SECOND YEAR REPORT
SAN BERNARDINO FREEWAY EXPRESS BUSWAY EVALUATION

September 1975

prepared for:
Southern California
Association of Governments

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SOUTHERN CALIFORNIA ASSOCIATION OF GOVERNMENTS

By:

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ACKNOWLEDGEMENTS AND AUTHORS

This report is prepared under the auspices of and with assistance from the Busway Evaluation Committee. Principal members of the committee during the period of this evaluation have been John Beil and William Dochnahl of SCAG; Daniel G. Miller of SCRTD; Edwin Anderson, John Kenan, I.K. Zipperman, and Michael Gallagher of Caltrans; and L. L. Clearwater of the City of Los Angeles. Ronald Fisher of UMTA has periodically provided a valuable overview function.

The report was written by or under the direction of John L. Crain. Dr. Patricia Milic performed much of the analysis, particularly concerning auto-transit diversion, impacts on energy and air quality, the performance analyses and the capacity calculations. Sydwell D. Flynn designed and supervised the survey operations and edited all of the report. Susan A. Kemp acted as research assistant and report coordinator. Barton Weitz planned the marketing analyses and performed the programming necessary for the computerized analyses using the Statistical Package for the Social Sciences.

SUMMARY

THE BUSWAY

The San Bernardino Freeway Express Busway is an 11-mile, double-lane, exclusive roadway for buses. The busway lanes are physically separated by concrete and flexible barriers from those serving the automobile traffic, making it a bus rapid transit system. This $57 million bus rapid transit system is the first such facility in the United States that is complete with off-line stations and double (bidirectional) bus lanes. (See Figure 1.)

Construction of the busway has been completed in stages, as indicated here. There are now 1,000 parking spaces at El Monte (300 of them temporary) with 700 more permanent spaces to be built by 11/75.

Element Completed	Date
E. half of Busway	1/73
El Monte Station	7/73
W. half of Busway	5/74
Hospital Station	11/74
College Station	2/75

THE EVALUATION

A comprehensive evaluation of the busway is being carried out as a joint effort of Southern California Association of Governments (SCAG), the Urban Mass Transportation Administration (UMTA), Federal Highway Administration (FHWA), California Department of Transportation (Caltrans), Southern California Rapid Transit District (SCRTD), and the City of Los Angeles.

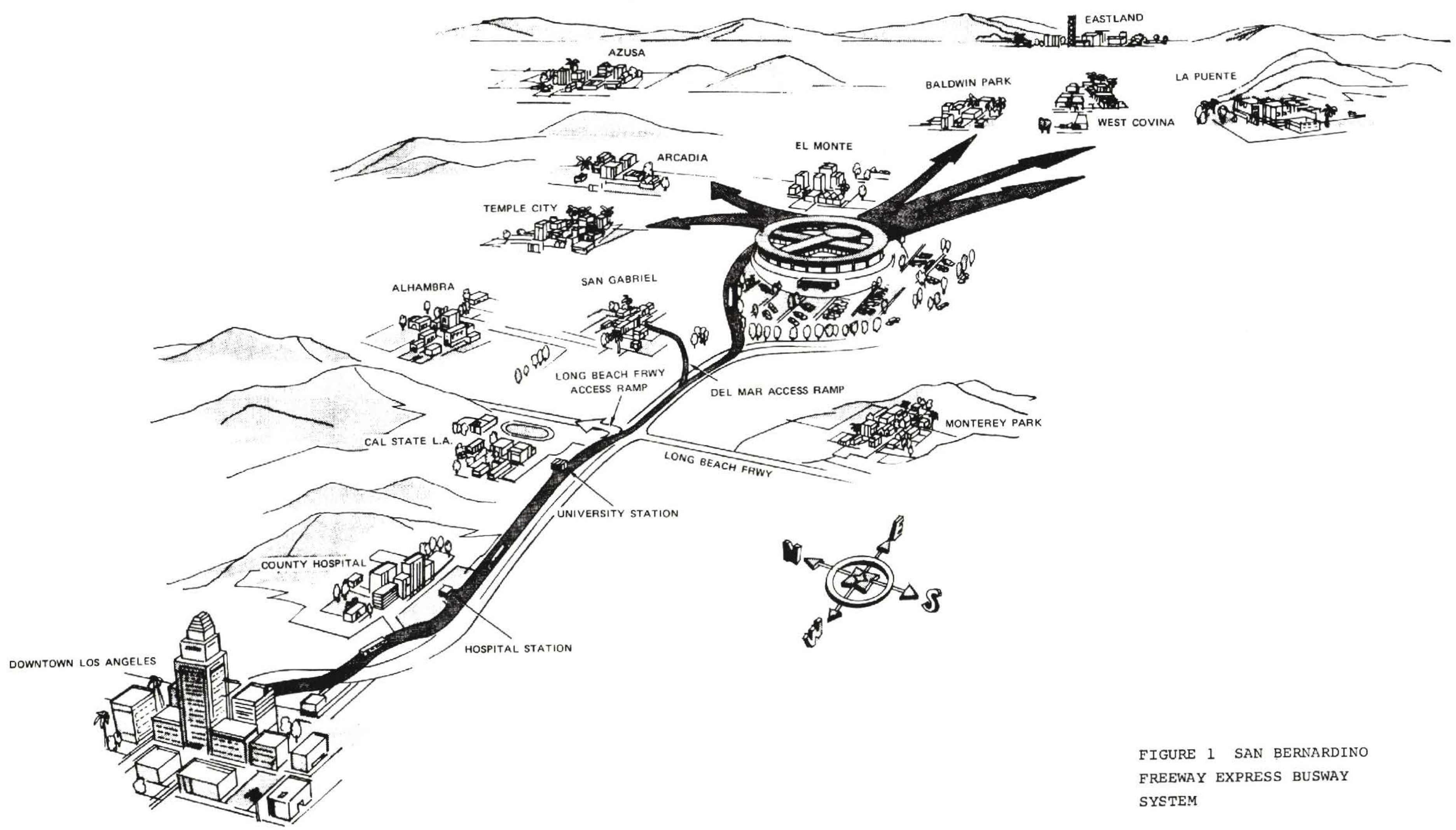

FIGURE 1 SAN BERNARDINO
FREEWAY EXPRESS BUSWAY
SYSTEM

This is a five-year effort assessing the operational and economic feasibility and the traveler response to the new facility.

The evaluation methodology is such that findings can be related to the other major national busway experiment, the Shirley Highway Busway in Washington, D.C., and to the planning of other bus priority systems in the Los Angeles Basin and throughout the country.

PASSENGERS AND TRIPS

Patronage Trends

The 27 months of uninterrupted patronage growth since inception of the busway is now being constrained by parking space at El Monte park-ride lot. The lot is filled to capacity by 8:30 AM.

Months After Busway Opened	Commuter Trips	Total Trips
0	1,000	1,800
3	1,250	2,000
6	2,000	3,600
12	4,600	6,600
18	8,000	9,000
24	9,200	12,000
27	10,000	14,500

Trip Purposes and Frequencies

Ninety-two percent (92%) of peak period users of the system are commuting to and from work. Ninety-four percent (94%) are regular riders.

Trip Profiles

The modes to the right are used getting to the bus in the morning (only half of the park-ride are at the El Monte Station).

Park-ride	55%
Walk	22
Driven by	17
Other bus	5
Other	1

After getting off the bus downtown, these modes are used. Of those who walk, 75% walk two blocks or less.

Walk	84%
Another bus	15
Car	1

Passenger Profiles

To the right is a pre-busway, post-busway comparison.

	Pre	Post
% Female	65	54
Average age	40	38
Avg. hshld. income	$11,100	$17,500

Auto Availability

Nearly 80% of the busway riders have automobiles and ride the bus by choice. Another 9% could use a car but at considerable inconvenience to another household member. 11% have no choice but to take the bus.

4%	from	0-car	hshlds.
33%	"	1-car	"
48%	"	2-car	"
15%	"	3+-car	"

BENEFIT AND DIVERSION

Economic Savings

Commuters who switch from auto to busway commuting can save up to $2.00 per one-way trip according to whether or not they previously drove alone, how much their downtown parking costs were, etc. Average savings are about $1.00.

Time Savings

Other than a very few persons who live within walking distance of El Monte Station and those who previously used a non-busway bus, the busway does not provide any door-to-door time savings compared with automobile commuting.

Prior Mode

Previous modes used by passengers before they switched to the busway are shown to the right.

50%	Drove alone
13%	Alternate driver or carried passengers
12%	Didn't make trip
11%	Auto passenger
10%	Non-busway bus
4%	Other

Reason for Using Busway

The most frequent reason cited for using the busway was that "it costs less" (the fare is now only 25 cents for any ride within Los Angeles County). The next most frequent responses are all related to avoiding the aggravation of congested freeway travel. The response "saves time" followed the above one.

IMPACTS

Vehicle Miles Saved

The increased busway usage is causing 5,550 one-way automobile trips per day to be diverted from freeway traffic. Of the 1,065 cars left at home or returned to home (after the commuter has been taken to the station), about 23% are driven for other purposes during the day. They are principally used for shopping and for someone else to take to work. There is a net savings in vehicle miles traveled (VMT) of 77,000 miles per day. This savings is 12.9% of the VMT of those cars still using the freeway lanes during the peak period. Regional VMT is 160 million per week day, counting the entire 24 hours.*

Energy Effects

During the first two years of busway operation there was a savings of about 1.5 million gallons of gasoline. This was about 25% more than was saved in the first two years of the Shirley Highway busway operations. The current savings per day from the San Bernardino Freeway busway is about 6,000 gallons of gasoline. However, about 1,000 gallons of diesel

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*Source: Regional Transportation Plan.

fuel are being burned each day by the added buses being used to carry the diverted commuters.

Air Quality Effects

The trends in air quality related to the busway are given below:

	Emissions (lbs./freeway mile/day)	
	Carbon Monoxide	Hydrocarbons
Spring, 1973 (at start of busway)	2607	456
November, 1974 (20 months later)	2084	326
November, 1974 (had there been no busway)	2472	381

The above indicates that the busway is producing about a 15% reduction in pollutants relative to conditions which would have existed had the busway not been built.

Traffic Effects

Although most of the new busway users had previously used cars, there has not been a noticeable change in freeway volumes. Automobile commuters changing to the freeway from parallel highways seem to be offsetting the diversion to transit. There has been a significant increase in freeway speed, apparently caused by some reduction in peak hour traffic caused by diversion to the busway.

Land Use

Because the corridor is a fully developed residential area, there has been as yet no readily apparent land-use impact. (The evaluation did not include a direct assessment of land-use changes.) The survey data do suggest that a large fraction of new residents have considered the proximity to busway service in their location decisions.

PASSENGER PERCEPTIONS

Reactions to the Service

Of nearly 2,000 riders interviewed, only 10% indicated unfavorable comments on the busway service. Surveys at the stations showed most persons pleased with the designs and convenient functioning of the stations, although there were some complaints about the limited parking, lack of protection from weather, and no rest-rooms.

Present Features

The features liked best, in order of preference, are shown at right.

Reduction of fare to 25¢
Frequency of service
Reduced travel time
Seat availability
El Monte terminal
Air-conditioned buses
Downtown exclusive lanes

Added Features

New features desired, in order of preference, were increased service frequency, extending the busway further into the suburbs, more bus lanes downtown, downtown stops closer to destination, and increased bus speeds.

Advertising, Promotion

People found out about the busway service mainly through friends, newspapers, and by seeing the bus on the busway.

HOW THE BUSWAY FUNCTIONS

Passenger Time at Park-Ride Station

The time park-ride passengers spend in the El Monte Station, from the moment they enter the parking lot until they reach the platform ready to board the bus, varies from 3 to 6 minutes in the morning, increasing as the parking lot fills. The time for those in the kiss-ride mode is 2 minutes. (Boarding/deboarding time functions are included in the report, including fraction of boarding that produces delays, by category; e.g., persons with chronic physical disabilities.)

Intermediate Stations

It takes a bus an average of 30 seconds to decelerate, board/deboard passengers, and accelerate back onto the busway.

Busway Speeds

The schedule time over the 11.2-mile busway, including stopping at the two intermediate stations, is about 14 minutes.

Downtown Flows

The bus travels at about 6 mph downtown, taking about 10 minutes to travel from the end of the busway to 6th and Olive Streets, the most frequent deboarding point. This is two-thirds of the trip time on the busway. The 12-block, contra-flow, exclusive bus lane does not seem to resolve this problem. It allows some improvement in routing but does not improve bus speed.

Capacity

The capacity of the bus system varies at different parts of the system.

	Capacity seats/hour
El Monte Station (peak direction)	8,000-10,500
Along busway	40,000-43,750
Through intermediate stations	6,000-13,000

The present downtown routes and congested streets are the primary limitation on capacity. Operating as at present, the downtown bus routing process allows possibly a doubling of the present peak hour volume (3,000 passengers per hour) before limiting further busway ridership growth. However, these downtown limitations need not be restrictive, since additional routes can be added. Furthermore, if conditions were such that full use of the busway capacity was required (e.g., gasoline rationing), the computations indicate that there will be considerable space for buses.

FORTHCOMING ACTIVITIES

A brief third-year report is planned for early 1976, emphasizing final market share and mode split analysis. The project will commence Phase III in May 1977, when buses are to share the busway with carpools. The busway design of a single lane and shoulder in each direction may pose problems for mixed traffic use and these need careful study prior to Phase III. It is proposed that the rate of carpools entering the busway will be metered so as to avoid impeding bus operations.

I. INTRODUCTION

HISTORICAL BACKGROUND

The San Bernardino Freeway Express Busway (SBFEB) is an 11.2 mile, two lane, exclusive roadway for buses, connecting downtown Los Angeles to the city of El Monte. (See Figure 1.) The busway is now completely constructed and operational (except for some additional parking that is being added). It is currently being used exclusively by buses. At a later time it will be tested with buses and carpools commingled on the busway lanes.

The busway project is a major development in bus rapid transit: an alternative form of high speed, grade separated public transportation currently under development in various parts of the country. Its forerunner is the highly successful Shirley Highway Busway serving downtown Washington, D.C., from the Virginia suburbs to the south. Other busways and systems of reserved lanes and priority treatment for buses are under development in other cities, but the SBFEB is the most complete system in the country, equipped with off-line stations, park-ride facilities, bi-directional lanes, feeder bus lines, and downtown reserved (contra-flow) lane.

The project is also part of the SCAG Short Range Transportation Plan that includes transportation improvements directed towards improving air quality and energy conservation. These transportation improvements include preferential treatment on freeways and major arterials for high occupancy vehicles, carpool action programs, transit development strategies, bicycle related programs, and commuter rail service. The San Bernardino Busway project will allow assessment of the effectiveness of selected transit strategies in attracting transit ridership and determination of the overall impact of transit improvements on auto usage.

Because of the national and regional significance of this project a comprehensive, five year evaluation of the busway is underway. This is the second year report of that evaluation, covering the operational and economic status of the busway and including considerable material on an engineering description of the facility, its functioning, and the public's reactions to the design.

CORRIDOR DEFINITION

As presently designed, the busway provides services to most of the San Bernardino Freeway Corridor, a residential traffic corridor east of downtown Los Angeles. (See Figure 2.) This corridor is defined, for purposes of this project, as that area bounded by the Los Angeles River on the west, by Azusa Avenue on the east, by Mission Road, Huntington Drive, and Interstate 210 on the north, and by the Pomona Freeway on the south. This is illustrated in Figure 22 later in this report. The principal transportation artery serving this corridor is the San Bernardino Freeway. This project study corridor is approximately 20 miles in length and varies between 2.5 and 8 miles in width. Included are portions of approximately 21 separate municipalities, plus part of Los Angeles itself. The busway actually serves an area considerably larger than the project study corridor by virtue of busway lines which begin to the east of the corridor.

The corridor encompasses about 35 square miles, is suburban in character, and houses a predominantly middle-class population of about three-quarters of a million people. This in-

FIGURE 2 SAN BERNARDINO FREEWAY, BUSWAY AND CORRIDOR

cludes about 190,000 households and 22,000 commuters who travel to the Los Angeles downtown area.

PROJECT EVALUATION SCHEDULE

The busway project and evaluation are subdivided into three phases. Phase I commenced with opening of the partially completed busway on January 29, 1973. The second phase started May 1, 1975 when the full system was operational. This phase was interpreted as beginning when the last of the three stations opened. Current plans are that Phase II, exclusive use of the busway by buses, will continue until May 1977. At that time Phase III, with mixed mode operations, will begin.

The evaluation also operates in these three phases but for purposes of economy is not continuous throughout the entire five year period.

LONG RANGE OBJECTIVES

The long-range objectives of the evaluation are:

- To perform a cost-effectiveness evaluation of the busway under exclusive bus usage and under mixed mode usage
- To determine the feasibility and characteristics of mixed-mode operation of the busway
- To determine the feasibility of providing three modes of transportation (auto, bus, rail) in a single corridor
- To establish a rational basis for planning future freeways incorporating mass transit facilities
- To determine the performance of alternate types of rubber-tired vehicles and communication and control systems suitable for use under these conditions
- To determine the effectiveness of and demand for fringe parking facilities in connection with the busway project

SCOPE OF EVALUATION

The overall evaluation plan, published as a separate report, embodies a variety of tasks ranging from counts of bus rides and auto traffic, to various surveys of public behavior and attitude, to various analyses of benefits, costs, operational performance, and so on. The objectives and activities of the Phase II evaluation are discussed below.

Phase II Objectives

The objectives of the Phase II evaluation are:

(1) To obtain a market analysis of the fully operational busway with exclusive bus usage

(2) To supplement the market analysis with data on mode split, benefits and costs, and commuter behavior that relate to SCAG regional planning

(3) To evaluate the trend in person-trip volumes on the fully operational busway relative to volumes on the adjacent highway lanes

(4) To evaluate the operational performance of the busway system and user reactions to features of the physical design

(5) To study bus-auto interaction in the Los Angeles downtown area

Work Tasks

The Phase II work tasks were established in the Evaluation Plan published in December, 1972. However, the work recently was reorganized into the following 12 tasks.

- Coordination—This task encompasses all coordination with the committee and related agencies.
- Time Series Analysis—This subsumes all analyses of transit and auto person-trip trends, causal factors, and cost-effectiveness.

- Traffic Data Studies—This comprises all of Caltrans' work on traffic monitoring and analysis.
- Transit Passenger Counts—This subsumes all SCRTD work on counting and reporting of patronage and service levels.
- On-Board Survey—This is the survey conducted in fall of 1974 that provides the principal data base for this report.
- Busway Cost Analysis—This provides an updated estimate of all operational and capital costs of the busway, identified by time of expenditure. Estimates also are made of bus operating cost per vehicle mile and per passenger trip reported on herein.
- Operational Performance Study—This task deals with physical and operational performance of the bus system including the passenger throughput capacity of the El Monte and Hospital Stations, a bus time-and-motion study, a schedule reliability survey, a user perception survey of the three stations, a bus operators' perception and attitudes survey, and culminates in a system capacity study. All of this work is reported herein.
- Bus-Auto Downtown Interaction Study—This is the Los Angeles Traffic Department's on-going effort to measure the impacts of the busway on downtown traffic and mobility. The output is covered in separate reports.
- Off Peak Survey—This survey of off-peak and reverse commute passengers was conducted in May, 1975. Emphasis was on non-work traveler benefits and on any economic benefits to inner-city residents. Reporting of this task will be included in the third year report.
- Household Survey—This survey, a repeat of the 1973 household survey reported on in the first year report, will be conducted in fall, 1975. It will be the final and most comprehensive assessment of mode split, market

share, and causal factors on the final Phase II cost-effectiveness assessment. Reporting of this task will be included in the third year report.

- Second Year Report—This is the preparation of the present report covering evaluation findings through calendar year 1974 and into the first quarter of 1975.
- Third Year Report—This will be the summary analysis and writing of the Phase II report, end of 1975.

ABOUT THIS REPORT

This second year report covers evaluative activities conducted primarily during 1974, the second year of busway operations, plus some activities conducted during the first four months of 1975.

The first year report emphasized public acceptance of the busway, ridership trends, market share, mode split analysis, and benefit-cost assessment. This report places emphasis on the operational experience gained to date and describes how the system functions. It is a highly detailed report and oriented toward those who will construct and operate other busways or who might wish to modify this one. After this introduction the report falls into three major parts which vary in focus and level of detail. Different readers will have varying interests in each part.

- Chapters II, III, and IV describe the busway and the "big" picture of its impacts. Chapter II describes the system in terms of design and operations. Chapter III discusses ridership growth and some of the busway's impacts on corridor automobile traffic and land use. Chapter IV gives some highlights on trip costs and traveler savings in time and cost.

- Chapters V, VI, and VII move to a greater level of detail, focusing on the nature of the commuter's response to the system. In Chapter V the principal source of data, a massive on-board survey, is described along with profiles of riders and the trips they are taking. Passenger perceptions of the stations and the system as a whole are discussed in Chapter VI, drawing from the on-board survey and various supplemental surveys. Chapter VII describes an analysis of the magnitude and nature of the auto-to-busway diversion that has occurred and the impacts of this diversion on energy consumption and air quality.

- The third and final part of the report, Chapters VIII, IX, and X tell, in considerable detail, how the system functions. This might be called an engineering design analysis. Chapter VIII attempts to answer a recurring question: Will a busway improve schedule reliability? Chapter IX reports on a series of time and motion studies describing how speedily buses and riders are handled within various portions of busway system. These studies also provide the data base for Chapter X, which gives an estimate of the carrying capacity of the busway, indicating which of its components would constrain passenger volumes if, because of pollution or energy conservation requirements, the busway was required to carry a much higher volume of riders.

Finally, there are six appendices that provide a level of detail too voluminous for the main body of the report.

II. BUSWAY CONFIGURATION

GENERAL

The busway system consists of the exclusive lanes (an 11.2-mile, two-lane roadway) and three rapid transit stations. The previous Figure 1 shows the general geographical layout; two-part Figure 3 is a plan view drawing showing the location of stations, the cross sectional design of the lane, and the speed limits imposed at various points along the busway.

CHRONOLOGY OF DEVELOPMENT

The busway has been constructed in stages. With the completion of each segment or feature of the system, the service level has been enhanced. The patronage has increased steadily as the stream of improvements has been added. Table 1 lists the chronology of major milestones in the development of the busway.

ROUTES AND SCHEDULES

There are nine busway lines. A detailed map of the entire El Monte-Los Angeles system is shown in Figure 4; frequency of service by line is given in Table 2. Lines 60, 401, 402, and 403 are long lines running to the eastern extremes of the corridor and beyond (e.g., some Line 60 buses run to San Bernardino, approximately 60 miles from downtown L.A.). Thus, these routes play the role of intercity lines. Within the corridor and during rush hours they play the role of commuter runs serving the home-to-work trips originating in the east end of the corridor. Lines 404 and 405 provide service to Los Angeles from points somewhat to the north of El Monte. Lines 52, 53, and 63 serve areas slightly west of El Monte. Most of these buses run on surface streets all

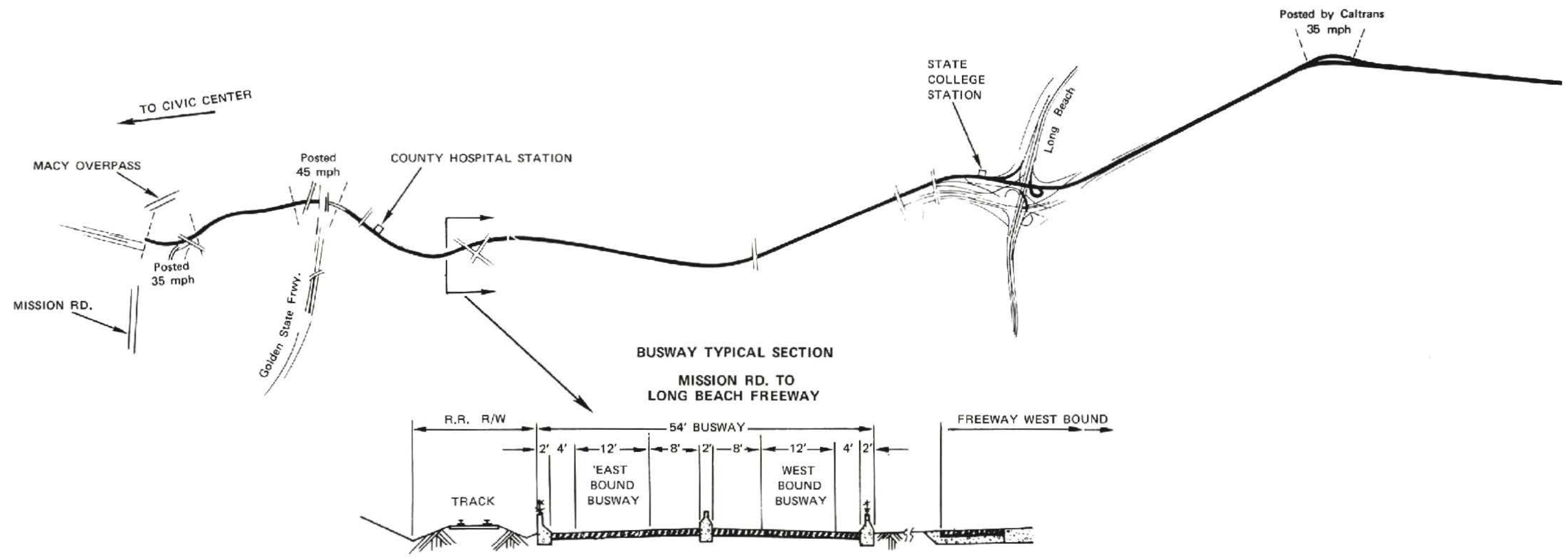


FIGURE 3 SAN BERNARDINO FREEWAY EXPRESS BUSWAY

(Part 1)

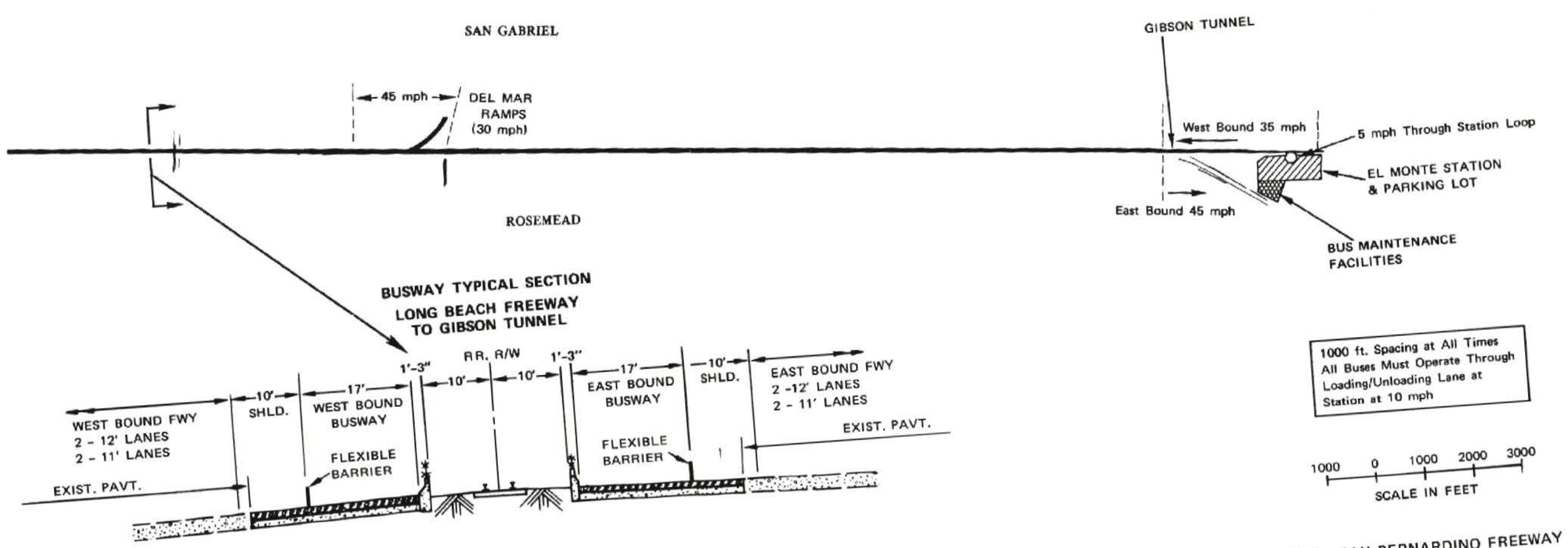


FIGURE 3 SAN BERNARDINO FREEWAY EXPRESS BUSWAY

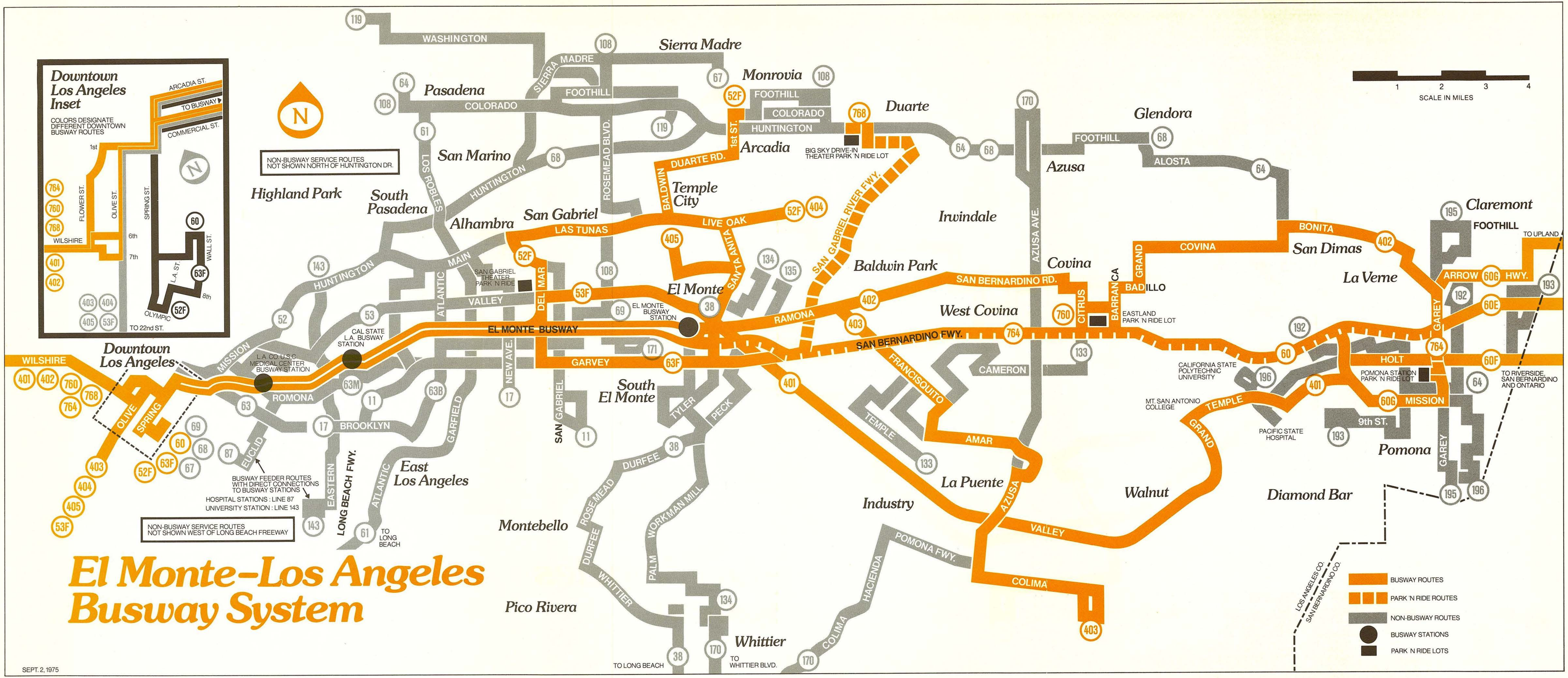
(Part 2)

Table 1

CHRONOLOGY OF BUSWAY DEVELOPMENT

January 29, 1973	Existing San Bernardino Freeway bus service began use of busway lanes from El Monte to Long Beach Freeway (seven miles)
July 8, 1973	Construction of Phase I Parking Lot (west half of parking--700 spaces) completed
July 8, 1973	South access road completed
July 16, 1973	El Monte Station and parking opened to public
August 15, 1973	Santa Anita Boulevard widened between Ramona Boulevard and San Bernardino Freeway
October, 1973	Del Mar Avenue access ramps completed and bus operations commenced
April, 1974	Bus fare reduced to 25¢
May, 1974	Construction of Busway lanes from Long Beach Freeway to Mission Road completed
June, 1974	Buses began use of complete busway, including buses entering at Del Mar ramp
August 12, 1974	SCRTD strike began
August 19, 1974	Carpools allowed on busway lanes during strike
October 18, 1974	Resumption of service
November 4, 1974	Hospital Station opened
February 19, 1975	College Station opened
May 1, 1975	Beginning of Phase II
December, 1975	Construction completed on Phase II parking facilities (700 more spaces at El Monte)
May 1, 1977	Anticipated beginning of Phase III

El Monte–Los Angeles Busway System



the way to Los Angeles. A few of the rush-hour trips enter the busway at the Del Mar ramps; these are denoted as Lines 52F, 53F, & 63F, indicating "flyer service" on the busway.

Table 2
BUSWAY LINES SERVICE FREQUENCIES
(6 AM-9 AM as of 2/27/75)

Busway Lines	6-7	7-8	8-9	Total
All buses	28	66	28	122
Buses departing El Monte Station	26	53	25	104
60	7	16	8	31
401	7	10	4	21
402	6	11	4	21
403	2	7	3	12
404	2	5	3	10
405	2	4	3	9
Lines entering busway at Del Mar Ramp				
53 f	2	6	2	10
52 f	-	5	-	5
63 f	-	2	1	3

As Table 2 shows, the frequency of buses on the busway west of the Del Mar ramps averages one every 90 seconds over the morning rush period. During the peak hour this increases to slightly more than one per minute, one every 55 seconds. This means a capacity of approximately 3300 seats per hour, at 50 seats per bus.

LANE DESIGN

As shown in Figure 3 the busway, along with a railroad right-of-way, occupies the median strip of the freeway from El Monte to a point just east of the Long Beach Freeway. Part 2 of Figure 3 illustrates the busway cross section between these points. The only entry/exit points in this section are at the El Monte Station and at the Del Mar ramps. The latter is an entry/exit point for lines 52F, 53F, and 63F, serving localities slightly west of El Monte. Figure 5 is a photograph of a bus traveling on the busway where it occupies the median strip of the freeway.

FIGURE 5 BUSWAY IN MEDIAN STRIP

Figure 6 illustrates entry point to busway at Del Mar ramps.

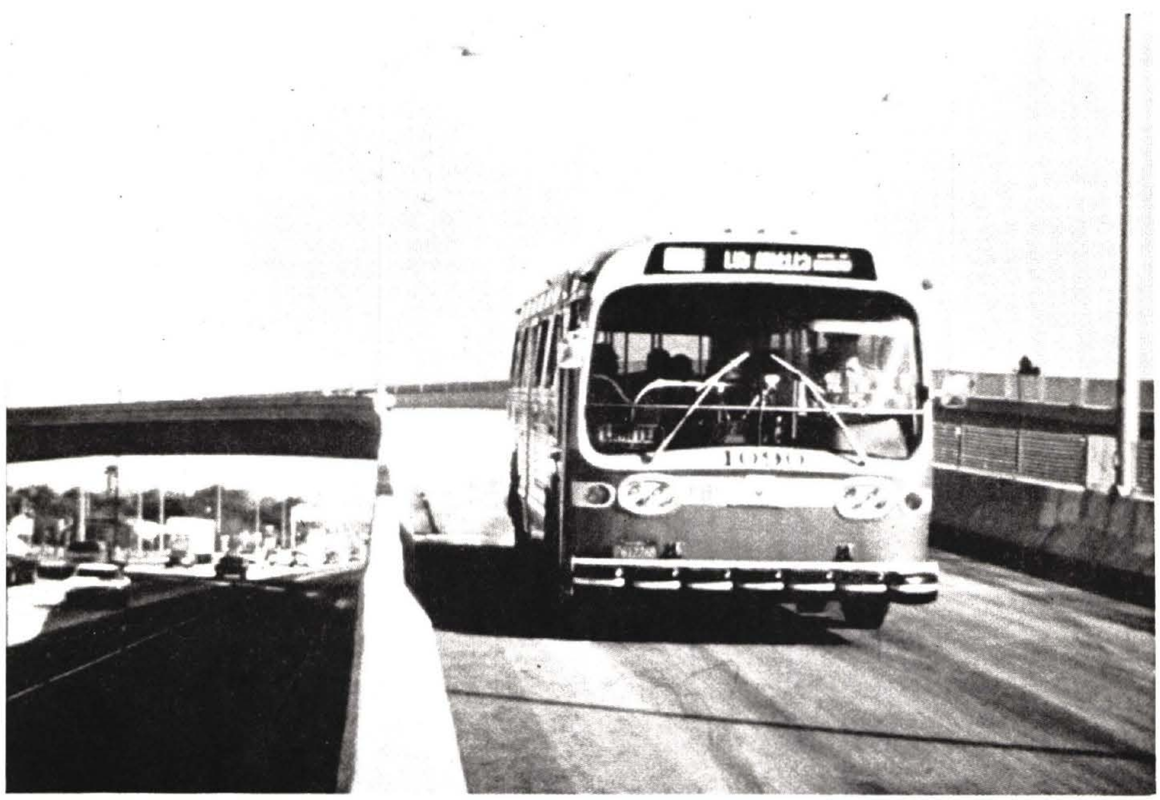


FIGURE 6 BUS ENTERING BUSWAY AT DEL MAR RAMP

As the busway nears the Long Beach Freeway it crosses over the westbound lanes and over the Long Beach Freeway to parallel the San Bernardino Freeway on the north. This separation of busway and freeway is shown in Figure 7.

FIGURE 7 BUSWAY SEPARATION FROM FREEWAY FOR ACCESS TO COLLEGE STATION

The busway enters the College Station from the east with the busway lanes at different levels—the westbound lanes at considerably higher level than the eastbound lanes, with students entering from a level even higher than the westbound bus lanes. Thus, the College Station is a three-level station with the westbound passenger boarding area about 40 feet above the eastbound boarding area.

Just west of the College Station the westbound lane crosses over the eastbound lane and comes down to the same level with it. The busway lanes are thus reversed and remain reversed into and through the Hospital Station.

This station is a center island design which requires the lanes to be reversed so that all passengers can board from an island between the lanes (see Figure 8).

FIGURE 8 LANE CONFIGURATION AT HOSPITAL STATION

The lanes continue on in this reversed fashion to the downtown entry/exit point at Mission Road. (See cross section in Figure 3.) The reverse lane configuration, in addition to facilitating loading/unloading at the Hospital Station, is also necessary for the process of properly locating the points where buses enter and leave the busway in the downtown area.

STATION DESIGNS

El Monte

The El Monte Station is the major terminal and interchange point in the system. It accommodates park-ride, kiss-ride, walk-in, through-bus, and bus-transfer patrons. The general concept of the station is illustrated in Figure 9. It is a circular design with buses circling a 10-sided loading platform which facilitates ten loading berths (see Figure 10). As this figure shows, the buses enter from the right, coming from east of El Monte via the adjacent Santa Anita Avenue, from the nearby bus storage yards, and from the busway itself. The buses coming eastward off the busway stop at a stop sign at the end of the busway. Buses exiting the terminal have the right-of-way at this point and cross in front of the buses coming off the busway. (This crossover is related to the station capacity calculations discussed in Chapter X.)

Buses entering the station wait at a holding point that is monitored by a TV camera. The station director sits in the center of the station at an oval control center and monitors the holding point on a video screen output of the TV camera. He directs the bus at the holding point to an empty loading berth of his choice, notifying both the bus driver and the waiting passengers of his decision through a loudspeaker system. The bus proceeds to that berth, loads and unloads passengers and departs at a scheduled departure time.

As stated earlier, passengers can arrive at the El Monte Station by several modes. In reality hardly any arrive by walking or on bicycles.[1] The vast majority come in on the feeder and through buses and about one-fourth by the park-ride, kiss-ride modes. The parking lot now has 700 permanent and 300 temporary parking spaces.

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[1] A Note on Bikes: There are also 20 "key" and four coin-operated bike lockers. The former lease for $5 per month, the latter for 25¢ daily. These are not used to capacity. Around the end of the year usage had dropped to six leases per month and one coin-operated locker per day. This low usage pattern is dissimilar to the BART experience, where lockers are used to capacity and more lockers are on order.

1. Terminal Building
2. Busway to Los Angeles
3. Phase I Parking
4. Proposed Phase II Parking
5. Planned Bus Maintenance Yard

FIGURE 9 AERIAL VIEW OF EL MONTE TERMINAL (PHOTO TAKEN ON SATURDAY; NOTE LACK OF PATRONAGE)

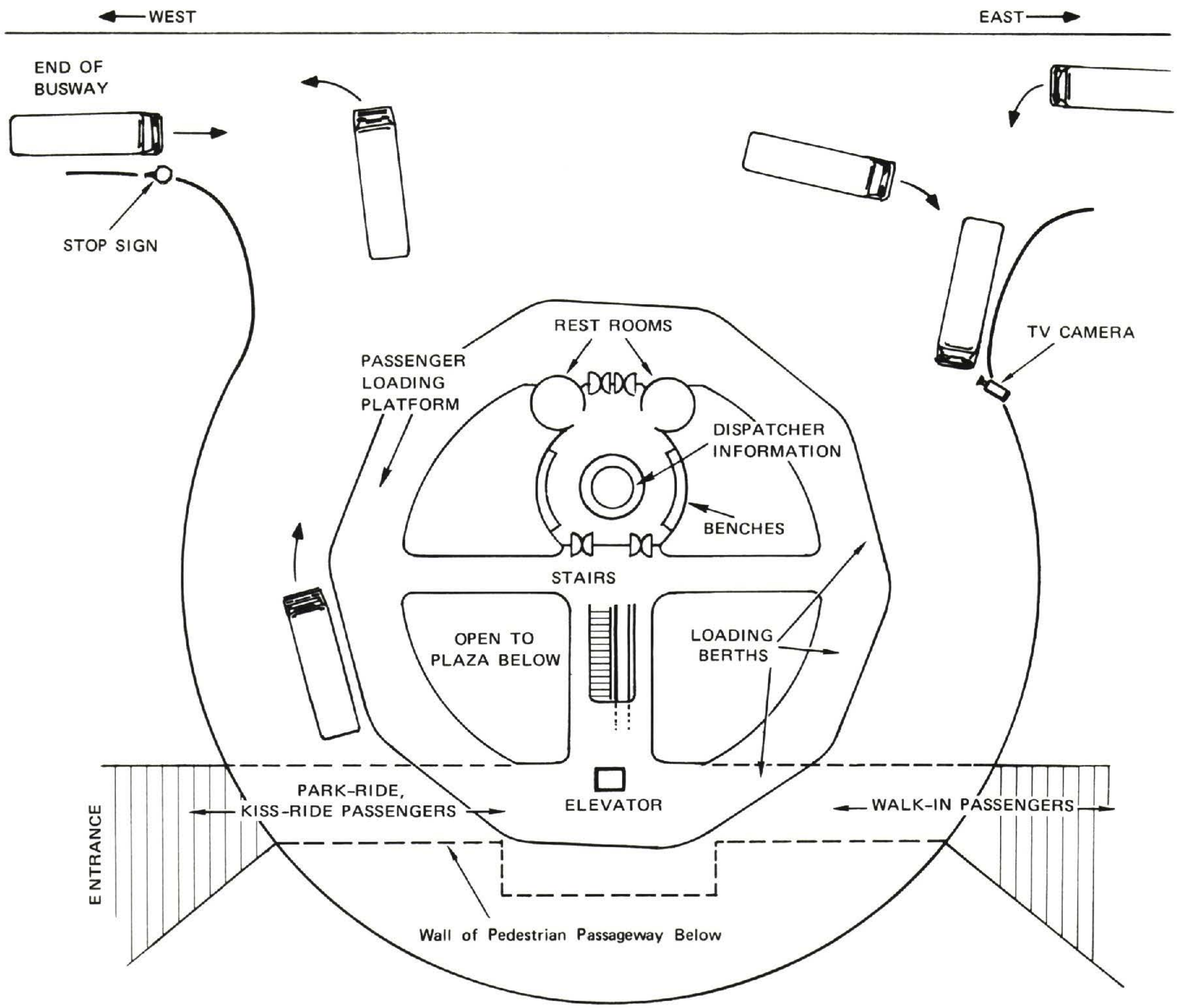

FIGURE 10 EL MONTE STATION, PLAN VIEW

Park-ride, kiss-ride passengers enter the terminal at ground level (lower left in Figure 10; see also Figure 27 in Chapter VI) walking through an underground passage and coming up to the second level boarding area via the escalator or elevator. The elevator is scarcely used; it is primarily used by physically disabled persons.

The station also has a lower level terminal used by intercity carriers for ticketing and passenger waiting. The intercity buses are loaded upstairs, where two of the berths are allocated to these buses (e.g., Greyhound and Trailways).

College Station

This station is a "destination" station in that there are no facilities for park-ride and kiss-ride passengers and there are no residential areas within walking distance. Thus, the station is only for students and faculty who go to California State University at Los Angeles; few trips originate there.

It is an offline station in the sense that "express" buses can pass through the station, while "local" buses are stopped to board and deboard passengers.

As discussed earlier, the College Station operates on three levels. This is also shown in Figure 11. The college is on high ground overlooking the freeway in a valley below, and people entering the station (mostly students) come in at a level above the boarding areas. A walkway leads from the campus onto an overhead bridge which provides entry to two towers that are about five stories high. One leads down to the westbound boarding area, about a third of the way down, and the other leads down to the ground level to the eastbound boarding area. (See also photographs of College Station, Figure 29 in Chapter VI.) The station is unattended.

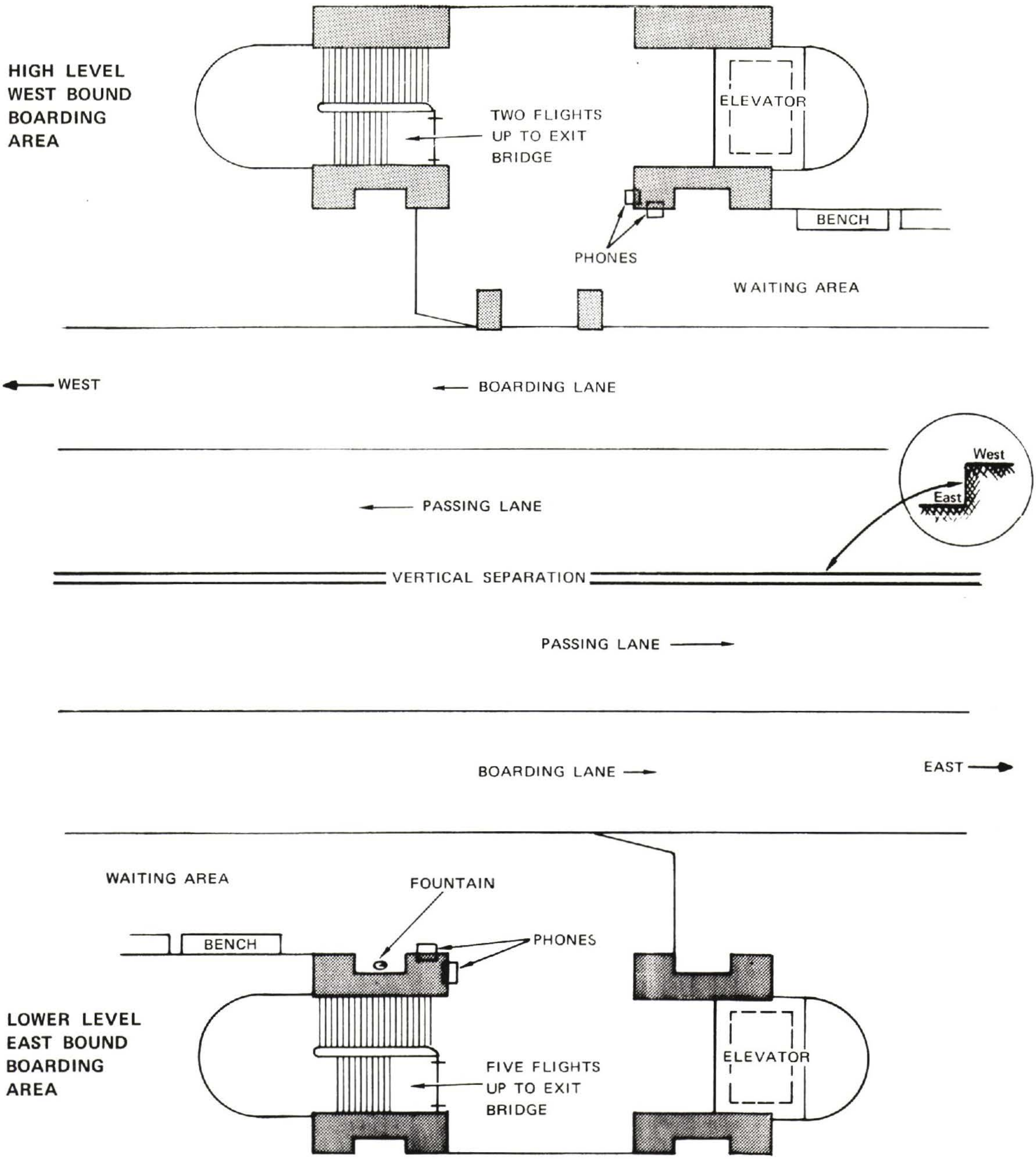

FIGURE 11 COLLEGE STATION, PLAN VIEW

Hospital Station

This is also a destination-only station and an offline station similar to the College Station as described above. One difference is that there is a north-south feeder bus line so that some passengers who originate their trips in the corridor use the station to transfer onto busway buses.

Figure 12 shows the layout of the Hospital Station. (See also photographs of Hospital Station, Figure 27 in Chapter V.) As discussed earlier, the lanes operate in a reverse-from-normal direction so that the doors of buses traveling in both directions open inward to the center of the busway. There is a security guard on duty at the station.

DOWNTOWN OPERATIONS

The busway buses emerge into the downtown street system at Mission Road and follow surface street routing through the downtown area. Figure 13 is a photograph of a typical bus-

FIGURE 13 BUSWAY BUS ON DOWNTOWN STREET

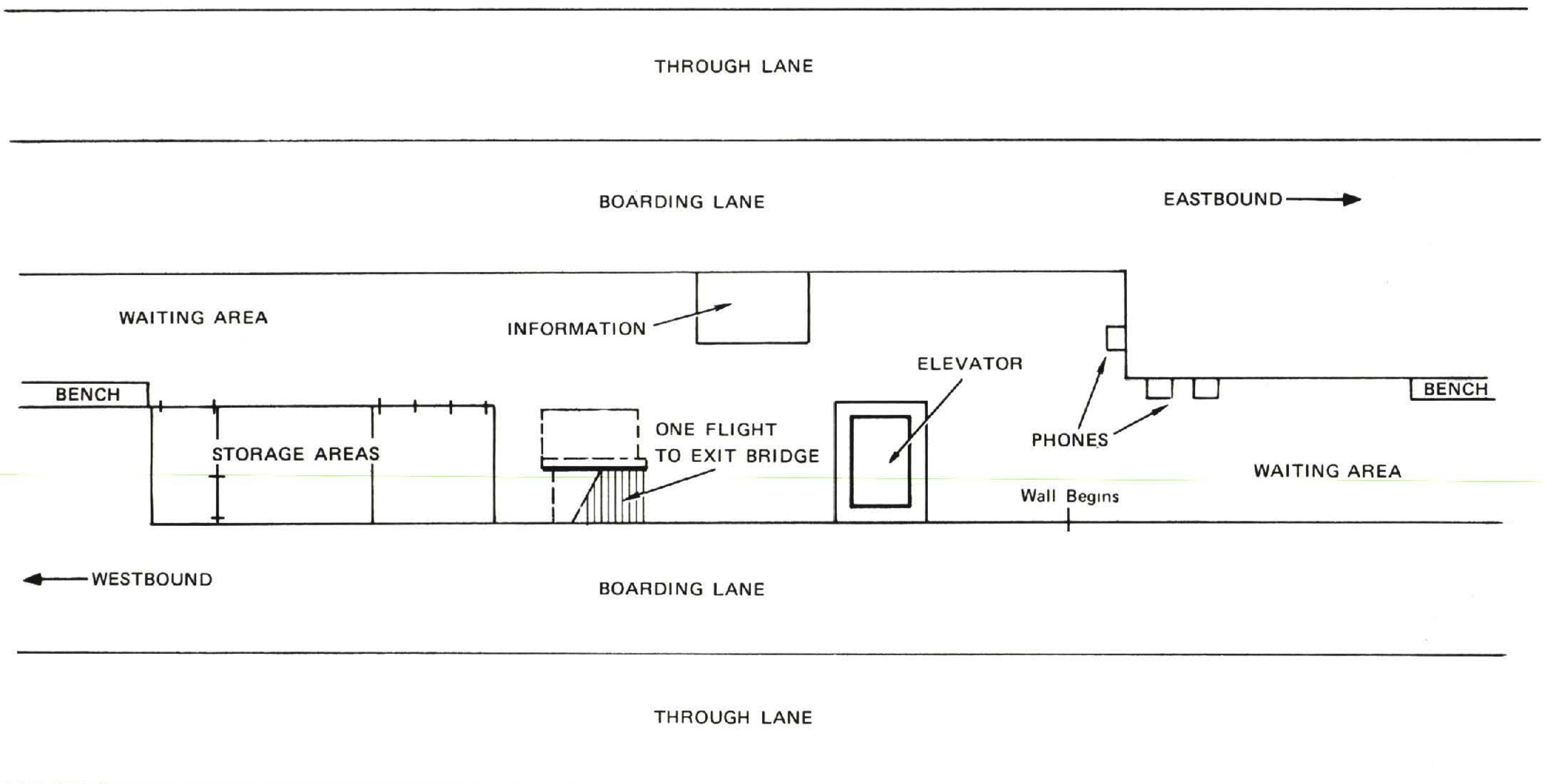

FIGURE 12 HOSPITAL STATION, PLAN VIEW

on-downtown-street situation. The network of downtown routes used to distribute busway passengers within the CBD is depicted in Figure 14.

The only present priority treatment for buses is a bus exclusive contraflow lane (shown in Figure 15) running northward on Spring Street, a one-way southbound street.

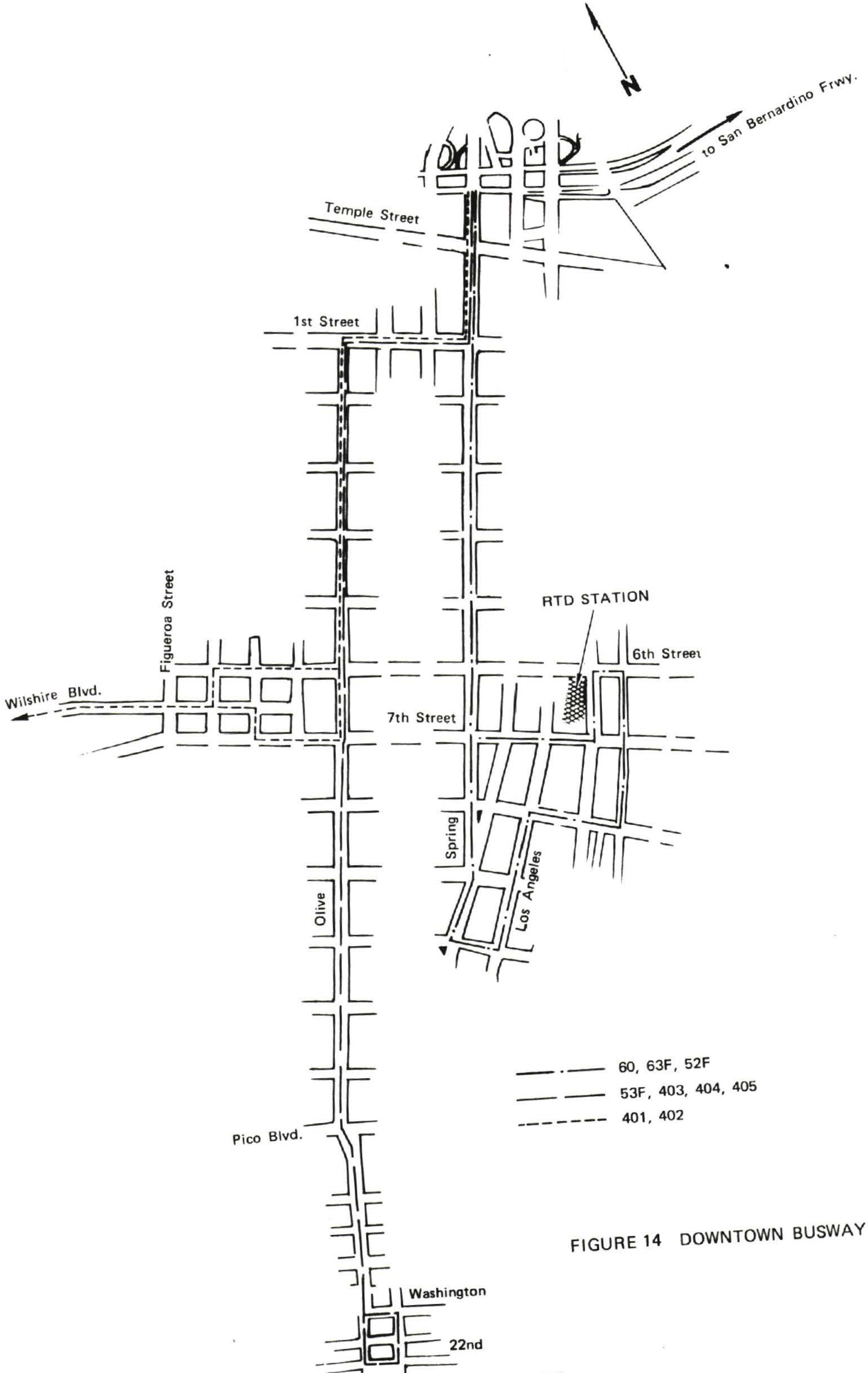

FIGURE 14 DOWNTOWN BUSWAY ROUTES

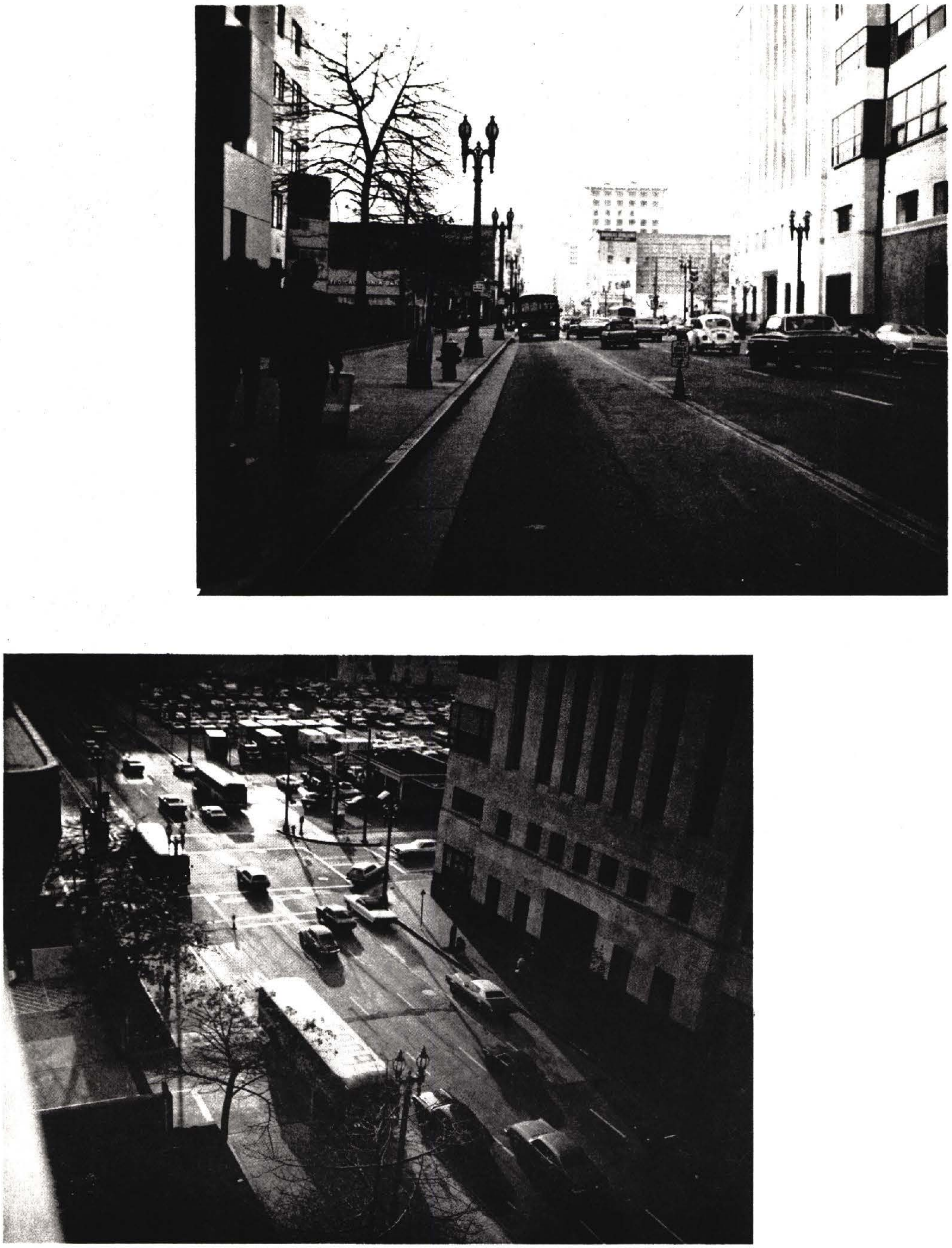

FIGURE 15 DOWNTOWN CONTRA-FLOW LANE (LOOKING SOUTH)

III. RIDERSHIP TRENDS, CORRIDOR IMPACTS

RIDERSHIP TIME SERIES ANALYSIS

Figure 16 shows the growth in ridership over the first 27 months of busway operation. All ridership counts are taken in both directions at a screenline where traffic enters and leaves the CBD. (The screenline is currently at Hospital Station.) The top patronage curve gives the total weekday ridership in both directions over the 17 hours when the busway is in operation. The count in late March was nearly 14,000 riders per day. The middle curve is the principal time series of interest. It represents the 5.5-hour, peak-period, peak-direction ridership, i.e. the approximate total of the inbound morning busway commuters plus the outbound evening commuters. This count, about 10,000 in late March, represents the volume of commuter trips being carried on the busway during the peak period when the freeway system is most congested. It can be compared with the basic carrying capacity of one of the parallel traffic lanes on the freeway which traditionally carries about 11,500 persons (1.26 occupants per car) in the peak direction during the same 5.5-hour period. Thus, the busway peak-direction lane is carrying about 87% of the person trips carried by the average of the parallel automobile peak-direction lane.

This is not to say that some equivalency in terms of cost-effectiveness is reached when the two volumes are equal. The busway is a higher cost facility than the automobile lane, but the benefits it produces (e.g., improved overall freeway speeds) are much larger.

The lower time series curve is the average peak-hour ridership during the two peak periods of traffic, from 7 to 8 AM

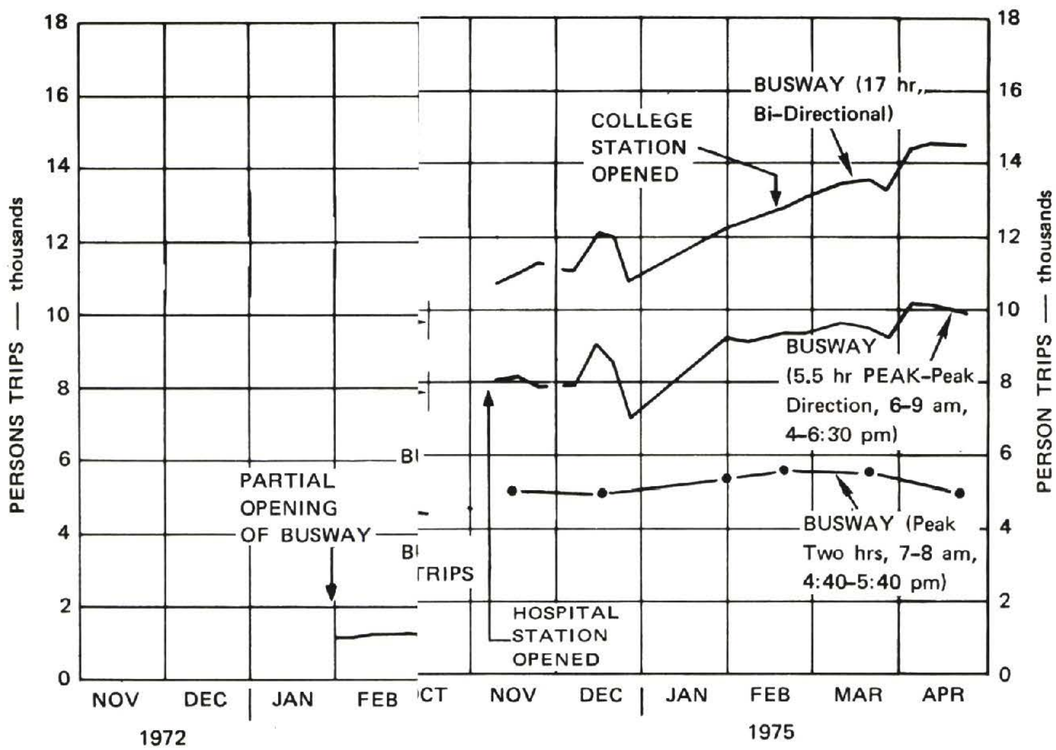

FIGURE 16 SAN BERNARDINO FREEWAY BUSWAY AND HIGHWAY COUNTS

and from 4:40 to 5:40 PM. This curve can be compared with the hourly capacity of a parallel automobile lane on the freeway, usually about 4,500 person-trips during the peak two hours with occupancy rates of about 1.26 persons per car. As the data indicate, the peak-hour busway count is now slightly higher than the comparable highway counts.

FREEWAY IMPACTS

Speeds

Figures 17 and 18, provided by the Caltrans representatives on the busway committee, illustrate the freeway traffic speeds over most of the time period of the busway operations. As the figures indicate and as might be expected because of the substantial auto-to-transit diversion that has occurred, there has been a significant improvement in traffic speeds.

The improvement cannot be entirely attributed to the busway; there has been considerable improvement in the carrying capacity of the freeway because of widening. Also, there are seasonal variations; summer speeds are slightly swifter than speeds at other times of the year.

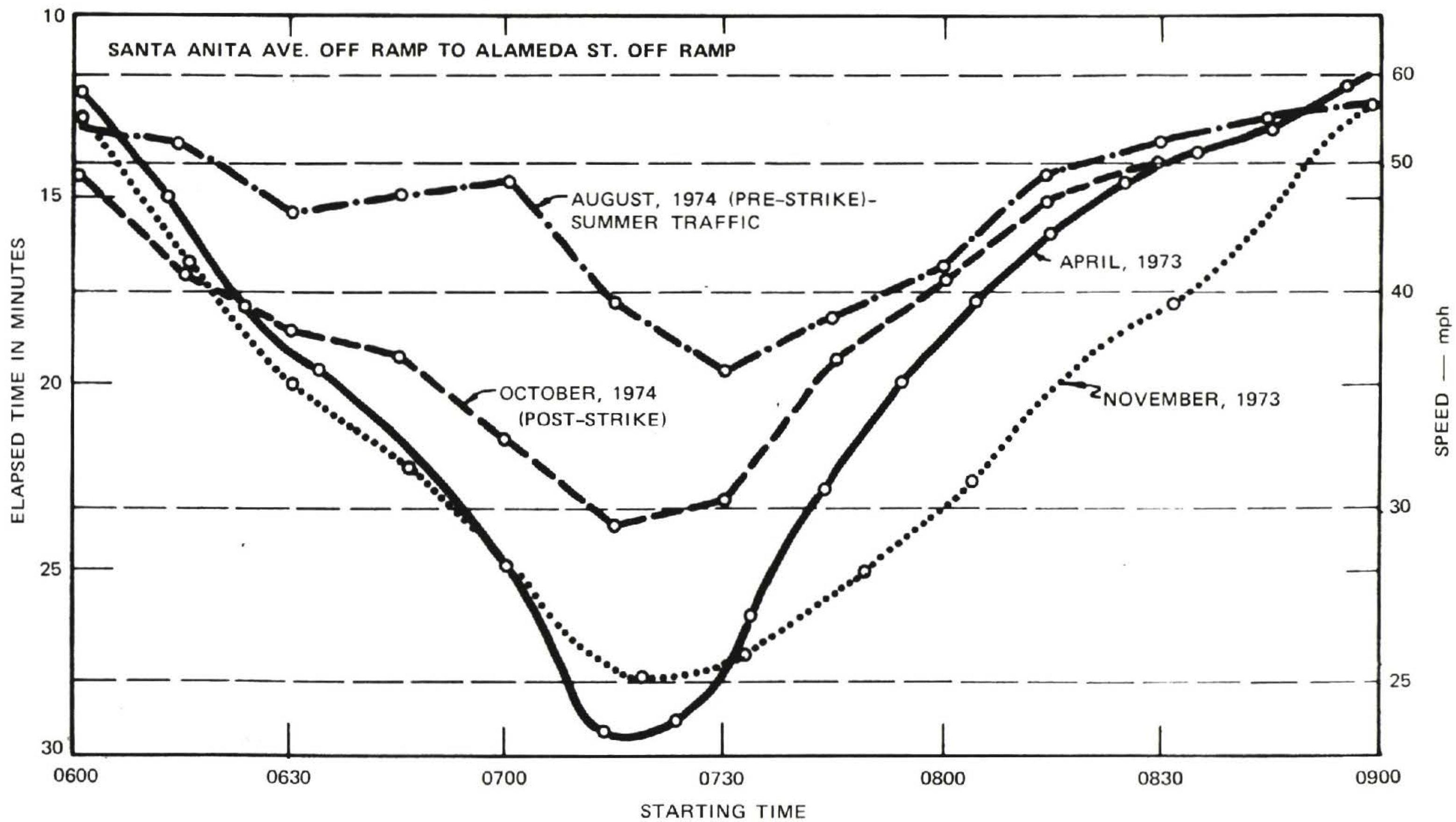

FIGURE 17 TRAVEL TIME AND SPEED (WESTBOUND SAN BERNARDINO FREEWAY)

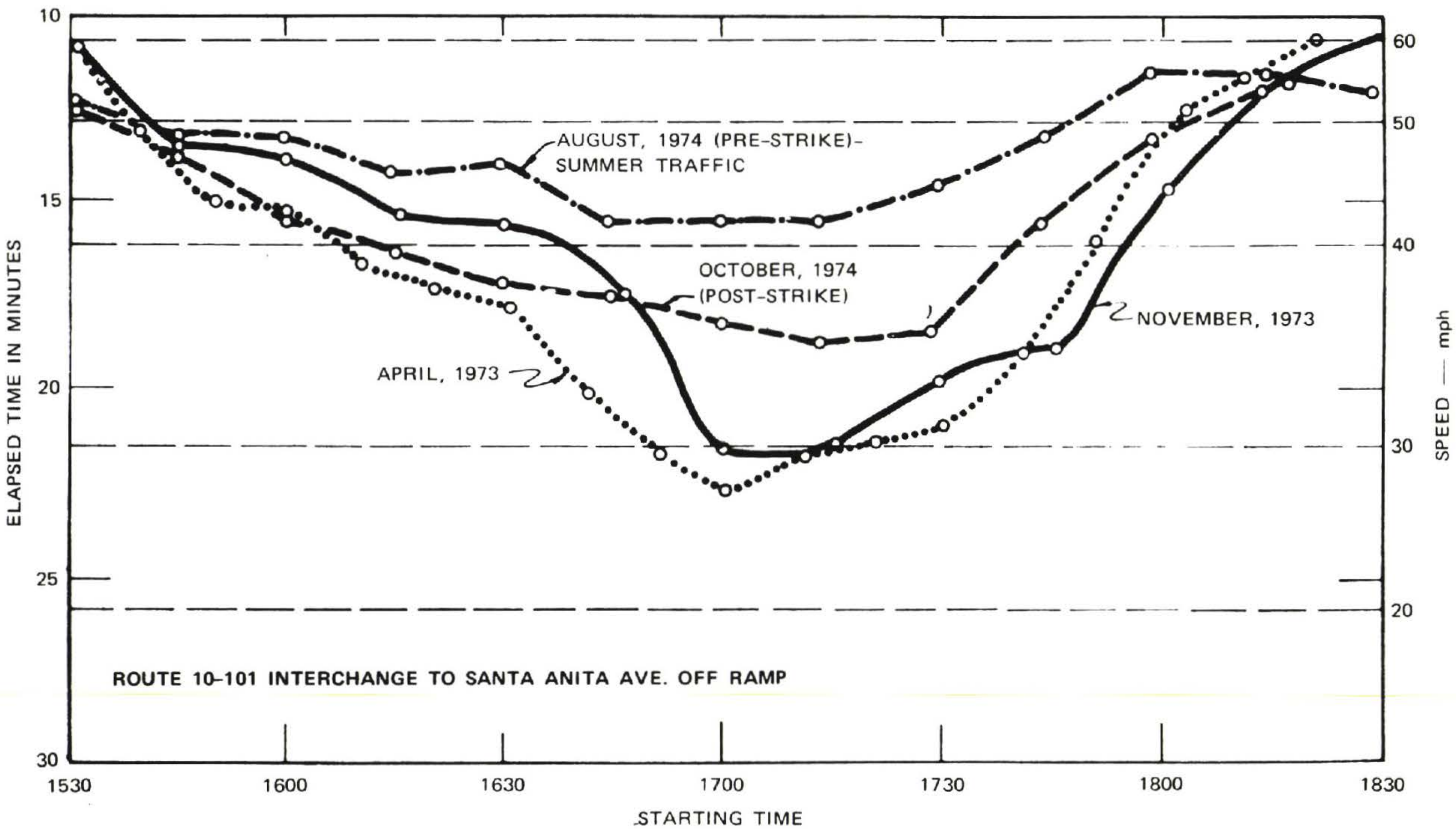

FIGURE 18 TRAVEL TIME AND SPEED (EASTBOUND SAN BERNARDINO FREEWAY)

Occupancy Rates

Figure 19 shows the trend in private vehicle occupancy rates on the San Bernardino Freeway lanes adjacent to the busway over recent months.

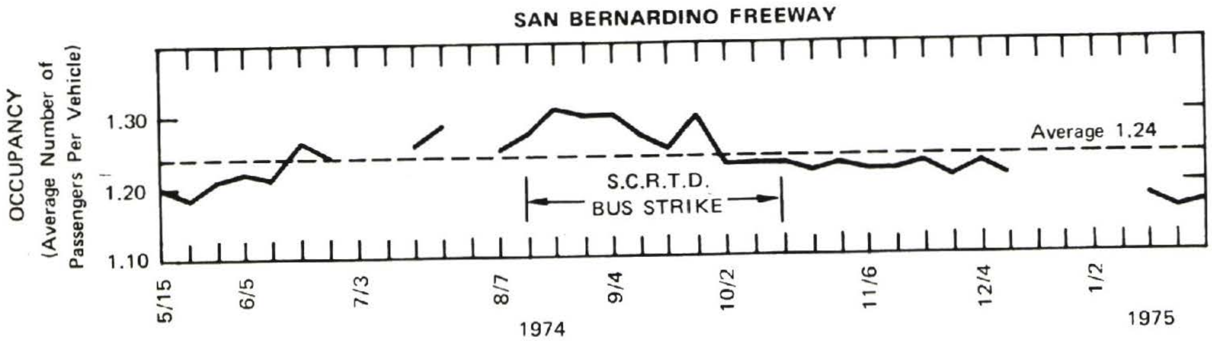

FIGURE 19 PRIVATE VEHICLE OCCUPANCY RATES

During the time period of busway operation the occupancy rate on parallel freeway lanes has averaged approximately 1.2 during the AM peak and 1.3 during the evening. There was some rise in these values during the energy crisis of early 1974 (not shown here) after which it returned to normal. During the summer there was some seasonal increase. The increase was probably not caused by the bus strike in August and September, since the busway lane was opened to carpools and some of the regular carpools left the freeway to use this faster lane.[1] Toward winter and into 1975 the AM rate seemed to have fallen to an all-time low of around 1.17 but subsequently (not shown here) has returned to the 1.2 level. Thus, the busway has not affected occupancy rates. This is consistent

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[1]During the SCRTD strike, arrangements were made to allow carpools of three or more persons to use the busway lanes if they obtained and displayed a permit. 1,620 permits were issued. Busway lanes were opened to carpools on August 19, one week after the strike began. About 700 carpools (2,300 persons) drove on the busway during the peak period. (See Figure 20.) Details of this operation are fully documented in Carpools Using Busway During Strike, California Department of Transportation—District 7, Freeway Operations Branch, February 1975.

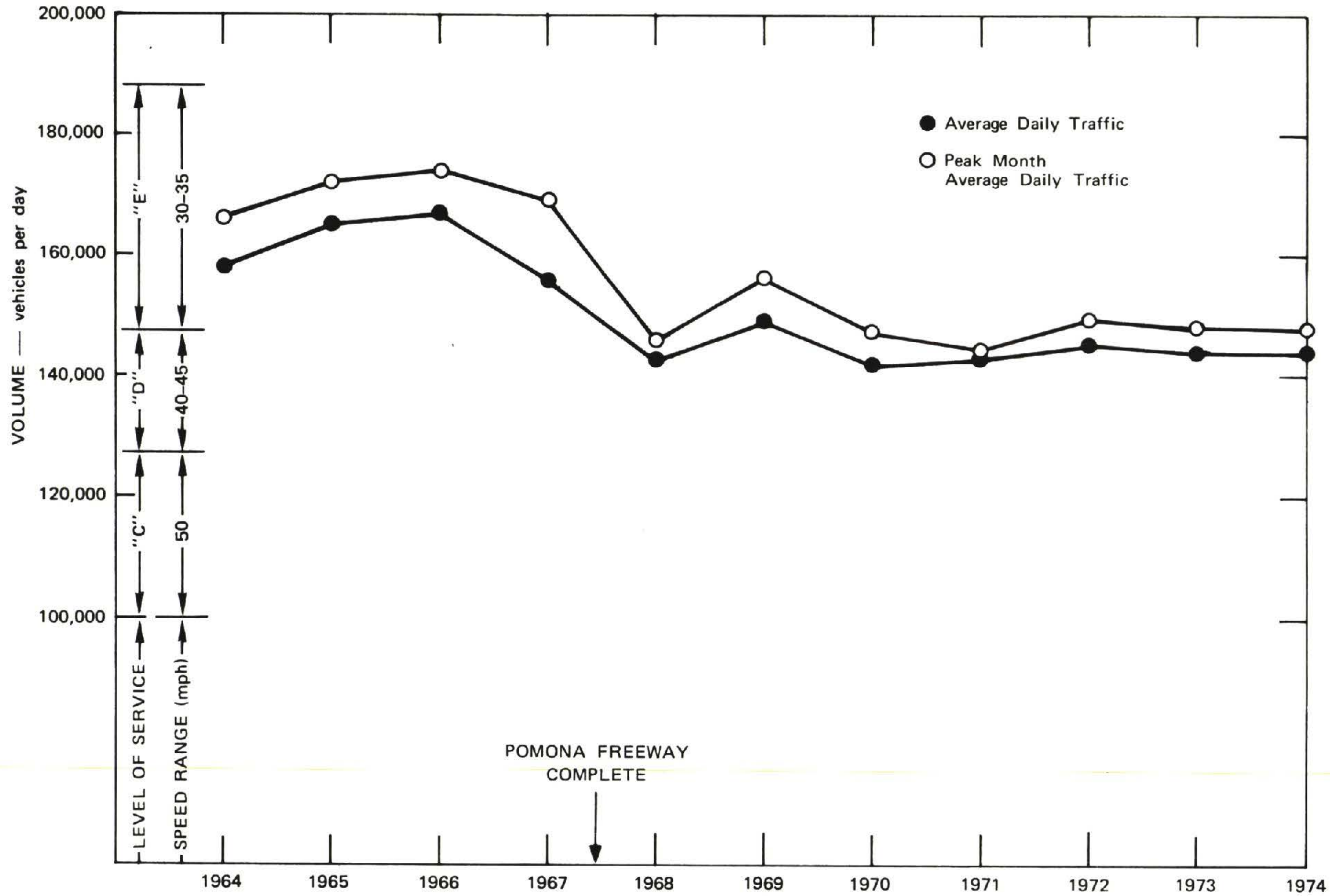
FIGURE 20 USE OF BUSWAY LANES BY CARPOOLS DURING TRANSIT STRIKE

with on-board surveys which indicate that a disproportionate share of auto passengers are not being diverted to the busway, lowering the occupancy rate of the remaining automobiles.

Volumes

There are two reasons to believe that overall peak-period traffic volumes on the San Bernardino Freeway have decreased, although this is difficult to assess from the recorded data. There definitely has been a significant shift of commuters from automobiles to busway travel (discussed in Chapter VII) and an improvement in auto traffic speeds. This implies a drop in peak-period volumes.

There is some traffic measurement relevant to this issue. Current volume counts indicate that the average daily traffic (ADT) has risen at some points along the freeway and dropped at others. Figure 21 shows the historical trend in the San Bernardino Freeway ADT. The traditional count point used is at the Almansor overcrossing about midway along the east-west axis of the busway. There has been no significant change in ADT at this point since 1973. During 1974, counts in March, August, and September indicate about 8,700 vehicles and 11,300 person trips (5.5-hour peak period, peak direction). East of this count point, there was a 6,000 vehicle reduction in the 1974 ADT count compared with 1973. There was also a drop of a lesser percentage west of the Almansor count station.



SOURCE: Cal Trans, Distric VII.

FIGURE 21 SAN BERNARDINO FREEWAY VOLUMES

Figure 22 illustrates the current measurement on peak period flows, on the freeway and on east-west parallel routes through the corridor.

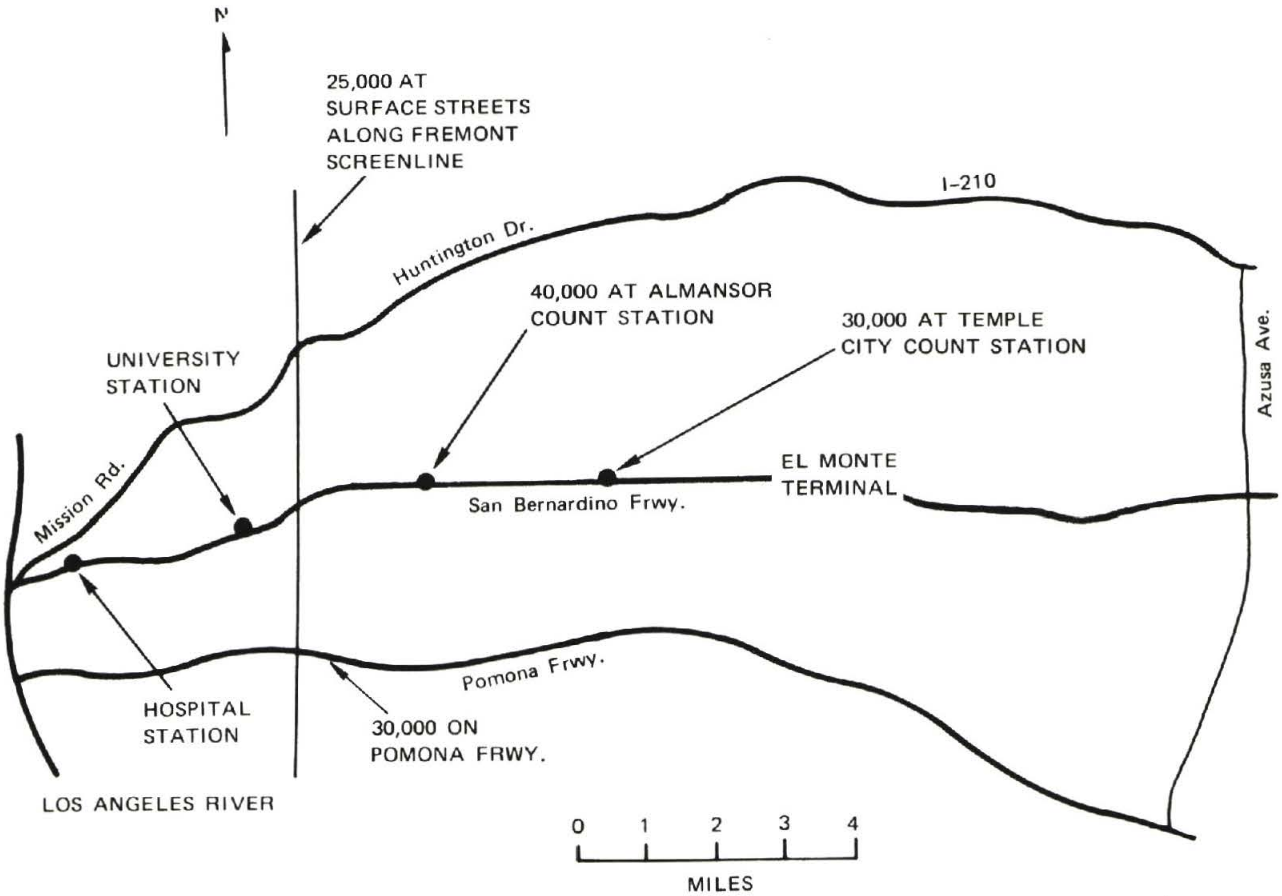


FIGURE 22 BUSWAY CORRIDOR AND COUNT POINTS (PEAK PERIOD)

The freeway volumes at the Almansor overcrossing average nearly 7300 cars per hour over the 5.5 peak period reaching 8000 at certain times. This is similar to previous counts. The peak period levels at other points throughout the corridor are also not significantly different from previous years.

The best explanation of the impacts of busway diversion on traffic flows and the observed speed improvements is as follows. The bottleneck point on the San Bernardino Freeway is in the vicinity of the Long Beach Freeway. The volume at this point is and has been at capacity, between 7500 and 8000 cars per hour. The elapsed time to get through this bottleneck has decreased, however, partially because of improvements to the freeway and partially because the peak period flow into the bottleneck has decreased, the latter caused by diversion to busway. Stated another way, some of the peak trips at the time of heaviest congestion have been diverted to the busway, shortening the queue of traffic into the bottleneck. However, the bottleneck is still processing the same maximum throughput.

Thus, the interpretation offered here is that overall corridor traffic counts appear to be unchanged. There has been growth in commute trips offset by some auto-to-busway diversion. The greatest diversion has been cars which traveled at the most congested times. This has appreciably reduced delay time at the bottleneck, increasing auto speeds, particularly during the peak hour. However, peak period freeway volumes at the maximum load point (Almansor) have remained essentially unchanged as cars are diverted from other arterials. Thus, the overall peak period freeway volumes remain at the 1973 level with the decrease in peak hour volumes offset by some spreading in distribution of cars versus time of day.

IMPACT ON LAND USE

The San Bernardino Freeway corridor is a fully developed residential corridor; since the busway has been in operation for less than two full years, it is not to be expected that major changes in land use could yet be ascribed to the busway, and no direct assessment of land-use changes was included in the study. Nevertheless, there is an indication from some people that their choice of residence has been influenced by the busway. Of the commuters questioned during the on-board survey, 15.7% said that their choice definitely had been influenced by the busway, and an additional 7.8% said that there had been a slight influence. Fewer said that their choice of employment had been influenced by the busway (14.4% definitely and 5.8% slightly). There was considerable overlap between the two groups, so that the descriptions of their transportation habits have many similarities.

To the dismay of some, the fraction of bus riders who claimed that SCRTD services had affected their residential location was higher on the pre-busway on-board survey. That survey (discussed in Appendix A of the First Year Report) reported about 39% were definitely influenced and 15% were slightly influenced. This is explained by the fact that the pre-busway riders were largely long-term, transit-captive riders who logically would live where they had access to bus service to their downtown jobs. On the other hand, the current riders are largely riding by choice and most are well settled in their present homes and on their present jobs long before they ever considered switching to busway commuting. Those people who have changed their home or job location within the last two years, however, could have been influenced in their decision by the existence of the busway.

What do we know about these people? This group most logically would be those who, in the on-board survey returns, indicated they had "always used the busway" and they had started using the busway some time after it had opened. Forty-three such respondents were isolated. This resulted in the following data:

	n	%
Home location influenced?		
Yes, definitely	11	26
Slightly	6	14
Not at all	26	60
Total	43	100
Job location influenced?		
Yes, definitely	14	34
Slightly	5	12
Not at all	22	54
Total	41*	100

*No response from 2.

The sample size is too small to render conclusions. However, the data suggest that a large fraction of new decisions are being affected by the busway.

IV. COMMENTS ON COSTS AND BENEFITS

BUSWAY OPERATING COST

The busway facility will cost approximately $57 million, exclusive of buses, when construction is complete. The breakdown of this capital investment is given in the First Year Report and is not important to the analysis reported on herein. Instead, at this point of the evaluation, attention is placed on operating cost and cost per person-trip.

The two five-day-week periods from October 21 to November 1, 1974, were selected to evaluate unit operating costs. Table 3 illustrates the costs of the primary busway lines, computed by SCRTD using the SCRTD full cost formula. This formula expresses operating cost as the sum of the following components:

1. operator pay hours @ $6.00 per hour*
2. fringe benefits @ 35% of 1
3. direct operating supplies @ 12¢ per mile
4. maintenance and operating overhead, 40% of 1 + 2 + 3
5. liability insurance @ 6¢ per mile
6. depreciation @ $3.29 per bus per day
7. general and administrative overhead, 7.5% of the sum of 1 - 6

The depreciation cost is allocated equally to all miles driven, not disproportionately higher for rush-period mileage, as is done by some transit properties. The pay hours include station and supervisory personnel. This cost analysis is limited to the primary bus lines operating through the El Monte Terminal; the Del Mar service busway lines

*Increased to $6.15 on 3-1-75 and $6.25 on 6-1-75.

(52F, 53F, and 63F) are not included in the cost computation. Some comments on the Del Mar service costs and ridership are included.

Table 3
BUSWAY OPERATING UNIT COSTS
(10 week days, 10/21/74-11/1/74)

Line Number	Miles Operated	Daily Cost	Per Mile Cost
60	7,151	$ 6,734	94.2¢
401	3,728	3,784	101.2
402	3,283	3,376	102.8
403	1,602	1,961	122.4
404	1,269	1,410	111.1
405	1,116	1,430	128.1
All lines	18,159	$18,695	102.3¢

Table 3 shows the operating costs to be just in excess of $1.02 per bus mile. This is considerably less than costs on other non-busway runs, which are on the order of $1.25 per mile for freeway routes and $1.75 to $2.00 for in-town local service. The reason for the lower busway operating cost is the higher busway speeds. The First Year Report showed that the faster busway speeds had no noticeable effect on manpower scheduling efficiency. (See page 121 of that Report.)

The operating costs shown in Table 3 are available relative to the operation of an entire line, not for a portion of a line. (The handling of this is discussed later in this chapter.) Therefore, the cost per bus-mile values listed in the table are computed over the full length of each bus line, not just the busway portion, and many of these lines extend well beyond the corridor, as shown in the previous Figure 22.

It also should be noted that the above computation understates rush-hour costs relative to vehicle depreciation and driver down time. The cost formula discussed on the previous page burdens all vehicle miles equally with these two cost components, although it is quite logical that peak-hour mileage should carry a larger share. It is the higher peak-period demand which sets the total fleet size (generating depreciation costs in off-peak times as buses sit idle) and which causes the off-peak driver down time.

There are other costs connected with operating the station that also must be considered. These are summarized in Table 4.

Table 4
MONTHLY STATION OPERATING COSTS

Operating Cost	El Monte Station Total	El Monte Station Week Days	Hospital Station Total	Hospital Station Week Days
Maintenance	$ 3,395[1]	$ 2,425	$ 246[2]	$ 175
Security	3,250[3]	2,028	2,007[4]	1,433
Ticket clerks	4,895[5]	3,872	None	None
Service directors	4,082[6]	2,915	None	None
Utilities	-[7]	-[7]	-[7]	-[7]
Total (partial)	$15,662	$11,240	$2,253	$1,608

[1]Three maintenance workers, i.e. 120 person-hours of effort per week. The workers receive $920 per month plus 23% fringes.

[2]One person day per week.

[3]Three patrolmen at average salary of $881 per month plus fringe benefits.

[4]Three private security agents working 16 hours per day, 30.6 days per month, at $4.10 per hour.

[5]Four persons at $995 per month plus 23% fringe benefits.

[6]Three service directors, one at $1,187 per month and two at $1,066 per month, all with 23% fringe benefits. These persons supply coverage from 5:15 AM until 10:15 PM, seven days per week.

[7]Data not readily available; amounts are negligible.

The above costs do not include maintenance and operating personnel for the park-ride lot nor are park-ride lot revenues included. According to Federal law (1964 UMTA Act, Appendix C), the parking lot revenues can be used only to defray parking lot operational costs. In practice the revenues have been averaging $3,300 per month and do tend to offset operational expense. Thus, these revenues and costs are not included in this analysis.

Also, Table 4 does not include costs at College Station. They are similar to Hospital Station except that the security force is handled under a special government program that provides certain cost reductions to SCRTD. Thus, we will use the Hospital Station operating costs as more indicative of the cost of an intermediate station.

Finally, it should be noted that current plans are to replace the present security force at Hospital Station with a security patrol car that will monitor all three stations. This will add further costs. There will be no immediate change at College Station. Also, some security guards will remain at El Monte Station; there have been problems of break-in and theft of cars in the park-ride lot there.

Tables 3 and 4 give the running costs of the primary bus lines that operate on the busway and the supplemental station costs. To synthesize these costs and relate them to the busway, two assumptions are necessary: a) the unit operating costs (costs per bus mile) applicable to an entire route are also applicable to the "within corridor" portion of that route, and b) to evaluate the cost per passenger, the "within corridor" portion of operating costs should be related to "within corridor" passenger trips.

The rationale for the first assumption is that the operating costs are primarily a function of speed, and the average "within corridor" speeds—on the busway, on the suburban surface streets, and on the freeway east of El Monte—are not significantly faster than the speeds outside the corridor. Most of the operations outside the corridor are on free-flowing freeways.

The second assumption is quite logical but leads to a severe problem in computation. It is difficult to isolate a count of passenger trips that can be associated with the "within corridor" costs. There are very accurate counts of busway passengers, taken at Hospital Station. However, to relate all "within corridor" costs to only these passenger trips is misleading. There are other passengers who board east of El Monte and deboard at El Monte Station or College Station and thus are missed in Hospital Station counts. There are also a few trips on the busway lines that are within the downtown area. Essentially, all of these trips are off the busway but should be related, somehow, to a portion of the "within corridor" costs. The resolution of this problem is discussed in conjunction with Table 6 below.

It also should be noted that many persons who use the park-ride mode live well beyond the eastern boundary of the corridor as it has been defined in this study. Originally, Azusa Avenue, ten miles east of El Monte Station, was believed to be a reasonable eastern limit of the "commuter-shed" that would be served by the busway. This assumption now appears to be too restrictive. A recent Caltrans survey of trip origins of cars parked at El Monte Station indicates that a third of the cars come from east of Azusa Avenue. The sketch below is a synthesis of the geographical distribution of origins measured in that survey.

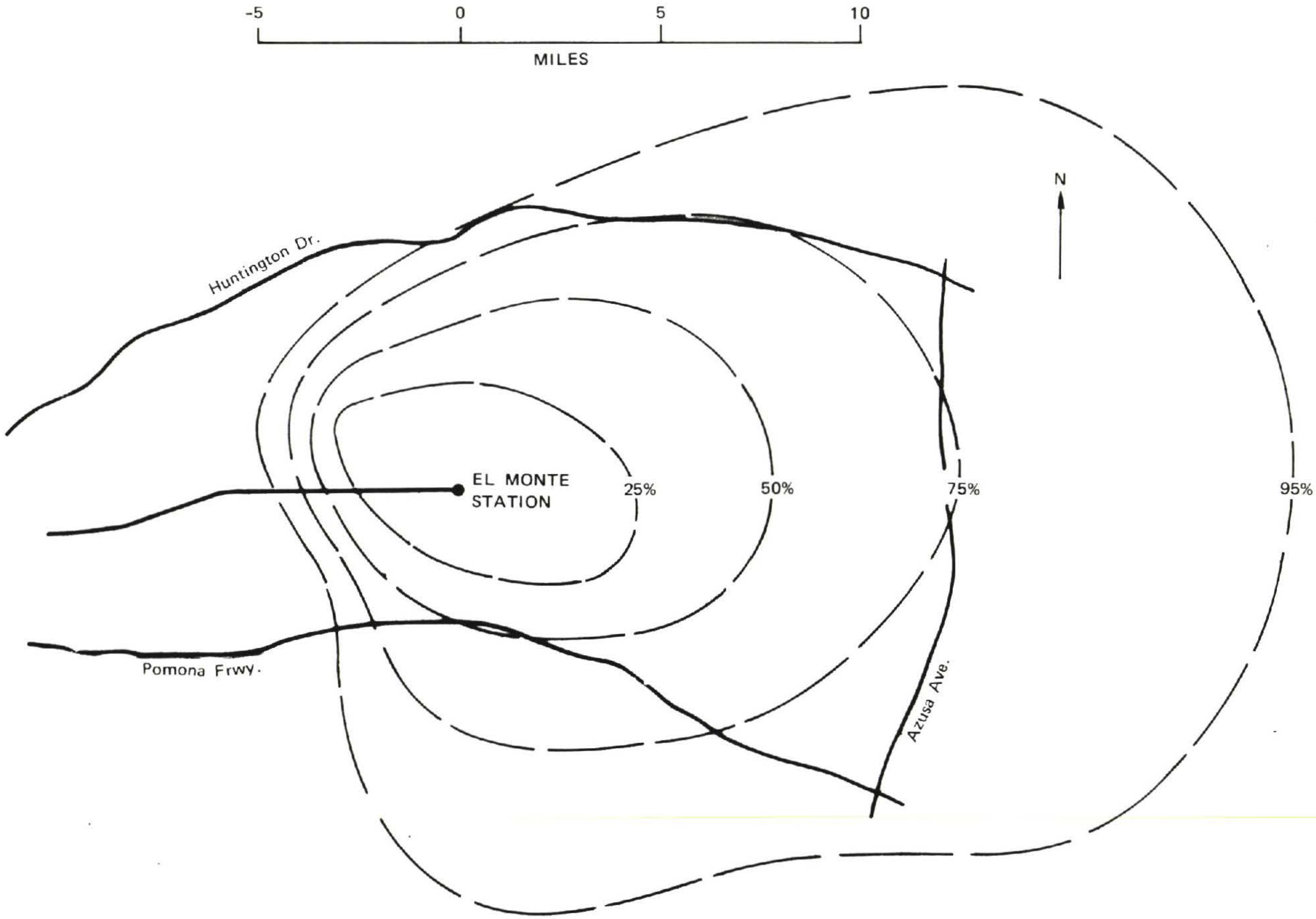


FIGURE **23** GEOGRAPHIC DISTRIBUTION OF TRIP ORIGINS OF USERS OF EL MONTE STATION PARK-RIDE FACILITY

There are also about 100 cars that park each day at the new Eastland park-ride lot at Eastland Shopping Center, which lies just outside the corridor, east of Azusa Avenue.

The existence of these outside-the-corridor busway users does not argue for inclusion of out-of-corridor bus mileage in the cost computation since they do not use the bus feeder service to come into the corridor. They are merely included here for purposes of completeness.

Table 5 has been developed based on the above assumptions and background.

Table 5
DAILY BUSWAY OPERATING COSTS, WITHIN CORRIDOR

Line No.	Total Trips	Total Miles[1]	Cost Per Mile (¢)	Total Cost($)	Cost per Trip ($)	AM Peak Trips	AM Peak Costs
60	140	3,832	94.2	$ 3,610	$25.78	30	$ 773
401	88	3,046	101.2	3,083	35.03	21	736
402	84	2,794	102.8	2,872	34.19	17	581
403	20	1,602	122.4	1,961	98.05	10	980
404	48	1,269	111.1	1,410	29.37	9	264
405	18	1,116	128.1	1,430	79.44	9	715
	398	13,659		$14,366		96	$4,049

[1]Estimated daily bus miles of operations within the corridor on November 1, 1974.

Not represented in Table 5, as previously stated, is the Del Mar service—routes 52F, 53F, and 63F. These routes have 531 bus miles of daily service, all of which are within the corridor and operated during peak periods. The unit operating costs of these few bus trips cannot be isolated from other costs but are estimated (by Bigelow-Crain Associates) to be approximately $1 per mile.

Table 6 represents an attempt to summarize the costs that should be related to busway commuter operations.

Table 6
SUMMARY OF PASSENGER COSTS AND PASSENGER TRIPS

	17 Hour Period	AM Peak Period
Costs:		
Primary routes	$14,366[1]	$4,049[1]
Station operations	659[2]	116[3]
Del Mar service	531[4]	531[4]
	$15,556	$4,696
Busway passengers:[5]		
Primary routes	9,535	3,272
Del Mar service	1,151	562
	10,686	3,834
AM reverse commute riders		383[6]
		4,217

[1]From Table 5.

[2]From Table 4, factored to daily costs.

[3]$659 multiplied by 3/17ths.

[4]As discussed in text, 531 miles @ $1 per mile.

[5]Patronage counts at Hospital Station on 11/7/74.

[6]Estimated from May 1975 off-peak survey, not reported on herein.

Table 6 implies that the cost per busway passenger trip is $1.46 over the course of the day and $1.11 during the AM rush period. These estimates, however, now must be reduced to account for the passengers previously mentioned who ride the busway lines off the busway, i.e. board and deboard east of the count point or within the downtown area. There are only two sets of data: the busway counts at Hospital Station and total counts taken on rare occasions when an SCRTD person rides the bus line counting every rider regardless of where or when they get on and off. This "on-off riding count" includes the missing "within corridor" trips we are seeking but also includes some "outside the corridor" trips.

There are some data of both types taken in the early spring of 1975. Comparing these two types of data, it would appear that total on-off counts on busway lines exceed the Hospital Station counts by about 60%. About half this excess seems to occur on trips made outside the corridor, mostly on Line 60. Thus, it would appear that besides the 4,217 busway trips indicated in Table 4, there are another 1,000 to 1,500 trips that can be related to some of the "within corridor" costs.

These trips are much shorter than the busway trips and do not contribute to any of the busway station costs. It would seem fair to allocate 10% of the "within corridor" costs to these non-busway trips. This allocation would reduce the "per busway passenger" trip costs by 10%, i.e. reducing the all-day cost of $1.46 to $1.30 and the rush-period cost of $1.11 to $1.00.

The above costs also should be considered in terms of the Ever-rising patronage levels. Ridership is rising faster than costs. For example, the following indicates the trend in AM peak supply-demand relationships:

	AM peak (westbound) bus trips	AM peak (westbound) riders	Riders per bus trip
22 November 1974	115	3,977	34.6
30 January 1975	116	4,676	40.3
27 February 1975	115	4,745	41.3

The load factor of 41 riders per inbound bus trip probably will not increase unless a significant rate of standees is accepted. However, the February supply-demand relationship indicates that the peak-period cost per trip has dropped nearly 20% since last November. Since off-peak and peak patronages have remained in the same proportion, the costs per bus trip as of the end of March 1975 are probably about $1.00 over the course of the day and about 80¢ during the peak periods. (Cost for Saturday and Sunday operations have not been discussed in this report.)

The commuter trip cost of 80¢ is partially offset by fare box revenues. Fare per passenger on the busway lines as of early 1975 were:

Line	Date	Fare/rider
60	no data	no data
401	3/75	11.2¢
402	3/75	12.0
403	2/75	13.5
404	4/75	9.9
405	4/75	8.5

Thus, with the 25¢ fare and the very extensive use of monthly and other passes, the fare per passenger has fallen to nearly 10¢. Thus, the subsidy cost is nearly 70¢ per trip. The average commuter trip is about 20 miles, indicating that the total trip cost (80 cents) is about 4¢ per mile.

TRAVELER COST SAVINGS

With the flat fare of 25¢ to ride the bus anywhere within Los Angeles County, the busway user enjoys a considerable economic savings over the costs of traveling by automobile. There are three conditions which affect the cost savings: the access mode used by the commuter to reach the El Monte Station where the busway begins, the price of parking in downtown Los Angeles if he had continued to drive, and whether or not he could share his automobile commute costs with other riders. Table 7 illustrates the amount of savings to commuters under these varying conditions. The prices and assumptions behind the computations in the table are:

- The bus fare is 25¢.
- The parking cost at El Monte Station is 5¢ per trip (50¢ per book of 10 tickets)
- Automobile operating cost (i.e. marginal cost) is 7¢ per mile.
- The mileage to downtown for those who live near El Monte, and can walk to the station, is 12 miles.
- For others, the mileage from home to El Monte Station is assumed to be five miles, 17 miles to downtown L.A.
- The parking cost in L.A. varies from zero (many people have company/government-provided free parking) to $2.00 per day.

Table 7
COMMUTE ECONOMIC COSTS/SAVINGS
($ per one-way trip)

	Access Mode to El Monte Station							
	Walk		Bus		Park-ride		Kiss-ride	
Commute Mode	Parks Free	Pays $2.00	Parks Free	Pays $2.00	Parks Free	Pays $2.00	Parks Free	Pays $2.00
A. If drives (to L.A.) alone	.84[1]	1.84	1.19[2]	2.19	1.19[2]	2.19	1.19[2]	2.19
B. If drives (to L.A.) with one rider who shares cost	.42	.92	.60	1.10	.60	1.10	.60	1.10
C. If busway used	.25	.25	.25	.25	.65	.65	.95	.95
Savings:								
Case A minus C	.59	1.59	.94	1.94	.54	1.54	.24	1.24
Case B minus C	.17	.67	.35	.85	-.05	.45	-.35	.15

[1]This number can be interpreted as follows: If a commuter lives close enough to walk to El Monte Station but chooses to drive alone, and parks free downtown, the trip will cost him 84¢.

[2]These numbers can be interpreted as follows: If the commuter lives far enough away from El Monte Station that he would have to use the "Bus," "Park-ride," or "Kiss-ride" mode to get there but chooses to drive alone (and parks free), his cost will be $1.19.

The per-trip economic savings vary from minus 35¢ to $1.94. The case of a person living close enough to walk to El Monte Station is included, although essentially no one does this.

TIME SAVINGS

There are also travel-time savings that the commuter can obtain by using the busway. The amount of savings varies according to two conditions of the commute trip. The first is the time during the morning rush period when the trip is started. (The morning commute trip has been selected for analysis; the evening trip produces similar conclusions.) The start time is relevant for two reasons: the auto travel-time varies over the peak period (see previous Figure 17); also, the time required to park at El Monte Station and walk to the boarding platform varies over the peak period, increasing as the parking lot fills to capacity. The second affecting condition is the method of access to El Monte Station. Table 8 lists the travel-time savings computed for these varying conditions.

There is a third dimension to time savings, not shown in the table but easily derived by reasoning and experience. The figure being used for freeway travel is an average, but in using congested freeways a traveler comes to know that he is quite often faced with a trip that takes longer than the average. In planning his trip, he would have to leave early enough to compensate for possible very heavy traffic. Thus, another advantage of riding the busway is its great regularity.

The computations in the table are based on the following facts and assumptions:

1. Auto travel-time on the freeway between El Monte and the Mission Street off-ramp is 16 minutes between 6 and 7 AM,

Table 8
COMMUTE TRAVEL TIME SAVINGS
(Home to Entry Point to Downtown, in Minutes)

Trip Start Time	Commute Mode	Access to El Monte Station Walk	Bus	Park-ride	Kiss-ride
	Auto time	20[1]	32	32	32
6-7 AM	Transit time	18	39	33	32
	Savings	2	-7	-1	0
	Auto time	24	36	36	36
7-8 AM	Transit time	18	39	34	32
	Savings	6	-3	2	4
	Auto time	18	30	30	30
8-9 AM	Transit time	18	39	36	32
	Savings	0	-9	-6	-2

[1]Entries in this cell tell the following: Auto driving time is 20 minutes, home to entry point in CBD (Mission Street off-ramp). Commuter lives in vicinity of El Monte Station and could walk to it. If he went by busway, transit time would be 18 minutes—4 minutes to walk and board, 14 minutes to get to Mission Street off-ramp.

20 minutes between 7 and 8 AM, and 14 minutes between 8 and 9 AM. This is based on the previous Figure 17 corrected to Mission Street endpoint (Table 8) from Alameda Street endpoint (Figure 17).

2. For auto drivers who live in the vicinity of El Monte Station, it is assumed that they have a 4-minute time loss getting their cars from home onto the freeway, in addition to the freeway trip-times cited above.

3. Auto travel-time from the points beyond El Monte Station requires 16 minutes (5 miles @ 20 mph + 1 minute to get started) plus the freeway driving times cited in Item 1.

4. Busway travel-time from El Monte Station to the Mission

Street off-ramp is 14 minutes. This is based on the 55 mph speed limit. If this rapid transit system were freed of this speed limit the running time would be 12 minutes—8 minutes to College Station, 2 minutes to Hospital Station, and one more minute to the off-ramp.

5. The feeder bus trip from home to El Monte Station is assumed to be 5 miles and takes 23 minutes plus a 2-minute time loss while traveling through the station.

6. The trip by car to the entrance of El Monte parking lot is assumed to be 16 minutes, as computed in Item 3.

7. For those who can walk to the station, we are assuming a 4-minute time loss, 3 minutes to walk to the terminal and another minute to the boarding platform.

8. The park-ride time losses at El Monte Station are 3.1 minutes from 6:30 to 7 AM, 4.2 minutes from 7 to 8 AM, and 6.3 minutes from 8 to 9 AM.

9. Comparable time for kiss-ride is estimated at 2 minutes.

Not included in the computations in Table 8 is the time spent in downtown travel for both the auto and the busway user. Not including this in the computation implies that this is a stand-off, that the average time loss in moving through the downtown streets by transit or auto is equal and that the walk from the bus stop to office is equal to the time spent in parking and walking to the office.

Table 8 indicates that there are time savings obtainable in busway use, but they are only obtainable under certain conditions. The only significant time savings are by those who can walk to El Monte Station (and few live close enough to do this). Over three-fourths of the riders board east of El Monte and, seemingly, lose time in using the busway. Of the one-fourth who board at El Monte Station, only about half seem to realize time savings.

To better understand this point, a special computer sort was made of the on-board survey data. The results are shown in Table 9. This table shows the percentage of people who, when asked for the main reason why they switched to busway travel, selected from the alternatives offered "saves time." Additionally, they are people who were classified as ex-drivers or ex-passengers based on their answer to the mode shift question. (See questions 12 and 13 in questionnaire form A, Appendix A.)

Table 9
IMPORTANCE OF TIME SAVINGS IN MODE SPLIT DECISION
(Number and Percent of Ex-Drivers and Ex-Auto Passengers Indicating That Time Saving Was Main Reason for Switching to Busway)

Peak Hour	Access Mode									
	Walk		Bus		Park-ride		Kiss-ride		All	
	n	%	n	%	n	%	n	%	n	%
6-7 AM	8	11.8	0	0.0	30[1]	18.5[2]	14	29.1	Not relevant	
7-8 AM	13	27.1	1	12.5	50	25.3	15	33.3		
8-9 AM	4	33.3	2	40.0	12	30.7	3	27.3		
	—		—		—		—			
6-9 AM	25	19.5	3	11.1	92	23.1	32	30.8	152	23.1

Sample size = 658

[1]This is the number of ex-drivers and ex-auto passengers who use the park-ride mode, starting their trip between 6 and 7 AM and who cited "saves time" as their main reason for switching.

[2]This is the above number (1) expressed as a percent of all ex-drivers and ex-auto passengers who park-ride and start their trip between 6 and 7 AM (162 persons).

Before giving further interpretation of Tables 8 and 9, it should be pointed out that park-ride and kiss-ride does not refer to only El Monte Station. For example, about 55% of the busway users currently drive their cars (and park) to meet one of the busway buses; however, only about 47% of these (or 26) park at El Monte Station. Similarly, many kiss-ride commuters are dropped off at points other than at El Monte Station.

The data presented are the responses of all previous auto users, either drivers or passengers. There appears to be some consistency between Table 8 and Table 9. Table 8 points out that only a few people are able to save time by using the busway. Table 9 shows that only a fourth (23.1%) of ex-drivers and ex-auto passengers cite saving time as their main reason for using the busway. There is also some correlation between the access mode used (which affects time savings) and the prevalence of citing the "saves time" reason.

There is a seemingly major inconsistency between Table 8 and Table 9, however. Table 8 shows how the latecomers to the El Monte Station park-ride lot lose time looking for a parking place and consequently obtain little time savings using the busway. This also would seem to be true if the person was trying to park at one of the other park-ride points or on the city streets. But, according to Table 9, as the morning period continues the park-riders become more frequent in their contention that the busway saves time. The only apparent reason for this is that in the late morning most people are parking in very effective locations elsewhere rather than still trying to park in the El Monte lot.

The overall conclusions from this time-cost analysis offered by the authors is the same as the conclusion registered in the First Year Report. Time and cost savings are important in the switching decisions but are not the causal factors behind the majority of the switching decisions. The reasons cited later, in Chapters VI and VII, of the rider's likes and dislikes of the busway and the reasons given for switching suggest that the major factor is the driver's desire to get away from the headaches of freeway driving.

V. ON-BOARD SURVEY

This chapter describes the on-board survey and the rider and trip characteristics derived from the survey data.

SURVEY DESIGN

The on-board survey was designed to sample those people who regularly commute to their downtown work location on the busway during the morning rush period, 6:00 AM to 9:00 AM.

The questionnaire was designed to be completed in five minutes and was printed on 8-1/2" x 14" hard stock (both sides) for ease in handling. The survey questions were divided between two forms: form A contained 17 questions, form B contained 19 questions. Seven of the questions appeared on both forms. A Spanish version (forms A and B) was printed on a different color. Copies of the questionnaire are included in Appendix A.

A training session for the 17 SCRTD checkers who were to administer the on-board questionnaire was held on November 19. The survey took place on Wednesday and Thursday, November 20 and 21 on clear days. Lines 52, 53, 63, and 60 were sampled on November 20 (24 trips) and lines 401, 402, 403, 404, and 405 on November 21 (34 trips). SCRTD checkers boarded the buses at the El Monte Station (except the 53 and 63 flyers, which were boarded at Division 9) and distributed questionnaires to all passengers, alternately handing out form A or form B. The questionnaires were collected before the passengers deboarded in the downtown area.

Out of the 2026 questionnaires distributed, 1935 were accepted as valid, producing a 96% response rate.

FIGURE 24   EL MONTE STATION AT NIGHT

RIDER PROFILES

The following is the basic demographic data of the sampled riders:

percent male	45.9
average age	37.5
average household income	$17,500

By Bus Route

Route 60 seems to have different passengers than the other routes, with a higher percentage of men, older persons, and households with lower incomes. Route 402 has more women but a higher income level. Route 405 has younger people, with higher income levels than the group as a whole.

By Start of Usage

A question was included in the survey asking when the rider started using the busway. However, since the resulting data do not adequately correspond to the patronage records, it was concluded that the response could be validly classified into only two groups, those who began to use the busway before and those who began to use the busway after the opening of El Monte Station. The profiles of these two groups are compared with the pre-busway profile.

	Pre-Busway	Early (Pre-El Monte)	Recent (Since El Monte)	All 1974 Riders
Percent male	34.5	41.1	49.3	45.9
Average age	40.1	39.5	36.2	37.5
Average income	11.1	16.6	18.3	17.5
Percent completed high school only	N.A.	43.1	26.8	33.9

This comparison shows a higher percentage of men among the more recent passengers, with more education and more income at a younger age.

By Previous Mode

On the whole, there are 46% men in the sample. Of those who drove as a previous mode 55.6% are men. This is a higher percentage of men than is in the total sample. In that sense more men shifted to the busway from being a driver or an alternate driver than did women, and more women either were always bus passengers or auto passengers than were men.

By age, those who shifted from being passengers tended to be under 30. Those who shifted from being drivers tended to be in their thirties. Those who shifted from being alternate drivers tended to be in the 40-64 age group.

Those who always have been bus riders tend to have incomes less than $10,000, those who were passengers tended to have incomes in the $10,000-$15,000 bracket, and those who shifted from driver or alternate driver tended to have incomes of more than $15,000.

By Life Cycle

An attempt was made to integrate several demographic descriptors into one, called Life Cycle. There were six categories within the variable. It was impossible to categorize 89 of the respondents because of missing data.

- Single is defined as single, any age, or divorced/widowed/separated under 65 years old
- Newly Married is defined as married, no children, under 50 years old

- Full Nest 1 are those who are married and have a youngest child at home under seven years old.
- Full Nest 2 are those who are married and have a youngest child at home who is seven years old or older.
- Empty Nest is defined as married, no children living at home, age 50 or more
- Sole Survivor is divorced/widowed/separated, and 65 years old or more

The last category is inadequately represented for analysis, having only six members. The remaining five categories are distributed as follows:

	n	%
Single	180	20.4
Newly Married	129	14.6
Full Nest 1	230	26.0
Full Nest 2	202	22.9
Empty Nest	142	16.1

Thus, the busway patronage appears to be well proportioned over the major life cycle categories excluding the sole survivor group.

By Auto Availability

Nearly 80% of the busway users ride the busway by choice. Another 9% indicated there was a car available for the trip but to use it would cause considerable inconvenience to others. The remaining 11% had no choice but to take the bus.

The 891 regular commuters who replied to the question of car ownership reported a total of 1607 cars, or an average of 1.8 cars each, a slightly higher average than reported by the occasional user (1.64) or the infrequent user (1.74).

Following is the distribution of cars per household:

cars	%
0	3.8
1	33.5
2	47.5
3	11.4
4+	3.7

TRIP PROFILES

By Trip Purpose

Riders were asked what the main purpose of their trip was. The distribution of response is as follows:

	%
Work	92.3
School or university	2.4
Business (work related trip)	2.3
Obtain personal service	1.4
Other	1.4
Shopping	0.1
Social, entertainment	0.1

By Trip Frequency

Regular riders who commute to the city at least four times per week comprise 93.5% of the passengers sampled. Another 4.5% are occasional riders and 2.0% travel very seldom.

By Access and Egress

The access to the busway bus is illustrated in Figure 25. More than half the regular riders drive their cars and park. Half of these cars are parked at El Monte, with "public lot,"

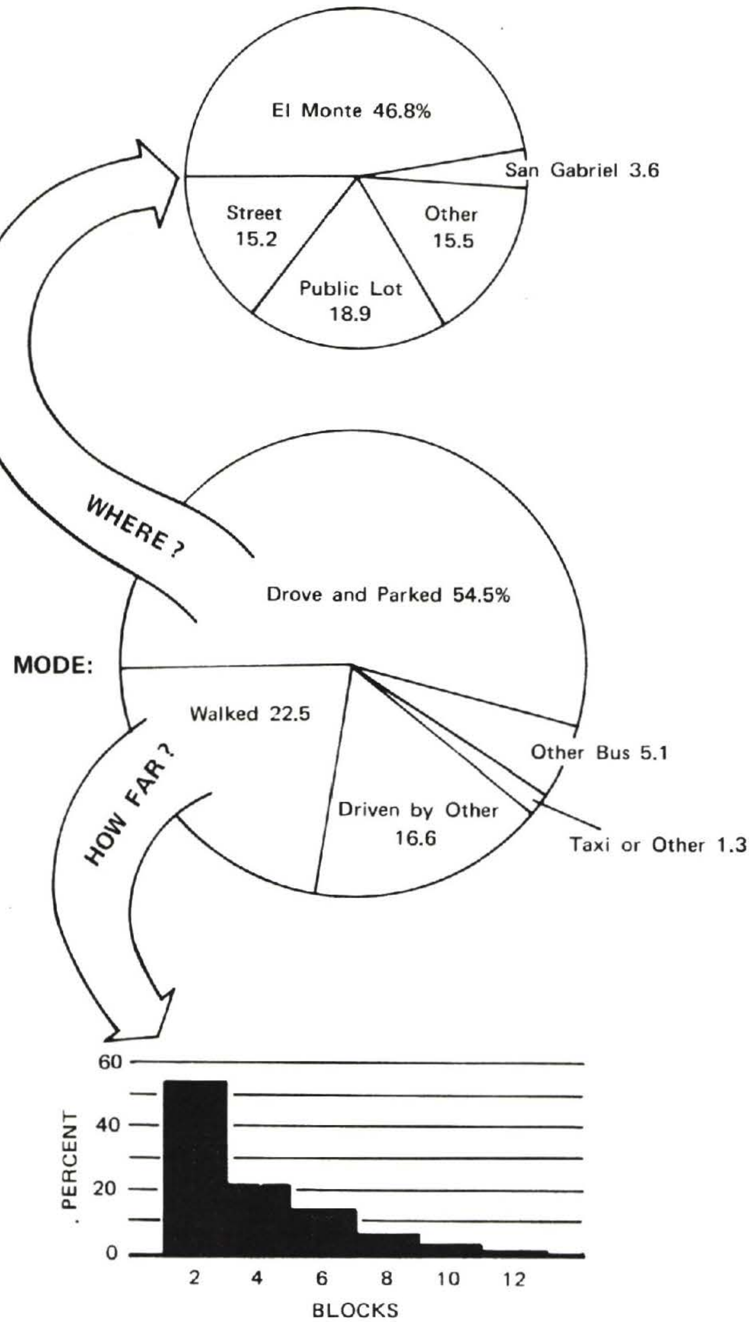


FIGURE 25 ACCESS CHARACTERISTICS

"on the street," and "other" being equally used by the rest. About one-fourth of the riders walk to the bus. Over half of them walk no more than two blocks, and 90% walk no more than six blocks. One-sixth are driven by others. Visual evidence at El Monte suggests that this group is more likely to be kiss-ride than carpoolers. Only five percent transfer from another bus.

Figure 26 shows the downtown distribution when people leave the bus. Fifteen percent take another bus, and virtually all of the rest walk. The walking distance is two blocks or less for three-fourths of them.

Although information was obtained from passengers about the length of time it takes to get from the bus stop to their destination, the quality of the data is poor. Reported times are unbelievably long. It could be used more readily to estimate the percent of commuters who eat breakfast downtown than to measure the effectiveness of bus routes.

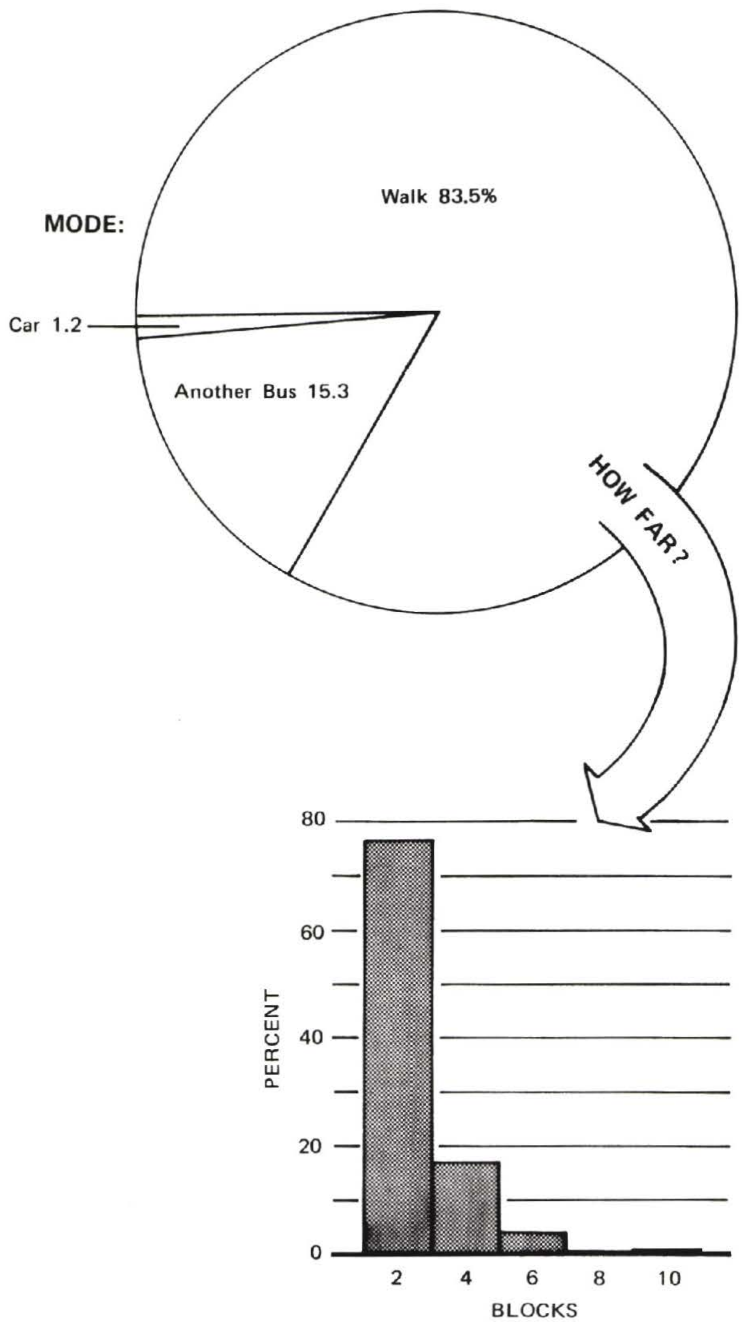


FIGURE 26 EGRESS CHARACTERISTICS

VI. PASSENGER PERCEPTIONS

Analyses in this section are based on data from the on-board survey except for the part on station perceptions, which is based on data from the station surveys.

REASONS FOR USING BUSWAY

The following is the distribution of multiple choice responses to the question "What are your main reasons for using the bus?"

Table 10
REASONS FOR USING BUSWAY

Reason	n	%
Costs less	1261	30.6
Freeway too congested	827	20.0
Gives me time to relax	708	17.2
Saves time	531	12.9
Dislike driving	389	9.4
Allows someone else to use car	140	3.4
Change in place of work	121	2.9
Other	106	2.6
Carpool broke up	43	1.0
Total	4126	100.0

There is some argument that the high frequency of "costs less" responses could be a deliberate overstatement by riders trying to avoid a rescinding of the 25¢ fare. There is considerable survey experience indicating that people will overstate their feelings or their projected behavior when their pocketbooks are involved. However, there was a deliberate attempt to place this question on the questionnaire and this response category within the question in such a way as to minimize any overstatements; i.e., the authors feel that the main reason for using the busway, of those reasons offered, is the main reason in the hearts and minds of a majority of the riders.

The response "saves time" ranked only fourth among the choices offered although the major function of the busway is seemingly to reduce travel time. This is discussed under Time Savings in Chapter IV.

To further understand the pattern, a study was made of the interaction between responses. Only 91 persons checked one response; all others who answered this question checked more than one. A determination was made of the frequency of occurrence of pairs of responses and this number was compared to the frequencies which would be expected (indicated by parentheses) if each of the "reasons" represented an independent factor. This interaction and comparison of frequencies is shown in Table 11.

Table 11
INTERACTION BETWEEN RESPONSES TO REASONS FOR USING BUSWAY

Responses	Conges-tion	Dislike Driving	Time To Relax	Saves Time	Saves Money	Total Responses In Category
Congestion	121	197 (167)	407 (303)	280 (227)	614 (540)	827
Dislike driving		69	218 (143)	124 (107)	268 (254)	389
Time to relax			81	243 (195)	546 (426)	708
Saves time				120	356 (347)	531
Saves money					364	1261
Total						3716

To understand the above table the entries in the upper right-hand cell are explained. There were 614 respondents who checked both "congestion" and "saves money." Given 827 "congestion" responses and 1261 "saves money" responses one would expect that, if there were no interdependence between these two factors, 540 persons (noted in parentheses) would have checked both of these reasons.

This process indicates considerable interdependence among "congestion," "time to relax," and "dislike driving." These are logical interdependencies. The first suggests a common factor which has been referred to in previous San Bernardino and Shirley Highway busway reports as the major reason for diversion--the irritation of the driver with congested freeway driving. It is not valid to associate the sum of the responses (congestion: 827, time to relax: 708, and dislike driving: 389) with a common factor called "irritation with congested driving" and claim it as the reason having the highest frequency count. However, it does imply that such an irritation factor exists, and that if it could have been isolated and phased into a survey question the question would have received a frequency count significantly higher than any of the counts obtained by the three component factors, i.e., higher than 827.

The highest degree of interdependence is between the "time to relax" and "saves money" factors; however, the authors have no interpretation to offer as to why this interdependence exists.

Early vs Recent Converts to Busway

Figure 27 indicates the differences in reasons for using the busway between those who started using the system prior to the opening of El Monte Station and those who started after

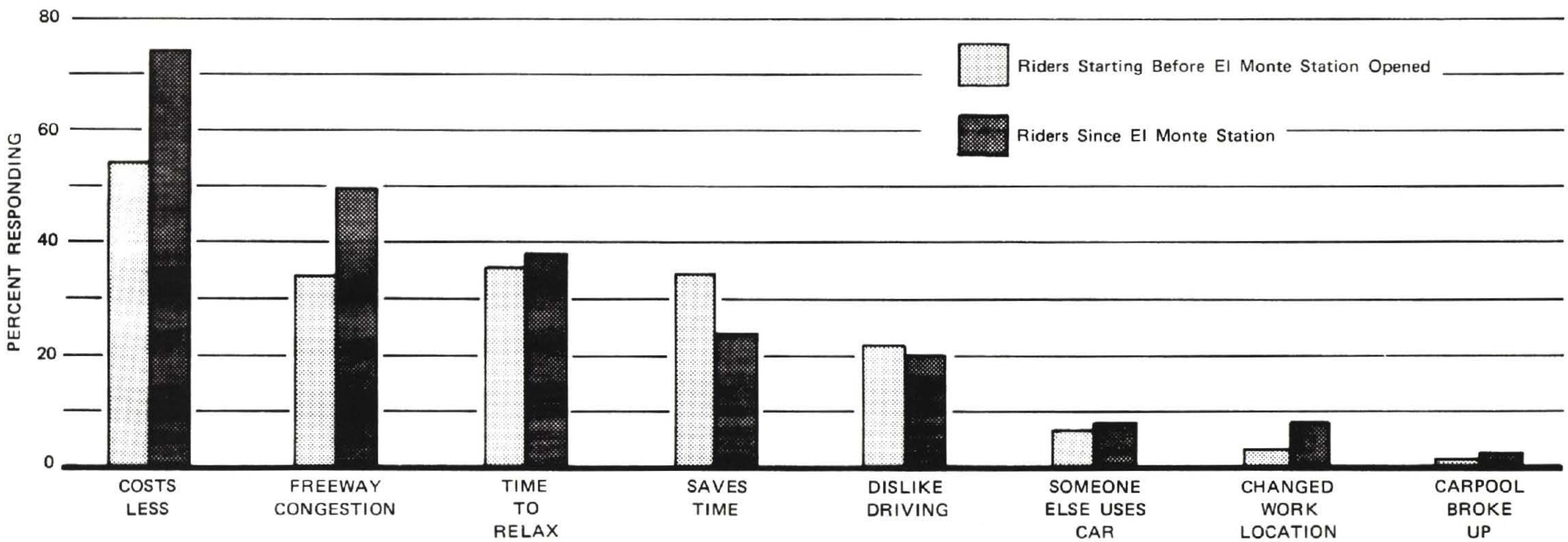


FIGURE 27 REASONS FOR USING BUSWAY

the station opened. There are significant differences relative to "costs less," "congestion," and "saves time."

Differences vs Life Cycle Group

There are also some interesting differences in the reasons given among the various life cycle groups. The following synopsis indicates which reasons were listed by each group at a significantly higher relative frequency than were listed by the general population surveyed.

Reason	Single	Newly Married	Full Nest 1	Full Nest 2	Empty Nest
Costs less			x		
Congestion			x		
Time to relax					
Saves time	x		x		
Dislike driving		x			x
Allows someone to use car			x		
Change job location	x	x			
Carpool broke up					x

FEATURES LIKED

Passengers were asked to rate the importance of seven features of the busway on a scale of 1 to 4 (1 meaning extremely important, 4 meaning of no importance). Table 12 indicates the distribution of responses in order of preference.

The features "reduction of fare to 25¢" and "seat availability" were included as reference points in that we know from previous surveys that these are important features to riders. Again it can be argued that the high rating given to the "reduction of fare to 25¢" is a deliberate overstatement given to ward off a fare increase.

Table 12
PREFERENCE FOR VARIOUS BUSWAY FEATURES

Feature	Average Rating	% Rating Feature As "Extremely Important"
Reduction of fare to 25¢	1.3	80
Present frequency of service	1.5	60
Reduced travel time through exclusive lanes	1.7	62
Seat availability	1.9	41
El Monte terminal	2.1	45
New air-conditioned buses	2.2	29
Exclusive bus lanes downtown	2.4	32

It should be noted that except for a few blocks the exclusive Spring Street lanes are used only by route 60 buses (about 25% of the total patronage). Consequently, it was of little importance to riders of all other routes. The route 60 riders gave it an importance rating of 2.0, only a moderate value; only 45% rated it as extremely important. Thus, those who used the exclusive lane did not rate it significantly higher than the general population of riders.

There were some variations in response patterns by demographic characteristics and by life cycle classifications, but these do not appear to be of consequence. They are summarized in Appendix D.

NEW FEATURES DESIRED

Those surveyed were asked to rank five possible changes in the busway system in order of importance, 1 through 5. Some riders responded by ranking all changes in a descending order of importance; some merely indicated a number for some of the changes (e.g., marked two items with a rank of "1," left two blank, and marked one with a rank of "5").

Table 13 is a presentation of the pattern of responses given, in what seems to be the overall order of importance based on the difference between the frequency of Number 1 rankings and the frequency of Number 5 rankings.

Table 13
PREFERENCES FOR VARIOUS CHANGES TO THE BUSWAY

Change	Number Giving #1 Ranking	Number Giving No Ranking	Number Giving #5 Ranking	Difference #1 Minus #5
Increase frequency of service	492	126	26	466
Extending busway east of El Monte	302*	151	206	96
More bus lanes downtown	187	154	101	86
Downtown stops closer to destination	190	150	167	23
Increase bus speeds	175	158	161	14

*This figure may have been smaller if the overall level of express service along the freeway east of El Monte were not so low. For example, people might be as satisfied with a well-serviced park-n-ride in Covina or West Covina, combined with service to the four bus slip ramps in that area, as with extension of the busway.

There are no noteworthy differences among demographic or life cycle groups. The importance of "increased frequency of service" varied considerably among bus routes and time of trip departure. The most affirmative responses came from those who commence their trip at or before 7:00 AM, particularly on routes 52F, 402, 404, and 405. (See Appendix D for more details.)

The "extend busway" feature received the second largest number of highest priority rankings and the largest number of lowest priority rankings. Those favoring the feature are more often male, richer, more likely to be married, and more likely to have more children. This is probably a description of commuters living east of El Monte who would benefit most from the extension. Indicated below are the percentages by bus route of those ranking this feature first and last.

Route	% Giving First Rank	% Giving Last Rank
402	40.7	18.5
401	36.4	18.0
403	34.7	10.7
60	32.6	12.6
405	29.2	31.9
404	25.6	23.1
63	17.5	30.0
52	10.2	49.0
53	7.8	39.1

If one compares the rank order above with the geographical location of routes (see Figure 4) one can conclude that the riders on the routes giving the highest value to the extension are the ones who would be benefited directly by an extension of the busway.

ADVERTISING EFFECTS

It is known from the pre-busway on-board survey and from other studies that different types of advertising have varying degrees of effectiveness, and each affects different socio-economic groups.

Table 14 lists the relative effectiveness of the advertising modes, based on the percentage of individuals indicating that they had heard of the busway through that advertising mode. Also listed for comparison are the 1972 pre-busway values measured in a comparable way.

The total adds to more than 100% because some people checked more than one advertising mode. As the data indicate, a

Table 14
EFFECTIVENESS BY ADVERTISING MODES

Advertising Mode	1974 % Affected	1972 Pre-Busway % Affected
Friends, relatives	37.7	25.8
Newspapers	21.7	2.4
Saw bus on busway or street	17.1	N.A.
RTD schedule	16.9	38.9
TV	15.0	5.8
Radio	11.8	5.6
RTD phone information	10.9	30.7
Other	5.0	11.1
Information on other buses	4.0	5.1
Transit Information Team	2.4	N.A.
Billboards	N.A.	2.4

variety of advertising modes are being used to acquaint commuters with the busway system--with friends and relatives, newspapers, television, and radio being much more effective than they were with pre-busway commuters, and with RTD schedules and phone information being much less important.

Table 15 indicates for each advertising method the particular market segment that is most sensitized to that method. This is determined by comparing the percentage in a given market segment of those who were affected by the advertising method in question with the percentage of the total busway ridership in that market segment. The market segment which shows the greatest difference in these two percentages is concluded to be the most sensitized to that advertising method.

Table 15
SPECIFIC MARKET SEGMENTS MOST AFFECTED BY ADVERTISING METHODS

Source of Information	Sex	Age	Marital Status	Income*	Education
Radio	-	50-64	Single	10-15	Some coll., coll. degree
TV	Male	-	Single	5-10	Some H.S., some coll.
Newspaper	Male	30-39	Married	15-30	Some coll., coll. degree
RTD phone	Female	21-29	Single, Divorced	5-10	Some college
RTD sched.	Male	40-49	-	15-30	Coll. degree
Saw bus	Male	30-39	Married	10-30	Some coll., coll. degree
Billboard	Male	21-29	Single	10-15	Some college
Other bus	Female	20, 50-64	Single	10-15	-
Friends	Female	21-29	Single	10-15	High school

*In thousands

The table indicates the effectiveness of the newspaper campaign in reaching the young married men of higher income and education and of the radio in reaching older people. The description of those who use the schedules suggests that some simplification of the schedule design is desirable.

The Transit Information Team is omitted because of the sparseness of responses.

Finally, the following synopsis is a second identification of market segments, computed in the same manner, affected this time in terms of life cycle categories.

Advertising Method	Single	Newly Married	Full Nest 1	Full Nest 2	Empty Nest
Radio				x	
TV	x				
Newspapers				x	x
RTD phone	x	x			
RTD schedules				x	
Saw bus on busway or street		x	x		
Billboards	x				
Information on other buses	x				
Friends, relatives	x		x		

PASSENGER COMMENT

The riders surveyed were given the opportunity to write in comments and criticisms about the busway service or other SCRDT operations. Of the 1933 persons surveyed, 890 had comments, some more than one. Their response was a mixture of highly favorable comments, those which requested additional service, outright complaints, and no comments at all. The breakdown by these categories is shown below for the 890 first comments.

Responses		n	% of All Passengers
Favorable		186	9.6
Neutral:			
Request for added service	400		
Other	104	504	26.1
No comment		1043	54.0
Unfavorable		200	10.3
Total		1933	

There were some additional second comments that were favorable and unfavorable, but regardless of how these might be incorporated the percentage distribution of comments given above would not be significantly altered.

It can be argued that this distribution indicates a generally favorable view by busway users. The survey gave them an excellent opportunity to criticize and only 10% did so. Another 400 (21%) seized the chance to ask for more service or changes that would benefit them.

Table 16 shows the breakdown of all comments by type, including the first and second comments. The favorable comments were nearly all of a very general nature, such as "great service," "keep it up," etc. The neutral comments requesting additional service in most all cases reflect the specific needs of the passenger—"need more buses on line 52," "could we have a stop at such-and-such street."

Table 16
CLASSIFICATION OF RIDERS' COMMENTS
(First and Second Comments)

Type of Comment	Fav	Neut	Unfav	Total
General comments	163	71	45	279
Scheduling	6	370[1]	0	376
Operators	12	3	72	87
Route and stops	2	139[1]	0	141
El Monte station	0	3	23	26
Equipment	0	24	69	93
Public information	0	5	29	34
Fare	36	5	2	43
Totals	219	620	240	1079[2]
% of all comments	20.3	57.5	22.2	

[1]All comments relating to scheduling and routes and stops were requests for specific service and were graded as neutral.

[2]Includes multiple responses.

FIGURE 28 EL MONTE STATION

STATION SURVEY

A part of the overall station evaluation was done through informal face-to-face interviews with users. Interviews were collected in the platform waiting area during peak and off-peak hours on a weekday. A total of 693 people were interviewed, 349 at the El Monte Station, 154 at the Hospital Station, and 190 at the College Station.

Passengers at all three stations were asked what they thought the station's best features were and what its inadequacies were. (Additional questions were asked, and these are discussed in Appendix E.) Responses to these two questions are shown in Tables 17 and 18.

Responses were analyzed not only in terms of their frequencies but also to see if responses varied by sex, by trip purpose, by time of day (peak or off-peak) and by those who use the stations during the day only as opposed to those who use them at night as well (after 7:00 PM). Results of this analysis are discussed in Appendix E. Variations in response by age or race are not significant and are not included in the discussion.

The overall reaction to all three stations is a positive one. When the number of positive and negative comments was compared, their ratio is as follows:

	Positive-Negative Ratio
El Monte Station	1.6
Hospital Station	1.5
College Station	2.2

At El Monte Station the most positive reaction comes from off-peak riders and those who use the station during the day

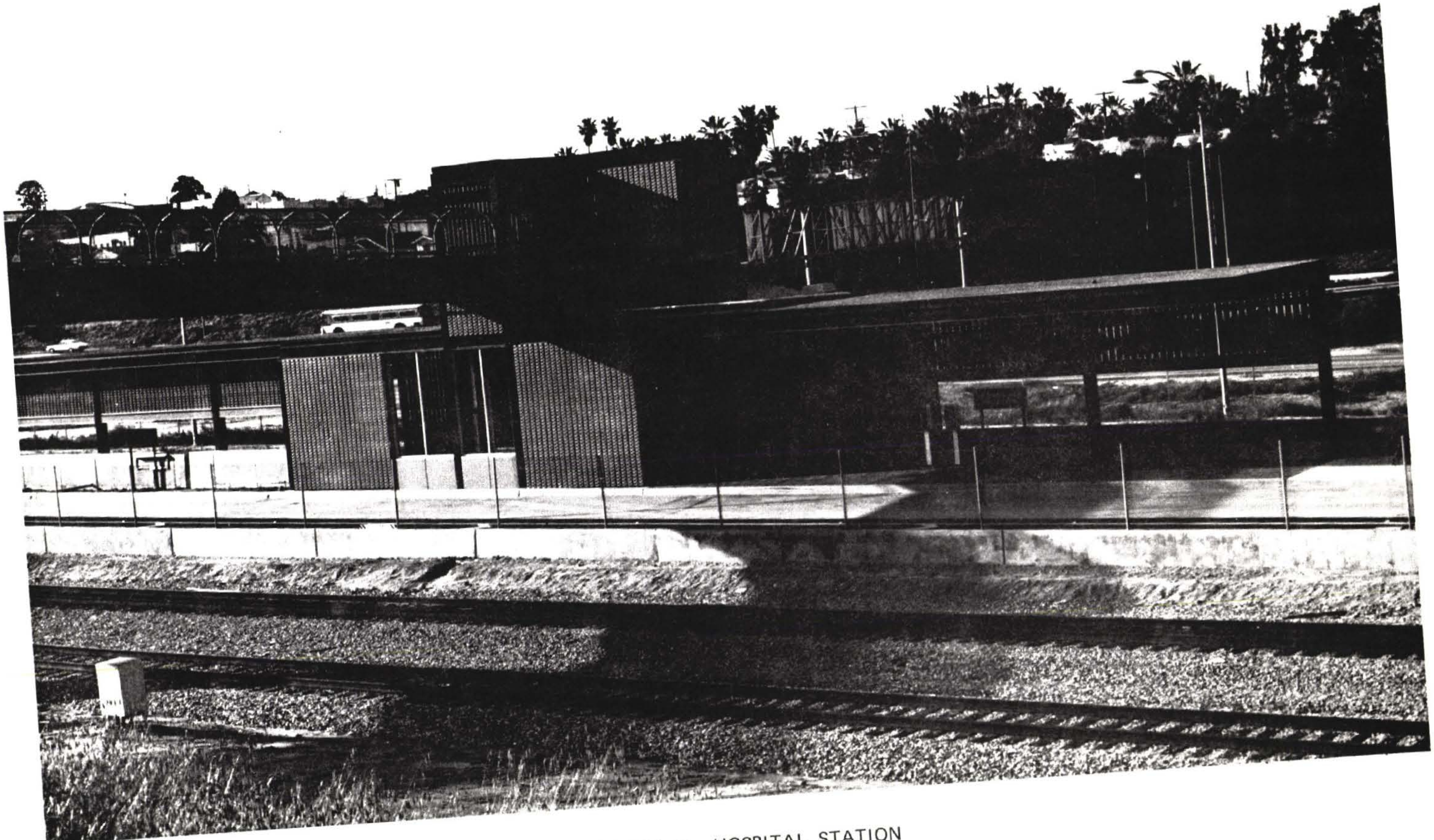


FIGURE 29 HOSPITAL STATION

Table 17
STATION FEATURES LIKED BEST

El Monte	Hospital	College
PROMPT FREQUENT SERVICE 24%	CONVENIENCE 31%	CONVENIENCE, ACCESS TO CAMPUS 40%
OPEN DESIGN, VISIBILITY 21%	JUST LIKE IT 19%	SPEED CUTS TRIP TIME 25%
SPEED IN MOVING PEOPLE, BUSES 15%	ELEVATOR 16%	ELEVATORS 15%
JUST LIKE IT 14%	PROTECTION FROM ELEMENTS 4%	APPEARANCE 5%
CLEAR, FREQUENT ANNOUNCEMENTS 5%	SPEED CUTS TRIP TIME 9%	COST SAVINGS 4%
LOBBY 4%	OTHER 14%	OTHER 11%
OTHER 18%		

Table 18
PERCEIVED INADEQUACIES OF STATION

El Monte	Hospital	College
NO INADEQUACIES 36%	NO INADEQUACIES 36%	NO INADEQUACIES 45%
MORE PARKING SPACE NEEDED 19%	NO REST ROOMS PROVIDED 16%	LACKS PROTECTION FROM WIND, RAIN 13%
VENDING MACHINES NEEDED 15%	LACKS PROTECTION FROM WIND, RAIN 16%	ELEVATORS OUT OF ORDER 11%
PERSONNEL RUDE, UNHELPFUL 7%	NO SECURITY GUARD 11%	INFORMATION, SCHEDULES NOT POSTED 8%
OTHER 22%	INFORMATION, SCHEDULES NOT POSTED 7%	NO REST ROOMS PROVIDED 7%
	OTHER 13%	OTHER 17%

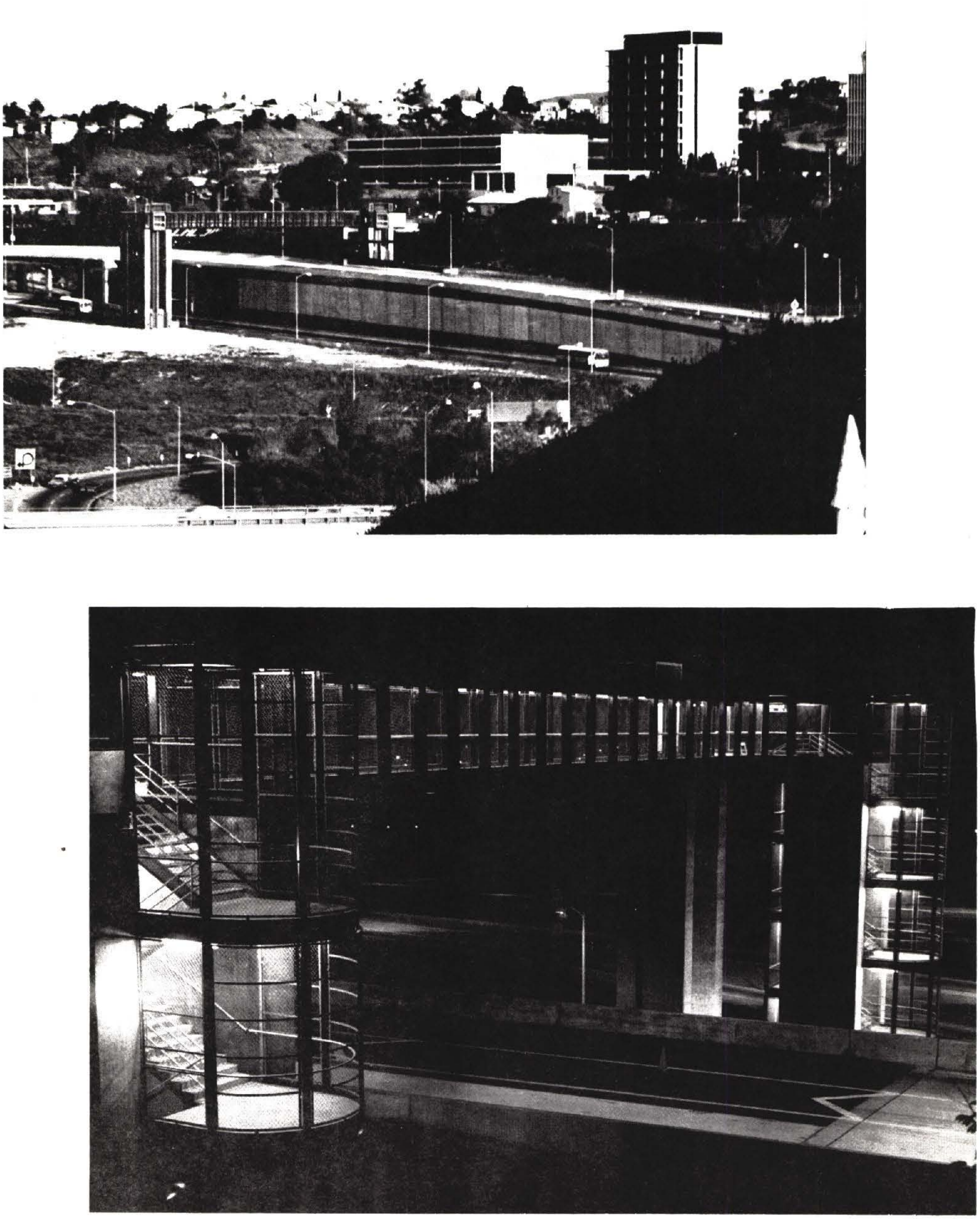


FIGURE **30** COLLEGE STATION, DAY AND NIGHT only, i.e., not after 7:00 PM. The most negative reactions come from people who use the station at night as well as during the day—the only group whose number of negative comments was higher than positive comments—and from commuters or peak period riders.

At the Hospital Station, as at El Monte, off-peak riders are the most positive group in their reaction to the station. Peak period commuters and those who use the station at night are the most negative group. In no groups did negative comments outweigh positive ones.

Ninety percent of the people interviewed at the College Station were students on their way to or from classes at California State University at Los Angeles. As can be seen by the ratio of positive to negative comments (2.2) they are extremely pleased with the station. Non-students were an even more positive group (3.7) but were a small sample size (19 people). The lowest ratio (1.9) came from people who use the station at night.

DRIVER PERCEPTIONS

The group of people most familiar with the busway and its method of operation are the bus drivers themselves. In order to include their perceptions and attitudes in this report a mail-out survey was sent to all operators who drive on the busway. Almost all questionnaires were returned by mail and 120 of these were tabulated and reported on below. (The questionnaire form used is attached as Appendix F.)

The bus operators' overall evaluation of the busway design and operation is a positive one. Forty percent rated it "excellent as is," 47% "good but with needed improvements," and 7% stated that the busway needed major changes.

The maximum legal speed permitted on the busway is 55 mph. Almost all drivers (91%) felt that this speed was too slow and that it should be increased to 65 mph. The required spacing between buses is 1000 feet. One-half (52%) of the drivers felt that this requirement was excessive and should be lowered to 500 feet. Forty-eight percent agreed with the current spacing requirement.

When asked to assess the effect of the downtown contraflow lane on bus speed, 54% of the drivers responded that it "speeds it up," 24% that it "slows it down," and 22% that speeds were unaffected. In order to increase bus speeds on the contraflow lane 57% of the drivers feel that signals should be synchronized to favor bus flow. The signals are currently synchronized to favor automobile traffic, which flows in the opposite direction. Thus, the system necessarily works against bus speeds. Since the contraflow lane is a single lane, no bus can pass another, and 30% of the drivers felt that speeds could be improved if a passing lane were provided. Additionally, they suggested relocating bus stops (11%), speeding up the boarding process (18%), removing local buses from the contraflow lane (8%), and other suggestions not categorized here (17%). These percentages add up to more than 100% because many drivers made more than one comment relative to speed improvement.

Sixteen drivers reported that their buses had broken down while driving on the busway and 27 reported that they had had experience with auto accidents while driving on the busway. Of these 27 responses, 20 said the auto accident involved intrusion into the bus lane, 13 that it involved intrusion into the shoulder. Only six felt that the accident interfered with their performance as a bus driver.

The great majority of drivers stated that there were no special problems involved in driving on the busway during foggy or rainy weather (79%) or at night (65%). The special problems which they did report were quite diverse. Eight reported that the busway became slippery. Three cited the need for more light on the busway, and two observed the need for a slower speed limit in such weather. Two drivers believed that lights or reflectors on the fence to the left would be helpful.

Drivers most often cited reduction in visibility due to glare as a problem with night driving. Fourteen complained of the glare caused by on-coming cars. Four suggested that the fence to the left of the busway be made higher in order to block the light. Four drivers suggested that the fence be marked by lights or paint in order to make it more visible at night. Four were concerned that the bright lights of the buses blind on-coming cars. Thirteen drivers objected to the glare caused by the interior lights of the bus.

A large percentage of drivers (42%) cited special loading and unloading problems at the El Monte Station. The largest single comment related to berth size being too small. This may lead to the problem of a bus driver being unable to pull his bus out of its berth into the single lane which leads around the station, if the berth directly in front of his bus is occupied. Some drivers commented that the station as a whole was too small to accommodate peak period traffic effectively. Fifty-eight percent felt that there were no special problems.

About a third of the drivers (30%) were satisfied with the service director's performance at the El Monte Station. The service director assigns each bus to a berth as it enters the station and at the same time announces to the public at which berth the incoming bus will be loading and its destination. The largest single comment related to improving his performance suggested that he be located in an area which completely isolated him from the necessity of answering any questions posed to him by the general public. Other comments of any frequency suggested changes in the current method of assigning buses to berths and that announcements be made more clearly and bilingually.

The bus operators are almost unanimous in their feeling that a mixture of carpools and buses should not be allowed on the busway. Almost all felt that carpools (even in a limited number) would have a bad or negative effect on the busway. The reasons behind this assessment are as follows (multiple answers allowed, so percentages add up to over 100):

- reservations about driving qualifications of general public 29%
- would result in slower service and thus defeat purpose of busway 27%
- would cause safety problems, lead to accidents 27%
- slow cars would slow down buses 13%
- cars more apt to break down on busway 13%
- would result in congestion 9%
- other 9%

VII. PEAK PERIOD DIVERSION

The evaluation of the busway includes the examination of what would have happened had there not been a busway. Some busway riders would have ridden another bus; some would have driven, either daily or cooperatively with others; some would have been passengers in automobiles. An estimate of the changes in travel patterns associated with the busway is presented herein, showing the recent increase in people who stopped driving to travel the busway. This has been reflected in savings in vehicle miles traveled (VMT), which, in turn, results in savings of energy and an improvement in air quality.

DIFFERENCE BETWEEN EARLY AND MORE RECENT BUSWAY RIDERS

As described in Appendix A, the responses to the survey question asking how long passengers had used the busway were separated into only two groups: those starting before, and those starting after, the opening of the El Monte Station. These two groups, when expanded to total ridership, are in the same proportion to patronage report figures showing 2000 riders before the El Monte Station opened and 6000 who have been added between the station opening and the on-board survey (November 1974). All numbers quoted are peak period peak direction person-trips.

In order to determine the number of cars diverted from the road as a result of the busway, these patronage values have been combined with the response on mode shift, the distribution of which is as follows:

Mode	Pre-El Monte %	Post-El Monte %
Have always used busway	5.5	9.9
Drove my car (alone)	37.0	59.0
Was an auto passenger	10.7	11.2

Was a driver (carrying passengers)	3.7	6.7
Was an alternate driver	3.5	10.6
Used a non-busway bus	39.6	2.4
Taxi	0.0	0.2

Those who have "always used the busway" are newcomers to the region, people maturing into the labor market, and people who have changed their route because of a change of home or job.

To translate these reponses to diverted vehicles, the categories are grouped by ex-driver, ex-bus rider, and ex-passenger, as shown in Figure 31 .

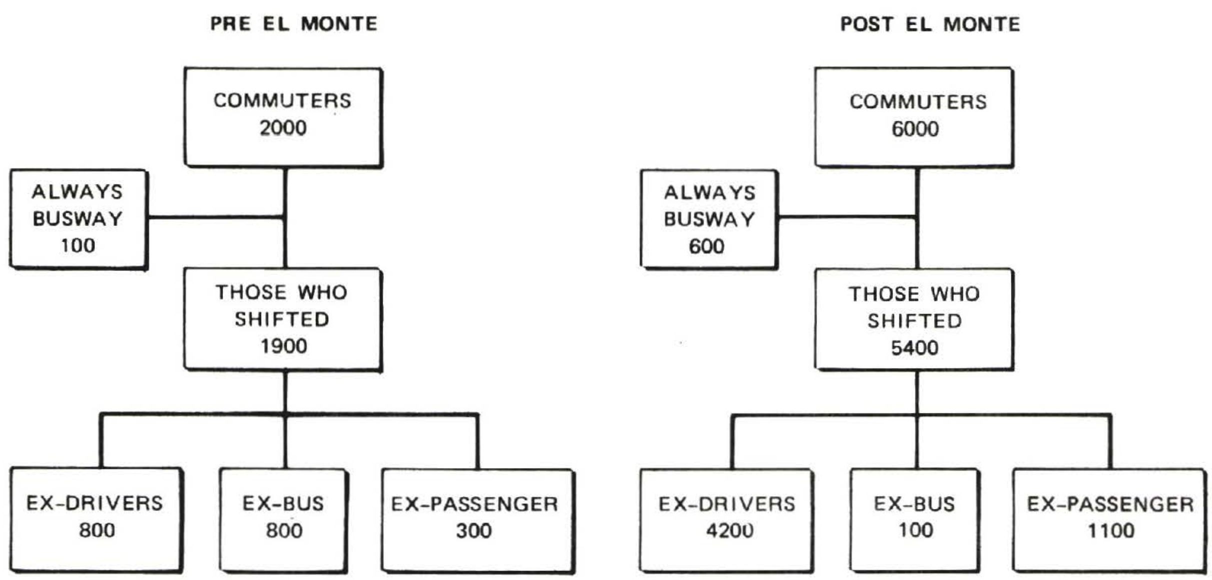


FIGURE 31 MODE SHIFT OF PASSENGERS BY LENGTH OF BUSWAY USAGE
(5.5 Peak Period, Peak Direction Busway Riders)

All of those who responded "drove my car (alone)" and "was a driver (carrying passengers)" were considered ex-drivers. The latter is different from the treatment in the Shirley Highway project in which "one-half of those persons who drove with passengers...are presumed to represent diverted vehicles."* It is assumed here that the passengers in such an arrangement would have responded "passenger." Those who responded "taxi" were allocated to the ex-driver group because they corresponded on a one-to-one basis with cars diverted from the freeway, even though the cars were not their own. Those who responded "was an alternate driver (drove ___ days per week)" were split between ex-driver and ex-passenger. The response to the second part of this question was predominantly "2 days per week," so these respondents were assigned 40% to ex-drivers and 60% to ex-passengers. This is higher than the "one out of six"** assumed in the Shirley Highway report.

As might be expected, in the earlier days of the busway the proportion of those who shifted from other buses was greater than in more recent days. Almost all of those who are shifting to the busway in the post-El Monte period are coming out of cars.

To convert the numbers in Figure 31 to the number of cars diverted from the road, we must first determine what percentage of the group who have always used the busway represent ex-drivers. If we assume that they would have followed the same pattern as observed in the Los Angeles region as a whole, then six to seven percent would have used transit, with the remainder distributed in cars with a 1.2 occupancy rate. This would produce about 80 one-way car trips per day for this group in the pre-El Monte period and 470 one-way car trips in the post-El Monte period.

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*The Shirley Highway Express-Bus-on-Freeway Demonstration Project/ Second Year Results, prepared for Urban Mass Transportation Administration, November 1973, p. 70.

**Ibid.

When these car trips are added to those which would have been made by ex-drivers, we get 880 one-way trips for pre-El Monte and 4670 for post-El Monte, or a total of 5550 one-way car trips diverted from the road. This represents 2775 commuter cars which did not make the roundtrip each day. It can be seen that this ratio (880:4670) is lower than the 1:3 implied by the patronage ratio of 2000 to 6000, as more and more of the share of riders comes from cars.

COMPARISON OF DIVERSION DATA WITH EARLIER RESULTS

In the first year report,* a diagram was given of the diversion pattern as of the end of 1973. This is reproduced in part in Figure 32, together with the total diversion as of the end of 1974.

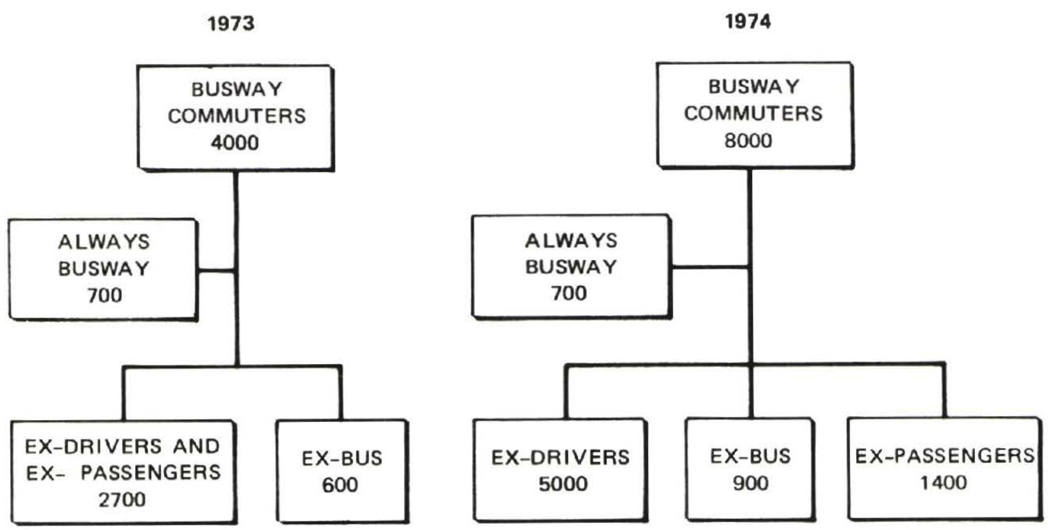

FIGURE 32 COMPARISON OF MODE SHIFT RESULTS

(5.5 hr Peak Period, Peak Direction Busway Riders)

The number of riders who were always busway users remains the same, which probably implies that one of the estimates is

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*First Year Report, San Bernardino Freeway Express Busway Evaluation, prepared for Southern California Association of Governments by Crain and Associates, February 1974, p. 115.

slightly in error. The number who have shifted from another bus is up from 600 to 900, but the overwhelming source of the 4000 additional trips per day comes from the automobile.

In the Shirley Highway analysis the ratio of the number of cars to the number of auto users was found to be 0.60.* In Figure 32 the ratio of 5000/(5000+1400) is 0.78. Half of this difference can be ascribed to the difference in treatment of carpoolers between the two studies and half is the real difference in occupancy rates.

IMPLICATIONS ON VMT

It is important to translate the estimate of the 5550 cars diverted daily from the San Bernardino Freeway corridor into reduced vehicle miles traveled (VMT). This allows the traffic impacts of the busway to be related to regional goals of VMT reductions. All figures quoted herein are weekday, 5.5 hour peak period savings.

In 1973, the average daily trip of automobile drivers, before they switched to the busway, was 19.8 miles one-way. It was 5.4 miles one-way to the El Monte Station for those who switched to busway travel and parked at the station.** The busway rider may leave his car home, be driven to the station (kiss-ride), or drive to the station himself (park-ride). If he drive to the station, he saved 14.4 miles each way. If he was driven to the station, and the car then was driven home, to return for him in the evening, the mileage saving was 9.0 miles a trip. If the car was left at home, the saving was 19.8 miles per trip.

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*Shirley Highway...Second Year Results, p. 15.

**First Year Report, SBFEB Evaluation, p. 118.

The response to the question "How did you get from your starting point to where you boarded this bus?" yielded the following percent distribution, for regular busway users.

Mode	%
Drove car and parked	54.7
Driven by someone else	16.7
Rode another bus and transferred to this one	5.1
Walked	22.6
Took taxi	0.9

The first response is the park-ride. The second category can be either car-sharing or kiss-ride. Observation at El Monte indicates that kiss-ride is twice as likely as carpooling, so we will use two-thirds of this figure (or 11.1%) to represent kiss-ride. The remaining 5.6% plus the other three categories all relate to leaving the car at home. This can be summarized in the following distribution:

Mode	%	VMT Saving/Day
Park-ride	54.7	14.4
Kiss-ride	11.1	9.0
Leave car home	34.2	19.8

However, these percentages apply to busway riders as a whole, and it is not reasonable to assume that the ex-bus riders follow the same pattern as the ex-drivers. Instead, if we assume that the ex-bus riders, who are more likely to be transit-dependent people, all leave their cars at home, the distribution of VMT savings is altered as follows:

Table 19
VMT SAVINGS FOR EX-DRIVERS

Mode	%	VMT Saving/Day
Park-ride	61.6	14.4
Kiss-ride	12.5	9.0
Leave car home	25.9	19.8

These numbers were obtained by subtracting the percentage of ex-bus people (11.2%, i.e. 900/8000) from the category "leave car home" and then normalizing the data so that the percentages add to 100. The 5550 car trips diverted from the freeway, if distributed as above, would produce a saving of 84,000 miles per day. This saving is decreased by the vehicle miles traveled by the bus and by the cars that either are left at home or taken home by those who "kiss and ride." The 229 daily peak period bus trips average approximately 15 miles per one-way trip and, in total, represent 3400 VMT.

The cars left at home are driven about 3900 VMT per day. The on-board survey indicates 22.8% of the cars left at home or returned to home are driven during the day, each about 16 miles per day. Thus, of the 2775 cars diverted, 1065 (38.4%) are left at home or taken home, and the 243 (22.8%) that are used generate 3900 VMT (16 miles each).

Thus, the gross saving in automobile mileage is 84,000 miles per day. The net saving in automobile mileage after subtracting the 3900 miles driven during the day by the cars left at home or taken home is 80,000 miles per day. When the additional 3400 miles per day of bus travel is subtracted, the final net saving is 77,000 VMT per day.

There are 30,000 cars a day going by on the freeway near El Monte Station during the peak period. Although some of them are not going to the CBD and cars from the corridor go to the CBD without using the freeway, this number gives a frame of reference to the VMT saving. Assuming that all 30,000 cars travel 19.8 miles a trip, the net saving of 77,000 miles a day is 12.9% of the mileage of those cars still using the freeway.

ENERGY CONSERVATION

One of the implications of the savings in VMT due to the busway is the decrease in gallons of gasoline used. It was estimated above that by diverting commuters from their cars, the busway was saving 80,000 VMT miles per day. If these diverted cars operate at the California State average, they would travel 12.3 miles per gallon.* The Shirley Highway report quoted 14.75 miles per gallon.** This implies that the busway bus is currently causing gasoline savings at a rate between 5400 and 6500 gallons per working day from the cars left at home. In addition, those cars still on the freeway are driving more freely. Since stop-and-start driving consumes more gasoline than steady flow, these drivers, too, are saving gasoline. The smoother flow results partly from diversion and partly from the improvements to the freeway itself. A saving of one mile per gallon would yield additional gasoline savings at the same order of magnitude as those computed above.

In order to estimate how many gallons of gasoline have been saved since the opening of the busway, it is prudent to consider certain differences between the pre-El Monte busway riders and the current riders (as of November 1974). As shown in a previous section, 880/2000 (or 44%) of the early riders were ex-drivers and 5550/8000 (or 69%) of the present riders are ex-drivers. The net miles saved per diverted trip are 13.7.***

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*Current estimate, private communication, Caltrans.

**Shirley Highway Project...Second Year Results, p. 42.

***The average VMT saved for each diverted car computed from Table 19 less the average VMT expended in other trips by the cars left at home or taken home.

During the 5.5 month pre-El Monte period, the average number of peak period trips per day was about 1400, yielding 66,000* gallons saved at the more conservative 14.75 miles per gallon rate. (All trips are, of course, one-way trips.) During the 14-month post-El Monte period (omitting the time of the strike) the average number of trips per day was 5100, yielding 961,000** gallons saved, for a total of 1,027,000 gallons saved since the opening of the busway.

The Shirley Highway project also evaluated the gasoline savings from cars diverted from the road. At the end of the first two years (as compared to the busway's 19.5 months) they had saved 1,198,000 gallons compared to the busway's 1,027,000. If the busway's savings are extrapolated to two years, at the current rate of 8000 commuter trips per day, by the end of two years the busway will have saved 1,511,000*** gallons. It would appear, therefore, that the busway is currently saving about 25% more gallons of gasoline than the Shirley Highway busway did, at the same stage of maturity.

There is, however, an investment in the additional energy consumed (diesel fuel burned) by the additional buses required to produce this savings in gasoline. There are currently about 229 peak period, peak direction bus trips traveling the 15 miles between El Monte and downtown. The buses get about 6.5 miles per gallon of diesel on the busway and 2.5 downtown. The consumption is 1493 gallons (i.e., 229 x 2 x 15 ÷ 4.6). Prior to the opening of the busway the consumption was about 470 gallons (55 trips per peak period obtaining about

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*1400 (peak trips) x 44% (ex-drivers) x 5.5 (months) x 21 (days/month) x 13.7 (miles saved/trip) ÷ 14.75 (miles/gallon).

**5100 (peak trips) x 69% (ex-drivers) x 14 (months) x 21 (days/month) x 13.7 (miles saved/trip) ÷ 14.75 (miles/gallon).

***The 1,027,000 gallons saved through the first 19.5 months plus 8000 (peak trips) x 69% (ex-drivers) x 4.5 (months) x 21 (days/month) x 13.7 (miles saved/trip) ÷ 14.75 (miles/gallon).

3.5 miles per gallon). The net difference is an increase of about 1000 gallons of diesel burned per day.

AIR QUALITY

The reduction in VMT resulting from diverted car trips and the smoother flow and increase of speed of those cars on the road both result in the improvement of air quality. The cars which are not used to commute do not emit pollutants at all, and those which are driven at a smoother speed emit fewer pounds of pollutants per mile. Computations of this decrease in emissions for the Shirley Highway project were difficult and laborious. In dealing with the California data, we are fortunate in having available the set of manuals prepared by the California Department of Transportation*, which gives the emission rate on a freeway for various mixes of passenger cars and heavy-duty vehicles as a function of speed and of year of measurement. All of the factors relating to California law and the deterioration of equipment are built into the curves presented in that manual. As a result, in order to estimate the emissions of carbon monoxide and hydrocarbons for a given length of highway for a given period of time, it is necessary only to know:

- the average route speed,
- the number of vehicles, and
- the percentage of heavy-duty vehicles.

In order to test the impact of the busway on the emissions of pollutants, three sets of computations were made. These measured the amount of pollutants emitted by cars on the San Bernardino Freeway during the 5.5 hour peak period under varying conditions, as follows:

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*Air Quality Manual, prepared for FHWA, Washington, D.C., by California Department of Public Works, 8 volumes, 1972, FHWA-RD-72-33, 34, 35, 36, 37, 38, 39, 40.

1. In early 1973 when the busway first opened.
2. In November 1974 with the busway diverting 5550 car trips per day from the road.
3. In November 1974 had no busway been built, adding an additional 5550 cars to the freeway.

The reason for the first calculation is to get the pre-busway air quality condition. The reason for the second calculation is to show what improvements the busway and other factors have produced in air quality. These factors are the general improvement in emissions control by car manufacturers and the improvement on the freeway itself. The first factor lowers the emission rate per car, at any speed. The second increases car speed on the freeway, which results in lower emission in pounds per mile. The third calculation is made to show how much worse air quality would be without the diversion effect.

The speeds were available for studies 1 and 2* and estimated from volume-speed relationships for study 3. Relative to study 3, because current vehicle counts are sufficiently close to capacity that the added vehicles would decrease the average speed level, the emissions are recomputed based on this lower average speed. (The Shirley Highway evaluation assumes that the speed is not affected by the addition of the non-driven vehicles.)

The traffic count for study 1 was derived from ADT counts for study 2, modified to reflect the slight change in ADT over that time period (see Figure 21, Chapter III). The traffic count was available for study 2 and for study 3 is the sum of the November 1974 values and the 5550 car trips derived in the earlier portion of this chapter. Speeds and volumes were available on an hourly basis. The percentage of heavy-duty vehicles used in all three studies is 5% based

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* Gallagher, Michael P., Carpools Using Busway During Strike, California Department of Transportation--Dist. 7, January 1975, pp. 11-12.

on weekly measurements taken by Caltrans throughout the last half of 1974.* The values of emissions for the three studies presented in Table 20 are the sums of the 5.5 hour peak travel.

Table 20
BUSWAY IMPACT ON AIR QUALITY
(Pounds Generated During Peak Period, per Freeway Mile, per Day)

	Carbon Monoxide	Hydro-carbons
1. Spring 1973	2607	456
2. November 1974	2084	326
3. November 1974 had there been no busway	2472	381
Observed percentage change	-20.1	-28.5
Percentage change had there been no busway	- 5.2	-16.4

This shows that over the duration of the busway, carbon monoxide emissions over the freeway have decreased by 20.1% and hydrocarbon emissions have decreased by 28.5%. If the busway had not been built, even with the improvement in emissions control and the configuration of the freeway, the additional cars on the road would have produced emissions of carbon monoxide only 5.2% lower than early 1973, and the hydrocarbon emissions would have decreased by only 16.4%. This indicates that the busway is producing a reduction of 15.7% in carbon monoxide emissions and 14.4% in hydrocarbon emissions relative to conditions which would have existed had the busway not been built, i.e., about a 15% reduction in air pollutants. This is too simple a model to have much precision, because, if all those cars were dumped on the freeway at once, some drivers would divert to the parallel roads. However, the San Bernardino Freeway carries 42% of the corridor traffic (see previous Figure 20), and the driver's options are limited. Furthermore, the only effect of the movement of a car to one of the parallel streets is that pollutants are emitted over a slightly wider band.

*Caltrans District 7, Advance Planning Section, traffic data.

It is difficult to compare these results with the Shirley Highway experience because the California pollution control law is more stringent than that of any other state. Also, the Shirley Highway data cover the time period 1971-1973 instead of 1973-1974. However, if after two years the results given in the second year report* are converted to the units of pounds per freeway mile, the results seem as comparable as the difference in circumstance permits.

Emissions Savings
(Pounds saved per peak period, per freeway mile, per day)

	Carbon Monoxide	Hydrocarbons
Shirley Highway	594	75
San Bernardino Freeway	388	55

Further growth in busway patronage will generate further savings. In a very rough-cut approximation, each 1000 passengers of the current composition (69% ex-drivers) added to the peak-period patronage will decrease the emissions over the freeway area by an additional 2% compared to the pre-busway emissions.

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*<u>Shirley Highway Project...Second Year Results</u>, p. 41.

VIII. SCHEDULE RELIABILITY

This chapter is devoted to the issue of the impact of the busway on schedule reliability (or, as discussed below, on trip time consistency). It has always been the contention of those who favored busways that a major benefit of the exclusive bus roadway would be a much more reliable service offered to the customer.

Although the bus passenger believes that the bus schedule is supposed to be an accurate charting of the desired position of the bus within the system at a specific time, the person who creates such a schedule operates under a more complicated set of rules than that statement implies. At SCRTD, bus drivers operate under two injunctions: "Don't fail to pick up all potential passengers" and "Don't deliver them to their destination late." Thus, during the pick-up portion of the route, they may not be early, and during the delivery portion, they may not be late. For a route which is wholly downtown, or any route for which both pick-up and delivery occur over the whole route, the schedule then becomes a rigid framework within which he operates.

For the commuter bus the pick-up mode is at one end of the route and the delivery mode at the other. For such a route, the published bus schedule in the pick-up area is carefully balanced between giving a time so early that potential riders must always wait a long time for the bus to arrive and one so late that the bus must wait at stops in order not to leave early. In the delivery area, the published portion of the schedule gives times which permit the bus not to be late except under major disruption.

A further complication in the demands on schedule-makers is that buses must arrive in pick-up areas with some regularity so that potential passengers can easily memorize the applicable portion of the schedule. An alternative to this is a frequency of runs so high that no memorizing is necessary, but this alternative is only rarely commercially feasible.

With these criteria for developing a bus schedule, it is clear that the difference between one type of highway and another for the bus route will not affect the accuracy with which a schedule will be met. What will be affected is the time interval allowed on the schedule to cover the route. For a road which has consistently heavy or light traffic, a reasonably constant time to traverse a given distance can be expected. For roads which vary in traffic volume, like freeways, it is necessary to set the schedule to allow for the worst congestion, and expect the bus to be frequently early in the delivery mode.

Another aspect of scheduling is the selection of the sequence of trips to be undertaken by a given bus and driver. This task must take into consideration human needs for regular rest breaks and produce a sequence of trips which minimizes dead-heading and the possibility of error. The schedule must build in some "fudge" factor against the possibility of late arrival from the previous run, so that lateness on one run will not accumulate through the day.

Given all these requirements on the making of schedules, what, then, can be the impact of the busway on schedule accuracy? A characteristic of the San Bernardino Freeway Express Busway is that it is the link between the pick-up mode and the delivery mode. With the exception of the College and Hospital stations, which are not yet major factors in the passenger selection of busway buses, all origins are at one end and all destinations are at the other.

In the morning peak, the pick-up is in the suburbs and the delivery is downtown. In the afternoon peak, this process is reversed. If the schedule functions as defined above, the probability of buses being early should be greater at the destination than at the origin of the trip. Using the peak period data for five busway routes (401, 402, 403, 404, and 405) for two midweek days in February, this condition is to some extent substantiated. The schedule performance of busway buses is shown below:

Peak Period		Percent Early Buses	Average Difference from Schedule* (All Buses)
AM	El Monte	19.3	1.56
	Downtown	22.5	1.93
PM	Downtown	22.6	0.57
	El Monte	38.3	-.30

*Actual arrival time minus scheduled time, in minutes.

In the morning, the percentage of buses which arrive early at the downtown destination (Wilshire and Figueroa or Olive and Seventh) is slightly larger than at El Monte, even though the average deviation from the schedule increases slightly. In the afternoon, the percentage of early buses nearly doubles at the El Monte destination, and the average arrival at El Monte is almost a minute earlier than the downtown departure.

A similar computation for buses traveling on the freeway, without benefit of exclusive busway lanes, yields much more striking data. These buses travel between park-and-ride lots in Fullerton and La Mirada and downtown Los Angeles. The schedule performance of freeway buses follows:

Peak Period		Percent Early Buses	Average Difference from Schedule* (All Buses)
AM	Fullerton La Mirada	21.3	0.39
	5th & Flower	65.9	-3.89
PM	5th & Flower	18.5	1.64
	Fullerton La Mirada	85.2	-8.96

*Actual arrival time minus scheduled time, in minutes.

As shown above, most afternoon buses arrive early by an average of almost nine minutes. In the afternoon, both the busway buses and the freeway buses spend about ten minutes in the downtown area. Then the busway buses travel a fairly regular 13-14 minute trip by the busway to El Monte. The freeway buses travel with the traffic flow on the Santa Ana Freeway for times which average 32 or 35 minutes, according to the route, but even in this small sample range from 21.5 to 46.25 minutes. The scheduler must therefore allow a much larger interval beyond the average time for buses traveling with the traffic flow on this freeway than he does for busway buses, in order to be sure that buses do not arrive late. This suggests that the variability of arrival, in relation to the mean travel time, is the statistic which defines the impact the kind of highway will have on the make-up of the schedule. The ratio of the standard deviation to the mean (here called the variability ratio) is suggested. Table 21 displays the variability ratio for buses traveling on the busway, in the downtown area, and on the freeway with the traffic flow.

The busway has consistently lower values, at about seven percent, compared to values of fifteen to twenty percent for other types of highway.

Table 21
VARIABILITY RATIO, BY TIME OF DAY AND TYPE OF HIGHWAY

Time of Day	Busway	Downtown	Freeway Fullerton	Freeway La Mirada
AM Peak	.074	.107	.145	.150
Midday	.053	.129	no runs	
PM Peak	.068	.239	.150	.152
Avg. run time	13-14 min.	10-12 min.	35 min.	32 min.

The implication of these differences for the schedule-maker is that allowing 15% more than mean travel time on the busway route will produce few late buses. To insure that buses are not late on downtown streets, 39% of the mean would be added, and for buses traveling in the stream of traffic on the freeway, 30%.

Further advantage can be taken of this lane variability ratio in the selection of trips to be undertaken by a given driver. The allowance of additional break time, to prevent the accumulation of lateness through the day, can be less for busway routes than for downtown or freeway bus routes. The combination of the lesser schedule allowance and the shorter break-time allowance means that the busway adds to potential productivity.

For those bus schedules made under different policies than those described here, the objective is the same: to carry the maximum number of passengers in the most efficient manner. The use of a busway permits the bus to travel a given distance in a more constant time than do downtown streets or the stream of traffic on the freeway. This minimizes the allowance on the schedule for traffic variation.

In summary, the busway does not add to schedule reliability in the sense that buses meet the schedules better. The schedules are constructed with the knowledge of how the bus performs on a particular kind of roadway and with the additional constraints, of equal importance, of spacing runs at regular intervals and picking up all potential passengers. The impact of the busway on the schedule is that shorter travel times can be allowed which, in turn, are translated to more efficient use of buses and drivers.

IX. TIME AND MOTION STUDY

The evaluation of the busway includes various time-and-motion studies of how efficiently the busway system processes passengers and buses at stations and downtown. This chapter reports the data from those studies and lays the base for the busway capacity computations offered in the next chapter. Further details and supporting data are given in Appendix B.

EL MONTE STATION

Park-Ride, Kiss-Ride Passenger Flows

Cars enter the El Monte Station parking lot from a single entrance at Santa Anita Avenue, and a signal at this intersection allows six cars to come through on "green" from either direction. Fifty yards beyond this entrance all cars must pass a ticket booth. A car with a monthly ticket can be served by the ticket booth in four seconds, with the average time observed being 5.5 seconds.

Most cars had a single occupant; very few carpools came to the lot. There was no sign that carpools were forming at this lot for other destinations. Twenty to twenty-five percent of the arriving passengers were kiss-and-ride.

The early arrivals could park near the terminal and walk to the station quickly. At 6:30 AM, the total time from the Santa Anita entrance to boarding platform is about three minutes. By 7:30, the lot has filled to a point that the parking time is slightly increased and the walk to the terminal is longer, producing a total time of five minutes. By 8:30, the lot is completely full, and people are either parking in a temporary lot beyond a wire fence or seeking to get into an illegal space. Because there are so few of these latecomers, few observations of them were made, and the estimate of the total time of almost eight minutes is not very reliable.

Once inside the lower level of the station, passengers can get to the upper level and boarding areas by elevator, escalator, or stairs. Essentially, none of the commuters use the elevator. In the morning, about eight percent of the people prefer to walk up. In the evening, over twenty percent prefer to walk down.

At night, people do not return in the same order as they arrive in the morning. As a result, the lot empties in an apparently random order. The time to walk from the terminal to the car is reasonably constant, and the average walk time in the evening is less than the reverse trip in the morning.

At 5:15, short queues of departing cars build up at the end of the parking lanes where they merge into the exit road, which costs an additional 30 seconds in egress time. At all other times, it takes a fairly constant four minutes from platform to street in the evening.

<u>Bus Flow</u>

Eastbound buses enter the station from the end of the busway; westbound buses enter on a bus-only road which connects to Santa Anita Avenue. Buses from either direction merge to approach the TV camera, at which point a berth is assigned by the service director (see Figure 33), and then continue on to the berth and the station exit. There is a stop sign at the end of the busway and buses leaving the station, whether eastbound toward the street or westbound toward the busway, must cross in front of buses stopped at this sign. Exiting buses have the right-of-way. (See Figure 10 in Chapter II.)

FIGURE 33 STATION DIRECTOR'S CONSOLE, EL MONTE STATION

Buses entering the station from the busway average five to six seconds from stop sign to TV camera, if not delayed by exiting buses. In congested periods, times of 10 to 15 seconds are not rare, so that the average peak period time is eight seconds. Buses coming from the street average eight to ten seconds from street to TV camera, but in AM peak period can be delayed up to 30 seconds, so that average access time is 12 seconds.

Once the bus leaves the camera, the path to the berth and to the exit covers the same distance regardless of which berth is used, and results in an average time of 43.5 seconds for cruise-in to berth plus cruise-out to exit. (See Appendix B for details.) The variations around the mean cruise-time values are large, usually because one or two measurements are very much larger than the rest. At the present level of service at El Monte, there is about one chance in 30 that a bus will be delayed 20 seconds or more in acess to or egress from the berth because another bus is using the single lane around the terminal. If there were no interference from other buses, the average time would have been 42.8 seconds. As the number of buses using the terminal increases, the likelihood of such tie-ups also will increase. It is not known how rapidly they will increase and what this will do to the average cruise-in/cruise-out time.

Time Required to Board/Deboard

As part of the time-and-motion study, the time required to board and deboard was measured at El Monte Station. This station is designed so that departing passengers can leave the loading area easily, without interfering with those waiting to board. The assignment of buses to berths is such that people waiting to board know at approximately which berth their bus will arrive. As the bus leaves the holding area (where the TV camera is located), an announcement is made over the loudspeaker specifying the exact berth. While they are preparing to board, the waiting people form an orderly queue (see Figure 34). As a result of all these features, there is a minimum of pushing and shoving within the queues, and the data which result probably represent a rather efficient process.

When passengers were being counted and timed, data takers were asked to indicate conditions which caused a delay in the normal boarding or deboarding process. These were categorized as follows:

- passengers with chronic* physical disabilities, such as braces, blindness
- passengers with acute physical disabilities, such as being too short to reach the steps, too heavy, pregnant, elderly, wearing casts
- passengers with situational disabilities, such as a crying child, a heavy package
- passengers requiring information or a transfer from the driver

The data were separated into two groups—those boarding or deboarding events which were apparently normal in tempo, and those which contained one or more of the above aberrations. A least-squares straight line fits each of the normal boarding/deboarding sets of data. The accuracy of the fit was not appreciably improved by using quadratic or exponential curves.

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*Names of disabilities selected are those defined in Travel Barriers, Transportation Needs of the Handicapped, prepared for Department of Transporation Office of Economic and Systems Analysis, Washington, D.C., by Abt Associates, Inc., Cambridge, Mass., August 1969, Contract T8-304, p. 12.

FIGURE 34 PASSENGERS BOARDING AT EL MONTE STATION

The equation for the number of seconds to board the bus, T_B, in terms of the number of passengers, P, is

$$T_B = 0.5 + 1.936P$$

The equation was not forced to have a zero intercept, but the start-up time which resulted is negligible.

The equation for the number of seconds to deboard the bus, T_D, in terms of the number of passengers, P, is

$$T_D = 3.8 + 1.127P$$

Here there is a longer start-up time while the queue forms in the bus or, if only a few are deboarding, the latter walk to the door from their position in the bus. Even though only the normal boardings/deboardings were used in deriving these equations, there is still some variation between individual boardings. Nevertheless, the two equations given here account for 82% of the total variation in T_B, and 77% of the total variation in T_D.

The above equations describe the normal boarding/deboarding process. Those events in which delays had occurred were examined next. The equation for normal boarding was evaluated, and the increment of delay time was determined. It was found that in some cases, mostly when large numbers of passengers were involved, even though delay conditions were noted the increment was negative. These events were discarded in the computation of the likelihood of delay and in the amount of delay. Table 22 displays the frequency of the delays, by type.

When two numbers occupy a position in the table, the first number is the original number of observations. The second number is the number of observations which actually produced delays and is the value represented by the percentage. In general, 14.1% of the boardings/deboardings displayed some delay. The most frequent type of delay was informational, on boarding, which is three times as frequent as informational on deboarding.

Table 22
DISTRIBUTION OF TYPES OF DEL.Y AT EL MONTE STATION

Type of Delay	Deboard No.*	Deboard %	Board No.*	Board %	Total No.*	Total %
Chronic	4/ 4	1.6	6/ 6	2.5	10/10	2.1
Acute	9/ 9	3.7	3/ 2	0.8	12/11	2.3
Situational	11/11	4.5	9/ 8	3.4	20/19	3.9
Informational	11/ 7	2.8	24/21	8.8	35/28	5.8
All delays	35/31	12.6	42/37	15.5	77/68	14.1
Normal boardings/ deboardings	215	87.4	201	84.5	416	85.9

*No. before oblique line = observations; no. after = real delays.

To estimate whether or not there was any pattern to the delays (such as whether or not informational delays were shorter when there were a lot of people), the data were plotted, but the sample sizes are small and no obvious patterns emerged. As a result, only average delays by category were computed. These are given in Table 23.

Table 23
AVERAGE AMOUNT OF DELAY PER PASSENGER BY CATEGORY AT EL MONTE STATION

Type of Delay	Deboard (seconds)	Board (seconds)
Chronic	15.2	10.8
Acute	13.1	3.5
Situational	14.2	16.0
Informational	25.7	15.6

The 3.5 value under "acute, boarding" represents only two events. Those who seek information on deboarding do seem to take longer than those who are boarding.

The conclusion to be derived from these two tables is that if the expected time of delay is added to the original curves an additional 2.2 seconds should be added to the boarding time and 2.1 seconds to the deboarding time, yielding total (TT) of

$$TT_B = 2.7 + 1.936P$$

and

$$TT_D = 5.9 + 1.127P$$

These equations, then, represent the average boarding and deboarding time of all passengers at El Monte Station.

An alternative method of treating the delays would have been to add the delays of each type as observed. This would have produced the equations

$$TT_B = 0.5 + 1.936P + 10.8C + 3.5A + 16.0S + 15.6I$$

and

$$TT_D = 3.8 + 1.127P + 15.2C + 13.1A + 14.2S + 25.7I$$

where P is the total number of passengers,
C is the number with chronic disabilities,
A is the number with acute disabilities,
S is the number with situational disabilities,
and I is the number with informational requirements.

Passenger Demand

Counts were taken on February 14 of the numbers of people boarding and deboarding buses during a 7.5 hour period. These data were used to derive the bus dwell time in berth at El Monte Station by hour of day. However, when the data were tabulated, additional information emerged. The pattern of boardings/deboardings throughout the day is more complicated than commuters boarding in the morning and deboarding in the afternoon. The number of buses and the number of passengers boarding and deboarding by time of day are given in Tables 24, 25, and 26. Buses which terminated at El Monte Station were counted as having zero boarding time. These data include buses in both directions.

The passenger count for the morning peak is given in Table 24. During this period 1616 people boarded and 402 deboarded.

Table 24
PASSENGER DEMAND, AM PEAK PERIOD, EL MONTE STATION

	6:00–6:29	6:30–6:59	7:00–7:29	7:30–7:59	8:00–8:29	8:30–8:59	Total
Board:							
No. of buses	13	29	34	24	18	14	132
No. of pass.	176	345	459	365	187	84	1616
Avg. per bus	13.5	11.9	13.5	15.2	10.4	6.0	12.2
Deboard:							
No. of buses	14	29	34	20	19	15	131
No. of pass.	48	117	111	48	48	30	402
Avg. per bus	3.4	4.0	3.3	2.4	2.5	2.0	3.1

If it is assumed that all 402 who got off one bus transferred to another, 1214 people came to the station to board the bus. This seems a reasonable assumption, because the El Monte Station is not a probable destination point in the morning. The total number of cars parked in the adjoining lot on that date was 1026, and 295 kiss-ride cars came to the lot. Data collected by time of day on January 20 and February 27 indicate that 94% of the parked cars and 83% of the kiss-ride cars came by the end of the morning peak. Applying these percentages to the February 14 data yields 964 parked cars and 245 kiss-ride cars by the end of the morning peak, for a total of 1209.

The peak hour as determined by number of buses is 6:30-7:30. During that time 63 buses went through the station, with an average of 12.8 people boarding and 3.6 people deboarding, per bus. During the hour from 7:00-8:00, more people board the buses and more people deboard per bus. There are then 14.2 people boarding and 2.9 people deboarding, per bus.

Table 25, the midday demand, shows a sharp rise in the number of people deboarding between 3:00 and 3:29 and a sharp rise in the number of people boarding 30 minutes later. These people include the returning shopper, the student, and the reverse commuter. However, the larger number boarding compared to deboarding in the 3:30-3:59 time interval probably includes commuters returning before the peak period who are forced to transfer at El Monte.

Table 25
PASSENGER DEMAND, MIDDAY, EL MONTE STATION

	2:00-2:29	2:30-2:59	3:00-3:29	3:30-3:59
Board:				
No. of buses	9	14	14	14
No. of pass.	56	47	59	132
Avg. per bus	6.2	3.4	4.2	9.4
Deboard:				
No. of buses	9	15	14	16
No. of pass.	61	55	126	161
Avg. per bus	6.8	3.7	9.0	10.1

The passenger count for the evening peak period is shown in Table 26. Although deboarding passengers are the largest group (2040), there is also a large group of boarding passengers (1055), implying that 2.5 times as many people are transferring at El Monte Station in the afternoon as in the morning (when there are only 402 deboarding passengers—assumed to be people who had to transfer).

Table 26
PASSENGER DEMAND, PM PEAK PERIOD, EL MONTE STATION

	4:00-4:29	4:30-4:59	5:00-5:29	5:30-5:59	6:00-6:30	Total
Board:						
No. of buses	18	24	31	31	11	115
No. of pass.	123	246	302	296	88	1055
Avg. per bus	6.8	10.2	9.7	9.5	8.0	9.2
Deboard:						
No. of buses	18	24	30	32	11	115
No. of pass.	394	443	618	431	154	2040
Avg. per bus	21.9	18.5	20.6	13.5	14.0	17.7

When the commuter leaves in the morning, he usually has only one route available to him, and that route may well take him to his destination. In the evening, the commuter returning from the city may well have the choice of several routes to El Monte, even though only one will take him home. The increase in the number transferring on the return trip suggests that people take the first possible bus to El Monte, even though it cannot save them time. They prefer to wait at El Monte Station instead of at a street corner.

In the on-board survey, conducted in the morning between El Monte and Los Angeles, only 5.3% of the respondents indicated that they had transferred to the bus on which they were riding. This suggests a group of about 200 transfers in the westbound direction each morning. The only explanation for the difference in this figure and 402 cited above, which is the number transferring in both directions, is that a great number of reverse commuters are having to transfer to continue to their eastward destination.

The PM peak hour as determined by number of buses (62) is 5:00-6:00, with an average of 9.6 people boarding and 16.9 people deboarding, per bus. The hour from 4:30-5:30, however, has more people deboarding (10.0) and more people per bus both boarding and deboarding (19.6).

<u>Total Time for a Bus to Pass through El Monte Station</u>

The pattern of bus travel around the station is different in the AM from the PM, as is the pattern of boarding and deboarding. For that reason, the total time that a bus spends in the station is different in those two time periods. Table 27 gives the total time per bus in the station if everything is done as efficiently as possible during the time of maximum congestion. The times to board and deboard have been computed by combining the average number of people who board and deboard in the peak hour with the equations given earlier in this chapter.

Table 27
TOTAL BUS TIME IN EL MONTE STATION

	AM Peak (seconds)	PM Peak (seconds)
To TV camera	12.0	8.0
Cruise in and out	43.5	43.5
Deboard	9.2	28.0
Board	30.2	22.1
Total	94.9	101.6

In the afternoon, there is a saving in access time to the TV camera. However, the extensive transferring in the afternoon increases the boarding time beyond that which one might expect, so that the total time in the afternoon is 6.7 seconds longer than in the morning.

This difference seems trivial when considered on the basis of a single bus, but when this is compounded through all the berths for an hour's time, it has an impact on the number of buses which can be processed through the station.

HOSPITAL STATION

All measurements made at the Hospital Station were taken in the area where passengers board and deboard. They included bus flow time, passenger count, and board/deboard times. Because there is no parking lot associated with this station, no study was made of access and egress. During February 11 and 13, 252 buses were observed westbound between 6:00 AM and 9:00 AM, and 268 buses were observed eastbound between 2:00 PM and 6:00 PM. Of these, 97 failed to stop, westbound, and 30 failed to stop, eastbound. (Stopping is not required if no passengers are boarding or deboarding.) There is no sign that the station is being used as a transfer point.

The average dwell time of the bus at the station was 3.02 seconds in the morning to board .087 people and deboard 1.06. In the afternoon, the time was 3.22 seconds to board 1.07 people and deboard .071. (No attempt was made to segregate the board and deboard times and the delay times.) It would appear that the incremental rate of time per passenger to either board or deboard as derived at El Monte Station is reasonably the same as at this station, but the intercept (start-up time) of almost six seconds on the deboard curve is higher than is observed at this intermediate station.

As at El Monte Station, conditions which delayed the board/

deboard process were noted with a description of the cause. The number of such delays was 34, which is 11.5% of the 293 boardings/deboardings. These delay times were included in computing the average bus dwell times.

The bus time in the station, defined as the time elapsed from when the front wheels hit the concrete deceleration lane leading to the boarding area until the rear wheels leave the concrete acceleration lane, varied from less than 15 seconds to one minute and 15 seconds, with the longer intervals not necessarily associated with extended boarding or deboarding times. The average time westbound was 31 seconds and eastbound was 35.5 seconds. This four-second difference cannot be attributed to a longer boarding/deboarding process in the eastward direction.

DOWNTOWN BUS OPERATIONS

Deboarding Locations

The on-board survey in November asked several questions about the downtown (deboarding) portion of the passenger's trip. The following is the distribution of deboarding locations:

Location	%
Olive, before Pico	33.2
Spring	25.8
1st, 7th, Wilshire before Figueroa	19.4
Wilshire Corridor beyond Figueroa	12.0
Other, outside CBD	9.6

Passengers in the first three entries (78.4%) deboarded within the area bounded by Temple Street and Pico Boulevard on the north and south, and by Los Angeles Street and Figueroa Street on the east and west (see Figure 14 in Chapter II). Once they

FIGURE 35 PASSENGERS BOARDING DOWNTOWN

get off the bus, 83% of the passengers walk to their destination, with three-fourths of these walking two blocks or less.

Boarding/Deboarding Times

An extensive analysis of time to board/deboard, as related to the number of passengers, was made at El Monte Station because the range of the number of passengers per bus was greater there than at any other location measured. When these curves were compared with boarding/deboarding times at the Hospital Station, it was found that the boarding curve at El Monte was similar and that the incremental time for additional passengers to deboard was similar. However, all deboarding times were higher than observed at Hospital Station. A similar phenomenon is observed when comparing the El Monte and downtown data. Since the downtown data cover a wider range of passengers deboarding than the Hospital Station data, it is possible to estimate the difference in queuing up time before deboarding for the CBD. It appears that an additive constant of 0.5 seconds for normal deboarding events would be the best estimate (as opposed to 3.8 seconds measured at El Monte). This means that the equations for downtown, including the expected time of delay for those with disability, are

$$T\ T_B = 2.7 + 1.936P$$

and

$$T\ T_D = 2.6 + 1.127P$$

The difference in equations between the El Monte Station and elsewhere probably can be explained from the combination of the geometry of the station and the speed of the bus. In the downtown area, the bus is traveling at five to ten miles an hour over relatively straight paths, so that people who are concerned about not getting off at the right corner may feel that it is safe to walk toward the door as the bus approaches their deboarding point. At the El Monte Station, the bus approaches the station at 45 mph, stops, and swings around the circle to the berth. Not only is this a less safe circumstance for walking toward the door but the likelihood of missing the chance to deboard has evaporated, causing the deboarding time to be greater at El Monte Station than elsewhere.

Dwell Time at Bus Stop

The analysis of the dwell time of a bus at a bus stop was limited to two locations, 6th and Olive and Spring Street at City Hall. The first was chosen because the downtown deboard information from the on-board questionnaire indicated that more people get off the bus at that corner in the morning (11.4%) than at any other location. In the afternoon, the comparable stop is 7th and Olive, so this point was used for PM peak data. Spring Street at City Hall was chosen as a location where many buses pass, even though not as many people (7.4%) deboard. The results of this analysis are shown in Tables 28 and 29 .

Table 28
BUS DWELL TIME, 6TH OR 7TH AND OLIVE

Time of Day	February 11 No. of Buses	February 11 Time/bus (Seconds)	February 13 No. of Buses	February 13 Time/bus (Seconds)
6th and Olive:				
6:30 7:00	12	50	14	42
7:00-7:30	23	41	21	41
7:30-8:00	26	42	26	47
8:00-8:30	17	47	20	44
8:30-9:00	8	41	12	40
7th and Olive:				
4:00-4:30	12	-	13	32*
4:30-5:00	15	-	14	39*
5:00-5:30	13	-	15	36*

*Bus routes 403, 404, 405 only.

Table 29
BUS DWELL TIME, SPRING STREET AT CITY HALL

Time of Day	February 11 No. of Buses	February 11 Time/bus (Seconds)	February 13 No. of Buses	February 13 Time/bus (Seconds)
6:30-7:00	19	14	18	16
7:00-7:30	31	11	37	9
7:30-8:00	35	6	35	7
8:00-8:30	23	5	20	6
8:30-9:00	12	10	11	12
4:00-4:30	23	22	25	31*
4:30-5:00	32	13	28	13*
5:00-5:30	37	15	37	14*

*Bus routes 401, 402, 403, 404, and 405.

Most buses stop at 6th and Olive, and many people deboard here in the morning. The average dwell time per bus is much longer than the average deboarding time, which is frequently only 25 to 30% of the dwell time. This suggests that buses are impeded from leaving, presumably by another bus in front. Although the number of buses per half hour does not exceed 26, a total of 20.5 minutes of stopped time is accumulated in one 30-minute interval, with an accompanying 47-second time per bus.

At the City Hall stop, although as many as 37 buses pass in a 30-minute period in the morning, relatively few stop to deboard passengers. The average dwell time of all AM buses, including those which did not stop, is under 10 seconds.

The Contraflow Lane

The contraflow lane is a bus-only lane on Spring Street (otherwise a one-way street) on which buses travel in the opposite direction from other traffic (see Figure 36). During the

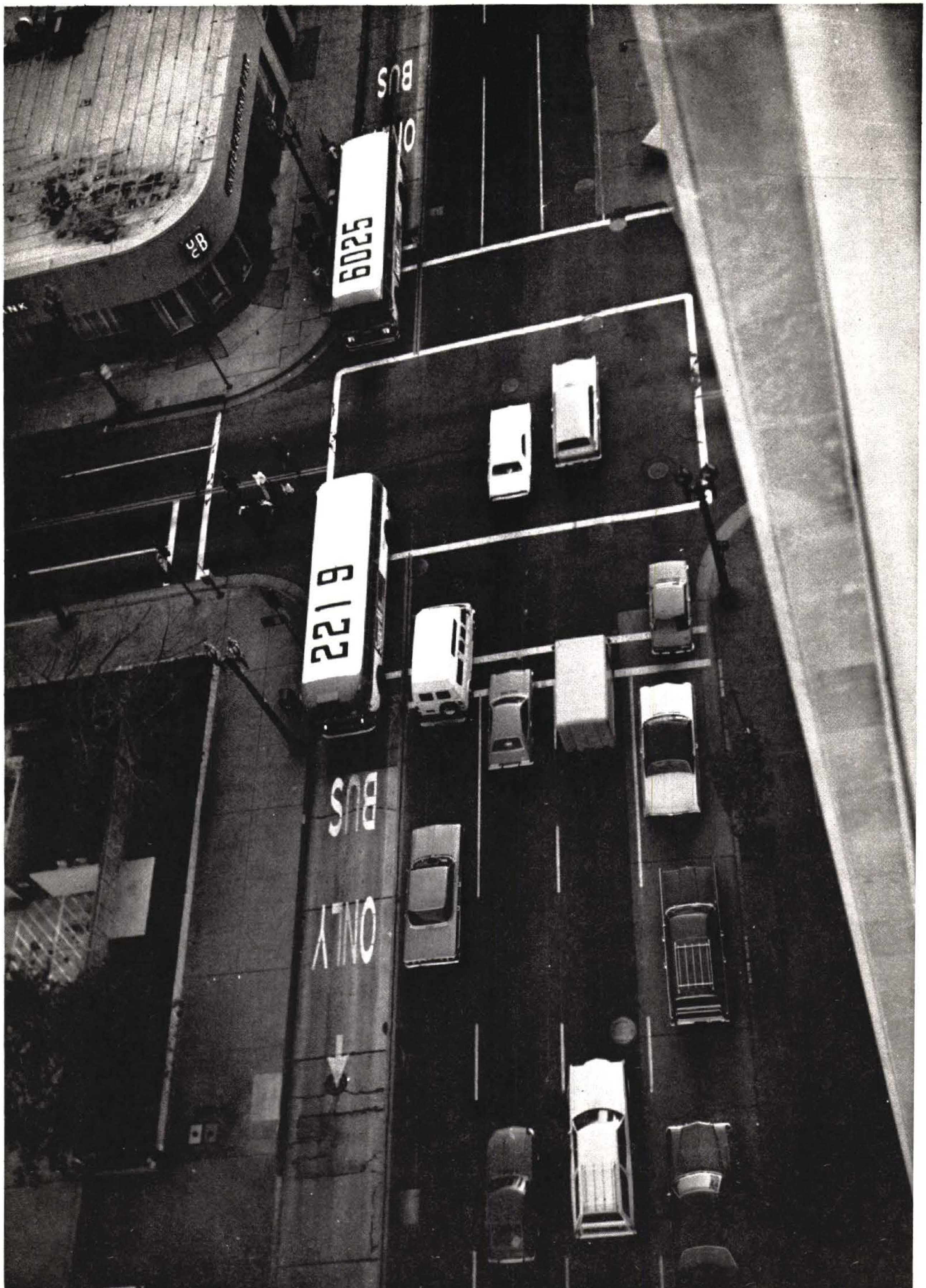

FIGURE 36 AERIAL VIEW OF CONTRA-FLOW LANE

recent measurements of downtown traffic flow, observers on both sides of Spring Street clocked buses between City Hall and Sixth Street, a distance of about five blocks. This included buses going with the traffic flow and in the contraflow lane. The direction of peak flow on Spring Street is such that most buses travel with the traffic flow in the AM, deboarding passengers, and travel on the contraflow lane in the PM, boarding passengers. Among several reasons for establishing the contraflow lane was the hypothesis that it would move the buses through the area more rapidly. According to data collected, the time savings has not occurred. Following is the average bus time, in minutes, on Spring Street between City Hall and Sixth Street:

Lane	AM Peak	Midday	PM Peak
With-flow	3.4	2.8	2.7
Contraflow	4.6	4.2	4.4

The peak usage of the contraflow lane in the afternoon produces average times a minute longer than the peak use of the with-flow lane in the morning. There appear to be several possible reasons for this. The boarding data indicate that no more than 15-20 seconds of the difference is likely to be associated with the fact that boarding is slower than deboarding. The lights are necessarily timed for the with-flow direction, and that will cause some time to be lost, and the slower rate of boarding may compound that problem. Since this is a single lane, no bus may pass another, but the amount of delay caused by this is unknown. One of the reasons why the contraflow lane was constructed was that it was considered to be one block closer than the route previously used to most PM peak trip origins. Therefore, the total time from office to departure from the CBD probably is not increased. As a result, this application is probably time-effective, but, in general, contraflow lanes in themselves do not save travel time if they are constructed without preferential traffic signaling and operate in the boarding mode.

(Furthermore, there is no evidence to suggest that preferential signaling is feasible for the boarding mode.)

Thus, it appears that the contraflow lane has not solved the basic problem of speeding downtown passenger distribution consistent with the greatly increased speed of the busway. However, it has demonstrated two positive features: obtaining the improved routing and proving the safety of contraflow traffic.

PEAK HOUR DOWNTOWN TRAFFIC

The data on the traffic congestion in the downtown area, presented in Table 30, are the result of the time-and-motion

Table 30
PEAK HOUR DOWNTOWN TRAFFIC*

AM Peak	Spring between 4th-5th	Olive between 5th-6th	First between Hill-Olive	Seventh between Olive-Grand
Peak-hour flow (units)**	1883	694	1004	788
Percent saturation	94	59	73	70
Non-busway buses	105	22	48	62
Busway buses	25	47	47	20
PM Peak	**Contraflow Approaching 3rd**	**Olive between 1st-4th**	**First between Spring-Bdwy.**	**Seventh between Olive-Grand**
Peak-hour flow (units)**	60	1005	1255	596
Percent saturation	16	67	73	48
Non-busway buses	62	7	44	61
Busway buses	18	47	47	18

*Most congested link.
**Units of passenger cars; one bus equals two cars.

study conducted on February 11 and 13. In addition, the City of Los Angeles Department of Traffic provided the values on peak hour flow and percent of saturation flow. These values pre-date the bus counts slightly but are the most recent available on a wide scale. The non-busway bus counts were obatined from schedules, and the busway buses are those counted on February 13. (Minor changes in on-time performance cause changes in the count when only a slice of the peak period is selected.)

Busway downtown routes were scanned and the most congested link (usually one block) on each downtown street was selected. The data derived from counts taken at these selected points describe the worst congestion for an area in which the bulk (78.4%) of the busway commuters deboard in the morning. The most congested link is Spring Street between 4th and 5th.

Note that the flow measurement in the PM peak on the contraflow lane (60 units or 30 buses) does not correspond to the 80 buses (62 non-busway plus 18 busway buses) noted in the same column. This is attributed to the difference in time when data was taken. The flow data were taken earlier when there was lighter use of the contraflow lane. The other columns of data are not believed to be so affected.

X. CAPACITY OF THE BUSWAY SYSTEM

DEFINITION

In simplest terms, the capacity of a busway system is the maximum number of buses per hour which can be sent through the system. The estimated number of buses per hour which can be processed at the stations depends on the assumptions made about boarding/deboarding and the path of the buses through the station. The number of buses per hour which can be driven over the busway lanes depends on the spacing between buses, whether or not passenger cars are mixed in with the buses, and the speed of travel. The maximum number of buses per hour which can travel the downtown streets depends on the mixture of cars and non-busway buses. The maximum numberof buses per hour which can use a bus stop depends on the dwell time and the number of non-busway buses which stop there as well. Each of these individual capacities is computed for several assumptions about the independent variables. The smallest of these individual capacities is the capacity of the system as a whole.

SCOPE OF ANALYSIS

Because boarding takes a different amount of time than deboarding and the locations for boarding and deboarding are reversed from morning to evening, capacity estimations will be made for both the morning peak and the afternoon peak periods.

Many of the measurements described in the time-and-motion study cannot be considered as constants. The cruise-in/cruise-out time at El Monte Station would increase as the number of buses being processed through the station increased because of the greater likelihood that two buses would try to use the single station lane at the same time. And dwell time at a lightly used bus stop would increase as the amount of usage increased. Nevertheless, measurements which were made will be used as constants in estimating the limitations of the busway system and, where possible, "fudge" factors applied to account for the optimism or pessimism of the computation. Frequent reference will be made to the Hoey and Levinson article* which contains a review of comparable data and suggestions for these "fudge" factors to represent the uncertainty of the process.

The elements of the system which will be evaluated are the El Monte Station, Hospital Station, busway lanes, traffic on the downtown links cited in the time-and-motion study, and bus dwell time at the downtown stops described there. It is assumed that had data been gathered for the College Station they would be comparable to time-and-motion studies conducted at the Hospital Station. (Data on the College Station were not available for this report, as the station did not open until February 1975.)

It is assumed that all busway routes will increase in proportion to their current volume. In areas where busway buses compete with other buses and with automobiles, a number of assumptions will be made to test the sensitivity of the results. These will include (1) non-busway buses do [do not] increase in the same ratio as busway buses and (2) automotive traffic is [is not] noticeably decreased over downtown bus routes as the number of buses increases.

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*Hoey, William F., and Herbert S. Levinson, <u>Bus Capacity Analysis</u>, presented at the 54th Annual Meeting, Transportation Research Board, Wednesday, January 15, 1975.

The smallest capacity computed is the capacity of the system. Should action be taken to remove that bottleneck, the capacity would increase to the next larger number. However, it is beyond the scope of this report to propose or analyze such actions which could modify the current capacity.

EL MONTE STATION

Analysis

The formula for computing the capacity at El Monte Station in number of buses per hour is

$$8(3600/TT)(1 - \text{discount})$$

where 8 is the number of berths*, 3600 is the number of seconds/hr, TT is the total time required to process a bus through the station, and the discount is a fudge factor applied to account for possible irregularity of bus arrivals.

In order to be able to use this formula, values of TT must be computed for each of the policies of boarding/deboarding and bus motion which are to be tested. The elements of total time of bus travel through the station are presented in Chapter IX.

It should be noted that the capacity estimate given by the formula must be split between eastbound and westbound buses. If the split is 80:20 in the peak direction, then the peak direction maximum flow is only 80% of this total two-way capacity.

The policies relative to boarding which are tested are four

*There are actually 10 berths, two of which are now being used by non-SCRTD intercity buses. Should these two berths be used for SCRTD commute buses, capacities here estimated would be 25% higher.

in number:

1. The same proportion of people board/deboard at El Monte Station as at present, and the number of people per bus is held constant at the present level. During the peak hour inbound on January 30, 1975, buses carried an average of 45.8 passengers and outbound buses carried an average of 47.1 passengers. Since the seating capacity of these buses is usually 48 to 50, this implies that many of the buses already had standees.
2. Hoey and Levinson suggest that capacity measurements be made with a load factor of 1.00.* This would result in many more buses having standees and would correspond to a circumstance in which the number of passengers grew more rapidly than buses could be acquired. Raising the average number of passengers to 50 implies a 9.2% increase in the number of passengers per bus boarding/deboarding in the morning and a 6.2% increase in the afternoon.
3. An additional facility is created east of El Monte so that the percentage of people boarding/deboarding at El Monte Station is decreased by 10%, although the average number of passengers per bus remains at the present level. If the method of responding to patronage growth is to build an additional station, El Monte would grow less rapidly than the system as a whole.
4. With the growth of patronage, some buses bypass Hospital and College stations. This will force more people to transfer at El Monte if they wish to go to these intermediate stops. The increase in the number of people transferring is assumed to be 20%. The transfers are the people who deboard in the AM and

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*Hoey and Levinson, Bus Capacity Analysis, p. 15.

the people who board in the PM. In the AM the people who deboard are increased by 20%, and the people who board are increased by the same number of people (not by the same percentage). In the PM the process is reversed--people who board are increased by 20%, and people who deboard are increased by the same number. The number of people per bus remains as at present.

There are two policies to be tested as to the handling of the buses in the station.

A. No bus leaves the TV camera and proceeds to a berth until the previous occupant of the berth reaches the station exit. This is approximately the way berth assignment is treated now when buses stack up.

B. No bus leaves the TV camera and proceeds to a berth until the previous occupant of the berth is perceived to have left. If this policy were used rather than the above (A), an average saving of 17 seconds might be assumed over the 43.5 seconds average cruise-in/ cruise-out time now existent.

Finally, an assumption must be made about the discount. Hoey and Levinson suggest 25%* to cover random variations in bus arrivals. The schedule reliability at El Monte Station through the peak period is excellent (see Appendix B). However, under conditions of heavier use the criss-cross flow of buses entering and exiting the station would impose delays in coming to the TV camera. If buses were arriving at five or six a minute, either the fixed use of a berth for a particular route would need to be abandoned, increasing the dwell time, or some unscrambling process from the queue waiting to go to the TV camera would be needed. Either solution would lead to an increase in the total time. In the

*Hoey and Levinson, Bus Capacity Analysis, p. 14.

absence of any other approach to a discount value, that of Hoey and Levinson has been used although some members of the SCRTD staff feel this is an overly optimistic assumption.

Results

Table 31 gives the total time, the discounted number of buses, and the discounted capacity for the four policies of loading, two policies of bus movement, and both AM and PM.

Table 31
CAPACITY AT EL MONTE STATION
(eight berths, bidirectional flow)

	Bus Handling Policies			
	AM Peak		PM Peak	
Passenger Handling Policies	A	B	A	B
1. Present proportions:				
Time/bus (seconds)	94.9	77.9	101.6	84.6
Maximum buses/hour	227	277	212	255
Capacity (people/hour)	10,400	12,700	10,000	12,000
2. More standees:				
Time/bus (seconds)	97.7	80.7	104.0	87.0
Maximum buses/hour	221	268	208	248
Capacity (people/hour)	11,100	13,400	10,400	12,400
3. Station east of El Monte:				
Time/bus (seconds)	91.8	74.8	97.3	80.3
Maximum buses/hour	236	289	222	269
Capacity (people/hour)	10,800	13,200	10,500	12,700
4. Bypass intermediate stations:				
Time/bus (seconds)	96.7	79.7	107.6	90.6
Maximum buses/hour	223	271	201	238
Capacity (people/hour)	10,200	12,400	9,500	11,200

The capacity in the afternoon is less than in the morning but by very little. The policy of more standees increases the capacity over the present but at the cost of greater passenger discomfort. This increase is greater in the AM than in the PM because the PM already has a higher average number of passengers per bus.

Building another station east of El Monte will only increase the capacity at El Monte Station a small amount if the share of boarding/deboarding passengers is only decreased by 10%. The policy of more buses bypassing the intermediate stations, which results in more transfers at El Monte, has slightly more impact in the PM when more transfers occur. Seemingly, the most effective method of increasing capacity at El Monte Station is to send the bus to the berth as soon as possible, and even that does not make massive changes.

All peak hour capacity figures given in Table 31 are approximately 4.5 to 5 times the present rate of use of the El Monte Station.

Again, the above are maximum bidirectional flows. During peak periods one can consider about 80% of this capacity allocated to the peak direction (i.e., capacity in the peak direction would be 8,000 to 10,500). If the two intercity berths are included the capacity would be raised by 25%. As stated earlier, SCRTD planning has been somewhat more conservative in its estimates. Their working assumptions have been 10 berths, three-minute cruise-in/cruise-out time, and 40 passengers per bus. This yields only 8000 passengers per hour with possibly 6000 in the peak direction. The three-minute cruise time is based on a more conservative fudge factor than Hoey and Levinson's 25%.

BUSWAY LANES

In order to compute the capacity of the busway lanes for buses only, an assumption must be made about the spacing between buses at maximum use. The assumption made here is to allow a spacing of one bus length for each ten miles an hour of speed. This is less than the 1000 feet spacing currently required on the busway and more than is currently in use on the freeway, especially at high speeds. Thus, at ten miles an hour, a bus occupies two bus lengths (70 feet), and there are 750 buses that can pass by a point in an hour. Similarly, 1210 buses spaced at five bus lengths can pass at 40 mph. Again, some discounting should be applied to account for unevenness in flow, particularly at entry and exit points and at the point where the buses from the Del Mar ramps merge with those coming from El Monte. Hoey and Levinson's 25% is used with the assumption that in this case it leads to a conservative final estimate.

This relationship between capacity and speed is the curve labeled 100% in Figure 37. The lowest speed on the open lanes is 35 mph. This yields a capacity of 875 buses an hour after discounting. (This is 40,000 people per hour at the current inbound load of 45.8 people/bus, and 43,750 people per hour at 50 people/bus.)

At the intermediate stations buses must slow to 10 mph. Thus, the limiting location on the busway lanes is at these intermediate stops, even if no buses stopped there. This is discussed further under the station evaluation section (which follows) rather than here. The 35 mph point is considered to be the capacity limiting point of the busway lanes.

The estimates given in Figure 37 depend on the spacing and discounting assumptions. However, these are unimportant because the busway lanes have a capacity many times greater than other points of the system. Much more conservative assumptions could be used (although the authors do not believe them to be warranted) and the busway lanes would still not restrict system capacity. (Spacing policy through the stations is critical, however. This is discussed later.)

The lower curves in Figure 37 show the impact on the bus lane

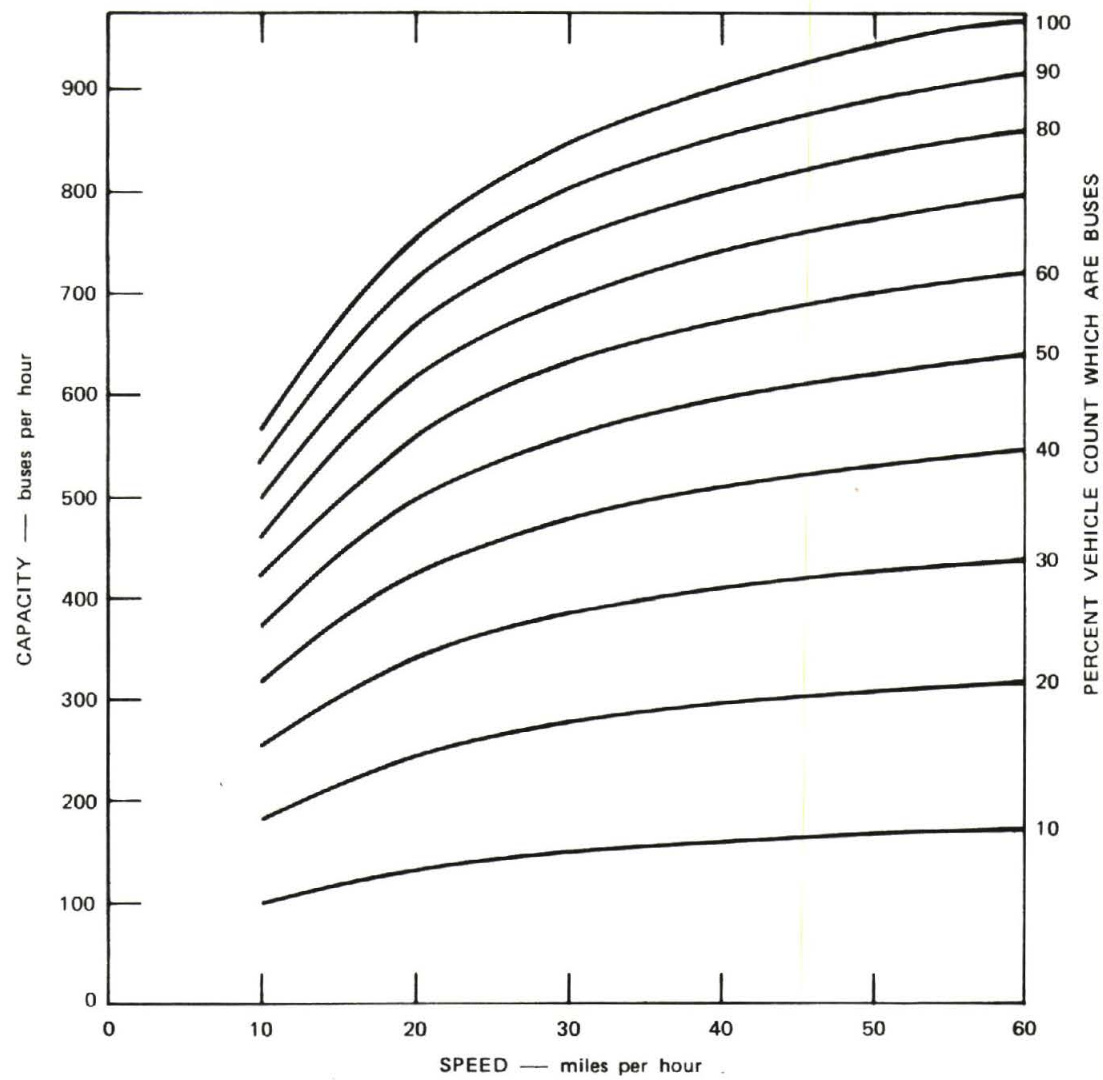

FIGURE 37 CHANGE IN CAPACITY WITH SPEED AND MIXTURES OF PASSENGER CARS

capacity as carpools are introduced. The percents on the curve labels are the percents, in terms of vehicles, of the total traffic which are buses. (Note that these curves are for a single lane of traffic and would not apply for downtown traffic, which has multiple lanes for travel.) These lower curves will be discussed later in this chapter.

HOSPITAL STATION

The procedure for computing the capacity at Hospital Station is the same as at El Monte, except that the number of berths is not as well defined. There is room for two buses, but if the nearer berth is filled the further one cannot be entered. The expected number of berths available is a function of the volume of buses stopping at the station. For this analysis we have used 1.5 berths as the expected value when the system is operating at capacity. The capacity in number of buses is then

$$1.5\ (3600/TT)\ (1 - \text{discount})$$

where the variables are as defined in the discussion of the El Monte Station.

In this case, as opposed to El Monte, the formula yields capacities in either direction. Thus the estimate will be of the peak direction capacity.

There are two policies to be tested, and both pertain to loading. Since there is no scheduler at the station, the bus enters the berth on arrival, if possible. The first policy is as at present, when no buses bypass the station. This was shown in Chapter IX to produce combined board and deboard times of 3.0 seconds in the AM and 3.2 seconds in the PM at the present level of boarding/deboarding passengers. Assuming that the number of buses will increase proportionately with increasing demand, the number of passengers per bus will again be 45.8 in the AM and 47.1 in the PM. The number of boarding/deboarding passengers per bus (and, consequently, the board/deboard time per bus) will also remain constant.

The second policy is that as the number of buses increases some buses bypass the intermediate stops, so that the number of people per bus boarding and deboarding increases. This policy increases the board/deboard time and introduces the possibility of delay as the bus leaves the station because it must merge with the passing traffic. It is assumed that the merge delay is five seconds.

Two cases are presented here. One assumes that one-third of the buses are express and pass through the station. As a result, two buses board and deboard all the Hospital Station passengers that otherwise would be handled by three buses. This increases the board/deboard time per bus by 50%. The capacity of the station is 50% more than the number of people in the buses that stop because passengers in the express buses must be included. The second case assumes that two-thirds of the buses pass through the station. This multiplies the board/deboard time and the capacity by three.

The results in Table 32 show that at the present policy the capacity is low but that the proper selection of the percent of express buses can increase the capacity to a value comparable to El Monte Station, without having decreased the capacity at El Monte appreciably.

DOWNTOWN TRAFFIC

When a bus travels in downtown traffic, it competes for space

Table 32
CAPACITY AT HOSPITAL STATION
(For Various Express Bus Policies)

	AM Peak	PM Peak
All stopping buses:		
Number of buses stopping/hour	131	114
Capacity (people/hour)	6,000	5,400
1/3 express buses:		
Number of buses stopping/hour	108	96
Capacity	7,400	6,800
2/3 express buses:		
Number of buses stopping/hour	96	86
Capacity	13,200	12,200

with passenger cars and with other buses. The assumption already has been made that all busway routes increase at the same rate. The rate of increase of all busway buses, relative to other routes, will be treated in two ways. First, it will be assumed that all bus routes grow at the same rate. This eventuality might be a result of a parking ban program combined with a massive increase in the price of gasoline. The second case assumes that, because the quality of service is better on the busway buses, these routes grow twice as fast as the non-busway buses.

The competition with automobiles will be treated in three ways. First, the assumption is made that no cars disappear from the street as the number of buses increases. This is an unreasonable assumption because the number of buses would not be increased without people to ride in them, and these people must come from somewhere. However, since it represents the lower limit of the problem it was included in the analysis. Second, the assumption is made that the number of cars is reduced by 10%. This gives an indication of the impact of a reduction in the number of cars on the congestion. Finally, the street is treated as though no cars were permitted on it at all. This is also unrealistic, unless modifications to the bus stop patterns were made (e.g., islands would be needed to permit boarding/deboarding in the center of the street). However, it represents maximum capacity without changing the location of bus routes downtown.

The mathematical manipulations required to combine the data on peak hour downtown traffic (see Table 30) with these hypotheses is described in Appendix C. Tables 33 and 34 describe the results of this analysis for morning and afternoon peak hour flow. Two numbers are given for each case, the capacity in buses per hour and the ratio of the maximum number of busway buses on the link to the present number.* The ratio shows how much the bus system can grow before reaching capacity. Thus, a ratio of 2.0 means that the system could double.

In the morning, Spring Street between 4th and 5th is the limiting link. If the busway grows no faster than the non-busway routes and no cars are removed from the streets in the process, there is still room for up to 40% growth. The current data indicate that the busway is in fact growing more rapidly, so that growth up to 90% is possible. Most of the

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*This concept of relating the estimated capacity to present volume of busway buses is used throughout the remainder of the chapter. Present volume is taken as the number of peak hour buses in operation on the nine busway lines during the January - February, 1975 period. This number is 65 buses inbound in the morning, (and 65 buses outbound in the evening), on the busway splitting into various streams downtown. The links analyzed (Tables 33 and 34) have 23 buses on Spring Street, 42 on Olive Street and on First Street, and 19 on Seventh Street.

Table 33
AM CAPACITY OF DOWNTOWN BUSWAY ROUTES

Route	Automobile Volume Same No. of Cars	10% Fewer Cars	No Cars
Spring Street (4th to 5th):			
1. All lines grow alike			
Capacity (buses/hour)	36	52	180
Capacity/present	1.6	2.3	7.8
2. Busway rate 2 times non-busway			
Capacity (buses/hour)	44	70	306
Capacity/present	1.9	3.0	13.3
Olive Street (5th to 6th):			
1. All lines grow alike	211	230	401
Capacity (buses/hour)	5.0	5.5	9.5
Capacity/present			
2. Busway rate 2 times non-busway			
Capacity (buses/hour)	242	265	468
Capacity/present	5.8	6.3	11.1
First Street (Hill to Olive):			
1. All lines grow alike	139	159	341
Capacity (buses/hour)	3.3	3.8	8.1
Capacity/present			
2. Busway rate 2 times non-busway			
Capacity (buses/hour)	170	197	440
Capacity/present	4.0	4.7	10.5
Seventh Street (Olive to Grand):			
1. All lines grow alike	61	69	137
Capacity (buses/hour)	3.2	3.6	7.2
Capacity/present			
2. Busway rate 2 times non-busway			
Capacity (buses/hour)	86	98	209
Capacity/present	4.5	5.2	11.0

Note to reader: The upper left hand cell of the table is read: 36 is the maximum number of buses per hour (peak period) that can be moved down Spring Street at the present level of automotive traffic, under assumption no. 1, before the street is saturated. This is 40% more busway buses that were present in January-February.

Table 34
PM CAPACITY OF DOWNTOWN BUSWAY ROUTES

Route	Same No. of Cars	10% Fewer Cars	No Cars
Contraflow (approaching 3rd):			
1. All lines grow alike			
Capacity (buses/hour)	42	42	42
Capacity/present	1.8	1.8	1.8
2. Busway rate 2 times non-busway			
Capacity (buses/hour)	58	58	58
Capacity/present	2.5	2.5	2.5
Olive Street (4th to 1st):			
1. All lines grow alike			
Capacity (buses/hour)	263	301	653
Capacity/present	6.3	1.2	15.5
2. Busway rate 2 times non-busway			
Capacity (buses/hour)	278	319	695
Capacity/present	6.6	7.6	16.5
First Street (Spring to Broadway):			
1. All lines grow alike			
Capacity (buses/hour)	167	271	444
Capacity/present	4.0	6.5	10.6
2. Busway rate 2 times non-busway			
Capacity (buses/hour)	205	343	571
Capacity/present	4.9	8.2	13.6
Seventh Street (Olive to Grand):			
1. All lines grow alike			
Capacity (buses/hour)	92	97	142
Capacity/present	4.8	5.1	7.5
2. Busway rate 2 times non-busway			
Capacity (buses/hour)	138	146	219
Capacity/present	7.3	7.7	11.5

new riders are coming out of cars at 1.2 people per car. Even if only a portion of the incremental bus riders on Spring Street come out of cars, the car traffic volume should shift rapidly to the second column of Table 33, i.e., 10% fewer cars.

This result differs from previous speculation concerning the difficulty of handling so many buses in the downtown area. The captive rider already is on the bus; that market is not growing rapidly. The growth on the busway is coming out of cars and, if the busway continues to grow, the number of cars must decrease. Since one busload of people is equal to 40 cars, capacity cannot be reached, in any realistic sense, without a dramatic decrease in the number of cars downtown. For this reason, no discount factor has been applied to the downtown computation as was done in the capacity estimates for the busway lanes and stations. Some discounting would seem necessary since it would be difficult to maintain smooth bus flows with the link operating at 100% of saturation, the condition where the street's capacity to process buses is reached. As stated above, however, it does not appear that this saturated traffic level would be reached because of the resulting decrease in auto traffic. Thus, the concept of the discount factor, concerning problems of irregularity of bus flow at capacity conditions does not seem to apply here.

In the afternoon, the contraflow lane on Spring Street creates a special problem. Since that lane is already for exclusive bus use, the only meaningful parameter is the relative rate of growth of busway buses compared to non-busway buses. Thus, the capacity of the contraflow lane is no more than 58 buses/hour, unless the busway buses increase at a higher ratio, compared to non-busway buses, than two to one. Should that limit be reached, some non-busway buses would need to be removed from the contraflow lane.

DOWNTOWN BUS STOPS

The limiting bus stop in the downtown area is at 6th and Olive in the morning, and 7th and Olive in the afternoon. The same two assumptions about bus route growth as were used in the previous section are evaluated.

Table 28 in Chapter IX summarizes the current dwell time at this bus stop. The procedure for computing the capacity of the bus stop is to determine the total time of use per bus by adding the cruise-in/cruise-out time to the dwell time. Then the number of additional buses per hour which might use the bus stop are apportioned between busway and non-busway buses.

The cruise-in/cruise-out time of 20 seconds suggested by Hoey and Levinson* seems reasonable. In the AM peak this produces a total time of use per bus of 1.078 minutes. Since this is a two-berth stop, there are 120 minutes of possible bus dwell time to an hour, and 111 buses may use the stop. At present 69 buses do (22 non-busway, 47 busway),** so there is available time for 42 more buses in the peak hour. If the busway routes grow at the same rate as the non-busway, 29 of them would be busway buses, for a capacity which is 1.6 times the present volume. If the busway routes grow at twice the rate of the other buses, 34 of the additional buses would be busway buses, for a capacity which is 1.7 times the present volume. Thus, as predicted by Hoey and Levinson,*** the minimum capacity occurs at the heaviest deboard stop in the AM peak.

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*Hoey and Levinson, Bus Capacity Analysis, p. 11.

**The "present" number of buses here are those counted on February 13 in conjunction with the schedule reliability measurements, and cited in Table 28.

*** Hoey and Levinson, Bus Capacity Analysis, p. 17

In the PM peak a total of 16 buses from the 403, 404, and 405 routes and 18 buses from the non-busway routes stop at 7th and Olive. Total time of use per bus is 0.95 minutes. This is a single berth, so the hourly capacity is 63 buses, or 29 more than current usage. If the busway routes grow at the same rate as non-busway, 14 would be busway, for a capacity of 1.9 times the present level. If the busway routes grow twice as fast, 19 of the 29 would be busway buses, for a capacity of 2.2 times the present level.

SUMMARY OF METHODOLOGY USED

The models of the various portions of the busway are not uniform in approach, although it is hoped that they are consistent in result. For example, there are two treatments of the difference in time between actual board/deboard and total dwell time. At El Monte and Hospital stations this is subsumed in the discount, along with other irregularities. At the street corner it is measured. In the study of the Hospital Station the evaluation of express buses is included, but no equivalent evaluation is made of possible alternatives for the contraflow lane or the downtown bus stops, such as removing some non-busway buses.

No discount has been applied to the treatment of traffic for reasons cited earlier. The discount factor was also not applied to the bus stop computations because the capacity of a bus stop can easily be increased by lengthening the stop or by moving the stop location for some routes.

CONCLUSIONS

Table 35 summarizes the analyses for each of the major components of the busway previously discussed. Minimum and maximum capacity estimates are given in this table based on

Table 35
CAPACITY ESTIMATES OF BUSWAY COMPONENTS
(Passengers per Hour)

	AM		PM	
	Minimum	Maximum	Minimum	Maximum
El Monte Station:				
Capacity	10,200	13,400	9,500	12,700
Ratio[1]	4.5[2]	5.9	4.0	5.4
Busway lanes:				
Capacity	40,000		43,750	
Ratio	13.5[3]		14.3	
Hospital Station:				
Capacity	6,000	13,200	5,400	12,200
Ratio	2.0	4.4	1.8	4.0
Downtown link: Spring Street[4]				
Capacity	2,000[5]	3,200[6]	2,700[5] [8]	
Ratio	1.9[7]	3.0	2.5	
Downtown bus stop: 6th/7th & Olive[9]				
Capacity	3,700[5]		1,700[6] [11]	
Ratio	1.7[10]		2.2	

[1]Ratio of estimated capacity to present (1/75) volumes.

[2]Present volume is 50 buses per hour.

[3]Present volume is 65 buses per hour, 15 entering from Del Mar ramps.

[4]Most constraining link.

[5]Assumption 1, "all lines grow alike" (Table 33), discarded as producing an unrealistic minimum.

[6]Assumption of "no cars" (Table 33, right-hand column) discarded as producing an unrealistic maximum.

[7]Present volume is 23 buses.

[8]Minimum and maximum are the same; fewer cars do not affect contraflow lane.

[9]Most constraining bus stop.

[10]Per February 13 count, 47 busway buses stop here.

[11]Per February 13 count, 16 busway buses stop here.

what are considered to be the most realistic of the assumptions used in the analysis.

A ratio of estimated capacities to present volumes is also included. This indicates the amount of growth in volume possible through each busway component. It also indicates the growth in system throughput before the component in question becomes constraining. For example, the present volume (as of January) is about 65 peak hour buses on the busway west of the Del Mar ramps. This volume can increase by 1.7 to 110 buses before the AM bus stop at 6th and Olive processes its maximum of 71 buses per hour and becomes constraining.

Table 35 indicates that the first bind might occur in any of three components--the Hospital Station, the Spring Street contraflow lane, or the bus stop at 6th/7th and Olive. If changes are made which alter the capacity at 6th/7th and Olive bus stop, the consideration of expressing some buses through the intermediate busway stations will be necessary. The first large change in routing design occurs as the capacity of the contraflow lane is reached. At no time will the busway lanes themselves be the limitation.

This means that accommodating carpools on the busway lanes should not decrease the capacity of the system if carpool volumes and speeds can be appropriately regulated. Figure 36 (previously shown) includes the capacities at various percentages of passenger cars. Assuming that passenger cars would travel the route of the express bus, capacity would be limited by the 10 mph speed restriction through the stations. If the assumption is made that as many as 250 buses per hour might eventually use the busway, the mix could accommodate 80% passenger cars, or 1000 automobiles per hour.

APPENDIX A

ON-BOARD SURVEY

SAMPLE SIZE

The questionnaires were distributed equally by forms A and B to passengers on nine routes. (Forms A and B had some differences in questions.) Information on bus route and time were added by the survey workers. The resultant sample is shown in Table A-1.

Table A-1
SAMPLE SIZE BY BUS LINE AND QUESTIONNAIRE FORM

Bus Line:	52F	53F	60	63F	401	402	403	404	405	Total
Form A	50	62	168	42	214	155	117	73	74	955
Form B	49	64	175	40	217	162	121	78	72	978
Total Sample	99	126	343	82	431	317	238	151	146	1933
Inbound Measurement 8/8/74	187	286	894	120	722	747	482	368	244	4050
Ratio, Sample to 8/8/74	.53	.44	.38	.68	.60	.42	.49	.41	.60	.48

There are essentially equal samples of form A and form B for each route, and the sample of 1933 is 48% of the inbound rush hour passengers of August 8, 1974. (Two questionnaires lack route numbers.) The fractions of commuters surveyed are not equal by route, but an adequate sample was obtained for each route. The method of sampling, by units of busloads, was probably the cause of the inequity of the ratios in Table A-1.

There are seven questions common to both forms A and B, fifteen on form A alone, and thirteen on form B alone. There is no limitation to the analysis of responses to questions on either form because of sample size, except that analysis by route for lines 52F, 53F, and 63F may be unreliable for questions not appearing on both forms. Response rates were high, with non-response rates rarely exceeding 5% and usually being closer to 2% for any line.

SUMMARY OF RESPONSES, BY QUESTION

Questions Appearing on Form A Alone

1. Where did you start this trip? 1. home 2. other (37 missing responses)

Of the 918 who answered this question, 69.5% responded "home". Included among the "other" group may be those who ate breakfast out, met their carpool at the corner, or made some other intermediate stop. This same type of response pattern persisted among people who stated they were on work trips but indicated they were not going directly to the office (see question 5B).

2. How did you get from your starting point to where you boarded this bus? (6 missing responses)

The distribution of the responses is shown and compared with corresponding pre-busway results, measured in the on-board survey taken in April, 1972.

	n	1974 %	Pre-Busway 1972 %
Drove car and parked	510	53.7	12.3
Walked	218	22.9	70.2
Driven by someone else	159	16.7	14.9
Rode another bus and transferred	50	5.3	1.5
Took taxi	9	0.9	0.7
Other	4	0.4	0.5

As would be expected, the two results are markedly different patterns. Although there has been some increase in the share of people taking feeder buses to the busway, the vast shift is toward people driving to the bus or busway station instead of walking to the bus.

2B. If "walked", how many blocks did you walk?

There were 271 responses to this question, or 53 more than responded "walked" in the previous question. It is not possible to determine the cause of this discrepancy—whether or not this is the distance walked to the feeder bus, carpool, etc. The discrepancy is not critical to any conclusions developed in the evaluations. Fifty-five percent walked two blocks or less and 85% walked five blocks or less. This compares with 61.1% at two blocks or less, and 91.1% at five blocks or less, in the 1972 data. The distribution of distances is given below.

Blocks	Percent
0	7.7
1	19.6
2	27.7
3	9.2
4	12.5
5	8.5
6	5.2
7	3.0
8	3.0
9	1.1
10	1.5
More than 10	1.2

2C. If "parked car", where did you park?

Again, the number of people who responded to this question is greater than the 510 who responded "parked car." The additional 57 people may be among those who were driven. The distribution of responses is:

	%
El Monte Station	46.6
Other public lot	19.6
Other	15.5
Street corner	14.5
San Gabriel Park and Ride	3.9

The 15.5 percent answering "other" most frequently responded in a variant of "shopping center lot." It is difficult to tell why "other public lot" would not have served as a response for these people. It may be because many public lots charge a fee, or because these lots are designed for shoppers, as opposed to the public at large.

3. Where did you get on this bus? (12 missing responses)

	%
El Monte	37.7
Street corner	46.5
Other	12.4
San Gabriel	3.4

The 12.4% who answered "other" primarily gave the specific street corner at which they boarded, but one-fourth of them cited the Eastland Shopping Center.

4. What is the <u>main</u> purpose of this trip? (7 missing responses)

	%
Work	92.3
School or university	2.4

Business	2.3
Obtain personal service	1.4
Other	1.4
Shopping	0.1
Social, Entertainment	0.1

These results are similar to the 92.4% work trips in 1972, and are certainly representative of morning rush hour traffic.

5A. Where will you get off this bus?

78.4% of the passengers deboarded within the area bounded by Temple Street and Pico Boulevard on the north and south, and by Los Angeles Street and Figueroa Street on the east and west. This breaks down into the following distribution:

Location	%
Olive, before Pico	33.2
Spring	25.8
1st, 7th, Wilshire, before Figueroa	19.4
Wilshire Corridor, beyond Figueroa	12.0
Other, outside CBD	9.6

5B. Where will this trip end? (17 missing responses)

90.4% of those responding answered "work." Since the previous work trip figure was 92.3% (question 4), this means that 27 people on "work" trips are not going directly to work but will first make an intermediate stop.

5C. The address there is ______________.

Responses to this question were not analyzed because it was decided, later in the analysis, to be unnecessary.

5D. About how long will it take you to get there when you leave the bus? (27 missing responses)

Minutes	%
0	1.6
1	8.5
2	12.8
3	13.9
4	3.3
5	29.0
6	0.9
7	1.5
8	1.6
10	10.1
11	0.2
12	6.0
15	6.0
More than 15	10.0

Thus, 69.1% are within five minutes of their destination.

6A. How will you get there when you leave this bus? (24 missing responses)

The responses below are shown with corresponding results from the 1972 data.

	1974 %	Pre-Busway 1972 %
Walk	83.0	75.2
Take another bus	15.7	22.0
Drive in car	0.9	0.4
Be picked up by car	0.3	0.9
Take taxi	0.1	1.3
Other	0.0	0.4

The only apparent shift is from a bus transfer to walking, indicating that work location and bus route are now closer together.

6B. If "walk," how many blocks will you have to walk?

There were 693 responses to this question, or 81 less than responded "walked" to the previous question. The responses are again given with the comparable 1972 responses.

Blocks	1974 %	1972 %
0	12.8	-
1	38.2	31.8
2	25.3	26.6
3	11.1	17.1
4	5.6	11.6
5	2.5	7.4
6	1.9	3.4
7	0.1	1.2
8 or more	2.4	2.1

The percentage at two blocks or less has increased from 58.4% to 76.3%, and at four blocks or less from 87.1% to 93.0%, again reflecting a greater proximity of work place to bus route.

7. During the transit strike how did you usually make this trip? (23 missing responses)

The greatest number drove alone, with half as many using the Busway Carpool.

	%
Drove my car	48.0
In a carpool on busway	23.9
In a carpool not on busway	18.6
Other	5.6
Stayed at home	3.9

Those who answered "other" were either not working in the CBD at the time or had made informal cooperative arrangements which they did not perceive as carpools.

15. Did this busway service influence the choice of your present address? (28 missing responses)

Of those responding, 15.9% said "yes, definitely" and 7.9% said "slightly." This question is not precisely the same as the question asked in 1972, which was "Did SCRTD bus service influence the choice of your present address?" At that time, the percent responding "yes, definitely" was 38.8% and those responding "slightly" was 15.3%. This represents a considerable decrease in affirmative response over the two year interval. It is likely that the main reason for this decrease is that many people who have switched to the busway from auto commuting selected their home location before they switched, considering the proximity to bus service as irrelevant since they would be driving to work. The 1972 ridership was composed primarily of long-term, transit-dependent people who had selected a home location because it was closer to bus service.

16. Did this busway service influence the choice of your present employment? (28 missing responses)

15.0% of the respondents answered "yes, definitely" and 5.9% answered "slightly." About half of those answering "yes, definitely" to this question answered the same way to question 15, above.

Questions on Form B Alone

7. How many cars are available for use by members of your household? (15 missing responses)

The profile in response to this question is not one of the classic captive rider. 62.6% of the respondents had two or more cars available for use.

Cars	%
0	3.8
1	33.5
2	47.5
3	11.4
4 or more	3.7

8. Do you have a license to drive? (12 missing responses)

89.5% answered affirmatively. In the state as a whole, the percent of adults over 18 who have driver's licenses is about 86.5%. The current sample yields a slightly higher value because it includes very few people over 65. For people in that age bracket, the percent licensed is lower.

9A. Was a car available for this trip? (12 missing responses)

	%
Yes, but I prefer to take the bus	79.8
No (bus only practical means)	11.1
Yes, but with considerable inconvenience to others	9.1

This compares with 21.4% "no," 16.4% "yes, but," and 62.2% "prefer bus" on the Shirley Highway Survey.* Of those who replied that they had no driver's license, 49 indicated a car was available. This would appear to indicate that people who could have been driven consider that a car is available for their use.

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*Shirley Highway... First Year Results, p. 74.

9B. If a car was available, is it usually driven during your absence? If yes, approximate number of miles per day _____.

Again, this question is not simple to interpret, since, in spite of the fact that 107 people indicated there was no car available, only 76 skipped this question. Thus, there is some confusion in the minds of the respondents as to the interpretation of "available." Only 206 of the respondents (22.8%) indicated that the car was driven in their absence.

The number of miles the car left at home was driven was given by 172 people, with values as high as 80 miles, but 51.7% indicated 10 miles or less, and 76.2% indicated 25 miles or less. Thus, at least three-fourths of the respondents indicated that bus usage is decreasing the vehicle miles of travel. The average distance driven is 16 miles per day.

9C. If a car was available, how is it used during your absence?

Although 206 people indicated that their car was driven in their absence, 374 responded to this question, many checking more than one use. In some cases, people were probably trying to account for multiple uses, but since there were so many people with two or more cars, people were probably also trying to account for multiple cars.

	Number of Responses
Not used	590
Shopping, errands	162
Another person takes it to work	126
School, university	50
Other	36
Total	964

11. Please indicate how important these bus features are in your decision to use the busway.

The results are shown in Table A-2. The average value in the table is computed by weighting the entries in the first four columns with the values 1 to 4. The smaller the average, the more important the feature. The number responding to the 25¢ fare as extremely important reflects more than the pleasure in saving money. There is a tendency to believe that a question about the fare in the questionnaire means that the fare is going to go up, and the response is overemphatic.

In July, 1972,* a similar set of questions was asked of Shirley Highway Busway users. The response was as follows:

	% of "Extremely Important" Responses
Constant reliable schedule	77
Air-conditioning/heating	56
Assurance of getting a seat	53
Less time between buses	38

The response to the busway questions shows less interest in the air-conditioning (in November) and more interest in saving time.

12. Please rank (1,2,3,4,5) the following possible changes in order of importance to you: (1=most important, 2=next most important, etc.)

Of the 978 questionnaires, 410 ranked the changes from 1 to 5. An additional 235 had numbers for all five parts of the question, but tended to treat this as five separate questions, marking, for example, three of the possible changes with a rank of 1, one with a rank of 3, and one with a rank of 5.

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*Shirley Highway... Second Year Results, p. 50.

Table A-2
IMPORTANCE OF BUS FEATURES

	Extremely	Quite	Slightly	Not At All	No Answer	Average Value	Percent "Extremely Important"
Reduction of fare to 25¢	719	122	36	20	81	1.3	80
Reduced travel time through exclusive bus lanes	561	179	94	77	67	1.7	62
Present frequency of service	500	255	64	21	138	1.5	60
El Monte Terminal	376	159	108	186	149	2.1	45
Seat availability	349	269	168	67	125	1.9	41
Exclusive bus lanes on Spring Street	264	174	164	226	150	2.4	32
New, air-conditioned buses	238	267	249	77	147	2.2	29

As a result, combined ranks are difficult to obtain.

	Number Ranked 1	Number Ranked 5	Number Blank
Increase frequency of service	492	26	126
Extending busway E. of El Monte	302	206	151
Downtown bus stops closer	190	167	150
More bus lanes downtown	187	101	154
Increased bus speed	175	161	158

There is a clear-cut favoring of increasing frequency of service, which arises again in the comments written at the end of the questionnaire. The attitude toward extending the busway is more ambivalent, with those who live near El Monte or a current busline expressing a lack of interest. Responses to the other three parts of the question are essentially the same.

13. Are you... 1. Male? 2. Female? (19 missing responses)

45.9% were male. This is considerably larger than the 36% from the pre-busway commuter survey.

14. What is your age group? (17 missing responses)

	%
20 or under	6.9
21-29	29.8
30-39	23.4
40-49	18.7
50-64	20.1
65 and over	1.1

In the pre-busway survey 46% were under 40.

15. Are you... 1. Married? 2. Single? 3. Divorced/Widowed/ Separated? (36 missing responses)

	%
Married	68.4
Single	19.4
Divorced/Widowed/Separated	12.2

16. What is the combined annual income of all household members?

As is expected, there were more people who skipped this question—77 in all. The median income is over $15,000.

	%
$5,000 or under	5.2
$5,001-$10,000	18.4
$10,001-$15,000	24.1
$15,001-$30,000	45.5
Over $30,000	6.8

17. What education level have you reached? (32 missing responses)

	%
Elementary	2.6
Some high school	5.7
High school diploma	25.6
Some college	40.0
College degree	19.6
Graduate studies	6.6

The median education level is "some college." Since there were 6.9% under 20 years of age, it seems probable that relatively few of the adults lack a high school diploma.

18. Do you have children living at home?

Corresponding with a median age in the thirties, 553 (or 58.8%) of the respondents have children at home.

If yes, age of youngest child _____.

Five hundred and twenty-two people responded to this question, with a median of 7 years, 95% 18 or younger, and one poor soul with a child of 44.

<u>Questions Appearing on Both Forms A and B</u>

(The first number is the question number on form A, the second on form B.)

8-1. How often do you make <u>this</u> inbound trip on the bus? (19 missing responses)

	%
Regularly	93.5
Occasionally	4.5
Very seldom	2.0

9-2. I started making this trip by bus __________. (60 missing responses)

It was intended that this question be used to sort rider profile and trip characteristics by the time period when the rider started to use the system, and to gain some insight into rider attrition rates. However, this did not appear to work out.

Below is the distribution of responses by time period based on the survey compared with a distribution based on the patronage data.

	Questionnaire %	Patronage Data %
Before opening of busway lanes	22.4	7.1
Since opening of busway lanes (January 1973)	15.9	3.7
Since opening of El Monte (July 1973)	22.9	56.4
Since 25¢ fare (April 1974)	38.7	32.8

The patronage data are based on ridership counts at the end of each time period of 1200 at 1/73, 1500 at 7/73, 6800 at 4/73, and 8000 at 11/73. A 3% per month attrition rate was assumed to deduce the numbers of persons from each time period who were still riding at the time of the survey.

It would seem that the 22.4% (pre-busway people) is an overstatement and/or includes later entries who transferred from another bus (which they were using prior to the busway opening). The 15.9% also appears to be an overstatement caused by poor phrasing of the statement (a person could have started riding recently and could have checked "since opening of the busway").

The problem was resolved in analysis by using only two categories, before and after El Monte Station opening, and hoping there would be enough accuracy at this level of disaggregation. Nothing was believed to be learned about attrition rates.

The large number who recorded "since the 25¢ fare" also may be a slight overstatement, representing a bias similar to that discussed under question 11-C of form B, in which people are overresponding to money questions.

10-3. Do you usually use the bus on both your inbound and return trips? (97 missing responses)

It is clear from the 98.2% who responded "both ways" that even the occasional inbound bus user returns by bus.

11-4. Since you first started using the busway, have you tended to use the busway more or less frequently? (28 missing responses)

Only 1% said that they had decreased usage, so the general level of satisfaction with the service is high.

	%
More frequently	64.9
About the same	34.1
Less frequently	1.0

An attempt was made to relate the change in usage to the current rate of usage, but the number of "occasional" and "very seldom" riders in the sample is small, and no clear pattern emerged. It does appear that regular riders who started since the 25¢ fare are more likely to be increasing their usage than people who started earlier.

12-5. How did you make this trip before using the busway? (42 missing responses)

	%
Drove my car (alone)	50.3
Have always used busway	11.6
Was an auto passenger	10.8
Used a non-busway bus	9.9
Was an alternate driver	7.9
Was a driver (carrying passengers)	5.4
Other	4.0
Taxi	0.1

According to the comments included by those who checked "other" almost all of them could have replied "Have used busway as long as I have made this trip." They apparently did not perceive this to be the same as "Have always used busway."

Of the 150 who responded that they were alternate drivers, 141 responded with a number of days. Of these, 17 replied four or more days a week, indicating some lack of understanding of the intent of the question.

13-6. What are your main reasons for using the busway?

Since there were multiple replies to this question, the usual percentage distribution does not serve to illuminate the responses. In all, 4126 responses were made—or an average of 2.1 per respondent. Ninety percent of these responses were in the five categories:

	Number of Responses
Costs less	1,261
Freeway too congested	827
Gives me time to relax	708
Saves time	531
Disliked driving	389

with the other categories trailing badly:

Allows someone else to use the car	140
Change of place of work	121
Other	106
Carpool broke up	43

Fully half of those who replied "other" had no choice but to ride the bus, adding comments saying they didn't drive, had no car, or the car had broken down. Parking problems, environmental concern, and energy conservation were also frequently mentioned.

A further analysis of the first five categories has been made to attempt to determine the interaction among them. The percent of those who marked each alone is:

	%
Costs less	29
Saves time	23
Congestion	15
Disliked driving	13
Relax	11

It is clear that most people marked more than one category.

An analysis was made of the interdependencies among the factors based on the frequency of cases where individuals indicated specific sets of responses. This analysis, too lengthy to include here, is summarized in Chapter V of the report.

14-10. In what ways did you find out about this busway service?

	% Responding
Friends, relatives	37.7
Newspapers	21.7
Saw bus on busway or street	17.1
RTD schedules	16.9
TV	15.0
Radio	11.8
RTD phone information	10.9
Billboards	7.4
Other	5.0
Information on other buses	4.0
Transit Information Team	2.4

Those who replied "other" frequently had been riding the bus for so long that they didn't remember learning. Other responses given include "work for RTD" and "employer" as the source of information.

For this survey, word-of-mouth is clearly ahead of all others. Two years before, "RTD phone" and "schedules" ranked 1-2, with "friends" a clear third. The effectiveness of the newspaper campaign is shown in the growth of importance of that entry as a source of information, and "saw bus" is now clearly an incentive to busway bus use.

17-19. Any comments or complaints?

There were 892 people who took time to write a comment, and 189 of them wrote more than one. Table A-3 gives the breakdown of both the first and second comments.

Table A-3
PASSENGER COMMENTS

Classification	Fav	First Comment Neut	Unfav	Total	Fav	Second Comment Neut	Unfav	Total
General Comments	158	61	37	256	5	10	8	23
Scheduling	5	305*	0	310	1	65*	0	66
Operators	6	3	50	59	6	0	22	28
Routes and Stops	2	119*	0	121	0	20*	0	20
El Monte Station	0	2	21	23	0	1	2	3
Equipment	0	7	66	73	0	17	3	20
Public Info	0	5	25	30	0	0	4	4
Fare	15	2	1	18	21	3	1	25
Totals	186	504	200	890	33	116	40	189

*All comments asking for changes in scheduling or in routes and stops were rated as neutral, except a few that were clearly praising these aspects of SCRTD service.

A	E													

A

THIS SURVEY IS TO IMPROVE YOUR BUS SERVICE
THE FOLLOWING QUESTIONS CONCERN THE TRIP YOU ARE NOW MAKING
WOULD YOU PLEASE TAKE 5 MINUTES TO ANSWER THESE QUESTIONS?
PLEASE RETURN COMPLETED FORM TO SURVEY TAKER

Si Usted Prefiere Puede Pedir un Cuestionario en Espanol

1. Where did you start this trip? 1 ◯ home 2 ◯ other

2A. How did you get from your starting point to where you boarded this bus? (Check one)
- 1 ◯ Drove car and parked
- 2 ◯ Driven by someone else
- 3 ◯ Rode another bus and transferred to this one
- 4 ◯ Walked
- 5 ◯ Took taxi
- 6 ◯ Other ________

B. If "walked", how many blocks did you walk? ________ (blocks)

C. If "parked car", where did you park? (Check one)
- 1 ◯ El Monte park and ride lot
- 2 ◯ San Gabriel park and ride lot
- 3 ◯ Other public lot
- 4 ◯ On street
- 5 ◯ Other ________

3. Where did you get on this bus? (Check one)
- 1 ◯ El Monte Station
- 2 ◯ San Gabriel park and ride
- 3 ◯ Street corner
- 4 ◯ Other ________

4. What is the main purpose of this trip? (Check one)
- 1 ◯ Work (regular commuting)
- 2 ◯ Business (a work-related trip)
- 3 ◯ Shopping
- 4 ◯ School or university
- 5 ◯ Social, entertainment, recreation
- 6 ◯ Obtain personal services, (lawyer, dentist, etc.)
- 7 ◯ Other ________

5A. Where will you get off this bus? ________ (location of bus stop)

B. Where will this trip end? 1 ◯ work 2 ◯ other

C. The address there is ________ (or nearest intersection)

D. About how long will it take you to get there when you leave the bus? ________ (number of minutes)

6A. How will you get there when you leave this bus? (Check one)
- 1 ◯ Drive in car parked near bus stop
- 2 ◯ Be picked up by car
- 3 ◯ Take another bus
- 4 ◯ Take taxi
- 5 ◯ Walk
- 6 ◯ Other ________

B. If "walk", how many blocks will you have to walk? ________ (blocks)

7. During the transit strike how did you usually make this trip?
- 1 ◯ Drove my car (alone)
- 2 ◯ In a carpool driving on busway (3 or more people per car)
- 3 ◯ In a carpool but not on busway (2 or more people per car)
- 4 ◯ Stayed at home
- 5 ◯ Other ________

8. How often do you make this inbound trip on the bus? (Check one)
- 1 ◯ Regularly - (at least four rides per week)
- 2 ◯ Occasionally - (one to three rides per week)
- 3 ◯ Very seldom

SEE OTHER SIDE

9. I started making this trip by bus
   1 ◯ Before opening of busway lanes
   2 ◯ Since opening of busway lanes (January 1973)
   3 ◯ Since opening of El Monte Busway Station (July 1973)
   4 ◯ Since 25¢ fare (April 1974)

10. Do you usually use the bus on both your inbound and return trips? 1 ◯ Yes 2 ◯ No

11. Since you first started using the busway have you tended to use the busway more or less frequently?
   1 ◯ More frequently
   2 ◯ Less frequently
   3 ◯ About the same

12. How did you make <u>this</u> trip before using the busway? (Check most common method)
   1 ◯ Have always used busway
   2 ◯ Drove my car (alone)
   3 ◯ Was an auto passenger
   4 ◯ Was a driver (carrying passengers)
   5 ◯ Was an alternate driver (drove ______ days per week)
   6 ◯ Used a non-busway bus
   7 ◯ Taxi
   8 ◯ Other ____________

13. What are your <u>main</u> reasons for using the busway?
   1 ◯ Freeway too congested
   2 ◯ Changed place of work
   3 ◯ Disliked driving
   4 ◯ Gives me time to relax
   5 ◯ Allows someone else to use car
   6 ◯ Saves time
   7 ◯ Carpool broke up
   8 ◯ Costs less
   9 ◯ Other ____________

14. In what ways did you find out about this busway service?
   1 ◯ Radio
   2 ◯ TV
   3 ◯ Newspapers
   4 ◯ RTD phone information
   5 ◯ RTD schedules, brochures
   6 ◯ Saw bus on busway or street
   7 ◯ Billboards, posters
   8 ◯ Information on other buses
   9 ◯ Friends, relatives
   10 ◯ Transit Information Team
   11 ◯ Other ____________

15. Did this busway service influence the choice of your present address?
   1 ◯ Yes, definitely
   2 ◯ Slightly
   3 ◯ Not at all

16. Did this busway service influence the choice of your present employment?
   1 ◯ Yes, definitely
   2 ◯ Slightly
   3 ◯ Not at all

17. Any comments or complaints? ____________________________________

____

____

____

Please do not write below this line.

B	E														

B

THIS SURVEY IS TO IMPROVE YOUR BUS SERVICE
THE FOLLOWING QUESTIONS CONCERN THE TRIP YOU ARE NOW MAKING
WOULD YOU PLEASE TAKE 5 MINUTES TO ANSWER THESE QUESTIONS?
PLEASE RETURN COMPLETED FORM TO SURVEY TAKER

Si Usted Prefiere Puede Pedir un Cuestionario en Espanol

1. How often do you make this inbound trip on the bus? (Check one)
   - 1 ◯ Regularly - (at least four rides per week)
   - 2 ◯ Occasionally - (one to three rides per week)
   - 3 ◯ Very seldom

2. I started making this trip by bus
   - 1 ◯ Before opening of busway lanes
   - 2 ◯ Since opening of busway lanes (January 1973)
   - 3 ◯ Since opening of El Monte Busway Station (July 1973)
   - 4 ◯ Since 25¢ fare (April 1974)

3. Do you usually use the bus on both your inbound and return trips? 1 ◯ Yes 2 ◯ No

4. Since you first started using the busway have you tended to use the busway more or less frequently?
   - 1 ◯ More frequently
   - 2 ◯ Less frequently
   - 3 ◯ About the same

5. How did you make this trip before using the busway? (Check most common method)
   - 1 ◯ Have always used busway
   - 2 ◯ Drove my car (alone)
   - 3 ◯ Was an auto passenger
   - 4 ◯ Was a driver (carrying passengers)
   - 5 ◯ Was an alternate driver (drove _______ days per week)
   - 6 ◯ Used a non-busway bus
   - 7 ◯ Taxi
   - 8 ◯ Other _______________

6. What are your main reasons for using the busway?
   - 1 ◯ Freeway too congested
   - 2 ◯ Changed place of work
   - 3 ◯ Disliked driving
   - 4 ◯ Gives me time to relax
   - 5 ◯ Allows someone else to use car
   - 6 ◯ Saves time
   - 7 ◯ Carpool broke up
   - 8 ◯ Costs less
   - 9 ◯ Other _______________

7. How many cars are available for use by members of your household? _______________ (number of cars)

8. Do you have a license to drive? 1 ◯ Yes 2 ◯ No

9A. Was a car available to you for this trip? (Check one)
   - 1 ◯ No (bus only practical means)
   - 2 ◯ Yes, but with considerable inconvenience to others
   - 3 ◯ Yes, but I prefer to take the bus

B. If a car was available, is it usually driven during your absence? 1 ◯ No 2 ◯ Yes _______________ (If yes, approximate number of miles driven per day)

C. If a car was available, how is it used during your absence?
   - 1 ◯ Not used
   - 2 ◯ Another person takes it to work
   - 3 ◯ Shopping, errands
   - 4 ◯ School, university
   - 5 ◯ Other _______________

10. In what ways did you find out about this busway service?

1 ◯ Radio
2 ◯ TV
3 ◯ Newspapers
4 ◯ RTD phone information
5 ◯ RTD schedules, brochures
6 ◯ Saw bus on busway
7 ◯ Billboards, posters
8 ◯ Information on other buses
9 ◯ Friends, relatives
10 ◯ Transit Information Team
11 ◯ Other ________________

11. Please indicate how important these bus features are in your decision to use the busway:

	1 Extremely	2 Quite	3 Only Slightly	4 Not At All
A. Reduce travel time through exclusive bus lanes	☐	☐	☐	☐
B. New, air-conditioned buses	☐	☐	☐	☐
C. Reduction of fare to 25¢	☐	☐	☐	☐
D. Present frequency of service	☐	☐	☐	☐
E. Exclusive bus lanes on Spring Street	☐	☐	☐	☐
F. Seat availability	☐	☐	☐	☐
G. El Monte Terminal	☐	☐	☐	☐

12. Please rank (1,2,3,4,5) the following possible changes in order of importance to you: (1 = most important, 2 = next most important, etc.)

	Rank
A. Increasing frequency of service	☐
B. Increasing bus speed from 55 to 65 mph	☐
C. More extensive bus lanes throughout downtown area	☐
D. Downtown bus stops closer to where you are going	☐
E. Extending busway eastward past El Monte	☐

13. Are you 1 ◯ Male 2 ◯ Female

14. What is your age group?

1 ◯ 20 or under
2 ◯ 21 - 29
3 ◯ 30 - 39
4 ◯ 40 - 49
5 ◯ 50 - 64
6 ◯ 65 and over

15. Are you 1 ◯ Married 2 ◯ Single 3 ◯ Divorced/Widowed/Separated

16. What is the combined annual income of all household members?

1 ◯ $5,000 or under
2 ◯ $5,001 - 10,000
3 ◯ $10,001 - 15,000
4 ◯ $15,001 - 30,000
5 ◯ Over $30,000

17. What education level have you reached?

1 ◯ Elementary
2 ◯ Some high school
3 ◯ High school diploma
4 ◯ Some college
5 ◯ College degree
6 ◯ Graduate studies

18. Do you have children living at home?

1 ◯ No 2 ◯ Yes ________________ (If yes, age of youngest child)

19. Any comments or complaints? ________________

A	S													

A

ESTE CUESTIONARIO SIRVE PARA MEJORAR SU SERVICIO DEL BUSWAY. LAS PREGUNTAS SIGUIENTES DAN RESPECTO AL VIAJE QUE HACE VD AHORA MISMO. PUEDE VD. CONTESTAR ESTAS PREGUNTAS EN SOLO 5 MINUTOS. POR FAVOR VUELVE VD. EL CUESTIONARIO COMPLETADO AL ASISTENTE DE ENCUESTA. MUCHAS GRACIAS.

1. ¿En dónde empezó Vd. este viaje? 1 ◯ En casa 2 ◯ En otra parte

2A. ¿Cómo llegó Vd. a la parada donde tomó el autobus? (Marque sola una)
- 1 ◯ Manejé el auto y lo dejé estacionado
- 2 ◯ Alguien me trajo en auto
- 3 ◯ Vine en otro bus y cambié a este bus
- 4 ◯ Vine a pie ó tomé un taxi
- 5 ◯ Otro medio de transporte

B. ¿Si vino Vd. a pie, cuántas cuadras tuvo Vd. que caminar? ________ (cuadras)

C. ¿Si estacionó Vd. el auto, en dónde lo estacionó? (Marque sola una)
- 1 ◯ El Monte park and ride parque
- 2 ◯ San Gabriel park and ride parque
- 3 ◯ Otro parque de estacionamiento
- 4 ◯ En la calle
- 5 ◯ Otro

3. ¿En dónde se subió a este bus? (Marque una)
- 1 ◯ El Monte Station
- 2 ◯ San Gabriel park and ride
- 3 ◯ En la esquina
- 4 ◯ Otro

4 ¿Cuál es el propósito principal de este viaje? (Marque una)
- 1 ◯ Ir al trabajo (viaje regular)
- 2 ◯ Voy de negocios (otro asunto relacionado con mi trabajo)
- 3 ◯ Voy de compras
- 4 ◯ Voy a la escuela ó a la universidad
- 5 ◯ Voy a asuntos sociales, de paseo ó recreacion
- 6 ◯ Servicios personales (a ver al licenciado, dentista, etc.)
- 7 ◯ Otro propósito

5A. ¿En dónde se va Vd. a bajar del bus? ________________ (Lugar de la parada del bus)

B. ¿En dónde va Vd. a terminar este viaje?
- 1 ◯ En mi trabajo
- 2 ◯ En otra parte

C. La dirección a donde voy es: ________________ (o la intersección más cercana)

D. ¿Cuánto tiempo tomará Vd. llegar a allí cuando baje Vd. de este bus? ________ (número de minutos)

6A. ¿Cómo llegará allí cuando baje Vd. del bus? (Marque sola una)
- 1 ◯ En el auto que tengo estacionado cerca de la parada del bus
- 2 ◯ Alguien me va a llevar en auto
- 3 ◯ Voy a tomar otro bus
- 4 ◯ En taxi
- 5 ◯ A pie
- 6 ◯ Otro medio de transporte

B. ¿Si Vd. va a pie, cuántas cuadras tendrá que caminar? ________ (cuadras)

7. ¿Durante la huelga transito, cómo tomaba Vd. este viaje usualmente?
- 1 ◯ Manejé mi auto (solo)
- 2 ◯ Viajé en un carpool que usó el busway (3 ó más personas cada auto)
- 3 ◯ Viajé en un carpool que no usó el busway (2 ó más personas cada auto)
- 4 ◯ Me quedé en casa
- 5 ◯ Otro ________________

8. ¿Qué tan frecuentemente hace Vd. este viaje? (Marque sola una)
- 1 ◯ Regularmente (cuando menos cuatro veces por semana)
- 2 ◯ De vez en cuando (una a tres veces por semana)
- 3 ◯ Rara vez

VEA VD. OTRO LADO

9. Empezé yo tomar este viaje por bus
   1 ◯ Antes de que los carriles del busway fueron abiertos
   2 ◯ Desde que los carriles del busway fueron abiertos (enero 1973)
   3 ◯ Desde que abrieron la estación del busway en El Monte (julio 1973)
   4 ◯ Desde que empezó el pasaje de 25 centavos (abril 1974)

10. ¿Usa Vd. el bus para sus viajes en las salidas y los regresos igualmente?
   1 ◯ Sí   2 ◯ No

11. ¿Desde que primero empezó Vd. usar el busway lo ha usado con mas o menos frecuencia?
   1 ◯ Con mas frecuencia
   2 ◯ Con menos frecuencia
   3 ◯ Casi lo mismo

12. ¿Como hacía Vd. este viaje antes de que usaba el busway? (Marque sola una)
   1 ◯ He usado yo siempre el busway
   2 ◯ Manejaba yo mi auto (solo)
   3 ◯ Era yo pasajero en otro auto
   4 ◯ Manejaba yo mi auto (con pasajeros)
   5 ◯ Alternaba yo el manejo de auto con otra persona (manejaba yo ______ días por semana)
   6 ◯ Usaba otro bus que no pertenecía al busway
   7 ◯ Taxi
   8 ◯ Usaba otro medio de transportacion

13. ¿Cuáles son sus razones principales por usar el busway?
   1 ◯ Autopista demasiado congestionado
   2 ◯ Cambié mi lugar de trabajo
   3 ◯ No me gusta manejar
   4 ◯ Me da tiempo a relajar
   5 ◯ Permite otra persona usar el auto
   6 ◯ Ahorrar tiempo
   7 ◯ Terminó el carpool
   8 ◯ Es más barato
   9 ◯ Otra razon

14. ¿Cómo se informó Vd. del servicio del busway?
   1 ◯ Radio
   2 ◯ Televisión
   3 ◯ Periódicos
   4 ◯ Información telefonica del RTD
   5 ◯ RTD horarios y folletos
   6 ◯ Observe el bus en el busway o en la calle
   7 ◯ Anuncios y cartelones
   8 ◯ Literatura en otros buses
   9 ◯ Amigos, parientes
   10 ◯ Equipo de información transito
   11 ◯ Otro medio

15. ¿Tuvo el servicio del busway influencia sobre la seleccion de su domicilio presente?

   1 ◯ Sí, ciertamente   2 ◯ Un poco   3 ◯ De ninguna manera

16. ¿Tuvo el servicio del busway influencia sobre la seleccion de su trabajo presente?

   1 ◯ Sí, ciertamente   2 ◯ Un poco   3 ◯ De ninguna manera

17. ¿Tiene algunos comentos o algunas quejas? ______________________________

____
____
____

Por favor no escriba debajo de esta linea.

B	S														

B

ESTE CUESTIONARIO SIRVE PARA MEJORAR SU SERVICIO DEL AUTOBUS. LAS PREGUNTAS SIGIENTES CONCERNE EL VIAJE QUE HACE USTED AHORA MISMO. PUEDE USTED CONTESTAR ESTAS PREGUNTAS EN SOLO 5 MINUTOS

1. ¿Qué tan frecuentemente hace usted este viaje? (marque solo uno)
   1 ◯ Regularmente (cuando menos cuatro veces a la semana)
   2 ◯ De vez en cuando (una a tres veces por semana)
   3 ◯ Rara vez

2. Empezé yo tomar este viaje por bus - (marque solo uno)
   1 ◯ Antes de que los carriles del busway fueron abiertos
   2 ◯ Desde que los carriles del busway fueron abiertos (enero 1973)
   3 ◯ Desde que abrieron la estación del busway en El Monte (julio 1973)
   4 ◯ Desde que empezó el pasaje de 25 centavos (abril 1974)

3. ¿Usa usted el bus para sus viajes en las salidas y los regresos?
   1 ◯ Sí   2 ◯ No

4. Desde que primero empezó usar usted el busway ha tendido que usarlo -
   1 ◯ Con más frecuencia   3 ◯ Casi lo mismo
   2 ◯ Con menos frecuencia

5. ¿Cómo hacía usted este viaje antes de que usara el busway? (marque solo uno)
   1 ◯ He usado yo siempre el busway
   2 ◯ Manejaba yo mi carro (solo)
   3 ◯ Era yo pasajero en otro auto
   4 ◯ Manejaba yo mi carro (con pasajeros)
   5 ◯ Alternaba yo el manejo del carro con otra persona (manejaba yo ___ días a la semana ___)
   6 ◯ Usaba yo otro carrile en el autopista
   7 ◯ Taxi
   8 ◯ Usaba yo otro medio de transportación

6. ¿Cuáles son sus razones principales por usar el busway?
   1 ◯ Autopista demasiado congestionado
   2 ◯ Cambié yo mi lugar de empleo
   3 ◯ No me gustó manejar
   4 ◯ Me da tiempo para relajar
   5 ◯ Le permite a otra persona usar el auto
   6 ◯ Me ahorra tiempo
   7 ◯ Terminó el carpool
   8 ◯ Es más barato
   9 ◯ Otra ______________________________

7. ¿Cuántos auto tiene los miembros de su familia a su disposición -
   Número de autos ______________?

8. ¿Tiene usted licencia para manejar?   1 ◯ Sí   2 ◯ No

9A. ¿Hay un auto a su disposición para este viaje? (marque solo uno)
   1 ◯ No, el bus es el único medio de transporte práctico
   2 ◯ Sí, pero tendría que molestar a otras personas
   3 ◯ Sí, pero prefiero tomar el bus

B. ¿Si un auto está disponible, usualmente esta manejado por otras personas durante su ausencia?
   1 ◯ No
   2 ◯ Sí (Si su respuesta es sí, el auto está manejado cuántas millas (cada día ________________________)

C. ¿Si un auto estuvo disponsible, cómo está usado durante su ausencia?
   1 ◯ El auto no está usado
   2 ◯ Otra persona lo maneja a su trabajo
   3 ◯ Viajes de compras
   4 ◯ Viajes a la escuela ó la universidad
   5 ◯ Otro ______________________________

VEA UD. OTRO LADO---

10. Por favor indique usted la importancia entre las razones abajo que pertenece a su decisión de usar el busway -

	1 Sumamente	2 Bastante	3 Un poco	4 Nada
A. Reducir tiempo de viajar para carriles exclusivos para buses.	☐	☐	☐	☐
B. Nuevo buses con aire acondicionado	☐	☐	☐	☐
C. Reducción del pasaje a 25 centvs.	☐	☐	☐	☐
D. Frecuencia de servicio presente	☐	☐	☐	☐
E. Carriles exclusivos para buses en la calle Spring	☐	☐	☐	☐
F. Asientos disponibles	☐	☐	☐	☐
G. El Monte Estación	☐	☐	☐	☐

11. Por favor indique usted en orden (1,2,3,4,5) los cambios posibles siguientes que le importa a usted (1 = muy importante, 2 = siguiente más importante, et cetera)

	Orden
A. Aumentar frecuencia de servicio	☐
B. Aumentar velocidad de buses de 55 a 65 millas	☐
C. Mas carriles exclusivos para buses en el centro de la ciudad	☐
D. Paradas para buses más cercano a su destinacion	☐
E. Extender el busway hacia el este de El Monte	☐

12. ¿Cuál es su sexo? 1 ◯ Hombre 2 ◯ Mujer

13. ¿A cuál de estos groupos de edad pertenece usted?

1 ◯ Menos de 20 años
2 ◯ De 21 a 29
3 ◯ De 30 a 39
4 ◯ De 40 a 49
5 ◯ De 50 a 64
6 ◯ De 65 para arriba

14. ¿Es usted - 1 ◯ Casado 2 ◯ Soltero 3 ◯ Divorciada/Viuda/Separada ?

15. ¿Cuál es el total de lo que ganan los miembros de su familia que viven con usted?

1 ◯ $5,000 ó menos
2 ◯ De $5,001 a 10,000
3 ◯ De $10,001 a 15,000
4 ◯ De $15,001 a $30,000
5 ◯ Más de $30,000

16. ¿Cuál nivel de educación ha cumplido usted?

1 ◯ Escuela de elemental
2 ◯ Alguna escuela alta
3 ◯ Diploma de escuela alta
4 ◯ Alguna Universidad
5 ◯ Grado de una universidad
6 ◯ Escuela de graduados

17. ¿Tiene usted niños viviendo en casa?

1 ◯ No 2 ◯ Sí (Si su respuesta es sí, cual es la edad del niño más joven ____________?)

18. ¿Tiene algunos comentos ó quejas? ____________________

____

____

____

POR FAVOR DE NO ESCRIBIR DUESPUES DE ESTA LINEA

☐☐☐☐☐☐

APPENDIX B
THE EL MONTE STATION IN USE

PASSENGER AND AUTOMOBILE FLOW

This section of this appendix describes time and capacity measurements of access to the El Monte station. They include the auto time to reach the parking booth from the street, the flow into the parking booth from the street, the flow into the parking lot in the morning, the walk from the parking lot to the terminal, the walk from the terminal entrance to the boarding platform, and the trip from the terminal entrance to the lot exit at night. These measurements were made on January 22 and 23, a Wednesday and Thursday, under clear, cool weather conditions.

Car Time, Entry to Ticket Booth

Observations of the driving time from the street to the ticket booth were made over five minute intervals between 6:25 AM and 8:30 AM. The measurements were to the nearest second. The average values, over the morning peak period, are given below.

Clock time:	6:25-6:30	6:55-7:00	7:25-7:30	7:55-8:00	8:25-8:30
Average trip time (sec.)	24	26	29	15	16
Sample size	36	60	60	29	15

The last two sets of times represent travel under no congestion or queuing.

The limit of 60 per five minutes does not represent the capacity of the ticket booth, which can serve a car in four seconds, but the impact of the traffic light at the street entrance. During peak period six cars can enter on the green, in either direction. These queue and are served, and the cars from the opposite direction enter. There are intervals without queues.

<u>Time, Ticket Booth To Terminal Entry</u>

The time from the ticket booth to the terminal entry was measured in two parts, for the car to park, and for the person to walk to the terminal. Each was measured to the nearest quarter minute by people standing on the boarding platform. A car would be watched from the moment it left the ticket booth until the driver emerged from the car. The person was watched until he disappeared into the terminal entrance on the lower level.

Approximately twenty to twenty-five percent of the cars entering the lot were kiss-and-ride, and there were no observations of carpools forming in the parking lot. All of the cars reported below were single occupant, and there were no signs of heavy carpool use to the lot.

As can be expected, the early arrivals parked near the terminals, with short walks. As the morning progressed, the length of time to park and to walk increased until the last person observed took eight minutes and forty-five seconds and then parked illegally. There was some indication that the people coming after eight o'clock were not aware of the three temporary lines of parking spaces beyond the fence.

Table B-1 contains the mean time to park, to walk, and, for the segment as a whole, for each time period of observation. The kiss-and-ride times are not included in these averages. The numbers for 8:35-8:50 are unreliable because each observation took so long that few observations were made. However, it is clear that the smooth flow from booth to terminal is destroyed by that time, at the present parking lot capacity.

Table B-1
ACCESS TO AND EGRESS FROM EL MONTE STATION

Morning Access
Time to Park and Walk to Terminal
(Seconds)

Clock Time	6:35-6:50	7:05-7:20	7:35-7:50	8:05-8:20	8:35-8:50
Booth to park	49	62	69	71	274
Walk to terminal	66	93	150	156	124
Booth to terminal	115	155	219	227	398

Evening Egress
Time to Walk to Car and Drive to Entry
(Seconds)

Clock Time	4:30-4:45	5:00-5:30	5:40-6:00	6:00-6:15
Walk to car	78	82	78	75
Drive to booth	91	96	69	90
Terminal to booth	169	178	147	165

Station Entry to Boarding Platform

This set of observations covers the trip from the entry to the tunnel to the boarding platform, in quarter minutes. The trip took 50 seconds, with no indication that those who preferred the stairs took longer. In the morning, about eight percent preferred to walk up. (At night, over twenty percent preferred to walk down.) About ten percent enter the lobby for some service, such as checking the time.

Station Exit to Ticket Booth

As might be expected, people do not return from work in the same order as they go to work. As a result, the lot empties in an apparently random order. The average time to walk from the terminal to the car is reasonably constant, at slightly under 80 seconds, as shown in Table B-2. An anomaly of the data is that the average time to walk to the car in the evening is less than the average time to walk from the car in the morning.

The cars leave the lot over a shorter time period than they take to fill it. As a result, short queues build up at the merges at the end of lanes. This generally longer time to go from parking space to ticket booth is also shown in Table B-1. The sum of these two sets of numbers shows a much more constant time for egress than for access, but the shorter walking time is reflected in the lower totals.

Car Time, Ticket Booth to Street

The time to leave the lot, from booth to street is similar to the congested times of morning entrance, except that at 5:15, when cars may be backed up past the booth, the average time is 52 seconds. Otherwise, the egress from booth to street takes 25 to 30 seconds, on the average. The barrier of the light is a factor in this time. Occasional cars that "hit" the light leave in times of 12 to 16 seconds.

Summary

The totals of these times is shown in Table B-2. It shows that, in the morning, a passenger is in the system for a minimum of three minutes before he is ready to wait for the bus. By 7:30, access time has increased to five minutes, and may be as great as eight minutes for the traveler at 8:30.

The totals for evening egress are more constant than morning arrival, at close to four minutes throughout the rush hour.

The sum of the morning and evening values indicates that the park-and-ride passenger may expect to spend 7.5 to 12 minutes at El Monte Station daily, exclusive of time waiting for the bus to arrive in the morning.

Table B-2
PASSENGER TIME SPENT AT EL MONTE STATION
(seconds)
Morning

Clock Time	6:30	7:00	7:30	8:00	8:30
Entry to ticket booth	24	26	29	15	16
Booth to terminal	115	155	219	227	398
Terminal entry to boarding platform	50	50	50	50	50
Total	189	231	298	292	464

Evening

Clock Time	4:30	5:15	5:45	6:00
Boarding platform to terminal exit	50	50	50	50
Terminal exit to booth	169	178	147	165
Booth to street exit	25	52	29	28
Total	244	280	226	243

BUS CRUISE TIMES

The hypothesis that the total time for a bus to travel from TV camera to berth to exit was the same for all berths was tested by measuring the cruise-in time for 194 buses and the cruise-out time for 181 buses, by berth of occupancy. The sample is not uniform over the berths, because not all locations are used equally. The time to park increases with distance from the camera, and the time to leave decreases, as can be seen in Table B-3 and Figure B-1. If one selected a value to smooth out the irregularities in the curve at Berth

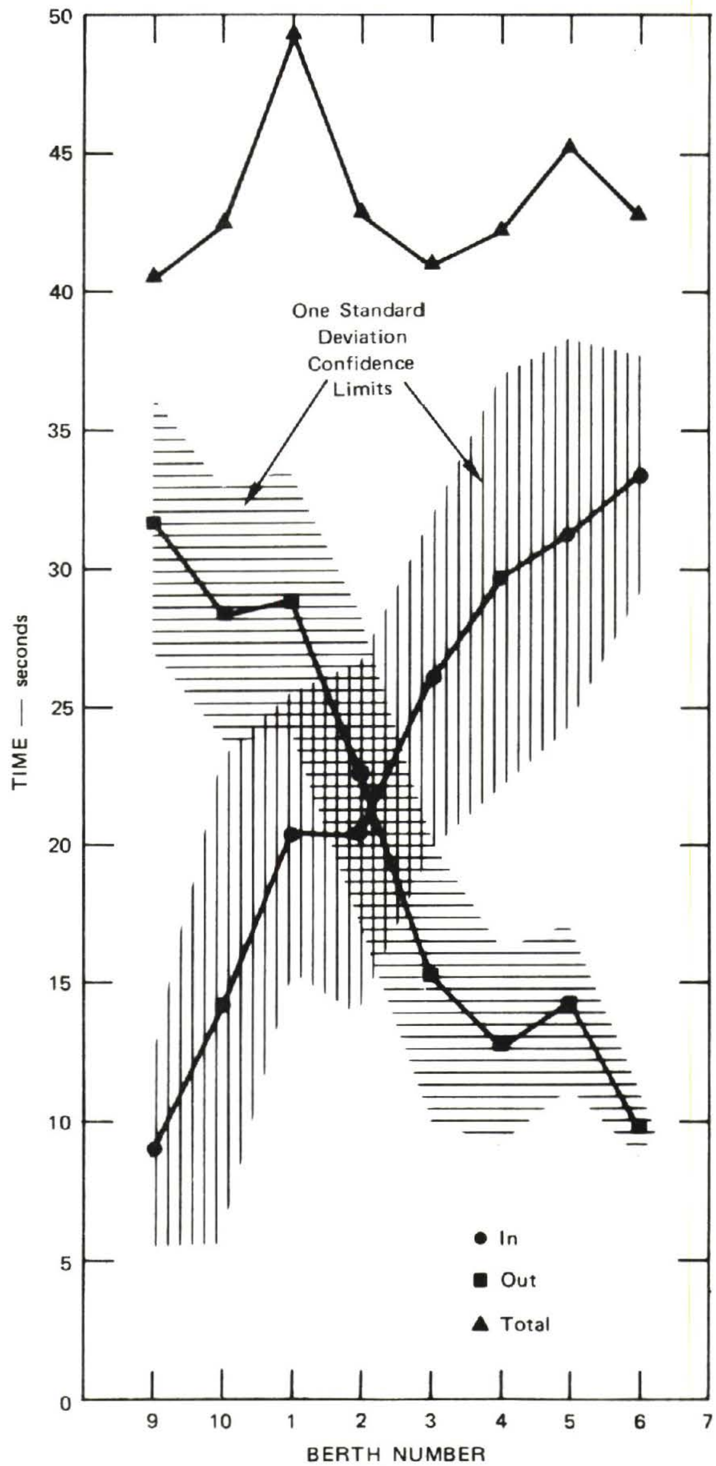

FIGURE B-1 CRUISE-IN, CRUISE-OUT TIME AT EL MONTE (BY BERTH)

1, the value would lie within one standard deviation of the current estimate.

Table B-3
EL MONTE STATION
CRUISE TIME, TV CAMERA TO BERTH, BERTH TO STOP SIGN
(Seconds)

	Berth Number							
	9	10	1	2	3	4	5	6
Cruise in:								
Sample	12	35	27	26	47	23	13	11
Average	8.8	14.1	20.4	20.3	25.8	29.5	31.2	33.3
Sigma	3.33	8.47	5.08	6.33	6.01	7.45	7.12	4.37
Cruise out:								
Sample	13	36	16	43	35	23	7	8
Average	31.6	28.3	28.8	22.5	15.2	12.7	14.3	9.6
Sigma	4.64	4.60	4.69	6.24	5.20	3.67	3.04	1.2
Total	40.4	42.4	49.2	42.8	41.0	42.2	45.5	42.9

The standard deviations are large, relative to the means, because about half of the sample had one or two measurements which are as much as 20 seconds larger than adjacent readings. This is caused by the delay when two buses attempt to use the single lane around the station simultaneously. For example, if a 38 second reading used in computing the average for Berth 3 cruise-out time were omitted, the average would shift from 15.2 seconds to 14.5 and the standard deviation from 5.20 to 3.47.

RELIABILITY OF PERFORMANCE

By matching the actual departure of 126 westbound and 146 eastbound buses to their scheduled departure, it has been possible to establish cumulative probability curves for the deviation from schedule in peak and off peak travel. These are shown in Table B-4. The eastbound curves and westbound peaks are very similar, with median values of 1.6, 1.0, and 1.5 minutes late. All three show that about 85% of the buses

Table B-4
CUMULATIVE PROBABILITY DISTRIBUTIONS FOR DEPARTURE FROM EL MONTE STATION
(Minutes)

Cumulative Percent	Westbound Peak	Westbound Offpeak	Eastbound Peak	Eastbound Offpeak
10	- .5	0	- 1.0	- .6
20	0	+ 1.2	- .4	- .4
30	+ .5	+ 2.4	+ .3	0
40	+ 1.0	+ 3.0	+ .9	+ .3
50	+ 1.5	+ 3.5	+ 1.6	+ 1.0
60	+ 2.0	+ 3.8	+ 2.5	+ 2.0
70	+ 3.0	+ 4.0	+ 3.4	+ 3.0
80	+ 4.3	+ 7.5	+ 4.5	+ 4.5
90	+ 5.5	+11.2	+ 5.7	+ 6.6
100	+10.0	+16.0	+11.0	+14.0

Note: - means bus is early
+ means bus is late

are less than 5 minutes late. The offpeak westbound curve shows poorer performance, with a median value of 3.5 minutes and about 75% of the buses less than 5 minutes late. Nevertheless, all these curves show such small deviations from schedule that in extrapolating current performance to greater traffic volumes in peak periods, it will be assumed that schedules are maintained.

APPENDIX C

MATHEMATICAL MODELS OF DOWNTOWN TRAFFIC

In the computations of the constraints that would be imposed on busway capacity by the downtown bus route networks, the following assmuptions were made. Three assumptions about automobile volumes were made.

1) no change
2) 10% reduction
3) no cars

There were two assumptions made about the growth rate of the busway buses.

1) growth would be the same as growth in non-busway buses
2) growth would be twice that of non-busway buses

The variables used in the modeling are

p = peak hour flow (in automobiles, where one bus is assumed equivalent to two automobiles)

s = percent saturation

c = capacity (in automobiles)

m = additional buses, all routes

n_a = current number of automobiles

n_b = current number of busway buses

n_n = current number of non-busway buses

d_{1b} = if all routes grow alike the share (i.e., fraction) of the additional buses required that would be busway buses

d_{2b} = if busway grows twice as fast, the share of additional buses required that would be busway buses

d_{1n} = if all routes grow alike, the share of additional buses required that would be non-busway buses

d_{2n} = if busway grows twice as fast, the share of additional buses required that would be non-busway buses

The computational procedure is that first, the capacity is computed

$$c = p/.01s$$

The .01 simply refers to the method of presentation of s in Table 28, Chapter IX.

The two d's can be computed.

<u>Case 1</u>

$$\frac{d_{1b}}{n_b} = \frac{d_{1n}}{n_n}$$

and

$$d_{1b} + d_{1n} = 1$$

produces

$$d_{1b} = \frac{n_b}{n_b + n_n}$$

<u>Case 2</u>

$$\frac{d_{2b}}{n_b} = \frac{2d_{2n}}{n_n}$$

and

$$d_{2b} + d_{2n} = 1$$

produces

$$d_{2b} = \frac{2n_b}{2n_b + n_n}$$

If there is no change in the number of cars

$$(c - p)/2 = m$$

and $d_{ib}m$ is the first entry in Table 31, where $i = 1,2$.

$$\frac{d_{ib}m + n_b}{n_b} = \text{capacity/present}$$

If the cars are reduced by 10%, the buses are first eliminated from the peak hour flow

$$p - 2\ (n_b + n_n) = a$$

and

$$(c - .9a)2 - (n_b + n_a) = m$$

where m is treated as above.

Finally, if there are no cars

$$(c/2) - (n_b + n_a) = m$$

and m is treated as above.

APPENDIX D

PASSENGER REACTION TO BUSWAY FEATURES AND FUTURE CHANGES

The on-board survey included a question on features of the busway system (question 11 on Form B). The rider was asked to check whether certain specified features were extremely important, quite important, slightly important or not important at all.

Similarly, passengers were asked to rate their responses to possible future changes (question 12 on Form B), ranking the changes at 1 for most important, 2 for next most important, etc.

The overall distributions of responses for both questions are given in Appendix A. This appendix describes how the response patterns vary with demographic characteristics and with life cycle category.

IMPORTANCE OF FEATURES BY DEMOGRAPHICS

Reduce Travel Time through Exclusive Bus Lanes

Although the sample as a whole is 53.6% female, those who ranked this feature as "Extremely Important" were 60.7% female. In large part, their age distribution and marital status was like the group as a whole. Their income was slightly clustered at under $10,000, and their education was less likely to have gone beyond high school. Since these three descriptors tend to be fairly highly correlated, it is hard to tell which motivated the response, but one guess is that those with lower incomes place a greater value on being on time to work.

New Air-Conditioned Buses

This feature was less frequently marked as "extremely important" by the group as a whole than the previous feature. Again, those doing so were 59.8% female. More of them than expected were over 50 years old, married, and with incomes under $10,000.

Reduction of Fare to 25¢

This feature was ranked as "extremely important" by more people than any other. There is no characteristic of sex, age, income or education in which they differ from the group as a whole.

Present Frequency of Service

Those marking this feature as "extremely important" were 59.8% female, less likely to have a college degree or more education than the sample as a whole, but like the group as a whole with respect to age, marital status or income.

Exclusive Bus Lanes on Spring Street

This was another feature not heavily favored by the group as a whole because it only affects route 60 for any distance. Those who favored this feature were 69.1% female, not married, with incomes under $10,000, and a high school diploma or less education.

Seat Availability

Those favoring this feature were 66.4% female, 50-64 years old, with some tendency toward incomes under $10,000, and a high school diploma.

El Monte Terminal

Those favoring this feature were 62.6% female, under 30 years old, with incomes from $5000 - $15,000, and a high school diploma or some college.

In summary, it is clear that women are more likely than men to mark a feature as "extremely important". It is not that they tend to mark at the extremes and the men in the central importance values. Except perhaps in the "air-conditioned buses" feature, men are dominant in the "not at all" value slot, and the distribution indicates that men mark each feature one importance slot lower than the women.

IMPORTANCE OF FEATURES BY TRANSIT DEPENDENCY

The attitude of the riders toward special bus features shows some variability between the transit dependent and the choice riders, with the captive riders ranking the features as more important. Features were rated on a scale of 1 to 4 with 1 denoting "extreme importance" and 4 "no importance". Thus, the lower the average, the more important is the feature.

Table D-1
AVERAGE VALUES OF BUS FEATURE IMPORTANCE, BY CAPTIVE VERSUS CHOICE PASSENGERS

Feature	Was a car available for this trip?		
	No	Yes, but with considerable inconvenience to others	Yes, but I prefer bus
A. Reduce travel time through exclusive bus lanes	1.5	1.7	1.7
B. New, air-conditioned buses	1.8	2.3	2.2
C. Reduction of Fare to 25¢	1.2	1.4	1.4
D. Present frequency of service	1.4	1.5	1.5
E. Exclusive bus lanes on Spring Street	1.9	2.4	2.5
F. Seat Availability	1.7	2.1	2.0
G. El Monte Terminal	2.1	2.4	2.1

The Spring Street contra-flow bus lanes play a large role only on route #60, which has the greatest number, though not the greatest share, of captive riders.

IMPORTANCE OF FEATURES BY LIFE CYCLE CATEGORY

The data was also sorted by the six life cycle categories represented in the survey population with the following results.

Table D-2
AVERAGE VALUES OF BUS FEATURE IMPORTANCE,
BY LIFE CYCLE CATEGORY

Busway Feature	Life Cycle Category				
	Single	New Married	Full Nest 1	Full Nest 2	Empty Nest
Reduce travel time	1.5	1.7	1.8	1.6	1.6
Air-conditioned buses	2.4	2.2	2.2	2.1	1.9
25¢ fare	1.3	1.2	1.2	1.3	1.3
Present frequency of service	1.5	1.6	1.6	1.5	1.5
Spring St. bus lanes	2.3	2.2	2.5	2.6	2.5
Seat availability	2.0	1.8	2.1	2.0	1.8
El Monte terminal	2.1	1.8	2.2	2.2	2.3

FUTURE CHANGE RANKINGS BY DEMOGRAPHICS

Table D-3 summarizes the description of passengers giving various responses to the question on Form B on possible changes in busway service. Passengers were asked to rank the five possible changes on a scale of 1 to 5, where 1 = most important, 2 = next most important, etc. Those described are the people giving the feature highest priority (1) and those giving it lowest priority (5). Since the three central rankings (2,3,4) are omitted from the table, it is not necessary that those in the last priority balance those in the first priority in any descriptive way.

Table D-3
IMPORTANCE OF POSSIBLE FUTURE
CHANGES IN BUSWAY DEMOGRAPHICS

	Increased Frequency	Increased Speed	More Downtown Bus Lanes	Closer Downtown Bus Stops	Extend Busway East of El Monte
			First Priority		
Percent Male	41.9	40.0	41.7	35.4	46.3
Average Age	37.2	24.5	37.7	37.2	38.3
Average Income (000's)	16.5	16.6	16.4	16.1	18.5
Percent Married	66.6	63.6	67.2	64.2	70.7
Percent high school diploma or less	33.8	38.1	39.1	39.1	31.5
			Last Priority		
Percent Male	40.0*	56.3	51.5	54.8	47.8
Average Age	38.2*	39.9	38.3	35.6	35.9
Average Income (000's)	20.4*	19.0	19.4	19.6	18.3
Percent Married	80.0*	72.0	75.0	72.1	69.0
Percent high school diploma or less	26.9*	30.5	22.8	22.8	27.0

*Sample under 30 people

The number of people ranking "increased speed", "more downtown bus lanes" and "closer downtown bus stops" as their highest priority was remarkably similar to the number ranking these changes as their lowest priority. The characteristics of these people, however, varied considerably. Those who favored increased speed were the youngest. Those who favored shorter downtown walks were predominantly female. The most interesting aspect of the table is the large difference between those who ranked these features first and those who ranked them last. In each case, those who ranked them last were more frequently male, richer, more likely to be married, and more educated.

The last possible change--"extend busway east of El Monte"--produced the second largest number of highest priority and the largest number of lowest priority rankings. Here the demographic description of the high and low priority groups is more similar than for any of the other features, and those favoring the feature are different from all the other groups in the first priority in having more men, being older, richer, more likely to be married, and having more education.

The "increased frequency" change received the greatest number of first priority and smallest number of last priority scores. Due to the small sample size not much reliance can be put on the values tabulated under last priority. The response to this question varied by bus route and by time of day. As can be seen in the following table the response was stronger on those traveling before 7 o'clock, with those on route 63 leading all the rest.

Table D-4
DESIRE FOR INCREASED BUS FREQUENCY
(Percent giving this change highest priority by route and time of day)

Bus Route	5:54-6:30	6:31-7:00	7:01-7:30	7:31-8:00	8:01-8:55
52	71.4	72.2	*	*	*
53	50.0	53.8	63.6	66.7	*
60	56.8	58.3	48.8	64.7	50.0
63	*	88.2	*	*	*
401	63.8	61.3	45.2	54.5	65.2
402	66.7	57.5	45.0	38.6	37.5
403	*	72.2	41.0	53.8	40.0
404	72.7	70.0	*	55.0	66.7
405	80.0	*	*	58.1	50.0
Total sample	231	211	203	243	90

*No data on this route at this time.

FUTURE CHANGE RANKINGS BY LIFE CYCLE CATEGORY

Finally, the following table indicates which life cycle group tended to give highest priority and lowest priority to each of the possible future changes cited on the questionnaire. An entry in this table indicates the group which gave a percentage of first priority rankings (denoted by an x) or a percentage of last priority rankings (denoted by a 0) higher than might be expected from their share of the bus population. Where no group gave a significantly higher percentage or where two groups were tied in the percentages given, this is so indicated.

Table D-5

DESIRE FOR NEW FEATURES BY LIFE CYCLE

	Single	Newly Married	Full Nest 1	Full Nest 2	Empty Nest
Frequency					0
Speed	x				0
More downtown bus lanes				0	x,0
Closer downtown stops	x	0	0		
Extending busway east of El Monte		0			x

x = first priority
0 = last priority

APPENDIX E

STATION SURVEY

A part of the overall station evaluation was done through informal face-to-face interviews with users. Interviews were collected in the platform waiting area during peak and off-peak hours on a weekday. A total of 693 people were interviewed, 349 at the El Monte Station, 154 at the Hospital Station, and 190 at the College Station. The El Monte Station was surveyed on February 5, 1975; the Hospital Station was surveyed on February 5 and 6, 1975; and College Station was surveyed on April 1 and 2, 1975.

EL MONTE STATION

Data takers approached passengers at random and asked them six or seven questions. (These are shown in Attachment E-A.) Table E-1 shows the response to the question "What do you feel are its [El Monte Station] best features?"

Table E-1
USER PERCEPTION OF EL MONTE STATION'S BEST FEATURES

Feature	n	% of Passengers Responding
Prompt, frequent service	82	23
Open design, visibility	72	21
Moves people, buses quickly	53	15
Just like it	49	14
Clear, frequent announcements	16	5
Lobby	14	4
Parking lot	9	3
Facilities in general	9	3
Personnel	9	3
Other	31	9

Answers to questions were analyzed not only in terms of their frequency but also to see if responses varied by sex, by trip purpose (work or other), by time of day (peak or off-peak hours), and by those who used the station during the day only as opposed to those who used it at night as well (after 7:00 PM). It may be helpful at this point to show a percentage breakdown of these different categories. They are shown in Table E-2.

Table E-2
DEMOGRAPHICS, EL MONTE STATION

User	Peak (6-9 AM)		Off-Peak (9 AM-3 PM)		6 AM-3 PM	
	n	%	n	%	n	%
All users	202	58	147	42	349	-
Male	103	51	80	54	183	52
Female	99	49	67	46	166	48
Worker	177	88	43	29	220	63
Other	25	12	104	71	129	37
Day	161	80	98	67	259	74
Day/night	41	20	49	33	90	26

"Prompt, frequent service" headed the list of the best features of the El Monte Station with 23% of those polled citing this feature. This perception varies little by sex, trip purpose, or time of day. However, those who use the station at night (after 7:00 PM) as well as during the day are not as satisfied with the service as those who use the station only during the day. Only 19% of night-time users included this as a "best feature" compared to 25% of the day-only users.

Second on the list of best features was "open design, visibility." Twenty-one percent of the El Monte passengers cited this feature, which seems to be more important to females, listed by 24%, as opposed to males, listed by 17%. It also ranks more heavily with people whose trip purpose is not work-related. Twenty-six percent of these people included this as a best feature; only 17% of the workers did so.

"Moves people and buses quickly" was listed as a best feature by 15% of those interviewed. This perception is almost uniform by sex, day or night use of station, and trip purpose. There is a variation among those who use the station during peak and off-peak hours. Twenty percent of off-peak riders listed this as a best feature; only 12% of peak period riders did so.

A number of people were unable to list a specific feature of the El Monte Station which appealed to them but indicated "I just like it." This response was fourth on the list, being cited by 14% of those interviewed. There is no variance in this response by sex, trip purpose, time of day, or day/night use.

Responses which fall in the "other" category include: central location (5), protection from elements (4), cleanliness (4), telephone information (3), restrooms (3), and escalator (3). Additional comments not listed had one or two responses each.

Table E-3 shows responses to the question "What do you feel are its [El Monte Station] inadequacies?"

Over one-third (36%) of the people interviewed felt that the station had no inadequacies. There was a higher percentage of females who felt this way (41%) than males (31%). Off-peak riders also seem to be a bit more positive in their attitude (39% responded "none") than peak period riders (33% of whom responded "none").

Table E-3
USER PERCEPTION OF EL MONTE STATION'S INADEQUACIES

Inadequacy	n	% of Passengers Responding
None	124	36
More parking spaces needed	66	19
Vending machines needed	51	15
Personnel rude, unhelpful, etc.	25	7
Lacks protection from wind, rain	14	4
Station is too small	10	3
Selection process of berths inadequate	8	2
Clock needs fixing	8	2
Cars jam entranceway in parking lot	7	2
Other	32	9

The biggest complaint about the station was that there are not enough parking spaces. Nineteen percent of those interviewed cited this inadequacy. Twenty percent of the day users felt that parking space was inadequate, while only 14% of day/night users felt it was a problem. There was no variation in this complaint by sex, trip purpose, or time of day.

Fifteen percent of the passengers polled felt that the station should have vending machines which sold hot/cold drinks, cigarettes, etc. Males outnumbered females in this complaint (17% of males vs 11% of females), and 20% of persons whose trip purpose was not work-related mentioned this as an inadequacy compared to 11% of those whose trip purpose was going to work.

Complaints concerning personnel came from 7% of those interviewed. These complaints referred to rudeness or the feeling that attempts to get information about schedules, costs, etc. were not handled properly by station personnel. This complaint varied little by sex, trip purpose, time of day, or day/night use.

Responses which fall in the "other" category include: escalator/elevator doesn't work (4) and lobby closes too early (4). Additional comments not listed had one or two responses each.

Table E-4 compares the number of positive and negative responses.

Table E-4
USER PERCEPTION OF EL MONTE STATION
POSITIVE VS NEGATIVE COMMENTS

User	Positive Comments	Negative Comments	Pos.-Neg. Ratio
All comments	344	221	1.56
Male	175	121	1.45
Female	169	100	1.69
Peak rider	196	167	1.17
Off-peak rider	148	24	2.47
Worker	207	127	1.63
Peak	172	105	1.64
Off-peak	35	22	1.59
Other	137	94	1.46
Day	258	130	1.98
Day/night	86	91	.95

The overall reaction to the El Monte Station is a positive one with 1.56 positive comments made for each negative comment. Stated another way, 61% of the comments were positive and 39% were negative.

The table indicates that the two groups with the most positive reaction to the station are off-peak and day-only users. Those with the most negative reactions are people who use the station after 7:00 PM as well as during the day—the only group whose negative comments outweighed their positive ones—and commuters or peak period riders.

Ninety passengers said they used the station after 7:00 PM. These people also were asked if they had concerns for their personal safety when they used the station at night. Sixteen persons, or 18%, said they did. Six of these were males; 10 were females. Some had specific concerns, e.g., that the back areas of the parking lot, which are some distance from the station building, needed better lighting. Others were more general, saying "I have concerns for my safety wherever I go at night."

HOSPITAL STATION

Passengers at the Hospital Station were asked the same questions as those people interviewed at El Monte. Table E-5 shows what these 154 riders feel are the best features of the station. Again, answers were analyzed not only in terms of

Table E-5
USER PERCEPTION OF HOSPITAL STATION'S BEST FEATURES

Feature	n	% of Passengers Responding
Convenient	45	29
Just like it	27	18
Elevator	23	15
Protection from wind, rain	16	10
Speed in moving people, buses	13	8
Other	21	14

their frequency but to see if answers varied by sex, trip purpose, time of day, and day-only vs day/night use. The percentage breakdown of these categories is shown in Table E-6.

Table E-6
DEMOGRAPHICS, HOSPITAL STATION

User	Peak (6-9 AM)		Off-Peak (9 AM-3 PM)		6 AM-3 PM	
	n	%	n	%	n	%
All users	66	43	88	57	154	-
Male	41	62	47	53	88	57
Female	25	38	41	47	66	43
Worker	54	82	46	52	100	65
Other	12	12	42	48	54	35
Day	44	67	64	73	108	70
Day/night	22	33	24	27	46	30

The convenience provided by the Hospital Station ranked highest among comments on its best features. Twenty-nine percent of the riders interviewed listed this feature, often adding "Now I don't have to transfer in Los Angeles." This perception varied little by sex, time of day, or trip purpose, but is ranked higher by those who use the station only during the day (listed by 33%) than by those who use it at night as well (listed by 22%).

Eighteen percent of those interviewed were unable to state what they felt was a single best feature of the station, responding more generally by "I just like it" or "It's all good." Off-peak riders are more positive than peak period riders (22% vs 12%), people whose trip purpose is not work-related are more positive than workers (20% vs 13%), and those who use the station during the night as well as the day are more positive than those who use it only during the day (28% vs 13%).

Having the use of the elevator ranked third on the list of best features and was cited by 15% of those interviewed. Apparently this feature is viewed as more important by males than females (20% vs 8%) and by off-peak riders than by peak period riders (18% vs 11%).

"Provides protection from wind, rain" and "speed in moving people and buses" ranked fourth and fifth. Responses which fall in the "other" category include: attractive design (3), security guard (3), and additional comments with one or two responses each.

Table E-7 shows what passengers at the Hospital Station perceive to be its inadequacies.

Table E-7
USER PERCEPTION OF HOSPITAL STATION'S INADEQUACIES

Inadequacy	n	% of Passengers Responding
None	54	35
No rest rooms provided	25	16
Lacks protection from wind, rain	24	16
No security provided	16	10
No information, schedules posted	11	7
Other	20	13

Over a third of the people interviewed (35%) felt that the station had no inadequacies. There was little variation in this feeling by sex, trip purpose, or day/night use of the station. The off-peak riders did state that there were no inadequacies more frequently than did peak period riders (40% vs 29%).

No rest rooms are provided at the Hospital Station and this was the Number 1 complaint cited by 16% of the passengers. This feeling is almost uniform by sex, trip purpose, time of day, and day/night use.

Sixteen percent of the people said that the station needed more protection from wind and rain. This comment most often referred to the overpass which crosses the busway connecting the station to Valley Boulevard, but also referred to the station itself, particularly that it was "cold." This complaint was cited more often by workers (20%) than by those whose trip purpose was not work-related (7%). There was little variation by sex, time of day, or day/night use.

A security guard is now on duty at the Hospital Station. However, at the time this user perception survey was made (February 5 and 6) no such service was provided, and this inadequacy was cited by 16% of the passengers, ranking third in their list of complaints. (This was reported immediately to SCRTD.) This concern was higher among females than males (15% vs 7%), among peak period riders than off-peak riders (21% vs 2%), and among workers than among those whose trip purpose was not work-related (13% vs 6%).

The Hospital Station does have an information booth, but it is not staffed at this time. Complaints referring to this need for information service were coted bu 7% of the passengers and ranked fourth on the list of inadequacies.

Responses which fall in the "other" catagory include: need for more lighting (4), need for more seats (4), complaints related to the elevator (3), and additional comments with one or two responses each.

Table E-8 compares the number of positive and negative responses.

Table E-8
USER PERCEPTION OF HOSPITAL STATION
POSITIVE VS NEGATIVE COMMENTS

User	Positive Comments	Negative Comments	Pos.-Neg. Ratio
All comments	145	96	1.51
Male	86	57	1.51
Female	59	39	1.51
Peak	59	51	1.16
Off-peak	86	45	1.91
Worker	96	67	1.43
Peak	49	43	1.14
Off-peak	47	24	1.96
Other	49	29	1.69
Day	104	67	1.55
Day/night	41	29	1.41

The most positive group reaction comes from off-peak workers who make almost twice as many positive comments as they do negative ones. The most negative reaction comes from peak period workers with an almost even ratio of positive and negative comments.

Thirty percent of the passengers said that they use the station after 7:00 PM, and almost half of these people expressed concerns for their personal safety when using the station at night.

COLLEGE STATION

Ninety percent of the passengers interviewed at the College

Station were students on their way to or from classes at California State University at Los Angeles. Almost uniformly they were delighted to have the new station in operation because it afforded them easy access to the college, cut down their trip time, and for those who had switched from driving, cut their travel costs. (Questions asked at this station are shown on Attachment E-B.)

Their responses to the question about the station's best features are shown in Table E-9, along with responses of other passengers interviewed who were not students. In addition to

Table E-9
USER PERCEPTION OF COLLEGE STATION'S BEST FEATURES

Feature	n	% of Passengers Responding
Convenience, access to campus	96	51
Speed, cutting down trip time	60	32
Elevator	35	18
Attractive appearance	12	6
Cost savings—trip less expensive	10	5
Other	26	14

looking at frequency of responses, answers were analyzed to see if there were variations among male vs female and day-only vs day/night use. Responses were not broken into peak and off-peak categories as such a division is not applicable to students. The percentage breakdown of these categories is shown in Table E-10.

Half (51%) of the people interviewed spoke of the convenience afforded them by the College Station and how it served to make the campus more easily accessible. This was mentioned more frequently by males (57%) than by females (43%).

Table E-10
DEMOGRAPHICS, COLLEGE STATION

	Student		Other		All	
	n	%	n	%	n	%
All	171	90	19	10	190	100
Male	89	52	11	58	100	53
Female	82	48	8	42	90	47
Day	121	71	15	79	136	72
Night	50	29	4	21	54	28

Thirty-two percent were delighted that the busway station cut down their trip time, many stating "It takes me half as long to get here now." They also mentioned that fewer transfers were now necessary. Females rated this speed factor higher than did males (39% vs 25%) as did day/night users vs day-only users (41% vs 28%).

One-fifth (20%) were pleased with the elevator, since the eastbound boarding platform would require climbing or descending five flights of stairs, were there no elevator. Females rated this feature higher than did males (22% vs 15%).

Some commented on the attractiveness of the station design and the lovely view one sees from the glass-walled elevators. Another group said that the station made their trip less expensive. Generally, these were people who had switched from driving to riding the bus and were spending less on gasoline and parking costs.

Responses which fell in the "other" category included: availability of phones (4) and cleanliness (3). Additional comments not listed had one or two responses each.

Table E-11 shows what users perceive to be the inadequacies of the College Station.

Table E-11
USER PERCEPTION OF COLLEGE STATION'S INADEQUACIES

Inadequacy	n	% of Passengers Responding
None	89	49
Lacks protection from wind, rain	25	13
Elevators frequently out-of-order	21	11
No information, schedules posted	15	8
No rest rooms provided	13	7
Other	34	18

The overall reaction to this station is decidedly a positive one. Almost half the people interviewed (49%) saw no inadequacies in the station. This reaction was higher among females than males (56% vs 39%) and among day-only users as opposed to day/night users (51% vs 35%).

The station is located in a windy valley and except for the elevators, no part of the station is totally enclosed. The main complaint, cited by 13% of those polled, had to do with this problem—that the station lacked protection from the wind and specifically that the overpass (between the eastbound and westbound platforms) needed protection from the rain. (It is enclosed in wire mesh.)

The day the survey was made one of the elevators was out-of-order for several hours. This frequent breakdown in elevators was the second complaint cited by 11% of the passengers. A maintenance man working to correct the malfunction said the breakdowns occurred because the elevators were too new and the kinks had not yet been worked out.

There is an information booth on the top level of the station, but at the time of this survey it was not staffed. This inability to get information and the fact that bus schedules are not posted on the lower levels was cited as an inadequacy by 8% of the passengers.

The fourth complaint was the lack of rest rooms. Additional concerns mentioned by passengers and aggregated into the "other" category include: lack of vending or coin-changing machines (9), lack of security personnel (7), and absence of clocks (4). Additional comments not listed had one or two responses each.

Table E-12 compares the number of positive and negative responses.

Table E-12
USER PERCEPTION OF COLLEGE STATION
POSITIVE VS NEGATIVE COMMENTS

User	Positive Comments	Negative Comments	Pos.-Neg. Ratio
All comments	239	108	2.21
Male	127	59	2.15
Female	112	49	2.29
Day	166	69	2.41
Day/night	73	39	1.87
Student	213	101	2.11
Other	26	7	3.71

As is evidenced by this table, station users have a decidedly positive view of the station, with 2.2 positive comments made for each negative one. Sixty-nine percent of the comments made were positive; 31% were negative.

Non-students are the most positive group. Those who use the station at night are the least positive but are still far from being a negative group with a positive-negative ratio of 1.9.

Of the 190 passengers interviewed, 54 (28%) said they used the station after 7:00 PM—mostly students attending evening classes at the college. Twenty-four expressed concern for their personal safety when using the station at night, due to its isolation and lack of security.

Related to this issue of security, passengers were asked, "If you had a choice would you prefer: 1) someone on duty in the information booth when you used the station, 2) a security guard patrolling the area, or 3) a closed-circuit TV system operating here?" and respondents were asked to rank their choices. Security guard ranked highest with a 1.5 ranking, followed by information booth (2.0) and TV (2.4). This ranking was uniform among males and females, day and night users, and students and non-students.

The information booth (currently not staffed) is located on the top level of the College Station, and one does not have a good view of either the westbound or eastbound loading platforms, located at lower levels, from this booth. Because of this, some passengers questioned whether or not a person working in the information booth could play an effective role in the security factor of the station.

Many wished to know where the closed TV circuit would be monitored and felt that if this were done at any distance this option also would have little effectiveness.

Attachment E-A

EL MONTE AND HOSPITAL STATION SURVEY

Good morning. We are conducting a survey to find out how people feel about the El Monte Station. I would like to ask you six questions.

Is your trip purpose work-related or otherwise?

Are you getting on or off the bus? (Usually this can be noted by data taker without asking the passenger.)

Do you feel this station has been effectively designed for passenger convenience?

What do you feel are its best features?

What do you feel are its inadequacies?

Do you feel the signs in the station are adequate and understandable?

Do you use this station at night (after 7:00 PM)?

(If answer is yes) Do you have any concerns about your personal safety when using the station at night?

Thank you very much.

(Note sex, race, and apparent age category. Do not ask person for this information.)

Attachment E-B

COLLEGE STATION SURVEY

1. What is your trip purpose? Work ___ School ___ Shopping ___ Other ___ (If school trip ask) Are you a Student ___ Teacher ___ Employee ___

2. (For all those who are not checked "Student" above ask) Did you take a feeder bus to get to this station? (If yes) What line did you ride?

3. What do you feel are the best features of this station?

4. What do you feel are its inadequacies?

5. Do you use the station at night (after 7:00 PM)? (If yes) Do you have concerns about your personal safety? If response is "Yes" probe for the reason.

6. If given a choice, would you prefer to have a person working at the information booth, a security guard patrolling the area, or a closed-circuit TV system operating here? Please rank these in order of importance to you.

7. Note sex, race, and apparent age of passenger. Do not ask for this information.

APPENDIX F

SURVEY OF BUS OPERATORS

BIGELOW-CRAIN ASSOCIATES

873 SANTA CRUZ AVENUE • MENLO PARK, CALIFORNIA 94025 • (415) 323-2471

As stated in the letter by Mr. J. T. Johnston, RTD General Superintendent of Transportation, the firm of Bigelow-Crain Associates is conducting an on-going evaluation of the San Bernardino Freeway Express Busway. We are asking for your participation in this survey to help us understand driver perceptions and attitudes toward busway operations and regulations.

Questions 1-11 all pertain to speed restrictions on the busway.

1. The maximum legal speed of 55 mph

    ____ could safely be increased (by ____ mph)

    ____ is about right

    ____ should be lowered

2. The 35 mph speed through Gibson tunnel, westbound, is

    ____ too slow ____ about right ____ too fast

3. The 45 mph speed through Gibson tunnel, eastbound, is

    ____ too slow ____ about right ____ too fast

4. The 30 mph speed on the Del Mar Ramps is

    ____ too slow ____ about right ____ too fast

    ____ don't drive this route

5. The 45 mph speed when approaching the Del Mar Ramps is

    ____ too slow ____ about right ____ too fast

6. The 35 mph (posted) speed on S curve near Fremont Ave, WB is

    ____ too slow ____ about right ____ too fast

7. The 35 mph speed, just east of Long Beach Fwy., eastbound is

    ____ too slow ____ about right ____ too fast

8. Omitted.

9. The 10 mph speed through the Hospital Station is

____ too slow ____ about right ____ too fast

10. The 10 mph speed through the College Station is

____ too slow ____ about right ____ too fast

11. The 5 mph speed through the El Monte Station loop is

____ too slow ____ about right ____ too fast

12. The required spacing of 1,000 feet between buses (when operating at 55 mph) is

____ too long (could be lowered to ____ ft.)

____ about right

____ should be longer (increase to ____ ft.)

13. How does the contra-flow lane affect bus speed (as compared to mixed traffic)?

____ slows it down ____ speeds it up ____ about the same

14. How can bus speeds on the contra-flow lane be improved?

____ synchronize signals to favor bus flow

____ provide a passing lane for buses

____ relocate bus stops

____ speed up the boarding process

____ other (please comment) ____

____

____

15. In what way could the service director at the El Monte Station be of more assistance to you and the public? ____________________

____

____

____

16. Do you feel there are any special loading or unloading problems at the El Monte Station?

____ no

____ yes (please comment) ____

____

____

17. What is your experience with bus breakdown while driving on busway?

____ no breakdowns

____ bus has broken down ____ times

18. The rules given in the BUSWAY OPERATING MANUAL pertaining to bus breakdowns are

____ clear and workable

____ O.K.

____ unworkable and need changes (please comment) _______________

____

____

19. Have you had any experience with auto accidents while driving on the busway?

____ no → Did it involve intrusion into the bus lane? ___ yes ___ no

____ yes → Did it involve intrusion into the shoulder? ___ yes ___ no

→ Did it affect your performance in any way? __________

____

20. Are there any special problems involved in driving on the busway during foggy or rainy weather?

____ no

____ yes (please comment) ______________________________

____

21. Any special problems at night?

____ no

____ yes (please comment) ______________________________

____

22. In its third phase of operation, it is proposed that the busway include a mix of carpools and buses. Do you feel this would work?

____ yes, definitely

____ yes, but with changes needed in the present system
(Please comment) ______________________________

____

____ no (explain) ______________________________

____

23. If a limited number of carpools were allowed to use busway lanes, what effect do you think this would have on bus speeds and schedule reliability?

____ a bad effect

____ some negative effect

____ little or no change

24. Would allowing carpools on busway lanes have an effect on the safety of the system?

____ yes, definitely

____ slightly

____ none at all

25. What is your overall opinion of the busway design?

____ excellent as is

____ good but could be improved by ______________________________

____

____

____ needs major changes, including ______________________________

____

____

Please give us--

Your age ____

Months/years as busway driver
____ yrs., ____ mos.

Years in service as a bus driver ____

Years in service with SCRTD ____