking and unstacking empties, and two pick-up trucks will be used in operations.

Operations will take place on an interim basis using mobile cranes until the gantry cranes can be installed. Interim operations are not expected to last more than six months.

## Frequency of Service

Current plans are for APL'S vessels to arrive in Honolulu from the West Coast - Los Angeles and Oakland - weekly, en route to Guam and the Far East before returning to the West Coast. The ships are tentatively scheduled to arrive in Honolulu on Tuesday and depart on Wednesday. They will be berthed at Pier 1 approximately 26 hours.

## Vessels

A total of five vessels will be calling at Honolulu - three C9's and two of APL's three C8's. The C9 vessels are capable of carrying a total of 1195 FEU's (forty-foot equivalent units) and are about 860 feet in length. The C8's carry 875 FEU's and are about 800 feet in length. The C9's are diesel propelled while the C8's are propelled by steam engines.

## CARGO

Projections indicate there will be about 542 FEU's per week carried to Hawaii from the mainland by the third year of operation. This includes (containers per week):

| Containers | FEU's | | |
|---|---|---|---|
| 206 | 103 | 20-ft. | dry containers |
| 388 | 388 | 40-ft. | dry containers |
| 32 | 32 | 45-ft. | dry containers |
| 19 | 19 | 40-ft. | refrigerated containers |
| 645 | 542 | | |

Approximately 25-30% of this cargo will be destined for the Neighbor Islands and will be shipped via common carrier. The remainder is destined for Oahu locations.

## TERMINAL OPERATIONS

The terminal will normally be open Monday through Friday from 8:00 AM to 5:00 PM for pick up and delivery of containers. Arriving vessels will be worked on a 24-hour basis while they are in port by the two diesel powered gantry cranes. All of the containers coming off the ship will be placed on chassis and/or stacked in the yard ready for pick-up. The vast majority of containers returning to the yard will be empty and will be block stowed (stacked 3 or 4 high) on the ground.

Most of the inbound containers from the mainland will be picked up and delivered to the consignees within 48 to 72 hours after discharge from the ship, on Wednesday, Thursday and Friday. This will require about 215 drays, or local moves per day, or about 27 per hour through the gate based on an 8-5 schedule, although it may be necessary to keep the gate open longer than 8-5 to meet the distribution schedule.

Outbound empties will return to the yard on a fairly even basis throughout the week. Most of the tractors returning empty containers will also pick up loaded containers on Wednesday, Thursday, and Friday.

## SOCIAL AND ECONOMIC CHARACTERISTICS

Construction costs for the improvements are estimated to be over one million dollars. Labor for construction and all materials will be purchased locally except for the gantry cranes. These will be brought via barge from the Port of Oakland, California. APL will have a staff of approximately 22 people in Honolulu, most of whom will be hired locally. Five will be located at Fort Armstrong while the remainder may be located in a separate sales and administration office.

APL will contract with Hawaii Stevedores, Inc., for stevedoring services as well as container and chassis maintenance and repair. Hawaii Stevedores estimates that 15 to 20 additional people will be hired to accommodate the increased workload, an increase of 11 to 14 percent over their present 140 employees.

## Environmental Characteristics

The proposed cargo handling improvements will have no effect on water quality, flora, fauna or vegetation. There will be an increase in traffic when the ship is in port being unloaded. There will be some minor impacts on air quality from the additional traffic and the gantry crane's diesel engines during ship off loading but not enough to cause a violation of air quality standards. There will be increased noise during this same period but not enough to violate state noise standards.

The gantry cranes will be fixed rail structures, as opposed to the mobile cranes, and will therefore be visible at all times rather than just when ships are at the pier. Some persons may consider them to be aesthetically unpleasing and to obstruct view planes.

No other adverse environmental impacts are anticipated.

# CHAPTER II

# DESCRIPTION OF THE AFFECTED ENVIRONMENT

## PHYSICAL CHARACTERISTICS

### Location

Fort Armstrong is located in the center of the Honolulu Waterfront, between downtown Honolulu and Kewalo Basin (see Figure 1). The 75-acre complex includes Piers 1 and 2 and has container and general cargo berths, warehouses, sheds, open paved storage areas for container back up and marshalling, and Foreign Trade Zone No. 9. The area also contains the U.S. Immigration Station, the Department of Health Building, and the Ala Moana Pumping Station, all historic buildings.

Pier 1 has a berth length of 1,266 feet and a yard area of 1,265,000 square feet. It has 78,000 square feet of shed area. Depth at the pier is 36 to 40 feet (Port Hawaii Handbook 1988-1989).

### Geology and Soils

Most of the Honolulu waterfront is underlain by reef limestone 5 to 20 feet below mean sea level. Soft lagoonal deposits made up of sand, silt, clay and occasional boulders are found above the ancient reef, covered by 5 to 10 feet of dredged coral fill. Incinerator and sanitary landfill overlay the dredged coral fill and lagoonal deposits.

The near-surface soils are composed of man-made fills to a depth about 10 feet below the existing ground surface. Underlying the fills are lagoon deposits consisting of coralline gravels and sands, and silts to depths of 40 to 50 feet. Beneath the lagoon deposit is a coralline reef, the thickness of which varies from 12 to 30 feet. The man-made fills are highly variable and contain numerous cobbles and boulders.

### Flood Hazard

According to the Civil Defense Tsunami Inundation map of Oahu, the Pier 1 portion of the site is within the projected inundation zone. According to the Federal Flood Insurance Rate map, the area is designated "C - Area of Minimal Flooding."

### Water Quality

Water quality near Pier 1 and in the harbor area is generally good. The proposed project will have no effect on water quality.

### Flora and Fauna

The project site is presently in industrial use. There is no natural vegetation and no native fauna in the project area.

### Air Quality

Because of favorable climatic conditions and a lack of heavy industry, air quality in Honolulu is relatively clean and free from pollutants, with only occasional violations of air quality standards. Climatic conditions and air quality are discussed in more detail in *Air Quality Analysis for Proposed Container Yard Improvements,*prepared by Michael Brandman Associates, Inc.

### Noise

The nearest potentially noise sensitive areas to the project site are the Waterfront-Tower highrise condominiums on South Street (now under construction); the Harbor Square Condominium on Nimitz Highway between Alakea and Richards Streets, and the Family Camping Area at Sand Island State Park across Honolulu Harbor Channel.

The noise environment at the highrise condominiums is normally dominated by motor vehicular traffic. Present maritime operations from Piers 1 and 2 can be audible at the condominiums and the park when lulls occur in traffic and in-between aircraft flights. Loading and unloading ships and barges may occur during the stevedores' second shift from 6:00 P.M. to 5:00 A.M. Diesel powered mobile cranes, commonly used in loading and unloading ships and barges, also may be audible in the environs at times. The auxiliary power systems in some ships may be heard, particularly if high velocity gas is exhausted at elevated heights through stacks.

The noise from existing maritime operations at Fort Armstrong should usually be in compliance with the State Department of Health (DOH) noise regulations. The project area was zoned industrial prior to the development of nearby condominiums and the park. DOH regulations state that the allowable noise levels shall apply subject to the order of precedence in which land uses were initiated. Industrial limits apply to the site even if new residential units are developed close to the facility. The regulations do not apply to "boat whistles, horns . . . . . and boats operating in any harbor" (Chapter 43, Administrative Rules, Title 11, 1981, Community Noise Control for Oahu, Department of Health).

Ambient noise conditions are discussed in more detail in *Noise Impact Analysis for the Proposed Container Yard Improvements,* prepared by Darby and Associates, Accousitical Engineers.

### Aesthetics

Views of Pier 1 are principally intermittent roadway views as seen from Nimitz Highway/Ala Moana Boulevard and stationary views from Sand Island. In describing the downtown area, the Coastal View Study notes that

> Stationary views from Sand Island are particularly significant in capturing the visual quality of this area and in illustrating the unity between the built

environment and Koolau Mountains in the background. These views are vivid and demonstrate high urban activity (Coastal View Study, 1987).

Pier 1 is presently used for loading and unloading cargo and has the open areas, warehouses, sheds, vehicles and miscellaneous items usual for a harbor area.

## SOCIAL AND ECONOMIC CHARACTERISTICS

### Land Ownership and Use

With the exception of the area which contains the U.S. Immigration Station and the Department of Health Building, all of Fort Armstrong is owned by the State of Hawaii and is under the jurisdiction the Harbors Division of the Department of Transportation. Fort Armstrong lies within the Kakaako District (see Figure 1) and is under the jurisdiction of the Hawaii Community Development Authority. All of the state-owned land on the site is zoned Waterfront Industrial (W1).

Honolulu Harbor is the major commercial harbor in Hawaii and among the ten largest container handling ports in the United States. Large container ships, tankers, and ocean-going and inter-island barges are on the move constantly night and day, loading and discharging cargo around the clock (Port Hawaii Handbook 1988-1989).

Fort Armstrong has been used for cargo handling for a long time. The first gantry crane was set up on the site in 1960 to accommodate the first all-container vessel to arrive in Hawaii. Later, three additional cranes were erected and were used continuously until 1981 when Matson transferred its container operations and cranes to Sand Island (Ampersand, 1981). Principal cargo and uses for Pier One are containers, autos, lumber, heavy machinery, paper products, and general cargo. Users include ACS Agencies, Alaska Cargo Transport, Hawaii Pacific Marine Lines, Fred L. Waldron, Ltd., Hawaiian Marine Lines, PAD Lines, PM&O Lines, SubSea Workboats, and U.S. Customs (Port Hawaii Handbook 1988-1989).

The long-range Honolulu Waterfront Master Plan developed by the Office of State Planning designates Pier 1 and 2 area of Fort Armstrong for passenger cruise ship terminals and deep draft lay berths areas for itinerant vessels. The short-range plan (5 to 10 years) supports existing directions within Honolulu Harbor and improved efficiency of specific maritime operations.

According to the Plan, key maritime elements within the next five to ten years include:

> Maintaining the existing container yard area at Fort Armstrong as an interim cargo handling facility, providing for the continuation of roll-on/roll-off activities and possibly reinstating gantry container operations if the need exists for such an operation at this facility. However, this is intended to be strictly a holding action until the disposition of the Kapalama Military Reservation lands is resolved and the use of Barbers Point Harbor for container facilities is fully evaluated. Any improvements to the Fort Armstrong yards for expanded container use should be solely at the

operator's or lessee's expense, and no leases should extend beyond a five-year time frame, with annual renewal possible thereafter until alternative cargo handling sites become available (Honolulu Waterfront Master Plan, January 1989).

Land use of the areas adjacent to Fort Armstrong is presently primarily industrial and commercial. The other major current use is public. Both the State Department of Health and U.S. Department of Immigration have buildings and offices at Fort Armstrong. On the other side of Fort Armstrong across the ship channel is Sand Island State Park. However, with the redevelopment of Kakaako, residential uses are returning to the area. Two high-rise residential condominiums are under construction on Ala Moana Boulevard across the street.

**Historic/Cultural Resources**

There are two historic buildings at Fort Armstrong, the State Department of Health Building and the U.S. Immigration Station. Neither will be affected by the proposed project.

**Demography and Employment**

As noted earlier, Fort Armstrong lies within the boundaries of the Hawaii Community Development Authority (HCDA). The Kakaako Plan adopted by the HCDA in 1982 provides a twenty-five to thirty years development framework. Implementation of the Plan will change a predominantly older, low-rise commercial/industrial area into a modern, high-density urbanized area with a large residential population (HCDA 1987).

According to the Kakaako Plan, there will be a three-fold increase of commercial, industrial, and residential floor area on the 456 acres of developable land in Kakaako. Currently businesses within the district employ about 19,700 people. This total would increase to 37,000 with the projected commercial and industrial development (HCDA 1987).

The Plan is currently being revised and updated to incorporate the recommendations of the Master Plan for the Honolulu Waterfront being prepared by the Office of State Planning.

**Traffic and Utilities**

Traffic

The Kakaako makai area where Fort Armstrong is located is served by one major East-West arterial street, Ala Moana Boulevard, and several mauka-makai collector/distributor roads such as Punchbowl Street, South Street, Cooke Street and Ward Avenue. Figure 1 shows the major arterials.

From Kakaako to Waikiki, Ala Moana Boulevard has three lanes in each direction. Exclusive left turn lanes are provided in the medians at major intersections. Separate phases are given to left turn movements at signalized intersections. The posted speed limit on Ala Moana is 35 miles per hour (mph).

Latest traffic counts taken by the State Department of Transportation (DOT) at the intersection of Ala Moana Boulevard and South Street in December 1986 were obtained and reviewed. Based on the 24-hour traffic count, it was determined that the heaviest traffic at the study intersection occurred on a weekday between 7:00 - 8:00 AM for the morning peak hour, and between 4:00 - 5:00 PM for the afternoon peak hour.

Additional turning movement counts were taken on Tuesday, August 29, 1989 between 6:30 - 8:30 AM and 3:30 - 5:30 PM at the study intersection. The recorded data establishes the present day condition upon which the project generated forecasted traffic was superimposed to determine the impact on the existing roads when the proposed APL container terminal begins operation in early 1990. The base data is contained in *Traffic Impact Assessment Report for APL Fort Armstrong Container Terminal,* prepared by Pacific Planning & Engineering, Inc.

Utilities

On-site utilities serving the container yard include electrical feeders, conduits and pull boxes; telephone conductors, conduits and pull boxes; storm drainage pipelines and manholes; water lines; and fuel lines.

# CHAPTER III

# PROBABLE IMPACTS OF THE PROPOSED ACTION AND MITIGATION MEASURES

## PROBABLE IMPACTS AND MITIGATION MEASURES

### Water Quality

There will be no impacts on water quality from construction of the facilities which will all take place above the water line. Impacts on water quality from operations are not expected to differ from existing ship docking, loading, and unloading operations.

### Air Quality

The proposed improvements at the Fort Armstrong facility would lead to a projected incremental increase in ambient concentrations over what would occur without the project. Since there is a measurable level of pollutant output, mitigation measures are suggested during construction. However, regional and local air quality are not expected to be dramatically affected and the pattern of rare exceeding of state standards for CO and ozone would not be affected. The possible sources of pollutant emissions associated with the proposed Fort Armstrong container yard improvements would not significantly impact Honolulu regional or local air quality.

Short-term construction emissions would be minimal and can be mitigated. Suppression measures for fugitive dust should be employed for any grading or demolition activities. Measures should include watering methods.

Long-term emissions from commercial vessels, dockside container handling equipment, and truck hauling each will make only incremental increases to ambient pollution levels. Cumulatively, emissions from all sources combined would still not lead to a significant increase in any of the pollutants of concern. Ambient levels at sensitive receptors in the local area, including residential units and the Sand Island State Park, will not change significantly from present levels. Although standards will not be violated, proper maintenance and handling of all equipment engines should be performed to reduce excess emissions resulting from insufficient or improper burning of fuels. Air pollution emissions remaining after proper equipment maintenance would be an unavoidable adverse impact (Michael Brandman Associates, 1989).

### Flora and Fauna

There will be no adverse impacts on flora and fauna.

### Noise

As noted earlier, the noise from existing maritime operations at Fort Armstrong should usually be in compliance with the State Department of Health (DOH) noise regulations. The proposed action involves continued use of the Fort Armstrong project area for ship loading and unloading operations using the same, or similar, equipment and vehicles except for the 100-foot wide diesel-powered gantry cranes. The main difference in noise impact to potentially noise sensitive areas will be (1) possible audible sounds from the diesel engines in the new cranes during quiet periods in the noise sensitive areas, and (2) a reduction in noise at the Sand Island camping area from non-elevated noise sources, e.g., front-end loaders, tractors, and mobile cranes which will be somewhat shielded by the ship at Pier 1 (Darby and Associates, 1989).

**Utilities**

Installation of the 800-foot landside crane rail and supporting reinforced concrete crane rail girder will interfere with several existing container yard utilities, including:

Electrical feeders, conduits and pull boxes
Telephone conduits and pull boxes
Storm drainage pipelines
Water lines

Existing active underground electrical and abandoned telephone ducts lie parallel to, and in the proposed location of, the landside crane rail girder. Installation of the girder will require relocation of active electrical duct lines and associated pull boxes adjacent to the new girder. The affected electrical and telephone ducts were originally installed as a part of the 1967 KHVH Transmitter Building site improvements and have been subsequently used by the United States Coast Guard for the routing of a power supply for the Honolulu Harbor Navigation Light. The Honolulu Harbor Navigation Light was installed to replace a beacon formerly mounted on the KHVH radio transmission tower. An alternative power supply will be provided for the Honolulu Harbor Navigation Light during the tie-in of new duck lines and conductors.

Existing 2-inch or 4-inch underground electrical ducts cross the proposed inland crane girder at three separate locations. Active ducts will be lowered below the crane rail girder, or may pass through the stem of the girder through openings which allow for settlement.

A portion of an existing 42-inch reinforced concrete pipe (RCP) storm drain needs to be reconfigured to clear the bottom of the proposed 40-inch deep crane rail girder. A new box culvert storm drain section will be used to replace that portion of the 42-inch RCP affected. Provision for storm drainage pumping during storm drain line reconstruction is anticipated.

An existing 6-inch water line crosses the proposed landside crane rail girder alignment. The affected water line section will be lowered below the crane rail girder with standard fittings.

Opposite the curve in Pier 1C are three existing pipelines which conflict with the proposed Honolulu end of the crane rail girder. An active 6-inch water line, and two abandoned and slurry-sealed diesel fuel lines require relocation or removal. The diesel fuel lines are abandoned in place and may be cut and capped using appropriate procedures. The water line can be easily lowered below the crane rail girder.

The utility interferences and proposed modification noted above are based upon a field survey performed for APL and record drawings obtained from the Harbors Division of the State of Hawaii, Department of Transportation. Actual field conditions encountered during excavation and crane girder construction may affect other unrecorded and currently unknown utilities.

**Traffic**

The traffic impact study to identify and assess future traffic impacts caused by the proposed project identifies and evaluates the potential impact of the traffic generated by the proposed terminal in the year 1990 when the project is expected to be in operation. Impacts are assessed with the proposed project during the morning and afternoon peak hours.

The analysis primarily focuses on the access intersection of Ala Moana Boulevard and South Street. The intersection provides access and egress to the project from all directions. The report discusses the impact on the intersection by determining the Levels-of-Service (LOS), and presents the findings and recommendations.

The results of the traffic operation analysis indicate that the proposed APL Fort Armstrong Container Terminal Operation will not significantly change the traffic flow quality because of its operation commencing in 1990. The operational analysis for the signalized intersection indicates no change in the LOS during the morning and afternoon peak hours. However, field observations indicate the study intersection is presently operating near LOS F during the morning and afternoon peak hours because of existing congested conditions. The analysis of existing conditions suggests better than actual LOS because of congestion at other intersections downstream.

The maximum number of vehicles entering and leaving the APL facility will occur during ship unloading and will amount to 27 entering and 27 leaving per hour. At this level of trips, the impact on the intersection traffic flow is negligible (Pacific Planning & Engineering, 1989).

Because the increase in traffic generated by the proposed project is not expected to significantly affect the existing traffic conditions, the recommendations for mitigation are intended to improve already congested conditions. These recommendations are:

- Whenever practical, schedule the delivery of loaded containers during the non-peak traffic hours.

- Schedule the return of empty containers to avoid the peak hour traffic.

- Coordinate with DOT-Harbors to achieve a scheduling plan that best serves the community.

### Historic/Archaeological Resources

The two historic buildings at Fort Armstrong will not be affected by the project.

### Social and Economic Conditions

The proposed project will provide economic and social benefits through improved cargo-handling facilities, the creation of additional jobs, and an additional carrier to import materials needed in Hawaii. The improved cargo-handling facilities will also be available for use by other vessels, resulting in greater efficiency of operations for all carriers. The addition of a third shipping company to the state provides greater opportunities for increased service levels and an alternative carrier in case of natural or man-made disasters, such as strikes. The project will also provide an alternative method of exporting materials to the Orient.

### Aesthetics

Some people will consider the gantry cranes to be aesthetically unpleasing and to obstruct views. Others will regard them as an interesting and natural part of harbor activity. In any case, this is an interim situation. The cranes will be relocated when permanent cargo handling facilities are constructed.

# CHAPTER IV

# ALTERNATIVES TO THE PROPOSED ACTION

## PROJECT ALTERNATIVES

The alternative to installation of the gantry cranes is to utilize mobile cranes for operations on a permanent rather than an interim basis.

## SITE ALTERNATIVES

Barbers Point was considered by American President Lines as an alternative to Fort Armstrong.

After extensive analysis (including a detailed computer simulation), it was found that Barbers Point Harbor would be unsafe for APL's vessels as it is presently constructed. Barbers Point Harbor was originally designed for vessels much smaller than those which APL intends to employ in its Hawaiian service.

## NO ACTION ALTERNATIVE

If the proposed project is not implemented, there will be no improvements to the existing cargo-handling facilities and no additional jobs will be created. There will be no opportunities resulting in increased service levels, nor an alternative carrier in case of natural or man-made disasters, such as strikes.

# CHAPTER V

## DETERMINATION

Since no adverse impacts are anticipated, a determination has been made that an environmental impact statement is not required.

## CHAPTER VI

## FINDINGS AND REASONS SUPPORTING DETERMINATION

Chapter 200 (Environmental Impact Statement Rules) of Title 11 Administrative Rules of the State Department of Health specifies criteria for determining if an action may have a significant effect on the environment. The relationship of the proposed project to these criteria is discussed below.

(1) *Involves an irrevocable commitment to loss or destruction of any natural or cultural resource;*

The project site has been modified extensively and has no natural resources. The only cultural resources in the area are the historic buildings which will not be affected.

(2) *Curtails the range of beneficial uses of the environment;*

The proposed facilities are located on a site currently used for the same purpose as the proposed use. Similar facilities were in place on the site until 1981.

(3) *Conflicts with the state's long-term environmental policies or goals and guidelines as expressed in Chapter 344, Hawaii Revised Statutes, and any revisions thereof and amendments thereto, court decisions or executive orders;*

The project does not conflict with long-term state environmental policies or goals.

(4) *Substantially affects the economic or social welfare of the community or state;*

The proposed improvements will provide economic and social benefits through the addition of cargo handling facilities and the creation of additional jobs and an alternative carrier to import materials needed in Hawaii. It will also provide an alternative method of exporting materials to the Orient.

(5) *Substantially affects public health;*

Public health is not threatened by existing facilities and functions at the site and there is no reason to expect that public health to be affected in the future by the new facilities.

(6) *Involves substantial secondary impacts, such as population changes or effects on public facilities;*

The project does not involve substantial secondary impacts such as population changes or effects on public facilities. Water, sewer, drainage, and transportation systems are adequate to serve the project.

(7) *Involves a substantial degradation of environmental quality;*

Environmental impacts will be minor. Environmental quality will not be significantly degraded.

(8) *Is individually limited but cumulatively has considerable effect upon the environment or involves a commitment for larger actions;*

The proposed project is viewed as an interim facility and is consistent with the state's waterfront master plan. It neither involves a commitment for a larger action nor results in significant adverse effects upon the environment.

(9) *Substantially affects a rare, threatened or endangered species, or its habitat;*

There are no rare, threatened, or endangered species (plant or animal) on the project site.

(10) *Detrimentally affects air or water quality or ambient noise levels;*

Noise and dust are unavoidable short-term consequences of construction but can be mitigated through strict adherence to public health regulations governing air pollution and noise.

There will be no impact on water quality. Impacts on air quality will be short-term and should not result in a violation of standards. Noise associated with operation of the cranes and cargo handling at the facility may pose a short-term nuisance for users of Sand Island State Park and residents of high-rise buildings across from the facility.

(11) *Affects an environmentally sensitive area such as a flood plain, tsunami zone, erosion-prone area, geologically hazardous land, estuary, fresh water, or coastal waters.*

The project is located in a coastal area within a tsunami zone. The use is consistent with existing land use regulations for the area.

Edward Y. Hirata
Director of Transportation

11/16/89
Date

# CHAPTER VII

## AGENCIES, ORGANIZATIONS AND INDIVIDUALS CONSULTED

### CONSULTED PARTIES

The following agencies and individuals were consulted during the preparation of this environmental assessment:

Department of Health
Environmental Protection & Health Services Division
Thomas Anamizu, Noise and Radiation Branch

Department of Land and Natural Resources
State Parks, Outdoor Recreation, and Historic Sites Division
Daniel Quinn, Planning Branch

Department of Transportation
Harbors Division
Harry H. Murakami, Engineering Branch
Elton Teshima, Engineering Branch
Artemio Delos Reyes, Property Management
James Costello, Oahu District Harbor Master

Office of State Planning
Edgar S. Marcus, Honolulu Waterfront Master Project

Hawaii Community Development Authority
Arnold K. Imaoka, Planner

City and County of Honolulu
Department of Land Utilization
Bennett Mark, Planner

Hawaii Stevedores, Inc.
George Serikaku, Vice-President

## PREPARERS

The following firms were involved in the preparation of this environmental assessment:

Kennedy/Jenks/Chilton

KRP Information Services

Pacific Planning & Engineering, Inc.

Darby & Associates

Michael Brandman Associates

## REFERENCES


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Pacific Planning & Engineering, Inc. *Traffic Impact Assessment Report for APL Fort Armstrong Container Terminal.* 1989.

FIGURES

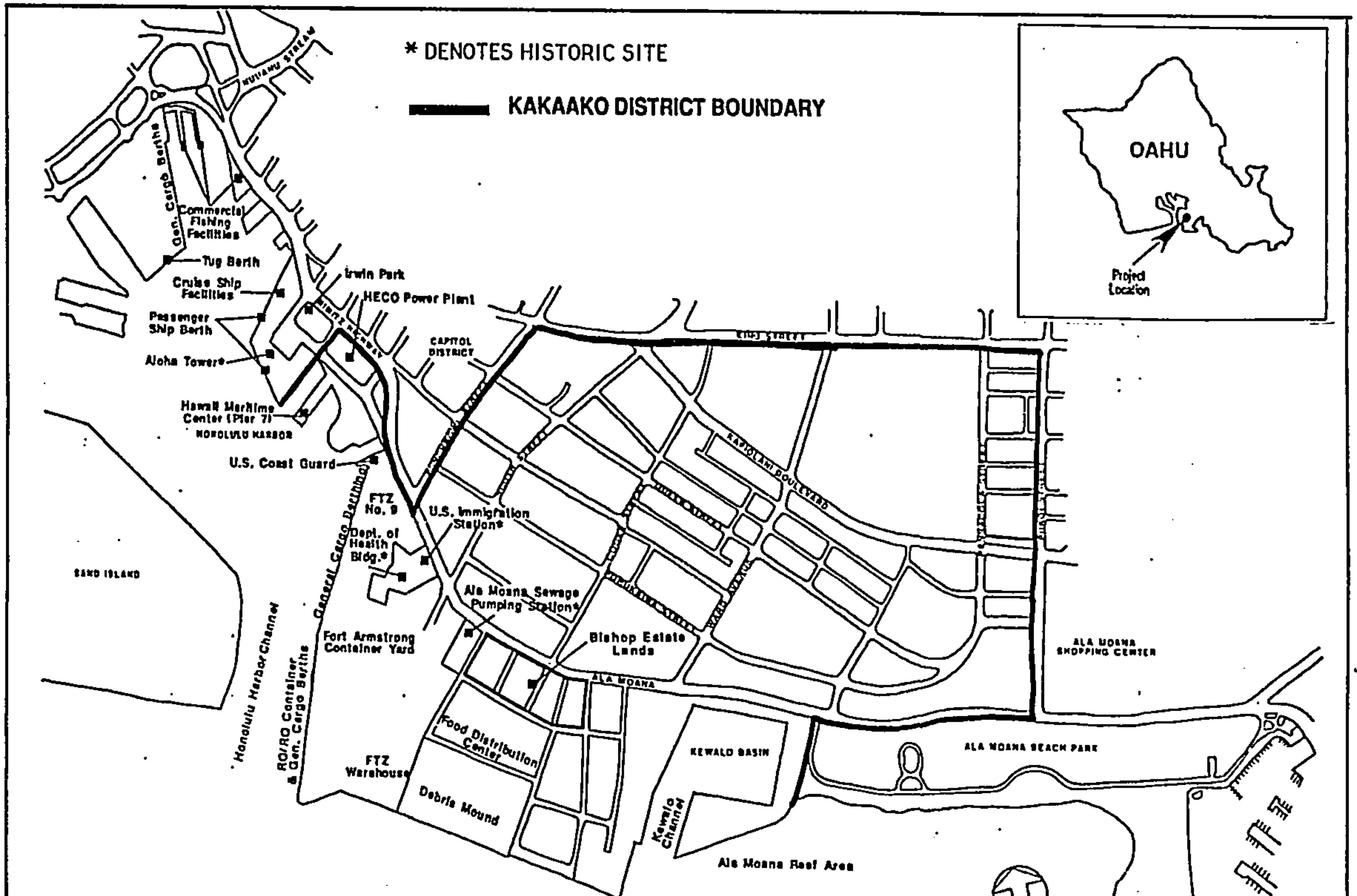
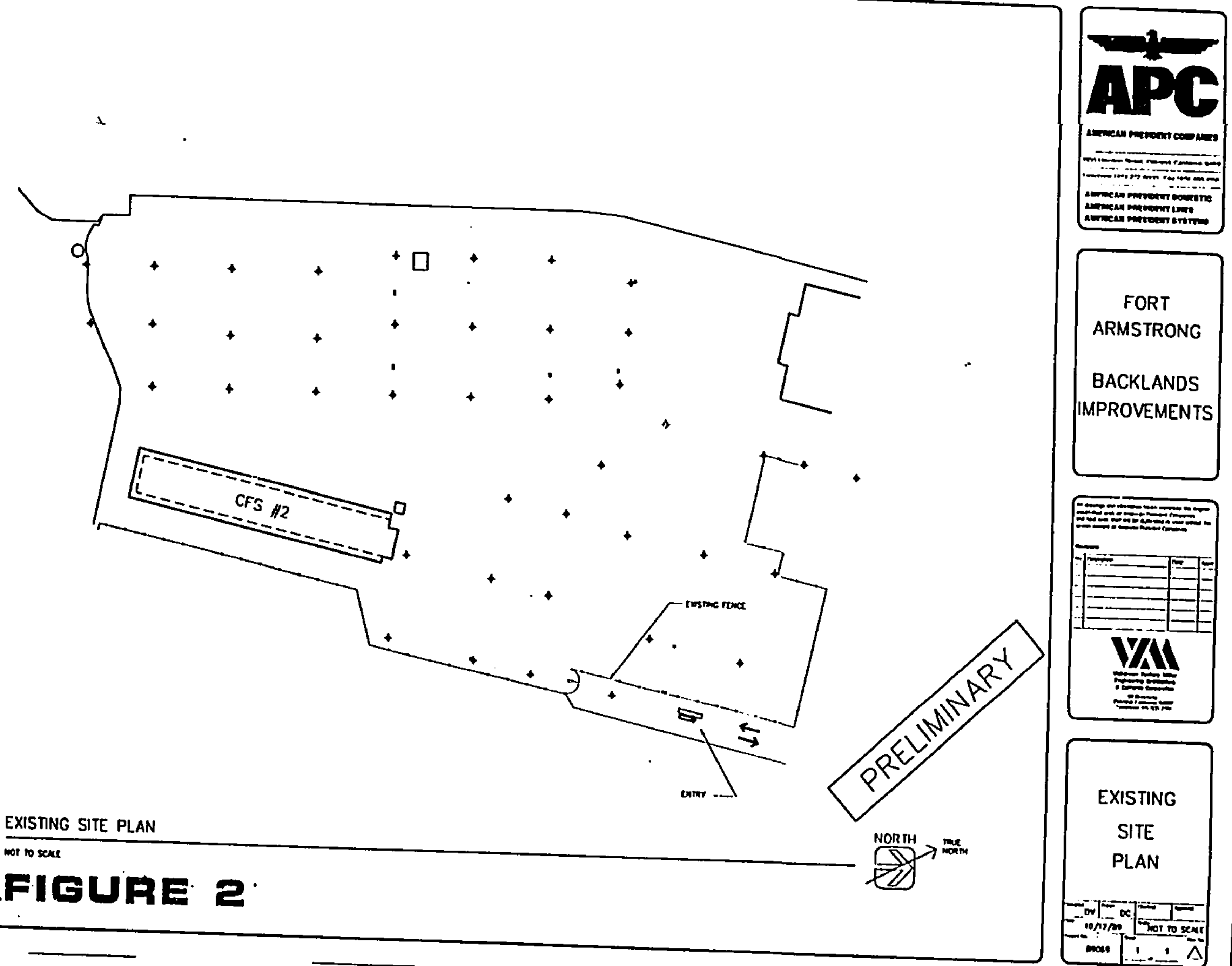



Figure 1
**PROJECT AREA**
(Not to Scale)

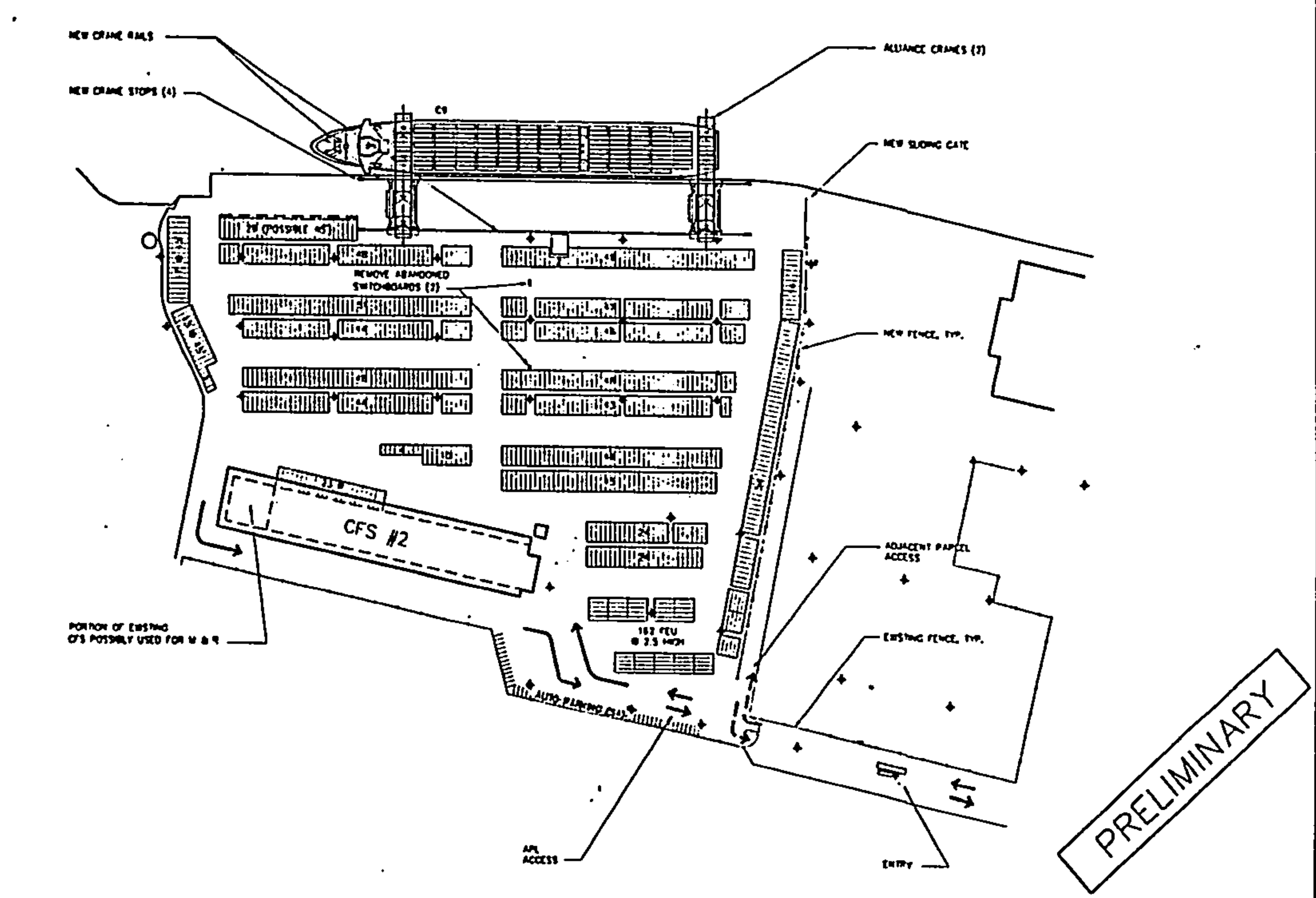
Adapted from *The Honolulu Waterfront* Background and Parameters
Hawaii Community Development Authority October, 1987




EXISTING SITE PLAN

NOT TO SCALE

**FIGURE 2**




PROPOSED SITE PLAN

NOT TO SCALE

APPROXIMATE AREA = 27.5 ACRES

**FIGURE 3**

APC
AMERICAN PRESIDENT COMPANIES
AMERICAN PRESIDENT DOMESTIC
AMERICAN PRESIDENT LINES
AMERICAN PRESIDENT SYSTEMS

FORT ARMSTRONG
BACKLANDS IMPROVEMENTS

PROPOSED SITE PLAN

DY | DC | 10/12/89 | NOT TO SCALE | 89069

FILE COPY

# Noise Impact Analysis
# for the Proposed Container Facility
# by American President Lines (APL)
# at Fort Armstrong
# Honolulu, Hawaii

October 1989

---

Darby & Associates
Acoustical Consultants

DARBY & ASSOCIATES
ACOUSTICAL CONSULTANTS

89-25
October 11, 1989

Kennedy/Jenks/Chilton
1164 Bishop Street, Suite 1400
Honolulu, HI 96813

Attention: Mr. Henry Sumida

Subject: Noise Impact Analysis for the Proposed Container Facility by American President Lines (APL) at Fort Armstrong, Honolulu, Hawaii

Dear Mr. Sumida:

Following are our findings and evaluations regarding the subject project:

I. Description of the Proposed Action - Noise

American President Lines, Ltd. (APL) proposes to improve the cargo loading and unloading facilities of Pier 1 at Fort Armstrong. Two 100 feet wide gantry cranes will be installed along approximately 800' of the wharf. The existing waterside rail will be replaced and a new grade beam 100 feet inland will be constructed. The cranes will be similar to those previously used for loading and unloading containers at Pier 1 by Matson Navigation before its operations were moved to Sand Island in 1981. The main difference between the two operations is that the APL cranes will be diesel-powered rather than electric and the rails will be 100' apart rather than 32'.

In addition to the crane rails, construction will include: segmenting and remodeling a portion of the existing Container Freight Station #2,

PALI PALMS PLAZA • 970 NO. KALAHEO AVENUE • SUITE A-311
KAILUA, HAWAII 96734 • (808) 254-3318 • FAX (808) 254-5295

tower and office building. Ten tractors, two fork lifts for stacking and unstacking empties, and two pick-up trucks will be used in operations.

Currently, plans are for APL's vessels to arrive in Honolulu from the West Coast---Los Angeles and Oakland--weekly, enroute to Guam and the Far East before returning to the West Coast. The ships are tentatively scheduled to arrive in Honolulu on Tuesday and depart on Wednesday. They will be berthed at Pier 1 for about 26 hours. A total of five vessels will be calling at Honolulu -three C9's and two of APL's three C8's. The C9 vessels are capable of carrying a total of 1195 FEU's (forty-foot equivalent units) and are about 860 feet in length. The C8's carry 875 FEU's and are about 800 feet in length. The C9's are diesel propelled while the C8's are propelled by steam engines.

The terminal will normally be open Monday through Friday from 8:00 am to 5:00 pm for pickup and delivery of containers. Arriving vessels will be worked on a 24-hour basis while they are in port by two diesel powered gantry cranes. All of the containers coming off the ship will be placed on chassis and/or stacked in the yard ready for pick-up. The vast majority of containers returning to the yard will be empty and will be block stowed (stacked 3 or 4 high) on the ground.

Most of the inbound containers from the mainland will be picked up and delivered to the consignees within 48 to 72 hours after discharge from the ship. This will require about 215 drays, or local moves per day, or about 27 per hour through the gate based on an 8-5 schedule, although it may be necessary to keep the gate open longer than 8-5 to accomplish this. Outbound empties will return to the yard on a fairly even basis throughout the week.

Operations will take place on an interim basis using mobile cranes until the gantry cranes can be installed. Interim operations are not expected to last more than six months.

## II. Description of the Affected Environment - Noise

Maritime industrial uses now occupy approximately 75 acres within the Fort Armstrong Area at Piers 1 and 2. This area, once the primary container cargo facility on Oahu, is currently dedicated to maritime break-bulk, periodic container cargo operations, ship maintenance operations, and the Foreign Trade Zone warehouse and offices used by the State Department of Health and U.S. Immigrations. The complex is bordered on the east by a food distribution center, the Ala Moana Sewage Pumping Station, and commercial buildings.

The nearest potentially noise sensitive areas to the project site are the Waterfront-Tower highrise condominiums on South St. (now under construction); the Harbor Square Condominium; and the Family Camping Area on Sand Island across Honolulu Harbor Channel. See Figure 1.

The noise environment at the highrise condominiums is normally dominated by motor vehicular traffic. Noise from traffic on the main artery through the area, Ala Moana Boulevard/Nimitz Highway, is shown to cause maximum hourly noise levels of 65 dB to persons on lanais in highrises at distances of 250 to 350 feet from the roadway. During evenings, when traffic volumes decrease by about one-third, the average hourly noise levels would be about 5 dB less. Between 2 a.m. to 5 a.m., when traffic levels are only about 250 vehicles per hour, the noise level may decrease by 10 to 12 dB.

Aircraft operations from Honolulu International Airport create a Day-Night Noise Level ($L_{dn}$) range of 55 to 60 $L_{dn}$ for the highrise condominiums mentioned, while the camping area on Sand Island experiences 65 to 70 $L_{dn}$. Typical maximum noise levels from aircraft departures were measured in the camping area on September 13, 1989, as 74 to 78 dB for interisland jet aircraft taking-off from the mauka runway (08L) while transoceanic aircraft causes 72 to 76 dB departing from the Reef Runway (08R). Some military aircraft departures readily cause maximum noise levels at least 10 dB greater than the commercial jet aircraft.

Present maritime operations from Piers 1 and 2 can also be audible at the noise sensitive areas mentioned when lulls occur in traffic and in-between aircraft flights. Loading and unloading ships and barges may occur during the stevedore's second shift from 6 p.m. to 5 a.m. Table I from reference 1 provides a summary of noise events measured on the site. On September 13th and 19th, 1989, front-end loaders servicing barges at Pier 1 could be heard at times during the day in the Sand Island camping area--both diesel engine sounds (during acceleration) and back-up alarms were detectable. Also, tractor trucks pulling out of the pier area were audible on occasion in the camping area. Diesel powered mobile cranes, commonly used in loading and unloading ships and barges also may be audible in the environs at times. It is also conceivable that the auxiliary power systems in some ships may be heard, particularly if high velocity gas is exhausted at elevated heights through stacks.

The noise from existing maritime operations at Fort Armstrong should usually be in compliance with the State Department of Health (DOH) noise regulations which allow 70 dBA to be generated for 90% of the time at the property line in industrial zoned districts (reference 2). During 10% of the time in a 20 minute period, 70 dBA can be exceeded. It is to be noted that the project area has been zoned industrial prior to the development of nearby condominiums and the park. The DOH regulations state that the allowable noise levels shall apply subject to the order of precedence in which land uses were initiated. Thus, industrial limits apply to the site even if new residential units are developed close to the facility. Also, it is to be noted that the regulations do not apply to "boat whistles, horns...and boats operating in any harbor."

III. Probable Impacts of the Proposed Action and Mitigation Measures -Noise

The proposed action involves continued use of the Fort Armstrong project area for ship loading and unloading operations using the same, or similar, equipment and vehicles except for the 100 foot wide diesel-powered gantry cranes. The main difference in noise impact to potentially noise sensitive areas will be (a.) possible audible sounds from the diesel engines in the new cranes during quiet periods in the noise sensitive areas, and (b.) a reduction in noise at the Sand Island camping area from non-elevated noise sources, e.g., front-end loaders, tractors, and mobile cranes which will be somewhat shielded by the ship at Pier 1.

Each gantry crane will have as primary power one Caterpillar D-399, 1,000 horsepower at 1200 rpm diesel engine driving an electric generator and one secondary power source consisting of a Caterpillar D-333, 300 horsepower at 1800 rpm diesel engine also driving an electric generator. These power units will be mounted about 64 feet above ground level on the cranes in an enclosure. See Figure 2. Engine exhaust mufflers will be provided. There should be no problem in meeting 70 dBA at the property lines in the direction of the highrise condominiums. If noise complaints occur from campers on Sand Island and it is shown that 70 dBA is exceed 10% of the time during a 20-minute period at the property line, then noise mitigation measures will be implemented; e.g., upgrading the engine exhaust silencers and/or installing acoustic treatment in the power unit enclosures. For example, assuming that the primary engine is located 50 feet from the property line, it has a rated exhaust noise level of 88 dBA at 50 feet with no exhaust muffling. Exhaust silencers with attenuations greater than 20 dBA are readily available. Similarly, mechanical noise for the D399 is rated at 83 dBA at 50 feet. Partial noise enclosures can be realistically implemented to reduce this noise source by 15 dBA if required.

The APL operation is estimated to handle about 19 refrigeration containers per week. On board, these containers use the ship's electrical system and should not be a major noise source.

Similarly, when unloaded, they will be operated by shoreside power. Thus, the refrigeration containers should not constitute major noise sources.

Also of consideration is the possible increase in traffic noise on Ala Moana Blvd. and South St. due to container trucks servicing the APL operations. The traffic study (reference 3) estimates that during a typical busy day after a ship has arrived that there will be about 27 trucks per hour arriving and about 27 trucks per hour departing. Using these data and the distribution of truck movements on Ala Moana Blvd. and South St., as well as the typical traffic volumes on those streets without the project generated traffic, increases in traffic noise levels due to the project have been estimated.

Calculations using a traffic noise computer model (reference 4) indicate that the additional trucks from the project on Ala Moana Blvd. will increase the average hourly noise level (HNL) by less than one (1.0) dBA during the hours from 8 am to 5 pm. During the morning on South St., the HNL may be increased by one-half (0.5) to one (1.0) dBA, while during the afternoons, the increase may range from one and one-half (1.5) to two (2.0) dBA.

Thus, it can be seen that in the worst case the increase in average traffic noise due to the proposed action should not exceed 2 dBA.

Also, it should be noted that similar scenarios and noise events presently occur when ships and barges are processed at Pier 1. Another consideration is that the container trucks are subject to the maximum noise levels allowed in the locally enforced motor vehicle noise regulations (reference 5).

The potential impact from construction noise to sensitive areas should be limited to the sounds from the demolition activities and the building of improvements needed for the cranes. Since it is anticipated that noise generated during construction will exceed allowable limits in reference 2, a permit will be obtained from DOH. DOH may grant permits to operate vehicles, construction equipment, power tools, etc. which emit noise levels in excess of the allowable limits. Required permit conditions for construction activities are:

"No permit shall allow construction activities creating excessive noise...before 7:00 am and after 6:00 pm of the same day."

"No permit shall allow construction activities which emit noise in excess of ninety-five dB(A)...except between 9:00 am and 5:30 pm of the same day."

"No permit shall allow construction activities which exceed the allowable noise levels on Sundays and on...[certain] holidays. Activities exceeding ninety-five dB(A) shall [also] be prohibited on Saturdays."

In addition, construction equipment and on-site vehicles or devices requiring an exhaust of gas or air must be equipped with mufflers.

Also, construction vehicles using traffic ways will satisfy the noise level requirements defined in reference 5.

IV. Summary

An analysis has been made of the potential noise impact from the proposed APL container facility at Fort Armstrong. The area is presently zoned industrial and is now used for similar maritime operations, except that APL proposes to install two gantry cranes and have scheduled service. The nearest noise sensitive areas are highrise condominium units mauka of Ala Moana Blvd. and the family camping area in Sand Island Park across the channel. These areas now experience significant motor vehicle noise, aircraft noise, and sounds from existing maritime and industrial operations. It is shown that the new cranes can meet State DOH noise regulations if required and that the additional container truck traffic from the project on Ala Moana Blvd. and South St. would cause less than a 2 dB increase in the hourly average noise level.

Sincerely,

Ronald A. Darby, P.E.

RAD/ld

References:

1. "Acoustic Study - Honolulu Waterfront Master Plan," by Darby & Associates, October 24, 1988.

2. "Chapter 43 - Community Noise Control for Oahu," Department of Health, State of Hawaii, Administrative Rules, Title 11, 1981.

3. "Traffic Impact Assessment Report for APL Fort Armstrong Container Terminal," by Pacific Planning & Engineering, Inc., October 1989.

4. "FHWA Highway Traffic Noise Prediction Model," Federal Highway Administration, December 1978.

5. "Chapter 42 - Vehicular Noise Control for Oahu,' Department of Health, State of Hawaii, Administrative Rules, Title 11, 1981.

TABLE I - Summary of Activities and Measured Noise Levels on August 30, 1988, at the Fort Armstrong Container Handling Facility

| Activity | (Approx. Feet) Distance to Source | dBA Maximum Noise Level |
|---|---|---|
| Incoming & Outgoing Trucks | 100' | 70-78 |
| Loading & Unloading by Forklift | 150' | 72-78 |
| Reverse Beep Alarm from Forklift | 150' | 72-76 |
| Heavy Forklift | 100' | 73-80 |
| Aircraft Flyover | - | 70-74 |

Note: The noise level exceeded 10% of the time ($L_{10}$) for the period from 2:17 p.m. to 2:42 p.m. was 75 ± 3 dBA.

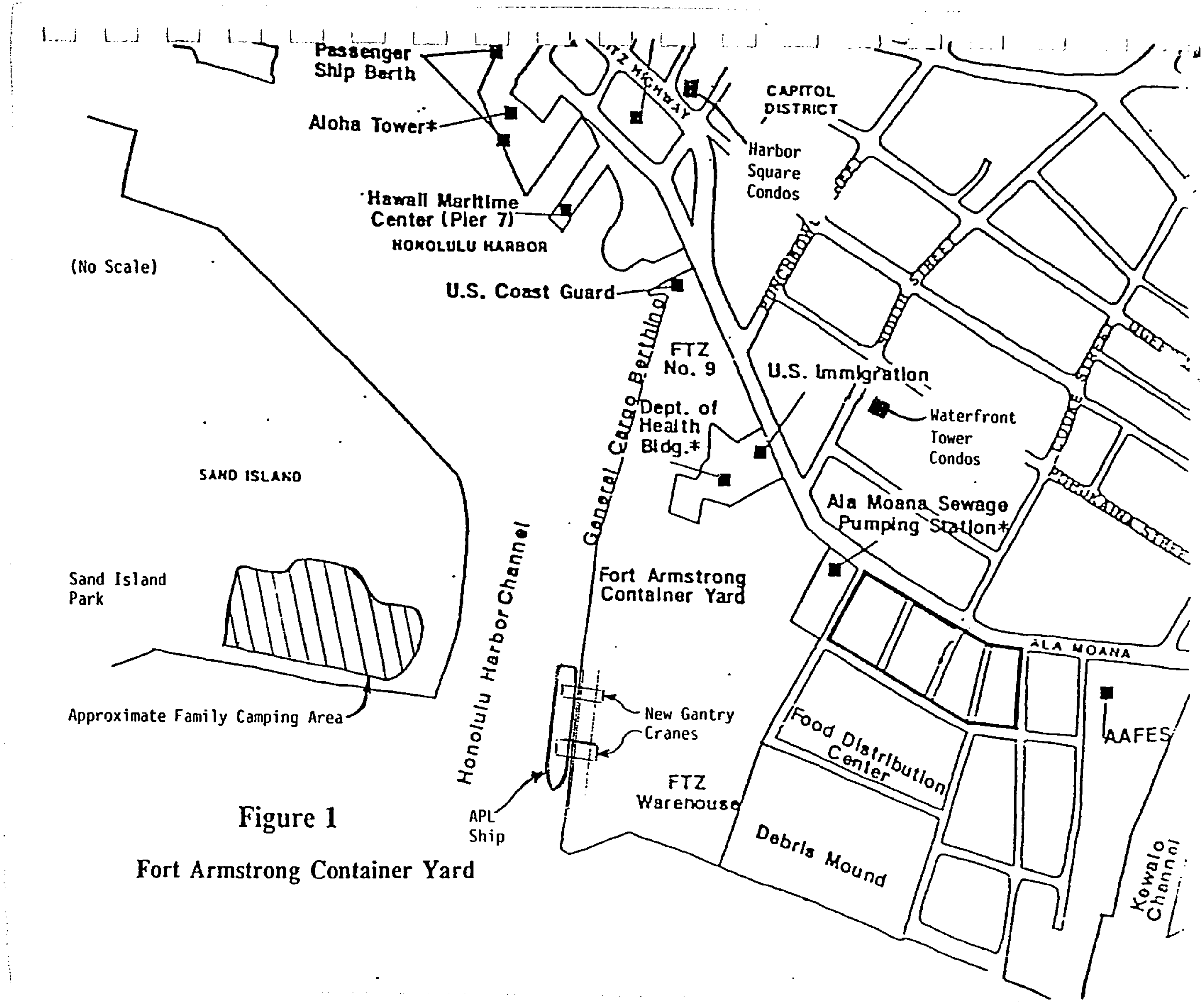



Figure 1

Fort Armstrong Container Yard

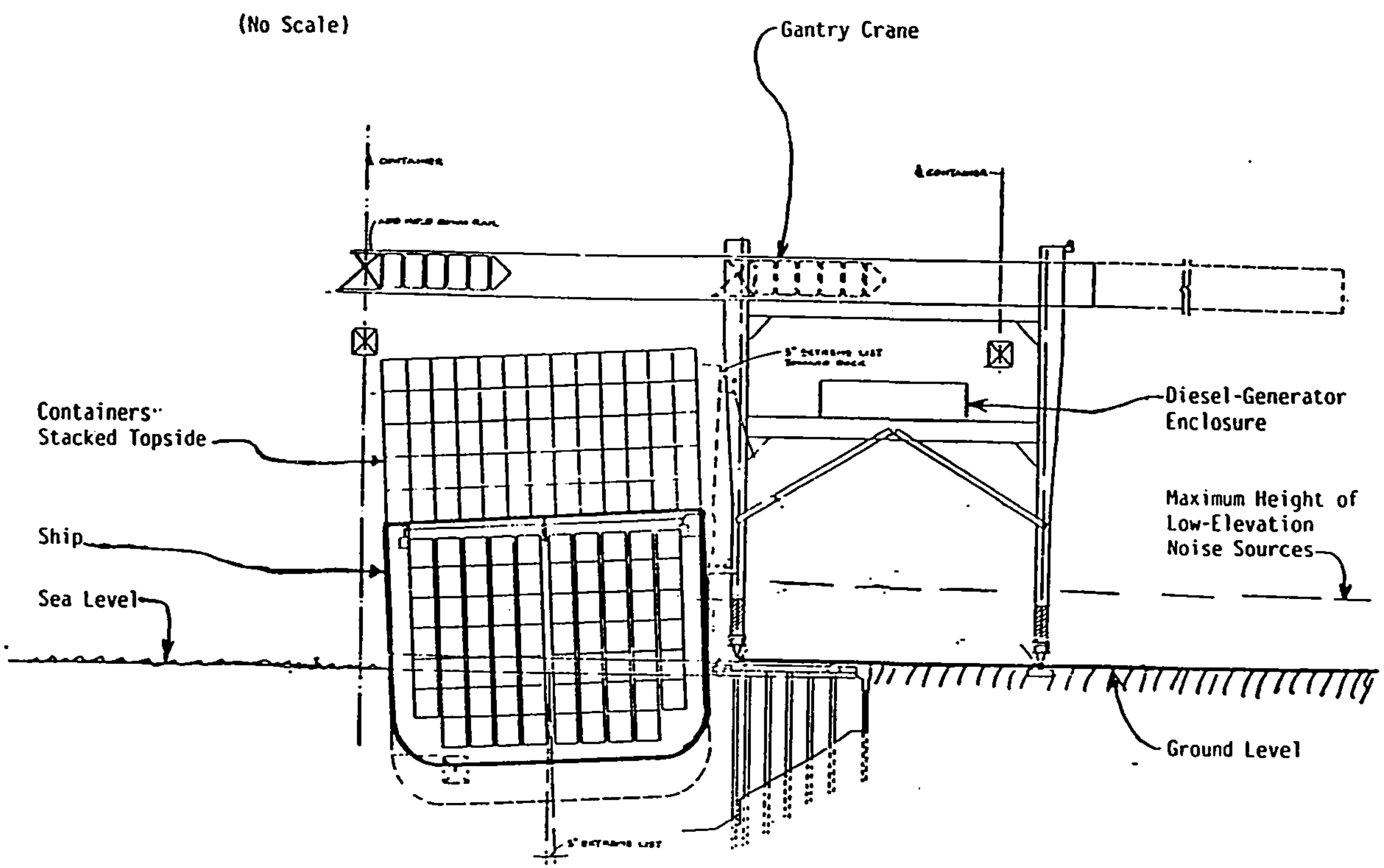



FIGURE 2 - Section Through Container Ship Showing Gantry Cranes

**AIR QUALITY ANALYSIS**
**PROPOSED CONTAINER YARD IMPROVEMENTS**
**AMERICAN PRESIDENT LINES -**
**FORT ARMSTRONG FACILITY**
**HONOLULU, HAWAII**

# FILE COPY

Prepared for:

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October 20, 1989

TABLE OF CONTENTS

Section Page

1 INTRODUCTION .......... 1

2 ENVIRONMENTAL SETTING .......... 2

2.1 Regional Setting .......... 2
2.1.1 Climate and Meteorology .......... 2
2.1.2 Micro-Climate of Honolulu .......... 3

2.2 Regional Air Quality .......... 4

2.3 Local Air Quality .......... 5

3 PROJECT IMPACTS .......... 11

3.1 Short-Term Emissions .......... 11

3.2 Long-Term Dock Area Source Emissions .......... 12

3.2.1 Commercial Vessels .......... 12
3.2.2 Dock Operations Equipment .......... 13

3.3 Long-Term Mobile Source Emissions .......... 15

3.3.1 Regional Air Quality .......... 17
3.3.2 Local Air Quality .......... 17

4 CONCLUSIONS .......... 21

5 MITIGATION MEASURES .......... 22

5.1 Short-Term (Construction) Emissions .......... 22
5.2 Long-Term Emissions .......... 22

6 UNAVOIDABLE IMPACTS .......... 23

7 REFERENCES .......... 24

**TABLE OF CONTENTS (continued)**

Appendices


Construction Equipment Emissions Spreadsheet Calculations

Mobile Source Emission Factor Model (MOBILE4) Computer Printouts -- 1989 and 1990 Conditions

Air Quality Dispersion Model (CALINE4) Input and Output Computer Printouts

## LIST OF TABLES


| Table | | Page |
|---|---|---|
| 1 | Summary of State of Hawaii and Federal Ambient Air Quality Standards | 6 |
| 2 | Summary of Annual Air Quality Data Sand Island Air Quality Monitoring Station | 7 |
| 3 | Summary of Annual Air Quality Data Dept. of Health Bldg. - Downtown Honolulu Air Quality Monitoring Station | 8 |
| 4 | Summary of Annual Air Quality Data Liliha Air Quality Monitoring Station | 9 |
| 5 | Commercial Vessel Emissions | 14 |
| 6 | Fort Armstrong Container Yard Dock Operations Equipment Emissions | 16 |
| 7 | Project-Related Mobile Source Pollutant Emissions Container Yard Diesel Truck Traffic | 16 |
| 8 | Maximum Carbon Monoxide Concentrations | 18 |

## LIST OF EXHIBITS


| Exhibit | | Follows Page |
|---|---|---|
| A | Air Sampling Sites - Oahu, Hawaii | 4 |
| B | Caline 4 Model Receptor Locations | 17 |

## SECTION 1
## INTRODUCTION

The following report on the possible air quality impacts of the proposed container yard improvements for the American President Lines Ft. Armstrong facility in Honolulu, Hawaii was prepared for Kennedy/Jenks/Chilton by Michael Brandman Associates, Inc. (MBA). The project consists of adding improvements to an already existing and operating docksite. Currently, the Ft. Armstrong facility consists of general container and cargo berths, Foreign Trade Zone offices, warehouses, and open paved storage areas. The proposed improvements would entail one weekly scheduling of vessel berths, container unloading and transfer to trucks for hauling, and the addition of dock-side container handling equipment, including two diesel-powered cargo-unloading cranes. American President Lines vessel operations would occur over a single 26-hour period each week (52 times per year).

SECTION 2

ENVIRONMENTAL SETTING

## 2.1 REGIONAL SETTING

### 2.1.1 CLIMATE AND METEOROLOGY

The outstanding features of Hawaii's climate include mild and equable temperatures year-round, moderate humidities, persistence of northeasterly trade winds, remarkable differences in rainfall within short distances, and infrequency of severe storms. In most of Hawaii there are only two seasons: "summer" and "winter." In "summer," between about May and October, the sun is more nearly overhead, the weather warmer and drier, and the trade winds most persistent. In "winter," between October and April, the sun is in the south, the weather cooler, and the trade winds are more often interrupted by other winds and by intervals of widespread cloudiness and rain. Hawaii's climate reflects chiefly the interplay of four factors: latitude, the surrounding ocean, the island's location relative to the storm tracks and the Pacific anticyclone, and terrain.

Hawaii is well within the tropical latitudes, which accounts for the relative uniformity throughout the year in length of day and received solar energy, and hence in temperature. The surrounding ocean supplies moisture to the air and acts as a giant thermostat since its own temperature varies little compared to that of large, continental land masses. The seasonal range of sea surface temperature near Hawaii is only 6 degrees (F). Because Hawaii is more than 2,000 miles from the nearest continental land mass, air that reaches it, regardless of its source, spends enough time over the equable ocean to moderate the harsher properties, including pollution, with which it may have begun its journey. Hawaii's warmest months are not June and July, when the sun is highest, but August and September; and its coolest months, not December, when the sun is farthest south and days are shortest, but February and March, reflecting the seasonal lag in the ocean's temperature.

The effects of the so-called storm tracks lying to the north of Hawaii are predominantly blocked by the "semi-stationary" Pacific High or anticyclone, a large mass of stable air generally situated northeast of Hawaii so that air moving outward from it streams past the islands as a northeasterly wind. These are the northeasterly trade winds, whose persistence directly reflects that of the Pacific High from which they come. The Pacific High follows the seasonal shift of the sun, moving northward in summer, southward in winter, and tends to be stronger in summer than in winter. In winter, with the weakening and occasional absence of the Pacific High and the closer approach of the storm tracks, the trade winds may be interrupted for days at a time by the invasion of the fronts of more northerly latitudes and by Kona storms which form nearer by. Hence, winter is the season of more frequent cloudiness and rainstorms, and southerly and westerly winds replace the trades for shorter or longer periods. Hawaii's heaviest rains are brought by winter storms during the October to April season.

Hawaii's terrain, with its endless variety of peaks, valleys, ridges, and broad slopes, profoundly influences every aspect of Hawaii's weather and climate. The mountains obstruct, deflect, and accelerate the flow of air. Where the warm, moist trade winds are forced to rise over windward coasts and slopes, cloudiness and rainfall are much greater than over the nearby open sea. Leeward areas, where the air descends, tend to be sunny and dry. Other sources of rainfall are the towering cumulus clouds that build up over mountains and interiors on sunny calm afternoons. Although such convection storms may be intense, they are usually brief and localized. It is these aspects, influenced by terrain, that create within the small compass of the islands a variety of microclimates that would not exist for flat islands of the same size.

### 2.1.2 MICRO-CLIMATE OF HONOLULU

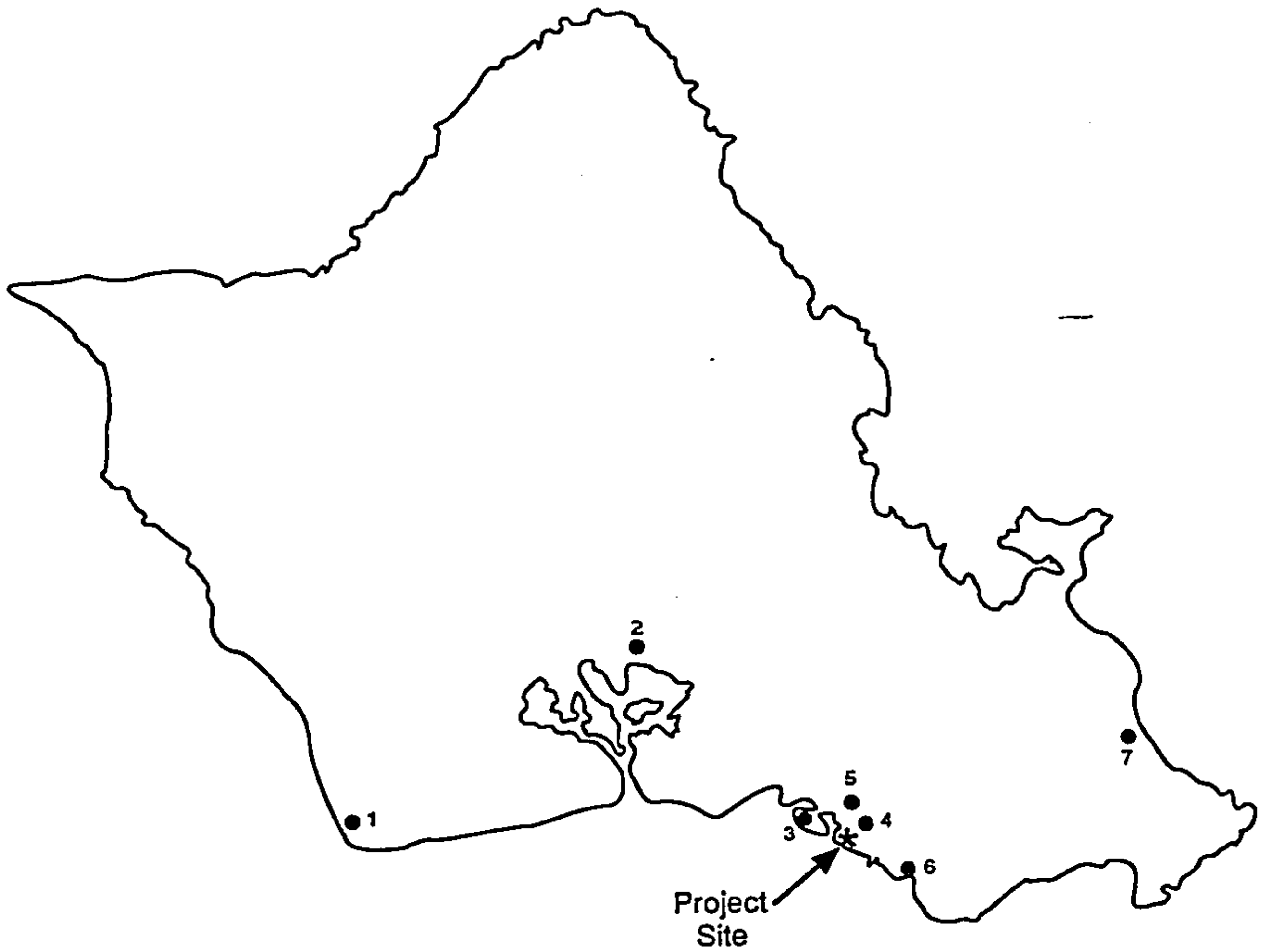
The project site is located in Ft. Armstrong at the center of the Honolulu waterfront approximately one-half mile south of downtown Honolulu. Honolulu lies on the leeside of the island of Oahu and its local climate demonstrates the associated effects described above. Rainfall averages 23.47 inches per year, a significant amount, but considerably less than windward areas of the island. Annual average daytime temperatures range from 88.3 degrees (F) in August to 79.9 degrees (F) in January. Average overnight low temperatures are maintained at a balmy 73.6 degrees (F) in summer and drop to 65.3 degrees (F) during winter. The small range of temperatures diurnally and throughout the year reflects the tropical latitude and oceanic influences. Relative humidity averages 68.5 percent annually.

Winds across the project area are an important meteorological parameter since they control both the initial rate of dilution of locally generated air pollutant emissions, as well as controlling their regional trajectory. The predominant wind pattern throughout the year at Honolulu is the northeasterly trade wind. These winds average 11.5 miles per hour (mph) annually, providing good ventilation for the local air quality. Between October and April, Honolulu may come under the influence of the southerly winds of Kona storms or of the southwesterly winds that precede and the northerly winds that follow cold fronts. These storm winds, as well as the trades, are sometimes strong enough to damage vegetation and structures. In the absence of the trades and of nearby storms, winds may become light and variable. Under these conditions, the effects of diurnal heating and cooling of the island are enhanced, giving rise to onshore sea breezes during the day and offshore land breezes at night.

## 2.2 REGIONAL AIR QUALITY

The Pollution Investigation and Enforcement Branch of the State of Hawaii Department of Health, Environmental Protection and Health Services Division is responsible for the sampling of ambient air quality and maintaining data from a network of air quality monitoring stations throughout the state. Prior to February 1971, ambient air quality monitoring was performed on a continuing basis at only one site in the State of Hawaii. Since that time, several additions, relocations, and discontinuations have occurred, and the air quality monitoring network expanded substantially to include a total of 10 active sites throughout the state at the end of 1987. Exhibit A shows the current locations of the air quality monitoring stations for the Island of Oahu, and the proximity of the project site.

Pollutant levels in air samples are compared to federal and state standards to determine air quality. These standards are set by the U.S. Environmental Protection Agency (EPA) and the State of Hawaii Department of Health at levels to protect public health and welfare with an adequate margin of safety. Both federal and state standards exist for carbon monoxide, nitrogen dioxide, ozone, sulfur dioxide, and lead. State standards are imposed for all particulate matter smaller than 500 microns. In 1987, the federal Total Suspended Particulate (TSP) standard was superseded by the federal




**Legend**

● Station Location and Number

Source: State of Hawaii Department of Health, 1987

2890008 September 1989

Michael Brandman Associates

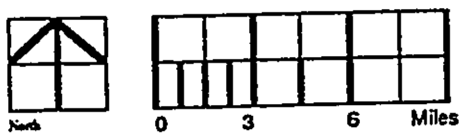



**Exhibit A**

Air Sampling Sites – Oahu, Hawaii
**APL-Ft. Armstrong Container Yard**

PM10 standard. PM10 is particulate matter 10 microns or less in diameter and is assumed to be of significant health risk due to the greater potential to penetrate the defenses of the human respiratory system. The current State of Hawaii and Federal Ambient Air Standards are listed in Table 1.

Due to extremely good ventilation from the surrounding ocean, the air over Hawaii is relatively clean and low in pollution. However, certain areas can be of concern, such as urban Honolulu, where large amounts of motor vehicles daily pour tons of exhaust gases and particulates into the air. Industrial air pollution is comparatively minor. Natural pollution from volcanic action can be severe in some areas under certain wind conditions, but occurs rarely in Honolulu. In general, natural ventilation from the predominant trade winds acts to clean regional air quality and reduce concentrations such that, on an annual basis, state and federal pollution control standards are rarely exceeded, even in the Honolulu area.

## 2.3 LOCAL AIR QUALITY

Existing ambient air pollution concentrations at the project site from both city and harbor sources can be described by sampling data at the three closest monitoring stations. These are located as follows: Station #3 at Sand Island approximately 1.25 miles to the northwest; Station #4 at the Department of Health Building in downtown Honolulu approximately 1 mile to the northeast; and Station #5 at Liliha approximately 3 miles to the north (see Exhibit A). The Sand Island Station monitors ozone, the Department of Health Station monitors particulate matter, carbon monoxide, sulfur dioxide, and lead, and the Liliha Station monitors only total suspended particulates and PM10. Air quality data for the years 1983 through 1987 are given in Tables 2, 3, and 4 for each of the three stations, respectively. Carbon monoxide readings from the Department of Health Station in downtown Honolulu represent worst-case ambient air levels for the project site.

Many physical and meteorological factors combine to allow motor vehicle pollutants to concentrate at high levels in certain parts of Honolulu. These include the site of the city in the lee of the trade winds and occasional long periods of light and variable wind flow; modified local air circulation due to tall buildings acting as obstacles to flow and higher surface temperatures caused by the heat of

TABLE 1

SUMMARY OF STATE OF HAWAII
AND FEDERAL AMBIENT AIR
QUALITY STANDARDS

| Pollutant | Hawaii State Standard | Federal Primary Standard[a] (Health) | Federal Secondary Standard[b] (Welfare) |
|---|---|---|---|
| Carbon Monoxide | | | |
| 1 hour | 10 mg/m$^3$ | 40 mg/m$^3$ | 40 mg/m$^3$ |
| 8 hour | 5 mg/m$^3$ | 10 mg/m$^3$ | 10 mg/m$^3$ |
| Nitrogen Dioxide | | | |
| 1 hour | -- | -- | -- |
| 24 hour | -- | -- | -- |
| Annual (Arithmetic) | 70 ug/m$^3$ | 100 ug/m$^3$ | 100 ug/m$^3$ |
| Particulate Matter | | | |
| 24 hour | 150 ug/m$^3$ | -- | -- |
| Annual (Arithmetic) | 60 ug/m$^3$ | -- | -- |
| PM-10[c] | | | |
| 24 hour | -- | 150 ug/m$^3$ | 150 ug/m$^3$ |
| Annual (Arithmetic) | -- | 50 ug/m$^3$ | 50 ug/m$^3$ |
| Ozone | | | |
| 1 hour | 100 ug/m$^3$ | 235 ug/m$^3$ | 235 ug/m$^3$ |
| Sulfur Dioxide | | | |
| 3 hour | 1,300 ug/m$^3$ | -- | 1,300 ug/m$^3$ |
| 24 hour | 365 ug/m$^3$ | 365 ug/m$^3$ | -- |
| Annual (Arithmetic) | 80 ug/m$^3$ | 80 ug/m$^3$ | -- |
| Lead | | | |
| 3 months (Arithmetic) | 1.5 ug/m$^3$ | 1.5 ug/m$^3$ | 1.5 ug/m$^3$ |

a Designed to prevent against adverse effects on public health.
b Designed to prevent against adverse effects on public welfare including effects on comfort, visibility, vegetation, animals, aesthetic values, and soiling and deterioration of material.
c Particulate matter which is 10 microns or less in diameter.

Source: State of Hawaii Department of Health.

TABLE 2

SUMMARY OF ANNUAL AIR QUALITY DATA
SAND ISLAND AIR QUALITY
MONITORING STATION

| Pollutant | 1983 | 1984 | 1985 | 1986 | 1987 |
|---|---|---|---|---|---|
| Ozone ($O_3$) | | | | | |
| State Standard (1-hr. avg. 100 ug/m$^3$ | | | | | |
| Federal Standard (1-hr. avg. 235 ug/m$^3$) | | | | | |
| Maximum Concentration | 123 | 104 | 198 | 88 | 84 |
| Number of Days State Standard Exceeded | 2 | 1 | 3 | 0 | 0 |

ug/m$^3$ = micrograms per cubic meter

Source: State of Hawaii Department of Health -- 1983, 1984, 1985, 1986, 1987.



JB/2890008.X

TABLE 3

SUMMARY OF ANNUAL AIR QUALITY DATA
DEPT. OF HEALTH BLDG - DOWNTOWN HONOLULU
AIR QUALITY MONITORING STATION

| Pollutant | 1983 | 1984 | 1985 | 1986 | 1987 |
|---|---|---|---|---|---|
| **Carbon Monoxide (CO)** | | | | | |
| State Standard (1-hr avg. 10 ug/m$^3$) | | | | | |
| Federal Standard (1-hr. avg. 40 ug/m$^3$) | | | | | |
| Maximum Concentration (ug/m$^3$) | 8.6 | 10.9 | 10.4 | 13.5 | 11.1 |
| Number of Days State Standard Exceeded | 0 | 1 | 1 | 3 | 1 |
| **Particulate Matter[a]** | | | | | |
| State Standard (24-hr. avg. 150 ug/m$^3$) | | | | | |
| Federal Standard (24-hr. avg. 260 ug/m$^3$) | | | | | |
| Maximum Concentration (ug/m$^3$) | 58 | 48 | 48 | 61 | 59 |
| Number of Days State Standard Exceeded | 0 | 0 | 0 | 0 | 0 |
| **Sulfur Dioxide ($SO_2$)** | | | | | |
| State Standard (AAM 80 ug/m$^3$) | | | | | |
| Federal Standard (AAM 80 ug/m$^3$) | | | | | |
| Maximum Concentration (ug/m$^3$) | 16 | <5 | <5 | 6 | 11 |
| Number of Days State Standard Exceeded | 0 | 0 | 0 | 0 | 0 |
| **Lead** | | | | | |
| State Standard ( 3 mos. 1.5 ug/m$^3$) | | | | | |
| Federal Standard (3 mos. 1.5 ug/m$^3$) | | | | | |
| Maximum Concentration (ug/m$^3$) | NM | 1.8 | 0.3 | 0.2 | 0.2 |
| Number of Times State Standard Exceeded | NM | 0 | 0 | 0 | 0 |

AAM = Annual Arithmetic Mean
NM = Not Monitored
ug/m$^3$ = Micrograms Per Cubic Meter

a State Particulate Matter Standard Changed to 150 ug/m$^3$ in 1987. Previously 100 ug/m$^3$. Federal Particulate Matter Standard Superseded by Federal PM-10 Standard in 1987.

Source: State of Hawaii Department of Health -- 1983, 1984, 1985, 1986, 1987.

TABLE 4

SUMMARY OF ANNUAL AIR QUALITY DATA
LILIHA AIR QUALITY MONITORING STATION[a]

| Pollutant | 1983 | 1984 | 1985 | 1986 | 1987 |
|---|---|---|---|---|---|
| **Particulate Matter**[b] | | | | | |
| State Standard (24-hr. avg. 150 $ug/m^3$) | | | | | |
| Federal Standard (24-hr. avg. 260 $ug/m^3$) | | | | | |
| Maximum Concentration ($ug/m^3$) | NM | 56 | 254 | 60 | 59 |
| Number of Days State Standard Exceeded | NM | 0 | 3 | 0 | 0 |
| **PM-10**[c] | | | | | |
| State Standard (None) | | | | | |
| Federal Standard (24-hr avg. 150 $ug/m^3$) | | | | | |
| Maximum Concentration ($ug/m^3$) | NM | NM | 52 | 35 | 33 |
| Number of Days State Standard Exceeded | NM | NM | NA | NA | NA |

NM = Not Monitored
NA = Not Applicable
$ug/m^3$ = Micrograms Per Cubic Meter

a Liliha site started on January 1, 1984
b State particulate matter standard changed to 150 $ug/m^3$ in 1987. Previously 100 $ug/m^3$. The federal particulate matter standard superseded by the Federal PM-10 standard in 1987.
c State PM-10 standard has not been promulgated yet.

Source: State of Hawaii Department of Health -- 1983, 1984, 1985, 1986, 1987.

buildings, pavements, and traffic; and large amounts of sunshine to enhance photochemical reactions and the production of ozone.

Ozone does not become a significant pollutant until most of the nitrogen dioxide from the rush hour traffic is consumed. Ozone requires a longer reaction time in the atmosphere compared to other pollutants. For this reason, peak levels of ozone can occur several miles downwind of the source. Only under conditions of light and variable winds would ozone concentrations peak nearer to the source. For Honolulu under normal wind conditions (trade winds), peak ozone concentrations would be offshore to the southwest. Sources upwind of Honolulu are not likely to cause high ozone levels at the project site. As seen in Table 2, ozone concentrations at the Sand Island station downwind of the city and adjacent to the project site only rarely exceed state standards in a given year.

Of more local concern is the creation of carbon monoxide which comes almost entirely from motor vehicles. Its distribution is more source localized as compared to ozone. Therefore, peak concentrations can occur in the Honolulu area due to the high volume of automobiles and for reasons discussed above. Table 3 shows that state 1-hour carbon monoxide standards are exceeded a few times a year. Peaks in carbon monoxide, as well as for other pollutants, generally follow a seasonal variance. Highest concentrations occur in winter when the influences of the trade winds are reduced and days of varying winds encumber ventilation.

Although the main sources of PM10 are automobile exhaust, tire wear, and turbulent dust-blowing, concentrations in the Honolulu area are well below federal standards (Table 4). Other pollutants, such as sulfur dioxide and lead, are also below state or federal standards (Table 3). Nitrogen dioxide is not monitored.

In addition to Honolulu traffic, other sources of emissions presently exist at the project site. These include harbor ship traffic, dock-side container handling equipment, and vehicle traffic to and from the various facilities in the Ft. Armstrong area. However, local ambient air quality at the project site and in the Honolulu area follows that of regional air quality in that it is relatively clean. All pollutants are generally below state and federal standards, with state ozone and carbon monoxide standards exceeded only rarely.

## SECTION 3
## PROJECT IMPACTS

The possible impacts on surrounding air quality from the proposed Ft. Armstrong Container Yard improvements fall into three identifiable categories, each with varying degrees of effects. Possible sources of project-related emissions which could add to existing air quality levels are:

- Short-Term Construction Emissions: Airborne dust and emissions from any heavy equipment needed for the construction phase of dock improvements.
- Long-Term Dock Area Source Emissions: Dock area source emissions from the proposed operations. These include emissions from commercial cargo vessels, container unloading cranes, and the various dockside container handling equipment.
- Long-Term Mobile Emissions: Vehicle emissions resulting from traffic traveling to and from the dock site due to the proposed improvements.

The nearest potentially sensitive receptors for the project site include the Waterfront-Tower highrise condominiums on South Street (now under construction) approximately one-half mile to the northeast, the Harbor Square condominium on Nimitz Highway between Alakea and Richards Streets approximately one-half mile to the north, and campsites at the Sand Island State Park approximately one-half mile to the northwest.

### 3.1 SHORT-TERM EMISSIONS

Preparation of the site for construction associated with the added improvements could produce two types of air contaminants: exhaust emissions from construction equipment and fugitive dust from any soil movement. New construction will include the remodeling of the existing Container Freight Station #2, tower, and office building, along with any construction or demolition required in the placing of rails for the new cargo unloading cranes. The above activities can all be considered sources of short-term emissions. These short-term effects could be troublesome to workers and adjacent developments.

## 3.2 LONG-TERM DOCK AREA SOURCE EMISSIONS

### 3.2.1 COMMERCIAL VESSELS

The proposed scheduling of cargo vessels from American President Lines at the Ft. Armstrong facility would include the weekly docking of one vessel for approximately 26 hours. Container unloading would take place during this time. A total of five APL vessels would be calling Honolulu--three diesel propelled (C9) ships and two (C8) steamships. Commercial vessels of this kind can emit air pollutants under two major modes of operation: underway and at dockside (auxiliary power).

Emissions underway are influenced by a great variety of factors including power source (diesel or steam), engine size (in horsepower or kilowatts), fuel used (diesel oil or residual oil), and operating speed and load. Ship characteristics and data on power sources, engine sizes, and fuel for each ship type were obtained from American President Lines. Underway emissions that would impact the proposed project area would be those that originate from the harbor area only. As ships taxi in and out of the dock, they are expected to be cruising in the harbor channel for no more than 1 hour, using a fraction of the maximum horsepower and fuel available.

While the vessels are docked, main engines shut down and are not a source of emissions. However, emissions do continue at dockside from auxiliary power sources. Power must be made available for the ship's lighting, heating, pumps, refrigeration, ventilation, etc. Both types of ships calling at the Ft. Armstrong facility would require the use of their on-board auxiliary power sources. The C9 ships use 2,500 kilowatt (kW) diesel generators, while the C8 ships primarily use a 2,500 kW turbo generator and a standby 2,000 kW diesel generator. Mr. John M. Dabbar, Manager of Marine Engineering for American President Lines, stated that dockside auxiliary power for the C8 and C9 vessels uses an actual output of 1200 kW. Emissions from the diesel-powered generators are also a source of underway emissions since they are used away from port as well.

Emissions estimates for both underway and dockside auxiliary power situations were calculated using the guidelines outlined in the EPA Compilation of Air Pollutant Emission Factors (AP-42) for inboard-powered vessels. Emission factors used to represent the APL vessels underway are based on empirical extrapolation from several studies of similar type commercial vessels (AP-42). Emission factors for dockside auxiliary power under diesel generator use were obtained from actual stack emissions measurements performed by APL on two C9 vessels. Calculated emissions give a representative idea of the magnitude of pollutants emitted. Worst-case scenarios, which include a maximum 26-hour docking time and the use of the standby diesel generators by the C8 vessels, were used. Results are given in Table 5.

Table 5 shows that the diesel-powered C9 vessels would have the potential to emit up to 93 pounds per visit of carbon monoxide, 201 pounds per visit of hydrocarbons, and 781 pounds per visit of nitrogen oxides. The steam-powered C8 vessels could have the potential to emit up to 74 pounds per visit of carbon monoxide, 184 pounds per visit of hydrocarbons, and 634 pounds per visit of nitrogen oxides. With proposed shipping schedules, the above emissions would impact local air quality once a week. Total emissions from all five vessels would relate to approximately 2.2 tons per year of carbon monoxide, 5.0 tons per year of hydrocarbons, and 18.4 tons per year of nitrogen oxides.

For both types of ships, emissions from the main engine underway are negligible compared to those from the auxiliary power diesel generators used during the entire time at dockside. While docked, commercial vessels would contribute incrementally to local pollutant concentrations. Local meteorology usually provides the harbor area with increased ventilation from predominant wind patterns discussed earlier. Under normal conditions, the emissions from the increased ship traffic to the Ft. Armstrong facility would result in insignificant impacts to local air quality.

### 3.2.2 DOCK OPERATIONS EQUIPMENT

The proposed dock operations include the following dockside equipment: two diesel-powered cargo-container cranes, two forklifts, ten hustlers (yard tractors), and two pick-up trucks. The equipment will be operating at various times and locations, according to the proposed weekly scheduling of vessels and container unloading and movement. The two container cranes and ten hustlers are to operate continously during the 26-hour vessel docking. The two forklifts and two pick-up trucks would operate continuously 40 hours per week. No dockside operations would occur during the

TABLE 5

COMMERCIAL VESSEL EMISSIONS (lb/visit)[a]

| APL Vessel Type | Operation Mode | CO | HC | $NO_x$ | $SO_x$ | Part. |
|---|---|---|---|---|---|---|
| Diesel Propelled C9 | | | | | | |
| | Underway[b] | 20.7 | 16.4 | 169.8 | ND | ND |
| | Dockside Auxiliary[a,c] | 72.7 | 184.6[d] | 612.0 | 298.7 | ND |
| | TOTAL | 93.4 | 201.0 | 781.8 | -- | -- |
| Steam Powered C8 | | | | | | |
| | Underway[b] | 1.4 | 0.3 | 22.3 | 63.6 | 8.0 |
| | Dockside Auxiliary[a,c] | 72.7 | 184.6[d] | 612.0 | 298.7 | ND |
| | TOTAL | 74.1 | 184.9 | 634.3 | 362.3 | -- |

ND = No Emissions Data Available

a Emissions based on one 26-hour docking period per visit (once a week).

b Underway emissions based on 1-hour total time in harbor area per visit. Emission factors obtained from AP-42.

c Auxiliary power emissions for C9 vessels based on primary diesel generator running at 1200 kW rated output. Auxiliary power emissions for C8 vessels based on stand-by diesel generator running at 1200 kW rated output. Emission factors generated from APL stack measurements during diesel generator use at dockside.

d Dockside auxiliary emission factors for hydrocarbons obtained from AP-42.

Source: EPA AP-42, 1985 and American President Lines, 1989.

weekend. Estimated emissions for the equipment were calculated using the methods outlined in the EPA Compilation of Air Pollutant Emission Factors (AP-42). The hours of operation for each type of equipment listed above were estimated based on proposed dock operation schedules. Emissions from dock equipment sources during the peak operations period (vessel 26-hour docking) are shown in Table 6. Computer printout results are in the Appendix.

Table 6 indicates that the proposed usage of dockside operations equipment during the 26-hour peak dock operations period would have the potential to generate up to 1,180 pounds of carbon monoxide, 94 pounds of exhaust hydrocarbons, 950 pounds of nitrogen oxides, and 79 pounds of particulates. This would impact local air quality once a week when the peak operations occur. As indicated in Tables 2, 3, and 4, ambient air quality monitoring stations exceed state standards for ozone, carbon monoxide, and particulates on rare occasions discussed earlier. The equipment to be used dockside during operations of the proposed container yard facility would contribute incrementally to these occurrences. The equipment would be situated at various locations on the dock and moving throughout the workday. This, along with local predominant offshore wind patterns, would help to avoid localized pollutant peak concentrations or "hotspots."

## 3.3 LONG-TERM MOBILE SOURCE EMISSIONS

Increased heavy-duty diesel truck traffic associated with cargo container hauling is the main long-term mobile source of emissions generated by the proposed Ft. Armstrong improvements. Estimated terminal operations would require 27 round-trips through the gate per hour at peak unloading times. The diesel engine differs from the spark-ignited gasoline engine in that excess air in the combustion chamber can allow fuel to be more completely burned. This reduces exhaust carbon monoxide but increases nitrogen oxide production owing to the excess oxygen in the chamber. The result is higher emission rates for nitrogen oxides and lower emission rates for carbon monoxide compared to gasoline-powered vehicles.

TABLE 6

FORT ARMSTRONG CONTAINER YARD
DOCK OPERATIONS EQUIPMENT EMISSIONS[a]

| Equipment | Peak Operation Period[a] (hrs) | Emissions (lb) CO | HC | $NO_x$ | $SO_x$ | Part. |
|---|---|---|---|---|---|---|
| Hustler (Tractor) (10) | 260 | 929 | 47 | 330 | 23 | 35 |
| Pick-up Truck (2) | 16 | 29 | 3 | 67 | 7 | 4 |
| Forklift (2) | 16 | 3 | 2 | 13 | 1 | 1 |
| Crane (2) | 52 | 218 | 43 | 541 | 40 | 39 |
| TOTAL | 328 | 1,180 | 94 | 950 | 72 | 79 |

a 26-hour vessel docking period (once a week).

Source: EPA AP-42, 1985 and Bay Area Air Quality Management District, 1989.

TABLE 7

PROJECT-RELATED MOBILE SOURCE POLLUTANT EMISSIONS
CONTAINER YARD DIESEL TRUCK TRAFFIC[a]

| Mode | Emissions (lb/day) Hydrocarbons | CO | $NO_x$ |
|---|---|---|---|
| Idle | 4.17 | 11.79 | 5.60 |
| Exhaust | 0.75 | 3.80 | 4.91 |
| TOTAL | 4.92 | 15.59 | 10.51 |

a Peak operation periods. Based on 27 round-trips per hour on 8-5 schedule.

Source: Michael Brandman Associates, Inc., American President Lines, Ltd. and Hawaii Stevedores, Inc., 1989.

### 3.3.1 REGIONAL AIR QUALITY

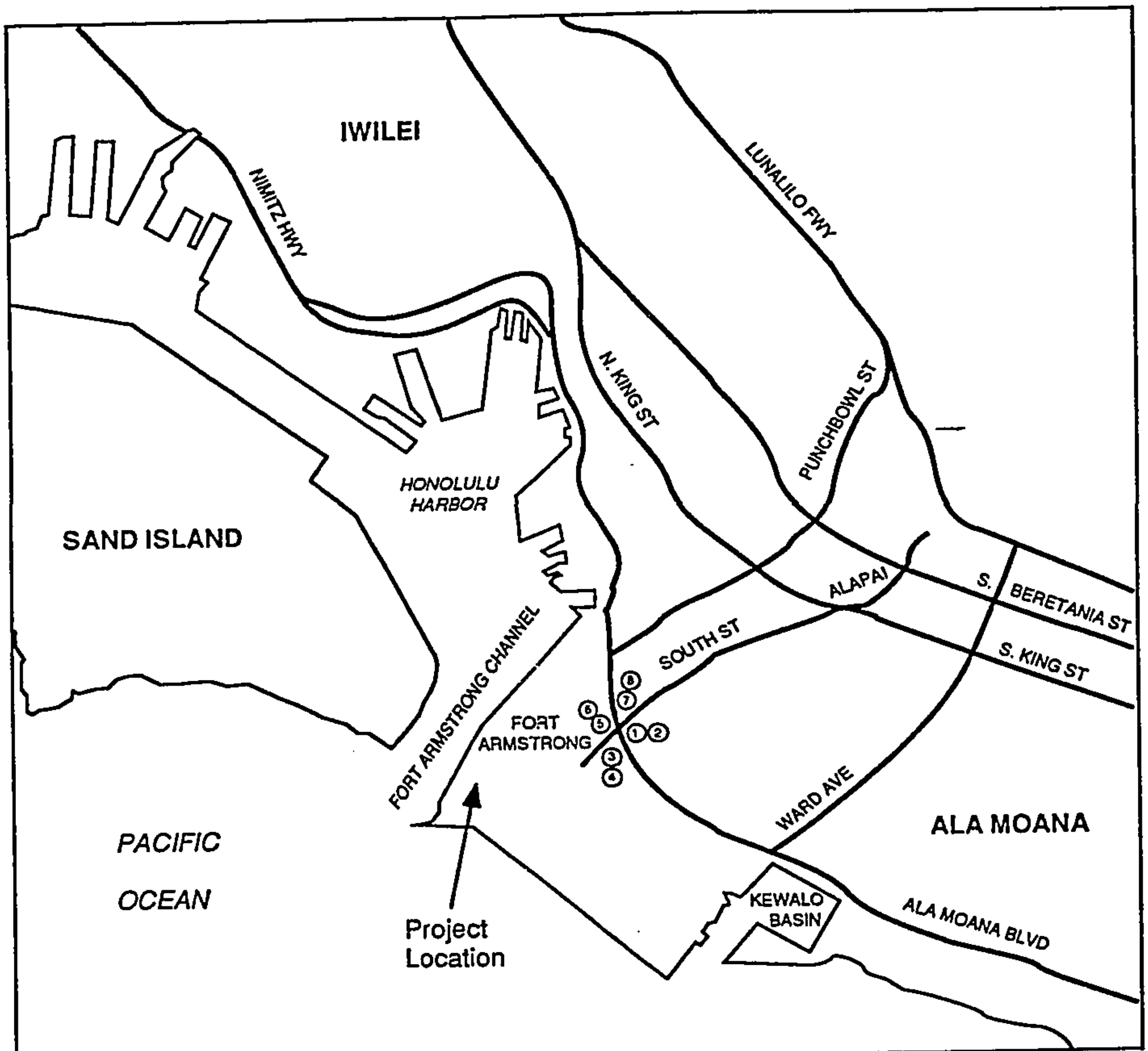
Emission rates for the various types of existing and future vehicle traffic in Honolulu under mean temperature and humidity conditions were calculated through the use of the EPA-approved model, MOBILE4. The model calculates emission rates under both idling and moving vehicle modes for hydrocarbons, carbon monoxide, and nitrogen oxides. Computer printout results are in the Appendix.

Estimated project-related emissions associated with diesel truck traffic in and out of the container yard, including idling time while loading, are shown in Table 7. Emissions represent worst-case conditions during peak operations, which would require approximately 215 round-trips in one working day. Table 7 shows that the increased diesel truck travel at the dock site could contribute up to 4.92 pounds per day of hydrocarbons, 15.59 pounds per day of carbon monoxide, and 10.51 pounds per day of nitrogen oxides into the ambient air.

Oxides of nitrogen, such as nitrogen dioxide, are not an ambient air concern in the Honolulu area, and the amount produced by the increased truck travel would not contribute to an exceedance of state or federal standards. However, hydrocarbons and nitrogen dioxide are constituents that can lead to the creation of ozone in the atmosphere. Although the state ozone standards are exceeded in the Honolulu area on rare occasions, the small amount of ozone attributed to the increased diesel truck traffic at Ft. Armstrong would not result in a measurable change in regional ambient air quality.

### 3.3.2 LOCAL AIR QUALITY

The impact of the proposed project on local air quality with respect to carbon monoxide was assessed through the use of the EPA-approved CALINE4 air quality model. The model allows microscale carbon monoxide (CO) concentrations to be estimated along a roadway corridor or at an intersection. Impacts from traffic patterns at the intersection of Ala Moana Boulevard and South Street were analyzed. This intersection is where all truck traffic must pass when entering or exiting the Ft. Armstrong container yard during hauling operations. Exhibit B shows the locations of receptor points where CO concentrations were calculated by the model.




Source: Pacific Planning & Engineering, Inc. 1989 and Michael Brandman Associates, Inc. 1989

**Legend**

(5) Receptor Location and Number

2190006 September 1989

Michael Brandman Associates

North

Not to Scale

Caline4 Model Receptor Locations
**APL-Ft. Armstrong Container Yard**

**Exhibit B**

TABLE 8

MAXIMUM CARBON MONOXIDE CONCENTRATIONS[a]
(parts per million)

| Receptor | Carbon Monoxide Concentrations (1 hr)[b] | | |
|---|---|---|---|
| | Existing (1989) | Without Project (1990) | With Project (1990) |
| Ala Moana Blvd./South St. | | | |
| 1 | 12.9 | 12.5 | 12.5 |
| 2 | 10.8 | 10.6 | 10.6 |
| 3 | 15.1 | 14.5 | 14.6 |
| 4 | 14.8 | 14.2 | 14.2 |
| 5 | 12.8 | 12.4 | 12.4 |
| 6 | 10.7 | 10.5 | 10.5 |
| 7 | 15.4 | 14.8 | 14.8 |
| 8 | 14.9 | 14.3 | 14.4 |

a The 1-hour average federal standard is 35 ppm (40 $ug/m^3$) and the 1-hour average State standard is 8.8 ppm (10 $ug/m^3$).
b Background CO levels of 8.5 ppm have been added to the 1-hour average concentration.

Source: Michael Brandman Associates, Inc. 1989 and Pacific Planning & Engineering, Inc. 1989.

Computer readouts for the CALINE4 model appear in the appendix. A brief discussion of input to the model follows. Table 8 presents the results of the analysis for the worst-case wind angle and windspeed conditions and is based upon the following assumptions:

- The modeling locations selected represent the intersections with the highest traffic volumes in proximity to residential or other sensitive receptors. Worst-case PM peak (4-5 p.m.) 1-hour levels were used.
- The calculations assume a meteorological condition of almost no wind (1.0 meters/second), a flat topographical condition between the source and receptor, and a mixing height of 1,000 meters.
- CO concentrations are calculated for the 1-hour averaging period, and then compared to the state and federal 1-hour standards.
- Concentrations are given in parts per million (ppm) at each of the receptor locations.
- The average speed (worst-case assumption) was assumed to be 15 miles per hour. Emission factors for 1989 and 1990 for the vehicle traffic mix for Honolulu conditions were obtained from the MOBILE4 mobile source emission factor model.
- Ambient (background) CO concentrations that represent the second worst-case CO concentrations measured at the downtown Honolulu air quality monitoring station in 1987 were added to the model results. The background concentration is 8.5 ppm for the 1-hour average (State of Hawaii Department of Health 1987).

As indicated in Table 8, carbon monoxide concentrations at the eight receptor locations will violate state 1-hour standards under worst-case meteorological conditions for existing, future no project, and future project-added traffic levels. As shown in Table 3, ambient CO levels in the Honolulu area exceed state standards only a few times a year during days of nonpredominant meteorological conditions. The truck traffic increases resulting from the proposed project will incrementally contribute to these episodes. Table 8 also indicates that the small fraction of increased future traffic due to the proposed project would lead to almost unnoticeable changes in local levels of carbon monoxide at the eight receptor locations, when compared to levels that would occur without the project.

Although traffic levels are expected to increase, emission rates are predicted to decrease as newer cars introduce better designs for emission control. The small increase in traffic due to the Ft. Armstrong improvement is not enough to offset this effect. Hence, CO concentrations at the eight receptor locations near the intersection of Ala Moana Boulevard and South Street are lower for future conditions, even with the project, than for existing conditions (see Table 8).

## SECTION 4
## CONCLUSIONS

In conclusion, the proposed improvements at the Ft. Armstrong facility would lead to a projected incremental increase in emissions over what would occur without the project. Since there is a measurable increase in emissions resulting from the project, mitigation measures are suggested. However, the historically good regional and local air quality are not expected to be affected, and the pattern of rare exceedances of state standards for CO and ozone would not increase. Project-related emissions are very low compared to background emissions. Since they will occur over a single 26-hour period each week, the likelihood of occurring during one of the rare meteorological regimes conducive to pollutant buildup is much less than if the emissions occurred on a daily basis.

The possible sources of pollutant emissions associated with the proposed Ft. Armstrong container yard improvements would not significantly impact Honolulu regional or local air quality. Short-term construction emissions would be minimal. Long-term emissions from commercial vessels, dockside container handling equipment, and truck hauling each will make only incremental increases to ambient pollution levels. Cumulatively, emissions from all sources combined would still not lead to a notable increase in any of the pollutants of concern. Ambient levels at sensitive receptors in the local area, including residential units and the Sand Island State Park, will not change significantly from present levels.

SECTION 5

MITIGATION MEASURES

## 5.1 SHORT-TERM (CONSTRUCTION) EMISSIONS

- For any grading or demolition to be performed, the responsible party should demonstrate suppression measures for fugitive dust. Measures should include watering.

## 5.2 LONG-TERM EMISSIONS

The following measure will be effective in reducing the effects of long-term emissions from dock area operations and mobile sources.[1]

- Proper maintenance and handling of all equipment engines should be performed to reduce excess emissions resulting from insufficient or improper burning of fuels.

## SECTION 6
## UNAVOIDABLE IMPACTS

Air pollution emission remaining after mitigation would be an unavoidable adverse impact.

## SECTION 7

## REFERENCES

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# APPENDICES

*CONSTRUCTION EMISSIONS*
(Diesel Powered Equipment)

This spreadsheet calculates the emissions from diesel-powered construction equipment in both grams and pounds per hour. Operator must input the number of hours equipment is expected to be in operation in the second column (Operation Period). Generation factors used were derived from AP-42 published by the EPA.

PROJECT: APL Ft. Armstrong - Honolulu
DATE: SEPT 8, 1989

| Construction Equipment | Operation Period (hours) | Carbon Monoxide | Emissions Exhaust Hydroc. | (in grams) Nitrogen Oxides | Sulfur Oxides | Particu-lates |
|---|---|---|---|---|---|---|
| Tractor (T) | 0 | 0 | 0 | 0 | 0 | 0 |
| Tractor (W) | 260 | 421,920 | 21,388 | 149,718 | 10,634 | 15,990 |
| Dozer (W) | 0 | 0 | 0 | 0 | 0 | 0 |
| Scraper | 0 | 0 | 0 | 0 | 0 | 0 |
| Grader | 0 | 0 | 0 | 0 | 0 | 0 |
| Loader (W) | 0 | 0 | 0 | 0 | 0 | 0 |
| Forklift | 16 | 1,458 | 713 | 6,004 | 550 | 426 |
| Off-road Truck | 16 | 13,069 | 1,389 | 30,227 | 3,296 | 1,856 |
| Roller | 0 | 0 | 0 | 0 | 0 | 0 |
| Miscellaneous | | | | | | |
| Auger | 0 | 0 | 0 | 0 | 0 | 0 |
| Backhoe | 0 | 0 | 0 | 0 | 0 | 0 |
| Crane | 52 | 99,154 | 19,359 | 245,523 | 18,178 | 17,706 |
| Pavement Bust | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 344 | 535,601 | 42,848 | 431,472 | 32,659 | 35,978 |

| Construction Equipment | Operation Period (hours) | Emissions (in pounds) Carbon Monoxide | Exhaust Hydroc. | Nitrogen Oxides | Sulfur Oxides | Particulates |
|---|---|---|---|---|---|---|
| Tractor (T) | 0 | 0 | 0 | 0 | 0 | 0 |
| Tractor (W) | 260 | 929 | 47 | 330 | 23 | 35 |
| Dozer (W) | 0 | 0 | 0 | 0 | 0 | 0 |
| Scraper | 0 | 0 | 0 | 0 | 0 | 0 |
| Grader | 0 | 0 | 0 | 0 | 0 | 0 |
| Loader (W) | 0 | 0 | 0 | 0 | 0 | 0 |
| Forklift | 16 | 3 | 2 | 13 | 1 | 1 |
| Off-road Truck | 0 | 29 | 3 | 67 | 7 | 4 |
| Roller | 0 | 0 | 0 | 0 | 0 | 0 |
| Miscellaneous | | | | | | |
| Auger | 0 | 0 | 0 | 0 | 0 | 0 |
| Backhoe | 0 | 0 | 0 | 0 | 0 | 0 |
| Crane | 52 | 218 | 43 | 541 | 40 | 39 |
| Boring Mach. | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 328 | 1,180 | 94 | 950 | 72 | 79 |

1 MOBILE4 MODEL

IBM-PC VERSION (1.00)


RUN NAME: FTARM
RUN BEGAN ON 09-13-89 AT 09:25:56

1APL FT. ARMSTRONG CONTAINER YARD

0
-M 56 COMMENT:
A/C CORRECTION FACTOR WILL BE CALCULATED.
+ VALUE OF INPUTTED AC USAGE PARAMETER IS IGNORED.
0TOTAL HC EMISSION FACTORS INCLUDE EVAPORATIVE HC EMISSION FACTORS.
0

0CAL. YEAR: 1989 REGION: LOW ALTITUDE: 500.
FT.
I/M PROGRAM: NO AMBIENT TEMP: 77.0
/ 77.0 / 77.0 F
ANTI-TAM. PROGRAM: NO OPERATING MODE: 20.6
/ 27.3 / 20.6
0EXISTING
ASTM CLASS: C
MINIMUM TEMP: 70. (F) MAXIMUM TEMP: 84. (F)
BASE RVP: 11.5 IN-USE (IU) RVP: 9.0
IU 1ST YR: 1989
ABSOLUTE HUMIDITY: 99.00 AC (DB / WB): .9
( 85.0 / 75.0)

| 0VEH. TYPE: | LDGV | LDGT1 | LDGT2 | LDGT | HDGV | LDDV | LDDT | HDDV | MC | ALL VEH |
|---|---|---|---|---|---|---|---|---|---|---|
| VEH. SPD.: | 15.0 | 15.0 | 15.0 | | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | |
| VMT MIX: | .709 | .128 | .086 | | .015 | .013 | .004 | .035 | .010 | |
| EXT. LOAD: | .000 | .000 | .000 | | | | | | | |
| TRLR TOW: | .000 | .000 | .000 | | | | | | | |
| 0COMPOSITE EMISSION FACTORS (GM/MILE) | | | | | | | | | | |
| TOTAL HC: | 3.61 | 4.43 | 5.00 | 4.66 | 8.31 | .76 | .95 | 3.31 | 4.72 | 3.86 |
| EXHST CO: | 32.19 | 39.76 | 43.20 | 41.14 | 93.52 | 2.06 | 2.25 | 16.32 | 28.50 | 33.94 |
| EXHST NOX: | 1.81 | 2.12 | 2.30 | 2.19 | 5.55 | 1.69 | 1.87 | 21.21 | .69 | 2.62 |
| 0HOT STABILIZED IDLE EMISSION FACTORS (GM/HR) | | | | | | | | | | |
| IDLE HC: | 29.61 | 36.35 | 36.03 | 36.22 | 26.82 | 2.04 | 8.51 | 17.96 | 65.24 | 30.50 |
| IDLE CO: | 335.49 | 384.41 | 367.12 | 377.45 | 282.66 | 14.39 | 22.75 | 49.77 | 166.20 | 326.60 |
| IDLE NOX: | 4.20 | 4.52 | 4.33 | 4.44 | 3.62 | 13.43 | 20.88 | 26.88 | 2.36 | 5.20 |

```
-M 56 COMMENT:
+              A/C CORRECTION FACTOR WILL BE CALCULATED.
               VALUE OF INPUTTED AC USAGE PARAMETER IS IGNORED.
OCAL. YEAR: 1990          REGION: LOW          ALTITUDE:  500.
FT.
                    I/M PROGRAM: NO        AMBIENT TEMP:   77.0
/ 77.0 / 77.0 F
               ANTI-TAM. PROGRAM: NO     OPERATING MODE:   20.6
/ 27.2 / 20.6
OW/PROJECT               ASTM CLASS: A
                   MINIMUM TEMP: 68. (F)  MAXIMUM TEMP: 88. (F)
                       BASE RVP: 10.0   IN-USE (IU) RVP:  9.0
IU 1ST YR: 1990
               ABSOLUTE HUMIDITY: 99.00     AC (DB / WB):     .9
( 85.0 / 75.0)
OVEH. TYPE:  LDGV  LDGT1  LDGT2   LDGT   HDGV   LDDV   LDDT   HDDV
 MC    ALL VEH
+
 VEH. SPD.: 15.0   15.0   15.0           15.0   15.0   15.0   15.0
 15.0
   VMT MIX:  .710   .127   .086           .015   .013   .004   .034
 .010
 EXT. LOAD:  .000   .000   .000
  TRLR TOW:  .000   .000   .000
OCOMPOSITE EMISSION FACTORS (GM/MILE)
 TOTAL  HC:  3.44   4.22   4.71   4.42   7.75    .73    .89   3.16
4.80   3.67
 EXHST  CO: 29.18  36.29  38.91  37.34  82.17   2.03   2.17  15.94
28.30  30.79
 EXHST NOX:  1.71   2.03   2.17   2.08   5.53   1.61   1.72  20.64
 .70   2.48
OHOT STABILIZED IDLE EMISSION FACTORS (GM/HR)
  IDLE  HC: 27.20  34.41  34.08  34.28  26.19   2.00   8.03  17.53
65.16  28.33
  IDLE  CO:296.93 347.71 332.99 341.78 271.62  14.17  22.31  49.50
165.00 291.41
  IDLE NOX:  3.79   4.10   3.92   4.03   3.36  12.78  18.01  23.53
 2.37   4.67

1                  RUN ENDED ON 09-13-89 AT 09:27:57
```

REPORT FOR FILE : moasth1

## 1. Site Variables

| | | | |
|---|---|---|---|
| U= | 1.0 M/S | ZO= | 108.0 CM |
| BRG= | 10.0 DEGREES | VD= | 0.0 CM/S |
| CLASS= | F STABILITY | VS= | 0.0 CM/S |
| MIXH= | 1000.0 M | AMB= | 0.0 PPM |
| SIGTH= | 10.0 DEGREES | TEMP= | 26.0 DEGREE (C) |

## 2. Link Description

| LINK DESCRIPTION | X1 | Y1 | X2 | Y2 | TYPE | VPH | EF (G/MI) | H (M) | W (M) |
|---|---|---|---|---|---|---|---|---|---|
| A. mauka | 0 | 0 | 0 | 200 | AG | 336 | 33.9 | 0.0 | 17.1 |
| B. diamond head | 0 | 0 | 200 | -100 | AG | 2498 | 33.9 | 0.0 | 30.5 |
| C. makai | 0 | 0 | 0 | -200 | AG | 109 | 33.9 | 0.0 | 17.1 |
| D. ewa | 0 | 0 | -200 | 100 | AG | 2404 | 33.9 | 0.0 | 30.5 |

| LINK | MIXW L (M) | MIXW R (M) | STPL (M) | DCLT (SEC) | ACCT (SEC) | SPD (MPH) | NCYC | NDLA | VPHO | EFI (G/MIN) | IDT1 (SEC) | IDT2 (SEC) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| A. | 0 | 0 | 0 | 0.0 | 0.0 | 0 | 0 | 0 | 0 | 0.0 | 0.0 | 0.0 |
| B. | 0 | 0 | 0 | 0.0 | 0.0 | 0 | 0 | 0 | 0 | 0.0 | 0.0 | 0.0 |
| C. | 0 | 0 | 0 | 0.0 | 0.0 | 0 | 0 | 0 | 0 | 0.0 | 0.0 | 0.0 |
| D. | 0 | 0 | 0 | 0.0 | 0.0 | 0 | 0 | 0 | 0 | 0.0 | 0.0 | 0.0 |

## 3. Receptor Coordinates

| | X | Y | Z |
|---|---|---|---|
| RECEPTOR 1 | 15 | 15 | 1.3 |
| RECEPTOR 2 | 30 | 30 | 1.3 |
| RECEPTOR 3 | 15 | -15 | 1.3 |
| RECEPTOR 4 | 30 | -30 | 1.3 |
| RECEPTOR 5 | -15 | -15 | 1.3 |
| RECEPTOR 6 | -30 | -30 | 1.3 |
| RECEPTOR 7 | -15 | 15 | 1.3 |
| RECEPTOR 8 | -30 | 30 | 1.3 |

MODEL RESULTS FOR FILE A:moasthl

| RECEPTOR | PRED CONC (PPM) | WIND BRG (DEG) | COCN/LINK (PPM) A | B | C | D |
|---|---|---|---|---|---|---|
| RECPT 1 | 4.4 | 282 | 0.4 | 0.0 | 0.0 | 4.0 |
| RECPT 2 | 2.3 | 274 | 0.3 | 0.0 | 0.0 | 2.1 |
| RECPT 3 | 6.6 | 300 | 0.0 | 1.8 | 0.1 | 4.7 |
| RECPT 4 | 6.3 | 303 | 0.0 | 2.9 | 0.1 | 3.3 |
| RECPT 5 | 4.3 | 102 | 0.0 | 4.2 | 0.1 | 0.0 |
| RECPT 6 | 2.2 | 94 | 0.0 | 2.1 | 0.1 | 0.0 |
| RECPT 7 | 6.9 | 120 | 0.4 | 4.9 | 0.0 | 1.7 |
| RECPT 8 | 6.4 | 123 | 0.3 | 3.4 | 0.0 | 2.8 |

REPORT FOR FILE : mosth2

1. Site Variables

| | | | |
|---|---|---|---|
| U= | 1.0 M/S | ZO= | 108.0 CM |
| BRG= | 10.0 DEGREES | VD= | 0.0 CM/S |
| CLASS= | F STABILITY | VS= | 0.0 CM/S |
| MIXH= | 1000.0 M | AMB= | 0.0 PPM |
| SIGTH= | 10.0 DEGREES | TEMP= | 26.0 DEGREE (C) |

2. Link Description

| LINK DESCRIPTION | X1 | Y1 | X2 | Y2 | TYPE | VPH | EF (G/MI) | H (M) | W (M) |
|---|---|---|---|---|---|---|---|---|---|
| A. mauka | 0 | 0 | 0 | 200 | AG | 336 | 30.8 | 0.0 | 17.1 |
| B. diamond head | 0 | 0 | 200 | -100 | AG | 2498 | 30.8 | 0.0 | 30.5 |
| C. makai | 0 | 0 | 0 | -200 | AG | 109 | 30.8 | 0.0 | 17.1 |
| D. ewa | 0 | 0 | -200 | 100 | AG | 2404 | 30.8 | 0.0 | 30.5 |

| LINK | MIXW L (M) | MIXW R (M) | STPL (M) | DCLT (SEC) | ACCT (SEC) | SPD (MPH) | NCYC | NDLA | VPHO | EFI (G/MIN) | IDT1 (SEC) | IDT2 (SEC) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| A. | 0 | 0 | 0 | 0.0 | 0.0 | 0 | 0 | 0 | 0 | 0.0 | 0.0 | 0.0 |
| B. | 0 | 0 | 0 | 0.0 | 0.0 | 0 | 0 | 0 | 0 | 0.0 | 0.0 | 0.0 |
| C. | 0 | 0 | 0 | 0.0 | 0.0 | 0 | 0 | 0 | 0 | 0.0 | 0.0 | 0.0 |
| D. | 0 | 0 | 0 | 0.0 | 0.0 | 0 | 0 | 0 | 0 | 0.0 | 0.0 | 0.0 |

3. Receptor Coordinates

| | X | Y | Z |
|---|---|---|---|
| RECEPTOR 1 | 15 | 15 | 1.3 |
| RECEPTOR 2 | 30 | 30 | 1.3 |
| RECEPTOR 3 | 15 | -15 | 1.3 |
| RECEPTOR 4 | 30 | -30 | 1.3 |
| RECEPTOR 5 | -15 | -15 | 1.3 |
| RECEPTOR 6 | -30 | -30 | 1.3 |
| RECEPTOR 7 | -15 | 15 | 1.3 |
| RECEPTOR 8 | -30 | 30 | 1.3 |

MODEL RESULTS FOR FILE A:moasth2

| RECEPTOR | PRED CONC (PPM) | WIND BRG (DEG) | COCN/LINK (PPM) A | B | C | D |
|---|---|---|---|---|---|---|
| RECPT 1 | 4.0 | 282 | 0.3 | 0.0 | 0.0 | 3.6 |
| RECPT 2 | 2.1 | 274 | 0.2 | 0.0 | 0.0 | 1.9 |
| RECPT 3 | 6.0 | 300 | 0.0 | 1.6 | 0.1 | 4.3 |
| RECPT 4 | 5.7 | 303 | 0.0 | 2.6 | 0.1 | 3.0 |
| RECPT 5 | 3.9 | 102 | 0.0 | 3.8 | 0.1 | 0.0 |
| RECPT 6 | 2.0 | 94 | 0.0 | 1.9 | 0.1 | 0.0 |
| RECPT 7 | 6.3 | 120 | 0.4 | 4.4 | 0.0 | 1.5 |
| RECPT 8 | 5.8 | 123 | 0.2 | 3.1 | 0.0 | 2.5 |

REPORT FOR FILE : moasth3

1. Site Variables

| | | | |
|---|---|---|---|
| U= | 1.0 M/S | ZO= | 108.0 CM |
| BRG= | 10.0 DEGREES | VD= | 0.0 CM/S |
| CLASS= | F STABILITY | VS= | 0.0 CM/S |
| MIXH= | 1000.0 M | AMB= | 0.0 PPM |
| SIGTH= | 10.0 DEGREES | TEMP= | 26.0 DEGREE (C) |

2. Link Description

| LINK DESCRIPTION | X1 | Y1 | X2 | Y2 | TYPE | VPH | EF (G/MI) | H (M) | W (M) |
|---|---|---|---|---|---|---|---|---|---|
| A. mauka | 0 | 0 | 0 | 200 | AG | 350 | 30.8 | 0.0 | 17.1 |
| B. diamond head | 0 | 0 | 200 | -100 | AG | 2498 | 30.8 | 0.0 | 30.5 |
| C. makai | 0 | 0 | 0 | -200 | AG | 144 | 30.8 | 0.0 | 17.1 |
| D. ewa | 0 | 0 | -200 | 100 | AG | 2425 | 30.8 | 0.0 | 30.5 |

(X1, Y1, X2, Y2 = LINK COORDINATES (M))

| LINK | MIXW L (M) | MIXW R (M) | STPL (M) | DCLT (SEC) | ACCT (SEC) | SPD (MPH) | NCYC | NDLA | VPHO | EFI (G/MIN) | IDT1 (SEC) | IDT2 (SEC) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| A. | 0 | 0 | 0 | 0.0 | 0.0 | 0 | 0 | 0 | 0 | 0.0 | 0.0 | 0.0 |
| B. | 0 | 0 | 0 | 0.0 | 0.0 | 0 | 0 | 0 | 0 | 0.0 | 0.0 | 0.0 |
| C. | 0 | 0 | 0 | 0.0 | 0.0 | 0 | 0 | 0 | 0 | 0.0 | 0.0 | 0.0 |
| D. | 0 | 0 | 0 | 0.0 | 0.0 | 0 | 0 | 0 | 0 | 0.0 | 0.0 | 0.0 |

3. Receptor Coordinates

| | X | Y | Z |
|---|---|---|---|
| RECEPTOR 1 | 15 | 15 | 1.3 |
| RECEPTOR 2 | 30 | 30 | 1.3 |
| RECEPTOR 3 | 15 | -15 | 1.3 |
| RECEPTOR 4 | 30 | -30 | 1.3 |
| RECEPTOR 5 | -15 | -15 | 1.3 |
| RECEPTOR 6 | -30 | -30 | 1.3 |
| RECEPTOR 7 | -15 | 15 | 1.3 |
| RECEPTOR 8 | -30 | 30 | 1.3 |

MODEL RESULTS FOR FILE A:moasth3

| RECEPTOR | * PRED CONC (PPM) | * WIND BRG (DEG) * | COCN/LINK (PPM) A | B | C | D |
|---|---|---|---|---|---|---|
| RECPT 1 | 4.0 | 282 | 0.4 | 0.0 | 0.0 | 3.7 |
| RECPT 2 | 2.1 | 274 | 0.2 | 0.0 | 0.0 | 1.9 |
| RECPT 3 | 6.1 | 300 | 0.0 | 1.6 | 0.2 | 4.3 |
| RECPT 4 | 5.7 | 303 | 0.0 | 2.6 | 0.1 | 3.0 |
| RECPT 5 | 3.9 | 102 | 0.0 | 3.8 | 0.2 | 0.0 |
| RECPT 6 | 2.0 | 94 | 0.0 | 1.9 | 0.1 | 0.0 |
| RECPT 7 | 6.3 | 120 | 0.4 | 4.4 | 0.0 | 1.5 |
| RECPT 8 | 5.9 | 123 | 0.2 | 3.1 | 0.0 | 2.5 |

FILE COPY

# APL FORT ARMSTRONG

## TRAFFIC IMPACT ASSESSMENT REPORT

OCTOBER 1989

PACIFIC PLANNING & ENGINEERING, INC.

# TRAFFIC IMPACT ASSESSMENT REPORT

FOR

APL FORT ARMSTRONG CONTAINER TERMINAL

TMK: 2-1-15:9
Honolulu, Hawaii

October 1989

Prepared for

American President Lines, Ltd.

Prepared by:

Pacific Planning & Engineering, Inc.
1144 Tenth Avenue, Suite 20
Honolulu, Hawaii 96816

TABLE OF CONTENTS


| | |
|---|---|
| I. EXECUTIVE SUMMARY | 1 |
| Conclusion | 1 |
| II. INTRODUCTION | 3 |
| III. PROJECT DESCRIPTION | 4 |
| General Description | 4 |
| Frequency of Service | 5 |
| Vessels | 5 |
| Terminal Operations | 5 |
| Cargo Container and Destination | 6 |
| IV. EXISTING CONDITIONS | 9 |
| Area Conditions | 9 |
| Traffic Conditions | 10 |
| Observed Traffic Conditions | 12 |
| Number of Pedestrians Crossing Intersection | 13 |
| V. TRAFFIC IMPACT ANALYSIS | 14 |
| Study Methodology | 14 |
| Future Ambient Traffic | 14 |
| Project Generated Traffic | 15 |
| Trip Distribution and Assignments | 16 |
| Traffic Forecasts | 16 |
| Traffic Impacts | 19 |
| VI. CONCLUSION | 21 |
| Conclusion | 21 |


APPENDICES


A. Definition of Level-of-Service for Signalized Intersections
B. Manual Traffic Counts
C. Operational Analysis Worksheets for Signalized Intersection

LIST OF TABLES


| | | |
|---|---|---|
| Table 1. | Percent Traffic Mix at Intersection of Ala Moana Blvd. & South St. | 12 |
| Table 2. | Level-of-Service Operational Analysis - Signalized Intersection | 20 |


LIST OF FIGURES


| | | |
|---|---|---|
| Figure 1. | Location Map and Roadway Network | 7 |
| Figure 2. | Existing Site Plan | 8 |
| Figure 3. | Existing Traffic - Morning and Afternoon Peak Hour | 11 |
| Figure 4. | 1990 Project Generated Traffic | 17 |
| Figure 5. | 1990 With the Project | 18 |

# EXECUTIVE SUMMARY

Pacific Planning & Engineering, Inc. (PPE) was engaged to undertake a traffic impact study to identify and assess future traffic impacts caused by APL's proposed container terminal operation at Fort Armstrong (Pier 1) Honolulu Harbor.

The project site is located at Pier 1 Honolulu Harbor on the Island of Oahu. The site consists of one parcel of land at the Fort Armstrong site on Kakaako Peninsula.

This report identifies and evaluates the potential impact of the traffic generated by the proposed terminal operation in the year 1990 when the project is expected to be in operation. Impacts are assessed with the proposed project during the morning and afternoon peak hours .

The analysis primarily focuses on the access intersection of Ala Moana Boulevard and South Street. The intersection provides access and egress to the project from all directions. The report discusses the impact on the intersection by determining Levels-of-Service (LOS), and presents the findings and recommendations.

## Conclusion

The results of the traffic operation analysis indicate that the proposed APL Fort Armstrong Container Terminal Operation will not significantly change the traffic flow quality because of its operation commencing in 1990.

The operational analysis for the signalized intersection indicates no change in the Level-of-Service (LOS) during the morning and afternoon peak hours. However, field observations indicate the study intersection is presently operating near LOS F during the morning and afternoon peak hours because of existing congested conditions. The analysis of existing conditions suggests better than actual LOS because downstream traffic congestion decreases the volume of cars that can proceed through the intersection.

The total number of vehicles generated by the APL facility is estimated to be about 54 vehicles during the peak hour. At this level of trips, the impact on the intersection traffic flow is negligible.

# INTRODUCTION

American President Lines (APL) is planning to initiate container cargo service between the West Coast, Hawaii, Guam and the Far East beginning in early 1990. APL operation will be located at Pier 1, Honolulu Harbor.

Pacific Planning & Engineering, Inc. (PPE) was engaged to conduct a traffic impact study to identify and assess the traffic impacts caused by APL's proposed container terminal operation.

This report identifies and evaluates the potential impact of the traffic generated by APL's proposed container cargo operation anticipated to begin in early 1990. The analysis primarily focuses on one major access into the Fort Armstrong container terminal area; the intersection of Ala Moana Boulevard and South Street.

## PROJECT DESCRIPTION

### General Description

American President Lines, Ltd. (APL) proposes to improve the cargo loading and unloading facilities of Pier 1 at Fort Armstrong. Two gantry cranes, each 100' wide and 130' tall, white with black engine houses, will be installed along approximately 800' of the wharf. The existing waterside rail will be replaced and a new grade beam and rail constructed 100 feet inland of the waterside rail. Existing rail foundations will not be affected. The cranes will be similar to those previously used for loading and unloading containers at Pier 1 by Matson Navigation before its operations were moved to Sand Island in 1981. The main difference between the two operations is that APL cranes will be diesel-powered rather than electric and the rails will be 100' apart rather than 32'.

In addition to the crane rails, new construction will include segmenting and remodeling a portion of the existing Container Freight Station #2, tower, and office building. The utilities will be relocated and the fender system extended three feet seaward. The yard will be restriped for use by chassis as opposed to straddle carriers. Ten tractors, two fork lifts for stacking and unstacking empties, and two pick-up trucks will be used in operations.

Operations will take place on an interim basis using mobile cranes until the gantry cranes can be installed. Interim operations are not expected to last more than 6 months.

Frequency of Service

Current plans are for APL's vessels to arrive in Honolulu from the West Coast - Los Angeles and Oakland - weekly, en route to Guam and the Far East before returning to the West Coast. The ships are tentatively scheduled to arrive in Honolulu on Tuesday and depart on Wednesday. They will be berthed at Pier 1 approximately 26 hours.

Vessels

A total of five vessels will be calling at Honolulu - three C9's and two of APL's three C8's. The C9 vessels are capable of carrying a total of 1195 FEU's (forty-foot equivalent units) and are about 860 feet in length. The C8's carry 875 FEU's and are about 800 feet in length. The C9's are diesel propelled while the C8's are propelled by steam engines.

Terminal Operations

The terminal will normally be open Monday through Friday from 8:00 AM to 5:00 PM for pick-up and delivery of containers. Arriving vessels will be worked on a 24-hour basis while they are in port by the two diesel powered gantry cranes. All of the containers coming off the ship will be placed on chassis and/or stacked in the yard ready for pick-up. The vast majority of containers returning to the yard will be empty and will be block stowed (stacked 3 or 4 high) on the ground.

Most of the inbound containers from the mainland will be picked-up and delivered to the consignees within 48 to 72 hours after discharge from the ship, on Wednesday, Thursday and Friday. This will require about 215 drays, or local moves per day, or about

27 per hour through the gate based on an 8-5 schedule, although it may be necessary to keep the gate open longer than 8-5 to meet the distribution schedule. Outbound empties will return to the yard on a fairly even basis throughout the week. Most of the tractors returning empty containers will also pick-up loaded containers on Wednesday, Thursday and Friday as shown below.

| | Mon | Tues | Wed | Thur | Frid | Weekly Total In | Weekly Total Out |
|---|---|---|---|---|---|---|---|
| Tractors Returning Empty Containers | 129 | 129 | 129 | 129 | 129 | 645 | |
| Tractors Only | 129 | 129 | 0 | 0 | 0 | | 258 |
| Tractors w/Load | 0 | 0 | 129 | 129 | 129 | | 387 |
| Tractors Only Entering | 0 | 0 | 86 | 86 | 86 | 258 | |
| Exiting w/Load | 0 | 0 | 86 | 86 | 86 | | 258 |
| Totals | 258 | 258 | 430 | 430 | 430 | 903 | 903 |
| Trips per Hour | 32 | 32 | 54 | 54 | 54 | | |

The vessels will be worked on a 24-hour basis while they are in port by two diesel powered gantry cranes, and a stevedore crew of 40 - 50 men per 11 hour shifts (first shift from 7:00 am to 6:00 pm, and the second shift from 6:00 pm to 5:00 am). APL will have a staff of approximately 22 people with five assigned to the terminal operation.

Cargo Containers and Destination

APL expects to deliver approximately 540 FEU's per week to Hawaii from the mainland by the third year of operation, as follows:

| | | |
|---|---|---|
| 1. | 20-ft. dry containers | 206 |
| 2. | 40-ft. dry containers | 388 |
| 3. | 45-ft. dry containers | 32 |
| 4. | 40-ft. refrigerated containers | 19 |
| | Total Containers | 645 |

Approximately 25% to 30% of the container cargos will be destined for the Neighbor Islands and will be shipped via common carrier barge. The remainder is destined for Oahu locations as follows:

| | | |
|---|---|---|
| 1. | Downtown Honolulu | 20% |
| 2. | Honolulu Waterfront | 10% |
| 3. | Honolulu Airport | 10% |
| 4. | Central Oahu | 10% |
| 5. | Leeward Oahu | 10% |
| 6. | Windward Oahu | 10% |
| 7. | Ala Moana / Waikiki | 30% |

## EXISTING CONDITIONS

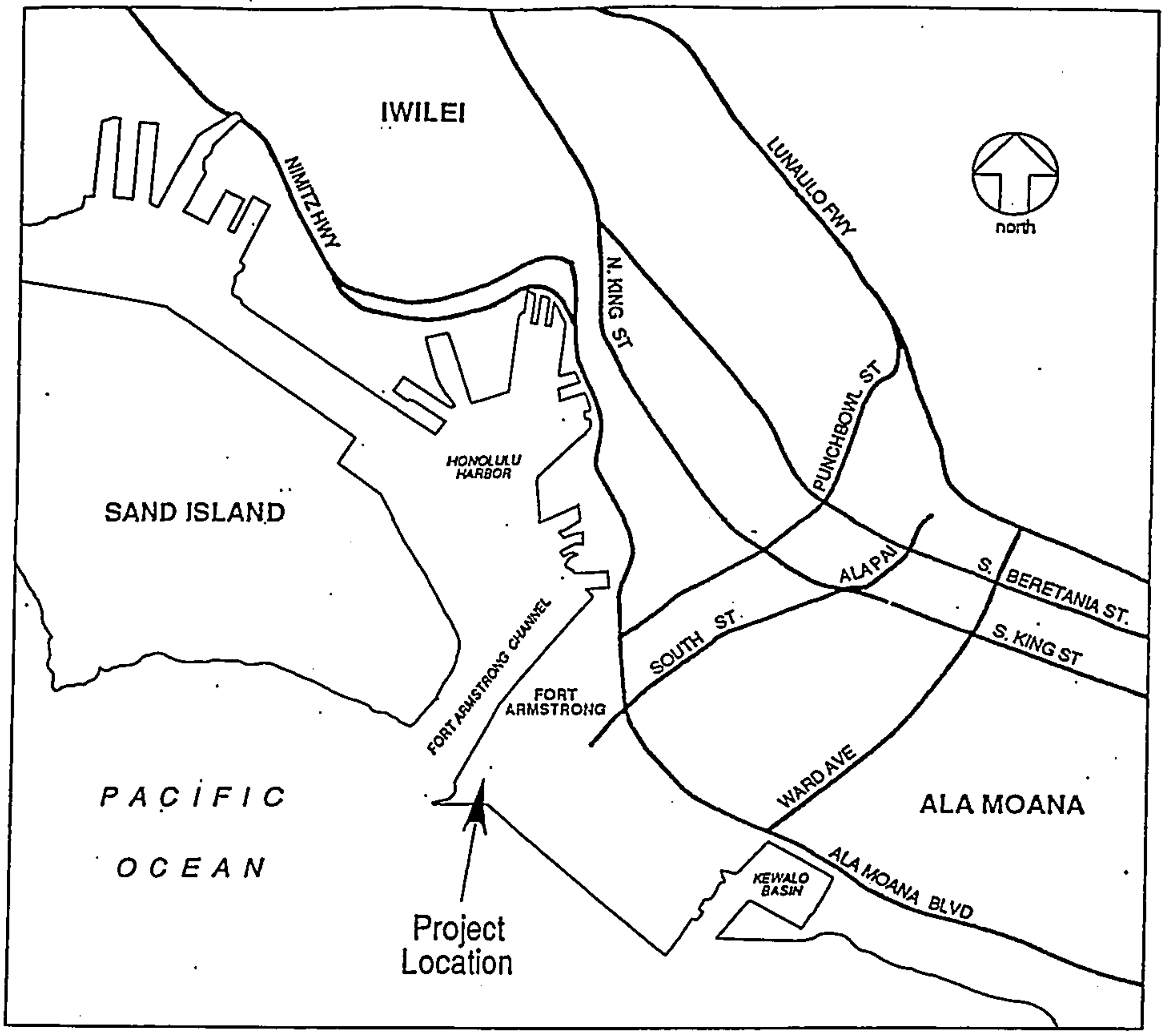
### Area Conditions

The project is located at Pier 1, Fort Armstrong on the Kakaako Peninsula. The site was formally used as a container yard by Matson Navigation Company before they relocated to the Sand Island Container Facility in 1981.

The Kakaako Makai area is served by one major East-West Arterial Street, Ala Moana Boulevard, and several mauka-makai collector/distributor roads such as Punchbowl Street, South Street, Cooke Street and Ward Avenue. Figure 1 shows the major arterials and figure 2 the existing site plan.

Ala Moana Boulevard stretches from Waikiki to Downtown Honolulu near the Aloha Tower. From Downtown Honolulu to Pearl Harbor, it becomes Nimitz Highway. Nimitz Highway/Ala Moana Boulevard are major divided highways providing an important link between the Honolulu International Airport, Downtown and Waikiki. There are four lanes in each direction from the Keehi Interchange to Sand Island Access Road. From Sand Island Access Road to Iwilei, three through lanes are provided in each direction. Between Iwilei and Kakaako, Nimitz Highway widens to four lanes in each direction.

From Kakaako to Waikiki, Nimitz Highway continues on as Ala Moana Boulevard with three lanes in each direction. Exclusive left turn lanes are provided in the medians at major intersections. Separate phases are given to left turn movements at signalized intersections. The posted speed limit on Nimitz / Ala Moana is 35 miles per hour (mph). The highway right-of-way width varies from 100 feet to 120 feet.



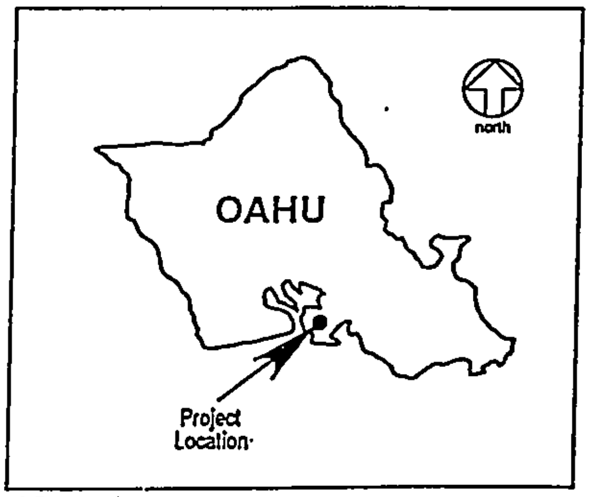




Figure 1. Location Map and Roadway Network

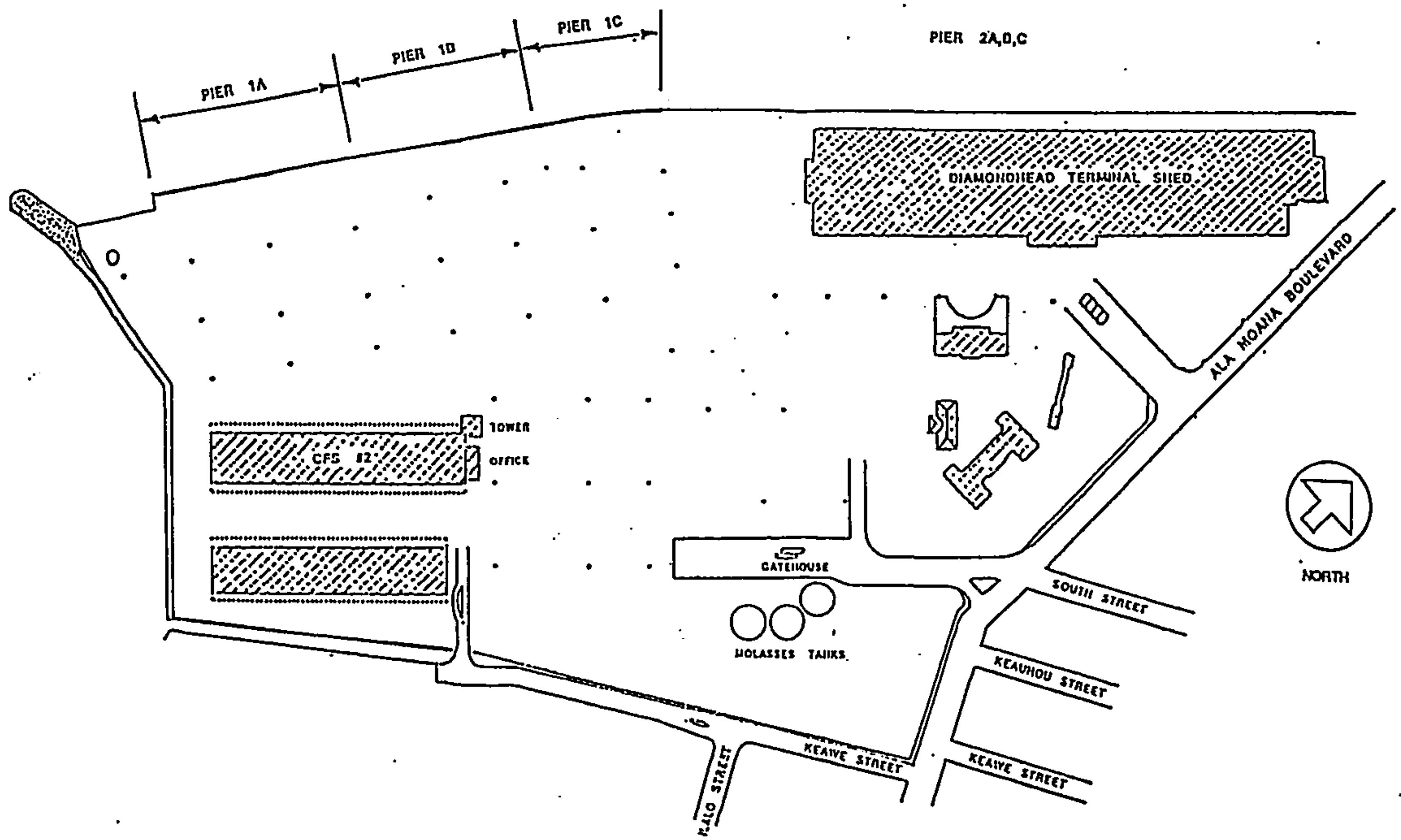


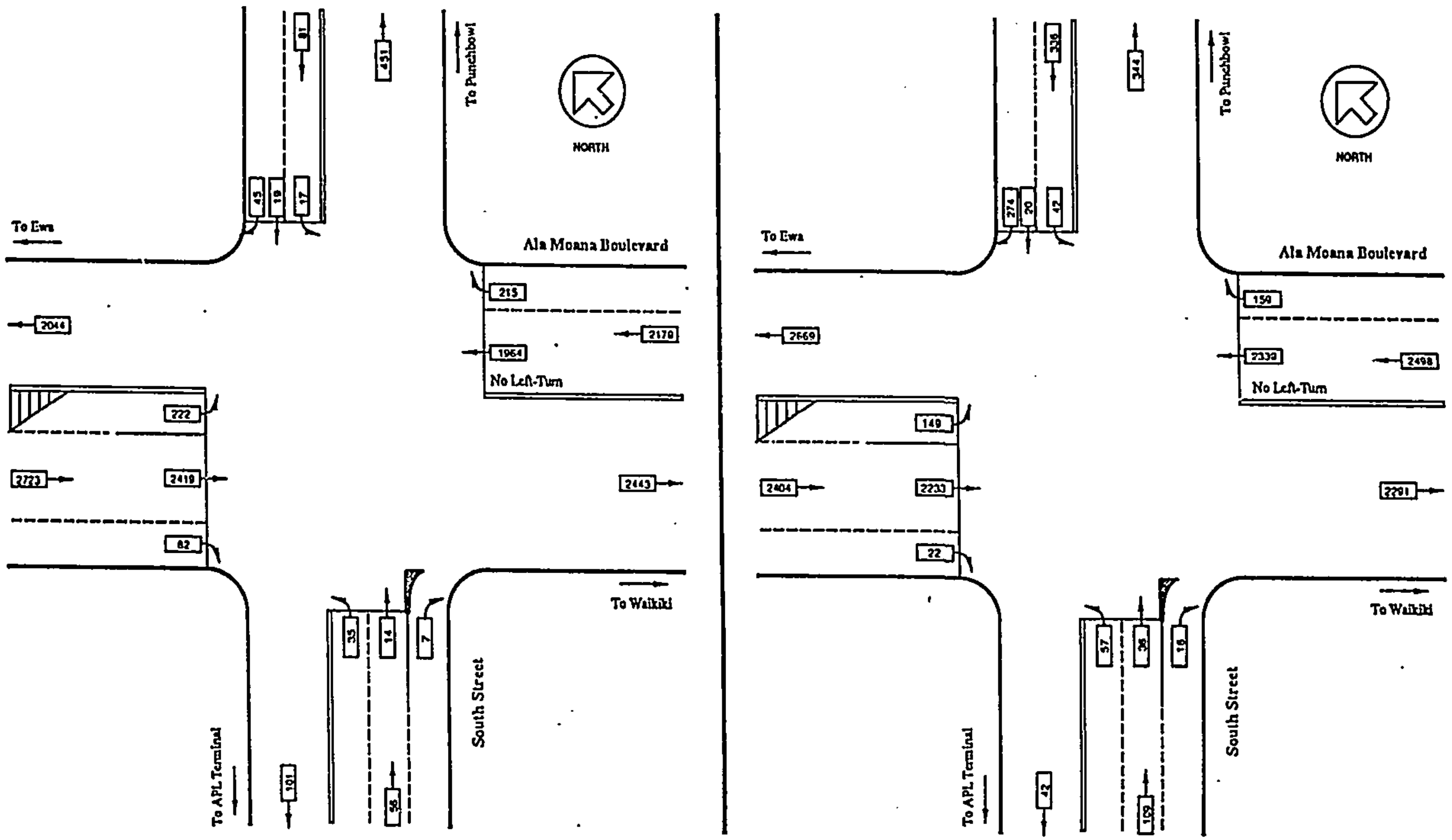

Figure 2. Existing Site Plan

Nimitz Highway serves as the major access to other roads serving the Waterfront area including Lagoon Drive and Sand Island Access Road. Ala Moana Boulevard serves as the major access to the Kakaako Makai area.

Traffic Conditions

Latest traffic counts taken by the State Department of Transportation (DOT) at the intersection of Ala Moana Boulevard and South Street in December 1986 were obtained and reviewed. Based on the 24-hour traffic count, it was determined that the heaviest traffic at the study intersection occurred on a weekday between 7:00 - 8:00 am for the morning peak hour, and between 4:00 - 5:00 pm for the afternoon peak hour.

Additional turning movement counts were taken by PPE on Tuesday, August 29, 1989 between 6:30 - 8:30 am and 3:30 - 5:30 pm at the study intersection. The volume of vehicles and the direction of movements are shown on figure 3. The recorded data establishes the present day condition upon which the project generated forecasted traffic was superimposed to determine the impact on the existing roads when the proposed APL container terminal begins operation in early 1990. Manual traffic count data is shown in Appendix B.




Morning Peak Hour 7:00 - 8:00 AM

Afternoon Peak Hour 4:00 - 5:00 PM

Figure 3. Existing Traffic

Observed Traffic Conditions

During field counts, the weather was clear and roadway pavement dry. The traffic movements at the study intersection were video-taped for future reference, and manual counts was obtained for all turning movements of passenger cars, trucks, buses and pedestrian volumes.

The following observations were also made during the field survey:

1. A stalled vehicle along South Street slightly impeded traffic exiting the Ft. Armstrong location between 4:30 and 4:45 pm. Vehicles exiting Ft. Armstrong were detoured around the stalled vehicle without much problem.
2. Westbound (Ewa) traffic along Ala Moana Boulevard was backed-up at the intersection with South Street due to heavy down-stream traffic resulting in a probable decrease in capacity of the six lane highway.
3. There were a number of mopeds travelling along Ala Moana Boulevard during the afternoon peak hour.
4. During the afternoon traffic count, three vehicles including one police motorcycle made an illegal left-turn from Ala Moana Boulevard heading Ewa onto South Street leading makai from the Fort Armstrong entrance.
5. Table 1 shows the traffic mix percentage observed at the intersection of Ala Moana Boulevard and South Street.

Table 1.
Percent Traffic Mix at Intersection of Ala Moana Boulevard & South Street

| Traffic Type | 7:00-8:00 AM Peak Hour % | 4:00-5:00 PM Peak Hour % |
|---|---|---|
| Cars, Vans & Light Trucks | 89% | 96% |
| Heavy Trucks | 7% | 2% |
| Motorcycles, Mopeds | 2% | 1% |
| Buses | 2% | 1% |
| Total | 100% | 100% |

Number of Pedestrians Crossing Intersection

During the 7:00 - 8:00 am morning peak hour, approximately 75 pedestrians were observed crossing the intersection in all directions, and 86 pedestrians were observed during the 4:00 - 5:00 pm afternoon peak hour.

## TRAFFIC IMPACT ANALYSIS

### Study Methodology

This report assesses the traffic impact during the morning and afternoon peak hours when the project generated traffic is expected to contribute the most traffic. Counts taken at the intersection indicate that the ambient morning peak hour traffic occurs between 7:00 - 8:00 am, and the afternoon peak hour traffic occurs between 4:00 - 5:00 pm on a weekday.

The focus of the study is to analyze the impact of project generated traffic at the intersection in early 1990 when the terminal is expected to be in full operation. The intersection was first analyzed for the existing traffic condition using the recorded field counts. The traffic estimated to be generated by the operation of the container terminal was then added to the existing traffic, and the combined turning movements at the study intersection was analyzed to determine the impact from the proposed terminal's operation. The results were compared by a measurement of level of service (LOS), established in the Highway Capacity Manual (HCM) Special Report 209 (1985 Edition).

### Future Ambient Traffic

Future ambient traffic was not considered because the proposed container terminal is expected to be in operation by early 1990 or within the next 4 - 6 months.

Project Generated Traffic

Vehicle trips generated by the proposed project was estimated based on information provided by APL.

All of the cargo containers will be placed on chassis and parked in the yard ready for pick-up with truck-tractors.

Based on the estimated 215 drays, or local moves per day (Wednesday, Thursday and Friday), about 11 truck-tractors without containers will be moving through the gate during the peak hours, and an estimated 16 truck-tractors with loaded containers will be returning to the terminal during the same peak hour. Twenty-seven truck-tractors will be leaving during the same period. Therefore, it is assumed that an average of 27 truck-tractors will be exiting and 27 entering the project site during the afternoon peak hour. The number of truck movements during the morning peak hour will be zero assuming the terminal operation begins at 8:00.

Vehicle trips generated by the 40-50 men per shift was not included in the peak hour traffic analysis because the day shift begins at 7:00 am and ends at 6:00 pm. The stevedores will need to be at the job site by 7:00 am, prior to the morning peak hour, and do not leave until 6:00 pm, an hour after the afternoon peak hour.

The APL staff of five at the proposed container terminal site was considered too small of a work force to generate any significant number of vehicle trips; therefore, no allowance was made to increase the vehicle trips generated by the APL staff.

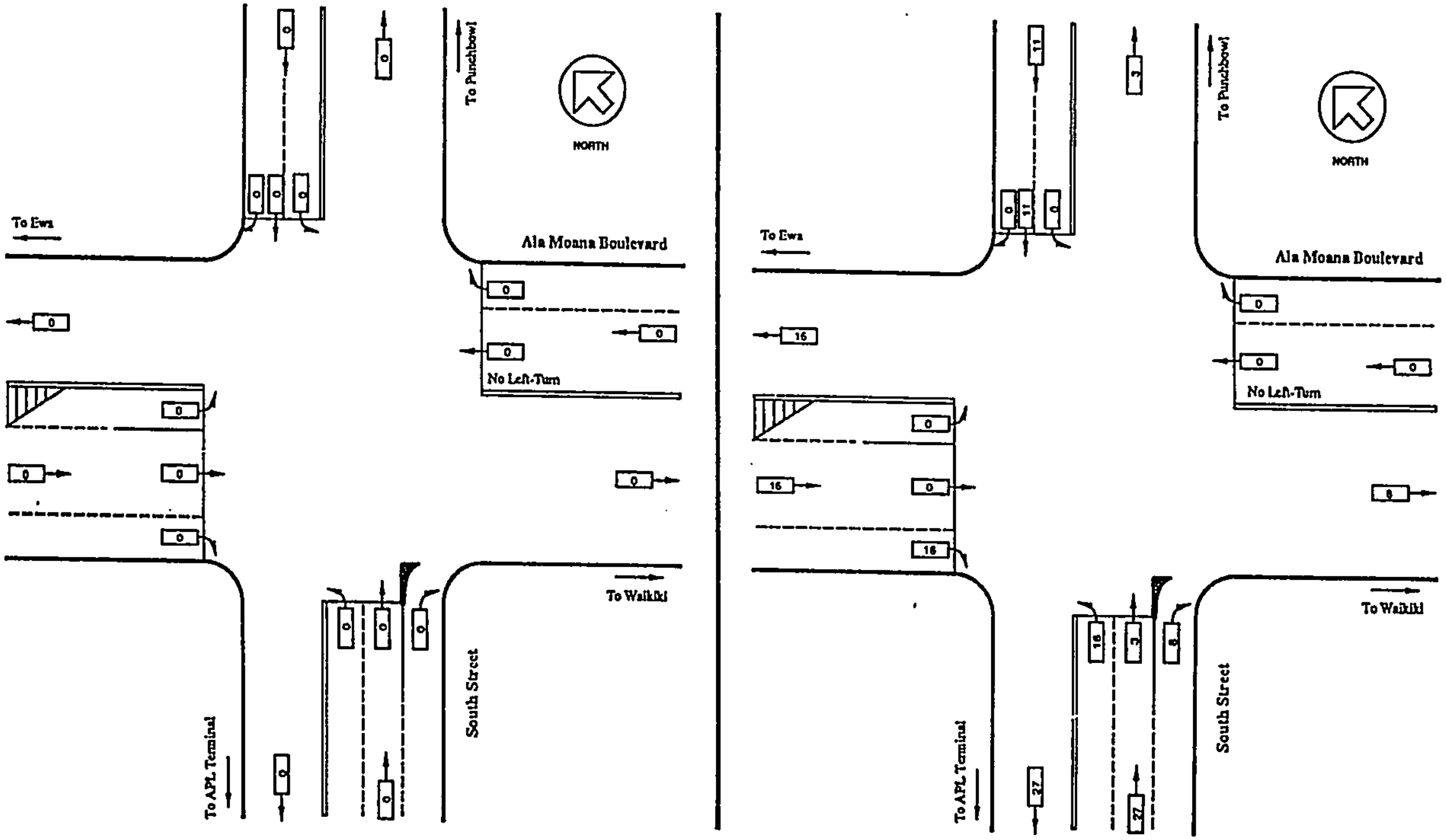
## Trip Distribution and Assignments

Trip distribution determines the predicted origins and destinations of traffic generated by the proposed container terminal operation. In the analysis, percentages of the trips entering and exiting the terminal site were applied to the estimated truck trip ends for origins and destinations out of the immediate area.

The distribution of incoming container cargo was estimated through a study conducted by APL. Based on the study, approximately 60% of the loaded containers will be headed towards Downtown Honolulu, Honolulu International Airport, Central Oahu and Leeward Oahu, while 30% will head toward Ala Moana and Waikiki with the remaining 10% destined for Windward Oahu. The truck tractors with empty containers are assumed to use the same route to return to the container terminal. Figure 4 shows the number of trips and the directions the containers will be headed as the truck-tractors leave the container terminal and enter the intersection of Ala Moana Boulevard and South Street.

## Traffic Forecasts

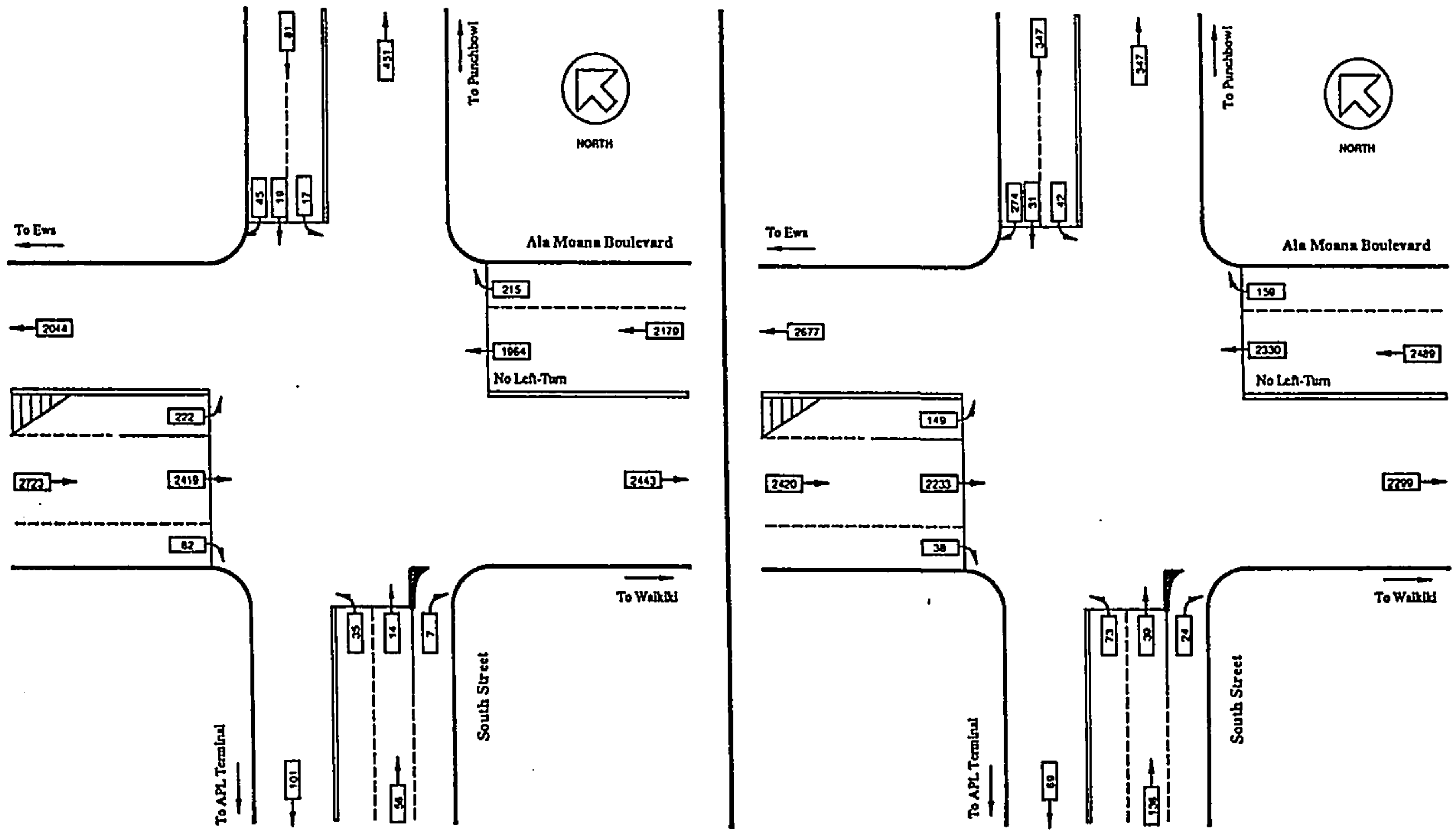
The estimated 54 truck trips generated by the proposed container terminal operation during the peak hours were superimposed onto the manual traffic counts at the study intersection to determine the total trips forecasted when the container terminal begins operation in early 1990. Figure 5 illustrates the turning movements of the forecasted traffic with the APL Fort. Armstrong Container Terminal Operation.




Morning Peak Hour 7:00 - 8:00 AM

Afternoon Peak Hour 4:00 - 5:00 PM

Figure 4. 1990 Project Generated Traffic




Morning Peak Hour 7:00 - 8:00 AM

Afternoon Peak Hour 4:00 - 5:00 PM

Figure 5. 1990 With The Project

Traffic Impacts

Traffic impacts resulting from the APL Container Terminal are measured and compared by the Level-of Service. LOS is the quantitative measurement that describes the operational conditions within a traffic stream. It generally measures the motorists' and passenger's perception in terms of speed, time, freedom to maneuver, traffic interruptions, comfort, convenience and safety. LOS for given intersection is divided into six categories ranging from free flow (LOS A) to congested flow (LOS F). A detailed explanation of each category for signalized intersections is given in Appendix A. The LOS or the capacity of a given intersection was determined by the use of the "Operational Analysis" calculation procedures contained in the Highway Capacity Manual (HCM), Special Report 209, 1985.

The results of the LOS analysis for the existing traffic and the 1990 forecasted traffic with the project generated traffic, indicate no change in the LOS. However, field observations indicate the study intersection is presently operating near a LOS F during the peak hours because of downstream traffic congestion causing low volumes of traffic negotiating the signalized intersection. Drivers were unable to proceed during the green phase because the downstream traffic had backed-up to the study intersection. Table 2 shows the result of the operational analysis for the LOS at the study intersection, while Appendix C contains the worksheets for the operational analysis for the signalized intersection.

Table 2. Level-of-Service
Operational Analysis - Signalized Intersection

Ala Moana Boulevard & South Street

Morning Peak Hour

| Approach Turning Movement | 1989 Existing | 1990 With Project |
|---|---|---|
| *Ala Moana Boulevard* | | |
| Eastbound | | |
| LT | F | F |
| TH | B | B |
| Westbound | | |
| TH | C | C |
| *South Street* | | |
| Northbound | | |
| LT | D | D |
| TH | D | D |
| RT | D | D |
| Southbound | | |
| TH | D | D |

Afternoon Peak Hour

| Approach Turning Movement | 1989 Existing | 1990 With Project |
|---|---|---|
| *Ala Moana Boulevard* | | |
| Eastbound | | |
| LT | F | F |
| TH | B | B |
| Westbound | | |
| TH | D | D |
| *South Street* | | |
| Northbound | | |
| LT | D | D |
| TH | D | D |
| RT | D | D |
| Southbound | | |
| TH | D | D |

## CONCLUSION

The results of the traffic operation analysis indicate that the proposed APL Fort Armstrong Container Terminal Operation will not significantly change the traffic flow quality because of its operation commencing in 1990.

The operational analysis for the signalized intersection indicates no change in the Level-of-Service (LOS) during the morning and afternoon peak hours. However, field observations indicate the study intersection is presently operating near LOS F during the morning and afternoon peak hours because of existing congested conditions. The analysis of existing condition suggest better than actual LOS because downstream traffic congestion decreases the volume of cars that can proceed through the intersection.

The total number of vehicles generated by the APL facility is estimated to be about 54 vehicles during the peak hour. At this level of trips, the impact on the intersection traffic flow is negligible.

APPENDIX A

DEFINITION OF LEVEL-OF-SERVICE

FOR

SIGNALIZED INTERSECTIONS

APPENDIX A

DEFINITION OF LEVEL-OF-SERVICE FOR SIGNALIZED INTERSECTIONS

The concept of levels of service is defined as a qualitative measure describing operational conditions within a traffic stream, and their perception by motorists and/or passengers. A level of service definition generally describes these conditions in terms of such factors as speed and travel time, freedom to maneuver, traffic interruptions, comfort and convenience, and safety. Six levels of service are defined for each type of facility for which analysis procedures are available. They are given letter designations, from A to F, with level-of-service A representing the best operating conditions and level-of-service F the worst.

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

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

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

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

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

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

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

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

APPENDIX B

MANUAL TRAFFIC COUNTS

Location: Ala Moana Boulevard & South Street
Date: August 29, 1989

Morning Traffic Count

| Time (am) | South Street Northbound LT | TH | RT | South Street Southbound LT | TH | RT | Ala Moana Boulevard Eastbound LT | TH | RT | Ala Moana Boulevard Westbound LT | TH | RT | Total All Approaches |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 6:30-6:45 | 2 | 3 | 2 | 3 | 13 | 5 | 48 | 522 | 50 | 0 | 375 | 17 | 1040 |
| 6:45-7:00 | 6 | 5 | 1 | 4 | 13 | 6 | 25 | 641 | 24 | 0 | 402 | 41 | 1168 |
| 7:00-7:15 | 6 | 4 | 1 | 4 | 4 | 5 | 45 | 577 | 19 | 0 | 409 | 36 | 1110 |
| 7:15-7:30 | 5 | 1 | 1 | 3 | 7 | 12 | 68 | 612 | 36 | 0 | 547 | 62 | 1354 |
| 7:30-7:45 | 17 | 4 | 3 | 4 | 3 | 15 | 52 | 584 | 17 | 0 | 491 | 62 | 1252 |
| 7:45-8:00 | 7 | 5 | 2 | 6 | 5 | 13 | 57 | 646 | 10 | 0 | 517 | 55 | 1323 |
| 8:00-8:15 | 10 | 2 | 2 | 1 | 3 | 13 | 53 | 594 | 13 | 0 | 464 | 50 | 1205 |
| 8:15-8:30 | 12 | 2 | 1 | 7 | 1 | 14 | 50 | 687 | 24 | 0 | 379 | 33 | 1210 |
| Peak Hour: 7:00 - 8:00 AM | | | | | | | | | | | | | |
| Total | 35 | 14 | 7 | 17 | 19 | 45 | 222 | 2419 | 82 | 0 | 1964 | 215 | 5039 |

Afternoon Traffic Count

| Time (pm) | South Street Northbound LT | TH | RT | South Street Southbound LT | TH | RT | Ala Moana Boulevard Eastbound LT | TH | RT | Ala Moana Boulevard Westbound LT | TH | RT | Total All Approaches |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3:30-3:45 | 33 | 23 | 4 | 5 | 11 | 50 | 38 | 570 | 15 | 2 | 704 | 36 | 1491 |
| 3:45-4:00 | 17 | 16 | 3 | 5 | 3 | 39 | 33 | 551 | 15 | 0 | 555 | 27 | 1264 |
| 4:00-4:15 | 23 | 23 | 3 | 11 | 3 | 69 | 37 | 541 | 9 | 0 | 498 | 49 | 1266 |
| 4:15-4:30 | 8 | 5 | 5 | 8 | 7 | 46 | 46 | 561 | 3 | 0 | 587 | 39 | 1315 |
| 4:30-4:45 | 16 | 3 | 5 | 14 | 9 | 83 | 35 | 583 | 5 | 1 | 679 | 35 | 1468 |
| 4:45-5:00 | 10 | 5 | 3 | 9 | 1 | 76 | 31 | 548 | 5 | 0 | 566 | 36 | 1290 |
| 5:00-5:15 | 7 | 5 | 0 | 15 | 5 | 71 | 25 | 560 | 11 | 0 | 620 | 29 | 1348 |
| 5:15-5:30 | 8 | 10 | 3 | 11 | 8 | 32 | 28 | 490 | 8 | 0 | 545 | 19 | 1162 |
| Peak Hour: 4:00 - 5:00 PM | | | | | | | | | | | | | |
| Total | 57 | 36 | 16 | 42 | 20 | 274 | 149 | 2233 | 22 | 1 | 2330 | 159 | 5339 |

# APPENDIX C

# OPERATIONAL ANALYSIS WORKSHEETS
# FOR
# SIGNALIZED INTERSECTION

# INPUT WORKSHEET

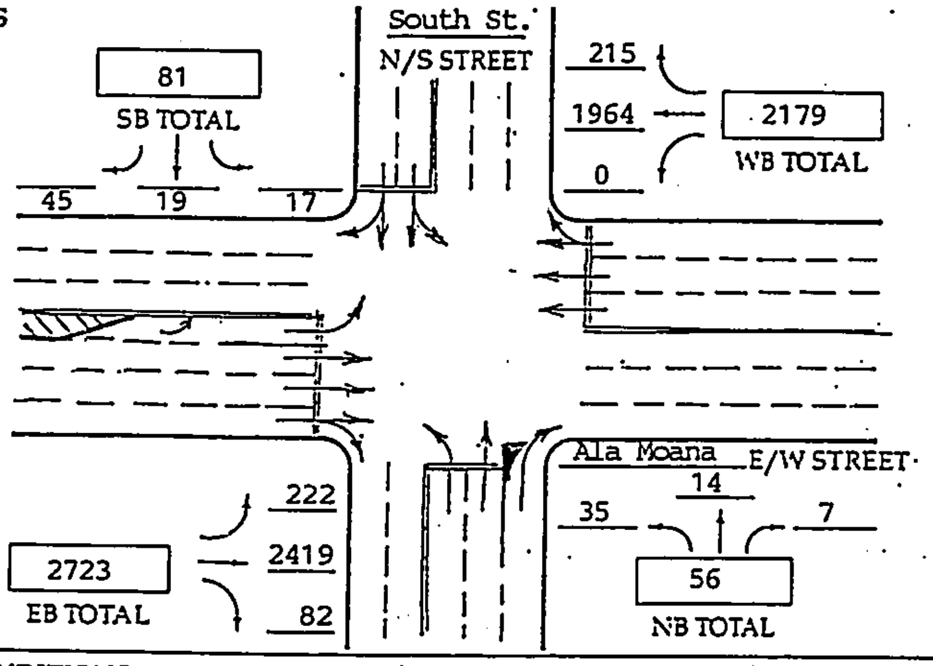
Intersection: Ala Moana @ South Street Date: 9/14/89

Analyst: RS/CH Time Period Analyzed: 7:00-8:00AM Area Type: ☐ CBD ☒ Other

Project No.: APL Fort Armstrong City/State: Honolulu/Hawaii

## VOLUME AND GEOMETRICS

NORTH




IDENTIFY IN DIAGRAM:

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

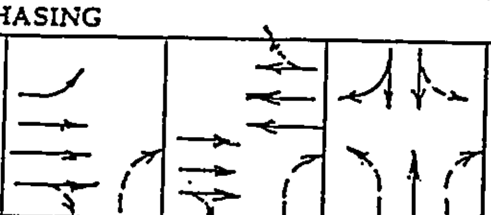
## TRAFFIC AND ROADWAY CONDITIONS

| Approach | Grade (%) | % HV | Adj. Pkg. Lane Y or N | Adj. Pkg. Lane $N_m$ | Buses ($N_B$) | PHF | Conf. Peds. (peds./hr) | Pedestrian Button Y or N | Pedestrian Button Min. Timing | Arr. Type |
|---|---|---|---|---|---|---|---|---|---|---|
| EB | 0 | 7 | N | | 0 | .93 | Low | | | 1 |
| WB | 0 | 7 | N | | 0 | .93 | Low | | | 2 |
| NB | 0 | 32 | Y | 0 | 0 | .93 | Low | | | 3 |
| SB | 0 | 9 | N | | 0 | .93 | Low | | | 3 |

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

## PHASING

DIAGRAM



| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Timing | G = 21 Y+R = 119 | G = 76 Y+R = 64 | G = 28 Y+R = 112 | G = Y+R = | G = Y+R = | G = Y+R = | G = Y+R = | G = Y+R = |
| Pretimed or Actuated | A | A | A | | | | | |

Protected turns | Permitted turns | Pedestrian | Cycle Length 140 Sec

Ala Moana/South 1989 AM Peak Hour

## VOLUME ADJUSTMENT WORKSHEET

| 1 Appr | 2 Mvt | 3 Mvt Volume (vph) | 4 Peak Hour Factor PHF | 5 Flow Rate vp (vph) | 6 Lane Group | 7 Flow rate in Lane Group vg (vph) | 8 Number of Lanes N | 9 Lane Utilization Factor U | 10 Adj. Flow v (vph) | 11 Prop. of LT or RT Plt or Prt |
|---|---|---|---|---|---|---|---|---|---|---|
| | LT | 222 | 0.93 | 239 | | 239 | 1 | 1.00 | 239 | 100% |
| EB | TH | 2419 | 0.93 | 2601 | | 2689 | 3 | 1.00 | 2689 | 97%<br>3% |
| | RT | 82 | 0.93 | 88 | | | | | | |
| | LT | | | | | | | | | |
| WB | TH | 1964 | 0.93 | 2112 | | 2343 | 3 | 1.00 | 2343 | 90%<br>10% |
| | RT | 215 | 0.93 | 231 | | | | | | |
| | LT | 35 | 0.93 | 38 | | 38 | 1 | 1.00 | 38 | 100% |
| NB | TH | 14 | 0.93 | 15 | | 15 | 1 | 1.00 | 15. | 100% |
| | RT | 7 | 0.93 | 8 | | 8 | 1 | 1.00 | 8 | 100% |
| | LT | 17 | 0.93 | 18 | | | | | | |
| SB | TH | 19 | 0.93 | 20 | | 87 | 2 | 1.00 | 87 | 21%<br>23%<br>56% |
| | RT | 45 | 0.93 | 48 | | | | | | |

Ala Moana/South 1989 AM Peak Hour

| SUPPLEMENTAL WORKSHEET FOR LEFT-TURN ADJUSTMENT FACTOR, flt | | | | |
|---|---|---|---|---|
| INPUT VARIABLES | EB | WB | NB | SB |
| Cycle Length, C (sec) | | | 140 | 140 |
| Effective Green, g (sec) | | | 28 | 28 |
| Number of Lanes, N | | | 1 | 2 |
| Total Approach Flow Rate, va (vph) | | | 60 | 87 |
| Mainline Flow Rate, vm (vph) | | | 23 | 69 |
| Left-Turn Flow Rate, vlt (vph) | | | 38 | 18 |
| Proportion of LT, Plt | | | 1.00 | 0.21 |
| Opposing Lanes, No | | | 2 | 1 |
| Opposing Flow Rate, vo (vph) | | | 69 | 23 |
| Prop. of LT in Opp. Vol., Plto | | | 0.27 | 0.00 |
| COMPUTATIONS | EB | WB | NB | SB |
| Sop | | | 3329 | 1800 |
| Yo | | | 0.021 | 0.013 |
| gu | | | 25.64 | 26.58 |
| fs | | | 0.832 | 0.898 |
| Pl | | | 1.000 | 0.417 |
| gq | | | 2.36 | 1.42 |
| Pt | | | 0.000 | 0.583 |
| gf | | | 0.00 | 0.89 |
| El | | | 1.35 | 1.31 |
| fm | | | 0.820 | 0.975 |
| flt | | | 0.82 | 0.99 |

Ala Moana/South 1989 AM Peak Hour

## SATURATION FLOW ADJUSTMENT WORKSHEET

| LANE GROUPS | | | | ADJUSTMENT FACTORS | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 Appr | 2 Lane Group Movements | 3 Ideal Sat. Flow (pcphgpl) | 4 No. of Lanes N | 5 Lane Width fw | 6 Heavy Veh fhv | 7 Grade fg | 8 Pkg fp | 9 Bus Block fbb | 10 Area Type fa | 11 Right Turn frt | 12 Left Turn flt | 13 Adj. Sat. Flow Rate s (vphg) |
| EB | LT | 1800 | 1 | 1.00 | 0.97 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 0.95 | 1659 |
| | TH | 1800 | 3 | 1.00 | 0.97 | 1.00 | 1.00 | 1.00 | 1.00 | 0.99 | 1.00 | 5186 |
| | RT | | | | | | | | | | | |
| WB | LT | | | | | | | | | | | |
| | TH | 1800 | 3 | 1.00 | 0.97 | 1.00 | 1.00 | 1.00 | 1.00 | 0.98 | 1.00 | 5133 |
| | RT | | | | | | | | | | | |
| NB | LT | 1800 | 1 | 1.00 | 0.86 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 0.82 | 1269 |
| | TH | 1800 | 1 | 1.00 | 0.86 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1548 |
| | RT | 1800 | 1 | 1.00 | 0.86 | 1.00 | 1.00 | 1.00 | 1.00 | 0.83 | 1.00 | 1285 |
| SB | LT | | | | | | | | | | | |
| | TH | 1800 | 2 | 1.00 | 0.96 | 1.00 | 1.00 | 1.00 | 1.00 | 0.97 | 0.99 | 3310 |
| | RT | | | | | | | | | | | |

Ala Moana/South 1989 AM Peak Hour

**CAPACITY ANALYSIS WORKSHEET**

| LANE GROUP | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 1 Appr. | 2. Lane Group Movements | 3. Adj. Flow Rate v (vph) | 4. Adj. Sat. Flow Rate s (vphg) | 5. Flow Ratio v/s | 6. Green Ratio g/C | 7. Lane Group Cap c (vph) | 8. v/c Ratio X | 9. Critical ? Lane Group |
| | LT | 239 | 1659 | 0.144 | 0.150 | 249 | 0.959 | X |
| EB | TH | 2689 | 5186 | 0.519 | 0.693 | 3594 | 0.748 | |
| | RT | | | | | | | |
| | LT | | | | | | | |
| WB | TH | 2343 | 5133 | 0.456 | 0.543 | 2787 | 0.841 | X |
| | RT | | | | | | | |
| | LT | 38 | 1269 | 0.030 | 0.200 | 254 | 0.148 | X |
| NB | TH | 15 | 1548 | 0.010 | 0.200 | 310 | 0.049 | |
| | RT | 8 | 1285 | 0.006 | 0.200 | 257 | 0.029 | |
| | LT | | | | | | | |
| SB | TH | 87 | 3310 | 0.026 | 0.200 | 662 | 0.132 | |
| | RT | | | | | | | |
| | | | | | 1.000 | | | |

Cycle Length, C= 140 sec

Σ (v/s)= 0.630

Lost Time Per Cycle, L= 15 sec

Xc=(Σ (v/s)xC)/(C-L)= 0.706

Ala Moana/South 1989 AM Peak Hour

LEVEL-OF-SERVICE WORKSHEET

| Lane Group | | First Term Delay | | | | Second Term Delay | | | | Total Delay and LOS | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 Appr | 2 Lane Group Movements | 3 v/c Ratio X | 4 Green Ratio g/C | 5 Cycle Length C (sec) | 6 Delay d1 (s/veh) | 7 Lane Grp Cap c (vph) | 8 Delay d2 (s/veh) | 9 Prog Factor PF | 10 Lane Group Delay (s/veh) | 11 Lane Group LOS | 12 Appr Delay (s/veh) | 13 Appr LOS |
| EB | LT | 0.959 | 0.150 | 140 | 44.90 | 249 | 33.62 | 1.00 | 78.52 | F | 19.59 | C |
| | TH | 0.748 | 0.693 | 140 | 10.42 | 3594 | 0.63 | 1.30 | 14.36 | B | | |
| | RT | | | | | | | | | | | |
| WB | LT | | | | | | | | | | 21.77 | C |
| | TH | 0.841 | 0.543 | 140 | 20.44 | 2787 | 1.77 | 0.98 | 21.77 | C | | |
| | RT | | | | | | | | | | | |
| NB | LT | 0.148 | 0.200 | 140 | 35.09 | 254 | 0.02 | 1.00 | 35.11 | D | 32.89 | D |
| | TH | 0.049 | 0.200 | 140 | 34.38 | 310 | 0.00 | 0.85 | 29.23 | D | | |
| | RT | 0.029 | 0.200 | 140 | 34.25 | 257 | 0.00 | 0.85 | 29.11 | D | | |
| SB | LT | | | | | | | | | | 29.73 | D |
| | TH | 0.132 | 0.200 | 140 | 34.97 | 662 | 0.01 | 0.85 | 29.73 | D | | |
| | RT | | | | | | | | | | | |

Intersection Delay= 20.84 sec/veh

Intersection LOS= C

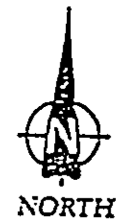
## INPUT WORKSHEET

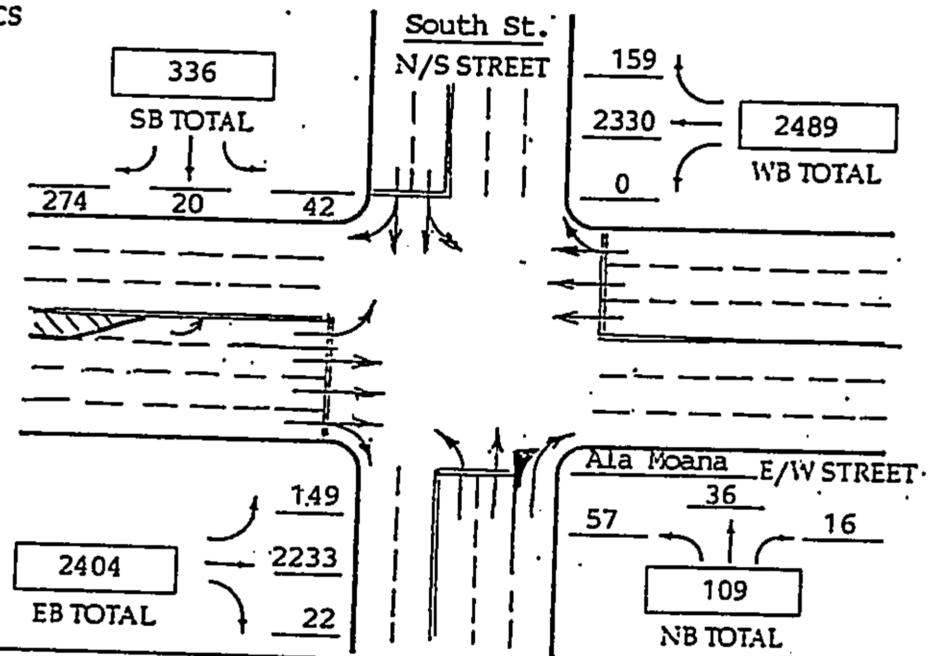
Intersection: Ala Moana @ South Street Date: 9/14/89

Analyst: SL/CH Time Period Analyzed: 4:00-5:00PM Area Type: ☐ CBD ☒ Other

Project No.: APL Fort Armstrong City/State: Honolulu/Hawaii

### VOLUME AND GEOMETRICS




IDENTIFY IN DIAGRAM:

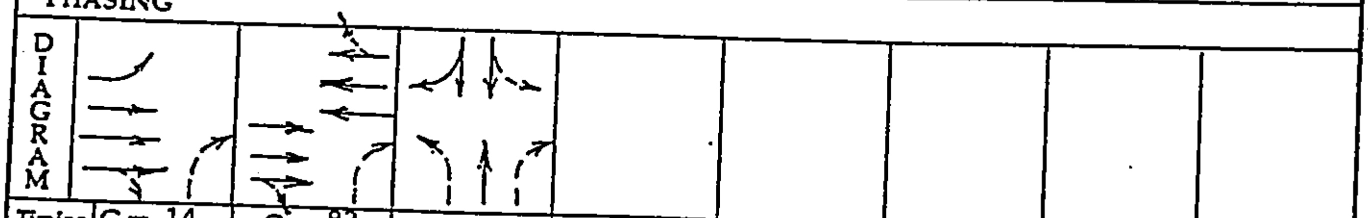
1. Volumes
2. Lanes, lane widths
3. Movements by lane
4. Parking (PKG) locations
5. Bay storage lengths
6. Islands (physical or painted)
7. Bus stops

### TRAFFIC AND ROADWAY CONDITIONS

| Approach | Grade (%) | % HV | Adj. Pkg. Lane Y or N | Adj. Pkg. Lane $N_m$ | Buses ($N_B$) | PHF | Conf. Peds. (peds./hr) | Pedestrian Button Y or N | Pedestrian Button Min. Timing | Arr. Type |
|---|---|---|---|---|---|---|---|---|---|---|
| EB | 0 | 2 | N | | 0 | .91 | Low | | | 1 |
| WB | 0 | 2 | N | | 0 | .91 | Low | | | 1 |
| NB | 0 | 5 | Y | 0 | 0 | .91 | Low | | | 3 |
| SB | 0 | 2 | N | | 0 | .91 | Low | | | 3 |

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

### PHASING



| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Timing | G = 14 Y + R = 126 | G = 82 Y + R = 58 | G = 29 Y + R = 111 | G = Y + R = | G = Y + R = | G = Y + R = | G = Y + R = | G = Y + R = |
| Pretimed or Actuated | A | A | A | | | | | |

Protected turns — Permitted turns — ------- Pedestrian — Cycle Length 140 Sec

Ala Moana/South 1989 PM Peak Hour

## VOLUME ADJUSTMENT WORKSHEET

| 1 Appr | 2 Mvt | 3 Mvt Volume (vph) | 4 Peak Hour Factor PHF | 5 Flow Rate vp (vph) | 6 Lane Group | 7 Flow rate in Lane Group vg (vph) | 8 Number of Lanes N | 9 Lane Utilization Factor U | 10 Adj. Flow v (vph) | 11 Prop. of LT or RT Plt or Prt |
|---|---|---|---|---|---|---|---|---|---|---|
| EB | LT | 149 | 0.91 | 164 | | 164 | 1 | 1.00 | 164 | 100% |
| | TH | 2233 | 0.91 | 2454 | | 2478 | 3 | 1.00 | 2478 | 99%<br>1% |
| | RT | 22 | 0.91 | 24 | | | | | | |
| WB | LT | | | | | | | | | |
| | TH | 2330 | 0.91 | 2560 | | 2735 | 3 | 1.00 | 2735 | 94%<br>6% |
| | RT | 159 | 0.91 | 175 | | | | | | |
| NB | LT | 57 | 0.91 | 63 | | 63 | 1 | 1.00 | 63 | 100% |
| | TH | 36 | 0.91 | 40 | | 40 | 1 | 1.00 | 40 | 100% |
| | RT | 16 | 0.91 | 18 | | 18 | 1 | 1.00 | 18 | 100% |
| SB | LT | 42 | 0.91 | 46 | | | | | | |
| | TH | 20 | 0.91 | 22 | | 369 | 2 | 1.00 | 369 | 13%<br>6%<br>82% |
| | RT | 274 | 0.91 | 301 | | | | | | |

Ala Moana/South 1989 PM Peak Hour

| SUPPLEMENTAL WORKSHEET FOR LEFT-TURN ADJUSTMENT FACTOR, flt | | | | |
|---|---|---|---|---|
| INPUT VARIABLES | EB | WB | NB | SB |
| Cycle Length, C (sec) | | | 140 | 140 |
| Effective Green, g (sec) | | | 29 | 29 |
| Number of Lanes, N | | | 1 | 2 |
| Total Approach Flow Rate, va (vph) | | | 120 | 369 |
| Mainline Flow Rate, vm (vph) | | | 57 | 323 |
| Left-Turn Flow Rate, vlt (vph) | | | 63 | 46 |
| *Proportion of LT, Plt* | | | 1.00 | 0.13 |
| Opposing Lanes, No | | | 2 | 1 |
| Opposing Flow Rate, vo (vph) | | | 323 | 57 |
| Prop. of LT in Opp. Vol., Plto | | | 0.14 | 0.00 |
| COMPUTATIONS | EB | WB | NB | SB |
| Sop | | | 3433 | 1800 |
| Yo | | | 0.094 | 0.032 |
| gu | | | 17.14 | 25.05 |
| fs | | | 0.673 | 0.876 |
| Pl | | | 1.000 | 0.261 |
| gq | | | 11.56 | 3.65 |
| Pt | | | 0.000 | 0.739 |
| gf | | | 0.00 | 2.40 |
| El | | | 1.67 | 1.34 |
| fm | | | 0.497 | 0.973 |
| flt | | | 0.50 | 0.99 |

Ala Moana/South 1989 PM Peak Hour

| SATURATION FLOW ADJUSTMENT WORKSHEET | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LANE GROUPS | | | | ADJUSTMENT FACTORS | | | | | | | | |
| 1 Appr | 2 Lane Group Movements | 3 Ideal Sat. Flow (pcphgpl) | 4 No. of Lanes N | 5 Lane Width fw | 6 Heavy Veh fhv | 7 Grade fg | 8 Pkg fp | 9 Bus Block fbb | 10 Area Type fa | 11 Right Turn frt | 12 Left Turn flt | 13 Adj. Sat. Flow Rate s (vphg) |
| EB | LT | 1800 | 1 | 1.00 | 0.99 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 0.95 | 1693 |
| | TH | 1800 | 3 | 1.00 | 0.99 | 1.00 | 1.00 | 1.00 | 1.00 | 0.99 | 1.00 | 5293 |
| | RT | | | | | | | | | | | |
| WB | LT | | | | | | | | | | | |
| | TH | 1800 | 3 | 1.00 | 0.99 | 1.00 | 1.00 | 1.00 | 1.00 | 0.98 | 1.00 | 5239 |
| | RT | | | | | | | | | | | |
| NB | LT | 1800 | 1 | 1.00 | 0.98 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 0.50 | 872 |
| | TH | 1800 | 1 | 1.00 | 0.98 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1755 |
| | RT | 1800 | 1 | 1.00 | 0.98 | 1.00 | 1.00 | 1.00 | 1.00 | 0.83 | 1.00 | 1457 |
| SB | LT | | | | | | | | | | | |
| | TH | 1800 | 2 | 1.00 | 0.99 | 1.00 | 1.00 | 1.00 | 1.00 | 0.86 | 0.99 | 3024 |
| | RT | | | | | | | | | | | |

Ala Moana/South 1989 PM Peak Hour

CAPACITY ANALYSIS WORKSHEET

| LANE GROUP 1 Appr. | 2. Lane Group Movements | 3. Adj. Flow Rate v (vph) | 4. Adj. Sat. Flow Rate s (vphg) | 5. Flow Ratio v/s | 6. Green Ratio g/C | 7. Lane Group Cap c (vph) | 8. v/c Ratio X | 9. Critical ? Lane Group |
|---|---|---|---|---|---|---|---|---|
| EB | LT | 164 | 1693 | 0.097 | 0.100 | 169 | 0.967 | X |
| | TH | 2478 | 5293 | 0.468 | 0.688 | 3641 | 0.681 | |
| | RT | | | | | | | |
| WB | LT | | | | | | | |
| | TH | 2735 | 5239 | 0.522 | 0.588 | 3081 | 0.888 | X |
| | RT | | | | | | | |
| NB | LT | 63 | 872 | 0.072 | 0.205 | 179 | 0.351 | |
| | TH | 40 | 1755 | 0.023 | 0.205 | 360 | 0.110 | |
| | RT | 18 | 1457 | 0.012 | 0.205 | 299 | 0.059 | |
| SB | LT | | | | | | | |
| | TH | 369 | 3024 | 0.122 | 0.205 | 620 | 0.596 | X |
| | RT | | | | | | | |
| | | | | | 1.000 | | | |

Cycle Length, C= 140 sec

Σ (v/s)= 0.741

Lost Time Per Cycle, L= 15 sec

Xc=(Σ (v/s)xC)/(C-L)= 0.830

Ala Moana/South 1989 PM Peak Hour

LEVEL-OF-SERVICE WORKSHEET

| Lane Group | | First Term Delay | | | | Second Term Delay | | | | Total Delay and LOS | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 Appr | 2 Lane Group Move-ments | 3 v/c Ratio X | 4 Green Ratio g/C | 5 Cycle Length C (sec) | 6 Delay d1 (s/veh) | 7 Lane Grp Cap c (vph) | 8 Delay d2 (s/veh) | 9 Prog Factor PF | 10 Lane Group Delay (s/veh) | 11 Lane Group LOS | 12 Appr Delay (s/veh) | 13 Appr LOS |
| EB | LT | 0.967 | 0.100 | 140 | 47.71 | 169 | 43.91 | 1.00 | 91.61 | F | 18.77 | C |
| | TH | 0.681 | 0.688 | 140 | 9.74 | 3641 | 0.37 | 1.38 | 13.95 | B | | |
| | RT | | | | | | | | | | | |
| WB | LT | | | | | | | | | | 31.15 | D |
| | TH | 0.888 | 0.588 | 140 | 18.89 | 3081 | 2.59 | 1.45 | 31.15 | D | | |
| | RT | | | | | | | | | | | |
| NB | LT | 0.351 | 0.205 | 140 | 36.23 | 179 | 0.50 | 1.00 | 36.73 | D | 33.11 | D |
| | TH | 0.110 | 0.205 | 140 | 34.40 | 360 | 0.01 | 0.85 | 29.24 | D | | |
| | RT | 0.059 | 0.205 | 140 | 34.03 | 299 | 0.00 | 0.85 | 28.93 | D | | |
| SB | LT | | | | | | | | | | 33.52 | D |
| | TH | 0.596 | 0.205 | 140 | 38.30 | 620 | 1.14 | 0.85 | 33.52 | D | | |
| | RT | | | | | | | | | | | |

Intersection Delay= 25.76 sec/veh

Intersection LOS= D

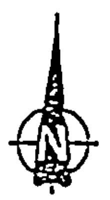
# INPUT WORKSHEET

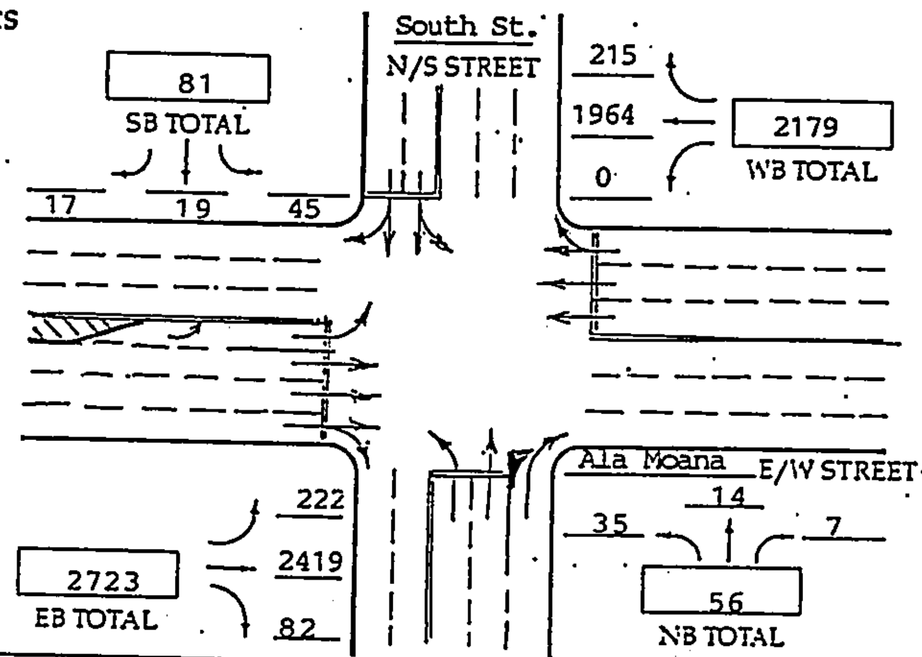
Intersection: Ala Moana @ South Street Date: 9/14/89

Analyst: RS/CH Time Period Analyzed: 7:00-8:00AM Area Type: ☐ CBD ☒ Other

Project No.: APL Fort Armstrong City/State: Honolulu/Hawaii

## VOLUME AND GEOMETRICS




IDENTIFY IN DIAGRAM:

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

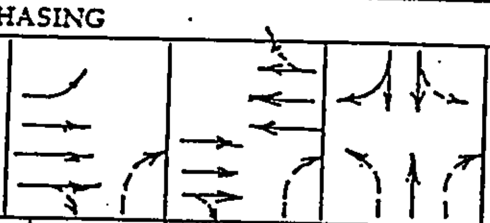
## TRAFFIC AND ROADWAY CONDITIONS

| Approach | Grade (%) | % HV | Adj. Pkg. Lane Y or N | Adj. Pkg. Lane $N_m$ | Buses ($N_B$) | PHF | Conf. Peds. (peds./hr) | Pedestrian Button Y or N | Pedestrian Button Min. Timing | Arr. Type |
|---|---|---|---|---|---|---|---|---|---|---|
| EB | 0 | 7 | N | | 0 | .93 | Low | | | 1 |
| WB | 0 | 7 | N | | 0 | .93 | Low | | | 2 |
| NB | 0 | 30 | Y | 0 | 0 | .93 | Low | | | 3 |
| SB | 0 | 15 | N | | 0 | .93 | Low | | | 3 |

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

## PHASING

DIAGRAM



| Timing | G = 21<br>Y + R = 119 | G = 76<br>Y + R = 64 | G = 28<br>Y + R = 112 | G =<br>Y + R = | G =<br>Y + R = | G =<br>Y + R = | G =<br>Y + R = | G =<br>Y + R = |
|---|---|---|---|---|---|---|---|---|
| Pretimed or Actuated | A | A | A | | | | | |

Protected turns | Permitted turns | -------- Pedestrian | Cycle Length 140 Sec

Ala Moana/South 1990 AM Peak Hour With Project

VOLUME ADJUSTMENT WORKSHEET

| 1 Appr | 2 Mvt | 3 Mvt Volume (vph) | 4 Peak Hour Factor PHF | 5 Flow Rate vp (vph) | 6 Lane Group | 7 Flow rate in Lane Group vg (vph) | 8 Number of Lanes N | 9 Lane Utilization Factor U | 10 Adj. Flow v (vph) | 11 Prop. of LT or RT Plt or Prl |
|---|---|---|---|---|---|---|---|---|---|---|
| EB | LT | 222 | 0.93 | 239 | | 239 | 1 | 1.00 | 239 | 100% |
| | TH | 2419 | 0.93 | 2601 | | 2689 | 3 | 1.00 | 2689 | 97%<br>3% |
| | RT | 82 | 0.93 | 88 | | | | | | |
| WB | LT | | | | | | | | | |
| | TH | 1964 | 0.93 | 2112 | | 2343 | 3 | 1.00 | 2343 | 90%<br>10% |
| | RT | 215 | 0.93 | 231 | | | | | | |
| NB | LT | 35 | 0.93 | 38 | | 38 | 1 | 1.00 | 38 | 100% |
| | TH | 14 | 0.93 | 15 | | 15 | 1 | 1.00 | 15 | 100% |
| | RT | 7 | 0.93 | 8 | | 8 | 1 | 1.00 | 8 | 100% |
| SB | LT | 17 | 0.93 | 18 | | | | | | |
| | TH | 19 | 0.93 | 20 | | 87 | 2 | 1.00 | 87 | 21%<br>23%<br>56% |
| | RT | 45 | 0.93 | 48 | | | | | | |

Ala Moana/South 1990 AM Peak Hour With Project

| SUPPLEMENTAL WORKSHEET FOR LEFT-TURN ADJUSTMENT FACTOR, flt | | | | |
|---|---|---|---|---|
| INPUT VARIABLES | EB | WB | NB | SB |
| Cycle Length, C (sec) | | | 140 | 140 |
| Effective Green, g (sec) | | | 28 | 28 |
| Number of Lanes, N | | | 1 | 2 |
| Total Approach Flow Rate, va (vph) | | | 56 | 81 |
| Mainline Flow Rate, vm (vph) | | | 49 | 64 |
| Left-Turn Flow Rate, vlt (vph) | | | 35 | 17 |
| Proportion of LT, Plt | | | 1.00 | 0.21 |
| Opposing Lanes, No | | | 2 | 1 |
| Opposing Flow Rate, vo (vph) | | | 64 | 49 |
| Prop. of LT in Opp. Vol., Plto | | | 0.27 | 0.00 |
| COMPUTATIONS | EB | WB | NB | SB |
| Sop | | | 3308 | 1800 |
| Yo | | | 0.019 | 0.027 |
| gu | | | 25.79 | 24.87 |
| fs | | | 0.835 | 0.844 |
| Pl | | | 1.000 | 0.440 |
| gq | | | 2.21 | 3.13 |
| Pt | | | 0.000 | 0.560 |
| gf | | | 0.00 | 1.52 |
| El | | | 1.35 | 1.33 |
| fm | | | 0.827 | 0.932 |
| flt | | | 0.83 | 0.97 |

Ala Moana/South 1990 AM Peak Hour With Project

## SATURATION FLOW ADJUSTMENT WORKSHEET

| LANE GROUPS | | | | ADJUSTMENT FACTORS | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 Appr | 2 Lane Group Movements | 3 Ideal Sat. Flow (pcphgpl) | 4 No. of Lanes N | 5 Lane Width fw | 6 Heavy Veh fhv | 7 Grade fg | 8 Pkg fp | 9 Bus Block fbb | 10 Area Type fa | 11 Right Turn frt | 12 Left Turn flt | 13 Adj. Sat. Flow Rate s (vphg) |
| EB | LT | 1800 | 1 | 1.00 | 0.97 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 0.95 | 1659 |
| | TH | 1800 | 3 | 1.00 | 0.97 | 1.00 | 1.00 | 1.00 | 1.00 | 0.99 | 1.00 | 5186 |
| | RT | | | | | | | | | | | |
| WB | LT | | | | | | | | | | | |
| | TH | 1800 | 3 | 1.00 | 0.97 | 1.00 | 1.00 | 1.00 | 1.00 | 0.98 | 1.00 | 5133 |
| | RT | | | | | | | | | | | |
| NB | LT | 1800 | 1 | 1.00 | 0.79 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 0.83 | 1175 |
| | TH | 1800 | 1 | 1.00 | 0.79 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1422 |
| | RT | 1800 | 1 | 1.00 | 0.79 | 1.00 | 1.00 | 1.00 | 1.00 | 0.83 | 1.00 | 1180 |
| SB | LT | | | | | | | | | | | |
| | TH | 1800 | 2 | 1.00 | 0.93 | 1.00 | 1.00 | 1.00 | 1.00 | 0.97 | 0.97 | 3137 |
| | RT | | | | | | | | | | | |

Ala Moana/South 1990 AM Peak Hour With Project

CAPACITY ANALYSIS WORKSHEET

| LANE GROUP | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 1 Appr. | 2. Lane Group Movements | 3. Adj. Flow Rate v (vph) | 4. Adj. Sat. Flow Rate s (vphg) | 5. Flow Ratio v/s | 6. Green Ratio g/C | 7. Lane Group Cap c (vph) | 8. v/c Ratio X | 9. Critical ? Lane Group |
| EB | LT | 239 | 1659 | 0.144 | 0.150 | 249 | 0.959 | X |
| | TH | 2689 | 5186 | 0.519 | 0.693 | 3594 | 0.748 | |
| | RT | | | | | | | |
| WB | LT | | | | | | | |
| | TH | 2343 | 5133 | 0.456 | 0.543 | 2787 | 0.841 | X |
| | RT | | | | | | | |
| NB | LT | 38 | 1175 | 0.032 | 0.200 | 235 | 0.160 | X |
| | TH | 15 | 1422 | 0.011 | 0.200 | 284 | 0.053 | |
| | RT | 8 | 1180 | 0.006 | 0.200 | 236 | 0.032 | |
| SB | LT | | | | | | | |
| | TH | 87 | 3137 | 0.028 | 0.200 | 627 | 0.139 | |
| | RT | | | | | | | |
| | | | | | 1.000 | | | |

Cycle Length, C= 140 sec

Σ (v/s)= 0.632

Lost Time Per Cycle, L= 15 sec

Xc=(Σ (v/s)xC)/(C-L)= 0.708

Ala Moana/South 1990 AM Peak Hour With Project

LEVEL-OF-SERVICE WORKSHEET

| Lane Group | | First Term Delay | | | | Second Term Delay | | | | Total Delay and LOS | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 Appr | 2 Lane Group Movements | 3 v/c Ratio X | 4 Green Ratio g/C | 5 Cycle Length C (sec) | 6 Delay d1 (s/veh) | 7 Lane Grp Cap c (vph) | 8 Delay d2 (s/veh) | 9 Prog Factor PF | 10 Lane Group Delay (s/veh) | 11 Lane Group LOS | 12 Appr Delay (s/veh) | 13 Appr LOS |
| EB | LT | 0.959 | 0.150 | 140 | 44.90 | 249 | 33.62 | 1.00 | 78.52 | F | 20.71 | C |
| | TH | 0.748 | 0.693 | 140 | 10.42 | 3594 | 0.63 | 1.41 | 15.58 | C | | |
| | RT | | | | | | | | | | | |
| WB | LT | | | | | | | | | | 21.54 | C |
| | TH | 0.841 | 0.543 | 140 | 20.44 | 2787 | 1.77 | 0.97 | 21.54 | C | | |
| | RT | | | | | | | | | | | |
| NB | LT | 0.160 | 0.200 | 140 | 35.17 | 235 | 0.03 | 1.00 | 35.20 | D | 32.96 | D |
| | TH | 0.053 | 0.200 | 140 | 34.41 | 284 | 0.00 | 0.85 | 29.25 | D | | |
| | RT | 0.032 | 0.200 | 140 | 34.27 | 236 | 0.00 | 0.85 | 29.13 | D | | |
| SB | LT | | | | | | | | | | 29.77 | D |
| | TH | 0.139 | 0.200 | 140 | 35.02 | 627 | 0.01 | 0.85 | 29.77 | D | | |
| | RT | | | | | | | | | | | |

Intersection Delay= 21.35 sec/veh

Intersection LOS= C

1990 With Project PM Peak Hour



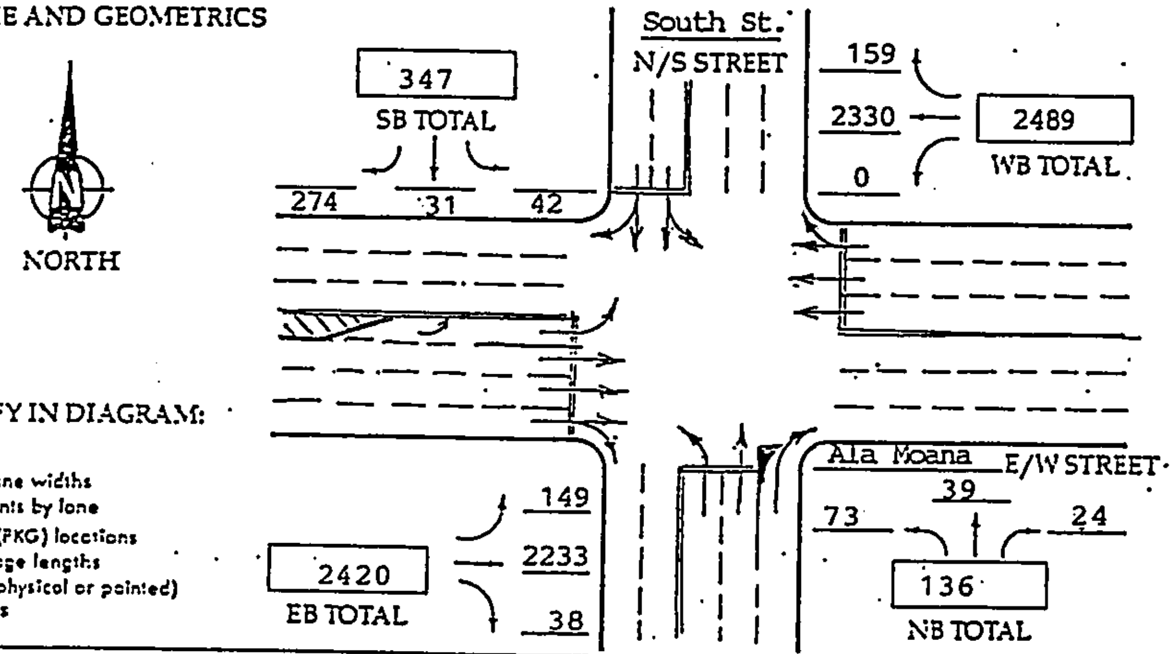
## INPUT WORKSHEET

Intersection: Ala Moana @ South Street Date: 9/14/89

Analyst: SL/CH Time Period Analyzed: 4:00-5:00PM Area Type: ☐ CBD ☒ Other

Project No.: APL Fort Armstrong City/State: Honolulu/Hawaii

VOLUME AND GEOMETRICS




IDENTIFY IN DIAGRAM:

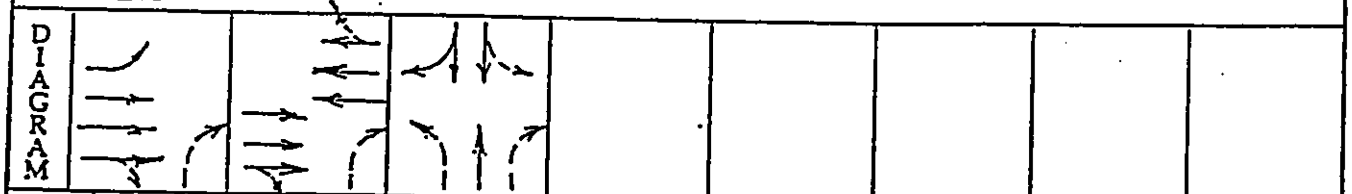
1. Volumes
2. Lanes, lane widths
3. Movements by lane
4. Parking (PKG) locations
5. Bay storage lengths
6. Islands (physical or painted)
7. Bus stops

TRAFFIC AND ROADWAY CONDITIONS

| Approach | Grade (%) | % HV | Adj. Pkg. Lane Y or N | Adj. Pkg. Lane $N_m$ | Buses ($N_B$) | PHF | Conf. Peds. (peds./hr) | Pedestrian Button Y or N | Pedestrian Button Min. Timing | Arr. Type |
|---|---|---|---|---|---|---|---|---|---|---|
| EB | 0 | 2 | N | | 0 | .91 | Low | | | 1 |
| WB | 0 | 2 | N | | 0 | .91 | Low | | | 1 |
| NB | 0 | 16 | Y | 0 | 0 | .91 | Low | | | 3 |
| SB | 0 | 5 | N | | 0 | .91 | Low | | | 3 |

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

PHASING



| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Timing | G = 14 Y + R = 126 | G = 82 Y + R = 58 | G = 29 Y + R = 111 | G = Y + R = | G = Y + R = | G = Y + R = | G = Y + R = | G = Y + R = |
| Pretimed or Actuated | A | A | A | | | | | |

Protected turns | Permitted turns | Pedestrian | Cycle Length 140 Sec

Ala Moana/South 1990 PM Peak Hour With Project

VOLUME ADJUSTMENT WORKSHEET

| 1 Appr | 2 Mvt | 3 Mvt Volume (vph) | 4 Peak Hour Factor PHF | 5 Flow Rate vp (vph) | 6 Lane Group | 7 Flow rate in Lane Group vg (vph) | 8 Number of Lanes N | 9 Lane Utilization Factor U | 10 Adj. Flow v (vph) | 11 Prop. of LT or RT Plt or Prt |
|---|---|---|---|---|---|---|---|---|---|---|
| EB | LT | 149 | 0.91 | 164 | | 164 | 1 | 1.00 | 164 | 100% |
| | TH | 2233 | 0.91 | 2454 | | 2496 | 3 | 1.00 | 2496 | 98% 2% |
| | RT | 38 | 0.91 | 42 | | | | | | |
| WB | LT | | | | | | | | | |
| | TH | 2330 | 0.91 | 2560 | | 2735 | 3 | 1.00 | 2735 | 94% 6% |
| | RT | 159 | 0.91 | 175 | | | | | | |
| NB | LT | 73 | 0.91 | 80 | | 80 | 1 | 1.00 | 80 | 100% |
| | TH | 39 | 0.91 | 43 | | 43 | 1 | 1.00 | 43 | 100% |
| | RT | 24 | 0.91 | 26 | | 26 | 1 | 1.00 | 26 | 100% |
| SB | LT | 42 | 0.91 | 46 | | | | | | |
| | TH | 31 | 0.91 | 34 | | 381 | 2 | 1.00 | 381 | 12% 9% 79% |
| | RT | 274 | 0.91 | 301 | | | | | | |

Ala Moana/South 1990 PM Peak Hour With Project

| SUPPLEMENTAL WORKSHEET FOR LEFT-TURN ADJUSTMENT FACTOR, flt | | | | |
|---|---|---|---|---|
| INPUT VARIABLES | EB | WB | NB | SB |
| Cycle Length, C (sec) | | | 140 | 140 |
| Effective Green, g (sec) | | | 29 | 29 |
| Number of Lanes, N | | | 1 | 2 |
| Total Approach Flow Rate, va (vph) | | | 149 | 381 |
| Mainline Flow Rate, vm (vph) | | | 69 | 335 |
| Left-Turn Flow Rate, vlt (vph) | | | 80 | 46 |
| Proportion of LT, Plt | | | 1.00 | 0.12 |
| Opposing Lanes, No | | | 2 | 1 |
| Opposing Flow Rate, vo (vph) | | | 335 | 69 |
| Prop. of LT in Opp. Vol., Plto | | | 0.14 | 0.00 |
| COMPUTATIONS | EB | WB | NB | SB |
| Sop | | | 3433 | 1800 |
| Yo | | | 0.098 | 0.038 |
| gu | | | 16.66 | 24.25 |
| fs | | | 0.666 | 0.832 |
| Pl | | | 1.000 | 0.262 |
| gq | | | 12.04 | 4.45 |
| Pt | | | 0.000 | 0.738 |
| gf | | | 0.00 | 2.77 |
| El | | | 1.69 | 1.35 |
| fm | | | 0.483 | 0.958 |
| flt | | | 0.48 | 0.98 |

Ala Moana/South 1990 PM Peak Hour With Project

## SATURATION FLOW ADJUSTMENT WORKSHEET

| LANE GROUPS | | | | ADJUSTMENT FACTORS | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 Appr | 2 Lane Group Movements | 3 Ideal Sat. Flow (pcphgpl) | 4 No. of Lanes N | 5 Lane Width fw | 6 Heavy Veh fhv | 7 Grade fg | 8 Pkg fp | 9 Bus Block fbb | 10 Area Type fa | 11 Right Turn frt | 12 Left Turn flt | 13 Adj. Sat. Flow Rate s (vphg) |
| EB | LT | 1800 | 1 | 1.00 | 0.99 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 0.95 | 1693 |
| | TH | 1800 | 3 | 1.00 | 0.99 | 1.00 | 1.00 | 1.00 | 1.00 | 0.99 | 1.00 | 5293 |
| | RT | | | | | | | | | | | |
| WB | LT | | | | | | | | | | | |
| | TH | 1800 | 3 | 1.00 | 0.99 | 1.00 | 1.00 | 1.00 | 1.00 | 0.98 | 1.00 | 5239 |
| | RT | | | | | | | | | | | |
| NB | LT | 1800 | 1 | 1.00 | 0.93 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 0.48 | 808 |
| | TH | 1800 | 1 | 1.00 | 0.93 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1674 |
| | RT | 1800 | 1 | 1.00 | 0.93 | 1.00 | 1.00 | 1.00 | 1.00 | 0.83 | 1.00 | 1389 |
| SB | LT | | | | | | | | | | | |
| | TH | 1800 | 2 | 1.00 | 0.98 | 1.00 | 1.00 | 1.00 | 1.00 | 0.86 | 0.98 | 2970 |
| | RT | | | | | | | | | | | |

Ala Moana/South 1990 PM Peak Hour With Project

CAPACITY ANALYSIS WORKSHEET

| LANE GROUP | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 1 Appr. | 2. Lane Group Movements | 3. Adj. Flow Rate v (vph) | 4. Adj. Sat. Flow Rate s (vphg) | 5. Flow Ratio v/s | 6. Green Ratio g/C | 7. Lane Group Cap c (vph) | 8. v/c Ratio X | 9. Critical ? Lane Group |
| EB | LT | 164 | 1693 | 0.097 | 0.100 | 169 | 0.967 | X |
| | TH | 2496 | 5293 | 0.472 | 0.688 | 3641 | 0.685 | |
| | RT | | | | | | | |
| WB | LT | | | | | | | |
| | TH | 2735 | 5239 | 0.522 | 0.588 | 3081 | 0.888 | X |
| | RT | | | | | | | |
| NB | LT | 80 | 808 | 0.099 | 0.205 | 166 | 0.484 | |
| | TH | 43 | 1674 | 0.026 | 0.205 | 343 | 0.125 | |
| | RT | 26 | 1389 | 0.019 | 0.205 | 285 | 0.093 | |
| SB | LT | | | | | | | |
| | TH | 381 | 2970 | 0.128 | 0.205 | 609 | 0.626 | X |
| | RT | | | | | | | |
| | | | | | 1.000 | | | |

Cycle Length, C= 140 sec

Σ (v/s)= 0.747

Lost Time Per Cycle, L= 15 sec

Xc=(Σ (v/s)xC)/(C-L)= 0.837

0.128
0.619

Ala Moana/South 1990 PM Peak Hour With Project

LEVEL-OF-SERVICE WORKSHEET

| Lane Group | | First Term Delay | | | | Second Term Delay | | | | Total Delay and LOS | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 Appr | 2 Lane Group Move-ments | 3 v/c Ratio X | 4 Green Ratio g/C | 5 Cycle Length C (sec) | 6 Delay d1 (s/veh) | 7 Lane Grp Cap c (vph) | 8 Delay d2 (s/veh) | 9 Prog Factor PF | 10 Lane Group Delay (s/veh) | 11 Lane Group LOS | 12 Appr Delay (s/veh) | 13 Appr LOS |
| EB | LT | 0.967 | 0.100 | 140 | 47.71 | 169 | 43.91 | 1.00 | 91.61 | F | 18.83 | C |
| | TH | 0.685 | 0.688 | 140 | 9.80 | 3641 | 0.39 | 1.38 | 14.06 | B | | |
| | RT | | | | | | | | | | | |
| WB | LT | | | | | | | | | | 31.15 | D |
| | TH | 0.888 | 0.588 | 140 | 18.89 | 3081 | 2.59 | 1.45 | 31.15 | D | | |
| | RT | | | | | | | | | | | |
| NB | LT | 0.484 | 0.205 | 140 | 37.33 | 166 | 1.76 | 1.00 | 39.09 | D | 34.54 | D |
| | TH | 0.125 | 0.205 | 140 | 34.51 | 343 | 0.01 | 0.85 | 29.34 | D | | |
| | RT | 0.093 | 0.205 | 140 | 34.27 | 285 | 0.00 | 0.85 | 29.14 | D | | |
| SB | LT | | | | | | | | | | 34.02 | D |
| | TH | 0.626 | 0.205 | 140 | 38.58 | 609 | 1.45 | 0.85 | 34.02 | D | | |
| | RT | | | | | | | | | | | |

Intersection Delay= 25.89 sec/veh

Intersection LOS= D