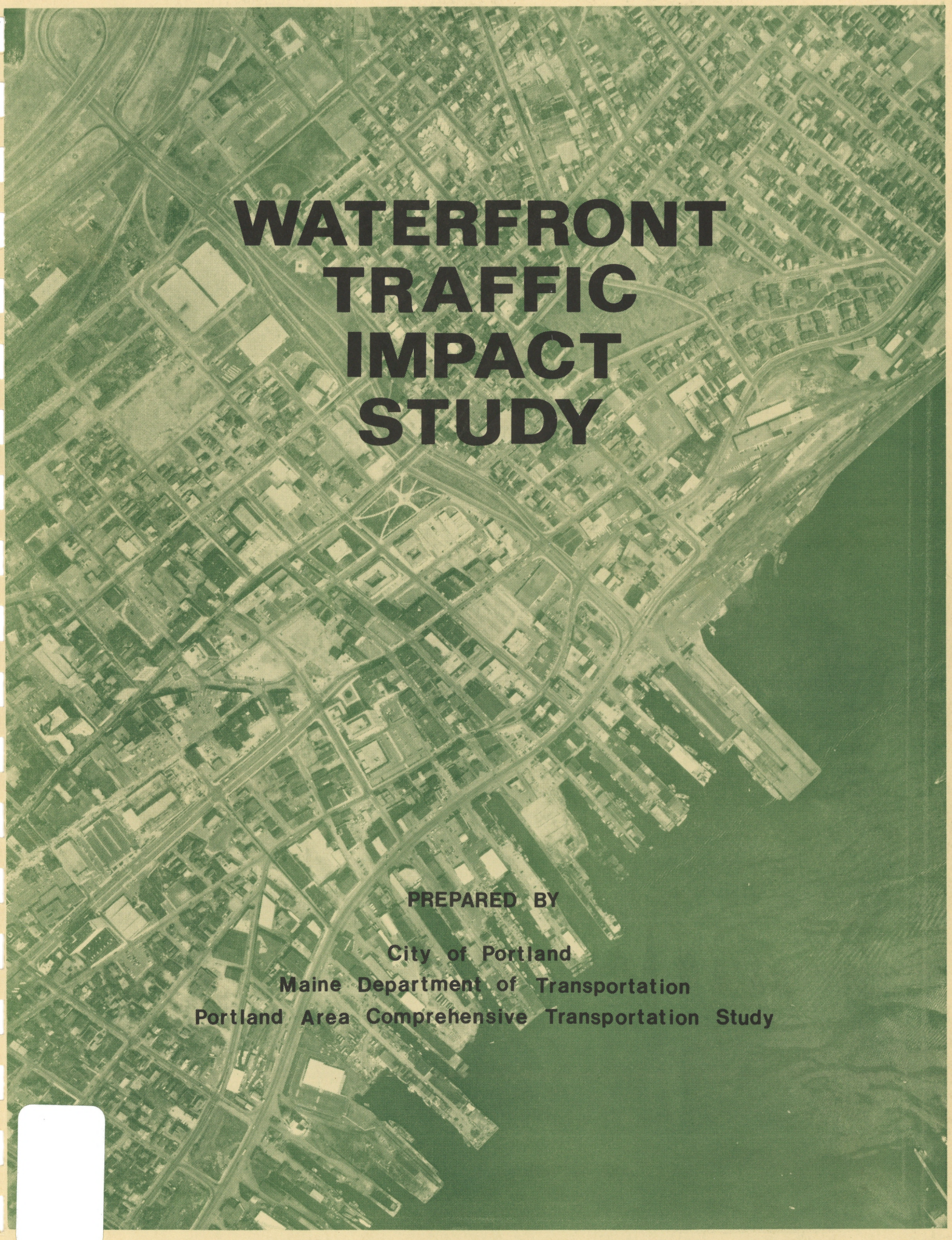
12-1981

Waterfront Traffic Impact Study

City of Portland

Maine Department of Transportation

Portland Area Comprehensive Transportation Study



WATERFRONT TRAFFIC IMPACT STUDY

PREPARED BY

City of Portland

Maine Department of Transportation

Portland Area Comprehensive Transportation Study

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December, 1981

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TABLE OF CONTENTS

TABLE OF CONTENTS, continued

LIST OF TABLES

LIST OF FIGURES

GLOSSARY OF TERMS

Term	Definition
CBD	Central Business District
Block Face	The adjacent street on a particular block. Typically used to identify on-street parking characteristics.
On-Street Parking	Parking that is allowed on any street adjacent to the curb.
Off-Street Parking	Parking in facilities removed from the street system, i.e., parking lots or garages.
Parking Factors	Typical factors applied to a development size in order to determine the parking demand associated to that development. The factors are developed from observation of developments across the nation.
Parking Demand	Represents the number of parking spaces needed to satisfy the adjacent land use during peak intervals.
Vehicle Accumulation	The measure of total vehicles parked at a given time.
Vehicle Turnover	The measure of the number of vehicles using a parking space or spaces over a given period.
Parking Duration	The length of time a vehicle or vehicles are parked; usually expressed as an average for a block face or parking lot.
AADT	Average Annual Daily Traffic that represents an estimate of the average 24-hour traffic volumes for a particular year.
Maximum Accumulation	The highest total parked vehicles observed on a block face or parking lot.

WATERFRONT TRAFFIC IMPACT STUDY

I. INTRODUCTION

The City of Portland has spent considerable effort in planning for the revitalization of its waterfront area. This successful planning effort has brought about two major developments presently in the design phase. The first is the Portland Fish Pier and the second is the Bath Iron Works facility. This study is concerned with the Bath Iron Works development.

Bath Iron Works (BIW) is proposing to expand its operation by construction of a major facility in Portland. The proposed facility will be primarily involved in vessel repair and rehabilitation. This facility is planned to become operational sometime in 1984 and will eventually attract up to 1,000 employees. Full employment is not envisioned before 1986. Therefore, there will be staging of employment levels.

Employees, patrons, visitors and goods/service deliveries are envisioned to be predominantly automobile oriented. Therefore, the purpose of this study is to examine vehicular and parking system impacts of the proposed facility and to propose strategies for minimizing any estimated impacts.

Scope of Study

The following framework was used in conducting this study.

1. Field Studies -- included a detailed traffic and pedestrian counting program, collection of accident information, surveys of parking spaces, and parking usage.
2. Analysis of Existing Conditions -- using the data gathered from the field studies, a thorough analysis of present conditions (traffic and parking) was accomplished.

3. Projections of Future Conditions -- this phase of the study projected future conditions in the study area; with and without the BIW facility.
4. Analysis -- a detailed analysis of the anticipated future conditions was conducted and improvement schemes were developed to eliminate or minimize any impacts created by BIW.

Site Location/Study Area

This study is primarily concerned with the immediate traffic and parking impacts created by the BIW facility. For purposes of analyzing traffic impacts of BIW, the study corridor included: Franklin Arterial from I-295 to Commercial Street, Commercial Street at Franklin Arterial, Washington Avenue at Cumberland Avenue and Congress Street, and Congress Street at India Street. The study corridor is illustrated on Figure 1.

The study area for analyzing parking impacts includes the area from Pearl Street to India Street, and Commercial Street to Middle Street. The parking study area is shown on Figure 2. Further details on the parking study area are provided later on in this study.

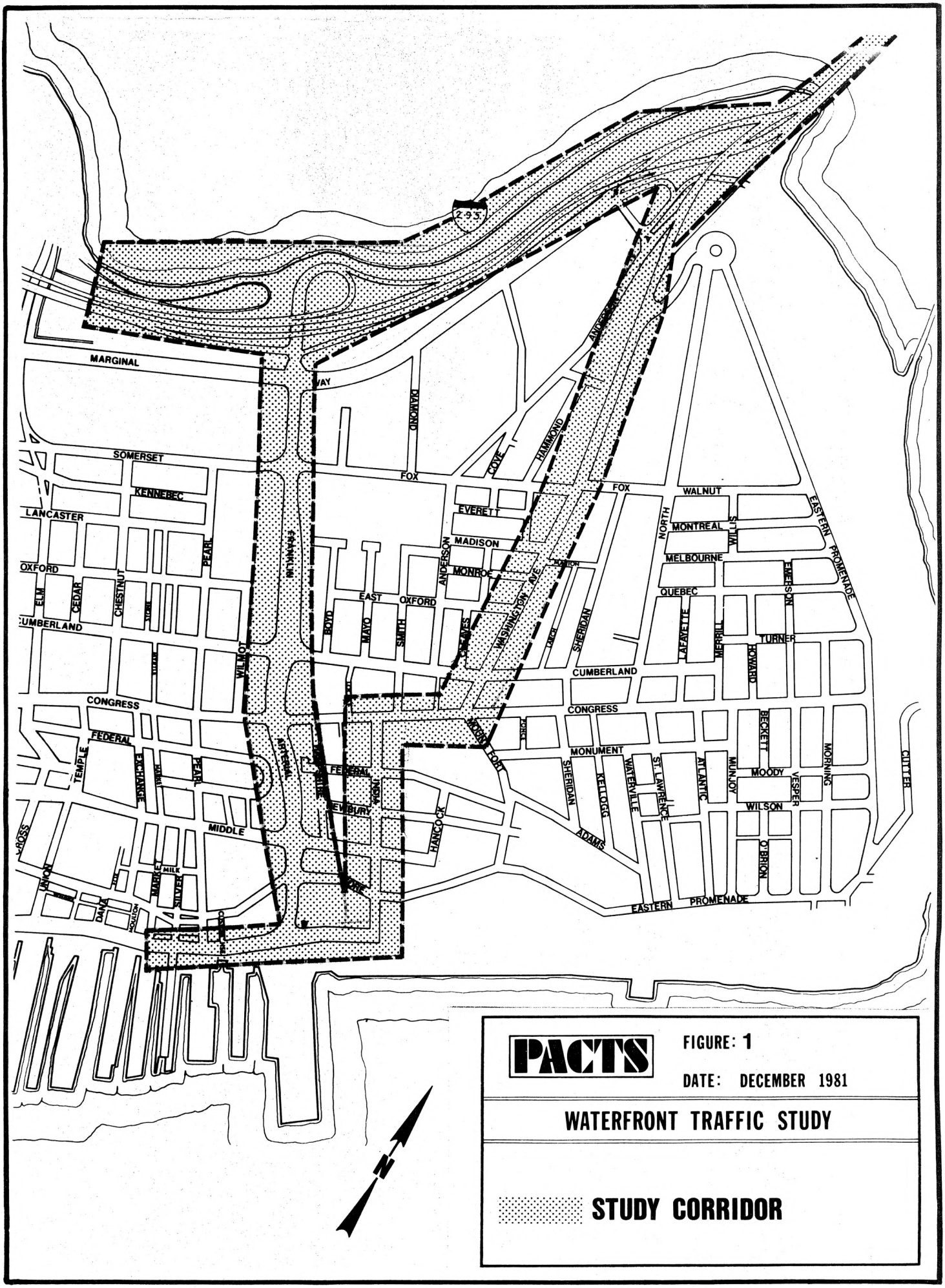

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FIGURE: 1

DATE: DECEMBER 1981

WATERFRONT TRAFFIC STUDY

STUDY CORRIDOR

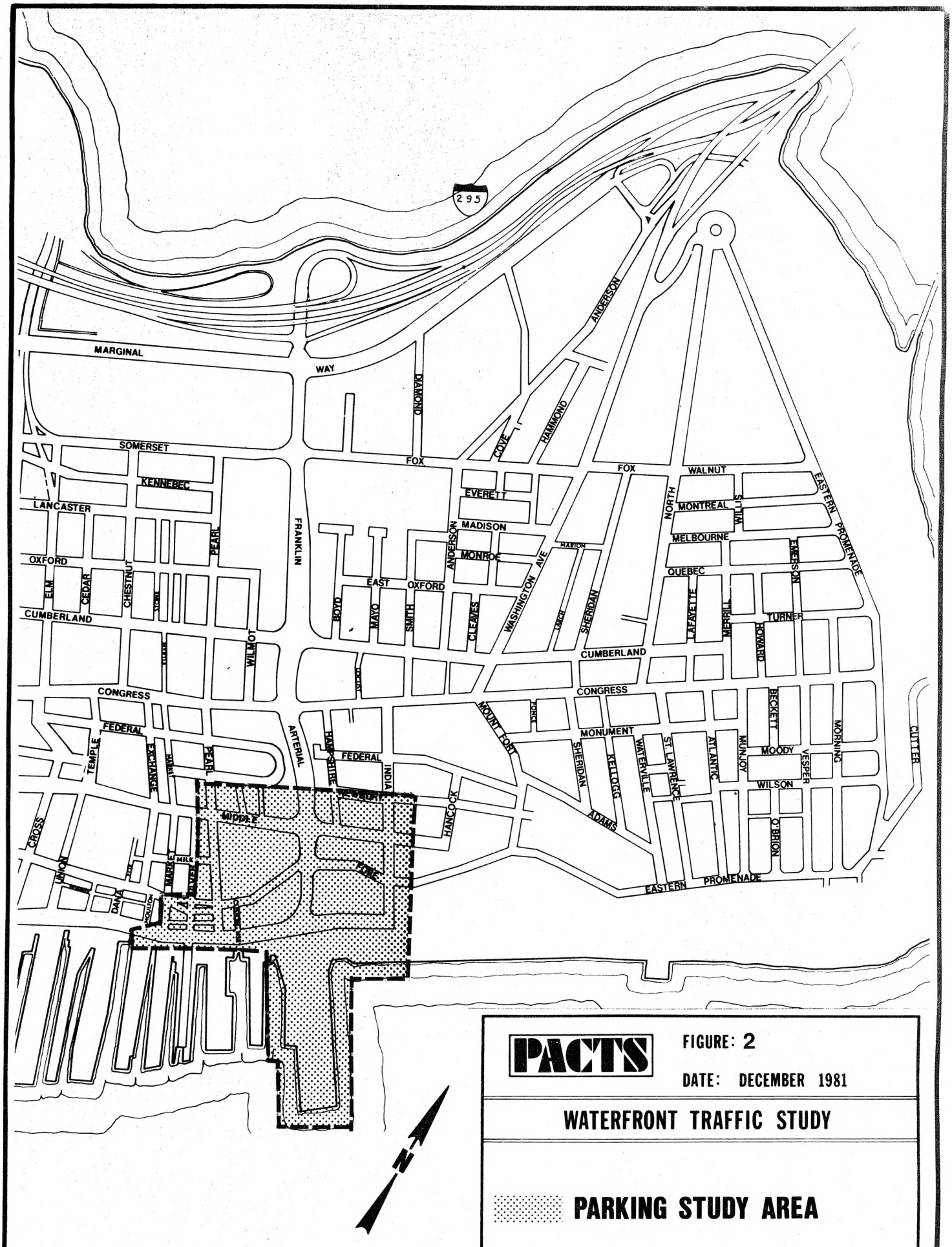

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FIGURE: 2

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WATERFRONT TRAFFIC STUDY

PARKING STUDY AREA

II. EXISTING TRAFFIC CONDITIONS

This chapter summarizes the existing traffic conditions of the study corridor. As previously discussed, the analysis was based on detailed field reconnaissance and a traffic and pedestrian counting program.

Traffic access and egress to the proposed BIW facility will primarily use the corridors of Franklin Arterial; Commercial Street; India Street, Congress Street and Washington Avenue.

The following describes each facility:

1. Franklin Arterial - is a multi laned principal arterial with restricted access that provides for a direct connection between the proposed site and Interstate 295. There are six streets that intersect this facility between I-295 and Commercial Street. At each location, traffic is controlled by traffic signals, with each signal supervised by a Traffic Responsive Arterial Coordination System.
2. Commercial Street - in the vicinity of the site is 70 feet wide and has two lanes that include diagonal parking and rail lines. Present parking regulations, goods/service delivery policies and the dual track rail line severely restrict the vehicular capacity of this street.
3. India Street - is a 40 foot, two-lane street that begins at Congress Street and ends at Commercial Street. Traffic is controlled on India Street with a stop sign at Congress Street while at Federal Street there is an amber flashing light. Sight distance along India Street is somewhat restricted, especially at the intersections of Middle, Fore and Federal Street, where regulations permit parking within 25 feet of the intersection approaches.

Traffic Volumes

The City of Portland conducted a traffic count program at each major intersection during the week of September 21, 1981. The traffic counts were taken between 7:00 A.M. to 9:00 A.M., 11:00 A.M. to 1:00 P.M., and 3:30 P.M. to 6:00 P.M. These intervals provide information for the expected peak hour and midday conditions.

The observed traffic counts data were factored to average conditions during 1981. The adjustment factors were provided by MDOT and reflect typical conditions for a facility of this functional class. Traffic volumes were then expanded to represent conditions in 1984 independent of the opening of Bath Iron Works. For purposes of this study, a growth factor of 1.5 per cent per annum was used.

The 1984 peak hour traffic volume summaries are shown in Appendix A. The morning peak hour for the study corridor would occur between 7:30 A.M. and 8:30 A.M. An average directional split of approximately 70 percent inbound and 30 percent outbound is expected. The midday peak hour will occur between 11:30 A.M. and 12:30 P.M. with a 50-50 directional split. The evening peak hour will occur between 3:30 P.M. and 4:30 P.M.

Figure 3 illustrates 1984 Average Annual Daily Traffic (AADT) figures for the study corridor. As shown on this figure, the 1984 AADTs vary considerably throughout the study area. The highest volume is estimated to occur on Franklin Arterial south of Marginal Way at 20,000 vehicles per day. The majority of the streets in the study area are estimated to have 1984 AADTs between 4,000 and 10,000 vehicles.

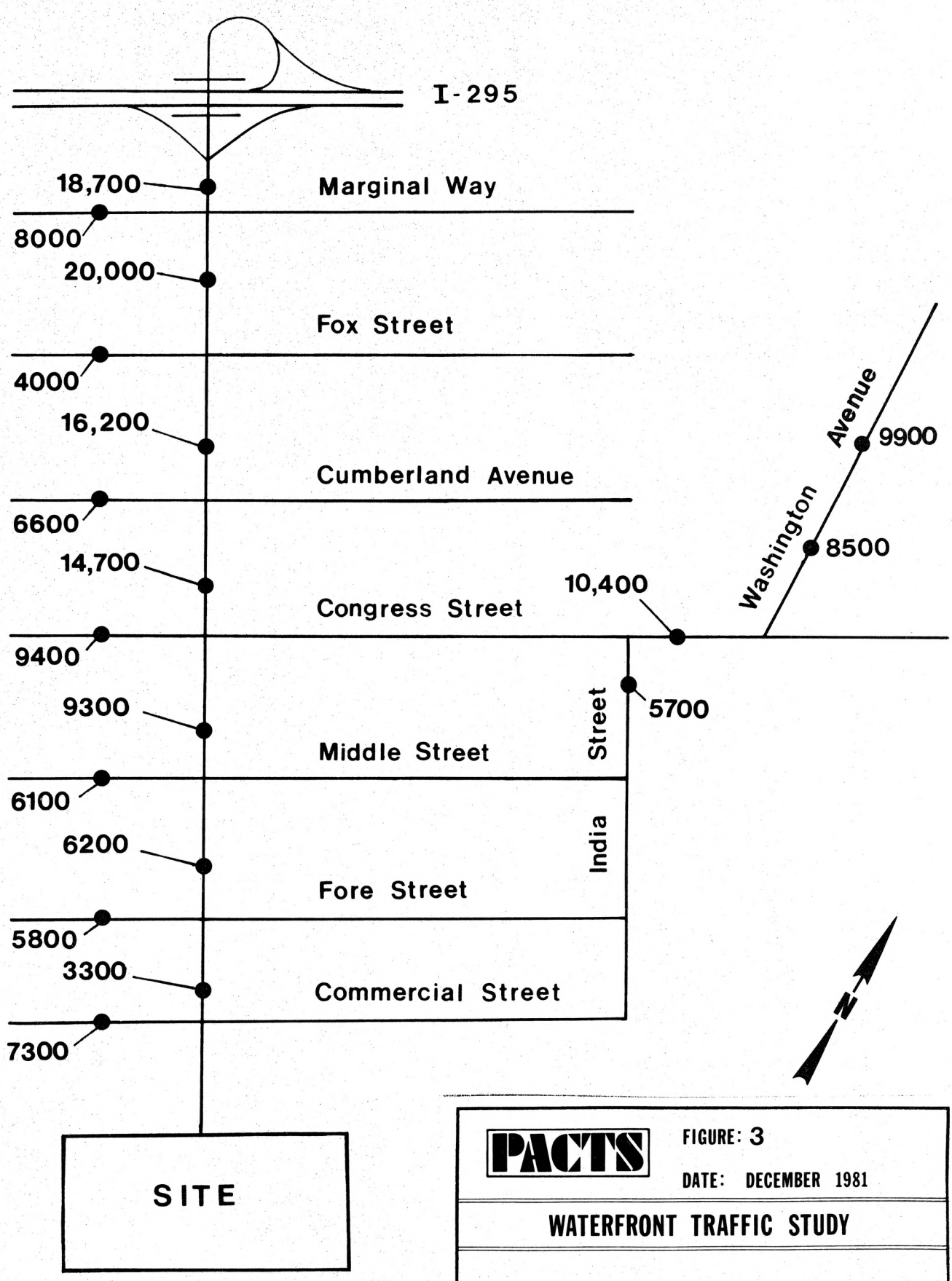

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FIGURE: 3

DATE: DECEMBER 1981

WATERFRONT TRAFFIC STUDY

ANNUAL AVERAGE DAILY TRAFFIC

Truck and Bus Traffic

Vehicle classification counts were taken in conjunction with the volume counts to ascertain the percentages of truck and bus traffic throughout the study corridor. For the purpose of this study, a vehicle with dual tires on the rear axle or greater was classified as a truck. Standard "pick-ups" were classified as passenger vehicles. The overall percentage of trucks and buses varied between 4 percent on Franklin Arterial and 16 percent on Congress Street.

Pedestrians

Pedestrian counts were also taken during the count program to determine the conflicts between pedestrians and vehicles in the study area. The heaviest concentration of pedestrian activity occurred on Cumberland Avenue and Congress Street at the Franklin Arterial and Washington Avenue intersections. At these locations, the average peak hour crossing in 1981 is 68 persons. At all other locations, pedestrian activity is minimal with several locations having no recorded pedestrian activity.

Performance of Street System

The performance of any street system is traditionally measured by comparison of volume (demand) and capacity (supply). Intersection capacity was calculated at all major intersections in the study corridor using techniques set forth in the Highway Capacity Manual.[1]

Level of Service is a qualitative measure of traffic flow under varying conditions taking into account such factors as: roadway widths, turning conflicts, driver comfort, safety, side clearances, and composition and volume of traffic.

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[1] Highway Capacity Manual, Transportation Research Board, Special Report 87, 1965.

Level of Service "A" is designated to signify "free flow" conditions and Level of Service "E" indicates "forced flow" or completely jammed conditions. Level of Service "C" is used for design purposes and describes conditions in which delays are not significant and at least 70 per cent of the time during the peak hour an intersection will "clear out." During peak periods, there may be times in which vehicles will have to wait for more than one cycle of the signal to travel through the intersection.

The capacity of each intersection was calculated based on Level of Service "C" design standards. Table 1 summarizes the anticipated 1984 volume to capacity ratios (v/c) for each peak period at the intersection approach. Based on the results of this analysis, the majority of each intersection approaches in the study corridor are functioning at an acceptable Level of Service.

There are only two intersection approaches where 1984 traffic volumes are expected to exceed the computed roadway capacity; India Street, westbound at Congress Street and eastbound Franklin Arterial at Congress Street. At India Street the capacity problem will occur in the PM peak hour where the volume/capacity ratio is 1.38. The capacity problem on Franklin Arterial will occur during the AM peak hour when the roadway volume is expected at 12 per cent greater than the roadway capacity.

At all other intersection approaches, the volume to capacity ratio is estimated less than 1.00.

Table 1

1984 VOLUME-CAPACITY ANALYSIS--SELECTED LOCATIONS
(without BIW)

LOCATION	APPROACH		SERVICE VOLUME	ROADWAY VOLUME		VOLUME/CAPACITY RATIO	
				Am	Pm	Am Peak	Pm Peak
Washington Ave.	Washington Ave	EB	1,300	577	350	.44	.27
@ Cumberland Ave	Washington Ave	WB	950	176	373	.19	.39
	Cumberland Ave	NB	400	124	226	.31	.57
	Cumberland Ave	SB	450	102	93	.23	.21
Washington Ave.	Washington Ave	EB	725	473	301	.65	.42
@ Congress St.	Mountfort St.	WB	210	30	72	.14	.34
	Congress St.	NB	1,045	193	442	.18	.42
	Congress St.	SB	340	180	204	.53	.60
Congress St.	Congress St.	NB	930	138	280	.15	.30
	Congress St.	SB	975	288	327	.30	.41
	India Street	WB	190	101	262	.53	1.38
Franklin Art.	Franklin Art.	EB	1,210	135	97	.11	.08
@ Commercial St.	State Pier	WB	150	29	25	.19	.17
	Commercial St.	NB	740	187	354	.25	.48
	Commercial St.	SB	950	202	143	.21	.15
Franklin Art.	Franklin Art.	EB	990	237	158	.24	.17
@ Fore Street	Franklin Art.	WB	1,130	92	197	.08	.17
	Fore Street	NB	650	155	302	.24	.46
	Fore Street	SB	500	171	140	.34	.28
Franklin Art.	Franklin Art.	EB	1,000	437	266	.44	.27
@ Middle St.	Franklin Art.	WB	1,090	190	320	.17	.29
	Middle Street	NB	700	98	320	.14	.46
	Middle Street	SB	650	124	145	.19	.22
Franklin Art.	Franklin Art.	WB	880	212	531	.24	.60
West Bound Lanes	Congress St.	NB	920	246	521	.27	.61
@ Congress St.	Congress St.	SB	600	286	346	.48	.58
Franklin Art.	Franklin Art.	EB	710	799	440	1.13	.62
East Bound Lanes	Congress St.	NB	625	181	381	.29	.61
@ Congress St.	Congress St.	SB	960	242	234	.25	.24
Franklin Art.	Franklin Art.	WB	1,020	306	744	.30	.73
West Bound Lanes	Cumberland Ave	NB	1,070	130	323	.12	.30
@ Cumberland Ave	Cumberland Ave	SB	700	248	214	.35	.31

Table 1 (continued)

LOCATION	APPROACH	SERVICE VOLUME	ROADWAY VOLUME		VOLUME/CAPACITY RATIO	
			Am	Pm	Am Peak	Pm Peak
Franklin Art.	Franklin Art. EB	960	895	506	.93	.53
East Bound Lanes	Cumberland Ave. NB	700	146	300	.21	.43
@ Cumberland Ave	Cumberland Ave. SB	1,070	208	167	.19	.16
Franklin Art.	Franklin Art. EB	1,450	1,149	626	.79	.43
@ Fox Street	Franklin Art. WB	1,310	344	850	.26	.65
	Fox Street NB	476	73	166	.15	.35
	Fox Street SB	340	128	177	.38	.52
Franklin Art.	Franklin Art. EB	1,460	1,131	581	.77	.40
@Marginal Way	Franklin Art. WB	1,940	417	1,020	.21	.53
	Marginal Way NB	500	324	302	.65	.60
	Marginal Way SB	550	42	104	.08	.19

SOURCE: City of Portland, Traff

Accident History

A complete accident analysis of each intersection was undertaken by reviewing the files of the City of Portland Police Department for the years 1979, 1980 and 1981.

Table 2 presents some general characteristics of accidents. This Table presents:

Time of Day;

Roadway conditions; and,

Accident Severity.

There were a total of 197 accidents in the study area. The majority occurred in daylight hours (69%), on dry pavement (59%) and resulted only in property damage (73.5%). There was one fatality at Franklin Arterial at Congress Street.

Collision diagrams of each accident were prepared, as well as computations of accident rates and intersection Critical Rate Factors (CRF). Summaries of the intersection accident rates and CRFs are listed in Table 3. Below is a general description of accident type and frequency for each major intersection in the study corridor.

Table 2

ACCIDENT PROFILE
1979, 1980, 1981

INTERSECTION	TOTAL ACCIDENTS	TIME		ROADWAY CONDITION			ACCIDENT SEVERITY		
		Day	Night	Slippery	Wet	Dry	Property	Injury	Fatality
Franklin Art. @ Marginal Way	26	24	2	2	5	19	19	7	0
Franklin Art. @ Fox Street	25	17	8	1	12	12	15	10	0
Franklin Art. @ Cumberland Avenue	29	16	13	4	9	16	20	9	0
Franklin Art. @ Congress Street	48	34	14	7	14	27	40	7	1
Franklin Art. @ Middle Street	13	8	5	3	3	7	9	4	0
Franklin Art. @ Fore Street	7	6	1	1	3	3	5	2	0
Franklin Art. @ Commercial St.	5	2	3	2	1	2	1	4	0
Congress Street @ India Street	8	5	3	0	1	7	6	2	0
Congress Street @ Washington Ave.	16	12	4	2	2	12	14	2	0
Congress Street @ Washington Ave.	20	6	14	3	6	11	15	5	0
TOTAL	197	130	67	25	56	116	144	52	1
PERCENT	-	66%	34%	13%	28%	59%	73.5%	26%	.5%

SOURCE: City of Portland Dept. of Public Works, Traffic Engineering Division

Table 3

ACCIDENT ANALYSIS
STUDY CORRIDOR

INTERSECTION	TOTAL ACCIDENTS 2 Yr-8 MONTHS	AVERAGE ANNUAL ACCIDENTS	ACCIDENTS PER MILLION ENTERING VEHICLES	CRITICAL RATE FACTOR
Franklin Arterial @ Marginal Way	26	9.74	1.08	.80
Franklin Arterial @ Fox Street	25	9.36	1.16	.82
Franklin Arterial @ Cumberland Avenue	29	10.86	1.37	.96
Franklin Arterial @ Congress Street	48	17.98	2.47	1.66
Franklin Arterial @ Middle Street	13	4.87	1.06	.57
Franklin Arterial @ Fore Street	7	2.62	.76	.36
Franklin Arterial @ Commerical Street	5	1.87	.64	.28
Congress Street @ India Street	8	3.00	.71	1.15
Congress Street @ Washington Avenue	16	5.99	1.32	.71
Cumberland Avenue @ Washington Avenue	20	7.49	1.55	.86

SOURCE: City of Portland Traffic Engineering Department

1. Franklin Arterial/Marginal Way -- There were a total of 26 accidents recorded for this intersection during th study time frame. The major type of collision was left turn vehicles colliding with vehicles from both approaches of Franklin Arterial. The southbound approach of Franklin Arterial had a total of eight accidents involving left turning vehicles and the northbound approach had five. There were three additional accidents involving vehicles failing to stop for red signal indications.

2. Franklin Arterial/Fox Street -- There were a total of 25 accidents recorded at this location. There were sixteen accidents involving left turn vehicles from both approaches of Franklin Arterial crossing the median area and colliding with oncoming through traffic.

3. Franklin Arterial/Cumberland Avenue -- There were 29 accidents recorded at this location. There were sixteen collisions involving traffic from both approaches of Franklin Arterial colliding with vehicles crossing Franklin Arterial. A review of the accident reports indicates that an apparent reason for this is the false assumption that "after turning left from Franklin Arterial one can proceed through onto Cumberland Avenue without stopping for the red light indication." There were a total of five accidents recorded for vehicles turning left from the right lane on Franklin Arterial.

4. Franklin Arterial/Congress Street -- There were 48 accidents recorded for this location for the study period. The most common accident type was vehicles failing to stop on the flashing red indication. There were a total of 24 accidents occurring when the signals were in a flashing mode.

There were nine accidents recorded that involved the left turns from Franklin Arterial. Again, similar to the Franklin Arterial/ Cumberland Avenue intersection there appears to be a problem with vehicles using the right lane on Franklin Arterial to make left turns. There were three accidents recorded for this type. There were seven accidents reported involving "rear end collision".

5. Franklin Arterial/Middle Street -- There were a total of 13 accidents reported for this location with the predominant accident type involving left turning traffic from both approaches of Franklin Arterial. There were six accidents reported for this type.

6. Franklin Arterial/Fore Street -- The study review indicates that seven accidents occurred at this location, with the majority (4) of the accidents occurring while the intersection was in a flashing mode.

7. Franklin Arterial/Commercial Street -- There were 5 accidents reported for this location. A review of the accident reports indicates no recurring accident type.

8. Congress Street/India Street -- Eight accidents were reported at this location; 6 involving traffic turning to or from India Street. The remaining two accidents were classified as "rear end" accidents.

9. Congress Street/Washington Avenue -- A total of 16 accidents occurred at this intersection during the study period. Four accidents involved vehicles turning right from Washington Avenue colliding with another vehicle also making the right turn. There were also three "rear end" accidents reported for this location.

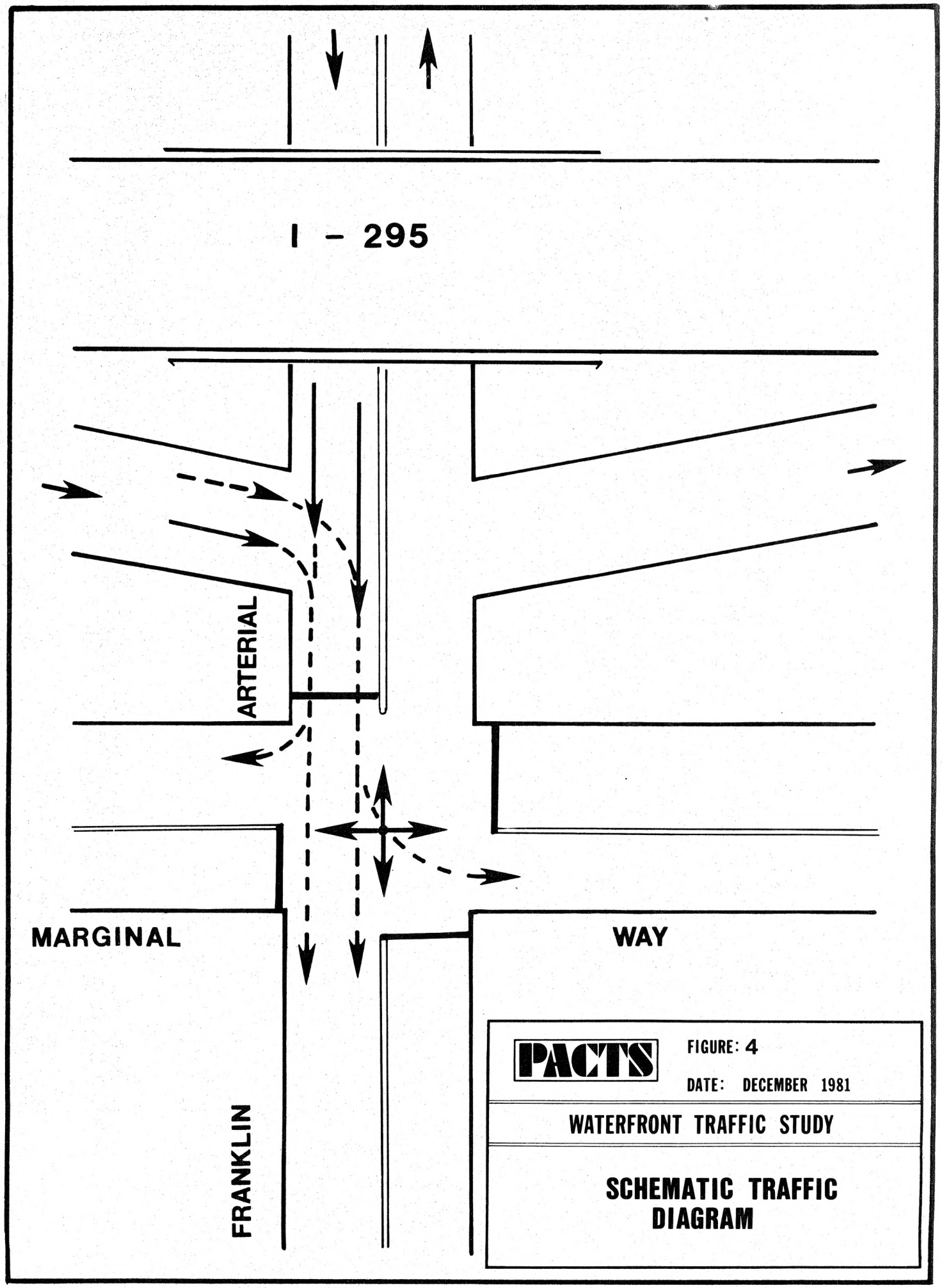
10. Washington Avenue/Cumberland Avenue -- Twenty accidents were recorded for this location with nearly half (8) of the accidents resulting from vehicles failing to stop for "red" signal indications. There were six accidents reported involving vehicles turning from Washington Avenue onto Cumberland Avenue.

Vehicle Queue - I-295 at Franklin Arterial

The configuration of the off-ramps from I-295 to Franklin Arterial merge at nearly right angles within 150 feet of the intersection of Franklin Arterial at Marginal Way. This configuration creates a weaving situation between various desires of traffic existing from both directions. The southbound off-ramp has the right-of-way, thus requiring the northbound off-ramp to yield at the merge. Traffic queues from the southbound off-ramp sometimes impeded flow on the northbound off-ramp. A schematic diagram of this location is presented on Figure 4.

For purposes of this study, vehicle queue count was undertaken on the northbound off-ramp. Field measurements indicate that approximately 35 vehicles can be stored on this ramp before traffic would queue onto I-295. The vehicle queue count was taken during every interval in the AM Peak Hour when the traffic control signal at Franklin Arterial displayed a red indication. When the signal indication turned green, the count was terminated until the next "red" interval.

The traffic queue summary for information collected in 1981 is summarized on Table 4. As evidence on this table, during the field observations traffic did not queue onto I-295. The peak condition occurred for a very short duration (7:50-7:53). During the peak 15 minutes (7:45-8:00) 153 vehicles arrived or 54.4% of the peak hour traffic.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ARTERIAL
MARGINAL
WAY
FRANKLIN
PACTS
FIGURE: 4
DATE: DECEMBER 1981
WATERFRONT TRAFFIC STUDY
SCHEMATIC TRAFFIC DIAGRAM

Table 4

EXISTING VEHICLE QUEUE PROFILE

I-295 NORTHBOUND OFF-RAMP AT FRANKLIN ARTERIAL

TIME (AM)	NO. OF VEHICLES[1]	PERCENT OF PEAK HOUR
7:30	2	.8
7:31	4	1.4
7:32	7	2.5
7:34	1	0.3
7:36	-	-
7:37	-	-
7:39	5	1.8
7:40	7	2.5
7:41	4	1.4
7:43	4	1.4
7:45	9	3.2
7:47	11	3.9
7:48	12	4.3
7:50	21	7.5
7:51	29	10.3
7:53	18	6.4
7:54	9	3.2
7:55	16	5.7
7:58	15	5.3
8:00	13	4.6
8:01	5	1.8
8:02	14	5.0
8:04	6	2.1
8:05	-	-
8:07	2	.7
8:08	-	-
8:09	2	.7
8:10	3	1.1
8:12	-	-
8:13	6	2.1
8:14	5	1.8
8:16	5	1.8
8:17	3	1.1
8:18	5	1.8
8:19	4	1.4
8:21	2	.7
8:22	6	2.1
8:24	7	2.5
8:25	9	3.2
8:27	4	1.4
8:28	3	1.1
8:29	3	1.1

(1) Volume counted at end of Franklin Arterial "Red" Interval

SOURCE: 1981 Count by PACTS/City of Portland

Vehicle Queue Analysis - 1984

The same factoring technique applied to all intersections was used to estimate the AM peak hour for the I-295 off ramps. The estimated average peak hour volume for this location independent of BIW is 347 vehicles. By applying the same general profile factors presented in Table 4, it is estimated that 189 vehicles would use this ramp during the peak 15 minutes. The 189 vehicles would be accommodated by 10 green cycles of the signal at Franklin Arterial (see Table 4).

Using a standard statistical technique based on an average of 18.9 events, no more than 30 vehicles can be at 95% confidence level. Therefore during the average months, the 30 vehicle queue would only be expected to occur 5% of the peak time.

Based on the above noted analysis, it appears the estimated 35 vehicle storage on this ramp would appear adequate during average months in 1984. An examination of vehicle queues during peak months was conducted to ascertain if during these months the vehicle queue might interfere with traffic on the mainline of I-295.

The same expansion factor between 1981-1984 was applied to the count results taken in September, 1981. Using this scenario, the expected peak hour is estimated at 425 vehicles. Using the same vehicle queue profile, during the peak 15 minutes an estimated 232 vehicles would arrive. The same statistical technique indicated 36 vehicles would arrive at 95% confidence level. The overall confidence level of less than 35 vehicles queued at this ramp would be near 82%. Therefore during peak months, nearly 20% of the peak fifteen minutes would queue onto the I-295 mainline.

Existing Traffic Signal Needs Evaluation

Within the study corridor street system, the only major intersection not signalized is Congress Street at India Street. To determine if signalization is warranted, 48-hour traffic volumes were tested against traffic signal criteria presented in the 1978 Edition of Manual on Unified Traffic Control Devices (MUTCD)[2]. The MUTCD provides minimum warrants for certain levels of traffic volumes under various conditions and provides a threshold before signal installation should be considered. In this study, it became apparent that this threshold was met. Further, accident analysis previously discussed also met the threshold.

Overview

From a traffic engineering vantage, the overall traffic operations for the study corridor in 1984 are anticipated to be generally acceptable. There are spot locations that may require modifications and improvements, some of the deficiencies include:

Franklin Arterial at Cumberland/Congress Streets

Congress at India Streets.

The I-295 northbound off-ramp at Franklin Arterial presents a special concern during peak hours of peak periods. There is little doubt that vehicles queuing onto an interstate facility present a potential safety hazard. It is in this regard that this ramp and the intersection should be carefully observed for potential changes in arrival patterns to avoid any vehicles queuing onto I-295.

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[2] Manual on Uniform Traffic Control Devices, U.S. Department of Transportation, Federal Highway Administration, 1978.

The PACTS Transportation Systems Management Highway Element of the Transportation Plan has already documented need for improvements to the intersections of Washington Avenue at Cumberland Avenue and Congress Street.

The next chapter of this report examines the parking system in the immediate site area.

III. PARKING

The proposed Bath Iron Works expansion is planned to accommodate all vehicular traffic parking needs within the confines of the site. While planning a facility that creates enough parking supply to meet the added parking need, there is nonetheless an impact to the parking system. The impact will be to those vehicles presently using the Maine State Pier for long and short-term parking needs.

Study Area

Approximately 400 feet is an accepted walking distance from a parking location to a destination. This figure, of course, varies with trip purpose, weather and other external factors. For purposes of this study and taking into consideration the special nature of this location, an imaginary 800 foot radius was drawn from the entrance of the Maine State Pier to delineate this study area.

The study area is shown on Figure 5 and is generally bounded by Commercial Street on the east, Pearl Street on the south, Middle Street on the west, and India Street on the north. Each block in the study area was numbered and every block face (adjacent street) was lettered A through D as illustrated on Figure 5.

Background

Previous studies have made references to the general study area as having parking deficiencies and need for expanded parking. The 1975 City Edges: Waterfront Improvement Plan, Portland Planning Department indicated:

"One of the greatest deficiencies in the waterfront is parking...

A special problem exists for the parking of vehicles owned by island residents. While this problem is severe during the summer, it is a constant problem due to the number of year-round island residents. More parking of a long-range nature is needed by the island residents."

"As the waterfront area continues to evolve as a retail, restaurant, and office center, parking problems will increase in severity. Development pressure may take a number of private lots for building site, thus furthering the intensity of the problem. Efforts should be made to provide additional municipal parking in the waterfront and the private sector should be required to provide parking with major development proposals."[3]

The recently published Central Business District Parking Study by Parsons Brinckerhoff Quade and Douglas, Inc., conducted separate surveys for users of Casco Bay Lines to better delineate the parking needs of these patrons.

The study concluded:

"Other elements of a long-term downtown parking strategy include:...

Provision of a centralized parking facility convenient to the dock for Casco Bay Lines Ferry users."[4]

Field Surveys

PACTS conducted a field survey of each block in the study area. The survey was conducted from 6:00 A.M. to 6:00 P.M. with field personnel traversing a block each hour and noting vehicle usage of every on street parking space. Additionally, vehicle accumulation counts were conducted at a majority of off street parking facilities.

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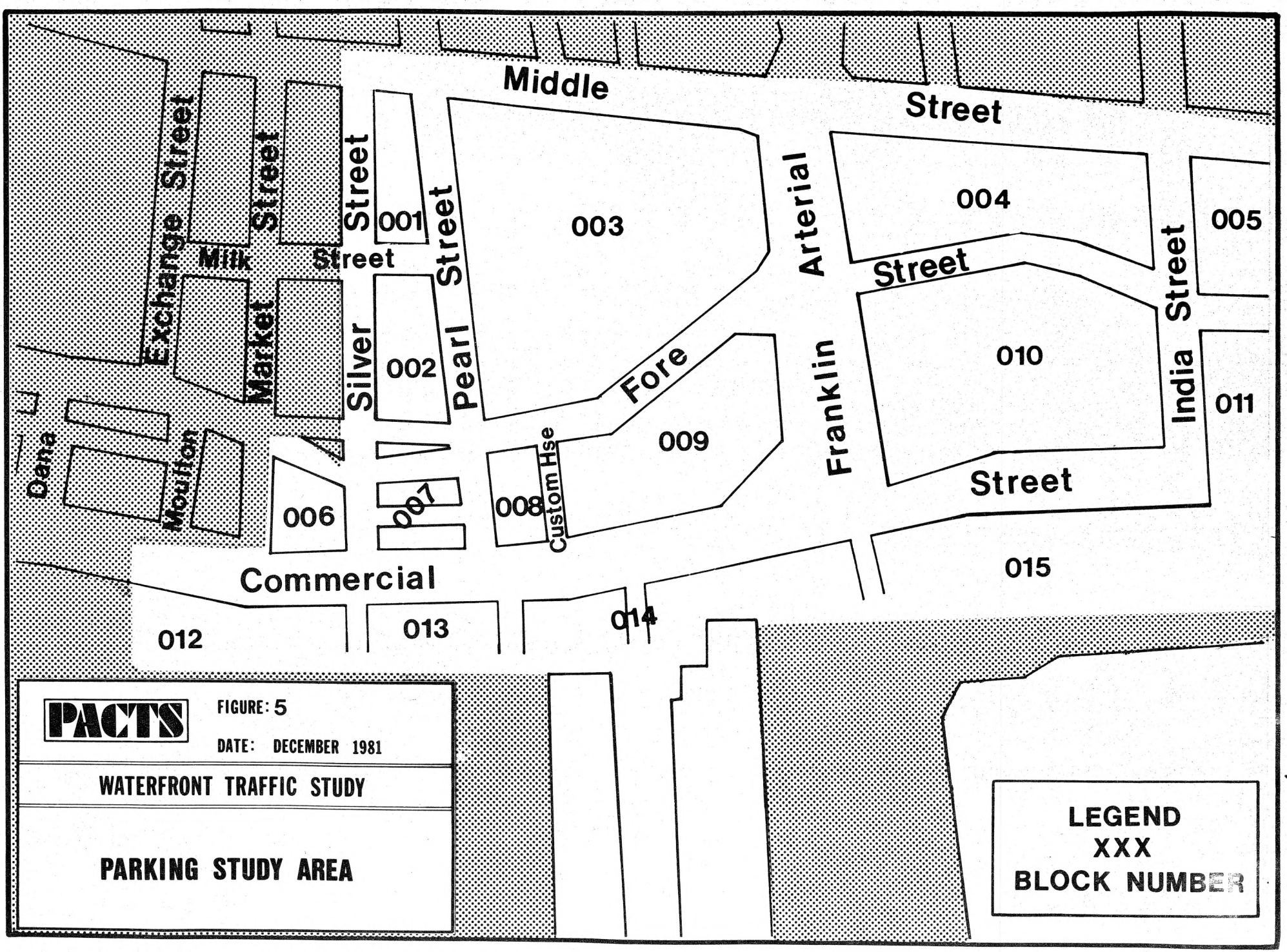
[3] City Edges: Waterfront Improvement Plan, Portland Planning Department, 1975.

[4] Final Report. Central Business District Parking Study, Portland, Maine. Parsons, Brinckerhoff, Quade and Douglas, Inc. Prepared for PACTS.


Middle Street
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Milk Street
Market Street
Silver Street
Pearl Street
Arterial
Fore
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India Street
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015
PACTS
FIGURE: 5
DATE: DECEMBER 1981
WATERFRONT TRAFFIC STUDY
PARKING STUDY AREA
LEGEND
XXX
BLOCK NUMBER

Parking Supply

There were a total of 340 legal on street parking spaces in the study area, and 11 special use (truck zones, taxi stands, etc.) spaces. The available on street parking supply is categorized as follows:

° unrestricted	187
° restricted 2 hours	15
° restricted 1 hour	79
° restricted 15 minutes	49
° one-hour meters	10

All of the off street parking supply within the study area bounds are privately controlled. For analysis purposes, however, this type of parking supply must be generally considered unavailable to accommodate any displaced parkers. This would hold true even though there might be a surplus of parking spaces available from the field surveys.

Parking Usage

Vehicle accumulation is the measure of total parked vehicles at any specific interval. The field observations for on street parking were made once an hour between 6:00 A.M. and 6:00 P.M. Table 5 summarizes the vehicle accumulation for the on street parking system by individual block face. Figure 6 graphically shows the total accumulation for the entire study area. This accumulation graph compares quite closely with the results of the information collected in the previously mentioned CBD Parking Study conducted in 1979.

When a parking system reaches 85 per cent of capacity, it is generally considered at practical capacity. There are a number of block faces in the study area that consistently, over the course of the day, were observed at or near capacity. In fact the total study area (336 spaces) from 9:00 A.M. to 4:00 P.M. operates at capacity.

Table 5

VEHICLE ACCUMULATION

On-Street Parking

BLOCK	# of SPACES	TIME 6/7	7/8	8/9	9/10	10/11	11/12	12/1	1/2	2/3	3/4	4/5	5/6	AVG.	%
001B	9	2	2	4	6	9	8	9	9	9	7	8	10	6.9	77
002B	10	4	10	10	10	10	10	10	10	10	9	6	4	8.6	85
C	4	1	1	1	2	2	4	4	4	3	3	4	6	2.9	73
003A	17	3	4	11	14	16	16	16	18	18	17	15	14	13.5	79
B	0	-	-	-	-	-	-	-	-	-	-	-	-	0	0
C	7	1	2	5	7	7	8	7	7	7	7	7	6	5.9	84
D	12	5	12	13	14	14	14	14	15	14	12	6	5	11.5	95
004A	21	9	12	11	15	14	17	16	17	20	14	9	10	13.6	65
B	8	1	4	4	4	4	6	4	5	4	6	2	5	4.1	51
C	3	3	3	3	4	3	3	3	2	4	3	1	1	2.75	91
D	0	-	-	-	-	-	-	-	-	-	-	-	-	0	0
004A	14	5	7	9	11	8	11	9	11	11	9	5	2	8.2	58
005D	8	1	2	1	5	8	4	9	7	6	6	7	8	5.3	66
006B	2	-	-	1	2	2	2	2	2	2	2	3	2	1.6	83
C	14	3	3	6	10	12	12	13	12	13	13	12	12	10.1	72
007A	8	2	2	3	5	6	5	7	6	7	6	7	5	5.1	63
B	0	-	-	-	1	1	1	-	-	-	-	-	-	0	0
C	17	17	14	10	19	16	15	20	18	15	15	16	16	15.9	94
D	0	-	-	-	1	-	-	-	-	-	-	-	-	0	0
008A	6	3	4	5	5	5	5	5	5	5	5	3	4	4.5	75
B	6	5	4	7	6	7	7	6	7	7	7	6	6	6.3	104
C	9	7	6	9	9	9	9	9	9	8	10	8	8	8.4	93
D	0	-	-	-	-	-	-	-	-	-	-	1	1	0	0
009A	14	1	2	9	15	13	13	13	12	11	12	12	7	10	71
B	0	-	-	-	-	-	-	-	-	-	-	-	-	0	0
C	12	9	7	9	10	8	12	14	13	11	13	12	8	10.5	88
D	5	2	2	5	5	5	4	4	3	4	4	-	-	3.3	65
010A	12	4	10	9	9	9	9	8	8	8	6	3	-	6.9	58
B	7	1	2	4	3	3	3	3	4	3	3	3	3	2.9	41
C	10	-	-	4	6	6	6	8	6	5	6	7	4	4.8	48
D	11	1	1	2	2	3	4	4	4	4	3	3	3	2.8	26
011D	8	-	-	-	-	2	2	2	1	4	4	3	5	1.9	24

Table 5

VEHICLE ACCUMULATION

On-Street Parking, Continued

BLOCK	# of SPACES	TIME 6/7	7/8	8/9	9/10	10/11	11/12	12/1	1/2	2/3	3/4	4/5	5/6	AVG.	%
012A	18	1	2	4	10	13	15	15	15	15	14	15	13	11	61
013A	18	10	11	12	15	17	27	15	16	13	18	16	17	15.8	86
014A	19	20	19	20	19	18	20	18	19	18	19	15	16	18.4	96
014A	31	28	26	23	22	26	23	21	25	24	23	22	23	23.8	77
015A	14	5	6	6	10	10	12	11	11	11	9	10	10	9.3	66

Source: PACTS

Figure 7 illustrates those block faces that show usage at or near capacity for more than four consecutive hours.

Vehicle Turnover

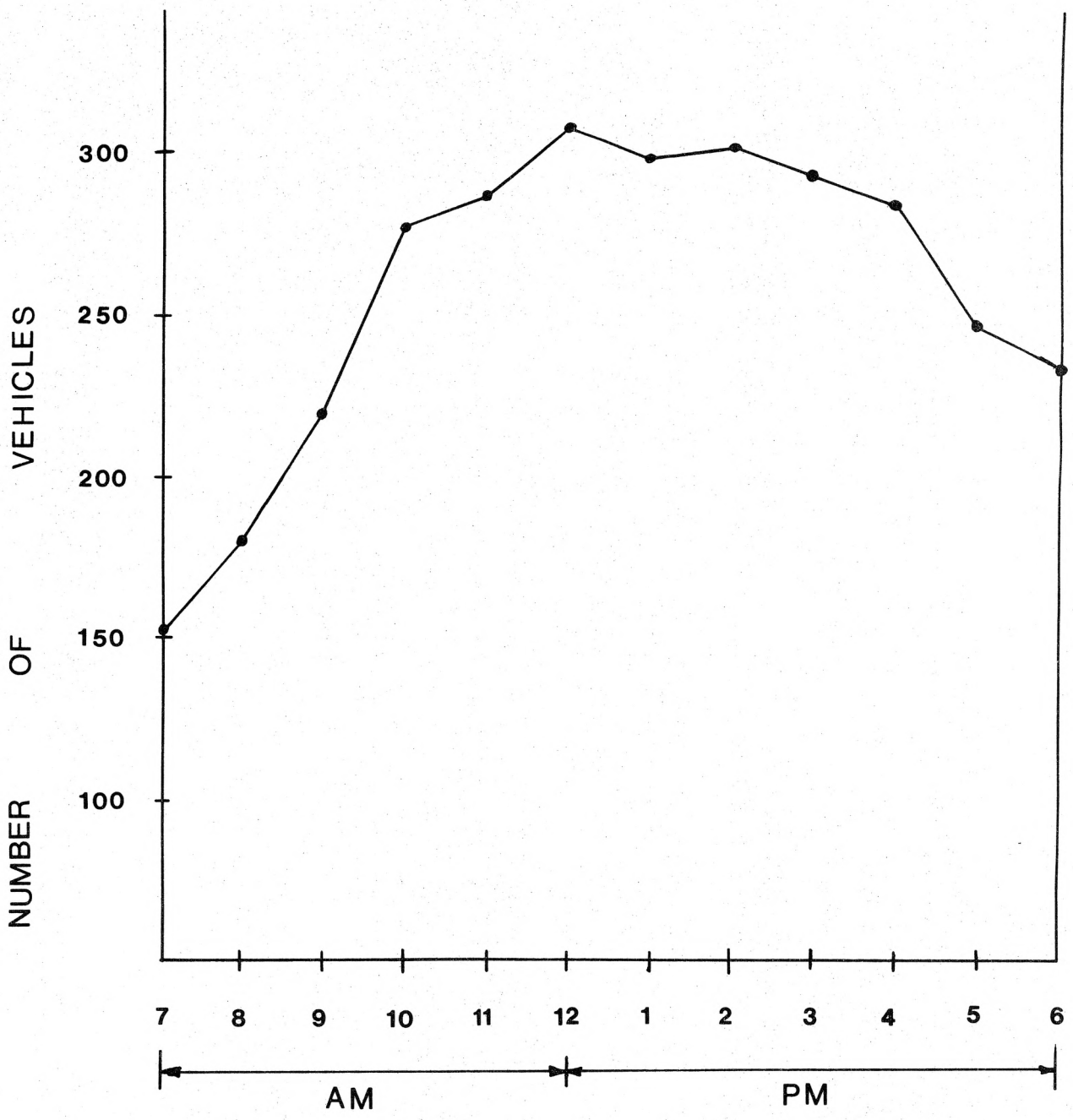
Vehicle turnover is a measure of how frequently a parking space is used by separate vehicles. A high turnover rate reflects frequent changes of vehicles and short parking duration. This type of parking characteristic is normally associated with convenience type of destinations. The lower turnover rates imply longer duration parking characteristics and low frequency vehicle usage such as work trips.

The on street parking turnover for each block face in the study area is presented on Table 6.

Parking Duration

When evaluating or designing any parking system, an important parking characteristic is parking duration. This is especailly important when considering the future of a parking system or any substantial changes to a system. Parking duration is generally defined as the length of time a vehicle remains at a given parking space.

Table 7 presents a summary of duration for on street parkers in the total study area.



PACTS

FIGURE: 6

DATE: DECEMBER 1981

WATERFRONT TRAFFIC STUDY

VEHICLE ACCUMULATION ON STREET PARKING

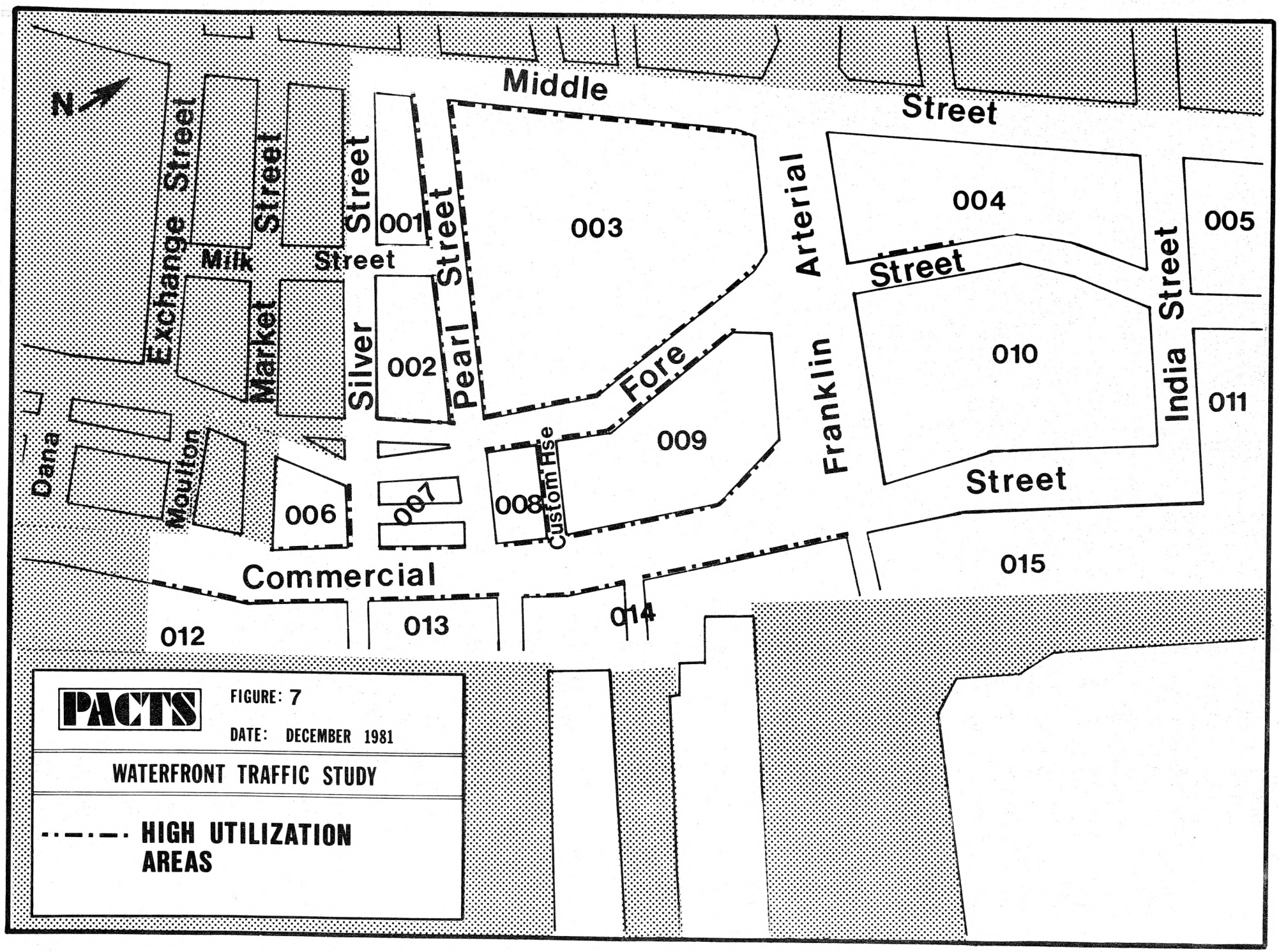

N
Middle Street
Exchange Street
Milk Street
Market Street
Silver Street
Pearl Street
Fore Street
Franklin Arterial
India Street
Dana Street
Moulton Street
Custom Hse
Commercial Street
001
002
003
004
005
006
007
008
009
010
011
012
013
014
015
PACTS
FIGURE: 7
DATE: DECEMBER 1981
WATERFRONT TRAFFIC STUDY
HIGH UTILIZATION AREAS

Table 6

VEHICLE TURNOVER - TOTAL STUDY AREA

On-Street Parking

BLOCK	FACE	No. of SPACES	1st HOUR	2nd HOUR	3rd HOUR	4th HOUR	5th HOUR	6th HOUR	7th HOUR	8th HOUR	8+ HOUR	TOTAL
0C1	B	9	23	6	-	2	1	1	1	-	2	36
002	B	10	1	3	-	1	-	-	1	-	9	15
	C	4	12	1	1	-	-	2	1	-	-	17
003	A	17	38	14	2	4	1	1	2	5	1	68
	B	0	-	-	-	-	-	-	-	-	-	--
	C	7	3	3	-	2	-	-	-	1	5	14
	D	12	-	-	-	-	-	-	-	-	-	--
004	A	21	14	3	2	-	-	-	1	4	10	34
	B	8	14	4	-	1	2	1	1	-	-	23
	C	3	1	1	-	1	-	1	1	-	1	6
	D	0	-	-	-	-	-	-	-	-	-	--
004a	C	14	7	3	2	1	-	-	-	2	6	21
005	D	8	24	8	4	1	2	-	-	-	-	39
006	B	2	-	1	-	-	-	-	-	-	2	3
	C	14	19	3	7	3	4	1	1	1	2	41
007	A	8	18	6	1	-	3	-	2	-	-	30
	B	0	3	-	-	-	-	-	-	-	-	3
	C	17	84	24	6	3	1	-	1	1	1	121
	D	0	1	-	-	-	-	-	-	-	-	1
008	A	6	1	-	-	-	-	-	-	1	4	6
	B	6	3	1	1	1	1	-	-	2	4	13
	C	9	12	5	3	1	3	-	2	2	2	30
	D	0	-	1	-	-	-	-	-	-	-	1
009	A	14	2	4	3	-	3	-	-	2	7	21
	B	0	-	-	-	-	-	-	-	-	-	-
	C	12	20	5	5	2	1	-	-	2	4	39
	D	5	3	2	2	-	-	-	-	2	1	10
010	A	12	2	-	-	-	1	-	-	2	7	12
	B	7	5	1	-	-	-	-	1	-	2	9
	C	10	5	2	3	-	-	-	2	1	2	15
	D	11	-	-	1	1	-	-	1	1	1	5

Table 6

VEHICLE TURNOVER - TOTAL STUDY AREA

On-Street Parking, Continued

BLOCK	FACE	No. of SPACES	1st HOUR	2nd HOUR	3rd HOUR	4th HOUR	5th HOUR	6th HOUR	7th HOUR	8th HOUR	8+ HOUR	TOTAL
011	D	8	4	4	1	1	1	-	-	-	-	11
012	A	18	10	6	7	-	-	2	2	2	5	34
013	A	18	57	22	4	3	3	-	-	2	1	92
014	A	50	43	21	13	6	5	5	4	7	20	124
015	A	14	3	2	3	1	-	1	-	1	4	15

Source: PACTS

Table 7

PARKING DURATION

DURATION HOURS	NUMBER OF VEHICLES	PERCENT
1	432	47
1 - 2	156	17
2 - 3	71	8
3 - 4	35	4
4+	215	24
TOTAL	909	100

Source: PACTS

Parking Violations

Another measure of the effectiveness of a parking system is the amount and type of parking violations. Observations of characteristics such as the number of double parkers, vehicles parking in restricted spaces or parkers staying beyond the limit all provide valuable information about the parking system.

Table 8 presents a summary of parking violations by type observed during the field surveys. It is important to note that these numbers were only recorded once per hour; therefore, greater instances of short-time violations may not be included in the totals.

Maine State Pier

As previously mentioned, the parking element of this technical study is involved with the impacts on parkers presently using the Maine State Pier. In this regard, several observations were made of users of this facility including a license plate check of origin of vehicle owner.

Table 8

PARKING VIOLATIONS

On-Street

BLOCK	FACE	# OF SPACES	DOUBLE PARKERS	REST. SPACES	PARKED BEYOND LIMIT	OTHERS	TOTALS
001	B	9	-	1	11	1	13
002	B	10	-	1	-	-	1
	C	4	-	1	-	1	2
003	A	17	1	4	20	-	25
	B	0	-	-	-	-	-
	C	7	-	2	-	-	2
	D	12	-	7	4	-	11
004	A	21	-	1	18	1	20
	B	8	-	-	-	-	-
	C	3	-	1	-	1	2
	D	0	-	-	-	-	-
005	D	8	1	7	7	2	17
006	B	2	-	-	-	-	-
	C	14	1	3	19	-	23
007	A	8	-	6	10	-	16
	B	0	-	3	-	-	3
	C	17	1	10	34	1	46
	D	0	-	1	-	-	1
008	A	6	-	1	-	-	1
	B	6	-	4	-	-	4
	C	9	1	-	18	-	19
	D	0	-	1	-	-	1
009	A	14	-	2	-	-	2
	B	0	-	-	-	-	-
	C	12	1	4	7	-	12
	D	5	-	2	-	-	2
010	A	12	-	1	-	-	1
	B	7	-	-	-	-	-
	C	10	-	3	-	-	3
	D	11	-	1	-	-	1
011	D	8	-	2	-	-	2
012	A	18	-	5	22	-	27
013	A	18	9	15	34	-	58

Table 8

PARKING VIOLATIONS

On-Street continued

BLOCK	FACE	# OF SPACES	DOUBLE PARKERS	REST. SPACES	PARKED BEYOND LIMIT	OTHERS	TOTALS
014	A pg 1	19	-	14	12	-	26
014	A pg 2	31	-	1	11	-	12
015	A	14	-	-	-	-	0
TOTAL		336	15	105	233	8	360
			4%	29%	65%	2%	

Source: PACTS

Presently, the Maine State Pier can accommodate 138 vehicles in the paved parking area. Hourly observations of vehicle accumulation were conducted at this facility. The results appear below in Table 9.

Table 9

VEHICLE ACCUMULATION

MAINE STATE PIER

HOUR	No. of VEHICLES	% of CAPACITY (1)
6-7	75	54
7-8	105	76
8-9	111	80
9-10	98	71
10-11	96	70
11-12	96	70
12-1	90	65
1-2	93	67
2-3	99	72
3-4	91	66
4-5	79	57
5-6	71	51

(1) Capacity = 138

Source: PACTS

As shown on this table, there is a surplus of parking available for current demands. It is noteworthy that the study was conducted sometime after the "summer peak" for the Casco Bay Islands. General observations by persons familiar with this area indicate extensive use of this facility by island residents in the summer. Casco Bay Lines has also indicated a need for additional parking in this area.

From observations of license plate numbers, it was possible to determine the number of vehicles that stayed "all day" at the Maine State Pier. Of the vehicles observed at 6:30 a.m., 44 stayed until 4:30 p.m. and 48 vehicles observed at 7:30 a.m. were observed at 4:30 p.m.

The home address of each license plate observed was traced through the DMV computer. Table 10 shows the results of this information.

Table 10

HOME ADDRESS OF VEHICLES

AT THE MAINE STATE PIER

LOCATION	NUMBER OF VEHICLES	PERCENT
Casco Bay Islands	11	12.5
Portland	24	27.3
South Portland	14	15.9
Westbrook	4	4.5
Other Portland Suburbs	3	3.4
Brunswick Area	6	6.8
Augusta, Auburn-Lewiston	3	3.4
Bangor and North Region	7	8.0
South Region	7	8.0
Out of State	9	10.2
TOTAL	88	100.00

There are several reasons for parking at this facility. Although it is posted that unauthorized vehicles will be towed at the owner's expense, it appears that some cars and tour charter buses associated with Casco Bay Lines park here. Several vehicles were noted to have Coast Guard stickers on their bumpers. Other vehicles belong to longshoremen, fishermen and persons doing business at the Maine State Pier.

Evaluation of Parking System

There are two indicators of individual block face/parking lot deficiencies. The first indicator is a supply-demand comparison based on the estimated demand from the surrounding land use. The other indicator is an analysis of parking usage (i.e., accumulation, turnover, and violations).

Land use base parking demand estimates were calculated in the previously noted Portland CBD Parking Study.[5] The demand estimates for blocks in the study area were categorized into long and short term demand. The demand estimates were compared to the available parking supply to determine any surplus or deficiencies. A careful analysis must be conducted of available parking supply (available to general public) versus parking space restricted to specific users (i.e., employee or customer parking). In addition, vehicles destined to a specific land use may park in an adjacent block(s) and walk to the final location. Therefore, supply-demand estimates must consider available supply within an acceptable walking distance to the destination. The acceptable walking distance varies according to terrain, anticipated parking duration and ultimate trip purpose. The Consultant in the Portland Parking Study showed the supply-demand estimates for each individual block and also presented the adjustments discussed above.

The supply-demand estimates are presented on Figure 8 showing net parking supply and adjusted parking supply. On an individual block by block basis there is a surplus parking supply. Accounting for private parking and interblock parking opportunities, however there is a deficiency of 53 parking spaces.

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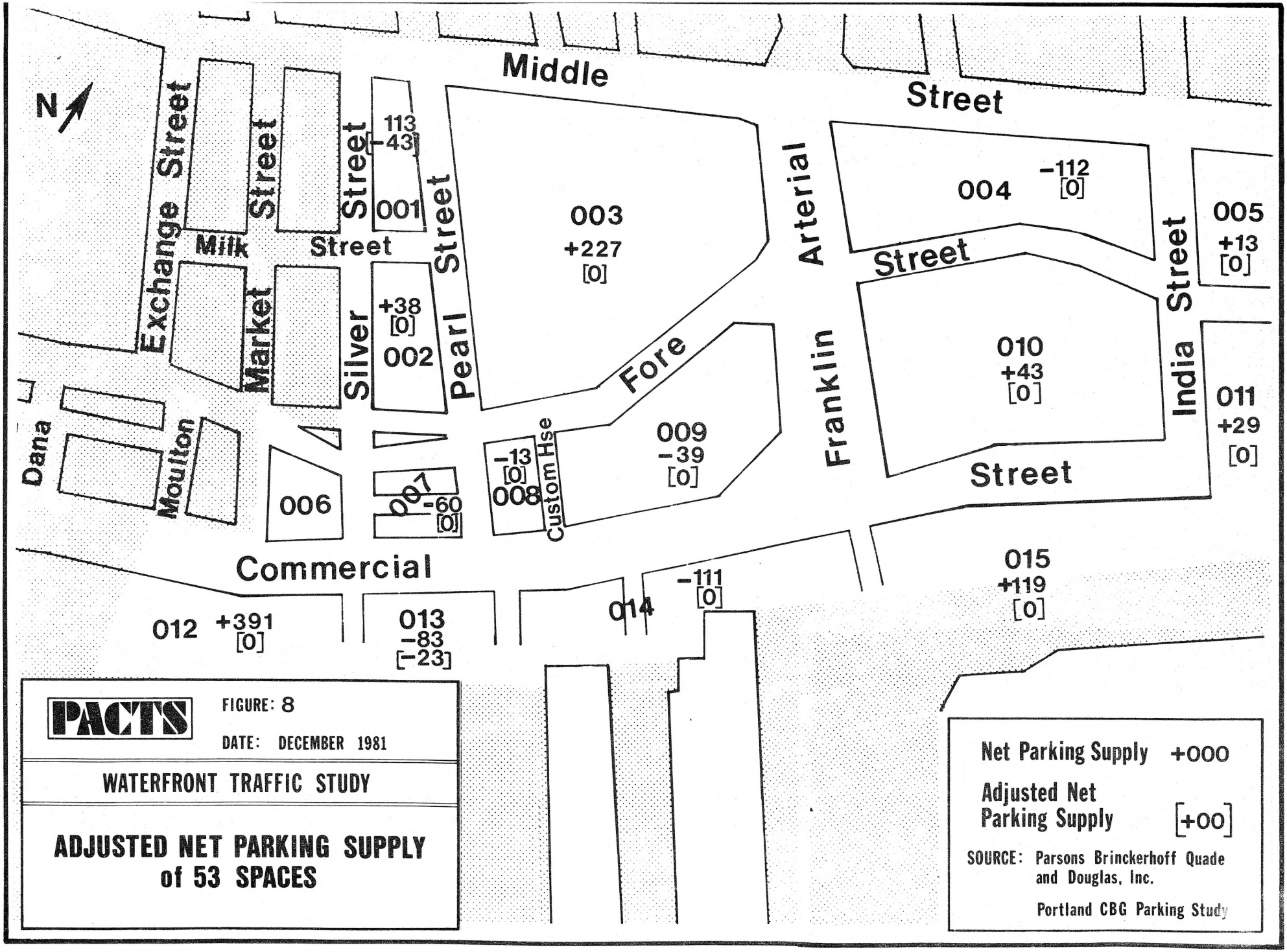
[5] Ibid.


N
Middle Street
Exchange Street
Milk Street
Market Street
Silver Street
Pearl Street
Fore Street
Arterial
Franklin Street
India Street
Dana Street
Moulton Street
Custom Hse
Commercial
001
113
[-43]
002
+38
[0]
003
+227
[0]
004
-112
[0]
005
+13
[0]
006
007
-60
[0]
008
-13
[0]
009
-39
[0]
010
+43
[0]
011
+29
[0]
012
+391
[0]
013
-83
[-23]
014
-111
[0]
015
+119
[0]
PACTS
FIGURE: 8
DATE: DECEMBER 1981
WATERFRONT TRAFFIC STUDY
ADJUSTED NET PARKING SUPPLY
of 53 SPACES
Net Parking Supply +000
Adjusted Net Parking Supply [+00]
SOURCE: Parsons Brinckerhoff Quade and Douglas, Inc.
Portland CBG Parking Study

Overview

Parking in the study area has been designated as deficient by two previous studies. The available parking for the public in the study is generally limited to on street. This study shows that for major portions of the day observed, the on street parking system is at or near capacity. This survey was conducted after the summer peak season. Additional pressures on available parking is more prevalent during that period.

IV. SITE AND PARKING NEEDS

This section of the study is concerned with estimating future traffic and parking needs created by the proposed development. As discussed previously, BIW is expected to begin operations in 1984, thus it is used as the design year.

Anticipated Site Traffic

The proposed Bath Iron Works Development will employ 1,000 total employees and will operate three work shifts. The majority of the work force (700 employees) will be assigned to the day shift, with 250 employees on the second shift and 50 employees assigned to the third shift. The day shift will work from 7:30 A.M. - 4:00 P.M. and the second shift will begin 45 minutes after the first shift.

Vehicle trip information available for various other major employers such as for Digital Company in Augusta, Pratt-Whitney Company in Berwick, and Unionmutual in Portland was used to project work trips. These data were compared to standards developed by the Institute of Transportation Engineers based on studies conducted throughout the nation for industrial developments. These data are presented below:

Digital Company	800 employees	.64 trips/employee
Pratt-Whitney	2000 employees	.63 trips/employee
Unionmutual Co.	1400 employees	.79 trips/employee
Institute of Trans. Eng.	--	.60 trips/employee

Average = .67 trips/employee

For purposes of this study the average trip rate of .67 trips per employee was used.

It is important at this point to note that an aggressive campaign for marketing of mass transit and ridesharing might reduce the magnitude of vehicle trips. BIW has been recognized throughout the State of Maine for its aggressive outreach program in this area of ridesharing for their facility in Bath. The City of Bath has restricted on street parking close to the BIW facility, therefore the rideshare program is used as a parking management tool as well.

Estimated vehicle trips for the BIW facility are presented on Table 11:

Table 11

ANTICIPATED SITE TRAFFIC

BATH IRON WORKS, PORTLAND

SHIFT	EMPLOYEES	TOTAL VEHICLES	PEAK HOUR TRAFFIC	
			Major Direction	Minor Direction
1	700	469	403	66
2	250	168	144	24
3	50	43	37	6

Source: Portland Traffic Engineering, PACTS, ITE, MDOT

Table 11 shows the Peak Hour traffic volumes in the major and minor direction. During the AM Peak, the major flow would be inbound and the minor flow would be outbound, and just the reverse for the evening peak hour.

Based on this information the "day shift" employees will generate approximately 470 total vehicles in the AM and PM peak hours. As discussed above, this traffic will be directionally split with 403 inbound and 66 outbound trips in the morning peak period. A mirror image of these patterns are expected to occur in the evening period.

The second shift will generate approximately 170 additional trips. During the same hour that traffic is exiting the BIW facility from the day shift, the evening shift is expected to generate 144 vehicles inbound and 24 vehicles outbound. Although there is a 45 minute "slack time" some of the inbound and outbound traffic are likely to overlap.

Service Deliveries

Based on conversations with representatives of the Bath Iron Works, it is estimated BIW will generate less than 20 delivery vehicles per day. For the most part, these vehicles are not expected during the peak hour. For purposes of this study, trucks were considered an insignificant impact to the study area.

Approach Distribution

In addition to "how many" vehicles are generated by BIW, it is necessary to estimate where they come from. This difficult task was performed using two methods and averaging the results. A brief description of each approach follows:

Home Based Work Trips UTPS PACTS Model - using district level trip data a profile of origin was developed for trips traveling to the waterfront area.

Population Distance - the population of each community was factored by dividing it by the distance away from BIW. The overall sum of these quotients provided a profile of origins to use in this study.

Figure 9 illustrates the regional approach distribution. As noted on this Figure, there are potential origins still available within the Portland Peninsula. To accommodate these potential origins it was assumed 10 per cent of the origins would occur at the Peninsula. Therefore the Approach Distributed as presented on Figure 9 was applied to 90 per cent of the anticipated traffic. The Peninsula traffic was assigned local roadways.

Traffic Assignment

The anticipated vehicular trips (Table 11) were assigned to regional routes according to the approach distribution as shown on Figure 9. Once traffic reaches those points on the regional route there are several potential routes to travel to the proposed BIW facility. Traffic was assigned to these local routes by using combinations of the following methods:

a) Existing time/distance measurements;
b) Trip length and trip time assignment information derived from the Maine Department of Transportation's Computerized Traffic Assignment; and
c) Knowledge and experience of existing vehicular travel patterns.

Table 12 shows the percentage split to each local roadway. These figures were applied to the anticipated traffic developed for the assignment process.

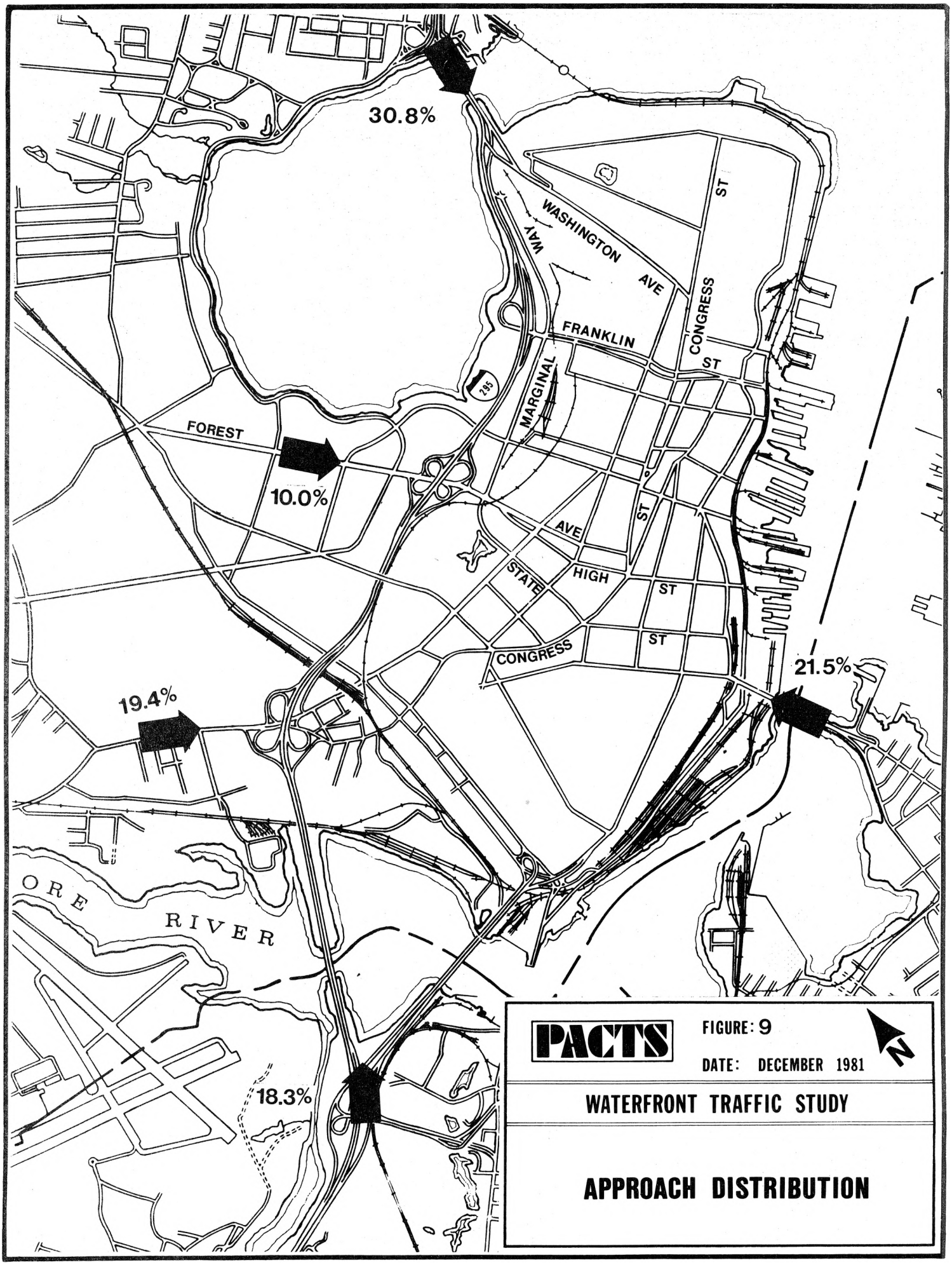
Figures 10 and 11 show the site traffic volume assignments for AM and PM peak hours, respectively.

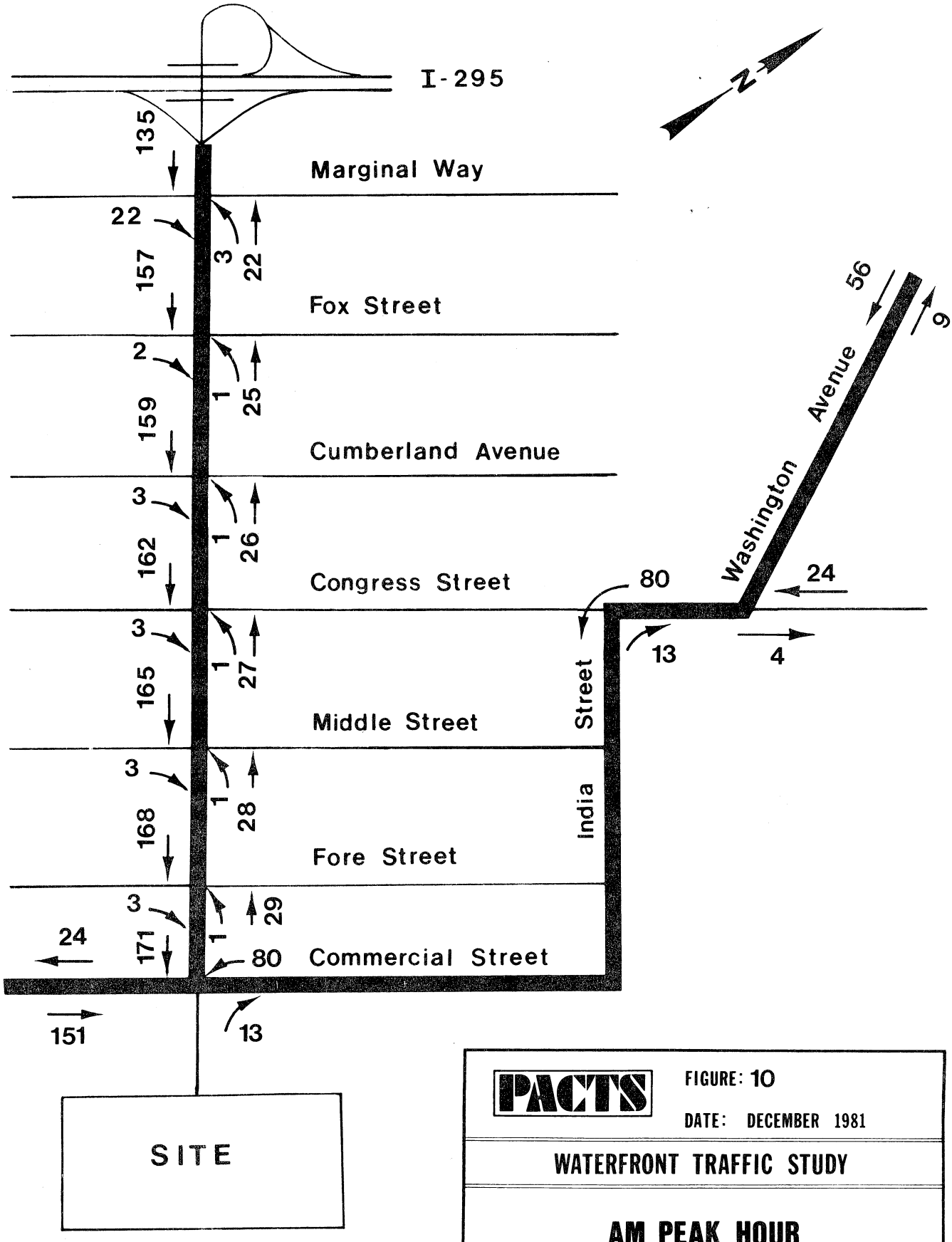
As shown on Figure 10, during the AM peak hour 171 vehicles will arrive to the site via Franklin Arterial and 30 vehicles will depart. From Commercial Street 80 vehicles will arrive from the south and 151 from the north. Department vehicles during this peak hour on Commercial Street are estimated at 13 and 24 to the south and north, respectively.

Table 12

SITE TRAFFIC DISTRIBUTION

REGIONAL ROUTE	TOTAL % OF ALL TRAFFIC	LOCAL ROADWAY ASSIGNMENT	% OF TRAFFIC
Congress Street	19.4		
		Franklin Art.	44.0
		Commercial, NB	56.0
Forest Avenue	10.0		
		Franklin Art.	40.0
		Marginal Way	60.0
Tukey's Bridge	30.8		
		Franklin Art.	50.0
		Commercial, SB	50.0
Veterans Bridge/ I-295	18.3		
		Franklin Art.	50.0
		Commercial, NB	50.0
Million Dollar Bridge	21.5		
		Commercial, NB	100.0
SUB TOTAL	100.0		
Portland Peninsula	10.0		
		West of Franklin	40.0
		East of Franklin	60.0
TOTAL			


30.8%
WASHINGTON AVE
WAY
ST
CONGRESS ST
FRANKLIN
MARGINAL
285
FOREST
10.0%
AVE
ST
STATE
HIGH
ST
CONGRESS
ST
21.5%
19.4%
ORE RIVER
18.3%
PACTS
FIGURE: 9
DATE: DECEMBER 1981
N
WATERFRONT TRAFFIC STUDY
APPROACH DISTRIBUTION



PACTS

FIGURE: 10

DATE: DECEMBER 1981

WATERFRONT TRAFFIC STUDY

AM PEAK HOUR SITE TRAFFIC ASSIGNMENT

Figure 11 presents the evening peak hour in which Franklin Arterial is expected to accommodate 182 vehicles departing the site and 92 vehicles entering. Commercial Street, south of the site, is anticipated to handle 85 and 41 vehicles, departing and arriving, respectively. Commercial Street, north of the site, is expected to accommodate 77 vehicles entering and 160 vehicles departing.

Combined Traffic Volumes

The estimated site traffic was superimposed onto both the 1984 AM and PM peak hour traffic flow diagrams to determine the magnitude of the increased traffic. These traffic volumes were used as a base for determining the anticipated traffic conditions at the intersections in the study corridor.

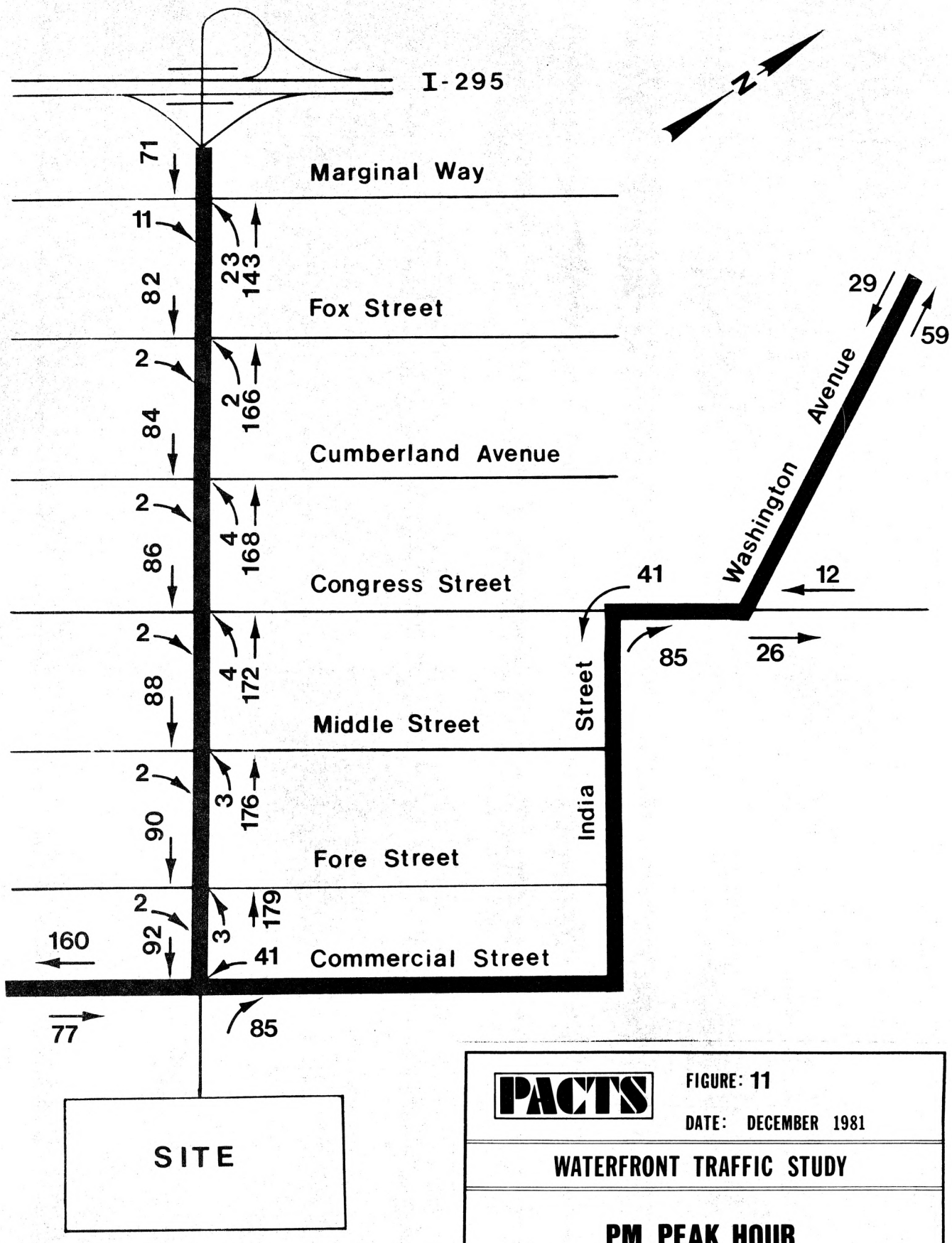
The combined traffic volumes for each intersection are presented in the Appendix. The analysis of the combined volume is presented in the next section of this study.

Parking Needs

The proposed BIW facility is expected to generate approximately 470 vehicles during the first shift. Typical standards have been developed for major facilities. Generally for planning purposes, every three employees require two parking spaces. For the BIW facility this would translate to 467 spaces, which is very close to the anticipated traffic for the site.

BIW would have to decide on the total spaces they would require for their unique operation, taking into account visitors, servicemen, salesmen, etc. It is expected that during the preparation of the site plan that these details would be considered and appropriate accommodations recommended.

For purposes of this study, it has been assumed that all traffic parking needs associated to the BIW facility will be accommodated within their facility. Any overflow is expected to be accommodated by other off street facilities developed by BIW. The recommendations set forth relative to the parking system in this site area do not reflect additional parking pressures resulting from BIW induced traffic.



PACTS

FIGURE: 11

DATE: DECEMBER 1981

WATERFRONT TRAFFIC STUDY

PM PEAK HOUR
SITE TRAFFIC ASSIGNMENT

V. ANALYSIS

This section discusses the future traffic and parking conditions that are anticipated when the proposed BIW facility is operational. This analysis was used to formulate the recommendations presentd in the next part of the study.

Traffic

Intersection capacities were computed for each intersection in the Study Corridor based on the combined traffic assignments. Table 13 illustrates the comparisons of both AM and PM peak hour conditions for existing and combined traffic volumes. With the addition of the anticipated site traffic to the base network, four intersection approaches indicate a capacity problem; the westbound approach of India Street at Congress Street; Maine State Pier at Commercial Street; Eastbound Franklin Arterial at Congress Street and Eastbound Franklin Arterial at Cumberland Avenue. At India Street the projected PM peak hour street volume is 347 vehicles and the computed capacity is 150 vehicles per hour or a resultant v/c ratio of 1.83. Maine State Pier at Commercial Street has a calculated v/c ratio of 2.85 indicating a significant increase in the approach volume when the anticipated site traffic is added to the street network. The volume to capacity ratio for eastbound Franklin Arterial at Congress Street and Cumberland Avenue during the AM peak hour is 1.21 and 1.10, respectively. All remaining intersection approaches have a recorded volume to capacity ratio of less than 1.00 indicating that traffic conditions at these locations will be within the acceptable range of Level of Service C operation.

Table 13

1984 VOLUME-CAPACITY ANALYSIS--SELECTED LOCATIONS
(with BIW)

LOCATION	APPROACH		SERVICE VOLUME	ROADWAY VOLUME		VOLUME/CAPACITY RATIO	
				Am	Pm	Am Peak	Pm Peak
Washington Ave.	Washington Ave	EB	1,300	633	379	.49	.29
@ Cumberland Ave	Washington Ave	WB	950	185	432	.19	.45
	Cumberland Ave	NB	400	124	226	.31	.57
	Cumberland Ave	SB	450	102	93	.23	.21
Washington Ave.	Washington Ave	EB	725	529	330	.73	.46
@ Congress St.	Mountfort St.	WB	210	30	72	.14	.34
	Congress St.	NB	1,045	206	527	.20	.50
	Congress St.	SB	340	204	216	.60	.64
Congress Street	Congress St.	NB	930	138	280	.15	.30
@ India Street	Congress St.	SB	975	368	438	.38	.45
	India Street	WB	190	114	347	.60	1.83
Franklin Art.	Franklin Art.	EB	1,210	306	189	.25	.16
@ Commercial St.	State Pier	WB	150	67	427	.45	2.85
	Commercial St	NB	740	338	431	.46	.58
	Commercial St	SB	950	282	184	.30	.19
Franklin Art.	Franklin Art.	EB	990	405	248	.41	.25
@ Fore Street	Franklin Art.	WB	1,130	122	379	.11	.34
	Fore Street	NB	650	158	304	.24	.47
	Fore Street	SB	500	171	140	.34	.28
Franklin Art.	Franklin Art.	EB	1,000	602	354	.60	.35
@ Middle Street	Franklin Art.	WB	1,090	219	499	.20	.46
	Middle Street	NB	700	101	322	.14	.46
	Middle Street	SB	640	124	145	.19	.22
Franklin Art.	Franklin Art.	WB	880	240	707	.27	.80
West Bound Lanes	Congress St.	NB	920	246	561	.27	.61
@ Congress St.	Congress St.	SB	600	286	346	.48	.58
Franklin Art.	Franklin Art.	EB	710	861	526	1.21	.74
East Bound Lanes	Congress St.	NB	625	184	383	.29	.61
@ Congress St.	Congress St.	SB	960	243	238	.25	.25
Franklin Art.	Franklin Art.	WB	1,020	333	916	.33	.90
West Bound Lanes	Cumberland Ave	NB	1,070	130	323	.12	.30
@ Cumberland Ave	Cumberland Ave	SB	700	248	214	.35	.31

Table 13 (continued)

LOCATION	APPROACH		SERVICE VOLUME	ROADWAY VOLUME		VOLUME/CAPACITY RATIO	
				Am	Pm	Am Peak	Pm Peak
Franklin Art.	Franklin Art.	EB	960	1,054	590	1.10	.61
East Bound Lanes	Cumberland Ave	NB	700	149	302	.21	.43
@ Cumberland Ave	Cumberland Ave	SB	1,070	209	171	.20	.16
Franklin Art	Franklin Art	EB	1,450	1,306	708	.90	.49
@ Fox Street	Franklin Art	WB	1,310	370	1,018	.28	.78
	Fox Street	NB	475	75	168	.16	.35
	Fox Street	SB	340	128	177	.38	.52
Franklin Art.	Franklin Art	EB	1,460	1,266	652	.87	.45
@ Marginal Way	Franklin Art	WB	1,940	442	1,186	.23	.61
	Marginal Way	NB	500	346	313	.69	.63
	Marginal Way	SB	550	42	104	.08	.19

Vehicle delay

Even though actual field conditions were not measured for this study an increase in delay is expected during the AM and PM peak hours, as traffic volumes generated by the proposed site are added to the network. This increase in delay will certainly occur on the northbound I-295 off-ramp and at the locations where approaches to intersections exceed capacity.

Traffic Signalization

As discussed in Section II, the intersection of Congress Street and India Street presently requires traffic signalization, therefore, the additional site traffic can only increase the need for the traffic signals.

Parking

As discussed previously, it has been assumed that BIW will provide sufficient parking for its own needs. Therefore, the parking needs evaluation relates to the number of vehicles presently parked at the Maine State Pier that would be displaced by the BIW facility.

There were 44 vehicles observed at the Maine State Pier prior to 7:00 AM that remained all day (see part III). Although no definitive documentation can be provided, it can be assumed that the majority of those vehicles were "overnight" parkers. Other vehicles that arrived and departed during the course of the survey were assumed to be business/employee trips.

All business/employee trips would be eliminated or relocated when BIW begins operations. Therefore it was assumed that these vehicles did not have to be considered in the parking system.

The "overnight parkers" were considered remaining in the study area and therefore would have to be accommodated in the system.

The overall parking needs in the study area for the time period studied would approach 100 spaces (includes the 50 spaces previously documented). It is important to note, that this figure could double during the peak summer period when the islands' population increases dramatically.

Overview

As shown in this section of the report, the BIW facility will create additional pressures on the traffic network while adding to an already documented parking deficiency in Portland. The next section of the report details a program that addresses these pressures.

PART VI RECOMMENDATIONS

The following recommendations should be considered during the course of the transition from now until BIW is fully developed. Ths present study has been envisioned as an integral component of a large waterfront transportation study. It is strongly recommended that this more detailed study be initiated as soon as possible. The latter study will take into account other developments, modal considerations and should encompass the major portion of Portland's Waterfront.

There are two general conditions that have been assumed as "given" during the course of this study. Therefore, they are not listed as recommendations. These assumptions are:

1. BIW will have a 7:00 a.m. shift start time. This will assist in minimizing the traffic impact; and,
2. BIW will provide sufficient parking to accommodate all employees, visitors and patrons. This study estimates that at least 470 spaces will be needed to do this.

Traffic Improvements

There are five recommendations to improve traffic flow on the street system network. The improvements have been categorized as "general" and "site specific". The "general" category refers to those improvements that should be developed irrespective of the BIW facility. The "site specific" improvements should be developed exclusively for this facility.

The improvement program for traffic circulations is as follows:

1. I-295 off ramps at Franklin Arterial -- (general) initial improvements should consider experimental low cost improvements such as temporary channelization, etc. Over the course of the transition, the experimental improvements could be observed and their effectiveness evaluated. This interchange should be studied in much greater detail during the next phase of this study and a longer range, more permanent solution should be developed. The ramp configuration and close proximity of Marginal Way presents a difficult situation that may require significant, expensive improvements.

2. India Street at Congress Street -- (general) the analysis of existing traffic conditions indicated that traffic signals are presently warranted at this location. The 1978 Manual on Uniform Traffic Control Devices (MUTCD) states, that traffic signals should be installed when the minor street (India Street) volume is in excess of 150 vehicles per hour for a period of eight hours and the major street volume (Congress Street) must equal 500 vehicles per hour for the same period.[6] Both of the minimum volume requirements are satisfied under 1981 conditions. The MUTCD further states that traffic signals can be installed when during a 12 month period five (5) traffic accidents have occurred that are susceptible to correction by traffic control signals.[7] Again, these conditions exist during 1981.

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[6] Op Cit.
[7] Ibid.

3. Congress Street at Washington Aenue and Cumberland Avenue, at Washington Avenue -- (general) these intersections are presently programmed in the MDOT Transportation Improvement Program. These projects should be implemented and not deferred for any other improvements. These improvement projects were recommended for implementation in the October, 1981 PACTS TSM Study. MDOT has scheduled these projects as part of their 1982-1983 Biennial Construction Program. The proposed improvement actions at these locations include elimination of parking at the intersection approaches, restriping of line markings, signal modernization and interconnection and radius improvement to better facilitate traffic flow.

4. Franklin Arterial -- (general) this important arterial should be thoroughly analyzed under the next phase of this study. The functional class, usage and future use of this facility should be addressed. The study should focus on the turning conflicts and land usage. There are three general areas that should be studied as part of that effort:

(a) Franklin at Fore/Middle Streets

(b) Franklin at Congress Street/Cumberland Avenue

(c) Franklin at Fox Street/Marginal Way

5. Intersection of Franklin Arterial at Commercial Street -- (site specific). The recommendations for this intersection will, of course, be developed in conjunction with the BIW Site Plan. Franklin Arterial extending from Commercial Street to Fore Street

should be included under this improvement. The preliminary design for ths improvement has already begun and is in close coordination with the BIW site plan. However, final design should be deferred until a more detailed traffic analysis of the Portland Waterfront can be completed.

Parking

The parking deficit estimated at over 100 spaces in the "off season" has been discussed previously. The parking system improvements to meet the deficit are not as identifiable as the traffic improvements. The City of Portland must carefully establish policies relating to parking in this area and in the entire CBD.

The following presents some general suggestions relating to policy, rather than site specific improvements:

1. On street parking - since this is the only parking supply available to the general public in the study area any proposed change to regulations that reduce the parking supply should also provide off street space to accommodate that loss.

2. New Development - should, as proposed for BIW, provide sufficient parking to accommodate all of their vehicular needs, at a minimum.

3. Enforcement and Loading Facilities - The City should establish a consistent enforcement program for vehicles parking illegally. Consideration of commercial goods service delivery needs should be an integral component of the next part of the study.

The following are recommendations to be studied further:

1. As the BIW site plan is developed any opportunity for additional parking for the general public should be explored.

2. The City will retain an existing parking lot adjacent to the BIW facility. This parking lot should be paved and improved, any expansion capabilities of this facility should be explored. The City should evaluate the rate structure and rental agreements at that time.

3. Surface Parking - Government owned land in the study area should be examined for development into surface parking lots. Any parking spaces developed should be made available to the general public.

4. Structured Parking (garages) - Any centralized parking structure proposal should be studied in detail, both for site, location and design; including a detailed financial analysis. Provisions for additional parking at an expensive monthly rent may not solve the parking deficiencies in the study area.

5. Other Studies - Any recommendations from other studies should be included in the parking policies for this study area. The American Cities Corporation study of the waterfront area is one example.

Overview and Conclusion

As shown in this study, the BIW project will create a minimal impact on the local roadway network and parking system. Few developments of this magnitude can be constructed without impacts. In this particular case the impacts are not severe and the improvement program can be tailored to eliminate or minimize these impacts.

Realization of the recommendations in this study provides a framework for accomplishing this task. BIW will evolve slowly over the course of the next four to five years, thus providing ample opportunity to review and re-evaluate these impacts and improvements.

Should BIW not be able to start its shift time at 7:00 a.m. It will significantly alter the recommendations presented in this report. Likewise, if BIW cannot provide sufficient parking spaces for the vehicles destined to the site, then it would change the parking improvement scheme.