OPERATING PLANS AND COST ESTIMATES

ALTERNATIVES ANALYSES

I-110 (HARBOR FREEWAY) CORRIDOR
I-5 (SANTA ANA FREEWAY) CORRIDOR

Prepared for the

SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT

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WILBUR SMITH & ASSOCIATES
GEORGE BEETLE COMPANY
JORDAN/AVENT & ASSOCIATES

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I. INTRODUCTION

The Southern California Rapid Transit District engaged Wilbur Smith and Associates in association with the George Beetle Company and Jordan/Avent & Associates to assist in evaluating transitway alignments and modal alternatives in the I-110 (Harbor Freeway) and I-5 (Santa Ana Freeway) corridors. The primary focus of this effort was an operational analysis of bus and rail alternatives, one element of an inter-agency work program designed to provide an environmental impact statement for a transitway project in each corridor.

The purpose of this report is to summarize the transit operating plans and operating cost estimates which were developed in this study. More detailed documentation is contained in a series of 31 Technical Memoranda and other working papers prepared and submitted during the course of the work.

Study Background and Scope

One element of the Regional Transit Development Plan (RTDP) for Los Angeles County is the development of "Freeway Transit" on a regional basis. Two high priority corridors, the Harbor (I-110) and Santa Ana (I-5) Freeways, were selected for further study and project development.

A two-phase inter-agency work program was implemented for each corridor, with Caltrans as the lead agency. Stage I, completed in April 1981, represented the initial stage of alternatives evaluation to satisfy Federal and State guidelines which call for an Alternatives Analysis and Draft Environmental Impact Statement for projects involving major capital investments. Stage I provided the basis for selection of the alternatives to be examined in greater detail in Stage II.

Stage II of the Freeway Transit Corridor Study work program involved: (1) the detailed description of fixed facilities for each selected alternative; (2) the development of construction and R/W cost estimates for selected alternatives; (3) the development of transit operating plans and operating cost estimates; (4) a comprehensive social, economic and environmental impact analysis; (5) an aesthetic review; (6) a comparative analysis of costs, benefits and cost-effectiveness; (7) financial plans; and (8) documentation in the form of a draft environmental impact statement for each corridor. The work covered by this report relates solely to Item (3), transit operating plans and transit operating cost estimates.

The I-110 (Harbor Freeway) corridor, for purposes of this study, was assumed to extend from Union Station in the Los Angeles CBD to San Pedro, a distance of about 25 miles. The I-5 (Santa Ana Freeway) corridor was assumed to extend from Union Station in the Los Angeles CBD to an interim terminus near the Los Angeles/Orange County line in Fullerton, a distance of about 20 miles.

Alternatives Studied

Fourteen alternatives were identified initially for study from the standpoint of transit operations and operations costs.(1) Subsequently, this initial set of alternatives was modified and expanded to include several operational variations for both rail and bus alternatives.(2) The resulting set of the alternatives for which operating plans were developed is described below:

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(1) TECHNICAL MEMORANDUM NO. 1, prepared by Wilbur Smith and Associates; June 4, 1981.

(2) Letter of September 1, 1981 from Norman P. Roy (Caltrans) to Alvin T. Holman (SCRTD) relative to TECHNICAL MEMORANDUM NO. 1, and subsequent instructions from Caltrans.

A. HARBOR CORRIDOR (I-110)

1. NO PROJECT - The present transit system (a benchmark for comparative analysis).

2. TSM - The present transit system modified to include four new stops for line haul services on the freeway; additional line haul service as specified in a freeway express bus plan developed by SCRTD;[3] and a 15 per cent increase in "background" bus service.

3a BUS/HOV TRANSITWAY (2 WAY) - Express buses and carpools operating (in both directions) on an exclusive transitway between the Los Angeles downtown area and Artesia Boulevard and in mixed-flow on the Harbor Freeway between Artesia and San Pedro, with all collection/distribution functions by transit performed by local feeder buses.

3b BUS/HOV TRANSITWAY (2 WAY) - Same as Alternative 3a but with selected express bus lines leaving the transitway to perform collection/distribution as well as line haul functions, thereby minimizing transfers.

3c BUS/HOV TRANSITWAY (1 WAY REVERSIBLE) - Same as Alternative 3a but with buses and carpools operating in a 1 way exclusive transitway in the peak travel direction only between downtown Los Angeles and Artesia, and in mixed traffic flow in the off-peak direction throughout the corridor and in the peak direction south of Artesia.

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(3) Proposed Harbor-Century Freeway Transitway Bus System, February 24, 1981, SCRTD.

4a ICTS (FULL SERVICE) - A fully grade-separated intermediate capacity guideway system utilizing relatively small 52 foot rail cars operating on the approved alignment of the Los Angeles Downtown People Mover between Union Station and the Convention Center in Downtown Los Angeles and in the median of of the Harbor Freeway, with a combination of at-grade and elevated sections between the downtown area and San Pedro and with all trains operating on the full length of the line.

4b ICTS (TURNBACKS) - Same as Alternative 4a but with trains not required to meet peak capacity requirements south of Artesia turned back at that location to reduce operating costs.

5a LIGHT RAIL TRANSIT (AT-GRADE) - Conventional light rail transit vehicles (similar to those operating in San Diego) operating on the same alignment as for ICTS south of Downtown Los Angeles and operating at-grade on selected downtown streets between 7th Street and Union Station, with all trains operating on the full length of the line.

5b LIGHT RAIL TRANSIT (GRADE-SEPARATED) - Same as Alternative 5a but terminating at an elevated station near the intersection of 7th and Flower Streets at the south edge of the Downtown L.A. core area to avoid at-grade operations on downtown streets; equivalent bus services between the LRT System terminal and Union Station via downtown employment centers were assumed in lieu of at-grade rail operations on downtown streets.

5c LIGHT RAIL TRANSIT (TURNBACKS) - Same as 5b but with turnbacks at Artesia.

6a HRT - VERMONT (FULL SERVICE) - A rail rapid transit alignment along Vermont Avenue involving a bored subway from the Los Angeles CBD to Gage Avenue, and aerial section from Gage to the I-105 Freeway. A technology similar to that planned for the Wilshire Corridor was assumed for this alternative.

6b HRT - VERMONT (TURNBACKS) - Same as Alternative 6a, but with turnbacks at Artesia.

HRT was the only mode considered for the Vermont alignment. The transitway with any of the other transitway alternatives would be located in the median of the freeway. It was assumed in all cases that the Century Freeway would be constructed with a transitway involving the same technology (BUS, ICTS, LRT or HRT) as that selected for the Harbor Freeway Corridor, and that the connection between a rail transitway in the Century Corridor and a rail transitway in the Harbor Corridor would involve vertical transfers (i.e. no direct track connections).

Line haul stations were specified for all alternatives at Santa Barbara, Slauson, Manchester, Rosecrans, I-105, Artesia, Carson, Pacific Coast Highway, Channel Street, the San Pedro terminus, and selected locations in Downtown Los Angeles including the northern terminus at Union Station. Rail alternatives terminated at Ports O' Call.

B. SANTA ANA FREEWAY CORRIDOR

1. NO PROJECT - The existing bus transit system.

2. TSM - The existing bus transit system with Line 800 modified to operate on the Santa Ana Freeway with stops at Norwalk and Rosemead / Lakewood and with a moderately increased service level, plus other low cost improvements specified by SCRTD.

3. ICTS - An intermediate capacity fully grade separated rail system between Union Station in Downtown Los Angeles and an interim terminal in Fullerton with provisions for transfer in the Norwalk area for Santa Ana/Century Corridor linkage.

4a LRT (CONSTRAINED) - Same as Alternative 3 but assuming conventional light rail transit vehicles operating in three car trains to minimize platform length.

4b LRT (UNCONSTRAINED) - Same as Alternative 4a but with unconstrained train length.

5a BUS/HOV (2 WAY) - Freeway express buses and carpools operating on a fully grade separated transitway between Downtown Los Angeles and the Fullerton park-and-ride terminal station, with freeway express buses stopping at all stations, and providing line-haul service functions only.

5b BUS/HOV (1 WAY REVERSIBLE) - Same as 5a but with a one way reversible transitway serving peak direction flow only with reverse-direction flow operating in mixed traffic.

For all cases involving a bus/HOV Transitway, it was assumed that freeway express bus services would be provided by articulated (high capacity) coaches, and that freeway

express bus speeds would be relatively unaffected by carpools (by limiting carpool use of the transitway to vehicles with 3 or more passengers).

Characteristics of Alternative Technologies

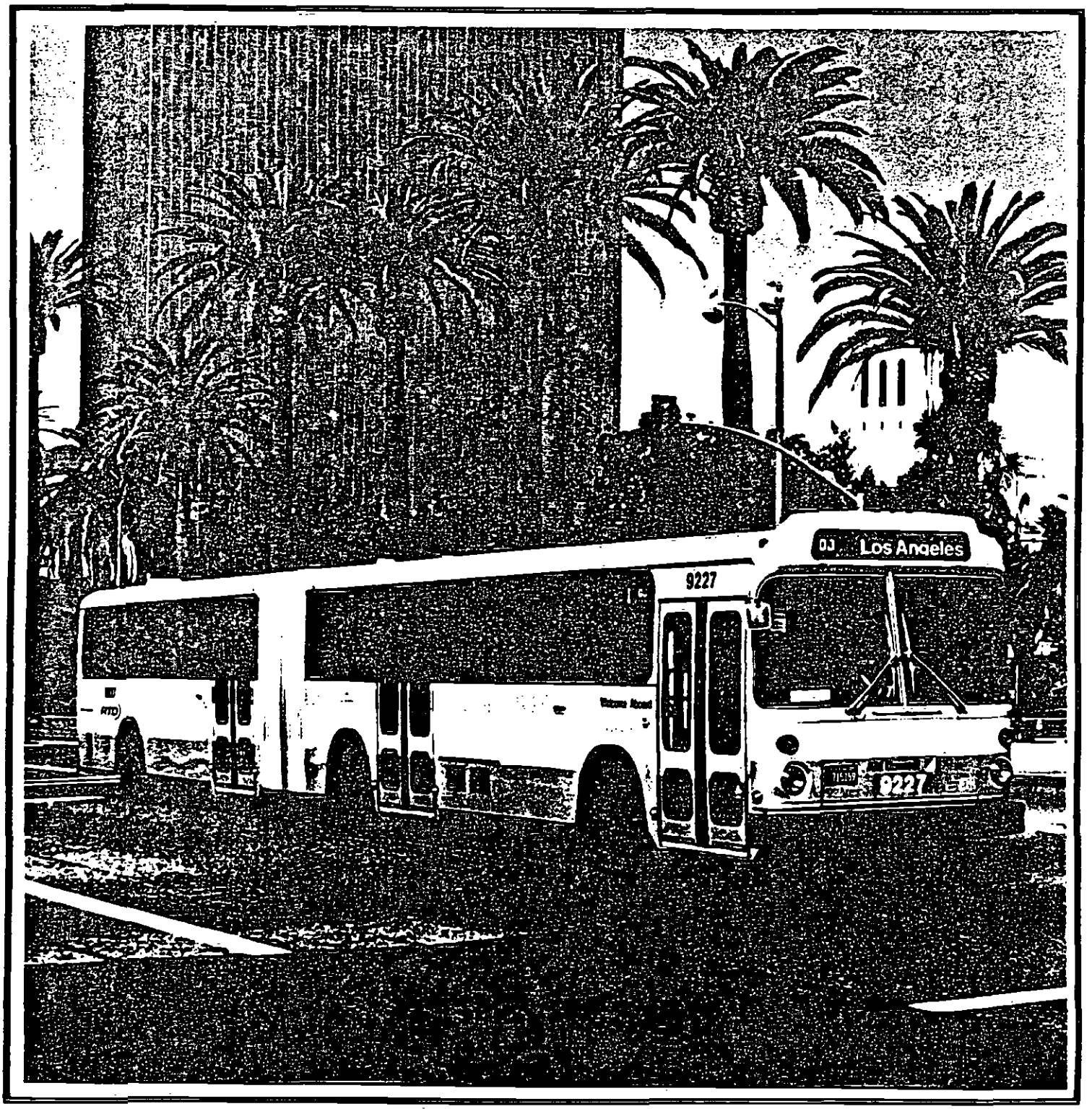
Four vehicle technologies were represented among the various transit alternatives tested in this study: articulated bus; ICTS rail vehicle; light rail transit vehicle (LRV); and heavy rail transit vehicle (HRT).

Articulated Buses - Freeway (express) transit services were assumed in all cases to be provided by articulated buses similar in design to those presently operated by SCRTD (see Figure 1). The general dimensions of these vehicles are shown below:

Length Overall (with standard bumpers)	60' max
Width (excluding mirrors, etc.)	102" max
Height Overall	125" max
Seating Capacity	up to 73
Step Height from ground (with 12.00 x 20 Tires):	
Front	14.53"
Rear	14.53"
Turning Radius:	
Outside	43.3'
Inside	25.6'
Door Width (between door leaves)	
Front	47.75"
Rear	47.75"
Headroom	78.34"
Wheelbase:	
Tractor	222.4"
Tailer	287.4"

FIGURE 1

TYPICAL SCRTD ARTICULATED BUS



Floor Height:	
Front Door	37.56"
Rear Door	38.27"
Aisle Width	22.0"

These vehicles have three doors to facilitate loading/unloading. They were assumed to have 69 seats, and be capable of accelerating from 0 to 50 miles per hour in 40 seconds (an average rate of acceleration of 1.25 mph/sec). Deceleration from 50 to 0 miles per hour in 20 seconds was assumed (average deceleration rate of 25 mph/sec). Cruising speed while in freeway express service was assumed to be 50 miles per hour. Operating speeds on arterials and downtown streets were assumed at 20 and 8 miles per hour, respectively. Dwell times at busway stations were calculated using the following formula[4]:

$$DT = (LR)(SF)\frac{(B)}{(F)} + C$$

where:

DT = Dwell time per bus stop.

LR = Loading Rate for articulated bus with prepayment and loading at front and center doors.

= 1.2 seconds per passenger.

SF = Safety factor to account for randomness of passenger arrivals within the hour.

= 1.25

B = boardings per hour per direction.

F = combined bus frequency.

C = a constant to account for opening and closing of bus doors (3 seconds).

The ICTS Technology - The Urban Transportation Development Corporation has developed an intermediate capacity transit system (ICTS) which was selected for the Los Angeles Downtown

(4) NCHRP Report 155, Bus Use of Highways, Wilbur Smith and Associates, 1975.

People Mover (LADPM) Project. This system was assumed as the "base case" rail alternative for this study (see Figure 2).

The ICTS vehicle is a 52-foot long, 8.2 foot wide car built as single units permanently coupled in married pairs. The married pairs would have attendant controls at each open end, thus functioning as double-ended units. The cars would have three plug doors (on each side) at quarter points, with no step wells. In addition, a proportional quantity of single unit cars may be utilized.

The ICTC cars would utilize conventional rotary motors, specified to be standard Garrett units with chopper control. The system would use a nominal 600 volt DC power supply through a third rail pick-up and suggested fourth rail return (to avoid potential problems of electrolytic corrosion). An acceleration capability of 3.2 mph/sec, and a nominal balancing speed of 60 mph were assumed.

Published data indicate a cruise speed of 45 miles per hour for ICTS vehicles, with a mean acceleration rate of 2.24 mph/sec (on level grade).

The ICTS system would operate as a barrier, pre-paid fare collection system (as designed for the LADPM project). Train control would be provided by a conventional automatic block system, with automatic train control and, possibly, automatic train operation. Vital relays would be used with fail-safe design principles. Minimum allowable headways would be approximately 60 seconds.

Several floor plans for seating in the 52-foot car were provided by the manufacturer; a transverse seating arrangement was assumed for this study with provisions for 32 seats on double-ended cars and 36 seats on single-ended cars, allowing space for

FIGURE 2

THE ICTS TECHNOLOGY

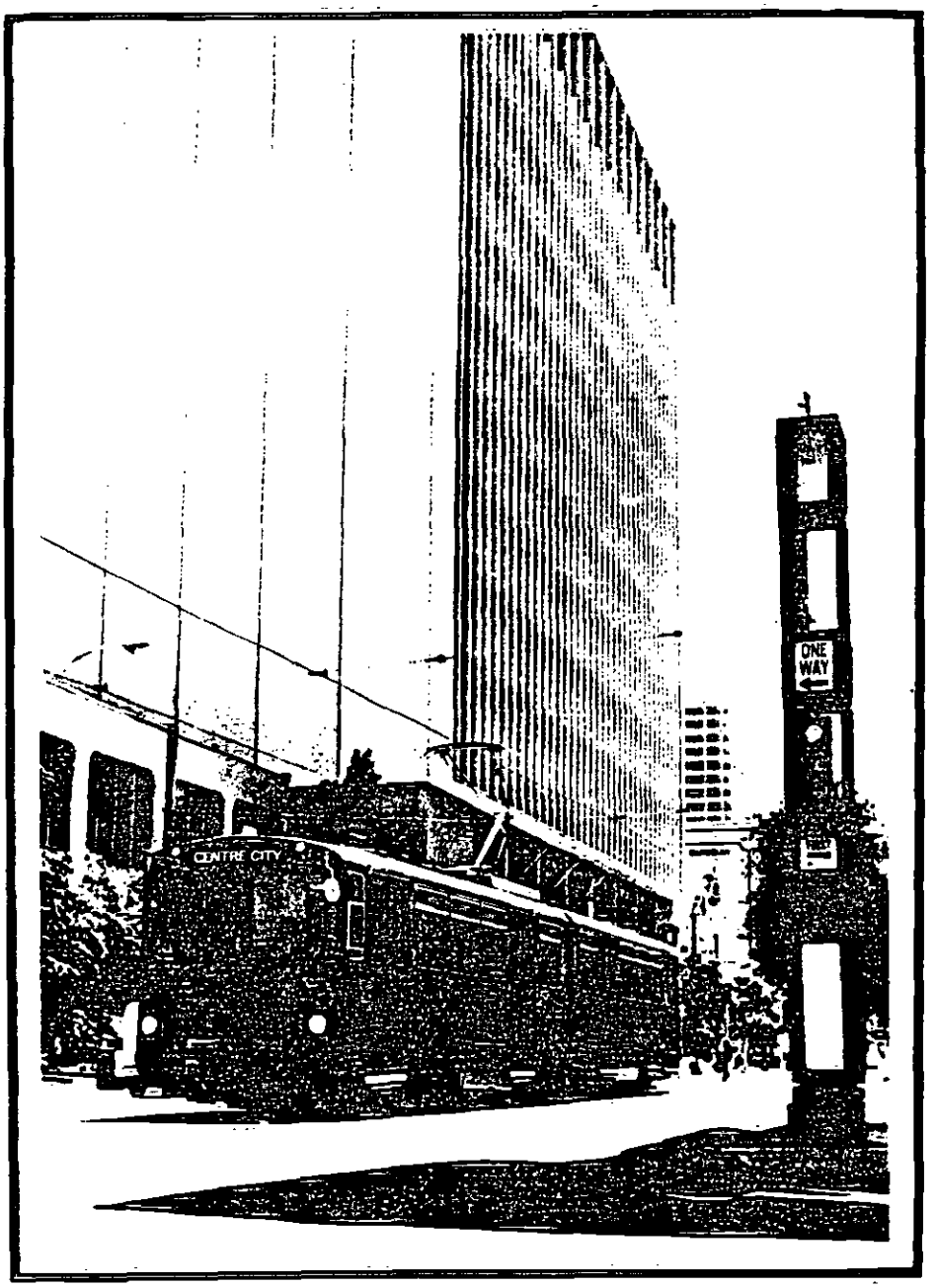
a console and attendant seat. Although published materials describing the ICTS system indicate that it is designed for operation without attendants on trains, a policy decision was made for this study that an attendant would be present.

The ICTS technology, as described above, would require full grade-separation throughout the line.

Light Rail Transit Vehicles (LRV's) - An intermediate capacity rail alternative to ICTS would be conventional light rail transit in the Freeway median. The following elements would characterize this alternative technology:

1) Capability to operate at grade (see Figure 3), with resultant savings of construction costs, as well as on grade-separated guideway;
2) Higher-capacity rail vehicle, capable of accommodating a mazimum load of 180 passengers with stadees, or a design load of 154 passengers;
3) The larger car would be wider (approximately 10 feet) and longer (approximately 75 feet) than the ITCS cars assumed, and built as an articulated unit.
4) Typical operation of such cars in trains of three vehicles, with total length of approximately 225 feet and platform requirements of approximately 240 feet.
5) Step wells on the cars for operations with low-level platforms where appropriate.
6) Simple station arrangements with self-validating fare collection wherever possible.
7) Minor adjustments of station locations from those established for the ICTS alternative.
8) Overhead electrical power supply, from a trolley wire, with or without catenary, at nominal 600 volts DC.
9) Conventional automatic block signals, as necessary or appropriate.

FIGURE 3
TYPICAL LRT VEHICLE
(AT GRADE IN CBD)



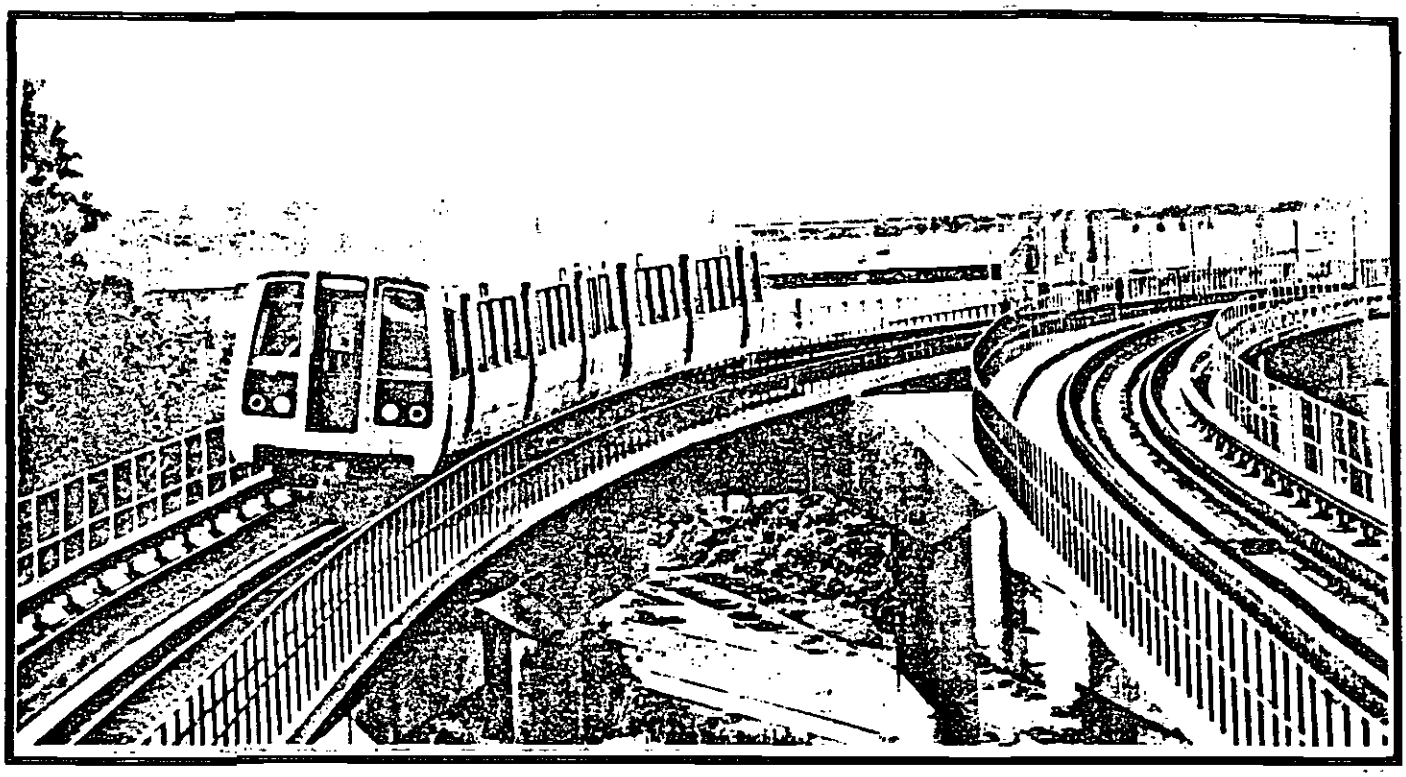
10) Arrangements for preemption of traffic signals at key intersections where delays otherwise could be large, where at-grade operations are assumed.
11) Operation of the service with train attendants.

Heavy Rail Transit (HRT) Vehicles - The term "heavy rail" is a misnomer since these vehicles are generally not significantly heavier than light rail transit vehicles. Rapid transit cars similar to those planned by SCRTD for the Wilshire Corridor Starter Line, and similar to those presently operating in Atlanta and Washington (see Figure 4), were assumed for purposes of developing an operating plan and cost estimate for the Vermont HRT alternative.

From discussions with the SCRTD Metro Rail design group on 19 May 1981, the following characteristics for a heavy rail transit alternative were specified:

1) Vehicles 75 feet long and 10 feet-6 inches wide.
2) Seventy four seats on the car, with maximum loading of 202 passengers and a design load of 189 passengers.
3) All cars built in a permanently married pair configuration.
4) Air conditioning on the cars, not in the stations.
5) Acceleration capability of 3 mph/sec, with top speed of 75 mph.
6) Double leaf doors, three on each side of each car.
7) High level platforms throughout.
8) All fare collection to be prepaid, with gated control at stations.
9) Supply of electrical energy from a third rail at nominal potential which may range from 600 to 1,000 volts DC.

FIGURE 4
TYPICAL RAPID TRANSIT (HRT) VEHICLE



10) Automatic block signals with automatic train control and, possibly, automatic train operation. The ATO would have a manual override capability similar to that on the PATCO cars.
11) Train lengths of six cars, initially.

Key Assumptions

Various assumptions had to be made to develop the operating plans and cost estimates presented in this report, and these were explicitly defined and documented in the technical working papers. The most significant among these related to:

- Alignment and Station Locations
- Passenger Demand Forecasts
- Policy Levels of Service
- Basic Operating Practices
- Downtown Operations and Constraints
- Fare Collection Method
- Interface with future Century Freeway Transitway
- Vehicle Loading Standards and Capacities

Alignment and Station Locations - All rail guideway and busway alignment and station location assumptions used in this study were supplied by Caltrans and are documented elsewhere. In general, freeway median locations were assumed outside downtown Los Angeles. Through downtown Los Angeles, the ICTS alternative for the Harbor Freeway Corridor would follow the horizontal and vertical alignments established for the Los Angeles Downtown People Mover; all other alternatives would involve at-grade operations in the downtown area. Representative locations for at-grade transit operations in the downtown area were defined, solely for purposes of this study, in a cooperative effort involving Caltrans, SCRTD and the consultant.[5]

(5) I-110 and I-5 Freeway Transit CBD Alignments, an SCRTD memorandum from Alvin Holman to I-110/I-5 Project Team.

Passenger Demand Forecasts - Passenger demand forecasts used in this study were essentially LARTS forecasts for 1995 developed prior to this study. Some adjustments were made to account for downtown ridership, variations in station locations and assumptions relative to future interface with the Century Freeway Transitway. In general, the busway passenger demand forecast used was from the LARTS "1995 Bus-Low" model run; the LARTS "1995 Rail-Low" model run was used for developing the ICTS and LRT operating plans; and the forecast for the HRT rail alternative along Vermont Avenue was provided by Caltrans from a prior SCRTD Metro-Rail study by another consultant.

In all cases, demand estimates for sections of line in the Los Angeles Central Business District were a composite based on available LARTS and LADPM projections. All estimates used for rail reflected a "vertical transfer" between Harbor Freeway Corridor and Century Freeway Corridor transit lines (no direct connections). Peak period - peak direction volumes, which were used to establish peak period service levels, were derived using an assumed 70/30 directional split.

Listed below are the peak hour - peak direction maximum load point volumes assumed for developing the operating plans presented in this report.[6]

	Pk Hr/Pk Dir Max Ld Pt Volume	
	Harbor Corridor	Santa Ana Corridor
Busway	6,200	5,200
ICTS/LRT	7,300	5,800
HRT-Vermont	7,500	-

(6) These forecasts were generally viewed as the high end of the range of realistic patronage potentials for these two corridors. It was not within the scope of this study to generate refined passenger demand forecasts relating specifically to the operating plans shown in this report.

Additional detail on the passenger demand forecasts used is provided in Technical Memorandum Nos. 4, 5, 8, 9 and 16.

Level of Service Policies - Policy headways assumed in developing all operating plans were 15 minutes during peak periods, shortened as necessary to satisfy estimated passenger volumes. The 15-minute headways were assumed to continue through the midday hours. Early morning headways would be 20 minutes; evening and night headways, 30 minutes.

Service would be operated 19 hours per day between 5:00 A.M. and midnight. Saturday and Sunday daytime service would be provided at 20 and 30 minutes, respectively.

These policy assumptions were found to have a significant effect upon operating cost comparisons of bus and rail alternatives.

Basic Operating Practices - Assumed operating practices were based on the current SCRTD labor contract. In the application, all attainable efficiencies in defining work and assigning manpower would be realized.

No regulatory speed limits were assumed for guideway (rail) operations. Assumed operating speeds were dictated solely by vehicle performance and guideway configuration constraints.

Downtown Transit Operations and Constraints - Downtown People Mover service was assumed as an element of the ICTS alternative in the Harbor Freeway Corridor. The operation is compatible with the regional rail service in every respect. A 90-105 second downtown shuttle service was defined for the DPM. The regional trains would be interleaved into the downtown shuttle schedule pattern in accordance with estimated service demands.

The 80 to 90 foot platform lengths defined for the Downtown People Mover system would create severe limitations on train lengths. Maximum platform lengths of 150 to 180 feet were assumed, allowing for three-car ICTS trains. With the use of married pair cars, the possibility of increasing this standard to 230 foot platforms for 4 car trains also was examined.

Fare Collection Method - A barrier, pre-paid fare collection system was assumed throughout for the ICTS and HRT Vermont alternatives. With the LRT alternatives, simple station arrangements with self-validating fare collection (as in San Diego) was assumed.

Interface with Future Century Freeway Transitway - It was assumed that if a rail alternative were selected for the Harbor Freeway Corridor, then the same rail mode would be selected for the Century Corridor. A "vertical transfer" between lines was assumed (rather than direct track connections) for purposes of formulating Harbor Freeway Corridor and Santa Ana Freeway Corridor operating plans.

For all bus plans it was assumed that a direct connection could made in mixed traffic between Harbor Freeway Corridor and Century Freeway Corridor Transit lines.

Transit Vehicle Loading Standards and Capacities - The supply of transit service required to satisfy the projected patronage demands for the various alternatives under study was developed based upon assumed transit vehicle loading standards and capacities. For the purposes of comparative analysis of alternative transit modes, emphasis was placed on consistency in calculating capacity for various vehicle types. Standards based upon observed maximum volumes for certain vehicles cannot be transferred to prototypical vehicles and the use of load factors (passengers per seat ratios) can cause bias because of different

seating - floor area arrangements which vary with individual operator policies.

For this analysis, therefore, transit vehicle loading standards and capacities were determined based upon the number of passenger seats provided plus an assumed ratio of standees per area of standing room. Where necessary, adjustments were made to allow for knee space and/or space near doors. The resulting comparative values are shown in Table 1.

In specifying vehicle capacities for sizing transit system plans, it was recognized that the determination of transit system capacity is more complex than making assumptions on capacities for vehicles alone. Public transportation operates as an integral system of infrastructure, vehicle, and pedestrian elements. The capacity of the system is in reality, the capacity of its most limited element. In practice, transit system capacities are determined not by vehicle floor area or guideway capacity, but by the ability of vehicles to load and discharge passengers at high-patronage stops. Research indicates that passenger loadings at less than 4 square feet per standing passenger begin to affect dwell times and schedule adherence to the point that the capacity of the system decreases (especially for buses) with increasing vehicle occupancies.[7] Thus, because the capacity values shown in Table 1 were to be used to reflect "average" capacities (allowing for irregularities in loading volumes), and should provide for reasonable passenger comfort, they were calculated as the number of seats provided plus standees at 4 square feet of standing room per standee.[8]

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(7) Kell, J.H., Levinson, H.S., et. al., Transportation Research Circular 212, Interim Material on Highway Capacity, Washington 1980, Transportation Research Board.

(8) For purposes of the SCRTD Wilshire Corridor "Starter Line" analyses in 1979, the capacity assumption for heavy rail cars (165) was based on 5 square feet per standee and a capacity value of 70 was used for an articulated bus in guideway service (assuming no standees).

Table 1

VEHICLE CAPACITY ASSUMPTIONS

VEHICLE TYPE/CONFIGURATION	NUMBER OF SEATS	DESIGN CAPACITY (SPACES) (1)	IN-VEHICLE LOAD FACTOR
Advanced Design Bus (ADB) GM RTS-40 ft. Length	47	66	1.4
Articulated Bus (ARTIC) AM General/MAN-60 ft. Length	69	97	1.4
Light Rail Vehicle (6-axle, ARTIC, Double Ended). Italian Breda/Cleveland-73 ft. Length	101	154	1.5
Intermediate Capacity Rail Vehicle (4-axle, Double Ended). Canadian ICTS/UTDC-55 ft. Length	32	85	2.7
Intermediate Capacity Rail Vehicle (4-axle, Single Ended). Canadian ICTS/UTDC-55 ft. Length	36	88	2.4
Heavy Rail Vehicle U.S. Budd Co./Miami, Baltimore-75 ft. Length	74	189	2.6

(1) Includes standees at 4 square feet per standing passenger as well as seated passengers.

OPERATING PLANS
HARBOR FREEWAY CORRIDOR

II. TRANSIT OPERATING PLANS
HARBOR FREEWAY CORRIDOR

Following the identification of alternatives to be studied and the specification of the basic assumptions outlined in Chapter I, representative transit operating plans were developed at a planning level of detail in the following sequence:

(1) A "base case" ICTS rail alternative was defined with adequate capacity to accomodate the specified peak period demand at the maximum load point on the line, and to represent a "full service" plan in which all trains would travel the full length of the line. The specified use of the Los Angeles Downtown People Mover with the ICTS system would limit train length to three cars due to platform length constraints. Use of the DPM would mean that the full length of line would be grade separated.

(2) An equivalent LRT rail alternative was then specified, with the same peak capacity as offered by the ICTS alternative. The initial specification of this alternative called for at-grade operations in the Los Angeles CBD with priority use of selected streets. Train length was constrained by downtown block lengths.

(3) Instructions were then received to analyze a fully grade-separated LRT alternative with a northern terminus at the southern edge of the CBD near a planned Wilshire Corridor rapid transit station at Seventh and Flower Streets. This concept, to be equivalent to the ICTS System as specified, would require a surface-bus collector/distributor system between the LRT terminus and Union Station.

(4) Operating plans were then developed for three types of Freeway Transit[9].

a) A two direction - two lane Busway with Trunk-Line "Limited Service" Freeway Transit with feeders;

b) A two direction - two lane Busway with Trunk-Line "Limited Service" Freeway Transit with off-freeway extensions to perform an integrated line haul/collection-distribution service concept; and

c) The Trunk-Line/Feeders plan (4a) with a single lane reversible busway.

(5) The ICTS and LRT full-service operating plans were then refined to incorporate service turn-backs at Artesia to better relate service levels to demand patterns along the line.

(6) An operating plan was developed for a Wishire Corridor-type HRT line along a specified Vermont Avenue alignment provided by CalTrans using demand data from a prior study. Again, it should be noted that comparisons between this alternative and ICTS, LRT and Bus alternatives should recognize the possibilities of bias due to the use of different demand data sources.

(7) A No-Build all-bus service plan was specified (as required for an environmental impact statement), consisting essentially of the existing transit system operating under 1995 conditions.

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[9] It is important to note that the line-haul capacity provided with the specified Freeway Transit operating plans was lower than that provided by the rail plans because the demand forecasts provided by CalTrans for this study were lower for express bus than for rail. Since these demand forecasts were developed prior to the specification of these operating plans, the indicated differences in patronage between rail and bus are somewhat speculative.

(8) A TSM all bus service plan also was developed for comparative analyses, representing completion of portions of SCRTD's "Sector Plan" with certain highway system improvements, up-grading of bus stops on the Harbor Freeway, and bus route refinements suggested by SCRTD.

Operational Analysis Assumptions

To assess operational requirements, estimates of equipment performance over each proposed route were made. Where guideways or busways were involved, information describing gradient, curvature and station locations was obtained from drawings supplied by CALTRANS. The operating schemes then developed reflect the specific physical, performance and service capabilities of each alternative, consistent with defined facility characteristics.

Operations were sized for ridership volumes at maximum load points for the predominant directional movement at various times of day. Patronage forecasts for the corridors under study were supplied by Caltrans.

Assumptions applicable to a particular operating plan are documented in the following sections of this Chapter. Assumptions pertinent to all alternatives are the following:

1) Operations would be conducted 19 hours daily, between 5:00 AM and midnight.
2) Service would be volume-based, but headways would not exceed policy service intervals established as follows:

Period	Maximum Policy Headway (minutes)
Early Morning	20
Peak Periods	15
Midday	15
Evening and Night	30

3) Operations were sized for typical weekday service, then annualized using 308 equivalent weekdays per year.
4) It was assumed that non-weekday service levels would vary throughout the day according to approximately the same pattern as on weekdays.
5) Sizing periods included morning and evening peak travel periods of three hours.
6) A yard and service facility would be located near the midpoint of the line. An appropriate allowance for deadhead (non-revenue) train-miles was included to reflect this choice. Selection of an alternate location should not significantly change the non-revenue mileage operated.
7) Peak-hour operations were sized to absorb the peak 20 minutes within the peak hour through the use of trippers. The peak 20-minute passenger volume was assumed to exceed the average 20-minute volume in the peak hour by 25 percent.
8) The temporal distribution of total daily ridership was based on current El Monte Busway experience, as follows:

Time of Day	% of Daily Boardings
Early morning (5:00-6:00 AM)	2.0
Morning pre-peak shoulder (6:00-7:00 AM)	8.0
Morning peak hour (7:00-8:00 AM)	15.0
Morning post-peak shoulder (8:00-9:00 AM)	7.0
Mid-day period (9:00 AM-3:00 PM)	24.0
Evening initial peak shoulder (3:00-4:00 PM)	7.0
Evening pre-peak shoulder (4:00-5:00 PM)	10.0
Evening peak (5:00-6:00 PM)	13.0
Early evening (6:00-9:00 PM)	10.0
Late evening (9:00-12:00 PM)	4.0
	100.0

9) The above temporal distribution was adopted except for the evening peak period. It was assumed that the evening peak hour would represent 15% (same as morning peak hour) of total daily travel, to be consistent with procedures used for estimating ridership. The temporal distribution was also revised to include a pre-peak shoulder and post-peak shoulder in the evening. The respective percentages of daily travel assumed for each of these periods was 7% for the pre-peak and 10% for the post-peak.

Each operating plan is presented as a description of the daily operational pattern for a particular option. Included in each plan are estimates of vehicle-hours and vehicle-miles. Also included are estimates of cycle time, headways, average speeds and fleet size.

The statistics presented in the operating plans were used directly in developing cost estimates for the various alternatives, as presented in Chapter IV.

The following sub-sections of this chapter document each of the operating plans for the Harbor Freeway Corridor.

ALTERNATIVE A-1
NO-BUILD BUS OPERATING PLAN
HARBOR FREEWAY CORRIDOR

The Stage II Project Work Program developed by CalTrans for Freeway Transit in the Harbor Freeway Corridor specified a No-Build Alternative to serve "as a benchmark for comparative analysis purposes"...which "includes the present transportation system with projected 1995 socio-economic data." For analysis purposes, the No-Build Alternative as specified consistedessentially of the existing transportation system operating under future year (1995) conditions.

The Year 1995 No-Build Highway System

The background highway system assumed to be in place for the No-Build Alternative under 1995 conditions was the same as the existing system. Based upon this definition, the No-Build Alternative did not include the Century Freeway. Bus operations on all roadways were assumed to be in mixed traffic.

The Year 1995 No-Build Transit System

The No-Build Transit System was represented by the 1978 operating system. Operating characteristics for the SCRTD system are documented in an SCRTD "4-24 Report" of 1978. Operating characteristics for other operators were based upon similar documentation of current (or recent year) operations.

The 1995 No-Build Transit system was categorized into four components as described below:

1) Freeway Transit Lines;

2) Transit lines on arterials parallel to Freeway Transit

lines;

3) Transit lines which would provide feeder service to line-haul routes in the corridor (i.e., categories 1 and 2 above); and

4) Background transit lines in the remainder of the region. These would include lines outside the Harbor Freeway Corridor within the SCRTD service area, and those municipal lines which are a part of the TSM Plan network.

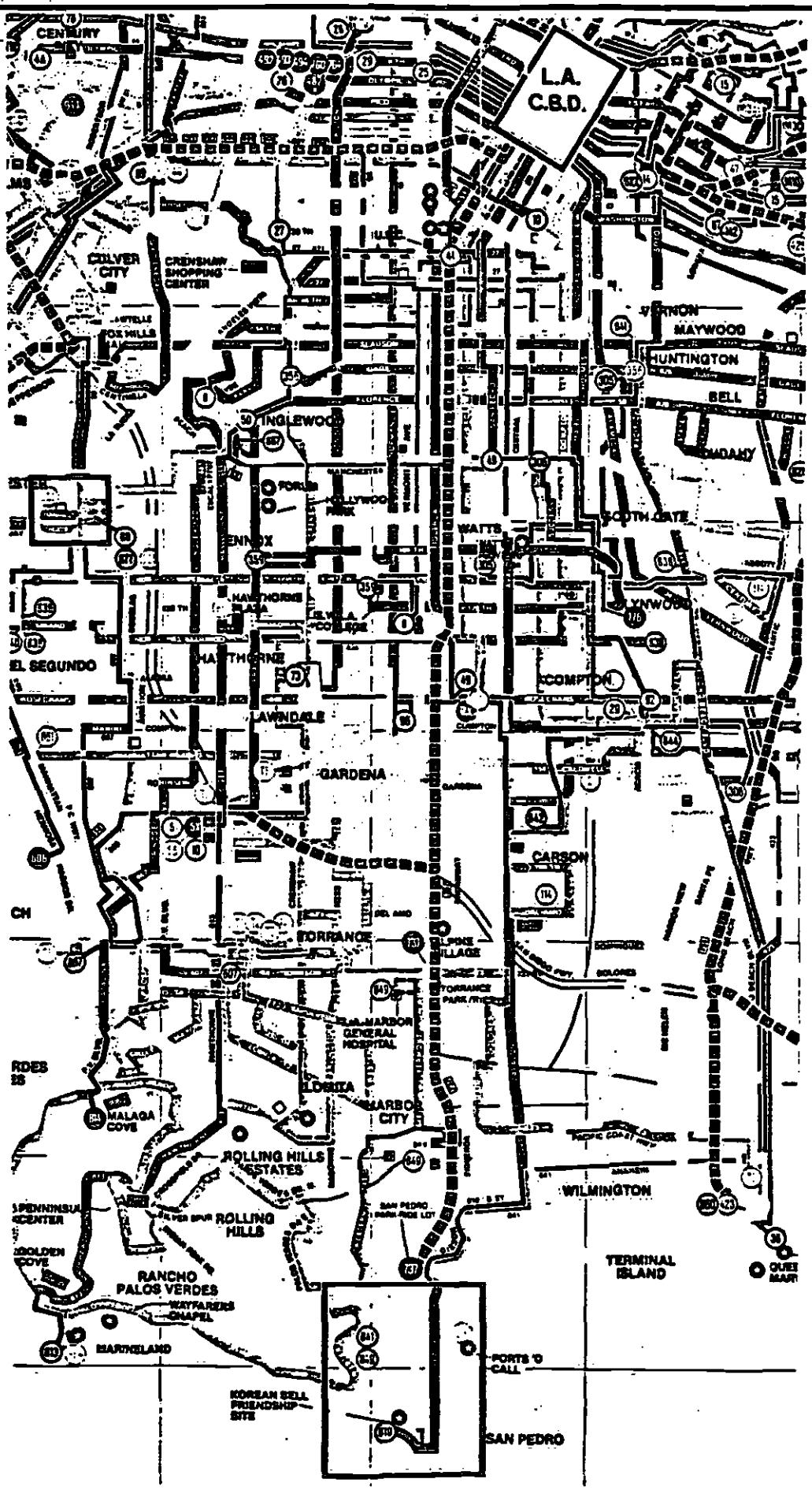
The route network for the 1995 No-Build Transit System in the Harbor Freeway Corridor is illustrated by the 1978 SCRTD Bus System Map (see Figure 5). Freeway Transit and parallel arterial lines serving the Harbor Freeway Corridor are listed in Table 2. The principal Freeway Transit lines for the No-Build Alternative are Lines 5X, 737, 810, 813, and 814. The combined bus frequencies for the peak period in the peak direction on the Harbor Freeway would be 23 buses per hour. This includes 10 peak hour express bus trips which would not serve intermediate stops.

Cross-corridor lines which would provide service to Harbor Freeway Corridor line-haul routes are listed in Table 3. These lines include services by SCRTD, Gardena Municipal Bus Lines, Torrance Transit System, and Long Beach Public Transportation Company.

Transit Support Facilities

The 1995 No-Build Alternative includes the following transit centers, park-ride lots and upgraded bus stops:

- The Union Station Transportation Center.



NO-BUILD ALTERNATIVE - BUS PLAN
HARBOR FREEWAY CORRIDOR

Figure 5

Table 2

SUMMARY LINE DESCRIPTION
NO-BUILD ALTERNATIVE - BUS PLAN
HARBOR FREEWAY CORRIDOR
FREEWAY TRANSIT AND PARALLEL ARTERIAL LINES

Route Function	Route[1]	Description	Round Trip Miles	Round Trip Min	Average Headways 6-9 3-6 Peak	9-3 Base	6-9 Eve.	9-12 Night	Directional Peak Hour Buses	Directional Peak Hour Cap.	Buses Required Type	Buses Required Peak	Buses Required Base	Vehicle Hours	Vehicle Miles
Parallel Art.	2	Brooklyn-Hooper-Compton		160	12	21	18	30	5			17	10	224.39	2,890
Parallel Art.	3	West 6th Street & Central Avenue		190	8	7.5	16	30	8			32	24	418.56	4,650
Parallel Art.	5	Redondo Bch.-LACBD Local Service		132	7	10	15	25	9			33	20	413.18	5,059
Freeway Transit	5X	Redondo Beach.-LACBD Fwy.Express Serv.		136	15	-	-	-	4			(2)	-	-	-
Parallel Art.	7	Eaglerock-South Broadway		176	7	20	16	30	9			28	15	344.19	4,565
Parallel Art.	8	Broadway-54th-Angeles Vista		120	13	20	25	25	5			12	8	158.05	1,836
Parallel Art.	29	San Pedro Str-West 7th Str.		142	7.5	10	16	36	8			23	16	288.28	3,189
Parallel Art.	33	L.A.-Watts-Compton-Wilmington		158	18	30	60	-	4			9	6	144.08	1,747
Parallel Art.	34	L.A.-Lynwood-Paramount		94	36	60	60	60	2			5	2	51.08	770
Parallel Art.	49	So.Figueros Str-San Pedro Street		166	11	20	20	30	6			17	10	218.44	2,854
Parallel Art.	92	L.A.-Watts-Compton		162	11	18	30	45	6			19	13	253.07	3,234
Freeway Transit	737	San Pedro		130	36	-	-	-	2			3	0	9.48	198
Freeway Transit	810	L.A.-Carson-Wilmington-San Pedro		188	18	28	30	60	4			11	7	146.38	2,714
Freeway Transit	813	L.A.-W. Torrance-Rolling Hills-Marinel.		194	26	30	36	-	4			8	7	109.20	2,459
Freeway Transit	814	L.A.No. Torrance-Redondo Bch-Palos Verdes		160	22.5	-	26	-	3			7	0	43.29	952
Freeway Transit	T1	Los Angeles		130	60	60	60	90	1						
Freeway Transit	T2	Los Angeles		130	60	60	60	-	1						
Freeway Transit	G1	Los Angeles	35	200	15	35	60	120	4			8	6	85.3	1,350

(1) G - Gardena Municipal Bus Lines
T - Torrance Transit System

(2) operating statistics are combined for both Line 5 and Line 5X.

Table 3

SUMMARY LINE DESCRIPTION
NO-BUILD ALTERNATIVE - BUS PLAN
HARBOR FREEWAY CORRIDOR
FEEDER BUS LINES

Route	Function	(1) Route	Description	Round Trip Miles	Round Trip Min.	Headways 6-9 3-6 Peak	Headways 9-3 Base	Headways 6-9 Eve.	Headways 9-12 Night	Directional Peak Hour Buses	Directional Peak Hour Cap.	Buses Required Type	Buses Required Peak	Buses Required Base	Vehicle Hours Hrs.	Vehicle Hours Min.	Vehicle Miles
Cross	Corridor	10	Adams Blvd-Normandie Ave-Prairie Ave		166	36	30	36	-	2			8	7	98	31	1,191
"	"	18	East Jefferson Blvd-Coliseum		70	20	20	23	90	3			6	4	67	40	816
"	"	27	Vernon-Santa Barbara-La Cienega		166	13	17	18	90	5			14	10	193	49	2,331
"	"	50	Florence Ave-Soto Street		160	11	20	20	30	6			24	12	284	14	3,118
"	"	95	Vernon Ave-Vermont Ave		126	4	5	18	20	15			38	19	391	07	4,156
"	"	176	South Los Angeles-Pacific Palisades		116	26	0	36	-	3			7	2	55	25	888
"	"	354	54th Street		90	26	30	90	-	3			2	2	26	56	304
"	"	828	Marina Del Rey-Huntington Pk-Whittier		186	14	15	20	60	5			13	13	202	21	2,810
"	"	832	Playa Del Rey-Norwalk		196	15	15	15	36	4			25	15	287	38	3,800
"	"	834	Century Boulevard		90	20	20	22.5	45	3			7	6	108	05	1,438
"	"	836	Imperial Highway		200	15	15	22.5	60	4			12	10	170	31	2,582
"	"	838	El Segundo Boulevard		100	26	30	45	-	3			4	4	58	21	744
"	"	840	Rosecrans Avenue		176	26	30	45	-	3			7	6	93	32	1,611
"	"	841	Huntington Pk-Long Bch-San Pedro		186	36	30	36	60	2			11	10	166	54	2,396
"	"	846	Artesia Boulevard		192	60	60	60	90	1			4	3	47	18	857
"	"	849	Harbor City-San Pedro		210	30	30	36	90	2			4	4	64	35	886
"	"	872	Barton Hill-Park Western Plaza		42	30	30	60	-	2			2	2	28	42	364
"	"	873	Long Beach-Redondo Beach-Santa Monica		206	36	30	30	45	2			6	5	90	43	1,376
"	"	G3	City of Compton & South Bay Center	21		30	30	45	-	2			3	3	38.5		570
"	"	T3	Long Beach			30	30	30	90	2							
"	"	T7	Sepulveda Boulevard			26	30	36	-	3							
"	"	LB14	San Pedro/Fish Harbor to Seal Bch. Leisure World	31.2	114	22.5	60	45	60	3	47				21	22	1,219

(1) G - Gardena Municipal Bus Lines
T - Torrance Transit System
LB - Long Beach Public Transportation Company

- On-line bus stops on the Harbor Freeway at Santa Barbara Avenue, Slauson Avenue, Manchester Boulevard.

- The San Pedro Channel Street Park-Ride Lot.

- The Del Amo transit center at Torrance Del Amo Boulevards.

ALTERNATIVE A-2
TSM BUS OPERATING PLAN
HARBOR FREEWAY CORRIDOR

For purposes of this study, it was originally agreed that the TSM alternative would consist of an improved highway system, SCRTD's proposed 1980 transit sector improvements, and an upgrading of existing bus stops on the Harbor Freeway. However, in late October 1981, it was agreed upon by all parties that the current stage of the sector plan represented the accomplishment of the 1980 sector plan within SCRTD's foreseeable fiscal resources. Consequently, the stage of the sector plan defined in the 424 report[10] for June 21, 1981 was chosen as the basis for developing the TSM plan. Availability of accurate operating cost factors for the June 21 1981 stage of the sector plan was also a consideration.

The Harbor Freeway Corridor TSM alternative described in this section includes an improved highway system, the June 21, 1981 stage of the SCRTD sector improvement program, and an upgrading of existing bus stops on the Harbor Freeway.

The background highway system assumed to be in place for the TSM alternative under 1995 conditions was essentially the same as the existing system. The one major exception would be the completion of the Century Freeway project. For the 1995 TSM Plan, the Century Freeway was assumed to be a six lane facility (three lanes in each direction) with exclusive lanes for buses and other HOVs. The freeway would interchange with the Harbor Freeway near Imperial Boulevard. Vehicular access between the Century Freeway Bus/Hov Roadway and the Harbor Freeway would be through the use of a mixed traffic interchange between the freeways. Bus operations on the Harbor Freeway would be in mixed traffic.

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(10) "Scheduled Service Operating Cost Factors, effective June 21, 1981", SCRTD.

The 1995 TSM Transit System was categorized into four components as described below:

1) Transit lines unaffected by Harbor Freeway Transit Service alternatives. These would include lines outside the Harbor Freeway Corridor and lines within the corridor which would not vary between Freeway Transit Alternatives;

2) Transit lines which would provide feeder service to Freeway Transit lines;

3) Transit lines on arterials parallel to Freeway Transit lines which provide competitive service through the corridor to the LACBD; and

4) Freeway Transit lines.

For the 1995 TSM Alternative, the unaffected lines, feeder lines, and parallel arterial lines (categories 1, 2 and 3) were based upon the June 21, 1981 stage of the Sector Improvement Plan and existing municipal service routes as shown in Figure 6. The assumed service levels and operating characteristics for these services are listed in Table 4.

The Freeway Transit line-haul routes were represented by the proposed SCRTD Harbor-Century Freeway Transitway Bus System, excluding Line 755 of that plan.[11] Additional Freeway Transit line-haul routes would include the Torrance 1 and 2 lines and the Gardena 1 line, with projected 15 percent service level growth rates for the year 1995. The route plan for the TSM Freeway Transit lines is illustrated in Figure 7. Line summary statistics for freeway transit line are in Table 5.

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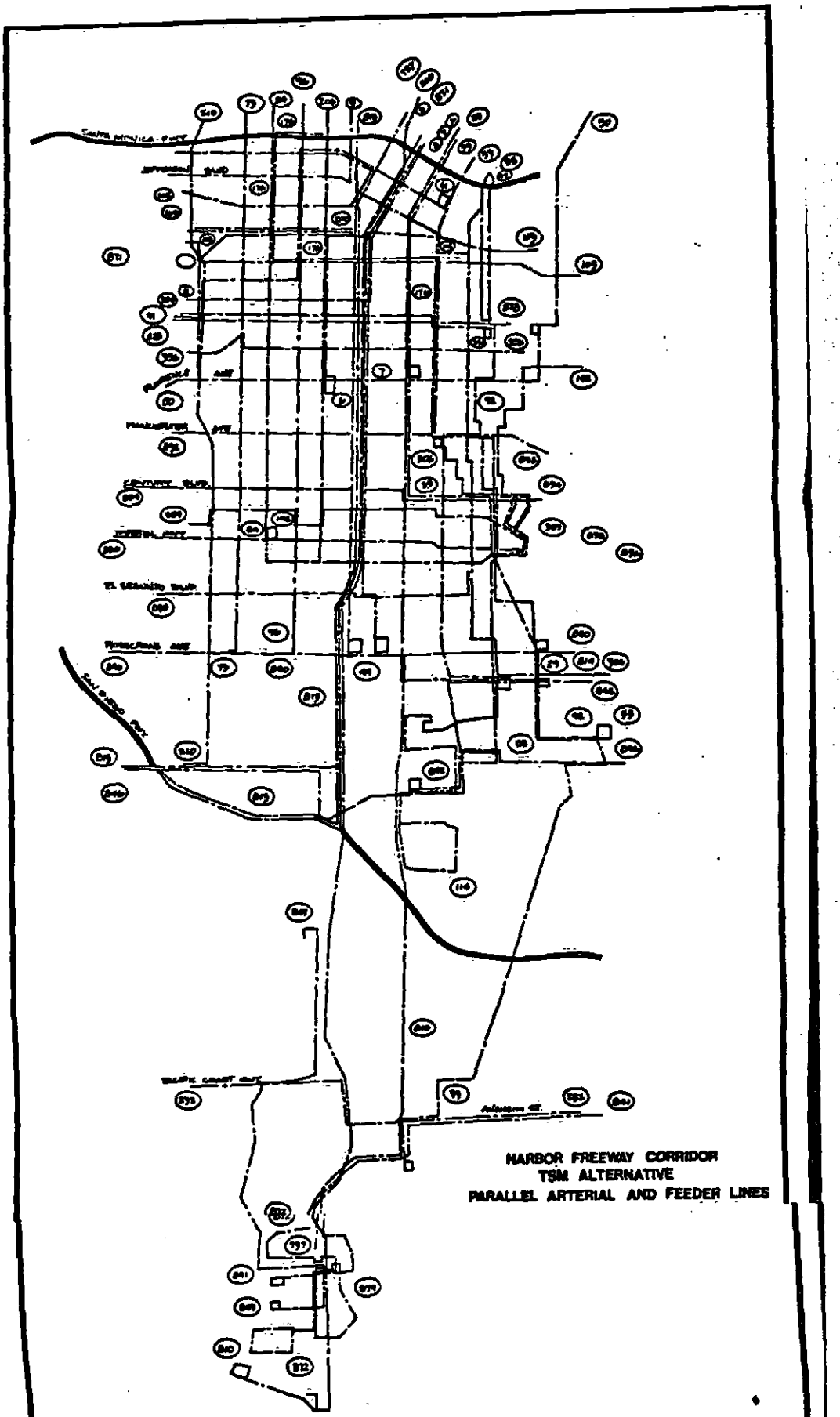
[11] Southern California Rapid Transit District, Proposed Harbor-Century Freeway Transitway Bus System, February 24, 1981.



HARBOR FREEWAY CORRIDOR
TSM ALTERNATIVE
PARALLEL ARTERIAL AND FEEDER LINES

Figure 6

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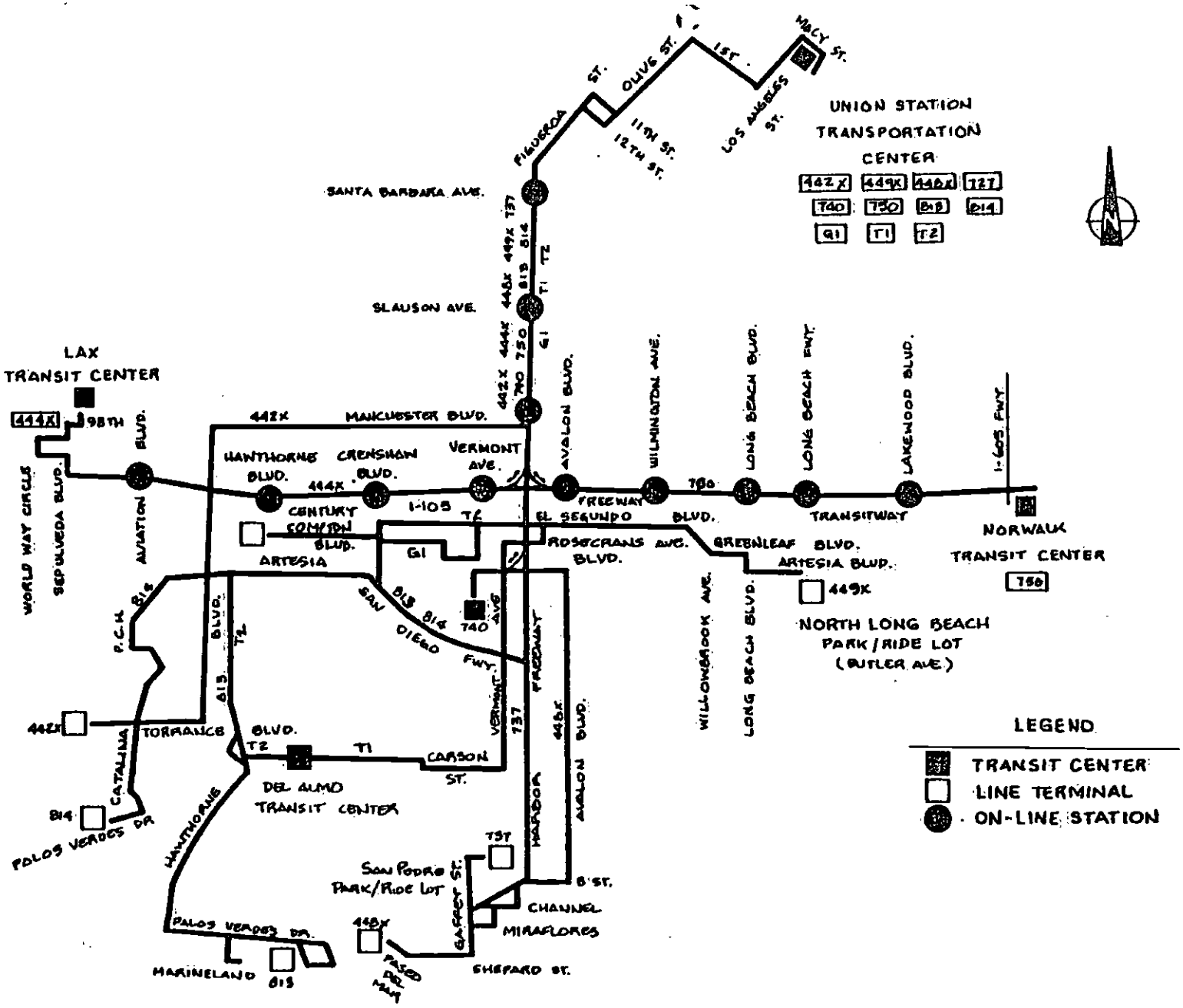


Harbor Freeway Corridor
TSM Alternative Line-Haul Routes

Vilbur Smith and Associates

Figure 7

Table 4

SUMMARY LINE DESCRIPTION

Harbor Freeway Corridor TSM Alternative
Parallel Arterial Lines and Feeder Lines

ROUTE TYPE	ROUTE	DESCRIPTION	VEHICLE HOURS	VEHICLE MILES	BUSES REQUIRED A.M. Rush	Day Base	P.M. Rush	Night
Trans-Corridor	5	Florence Ave-Crenshaw Blvd.	377.2	4,717	17	19	23	2
Trans-Corridor	6	Vermont Ave-Santa Barbara Ave-Broadway	273.2	3,789	23	15	24	2
Trans-Corridor	7	Eagle Rock-South Broadway	321.2	4,376	26	14	27	2
Trans-Corridor	8	West 54th Street-North Main Street	155.5	1,808	12	8	10	1
Trans-Corridor	9	West Jefferson Blvd-Huntington Park	471.5	6,106	45	21	44	2
Cross-Corridor	29	Compton Blvd-Avalon Blvd-San Pedro Street	266.1	2,954	22	14	26	1
Trans-Corridor	33	L.A.-Compton-Wilmington	114.4	1,724	12	9	6	9
Cross-Corridor	41	Alvarado Street	85.4	1,028	5	6	6	6
Cross-Corridor	44	Beverly Blvd-West Adams Blvd.	395.8	4,664	39	19	36	1
Trans-Corridor	49	San Pedro-South Figueroa Street	230.3	3,078	2	19	10	21
Cross-Corridor	50	Florence Avenue-Soto Street	271.2	3,105	24	11	24	2
Trans-Corridor	53	Central Avenue	239.5	2,752	16	13	18	1
Trans-Corridor	55	Wilmington Avenue-Compton Avenue	242.0	3,282	22	10	20	1
Trans-Corridor	73	Van Ness Ave-Arlington Avenue	107.6	1,227	5	8	7	8
Trans-Corridor	84	Western Avenue	292.2	3,308	5	27	14	22
Trans-Corridor	92	Watts-Sierra Vista	244.8	3,076	17	13	21	1
Trans-Corridor	96	Normandie Avenue	160.6	1,937	11	10	11	
Cross-Corridor	102	Exposition Boulevard	62.7	717	4	4	4	
Cross-Corridor	103	Santa Barbara Avenue	41.1	400	3	3	3	
Cross-Corridor	105	Vernon Avenue	289.1	3,485	21	13	23	1
Trans-Corridor	114	Carson-Compton-Lynwood	38.3	543	3	3	3	
Cross-Corridor	142	120th Street	106.0	1,449	7	7	7	
Cross-Corridor	176	Western Ave-Vernon Ave-Central Ave.	430.0	906	8		6	
Trans-Corridor	200	Alvarado Street	117.1	1,002	9	7	9	
Trans-Corridor	204	Vermont Avenue	486.6	5,734	40	26	36	
Trans-Corridor	210	Crenshaw Boulevard	295.6	3,755	20	17	20	

Table 4
(Continued)

SUMMARY LINE DESCRIPTION

Harbor Freeway Corridor TSM Alternative
Parallel Arterial Lines and Feeder Lines

ROUTE TYPE	ROUTE	DESCRIPTION	VEHICLE HOURS	VEHICLE MILES	BUSES REQUIRED A.M. Rush	Day Base	P.M. Rush	Night
Cross-Corridor	232	Pacific Coast Highway	105.4	1,550	6	6	7	
Trans-Corridor	306	Wilmington Avenue	26.8	318	2	2	2	
Cross-Corridor	354	Slauson Avenue	26.9	304	2	2	2	
Cross-Corridor	356	Gage Avenue	40.2	432	3	3	3	
Cross-Corridor	359	180th Street	28.7	407	2	2	2	
Cross-Corridor	828	Slauson Avenue	223.0	3,010	14	14	15	
Cross-Corridor	832	Manchester Avenue	245.3	3,192	15	15	15	
Cross-Corridor	834	Century Boulevard	116.8	1,561	8	6	8	
Cross-Corridor	836	Imperial Highway	181.7	3,057	11	11	12	
Cross-Corridor	838	El Segundo Boulevard	58.5	840	4	4	4	
Cross-Corridor	840	Rosecrans Avenue	110.7	1,905	8	7	8	
Cross-Corridor	841	Anaheim Str-Harbor Blvd-7th Street	173.9	2,484	10	9	11	
Trans-Corridor	842	Compton Boulevard	27.2	419	2	2	2	
Cross-Corridor	846	Artesia Boulevard	59.8	999	4	4	4	
Trans-Corridor	849	Western Ave-Vermont Ave.	64.6	862	4	4	4	
Cross-Corridor	871	Santa Barbara Avenue-Hill Street	148.0	2,212	10	8	11	
Cross-Corridor	872	San Pedro Street	28.7	362	2	2	2	
Cross-Corridor	874	San Pedro Street	13.9	125	1	1	1	
		Cross-Corridor Total	3,117.1	41,148	233	171	240	11
		Trans-Corridor Total	4,286.1	53,813	293	247	311	72
		TOTAL	7,403.2	94,961	526	418	551	83

Table 5

SUMMARY LINE DESCRIPTION

TSM ALTERNATIVE - BUS PLAN

HARBOR FREEWAY CORRIDOR

FREEWAY TRANSIT - LINE-HAUL ROUTES

ROUTE	DESCRIPTION	VEHICLE HOURS	VEHICLE MILES			BUSES REQUIRED			
			FREEWAY	SURFACE	TOTAL	A.M. PEAK	DAY BASE	P.M. PEAK	NIGHT
442X	L.A.-Inglewood Express	210.1	628	2,450	3,078	20	7	20	-
444X	L.A.-LAX Express	231.9	3,144	718	3,862	15	10	15	10
448X	L.A.-San Pedro Express	329.4	3,304	1,547	4,851	24	16	24	8
449X	L.A.-Compton Express	76.8	515	762	1,277	10	-	10	-
737	L.A.-Channel St. P/R	83.2	1,257	267	1,524	11	-	11	-
740	L.A.-South Bay Transit Center	120.7	1,530	574	2,104	16	-	16	-
750	L.A.-Norwalk Transit Center	141.4	2,048	434	2,482	18	-	18	-
813	L.A.-Palos Verdes All Day	245.9	2,062	2,479	4,541	15	15	15	7
814	L.A.-Palos Verdes Peak Only	106.7	847	1,159	2,006	14	-	14	-
G1	Gardena to L.A. via Harbor Fwy.	137.7	1,023	1,245	2,268	13	5	13	2
T1	Fashion Sq. to L.A. via Harbor Fwy.	47.6	499	305	804	4	2	4	4
T2	Fashion Sq. to L.A. via Harbor Fwy.	45.4	383	422	805	12	2	12	-
	TOTAL	1,776.8	17,240	12,362	29,602	172	57	172	31

The combined bus frequencies for the peak period in the peak direction on the Harbor Freeway would be 62 buses per hour. However, 22 (out of 62) of the peak hour buses are express trips which would not serve intermediate stations and stops.

Transit Support Facilities

The 1995 TSM Alternative included existing and proposed transit centers, park and ride lots and upgraded bus stops. These included:

- The Union Station Transportation Center;
- On-line bus stops on the Harbor Freeway at Santa Barbara Avenue, Slauson Avenue, Manchester Boulevard;
- The South Bay Transit Center on Vermont Avenue near Artesia Boulevard;
- The San Pedro Channel Street Park and Ride Lot;
- The LAX Transit Center at Airport Lot C;
- The Norwalk Transit Center near Studebaker Road and the 605 Freeway;
- The Fullerton Transit Center;
- The Century Freeway On-line Transit Station at Aviation Boulevard, Hawthorne Boulevard, Crenshaw Boulevard, Vermont Avenue, Avalon Boulevard, Wilmington Avenue, Long Beach

Boulevard, Long Beach Freeway and Lakewood Boulevard; and

- The North Long Beach Park and Ride Lot at Butler Avenue and Artesia Boulevard.

TSM Transit Plan Operating Data

Table 6 summarizes the operating characterisitics of the total Harbor Freeway Corridor TSM alternative plan in terms of Bus Miles, Bus Hours and Peak and Base Bus Requirements. Articulated buses were assumed on all SCRTD Freeway Transit Line-Haul routes and improved ADB's on Parallel Arterial and Feeder lines. Improved ADB's were assumed on Torrance and Gardena Routes. Bus Hours and Bus Miles include both revenue and non-revenue service.

Combined service levels of TSM Freeway Transit Routes plus June 21, 1981 parallel arterial and feeder lines represent an approximate twenty percent increase in supply over current corridor levels.

Table 6

SUMMARY OF TSM ALTERNATIVE
OPERATING STATISTICS

Harbor Freeway Corridor

	PARALLEL ARTERIAL AND FEEDER LINES	FREEWAY TRANSIT LINE HAUL ROUTES	TOTAL CORRIDOR BUS LINES
Improved ADB Bus Miles-Freeway	-	1,905	1,905
Improved ADB Bus Miles-Surface	94,961	1,245	96,206
ARTIC Bus Miles-Freeway	-	15,335	15,335
ARTIC Bus Miles-Surface	-	11,117	11,117
TOTAL BUS MILES	94,961	29,602	124,563
Improved ADB Bus Hours	7,403.2	230.7	7,633.9
ARTIC Bus Hours	-	1,546.1	1,546.1
TOTAL BUS HOURS	7,403.2	1,776.8	9,180.0
Improved ADB Peak Bus Requirement	526	29	555
ARTIC Peak Bus Requirement	-	143	143
TOTAL PEAK BUS REQUIREMENT	526	172	698
Improved ADB Base Bus Requirement	418	9	427
ARTIC Base Bus Requirement	-	48	48
TOTAL BASE BUS REQUIREMENT	418	57	475

ALTERNATIVE A-3a
FREEWAY BUS TRANSIT OPERATING PLAN
LIMITED SERVICE-TRUNK LINE WITH FEEDERS
HARBOR FREEWAY CORRIDOR

This plan was developed to represent a bus operational concept similar to the rail alternatives. It would function as a limited service - trunk line with a bus feeder system serving stations from the surrounding service area. An alternate plan which features trunk line extensions with more varieties of service is described in a subsequent section of this report.

Planning Assumptions

The definition of this alternative was based on various assumptions relating to physical features of the busway, the transit vehicles used, fare collection practice, the patronage projected, and policy service levels.

Physical Features of the Busway - The Harbor Freeway Bus Transit services would utilize a two-directional/two-lane Busway/HOV Roadway to be constructed between Artesia Boulevard and Adams Boulevard near Figueroa Street. The alignment and profile for the Busway/HOV Roadway are defined as the "Harbor Freeway Bus-4" alternative, documented by Caltrans staff in the Stage I Report. The alignment would be in the freeway median on an elevated structure except through fill sections of the highway - where the roadway would be at the existing elevation of the highway median.

Ingress and egress to and from the busway would be limited and restricted to bus/high-occupancy-vehicle (Bus/HOV) use. Access points between the facility and the freeway would be located near Exposition Boulevard, Florence Avenue, Manchester Avenue, Alondra Boulevard and Rosecrans Avenue. Access to the

street system would occur near Adams Boulevard and at mixed traffic interchanges with the arterial street system.

Proposed Harbor Freeway Busway stations would be located at Exposition Boulevard, Slauson Boulevard, Manchester Avenue, Rosecrans Avenue, Carson Street and the Pacific Coast Highway. The stations would be on-line with provisions for carpool and express bus bypass.

The proposed Century Freeway would contain a similar facility in the freeway median. Buses and carpools would have to exit the HOV roadway at one freeway and weave through mixed traffic to reach the HOV roadway on the other freeway -- across three traffic lanes on the Century Freeway in 3,000 feet and across four lanes in 4,000 feet on the Harbor Freeway. This arrangement prevents LAX-LACBD buses (line 444X) from stopping at the Vermont Avenue station on the Century Freeway Bus/HOV Roadway.

Transit Vehicles - This alternative assumes the use of articulated buses (ARTIC's) for busway operations. These vehicles would have a seating capacity of 69 passengers and a design capacity of 97 passengers with standees.

Fare Collection - The operating plan assumes use of a prepaid fare collection system at busway stations. It was assumed that passengers would pay fares at a barrier as they enter or leave the stations. For example, a patron traveling between the Carson Street station and an LACBD bus stop would pay while entering the Carson Street Station. The return trip (LACBD to Carson Street) fare would be collected as the patron leaves the Carson Street station. Therefore, no fares would be collected while boarding vehicles, allowing loading at more than one vehicle door and faster loading rates.

Patronage Projections - The transit demand projections used for development of this plan are documented in Table 7. The assumed demand at the maximum load point was 6,200 passengers per hour in the peak direction.

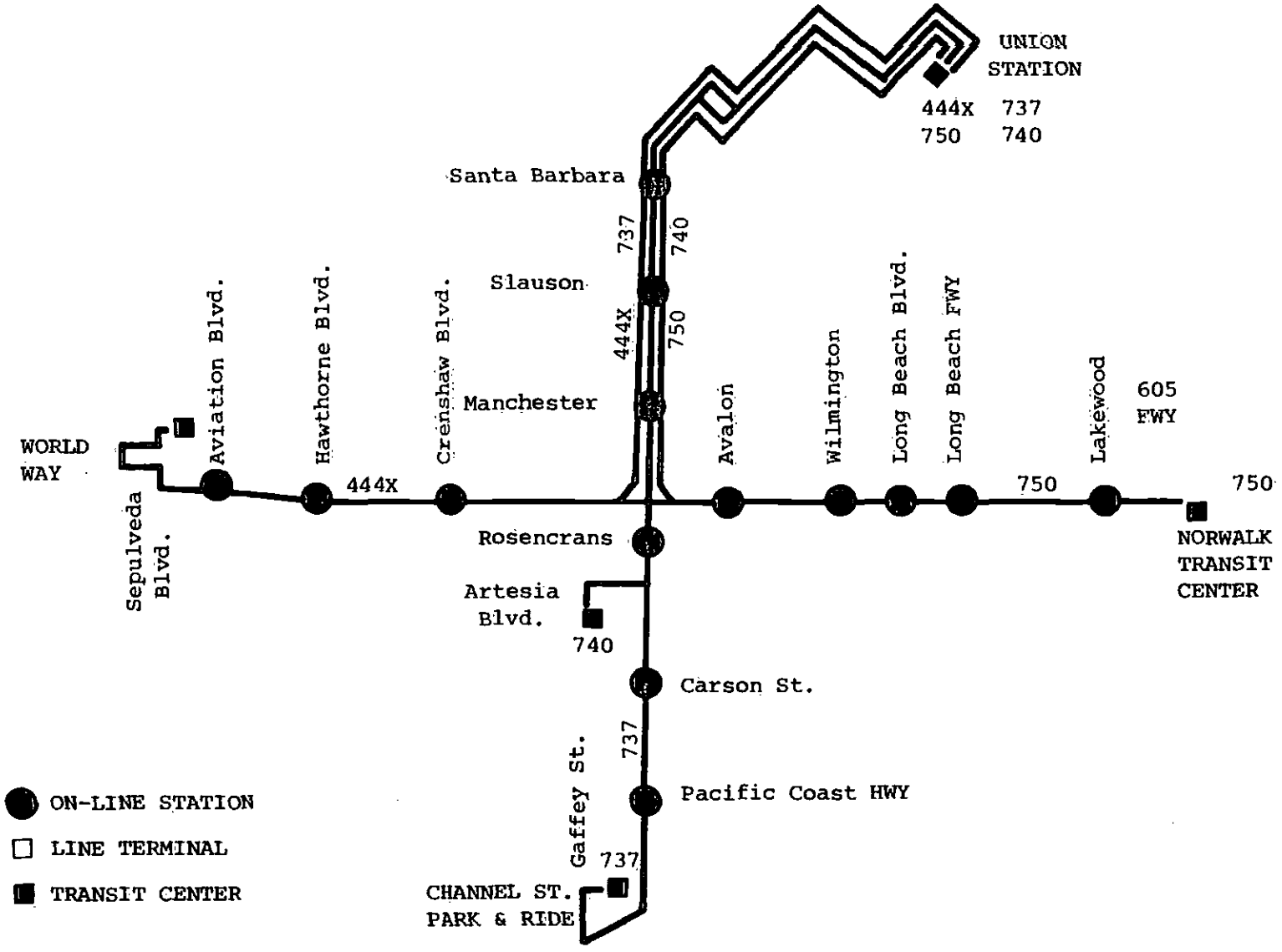
Policy Service Levels and Hours - Maximum policy headways were established at 15 minutes during peak periods (6-9 am and 3-6 pm), shortened as necessary to satisfy estimated passenger demand. The 15-minute headway would continue through the midday (9:00 am - 3:00 pm) hours. Early morning headways would be 20 minutes; evening and night headways, 30 minutes. Service would be operated 19 hours per day between 5:00 am and 12:00 midnight.

Operating Plan

Bus needs and operating characteristics were developed for a typical weekday. Bus routes, route distances and travel times, service levels, and operating statistics are detailed in the following sections.

Route Plan - The route plan would consist of three limited service-trunk lines operating exclusively within the Busway facility, and one short service line extending to the Artesia/ Vermont Transit Center. Figures 8 and 9 illustrate the line-haul routing plan used for the proposed Harbor Freeway Busway/ HOV Roadway and for the LACBD. Each bus line would operate between outlying transit center/park-and-ride lots, through the Los Angeles Central Business District to Union Station.

Route Distance and Travel Times - Tables 8A to 8D display the route distances and travel times between stations/stops for each bus line. Bus operating speeds on the Harbor Freeway while in mixed flow (under 1995 conditions) were assumed at an average speed of 50 miles per hour. Operating speeds on arterial and downtown (or World Way) streets with bus stops were assumed at



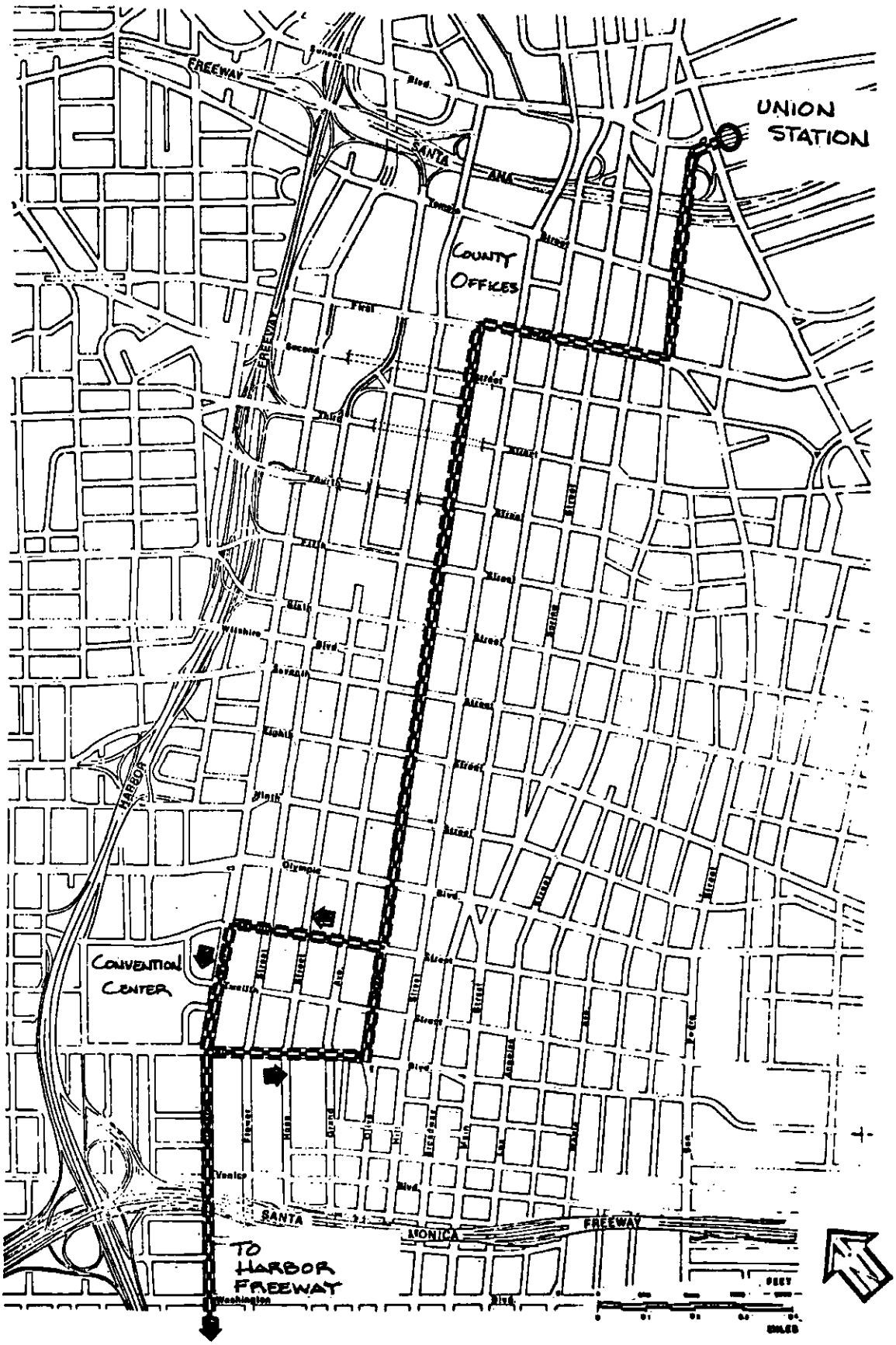
Busway Route Plan

Harbor Freeway Corridor

Limited Service - Trunk Line with Feeders

Wilbur Smith and Associates

FIGURE 8



Assumed Freeway Transit Bus Routing
Los Angeles Central Business District

Wilbur Smith & Associates

Figure 9

Table 7

PEAK HOUR DIRECTIONAL PASSENGER VOLUMES

HARBOR FREEWAY BUSWAY

BETWEEN STATIONS/STOPS	NUMBER OF PASSENGERS CARRIED NORTHBOUND (A.M.) SOUTHBOUND (P.M.)	SOUTHBOUND (A.M.) NORTHBOUND (P.M.)	TWO-WAY TOTAL
San Pedro and Pacific Coast Highway	712	305	1,017
Pacific Coast Highway and Carson	1,113	477	1,590
Carson and Artesia	1,792	768	2,560
Artesia and Rosecrans	2,066	886	2,952
Rosecrans and Century Freeway	2,419	1,037	3,456
Century Freeway and Manchester	6,149	2,635	8,784
Manchester and Slauson	5,839	2,503	8,342
Slauson and Coliseum (Exposition Blvd.)	5,884	2,522	8,406
Coliseum and Figueroa/ Venice	6,229*	2,670*	8,899*
Figueroa/Venice and Figueroa/14th	6,054	2,620	8,674
Figueroa/14th and Figueroa/Pico	6,039	2,619	8,658
Figueroa/Pico and Figueroa/12th-11th	5,874	2,537	8,411
Figueroa/12th-11th and 12th-11th/Hope	5,743	2,442	8,185
12th-11th/Hope and 12th-11th/Grand	5,702	2,400	8,102
12th-11th/Grand and Olive/12th-11th	5,541	2,361	7,902
Olive/12th-11th and Olive/Olympic	5,325	2,350	7,675
Olive/Olympic and Olive/9th	5,102	2,298	7,400
Olive/9th and Olive/8th	4,966	2,233	7,199

* Maximum Load Point of Corridor

Table 7 (Continued)

PEAK HOUR DIRECTIONAL PASSENGER VOLUMES

HARBOR FREEWAY BUSWAY

BETWEEN STATIONS/STOPS	NUMBER OF PASSENGERS CARRIED NORTHBOUND (A.M.) SOUTHBOUND (P.M.)	SOUTHBOUND (A.M.) NORTHBOUND (P.M.)	TWO-WAY TOTAL
Olive/8th and Olive/7th	4,512	2,056	6,568
Olive/7th and Olive/6th	2,837	1,289	4,126
Olive/6th and Olive/5th	2,034	945	2,979
Olive/5th and Olive/4th	1,609	686	2,295
Olive/4th and Olive/3rd	1,568	640	2,208
Olive/3rd and Olive/1st	1,425	595	2,020
Olive/1st and 1st/Hill	1,301	531	1,832
1st/Hill and 1st/Broadway	1,028	531	1,559
1st/Broadway and 1st/Main	863	311	1,174
1st/Main and 1st/Los Angeles	597	211	808
Los Angeles/1st and Los Angeles/Temple	489	184	673
Los Angeles/Temple and Los Angeles/Arcadia	159	82	241
Los Angeles/Arcadia and Alameda	133	69	202
Alameda and Union Station	51	43	94

Source: Caltrans interpretation of LARTS projections combined with LACBD projections by WSA staff.

Table 8A

SUMMARY LINE DESCRIPTION - HARBOR FREEWAY BUSWAY

Limited Service - Trunk Line Plan/Line 737

	DISTANCE BETWEEN STATIONS (MILES)	CUMULATIVE DISTANCE (MILES)	RUNNING	DWELL[1]	STATION TO STATION	AVERAGE SPEED (MPH)
Channel Street (P&R Transit Center)		0.0			0.0	
	3.2		6.0			
Pacific Coast Highway		3.2		0.6	6.6	29.1
	3.5		7.0			
Carson		6.7		0.8	7.8	26.9
	4.5		8.5			
Rosecrans		11.2		0.4	8.9	30.3
	3.9		5.0			
Manchester		15.1		0.4	5.4	43.3
	2.5		3.3			
Slauson		17.6		0.2	3.5	42.9
	1.3		1.9			
Coliseum		18.9		0.4	2.3	33.9
	2.3		6.9			
Convention Center		21.2		-[2]	6.9	20.0
	2.3		17.3			
Union Station		23.5		-[3]	17.3	8.0
	23.5				58.7	24.0

(1) Based upon peak hour, peak direction requirements.
(2) Dwell times included in assumed overall travel speed on Figueroa Street to the Convention Center of 20 MPH.
(3) Dwell times included in assumed overall travel speed in downtown of 8 MPH.

Table 8B

SUMMARY LINE DESCRIPTION - HARBOR FREEWAY BUSWAY

Limited Service - Trunk Line Plan/Line 740

	DISTANCE BETWEEN STATIONS MILES	CUMULATIVE DISTANCE (MILES)	RUNNING	DWELL (1)	STATION TO STATION	AVERAGE SPEED (MPH)
Artesia Blvd. P&R Center		0.0			0.0	
	2.4		5.1			
Rosecrans		2.4		0.4	5.5	26.2
	3.9		5.0			
Manchester		6.3		0.4	5.4	43.3
	2.5		3.3			
Slauson		8.8		0.2	3.5	42.9
	1.3		1.9			
Coliseum		10.1		0.4	2.3	33.9
	2.3		6.9			
Convention Center		12.4		-(2)	6.9	20.0
	2.3		17.3			
Union Station		14.7		-(3)	17.3	8.0
	14.7				40.9	21.6

(1) Based upon peak hour, peak direction requirements.
(2) Dwell times included in assumed overall travel speed on Figueroa Street to the Convention Center of 20 MPH.
(3) Dwell times included in assumed overall travel speed in downtown of 8 MPH.

Table 8C

SUMMARY LINE DESCRIPTION

HARBOR FREEWAY BUSWAY

Limited Service - Trunk Line Plan/Line 444X

STATION/STOP	DISTANCE BETWEEN STATIONS (Miles)	CUMMULATIVE DISTANCE (Miles)	TRAVEL TIME (Minutes) Running	Dwell (1)	Station-To-Station	AVERAGE SPEED (MPH)
96th (LAX Transit Center)		0.0		0.0	0.0	
	4.0		18.4			
Aviation		4.0		0.3	18.7	12.8
	1.2		1.8			
Hawthorne		5.2		0.5	2.3	31.3
	1.7		2.4			
Crenshaw		6.9		0.4	2.8	36.9
	4.6		5.9			
Manchester		11.5		0.4	0.3	43.8
	2.5		3.3			
Slauson		14.0		0.2	3.5	42.9
	1.3		1.9			
Coliseum		15.3		0.4	2.3	33.9
	2.3		6.9			
Convention Center		17.6		-(2)	6.9	20.0
	2.3		17.3			
Union Station		20.3		-(3)	17.3	8.0
LAX Transit Center to Union Station	19.9				60.1	19.9

(1) Based upon peak hour, peak direction requirements
(2) Dwell times included in assumed overall travel speed on Figueroa Street to the Convention Center of 20 MPH
(3) Dwell times included in assumed overall travel speed in downtown of 8 MPH

Table 8D

SUMMARY LINE DESCRIPTION

HARBOR FREEWAY BUSWAY

Limited Service - Trunk Line Plan/Line 750

STATION/STOP	DISTANCE BETWEEN STATIONS (Miles)	CUMMULATIVE DISTANCE (Miles)	TRAVEL TIME (Minutes) Running	Dwell[1]	Station-to-Station	AVERAGE SPEED (MPH)
Studebaker (Norwalk Transit Ctr)		0.0		0.0	0.0	0.0
	2.3		3.1			
Lakewood		2.3		0.2	3.3	41.8
	2.2		3.0			
Long Beach Freeway		4.5		0.4	3.4	38.8
	2.0		2.7			
Long Beach Boulevard		6.5		0.6	3.3	36.4
	1.7		2.4			
Wilmington		8.2		0.4	2.8	36.4
	1.6		2.3			
Avalon		9.8		0.5	2.8	34.3
	3.0		3.9			
Manchester		12.8		0.4	4.3	41.9
	2.5		3.3			
Slauson		15.3		0.2	3.5	42.9
	1.3		1.9			
Coliseum		16.6		0.4	2.3	33.9
	2.3		6.9			
Convention Center		18.9		-[2]	6.9	20.0
	2.3		17.3			
Union Station		21.6		-[3]	17.3	8.0
Norwalk Transit Center to Union Station	21.2				49.9	25.5

(1) Based upon peak hour, peak direction requirements

(2) Dwell times included in assumed overall travel speed on Figueroa Street to the Convention Center of 20 MPH

(3) Dwell times included in assumed overall travel speed in downtown of 8 MPH.

20 and 8 miles per hour, respectively.

Headways - The individual bus line service requirements for meeting patronage demands are listed on Tables 9A to 9D. The combined average bus headway (occurring between Century Freeway and Union Station) for the peak hour in peak direction would be approximately 45 seconds. This would likely require two bus berths per station at the Manchester, Slauson, and Coliseum stations. In the LACBD, a skip-stop arrangement would be used.

Operating Statistics - Estimated bus trips, cycle times, equipment needs, bus hours, and bus miles by line are shown in Table 10. Assumptions utilized for calculation of revenue and non-revenue hours and miles are documented elsewhere.

Table 9A

BUS ASSIGNMENTS BY HOUR OF THE DAY

HARBOR FREEWAY BUSWAY

Limited Service - Trunk Line Plan/Line 737

Schedule Hour	Design Passenger Volume/Hour (IN)	Design Passenger Volume/Hour (OUT)	Buses/Hour (One-Way Revenue Trips)[1] (IN)	Buses/Hour (One-Way Revenue Trips)[1] (OUT)	Total Buses/Hour	Design Headway (Minutes) (IN)	Design Headway (Minutes) (OUT)
5-6 AM	230	230	3	3	6	20.0	20.0
6-7	1,200	970	12	9	21	5.0	6.7
7-8	2,400	970	27	12	39	2.2	5.0
8-9	1,200	970	12	9	21	5.0	6.7
9-10	600	600	5	5	10	12.0	12.0
10-11	600	600	5	5	10	12.0	12.0
11-12	600	600	5	5	10	12.0	12.0
12-1 PM	600	600	5	5	10	12.0	12.0
1-2	600	600	5	5	10	12.0	12.0
2-3	600	600	5	5	10	12.0	12.0
3-4	970	910	9	8	17	6.7	7.5
4-5	970	1,660	9	18	27	6.7	3.3
5-6	970	2,400	10	27	37	6.0	2.2
6-7	600	910	7	12	19	8.6	5.0
7-8	600	600	7	7	14	8.6	8.6
8-9	600	600	7	7	14	8.6	8.6
9-10	230	230	2	2	4	30.0	30.0
10-11	230	230	2	2	4	30.0	30.0
11-MID-NIGHT	230	230	2	2	4	30.0	30.0
TOTAL			139	148	287		

(1) Based upon maximum load point north of Rosecrans; includes lines 737 and 740 (Short Lines).

(2) Totals do not balance due to differences between AM and PM peak requirements.

Table 9B

BUS ASSIGNMENTS BY HOUR OF THE DAY
HARBOR FREEWAY BUSWAY

Limited Service - Trunk Line Plan/Line 740

Schedule Hour	Design Passenger Volume/Hour[1] (IN)	(OUT)	Buses/Hour (One-Way Revenue Trips) (IN)	(OUT)	Total Buses/Hour	Design Headway (Minutes) (IN)	(OUT)
5-6 AM	230	230	3	3	6	20.0	20.0
6-7	1,200	970	4	4	6	15.0	15.0
7-8	2,400	970	4	4	6	15.0	15.0
8-9	1,200	970	4	4	6	15.0	15.0
9-10	600	600	4	4	6	15.0	15.0
10-11	600	600	4	4	6	15.0	15.0
11-12	600	600	4	4	6	15.0	15.0
12-1 PM	600	600	4	4	6	15.0	15.0
1-2	600	600	4	4	6	15.0	15.0
2-3	600	600	4	4	6	15.0	15.0
3-4	970	910	4	4	6	15.0	15.0
4-5	970	1,660	4	4	6	15.0	15.0
5-6	970	2,400	4	4	6	15.0	15.0
6-7	600	910	2	2	4	30.0	30.0
7-8	600	600	2	2	4	30.0	30.0
8-9	600	600	2	2	4	30.0	30.0
9-10	230	230	2	2	4	30.0	30.0
10-11	230	230	2	2	4	30.0	30.0
11-MIDNIGHT	230	230	2	2	4	30.0	30.0
TOTAL			63	63[2]	126		

(1) Based upon maximum load point north of Rosecrans; includes lines 737 and 740.

(2) Totals do not balance due to differences between AM and PM peak requirements.

Table 9C

BUS ASSIGNMENTS BY HOUR OF THE DAY

HARBOR FREEWAY BUSWAY

Limited Service - Trunk Line Plan/Line 444X

Schedule Hour	Design Passenger Volume/Hour[1] (IN)	(OUT)	Buses/Hour (One-Way Revenue Trips) (IN)	(OUT)	Total Buses/Hour	Design Headway (Min.) (IN)	(OUT)
5-6 AM	190	190	3	3	6	20.0	20.0
6-7	990	800	13	11	24	4.6	5.5
7-8	1,970	800	26	13	39	2.3	4.6
8-9	990	800	13	11	24	4.6	5.5
9-10	490	470	8	8	16	7.5	7.5
10-11	490	490	8	8	16	7.5	7.5
11-12	490	490	8	8	16	7.5	7.5
12-1 PM	490	490	8	8	16	7.5	7.5
1-2	490	490	8	8	16	7.5	7.5
2-3	490	490	8	8	16	7.5	7.5
3-4	800	750	11	10	21	5.5	6.0
4-5	800	1,360	11	18	29	5.5	3.3
5-6	800	1,970	11	26	37	5.5	2.3
6-7	490	750	8	11	19	7.5	5.5
7-8	490	490	8	8	16	7.5	7.5
8-9	490	490	8	8	16	7.5	7.5
9-10	190	190	3	3	6	20.0	20.0
10-11	190	190	3	3	6	20.0	20.0
11-MID NIGHT	190	190	3	3	6	20.0	20.0
TOTAL			169	176	345		

(1) Based upon maximum load point north of Coliseum

Table 9D

BUS ASSIGNMENTS BY HOUR OF THE DAY

HARBOR FREEWAY BUSWAY

Limited Service - Trunk Line Plan/Line 750

Schedule Hour	Design Passenger Volume/Hour (1) (IN)	(OUT)	Buses/Hour (One-Way Revenue Trips) (IN)	(OUT)	Total Buses/Hour	Design Headway (Minutes) (IN)	(OUT)
5-6 AM	210	210	4	4	8	15.0	15.0
6-7	1,080	870	14	12	26	4.3	5.0
7-8	2,160	870	28	14	42	2.1	4.3
8-9	1,080	870	14	12	26	4.3	5.0
9-10	540	540	8	8	16	7.5	7.5
10-11	540	540	8	8	16	7.5	7.5
11-12	540	540	8	8	16	7.5	7.5
12-1 PM	540	540	8	8	16	7.5	7.5
1-2	540	540	8	8	16	7.5	7.5
2-3	540	540	8	8	16	7.5	7.5
3-4	870	820	12	11	23	5.0	5.5
4-5	870	1,490	12	20	32	5.0	3.0
5-6	870	2,160	12	28	40	7.5	2.1
6-7	540	820	8	12	20	7.6	5.5
7-8	540	540	8	8	16	7.5	7.5
8-9	540	540	8	8	16	7.5	7.5
9-10	210	210	4	4	8	15.0	15.0
10-11	210	210	4	4	8	15.0	15.0
11-MID-NIGHT	210	210	4	4	8	15.0	15.0
TOTAL			180	189	369		

(1) Based upon maximum load point east of Avalon.

Table 10

SUMMARY OF OPERATING STATISTICS

ALTERNATIVE A-3a

BUS ROUTE	BUS TRIPS PER DAY (19 Hours)	LINE[1] LENGTH (Miles)	CYCLE[2] TIME (Mins.)	BUSES NEEDED AM PEAK	BASE	PM PEAK	NIGHT	BUS HOURS[3] REVENUE	NON-REVENUE	TOTAL	BUS MILES REVENUE	NON-REVENUE	TOTAL
737 (San Pedro - LACBD)	287	23.5	129.1	58	11	58	5	308.9	94.5	403.4	6744.5	1890.0	8,634.5
740 (Artesia & Vermont-LACBD	126	14.7	90.0	6	6	6	3	94.5	5.4	99.9	1852.2	108.0	1,960.2
444X (LAX - LACBD)	345	19.9	132.2	58	18	58	7	380.1	88.2	468.3	6865.5	1764.0	8,629.5
750 (Norwalk - LACBD)	369	21.2	109.8	53	15	53	8	337.6	81.9	419.5	7822.8	1638.0	9,460.8
Totals	1,127			175	50	175	23	1121.1	270.0	1391.1	23285.0	5400.0	28,685.0

(1) Based upon northbound direction

(2) Roundtrip including layover (factor = 1.10)

(3) Bus Hours = $\underbrace{\left[\frac{(\text{Running time} \times \text{Bus trips})\ 1.10}{60}\right]}_{\text{Revenue Hours}} + \underbrace{\left[\frac{(\text{Base buses})\ 54 + (\text{Peak only buses})\ 108}{60}\right]}_{\text{Non-Revenue Hours}}$

ALTERNATIVE A-3b
FREEWAY BUS TRANSIT OPERATING PLAN
LIMITED SERVICE-TRUNK LINE WITH ARTERIAL EXTENSIONS
HARBOR FREEWAY CORRIDOR

An alternative bus operating plan for Harbor Freeway Bus Transit would function as a limited service - trunk line with arterial extensions, plus feeders serving stations from surrounding areas. This plan was developed as an alternative to the Limited Service-Trunk Line Plan presented in the previous section.

Planning Assumptions

Assumptions relative to physical features of the busway, transit vehicles (articulated coaches), fare collection, line haul demand and policy service levels for this alternative were the same as for the trunk line - with feeders service concept.

Operating Plan

The operating plan would be a modified version of the "Proposed Harbor-Century Freeway Transitway Bus System" developed by SCRTD staff.[12] The key differences between this plan and the plan originally developed by SCRTD staff are as follows :

- Line 448X would be moved from Avalon Boulevard to the Harbor Freeway Busway;
- Service levels on the busway line-haul section would be provided at demand levels;
- All bus lines would service each on-line station (including Carson Street and P.C.H.);
- Lines 813 and 814 would be re-routed following Artesia Boulevard directly to the Harbor Freeway, and service the proposed Artesia/Vermont Transit Center; and

(12) Southern California Rapid Transit District Proposal Harbor-Century Transitway System, SCRTD Planning Department, February 1981.

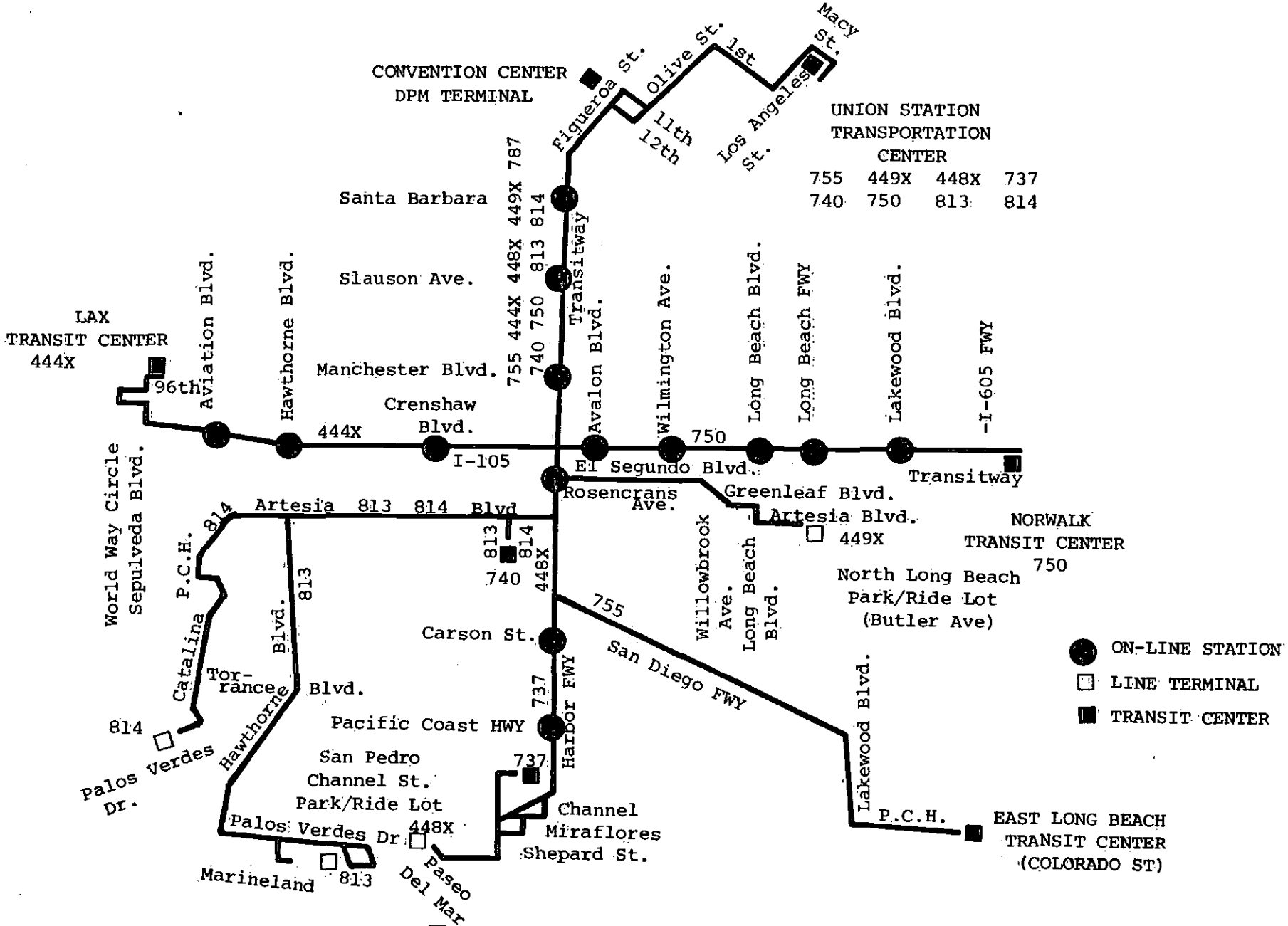
- The Avalon Boulevard Line 448X would be replaced with a local service line operating between San Pedro and the Century Freeway/Busway Avalon Station.

Route Plan - The route plan would consist of nine limited service lines, three of which would operate exclusively within the Busway facility. The other lines would extend from the Busway into surrounding service areas. Figure 10 shows the routing plan for Freeway Transit buses with Alternative A-36. A typical LACBD bus stop plan is shown in Figure 11. Each bus line would operate between outlying transit center/park and ride lots, through the Los Angeles Central Business District to Union Station.

Route Distances and Travel Times - Tables 11-A to 11-I display the route distances and travel times between stations/stops for each bus line. Dwell times assume prepaid fares throughout the system.

Headways - Bus service requirements for meeting patronage demands are shown in Tables 12A through 12C. The Century Freeway corridor lines 750 and 444X are identical in route distance, travel times and service requirements to the same lines in the trunk lines + with feeders plan. The seven South Bay lines were assigned headways which, when combined, would meet demand estimates for this line-haul portion of the Harbor Freeway Corridor. This was accomplished by running all lines on policy headways individually, augmented where necessary to meet demand as follows :

- Line 737 was assigned 7 buses in the peak hour, peak direction (7-8 A.M. inbound and 5-6 P.M. outbound) instead of the required policy minimum of 4 buses; and
- Lines 813, 449X and 448X were assigned 5 buses each in the outbound direction from 6-7 P.M. instead of the required policy minimum of 3 buses per hour.



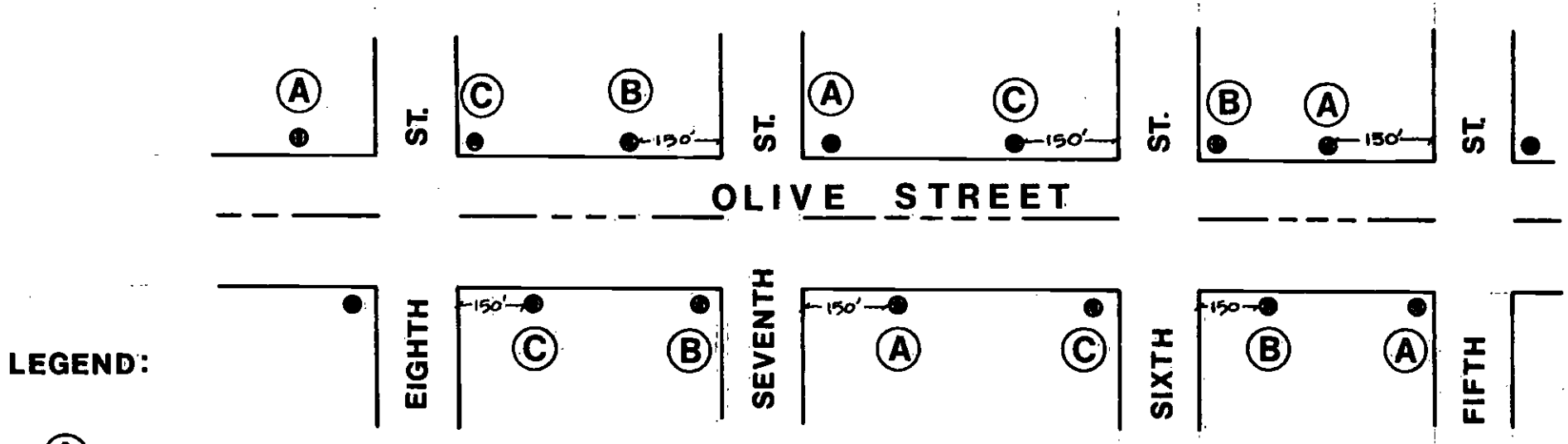
Busway Route Plan

Harbor Freeway Corridor

Limited Service - Trunk Lines With Extensions

Wilbur Smith and Associates

FIGURE 10



ILLUSTRATIVE EXAMPLE OF OLIVE STREET BUS STOP PLAN IN FINANCIAL DISTRICT OF LACBD

Wilbur Smith and Associates

FIGURE 11

Table 11A

SUMMARY LINE DESCRIPTION

HARBOR FREEWAY BUSWAY

Limited Service - Trunk Line Plan/Line 750 to Norwalk
Trunk Lines With Arterial Extensions

STATION/STOP	DISTANCE BETWEEN STATIONS (Miles)	CUMULATIVE DISTANCE (Miles)	TRAVEL TIME (Minutes) Running	Dwell[1]	Station-to-Station	AVERAGE SPEED (MPH)
Studebaker (Norwalk Transit Ctr)		0.0		0.0	0.0	0.0
	2.3		3.1			
Lakewood		2.3		0.2	3.3	41.8
	2.2		3.0			
Long Beach Freeway		4.5		0.4	3.4	38.8
	2.0		2.7			
Long Beach Boulevard		6.5		0.6	3.3	36.4
	1.7		2.4			
Wilmington		8.2		0.4	2.8	36.4
	1.6		2.3			
Avalon		9.8		0.5	2.8	34.3
	3.0		3.9			
Manchester		12.8		0.4	4.3	41.9
	2.5		3.3			
Slauson		15.3		0.2	3.5	42.9
	1.3		1.9			
Coliseum		16.6		0.4	2.3	33.9
	2.3		6.9			
Convention Center		18.9		_(2)	6.9	20.0
	2.3		17.3			
Union Station		21.6		_(3)	17.3	8.0
Norwalk Transit Center to Union Station	21.2				49.9	25.5

(1) Based upon peak hour, peak direction requirements.
(2) Dwell times included in assumed overall travel speed on Figueroa Street to the Convention Center of 20 MPH.
(3) Dwell times included in assumed overall travel speed in downtown [illegible]

Table 11B

SUMMARY LINE DESCRIPTION

HARBOR FREEWAY BUSWAY

Limited Service - Trunk Line Plan/Line 444X to LAX
Trunk Lines With Arterial Extensions

STATION/STOP	DISTANCE BETWEEN STATIONS (Miles)	CUMULATIVE DISTANCE (Miles)	TRAVEL TIME (Minutes) Running	Dwell[1]	Station-to-Station	AVERAGE SPEED (MPH)
96th (LAX Transit Center)		0.0		0.0	0.0	
	4.0		18.4			
Aviation		4.0		0.3	18.7	12.8
	1.2		1.8			
Hawthorne		5.2		0.5	2.3	31.3
	1.7		2.4			
Crenshaw		6.9		0.4	2.8	36.9
	4.6		5.9			
Manchester		11.5		0.4	0.3	43.8
	2.5		3.3			
Slauson		14.0		0.2	3.5	42.9
	1.3		1.9			
Coliseum		15.3		0.4	2.3	33.9
	2.3		6.9	-(2)	6.9	20.0
Convention Center		17.6				
	2.3		17.3	-(3)	17.3	8.0
Union Station		20.3				
LAX Transit Center to Union Station	19.9				60.1	19.9

(1) Based upon peak hour, peak direction requirements.
(2) Dwell times included in assumed overall travel speed on Figueroa Street to the Convention Center at 20 MPH.
(3) Dwell times included in assumed overall travel speed in downtown of 8 MPH.

Table 11C

SUMMARY LINE DESCRIPTION - HARBOR FREEWAY BUSWAY

Limited Service - Trunk Line Plan/Line 737 to San Pedro
Trunk Lines With Arterial Extensions

STATION/STOP	DISTANCE BETWEEN STATIONS (Miles)	CUMULATIVE DISTANCE (MILES)	RUNNING	DWELL	STATION TO STATION	AVERAGE SPEED (MPH)
Channel Street (P&R Transit Center)		0.0			0.0	
	3.2		6.0			
Pacific Coast Highway		3.2		0.6	6.6	29.1
	3.5		7.0			
Carson		6.7		0.8	7.8	26.9
	4.5		8.5			
Rosecrans		11.2		0.4	8.9	30.3
	3.9		5.0			
Manchester		15.1		0.4	5.4	43.3
	2.5		3.3			
Slauson		17.6		0.2	3.5	42.9
	1.3		1.9			
Coliseum		18.9		0.4	2.3	33.9
	2.3		6.9			
Convention Center		21.2		-(2)	6.9	20.0
	2.3		17.3			
Union Station		23.5		-(3)	17.3	8.0
	23.5				58.7	24.0

(1) Based upon peak hour, peak direction requirements.
(2) Dwell times included in assumed overall travel speed on Figueroa Street to the Convention Center of 20 MPH.
(3) Dwell times included in assumed overall travel speed in downtown of 8 MPH.

Table 11D

SUMMARY LINE PERFORMANCES

HARBOR FREEWAY BUSWAY

Trunk Lines With Arterial Extensions/Line 813 to Palos Verdes

STATION/STOP	DISTANCE BETWEEN STATION/STOP (Miles)	CUMULATIVE DISTANCE (Miles)	TRAVEL TIME (Minutes) Running	Dwell[1]	Station-to-Station	AVERAGE SPEED (MPH)
South Line Terminal (Beachview & Sec. Hill Drs)		0.0		0.0	0.0	0.0
	16.6		48.2			
Artesia		16.6		0.6	48.8	20.4
	2.4		5.1			
Rosecrans		19.0		0.4	5.5	26.2
	3.9		5.0			
Manchester		22.9		0.4	5.4	43.3
	2.5		3.3			
Slauson		25.4		0.2	3.5	42.9
	1.3		1.9			
Coliseum		26.7		0.4	2.3	33.9
	2.3		6.9			
Convention Center		29.0		-[2]	6.9	20.0
	2.3		17.3			
Union Station		31.3		-[3]	17.3	8.0
Line Terminal to Union Station	31.3				89.7	20.9

(1) Based upon peak hour, peak direction requirements.
(2) Dwell times included in assumed overall travel speed on Figueroa Street to the Convention Center of 20 MPH.
(3) Dwell times included in assumed overall travel speed in downtown of 8 MPH.

Table 11E

SUMMARY LINE PERFORMANCE

HARBOR FREEWAY BUSWAY

Trunk Line With Arterial Extensions/Line 814 to Palos Verdes

STATION/STOP	DISTANCE BETWEEN STATION/STOP (Miles)	CUMULATIVE DISTANCE (Miles)	TRAVEL TIME (Minutes) Running	Dwell (1)	Station-to-Station	AVERAGE SPEED (MPH)
South Line Terminal (Palos Verdes Dr. West & via Chico)		0.0		0.0	0.0	0.0
	14.0		40.2			
Artesia		14.0		0.6	40.8	20.6
	2.4		5.1			
Rosecrans		16.4		0.4	5.5	26.2
	3.9		5.0			
Manchester		20.3		0.4	5.4	43.3
	2.5		3.3			
Slauson		22.8		0.2	3.5	42.9
	1.3		1.9			
Coliseum		24.1		0.4	2.3	33.9
	2.3		6.9			
Convention Center		26.4		-(2)	6.9	20.0
	2.3		17.3			
Union Station		28.7		-(3)	17.3	8.0
Line Terminal to Union Station	28.7				81.7	21.4

(1) Based upon peak hour, peak direction requirements.
(2) Dwell times included in assumed overall travel speed on Figueroa Street to the Convention Center of 20 MPH.
(3) Dwell times included in assumed overall travel speed in downtown of 8 MPH.

Table 11F

SUMMARY LINE PERFORMANCE

HARBOR FREEWAY BUSWAY

Trunk Lines With Arterial Extensions/Line 740 to Artesia Blvd. P/R

STATION/STOP	DISTANCE BETWEEN STATION/STOP (Miles)	CUMULATIVE DISTANCE	TRAVEL TIME (Minutes) Running	Dwell[1]	Station-to-Station	AVERAGE SPEED (MPH)
Artesia P/R (Artesia Blvd. & Vermont Ave.)		0.0		0.0	0.0	0.0
	2.4		5.1			
Rosecrans		2.4		0.4	3.5	26.2
	3.9		5.0			
Manchester		6.3		0.4	5.4	43.3
	2.5		3.3			
Slauson		8.8		0.2	3.5	42.9
	1.3		1.9			
Coliseum		10.1		0.4	2.3	33.9
	2.3		6.9			
Convention Center		12.4		-[2]	6.9	20.0
	2.3		17.3			
Union Station		14.7		-[3]	17.3	8.0
Artesia P/R to Union Station	14.7				40.9	21.6

(1) Based upon peak hour, peak direction requirements.
(2) Dwell times included in assumed overall travel speed on Figueroa Street to the Convention Center of 20 MPH.
(3) Dwell times included in assumed overall travel speed in downtown of 8 MPH.

Table 11G

SUMMARY LINE PERFORMANCE

HARBOR FREEWAY BUSWAY

Trunk Lines With Arterial Extensions/Line 449X to N. Long Beach P/R

STATION/STOP	DISTANCE BETWEEN STATION/STOP (Miles)	CUMULATIVE DISTANCE (Miles)	TRAVEL TIME (Minutes) Running	Dwell[1]	Station-to-Station	AVERAGE SPEED (MPH)
N. Long Beach P/R (Artesia Blvd. & Butler Blvd.)		0.0		0.0	0.0	0.0
	10.7		29.1			
Manchester		10.7		0.4	29.5	24.1
	2.5		3.3			
Slauson		13.2		0.2	3.5	42.9
	1.3		1.9			
Coliseum		14.5		0.4	2.3	33.9
	2.3		6.9			
Convention Center		16.8		-[2]	6.9	20.0
	2.3		17.3			
Union Station		19.1		-[3]	17.3	8.0
N. Long Beach P/R to Union Station	19.1				59.5	19.3

(1) Based upon peak hour, peak direction requirements.
(2) Dwell times included in assumed overall travel speed on Figueroa Street to the Convention Center of 20 MPH.
(3) Dwell times included in assumed overall travel speed in downtown of 8 MPH.

Table 11H

SUMMARY LINE PERFORMANCE

HARBOR FREEWAY BUSWAY

Trunk Lines With Arterial Extensions/Line 448 to San Pedro

STATION/STOP	DISTANCE BETWEEN STATION/STOP (Miles)	CUMULATIVE DISTANCE (Miles)	TRAVEL TIME (Minutes) Running	Dwell[1]	Station-to-Station	AVERAGE SPEED (MPH)
South Line Terminal (Alevaria Str. & Paseo Del Mar)		0.0				
	7.2		22.0			
Pacific Coast Highway		7.2		0.6	22.6	19.1
	3.5		7.0			
Carson Street		10.7		0.8	7.8	26.9
	4.5		8.5			
Rosecrans		15.2		0.4	8.9	30.3
	3.9		5.0			
Manchester		19.1		0.4	5.4	43.3
	2.5		3.3			
Slauson		21.6		0.2	3.5	42.9
	1.3		1.9			
Coliseum		22.9		0.4	2.3	33.9
	2.3		6.9	-[2]		
Convention Center		25.2			6.9	20.0
	2.3		17.3	-[3]		
Union Station		27.5			17.3	8.0
	27.5				74.7	22.1

(1) Based upon peak hour, peak direction requirements.
(2) Dwell times included in assumed overall travel speed on Figueroa Street to the Convention Center of 20 MPH.
(3) Dwell times included in assumed overall travel speed in downtown of 8 MPH.

Table III

SUMMARY LINE PERFORMANCE

HARBOR FREEWAY BUSWAY

Trunk Lines With Arterial Extensions/Line 755 to E. Long Beach Transit Center

STATION/STOP	DISTANCE BETWEEN STATION/STOP (Miles)	CUMULATIVE DISTANCE (Miles)	Running	Dwell[1]	Station-to-Station	AVERAGE SPEED (MPH)
E. Long Beach Transit Center		0.0				
	15.6		42.0			
Artesia		15.6		0.6	42.6	22.0
	2.4		5.1			
Rosecrans		18.0		0.4	5.5	26.2
	3.9		5.0			
Manchester		21.9		0.4	5.4	43.3
	2.5		3.3			
Slauson		24.4		0.2	3.5	42.9
	1.3		1.9			
Coliseum		25.7		0.4	2.3	33.9
	2.3		6.9	-[2]	6.9	20.0
Convention Center		28.0				
	2.3		17.3	-[3]	17.3	8.0
Union Center		30.3				
E. Long Beach Transit Center to Union Station	30.3				83.5	21.8

(1) Based upon peak hour, peak direction requirements.
(2) Dwell times included in assumed overall travel speed on Figueroa Street to the Convention Center of 20 MPH.
(3) Dwell times included in assumed overall travel speed in downtown of 8 MPH.

Table 12A

BUS ASSIGNMENTS BY HOUR OF THE DAY

HARBOR FREEWAY BUSWAY

Limited Service-Trunk Line With Arterial Extensions/Line 750

Schedule Hour	Design Passenger Volume/Hour (1)		Buses/Hour (One-Way Revenue Trips)		Total Buses/Hour	Design Headway (Minutes)	
	(IN)	(OUT)	(IN)	(OUT)		(IN)	(OUT)
5-6 AM	210	210	4	4	8	15.0	15.0
6-7	1,080	870	14	12	26	4.3	5.0
7-8	2,160	870	28	14	42	2.1	4.3
8-9	1,080	870	14	12	26	4.3	5.0
9-10	540	540	8	8	16	7.5	7.5
10-11	540	540	8	8	16	7.5	7.5
11-12	540	540	8	8	16	7.5	7.5
12-1 PM	540	540	8	8	16	7.5	7.5
1-2	540	540	8	8	16	7.5	7.5
2-3	540	540	8	8	16	7.5	7.5
3-4	870	820	12	11	23	5.0	5.5
4-5	870	1,490	12	20	32	5.0	3.0
5-6	870	2,160	12	28	40	7.5	2.1
6-7	540	820	8	12	20	7.6	5.5
7-8	540	540	8	8	16	7.5	7.5
8-9	540	540	8	8	16	7.5	7.5
9-10	210	210	4	4	8	15.0	15.0
10-11	210	210	4	4	8	15.0	15.0
11-MID-NIGHT	210	210	4	4	8	15.0	15.0
TOTAL			180	189	369		

(1) Based upon maximum load point east of Avalon.

Table 12B

BUS ASSIGNMENTS BY HOUR OF THE DAY

HARBOR FREEWAY BUSWAY

Limited Service Trunk Line With Arterial Extensions/Line 444X

Schedule Hour	Design Passenger Volume/Hour (1)		Buses/Hour (One-Way Revenue Trips)		Total Buses/Hour	Design Headway (Min.)	
	(IN)	(OUT)	(IN)	(OUT)		(IN)	(OUT)
5-6 AM	190	190	3	3	6	20.0	20.0
6-7	990	800	13	11	24	4.6	5.5
7-8	1,970	800	26	13	39	2.3	4.6
8-9	990	800	13	11	24	4.6	5.5
9-10	490	470	8	8	16	7.5	7.5
10-11	490	490	8	8	16	7.5	7.5
11-12	490	490	8	8	16	7.5	7.5
12-1 PM	490	490	8	8	16	7.5	7.5
1-2	490	490	8	8	16	7.5	7.5
2-3	490	490	8	8	16	7.5	7.5
3-4	800	750	11	10	21	5.5	6.0
4-5	800	1,360	11	18	29	5.5	3.3
5-6	800	1,970	11	26	37	5.5	2.3
6-7	490	750	8	11	19	7.5	5.5
7-8	490	490	8	8	16	7.5	7.5
8-9	490	490	8	8	16	7.5	7.5
9-10	190	190	3	3	6	20.0	20.0
10-11	190	190	3	3	6	20.0	20.0
11-MID NIGHT	190	190	3	3	6	20.0	20.0
TOTAL			169	176	345		

(1) Based upon maximum load point north of Coliseum

Table 12C

BUS ASSIGNMENTS BY HOUR OF THE DAY

HARBOR FREEWAY BUSWAY

Composite of South Bay Lines
Trunk Lines With Arterial Exensions/
Lines 737, 813, 814, 740, 449X, 448X, 755

Schedule Hour	Design Passenger Volume/Hour		Buses/Hour (One-Way Revenue Trips)[1]		Total Buses/Hour	Average Headway (Minutes)	
	(IN)	(OUT)	(IN)	(OUT)		(IN)	(OUT)
5-6 AM	230	230	9	9	18	6.7	6.7
6-7	1,200	970	28	28	56	2.1	2.1
7-8	2,400	970	31	28	59	1.9	2.1
8-9	600	970	28	28	56	2.1	2.1
9-10	600	600	12	12	24	5.0	6.7
10-11	600	600	12	12	24	5.0	5.0
11-12	600	600	12	12	24	5.0	5.0
12-1 PM	600	600	12	12	24	5.0	5.0
1-2	600	600	12	12	24	5.0	5.0
2-3	600	600	12	12	24	5.0	5.0
3-4	910	910	28	28	56	2.1	2.1
4-5	970	1,660	28	28	56	2.1	2.1
5-6	970	2,400	28	31	59	2.1	1.9
6-7	600	910	9	15	24	6.7	4.0
7-8	600	600	9	9	18	6.7	6.7
8-9	600	600	9	9	18	6.7	6.7
9-10	230	230	6	6	12	10.0	10.0
10-11	230	230	6	6	12	10.0	10.0
11-MID-NIGHT	230	230	6	6	12	10.0	10.0
TOTAL			297	303	600		

(1) Based upon maximum load point north of Coliseum

Policy headway frequencies were used for these lines at all other times of day, and on all other South Bay Lines.

Lines 813, 449X, 448X, 750 and 444X would operate all day from 5 AM to 12 midnight; lines 737, 814, 740 and 755 would operate peak hour service only, from 6-9 AM and 3-6 PM.

The combined average bus headway for all lines (occurring north of the Century Freeway) for the peak hour in the peak direction would be approximately 45 seconds. This would probably require two bus berths per station at the Manchester, Slauson, and Coliseum Stations. In the LACBD, a skip-stop arrangement would be used (see Figure 12).

Operating Statistics - Estimated operating statistics for Alternative A-3b are summarized in Table 13.

Table 13

SUMMARY OF OPERATING STATISTICS

ALTERNATIVE A-3b

BUS ROUTE	BUS TRIPS PER DAY (19 Hours)	LINE LENGTH[1] (Miles)	CYCLE TIME[2] (Mins.)	BUSES NEEDED				BUS HOURS[3]			BUS MILES		
				AM PEAK	BASE	PM PEAK	NIGHT	REVENUE	NON-REVENUE	TOTAL	REVENUE	NON-REVENUE	TOTAL
750	369	21.2	109.8	53	15	53	4	337.6	81.9	419.5	7822.8	1638.0	9,460.8
444X	345	19.9	132.2	58	18	58	5	380.1	88.2	468.3	6865.5	1764.0	8,629.5
737	54	23.5	129.1	15	-	15	-	58.1	27.0	85.1	1269.0	540.0	1,809.0
813	134	31.3	197.3	14	14	14	7	215.4	12.6	228.0	4194.2	252.0	4,446.2
814	48	28.7	179.7	12	-	12	-	71.9	21.6	93.5	1377.6	432.0	1,809.6
740	48	14.7	90.0	6	-	6	-	36.0	10.8	46.8	705.6	216.0	921.6
449X	134	19.1	130.9	9	9	9	5	146.2	8.1	154.3	2559.4	162.0	2,721.4
448X	134	27.5	164.3	11	11	11	6	183.5	9.9	193.4	3685.0	198.0	3,883.0
755	48	30.3	183.7	13	-	13	-	73.5	23.4	96.9	1454.4	468.0	1,922.4
Totals	1,314			191	67	191	27	1502.3	283.5	1785.8	29933.5	5670.0	35,603.5

(1) Based upon northbound direction

(2) Roundtrip including layover (factor = 1.10)

(3) Bus Hours = $\frac{\text{(Running time X Bus trips)}}{60}$ 1.10 + $\frac{\text{(Base buses) 54 + (Peak only buses) 108}}{60}$

Revenue Hours Non-Revenue Hours

ALTERNATIVE A-3c
REVERSIBLE LANE BUSWAY OPERATING PLAN
HARBOR FREEWAY CORRIDOR

This Plan is similar to the Trunk Line-With-Feeders Plan with the exception that the busway would be a reversible, one-lane facility. The facility would serve northbound passengers during the A.M. peak and southbound passengers during the P.M. peak.

It was assumed for this analysis that levels of service and feeder characteristics would be similar to those of the Trunk Line-With-Feeders Plan, and that operating speeds on the busway (peak commute direction) would also be comparable.

Buses in the reverse commute direction would operate in mixed traffic on the Harbor Freeway; it was assumed in this analysis that operating speeds in the reverse commute direction would be similar to those of the Harbor Freeway buses in the TSM plan. In the off-peak, assumed round trip times were based on one-way travel at busway speeds plus one-way travel at mixed traffic speeds, regardless of direction of operation of the reversible busway.

Configuration of the Reversible Busway Plan routes was identical to those for the Trunk Line-With-Feeders Plan. Due to the slower reverse-commute direction operations in mixed traffic, more bus hours and peak buses would be required to provide the same level of service as the Trunk Line-With-Feeders Plan. Increased fleet requirements also result from a slight increase in bus miles due to deadheading of the extra buses required.

Operating characteristics of the Reversible Busway Plan are listed in Table 14.

Table 14
OPERATING CHARACTERISTICS-REVERSIBLE BUSWAY PLAN
Harbor Freeway Corridor

LINE	ROUTE TYPE	BUS TYPE	BUS MILES FREEWAY	BUS MILES SURFACE	BUS MILES TOTAL	BUS HOURS	PEAK BUS REQ.(1)
442X	Freeway Transit(2)	ARTIC	628	2,450	3,078	210.1	20
444X	Freeway Transit	ARTIC	7,098	1,622	8,720	496.0	61
448	Feeder	ADB	461	576	1,037	59.1	4
449	Feeder	ADB	-	983	983	62.8	4
737	Freeway Transit	ARTIC	7,226	1,535	8,761	428.9	62
740	Freeway Transit	ARTIC	1,438	540	1,978	109.2	7
750	Freeway Transit	ARTIC	7,853	1,662	9,515	446.8	55
755	Feeder	ADB	783	295	1,078	51.1	7
813	Feeder	ADB	283	2,407	2,690	139.1	8
814	Feeder	ADB	-	888	888	46.7	6
G1	Feeder	ADB	-	695	695	59.5	6
T1	Feeder	ADB	-	378	378	30.9	3
T2	Feeder	ADB	-	387	387	32.5	3
	Subtotal ADB		1,527	6,609	8,136	481.7	41
	Subtotal ARTIC		24,423	7,809	32,052	1,691.0	205
TOTAL			25,770	14,418	40,188	2,172.9	246

(1) Not Including spares

(2) Operates in mixed traffic on Harbor Freeway.

ALTERNATIVE A-4a
ICTS OPERATING PLAN (FULL SERVICE)
HARBOR FREEWAY CORRIDOR

An operating plan for ICTS in the Harbor Corridor was developed based on the following major assumptions:

(1) Guideway location plans, verticle profile with station locations specified by CalTrans;

(2) Use of the Los Angeles Downtown People Mover guideway in the CBD;

(3) Patronage projections supplied by CalTrans;

(4) Train performance data supplied by the manufacturer; and

(5) Full service (i.e., all trains running the full length of line).

Route Length and Station Locations

Total route length between Union Station and Port of Call via the Harbor Freeway/DPM alignment would be about 25 miles. For purposes of this study, stations were assumed at the following locations; from south to north.[13]

Ports of Call
Channel Street
Pacific Coast Highway
Carson
Artesia
Rosecrans
Century (transfers)
Manchester
Slauson
Coliseum
Convention Center

---

(13) The route originally ended in San Pedro near Channel Street and was subsequently extended to Ports of Call.

Seventh & Figueroa
Fifth & Figueroa
Library
Pershing Square
Hill Street
Civic Center
Little Tokyo
Union Station

Patronage

Patronage projections for the Harbor Freeway Corridor supplied by Caltrans indicate total daily transit boardings of 135,000, with 7300 passengers per hour at the maximum load point in the peak hour. Projected peak hour directional passenger volumes are summarized in Table 15.[14]

Train Performance Estimates

Estimates of ICTS train performance were made, reflecting the extension of the line to Ports of Call. In addition, these estimates reflected the following:

(1) Operation under peak conditions with a full seated and standing load of 85 passengers per car;
(2) 3 cars per train (2 powered), reflecting the train length restriction imposed by 150 foot platforms specified for the LADPM;
(3) Use of a maximum speed of 60 mph, except where curves would require speed restriction;

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(14) Subsequent to the development of these estimates, it was decided by Caltrans to extend the line to Ports-of-Call.

Table 15

PEAK HOUR DIRECTIONAL PASSENGER VOLUMES

HARBOR FREEWAY GUIDEWAY

BETWEEN STATIONS	NUMBER OF PASSENGERS CARRIED NORTHBOUND (A.M.) SOUTHBOUND (P.M.)	SOUTHBOUND (A.M.) NORTHBOUND (P.M.)	TWO-WAY TOTAL
San Pedro and Pacific Coast Highway	863	370	1,233
Pacific Coast Highway and Carson	1,288	551	1,839
Carson and Artesia	1,968	845	2,813
Artesia and Rosecrans	2,259	971	3,230
Rosecrans and Century Freeway	2,427	1,041	3,468
Century Freeway and Manchester	5,642	2,620	8,262
Manchester and Slauson	6,518	2,794	9,312
Slauson and Coliseum (Exposition Blvd.)	6,888	2,952	9,840
Coliseum and Convention Center	7,286*	3,122*	10,408*
Convention Center and Seventh/Figueroa	5,535	3,114	8,649
Seventh/Figueroa and Fifth/Figueroa	3,034	2,289	5,323
Fifth/Figueroa and Library	1,861	1,861	3,722
Library and Pershing Square	2,063	2,365	4,428
Pershing Square and Hill Street	2,242	2,846	5,090
Hill Street and Civic Center	1,928	3,458	5,386
Civic Center and Little Tokyo	1,700	3,968	5,668
Little Tokyo and Union Station	1,763	4,113	5,876

Source: Caltrans interpretation of LARTS projections combined with DPM patronage projections by WSA staff.

* Maximum load point of corridor

(4) Car characteristics as specified in Chapter I of this report. All axles would be powered on single cars. For married pairs, one car would be powered on all axles and one with no power.
(5) Operation during off-peak periods of individual married pairs carrying a seated load of 35 passengers; half of the axles in these trains would be powered.
(6) Initial acceleration rates of about 2 mphps, and balancing speeds of 80 mph for the peak trains and 65 mph for off-peak trains.

Based on these assumptions, train performance calculations (Tables 16 and 17) indicated that average commercial speeds would be about 37 miles per hour.

Operating Plan - Full Service (Alternative A-4a)

In addition to conditions outlined above, other basic assumptions made in developing ICTS operating plans were as defined at the beginning of this chapter. It was assumed that standees would be permitted in peak periods only. All off-peak riders would be provided a seat. ICTS car capacity was assumed as 32 seated and 53 standees for a total of 85. Standee capacity was estimated based on an allowance of 4 square feet per standing passenger as discussed in Chapter I.

To satisfy estimated demand at the maximum load point, the ICTS system would begin operation at 5:00 AM at a headway of 5 minutes. The headway would drop to 3-1/2 minutes at 6 AM and to 2 minutes for the peak hour between 7 and 8 AM. After the peak hour, the headway would increase to 3 minutes, where it would remain until 4:00 PM.

At 4:00 PM the evening peak hour would begin, reducing the headway to 2 minutes until 5:00 PM. In the post-peak PM shoulder periods, the headway would change to 3 minutes until 6:00 PM,

Table 16

TRAIN PERFORMANCE

ICTC (SI TERMINUS SB 03 DEC 81

PASSENGER STATION	MAX SPEED REACHED (MPH)	RUN TIME (MIN)	AVERAGE RUN SPEED (MPH)	DWELL TIME (SEC)	AVERAGE LINK SPEED (MPH)
UNION	0.0	0.00	0.0	0	0.0
LITTLE TOKYO	47.8	1.08	33.2	20	25.4
CIVIC CENTER	29.8	0.80	16.7	20	11.8
HILL STREET	31.6	0.95	23.1	20	17.1
PERSHING SQUARE	20.7	0.90	17.0	20	12.4
LIBRARY	33.9	0.58	21.8	20	13.6
5TH STREET	16.4	0.88	13.5	20	9.0
7TH STREET	41.9	0.60	24.4	20	15.7
CONVENTION CTR	57.2	1.02	37.2	20	28.0
SANTA BARBARA AV	60.0	2.85	48.6	20	43.5
SLAUSON AVE	61.0	1.75	44.0	20	37.0
MANCHESTER BLVD	60.0	2.98	49.8	20	44.8
CENTURY FREEWAY	61.0	2.42	48.2	20	42.4
ROSECRANS	60.0	2.52	46.0	20	40.0
ARTESIA BLVD	60.0	2.43	48.1	20	42.3
CARSON ST	60.0	3.03	50.2	20	45.2
PACIFIC COAST HY	60.0	3.00	51.7	20	47.6
CHANNEL STREET	60.0	3.35	48.2	20	43.8
PORTE OF CALL	56.9	2.68	37.9	20	33.7

DEPARTURE-ARRIVAL TIME = 40.48 MINUTES

TOTAL TRIP LENGTH = 25 MILES

AVG. COMMERCIAL SPEED = 37 MPH

ENERGY CONSUMPTION:

KWH/REVENUE CAR-MILE = 3.08

MOTOR CURRENTS:

RMS ARMATURE CURRENT = 237 AMPERES
RMS FIELD CURRENT = 183 AMPERES
RMS MOTOR RATING = 300 AMPERES

Table 17

TRAIN PERFORMANCE

ICTS P&C TERMINUS NB 03 DEC '81

PASSENGER STATION	MAX SPEED REACHED (MPH)	RUN TIME (MIN)	AVERAGE RUN SPEED (MPH)	DWELL TIME (SEC)	AVERAGE LINK SPEED (MPH)
PORTS OF CALL	0.0	0.00	0.0	0	0.0
CHANNEL STREET	55.9	2.78	36.5	20	32.6
PACIFIC COAST HY	60.0	3.32	45.7	20	44.2
CARSON ST	60.0	3.98	53.0	20	47.9
ARTESIA BLVD	60.0	3.10	49.1	20	44.4
ROSECRANS	60.0	2.48	47.8	20	42.0
CENTURY FREEWAY	60.0	2.46	46.6	20	41.1
MANCHESTER BLVD	60.0	2.47	47.3	20	41.6
SLAUSON AVE	60.0	2.02	49.0	20	44.1
SANTA BARBARA AV	59.5	1.78	43.2	20	36.4
CONVENTION CTR	60.0	2.07	45.2	20	40.7
7TH STREET	30.9	1.10	34.4	20	26.4
5TH STREET	26.5	0.80	24.6	20	16.5
LIBRARY	21.3	0.76	14.8	11	10.0
PERSHING SQUARE	26.7	0.42	30.5	20	16.5
MILL STREET	22.2	0.78	19.6	20	13.7
CIVIC CENTER	32.0	0.95	23.1	20	17.1
LITTLE TOKYO	21.5	0.78	17.1	20	12.0
UNION	41.1	1.33	27.0	20	21.6

DEPARTURE-ARRIVAL TIME = 40.79 MINUTES

TOTAL TRIP LENGTH = 25 MILES

AVG. COMMERCIAL SPEED = 36.7 MPH

ENERGY CONSUMPTION:

KWH/REVENUE CAR-MILE = 3.47

MOTOR CURRENTS:

RMS ARMATURE CURRENT	=	247	AMPERES
RMS FIELD CURRENT	=	168	AMPERES
RMS MOTOR RATING	=	300	AMPERES

then increase to 3-1/2 minutes until 9:00 PM. In the late evening (9:00 PM - 12:00 PM), the headway would be 8 minutes.

In order to accommodate peaking within the peak hour, 2 three-car trippers would be run in each peak hour. This would reduce average peak-hour headways to slightly less than 2 minutes.

Round-trip route mileage for the ICTS option in the Harbor Freeway Corridor is 50.0 miles. Total running time, including average 20-second dwell times at all stations, was estimated to be 81 minutes. Running time was based on operation of 3-car trains, two powered, carrying 85 passengers per car. All trains would be powered from both ends, so that turnbacks could be accomplished using a switchback arrangement. At least three minutes was allotted for directional reversal at each end of the line.

The estimated running time reflects an average of 20 seconds of dwell time at each station. A separate analysis of probable station-specific dwell times was conducted to confirm the assumed 20-second average. This analysis was based on estimated platform level boardings and station passenger volumes. The result was an estimated average dwell of approximately 15 seconds for the ICTS alternative. In light of this analysis, the assumed 20-second dwell time was viewed as conservative, and was used throughout the operational analysis.

All ICTS trains were assumed to run between Union Station and Ports of Call, stopping at all stations throughout the day. A maximum of 120 cars would be required on line at one time. Allowing for 15% spares, the total fleet requirement would be 138.

Applying these principles, the resulting operating statistics associated with the Harbor ICTS option are as presented in Table 18.

Table 18

ICTS ALTERNATIVE-FULL SERVICE PLAN
OPERATING STATISTICS SUMMARY
HARBOR FREEWAY CORRIDOR

Item	
Minimum Cycle Time, min.	83
Peak Headway, min.	2
Base Headway, min.	3
Average Speed, mph.	39
Corridor Route-Miles.	25
Fleet Size.	138
Annual Train-Hours (thousands).	154.9
Annual Car-Miles (millions).	16.54
Annual Passenger-Space-Miles (millions).	795.9
Annual Passengers (millions).	40.6
Annual Gross Ton-Miles (millions).	352.8

Bus Feeder Plan For ICTS Alternative

The ICTS Alternative would be fed by the bus feeder services listed in Table 19.

Table 19
FEEDER BUS PLAN FOR ICTS ALTERNATIVE
HARBOR FREEWAY CORRIDOR

	Route Type	Bus Type	Bus Miles			Bus Hours	Peak Bus Required
			Freeway	Surface	Total		
442X	Freeway Transit	Artic	628	2,450	3,068	210.1	20
444	Century Feeder	Artic	2,312	2,040	4,352	229.3	27
448	Feeder	ADB	---	1,104	1,104	87.3	7
449	Feeder	ADB	---	983	983	62.8	4
750	Century Feeder	Artic	98	4,101	4,199	134.9	18
755	Feeder	ADB	457	421	878	45.6	6
813	Feeder	ADB	283	2,407	2,690	139.1	8
814	Feeder	ADB	---	888	888	46.7	6
G1	Feeder	ADB	---	695	695	59.5	6
T1	Feeder	ADB	---	378	378	30.9	3
T2	Feeder	ADB	---	387	387	32.5	3
		Subtotal ADB	740	7,263	8,003		
		Subtotal Artic	3,078	8,591	11,629		
			3,788	15,854	19,632		

ALTERNATIVE A-4b
ICTS OPERATING PLAN
WITH TURNBACKS AT ARTESIA
HARBOR FREEWAY CORRIDOR

Alternative A-4a represented a "full service" operating plan for ICTS in the Harbor Corridor. Alternative A-4b is an alternative operational configuration that would include provision for reversing trains at Artesia. Service south of Artesia would only be provided as ridership or policy headways would dictate. All basic assumptions made were the same as those made in developing the full service plan except as indicated below.

Operating Plan

The Harbor Corridor ICTS option involving selective reversal of trains at Artesia would operate between terminal stations at Ports-of-Call and Union Station in downtown Los Angeles. Between Union Station and the Convention Center the ICTS option would operate on the Downtown People Mover alignment, restricting train lengths to three 52-foot cars.

Patronage estimates provided for the Harbor ICTS alternative indicate total daily transit boardings of 135,000. The maximum load point between Ports-of-Call and Union Station would be located on the link between stations at the Coliseum and Convention Center. The maximum load volume on this link was given to be 7,300 riders.

To analyze opportunities for turnbacks at Artesia, maximum load point links were estimated for sections of line between Ports-of-Call and Artesia, and Artesia and Union Station. These estimates were prepared using information supplied by CalTrans, and indicate maximum load point volumes of 1,970 riders on the link between Carson and Artesia for the segment south of Artesia. North of Artesia the maximum load point link would be

located between stations at Coliseum and Convention Center. The directional volume on this link is shown as 7,300 riders in the peak hour.

To satisfy estimated demand at the maximum load point on the section between Artesia and Ports-of-Call, the system would begin operation at 5 AM at a headway of 20 minutes. The headway would decrease to 12 minutes at 6 AM for the beginning of peak-period service. During the peak hour between 7 AM and 8 AM, 8-1/2 minute headways would accommodate estimated ridership at the maximum load point.

At 8 AM, 10-minute service intervals would begin and continue to the start of the evening peak hour, when frequency would increase to every 8-1/2 minutes between 4 and 5 PM. At 5 PM, headways would increase to 10 minutes until 6 PM, when off-peak early evening service would begin. Between 6PM and 9PM, service between Artesia and Ports-of-Call would operate at 12-minute headways. After 9 PM, trains would operate every 30 minutes until midnight. All trains would run between Ports-of-Call and Union Station in downtown Los Angeles

To accommodate peaking within the peak hour on the segment between Artesia and Ports-of-Call, one 3-car tripper would operate in the peak hour.

To satisfy estimated demand at the maximum load point for the northern segment between Union Station and Artesia, operations would occur at 6-minute headways. At 6 AM, the headway would drop to 4-1/2 minutes. During the peak hour between 7AM and 8 AM trains would operate every 3 minutes to accommodate forecast ridership. In the midday, trains would operate between Artesia and Union Station every 3-1/2 minutes. For the evening peak hour between 4 PM and 5 PM, headways would be 3 minutes.

During the afternoon post-peak shoulder, headways of 4 minutes would accommodate estimated ridership. During the early evening between 6 PM and 9 PM, 4-1/2 minute headways would suffice between 9 PM and midnight.

In order to accommodate the peak 20 minutes within the peak hours, three 3-car trains would operate as peak hour trippers, between Artesia and Union Station. All ICTS trains operating on the Harbor Freeway guideway would have three car consists.

The trains operating between Ports-o-Call and Union Station would reduce the headway intervals on the Artesia to Union Station segment. Headways are volume-based, however, the trains operating northbound from Ports-o-Call would be generally filled at Artesia. Thus, capacity need north of Artesia would be met with trains that would turn at Artesia.

Round trip route mileage for the Harbor ICTS option between Ports-of-Call and Union Station is 50 miles. Total running time, including average 20-second dwell times at stations, was estimated to be 81 minutes. All trains would be powered from both ends, so that turnbacks could be accomplished using a switchback arrangement.

Round trip route mileage for the ICTS option between Artesia and Union Station is slightly more than 29 miles. The running time on this segment is estimated to be 53 minutes. At least 3 minutes has been allotted for directional reversal at each segment terminus.

A maximum of 102 cars are required on line at one time. Allowing for 15 percent spares, the total fleet requirement would be 119.

Applying these principles, estimates of operating statistics

associated with the Harbor ICTS option with turnbacks at Artesia were delivered on an annual basis as shown in Table 20.

Table 20

OPERATING STATISTICS SUMMARY
ICTS OPERATING PLAN WITH TURNBACKS
Harbor Freeway Corridor

Item	North of Artesia	South of Artesia
Minimum Cycle Time, min.	59	87
Peak Headway, min.	3	8.5
Base Headway, min.	3.5	10
Average Speed, mph.	33	39
Corridor Route-Miles	14.6	25
Fleet Size	118	
Annual Train-Hours (thousands)	139.9	
Annual Car Miles (millions)	12.63	
Annual Passenger-Space-Miles (millions)	608.8	
Annual Passengers (millions)	40.6	
Annual Gross Ton-Miles (millions)	282.4	

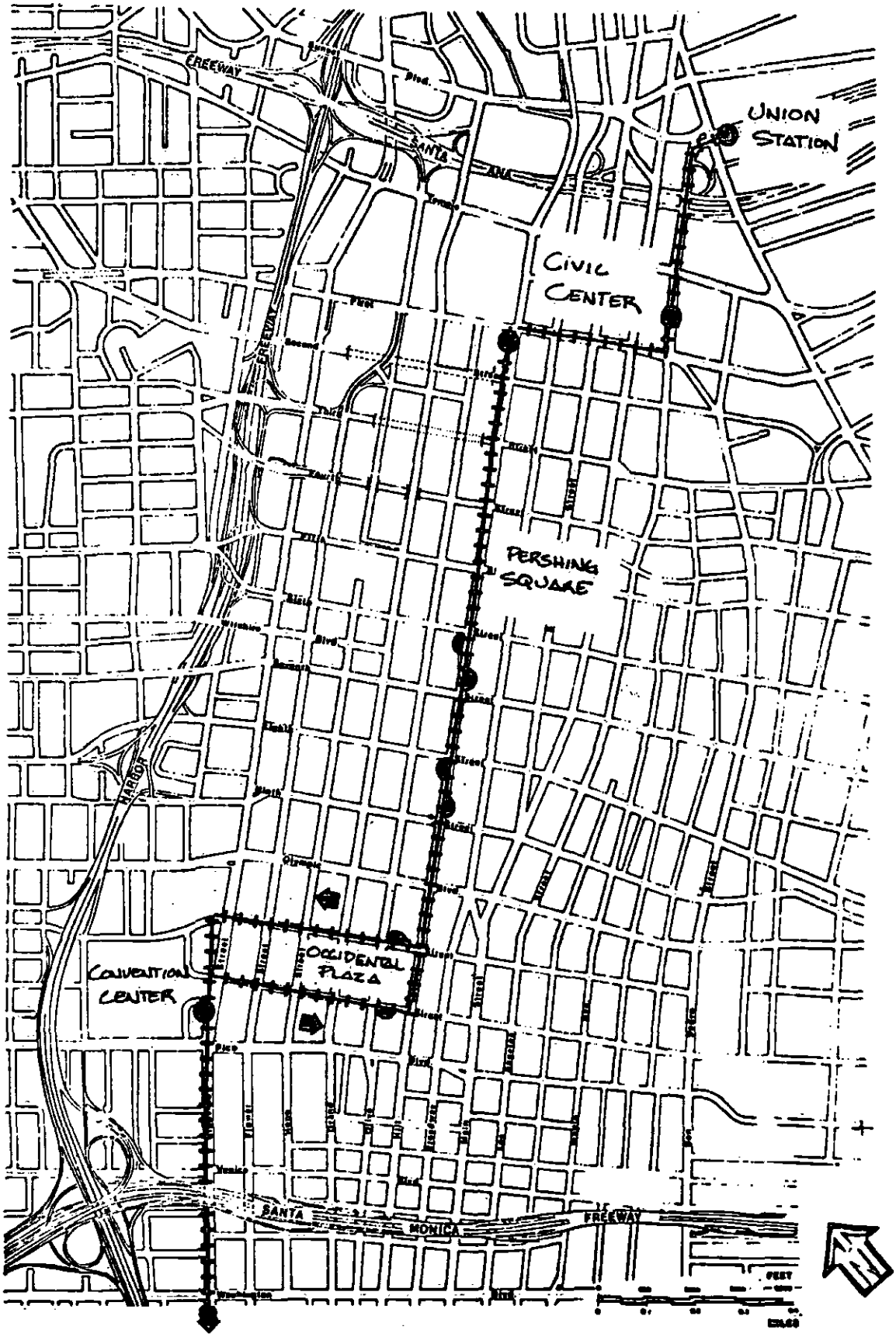
ALTERNATIVE A-5a
LRT OPERATING PLANS - FULL SERVICE
AT-GRADE IN CBD
HARBOR FREEWAY CORRIDOR

Originally, it was assumed that the light rail transit option for the Harbor Freeway Corridor would operate over the same San Pedro-Union Station route as the ICTS option as originally defined. Operations in downtown Los Angeles would be conducted at grade along the route shown in Figure 12. The at-grade segments would be located in exclusive rights-of-way, permitting operation at prevailing speed limits (25 mph, reduced as necessary at curves, steep grades and stations) without traffic interference. It was also assumed that arrangements would be made for provision of priority access through street intersections, using traffic signal preemption.

Longer train lengths would be available to the light rail alternative, as the only restriction would be the downtown block lengths. Maximum train lengths were established at three cars, or approximately 225 feet, for the purposes of this preliminary analysis.

Round-trip travel time for this light rail option was estimated to be about 83 minutes. Allowing for turnback time, minimum cycle time would be approximately 90 minutes. The lower cycle time of the ICTS car was due primarily to its higher accelerative capability.

Headways of 4 minutes in the peak, 6 minutes during the base and early morning, 8 minutes in the early evening and 20 minutes in the late evening would be required to accommodate the estimated 135,000 daily riders. Three-car trains would be used throughout.



Assumed At-Grade LRT Routing
Los Angeles Central Business District

Wilbur Smith & Associates

Figure 12

Given the need to operate 3-car trains, initial performance calculations using trains of 3 powered cars, were re-examined. The new estimates indicated a slightly longer round-trip running time of 84 minutes. This variance was not considered significant, however, and could be accommodated within the 90-minute cycle time already identified.

A fleet of 69 vehicles would be required for peak-period operations with this plan. Adding an allowance of 15 per cent for spares yielded a total estimated fleet of 80.

Table 21 presents a comparison of estimated weekday operating statistics expressed on an equivalent annual basis for the light rail alternative in the Harbor Corridor.(15)

Table 21
Operating Statistics Summary
Preliminary (At-Grade) LRT Concept
Harbor Freeway Corridor

Estimated Operating Statistics	LRT
Minimum Cycle Time, min.	90
Peak Headway, min.	4
Base Headway, min.	6
Average Speed, mph.	32
Annual Revenue Train-Hours (thousands)	77.0
Annual Revenue Car-Miles (millions)	6.88
Annual Passenger-Space-Miles (millions)	777.7
Annual Passengers (millions)	308.1
Corridor Route-Miles	22.7
Fleet Size	80

(15) An annualization factor of 250 was used for these preliminary analyses, whereas a factor of 308 was adopted for all subsequent calculations.

ALTERNATIVE A-5b
LRT OPERATING PLAN - FULL SERVICE
GRADE SEPARATED
HARBOR FREEWAY CORRIDOR

Subsequent to completion of the preliminary analysis described above, instructions were received to assume that the LRT line would originate at Ports-O-Call and terminate at Seventh Street at the outer edge of the Los Angeles CBD, where a vertical transfer with the Wilshire line and a downtown bus shuttle would be available. For this concept, design year demand was projected at 84,000 boardings per day, with 6,700 passengers per hour in the peak direction at the maximum load point between the Coliseum and Convention Center Stations.

Use of 4-car trains for this alternative was assumed.

Round-trip travel time for this version of the light rail option was estimated to be 67 minutes. Allowing for turnback time, minimum cycle time would be approximately 73 minutes. Light rail running time estimates were based on the assumed consist of 4 cars per train carrying 154 passengers per car. All cars would be powered.

Headways of 5-1/2 minutes in the peak, 15 minutes during the base and early evening, 25 minutes in the early morning and 30 minutes in the late evening would be required to accommodate the estimated daily ridership. Four-car trains would be used throughout, except in the early morning and late evening, where 3-car trains would suffice.

A fleet of 56 vehicles would be required for peak-period operations. Adding an allowance of 15% for spares yielded a total estimated fleet of 65.

The initial analysis of this light rail option assumed that all trains would run between Ports-O-Call and Seventh Street, making all stops. The stations included in this analysis

ALTERNATIVE A-5b
LRT OPERATING PLAN - FULL SERVICE
GRADE SEPARATED
HARBOR FREEWAY CORRIDOR

Subsequent to completion of the preliminary analysis described above, instructions were received to assume that the LRT line would originate at Ports-O-Call and terminate at Seventh Street at the outer edge of the Los Angeles CBD, where a vertical transfer with the Wilshire line and a downtown bus shuttle would be available. For this concept, design year demand was projected at 84,000 boardings per day, with 6,700 passengers per hour in the peak direction at the maximum load point between the Coliseum and Convention Center Stations.

Use of 4-car trains for this alternative was assumed.

Round-trip travel time for this version of the light rail option was estimated to be 67 minutes. Allowing for turnback time, minimum cycle time would be approximately 73 minutes. Light rail running time estimates were based on the assumed consist of 4 cars per train carrying 154 passengers per car. All cars would be powered.

Headways of 5-1/2 minutes in the peak, 15 minutes during the base and early evening, 25 minutes in the early morning and 30 minutes in the late evening would be required to accommodate the estimated daily ridership. Four-car trains would be used throughout, except in the early morning and late evening, where 3-car trains would suffice.

A fleet of 56 vehicles would be required for peak-period operations. Adding an allowance of 15% for spares yielded a total estimated fleet of 65.

The initial analysis of this light rail option assumed that all trains would run between Ports-O-Call and Seventh Street, making all stops. The stations included in this analysis

were as follows:

Harbor LRT Stations
Seventh Street
Convention Center
Santa Barbara Avenue
Slauson Avenue
Manchester Boulevard
Century Freeway
Rosecrans Avenue
Artesia Boulevard
Carson Street
Pacific Coast Highway
Channel Street
Port-O-Call

Table 22 presents the estimated operating statistics for the fully grade separated version of the light rail alternative.

Table 22
Operating Statistics Summary
LRT Alternative A-5b
Harbor Freeway Corridor

Item	
Minimum Cycle Time, min.	73
Peak Headway, min.	5.5
Base Headway, min.	15
Average Speed, mph.	42
Corridor Route-Miles.	22.9
Fleet Size.	65
Annual Revenue Train-Hours (thousands).	41.2
Annual Revenue Car-Miles (millions).	5.64
Annual Passenger-Space-Miles (millions).	648.3
Annual Passengers (millions).	25.3
Annual Gross Ton-Miles (millions).	268.2

Downtown Distribution and Feeder Plan for Harbor Freeway LRT

To provide service through downtown to Union Station and to ensure comparibility with all-bus alternatives, a shuttle route was devised for downtown distribution of persons desiring to travel beyond the Seventh Street terminus with this LRT alternative.

The routing assumed for the downtown distribution bus was based on two factors: (1) policy established in Technical Memorandum No. 6, LACBD Bus and LRT At-Grade Routing Assumptions, and, (2) current operational practice in downtown Los Angeles.

The primary shuttle bus routing in the downtown area was assumed to be along Olive Street. However, since the LRT terminates on Figueroa Street four blocks to the west, a jog was required to make the transition from the LRT Figueroa alignment to the desired Olive Street bus alignment. In order to avoid undesirable left turns or other operational problems, the LRT terminus loop of the shuttle bus was modeled after the current routing of Wilshire line lines between Figueroa and Olive.

The assumed routing of the downtown distributor bus was defined as follows: From the LRT terminus at Figueroa and Seventh, the bus would proceed north on Figueroa, east on Wilshire, north on Flower, east on Sixth, north on Olive to First Street. From Olive and First, the route would continue east on First, thence north on Los Angeles, to Union Station. Return routing would be via Los Angeles, First, and Seventh to the LRT terminus.

Level of Service of Downtown Shuttle - In order to provide an appropriate level of service on the downtown shuttle, two factors were devised based on available patronage data. The first factor was based on the relationship between patronage arriving at Seventh Street and patronage at the maximum load

point of an LRT line. Available patronage forecasts indicated that 74 percent of the projected patronage at the maximum load point on a Harbor Corridor LRT would continue at least as far as Seventh Street. The second factor was devised to estimate how many of those patrons arriving at Seventh Street were "through" patrons (i.e. would remain on the LRT line if it continued further through downtown). It was estimated that 70 percent of the LRT patronage south of Seventh Street would use the line north of Seventh Street. This factor was derived by taking daily patronage south of Seventh Street, subtracting the northbound offs and southbound ons, and adding in the northbound ons and the southbound offs. (These last two components tend to give a conservative bias to the factor since some patrons with both origin and destination north of Seventh Street would use other SCRTD lines or modes in the absence of LRT service.)

Combining the factor 74 percent and 70 percent yielded a factor of 52 percent (.52). Since LRT level of service is tailored to maximum load point demand, required capacity of the downtown distributor shuttle was assumed to be 52 percent of LRT capacity for any given time of day. During the peak hour, for example, LRT service requirements were estimated at eleven four-car trains. Assuming a capacity of 154 passengers per car, this amounts to a capacity of 6,776 persons per hour. Multiplying 6,776 by .52 yields 3,524 passengers requiring shuttle service. Assuming an ADB capacity of 66 passengers, this amounts to a shuttle bus requirement of 54 trips per hour. Given a round trip time (including recovery time) of 32 minutes for this short route, this demand can be met with 29 ADB's. Bus requirements for other times of the day were calculated in a similar manner, always assuming service for 52 percent of the maximum load point patronage on the LRT. Operating statistics for the Downtown LRT shuttle are contained in Table 23.

Table 23

FEEDER/DOWNTOWN DISTRIBUTION PLAN FOR HARBOR LRT ALTERNATIVE

	Route Type	Bus Type	Bus Miles			Bus Hours	Peak Bus Required
			Freeway	Surface	Total		
442X	Freeway Transit	Artic	628	2,450	3,068	210.1	20
444	Century Feeder	Artic	2,312	2,040	4,352	229.3	27
448	Feeder	ADB	---	1,104	1,104	87.3	7
449	Feeder	ADB	---	983	983	62.8	4
750	Century Feeder	Artic	98	4,101	4,199	134.9	18
755	Feeder	ADB	457	421	878	45.6	6
813	Feeder	ADB	283	2,407	2,690	139.1	8
814	Feeder	ADB	---	888	888	46.7	6
G1	Feeder	ADB	---	695	695	59.5	6
T1	Feeder	ADB	---	378	378	30.9	3
T2	Feeder	ADB	---	387	387	32.5	3
	Downtown Shuttle	ADB	---	2,699	2,699	301.0	29
		Subtotal ADB	740	9,962	10,702		
		Subtotal Artic	3,078	8,591	11,629		
			3,788	18,553	22,331		

Feeder Bus Plan - The LRT alignment in the Harbor Freeway Corridor can be fed by a set of feeders similar to those previously defined for the all-bus trunk line with feeders ("rail-like") plan, with some minor revisions. Table 23 defines the feeders plan for the Harbor Freeway LRT Alternative.

The major differences between the feeder plans for busway and LRT alternatives are in the routings of lines 755 and 448. Line 755, which connects East Long Beach Park-and-Ride to the Rosecrans busway station, was rerouted via Carson Boulevard to the Carson LRT station. Line 448, which feeds the Pacific Coast Highway (PCH) station, was rerouted slightly to serve the Ports-O-Call station, San Pedro patrons would have a choice of accessing the LRT line at the PCH or Ports-O-Call station depending on where they board the 448 line. Lines 444X and 750, which linked the two termini of the Century Freeway with downtown Los Angeles via the Harbor Freeway Busway were cut back in this plan as feeders to the Century station. These lines, defined herein as "Century Freeway Feeders" were designated 444 and 750 to facilitate comparisons among alternatives; in reality, this feeder function would be accommodated by augmenting headways on one of the Century Freeway Busway through lines. Trunk Line 740, which served the Artesia park-and-ride lot in the all-bus trunk with feeders alternative, was not included in this alternative because Artesia has been designated a station stop; the municipals plus the 813 and -14 SCRTD lines which served Artesia park-and-ride in the all-bus alternative serve this Artesia LRT station directly in this alternative.

Lines 444, 750 and 448 were given demand headways of 29 buses per hour, 26 buses per hour and 7 buses per hour respectively, in the peak hour. All other lines were assigned policy headways of 4 buses per hour except the municipals, for which 2 buses per hour have been assumed. In the off peak period, the Century Freeway lines each provide 8 buses per hour. Lines 813, 449 and

448 were assigned policy headways during the off-peak, while lines 814 and 755 were assumed to have no off-peak service.

All feeder lines were assumed to use ADB's except the two Century Feeders, for which articulated buses were assumed.

ALTERNATIVE A-5c
LRT OPERATING PLAN
WITH TURNBACKS AT ARTESIA
HARBOR FREEWAY CORRIDOR

Alternative A-5b represented a "full service" operating plan for LRT in the Harbor Freeway Corridor. This alternative represents a variation of that plan with turnbacks at Artesia. In both cases, the line would extend from Ports-o-Call to a northern terminus at Seventh Street, where a vertical transfer with the Wilshire HRT lane and surface bus transit would be available. All basic assumptions made in developing this turn-back option were the same as those made for the full-service option except as noted below.

For the full service alternative, total daily boardings of 84,000 were estimated with the maximum load point link between stations at Coliseum and Convention Center, where the peak hour directional volume was forecast to be 6,700.

Using available on-off information, the maximum load point links and volumes for the segments between Ports-o-Call and Artesia, and Artesia and Seventh Street were derived for Alternative A-5c. The maximum load point link for the segment south of Artesia would occur between stations at Artesia and Carson, with a peak-hour directional link volume of 1,810. For the segment morth of Artesia, the maximum load point link would lie between stations at Coliseum and Convention Center, with the directional link volume during the peak hour estimated to be 5,430.

This LRT system would not operate on the Downtown People Mover Guideway, allowing use of longer trains. Four-car maximum train lengths were assumed for this alternative.

Operating Plan

The passenger volume estimates provided for this option

indicate what policy headways would govern service operated between the hours of 5 AM and 6 AM, 9 AM and 3 PM, and 9 PM and midnight. During these periods, trains would operate at headways of 20, 15, and 30 minutes, respectively, over the entire line between Seventh Street and Ports-o-Call, and no turnback service would be provided.

Throughout the peak period, trains originating at Ports-o-Call would operate at 15-minute intervals. These would be supplemented by trains operating between Artesia and Seventh Street at 15-minute intervals, reducing the effective headway during the peak hour between Artesia and Seventh Street to 7-1/2 minutes.

One 4-car peak period tripper would operate between Ports-o-Call and Seventh Street to accommodate the peak 20 minutes within each peak hour.

For the service period between 6 PM and 9 PM, trains would operate between Ports-o-Call and Union Station every 30 minutes, and would be supplemented by trains operating between Artesia and Seventh Street at 30 minute intervals. Thus, the headway between Artesia and Seventh Street would be effectively reduced to 15 minutes for this period.

Trains operating from Ports-o-Call would arrive at Artesia approximately 60 percent loaded. The excess capacity available on these trains was accounted for in determining capacity requirements for the Artesia-Seventh Street segment.

All trains would operate in 4-car consists, except for operations between 5AM and 6 AM on the Ports-o-Call-Seventh Street section, which would have trains operating in 3-car consists.

Round trip travel time for the light rail option between Seventh Street and Ports-o-Call was estimated to be 67 minutes, including an average 20-second dwell time at each station. Allowing for turnback time, minimum cycle time would be approximately 73 minutes. For the Artesia to Seventh Street section of the line, the round-trip travel time would be approximately 37 minutes, increased to 43 minutes to allow for turnbacks at terminals.

There are approximately 22.9 route miles between terminal stations at Ports-o-Call and Seventh Street, and about 12.5 route miles between Artesia and Seventh Street.

Table 24 presents estimated operating statistics for this variation of the light rail alternative.

Table 24

OPERATING STATISTICS SUMMARY
LRT OPERATING PLAN-WITH TURNBACKS
HARBOR FREEWAY CORRIDOR

ITEM	NORTH OF ARTESIA	SOUTH OF ARTESIA
Minimum Cycle Time, min.	43	73
Peak Headway, min.	5.5	8.5
Base Headway, min.	15	15
Average Speed, mph.	39	42
Corridor Route-Miles	12.0	22.9
Fleet Size	65	
Annual Revenue Train Hours (thousands)	37.0	
Annual Revenue Car-Miles (millions)	4.99	
Annual Passenger-Space Miles (millions)	597.7	
Annual Passengers (millions	25.3	
Annual Gross Ton-Miles (millions).	241.1	

ALTERNATIVE A-6a
VERMONT ALIGNMENT (HRT) OPERATING PLAN
FULL SERVICE
HARBOR FREEWAY CORRIDOR

A "full-service" operating plan for rapid transit (HRT) along the Vermont Avenue alignment was developed based on the following key inputs:

(1) Guideway location, vertical profile data and station locations provided by Caltrans;
(2) Patronage projections from a 1981 SCRTD report "Patronage Impact of Possible Future Line Extensions"; and
(3) Train performance characteristics drawn from specifications of the Baltimore/Miami rapid transit car.

Route Length and Station Locations

As with all other alternatives, it was assumed that trains would operate between terminals at Union Station in downtown Los Angeles and Ports -O- Call in San Pedro, a distance of 24.3 miles. There would be 19 stations as listed below:

Union Station
First & Broadway
Fifth & Broadway
Olympic & Broadway
Convention Center
Adams & Figueroa
Jefferson
Santa Barbara
Slauson
Manchester
Imperial
Rosecrans

Artesia
I-405
Carson
Sepulveda
Pacific Coast Highway
Channel Street
Ports -O- Call

Patronage

The operating plan was developed assuming total daily boardings in 1995 of 147,000, with the maximum load point link between stations at Pico and Olympic. The total daily volume on the maximum load point link was assumed to be 66,970. To estimate the peak hour volume at the maximum load point, the following assumptions were made:

1) Peak-hour link volumes would maintain the same proportional relationship among links as the total daily volumes.
2) The ratio of the peak-hour line volume to the total daily line volume will be the same as the ratio of the peak-hour link volume to the total daily link volume.
3) The peak-period directional split would be 70/30.

Applying these assumptions resulted in a total peak-hour directional volume at the maximum load point of 7,500 riders.

Other Policy Assumptions

The operation was sized assuming that standees would be permitted in peak periods only. In off-peak periods, all riders would be provided a seat. Vehicle passenger capacity was as specified in Table 1, Chapter I. The capacity for heavy rail equipment was taken as 74 seated and 115 standees, for a total of 189.

Assumptions regarding policy headways, hours of service, yard and service facility location, peaking within the peak hour and temporal distribution were as described for development of other alternatives. For example:

1) Operations would be conducted 19 hours daily between the hours of 5:00 AM and midnight.
2) Service would be volume-based, but not to exceed policy service intervals established as follows:

Period	Maximum Policy Headway (minutes)
Early Morning	20
Peak Periods	15
Midday	15
Evening and Night	30

3) Sizing periods have been defined by others to include peak periods of three hours.
4) A yard and service facility would be located near the midpoint of the line. An appropriate allowance for deadhead (non-revenue) train-miles was included to reflect this choice. Selection of an alternative location should not significantly change the non-revenue mileage operated.
5) Peak-hour operations were sized to absorb the peak 20 minutes within the peak hour through the use of trippers. The peak 20-minute passenger volume has been assumed to exceed the average 20-minute volume in the peak hour by 25%.
6) The temporal distribution of total daily ridership was based on current El Monte Busway experience, as follows:

Time of Day	% of Daily Boardings
Early morning (5:00 - 6:00 AM)	2.0
Morning pre-peak shoulder (6:00 - 7:00 AM)	8.0
Morning peak hour (7:00 - 8:00 AM)	15.0
Morning post-peak shoulder (8:00 - 9:00 AM)	7.0
Mid-day period (9:00 AM - 3:00 PM)	24.0
Evening initial peak shoulder (3:00 - 4:00 PM)	7.0
Evening pre-peak shoulder (4:00 - 5:00 PM)	10.0
Evening peak (5:00 - 6:00 PM)	13.0
Early evening (6:00 - 9:00 PM)	10.0
Late evening (9:00 - 12:00 PM)	4.0
	100.0

7) The above temporal distribution was adopted except in the evening peak period. It was assumed that the evening peak hour would represent 15% (same as morning peak hour) of total daily travel, to be consistent with the procedure used for other alternatives. The temporal distribution also was revised to include a pre-peak shoulder in the evening. The respective percentages of daily travel for each of these periods were 7% for the pre-peak and 10% for the post-peak.

Simulation of Vermont Profile/Alignment

Performance simulation estimates were made for both the northbound and southbound directions using the profile/alignment information provided by Caltrans for the Vermont HRT Alternative. The runs were made assuming the use of six cars per train, all powered, operating under peak conditions with a full seated and standee load of 189 passengers per car. A maximum speed of 70 mph was used, except where restrictions were required to negotiate curves.

The results of the simulation estimates indicated that the average speed of 37.7 mph does not vary with direction.

Operating Plan

Round-trip route mileage would be 48.6 miles. Total running time, including average 20-second dwell times at all stations, was estimated to be 78 minutes. Performance estimates were based on operation of 6-car trains, all powered. Trains would be powered from both ends, simplifying turnback operations.

To accommodate passenger volumes at the maximum load point, operations would begin at 5:00 AM with 20-minute headways. At 6:00 AM, the headway would shorten to 15 minutes until 7:00 AM, when it would decrease to 10 minutes for the peak hour. Between 8:00 AM and 4:00 PM, headways would be 12 minutes.

At 4:00 PM, trains would operate at 10-minute headways for the afternoon peak hour. At 5:00 PM, the headway would increase to 12 minutes until 6:00 PM, when it would increase to 15 minutes until 9:00 PM. For late evening service (9:00 PM to midnight), headways would be 30 minutes.

To absorb volumes during the peak 20 minutes of the peak hour, one 5-car tripper would operate.

Station platforms were projected to be 500 feet long. This restricts train lengths to 6, 75-foot vehicles. During early morning (5:00-6:00 AM) and the late evening (9:00 PM-midnight) service periods, trains would operate in 5-car consists. For the remainder of the day, 6 cars per train would be required.

A maximum of 53 cars would be required on line at one time. Allowing for 15% spares, the total fleet requirement would be 61.

Based on these principles, operating statistics for the Vermont rapid transit option would be as summarized below in Table 25.

Table 25

OPERATING STATISTICS SUMMARY

(HRT ALTERNATIVE)

HARBOR FREEWAY CORRIDOR

Item	
Minimum Cycle Time, min.	84
Peak Headway, min.	10
Base Headway, min.	12
Average Speed, mph.	38
Corridor Route-Miles	24
Fleet Size.	61
Annual Train-Hours (thousands).*	32.2
Annual Car-Miles (millions).*	6.4
Annual Passenger-Space-Miles (millions).*	731.5
Annual Passengers (millions).*	37.5
Annual Gross Ton-Miles (millions).*	292.0

* Based on annualization factor of 255.

Bus Feeder Plan For Vermont HRT Alternative

The Vermont HRT Alternative can be fed by a bus feeder plan identical to the LRT bus feeder plan minus the downtown distribution shuttle. Table 26 recapitulates the feeder portion of this plan.

Table 26

FEEDER PLAN FOR VERMONT HRT

	Route Type	Bus Type	Bus Miles Freeway	Bus Miles Surface	Bus Miles Total	Bus Hours	Peak Bus Required
442X	Freeway Transit	Artic	628	2,450	3,068	210.1	20
444	Century Feeder	Artic	2,312	2,040	4,352	229.3	27
448	Feeder	ADB	---	1,104	1,104	87.3	7
449	Feeder	ADB	---	983	983	62.8	4
750	Century Feeder	Artic	98	4,101	4,199	134.9	18
755	Feeder	ADB	457	421	878	45.6	6
813	Feeder	ADB	283	2,407	2,690	139.1	8
814	Feeder	ADB	---	888	888	46.7	6
G1	Feeder	ADB	---	695	695	59.5	6
T1	Feeder	ADB	---	378	378	30.9	3
T2	Feeder	ADB	---	387	387	32.5	3
		Subtotal ADB	740	7,263	8,003		
		Subtotal Artic	3,078	8,591	11,629		
			3,788	15,854	19,632		

SUPPLEMENTAL FEEDER SERVICE TO LINE HAUL SERVICES IN THE HARBOR FREEWAY CORRIDOR

Each of the transit plans described in above sections contains a feeder element designed to conect line-haul services with park-and-ride sites and other concentrations of potential patrons. Other feeder service will be provided by cross corridor lines in the assumed "background" service (i.e., existing routes unaffected by the various transit plans presented herein). However, since the amount of reserve capacity which will exist in these lines in 1990 is unknown, it was assumed for purposes of this analysis that the existing service levels on these lines would have no reserve capacity to perfrom feeder functions. Consequently, a supplemental feeder plan was developed for each alternative based on increments to existing cross-corridor lines.

Table 27 through 31 define the supplemental feeder service required to fully serve projected transit access patronage at each transit station under each alternative. Service levels are based on mode-of-access station volumes provided by Caltrans, and routes are defined as service increments ("trippers") on existing routes or portions thereof.

Table 27

SUPPLEMENTARY FEEDER SERVICE

Harbor Freeway Corridor

TWO-WAY BUSWAY

Served	Line	Area Served	Pk Hr Buses/ Hour	Daily Trips	Peak Buses Req'd	Daily Bus Miles	Daily Bus Hours
Santa Barbara	18A	Crenshaw to Alameda	7	48[1]	11	984.0	95.6
Slauson	828A	Crenshaw to Alameda	2	12	3	244.8	19.0
Manchester	832A	Crenshaw to Alameda	4	24	5	468.0	39.8
Artesia	846A	Harbor to Alameda	3	18	3	313.2	21.9
Carson	849A	Harbor to Alameda	4	24	3	30010	24.6
PCH	873A	Harbor to Long Beach Terminal	2	12	4	372.0	30.0
San Pedro	841A	Harbor to Long Beach Freeway	4	24	5	516.0	39.8
	T O T A L				34	3,198.0	270.7

[1] Includes one extra bus/hour midday

Table 28

SUPPLEMENTARY FEEDER SERVICE

Harbor Freeway Corridor

REVERSIBLE LANE BUSWAY

Served	Line	Area Served	Pk Hr Buses/ Hour	Daily Trips	Peak Buses Req'd	Daily Bus Miles	Daily Bus Hours
Santa Barbara	18A	Crenshaw to Alameda	5	36[1]	8	720.0	70.8
Slauson	828A	Crenshaw to Alameda	2	12	3	244.8	19.0
Manchester	832A	Crenshaw to Alameda	4	24	5	468.0	39.8
Artesia	846A	Harbor to Alameda	2	12	2	208.8	14.6
Carson	849A	Harbor to Alameda	4	24	3	300.0	39.8
PCH	873A	Harbor to Long Beach Terminal	2	12	4	372.0	30.0
San Pedro	841A	Harbor to Long Beach Freeway	1	6	1	120.0	9.5
	T O T A L				26	2,433.6	223.5

[1] Includes one extra bus/hour midday

Table 29

SUPPLEMENTARY FEEDER SERVICE

Harbor Freeway Corridor

LRT ALTERNATIVE

Served	Line	Area Served	Pk Hr Buses/ Hour	Daily Trips	Peak Buses Req'd	Daily Bus Miles	Daily Bus Hours
Santa Barbara	18A	Crenshaw to Alameda	7	48[1]	11	984.0	95.6
Slauson	828A	Crenshaw to Alameda	3	18	4	349.2	27.6
Manchester	832A	Crenshaw to Alameda	5	30	7	612.0	51.1
Artesia	846A	Harbor to Alameda	1	6	1	104.4	7.3
Carson	849A	Harbor to Alameda	4	24	3	300.0	39.8
PCH	873A	Harbor to Long Beach Terminal	2	12	4	372.0	30.0
San Pedro	841A	Harbor to Long Beach Freeway	1	6	1	120.0	9.5
	T O T A L				31	2,841.6	290.9

[1] Includes one extra bus/hour midday

Table 30

SUPPLEMENTARY FEEDER SERVICE

Harbor Freeway Corridor

ICTS ALTERNATIVE

Served	Line	Area Served	Pk Hr Buses/ Hour	Daily Trips	Peak Buses Req'd	Daily Bus Miles	Daily Bus Hours
Santa Barbara	18A	Crenshaw to Alameda	7	48[1]	11	984.0	95.6
Slauson	828A	Crenshaw to Alameda	4	24	5	453.6	36.2
Manchester	832A	Crenshaw to Alameda	6	36	8	720.0	60.6
Artesia	846A	Harbor to Alameda	1	6	1	104.4	7.3
Carson	849A	Harbor to Alameda	4	24	3	300.0	39.8
PCH	873A	Harbor to Long Beach Terminal	2	12	4	372.0	30.0
San Pedro	841A	Harbor to Long Beach Freeway	1	6	1	120.0	9.5
		T O T A L			33	3,054.0	279.0

(1) Includes one extra bus/hour midday

Table 31

SUPPLEMENTARY FEEDER SERVICE

Harbor Freeway Corridor

VERMONT HRT ALTERNATIVE

Station Served	Line	Area Served	Pk Hr Buses/ Hour	Daily Trips	Peak Buses Req'd	Daily Bus Miles	Daily Bus Hours
Jefferson		Crenshaw to Alameda	2	12	3	264.0	24.8
Santa Barbara	18A	Crenshaw to Alameda	4	24	7	564.0	51.4
Slawson	828A	Crenshaw to Alameda	4	24	5	453.6	36.2
Manchester	832A	Crenshaw to Alameda	7	48[1]	9	882.0	76.9
Artesia	846A	Vermont to Alameda	1	6	1	110.4	7.7
Carson	849A	Vermont to Alameda	4	24	4	345.6	27.6
Sepulveda		Crenshaw to Alameda	1	6	1	108.0	9.1
PCH	863A	Vermont to Long Beach Terminal	2	12	4	384.0	31.4
San Pedro	841A	Park/Ride to Long Beach Freeway	2	12	3	276.0	20.8
		T O T A L			37	3,387.6	285.9

[1] Includes one extra bus/hour midday.

ALTERNATIVE A-6b
VERMONT (HRT) OPERATING PLAN
WITH TURNBACKS
HARBOR FREEWAY CORRIDOR

Alternative A-6a represented an operating plan for a full service rapid transit alternative along the Vermont Avenue Alignment. Alternative A-6b is a variation of the Vermont HRT alternative that would provide for train reversal at Artesia.

The turnback plan was developed based on estimates of patronage provided by Caltrans staff. These estimates indicate that the maximum load point between Ports-of-Call and Union Station would lie in the link between stations at Pico and Olympic. The total daily volume on the maximum load point link was given to be 66,970. To estimate the peak hour volume at the maximum load point, the following assumptions were made:

1) Peak-hour link volumes would maintain the same proportional relationship among links as the total daily volumes;

2) The ratio of peak-hour line volume to total daily line volume would be the same as the ratio of peak-hour link volume to total daily link volume; and

3) The peak-period directional split (70/30) would be the same as was assumed for other alternatives.

The operation was sized assuming that standees would be permitted in peak periods only. In off-peak periods, all riders would be provided a seat. Vehicle passenger capacity would be as shown in Table 1, Chapter I. The capacity for heavy rail equipment was estimated to be 74 seated and 115 standees, for a total of 189.

Other basic assumptions used for this operations analysis were as applied for other alternatives. Thus for example:

1) Operations would be conducted 19 hours daily between the hours of 5:00 A.M. and midnight.

2) Service would be volume based, but not to exceed policy service intervals establish as follows:

Period	Maximum Policy Headway (minutes)
Early Morning	20
Peak Periods	15
Midday	15
Evening and Midnight	30

3) Operations were analyzed for weekday service, then annualized using 308 equivalent weekdays per year. The annulization factor is passenger-volume-based. The corollary assumption must be that non-weekday service levels would follow the same pattern.

4) Sizing periods were defined to include peak periods of three hours.

5) A yard and service facility would be located near the midpoint of the line. An appropriate allowance for deadhead (non-revenue) train-miles was included to reflect this choice. Selection of an alternate location should not significantly change the non-revenue mileage operated.

6) Peak-hour operations were sized to absorb the peak 20 minutes within the peak hour through the use of trippers. The peak 20-minute passenger volume was assumed to exceed the average 20-minute volume in the peak hour by 25%.

7) The temporal distribution of total daily ridership was based on current El Monte Busway experience, as follows:

Time of Day	% Of Daily Boardings
Early morning (5:00 - 6:00 A.M.)	2.0
Morning pre-peak shoulder (6:00 - 7:00 A.M.)	8.0
Morning peak hour (7:00 - 8:00 AM)	15.0
Morning post-peak shoulder (8:00 - 9:00 A.M.)	7.0
Mid-day period (9:00 A.M. - 3:00 P.M.)	24.0
Evening initial peak shoulder (3:00 - 4:00 P.M.)	7.0
Evening pre-peak shoulder (4:00 - 5:00 P.M.)	10.0
Evening peak (5:00 - 6:00 P.M.)	13.0
Early evening (6:00 - 9:00 P.M.)	10.0
Late evening (9:00 - 12:00 P.M.)	4.0
	100.0

8) The above temporal distribution was adopted except in the evening peak period. It was assumed that the evening peak hour would represent 15 percent (same as morning peak hour) of total daily travel, to be consistent with procedures used for estimating ridership. The temporal distribution also was revised to include a pre-peak shoulder and post-peak shoulder in the evening. The respective percentages of daily travel for each of these periods were 7% for the pre-peak and 10% for the post-peak.

Station stops included in the analysis of this option are listed below. Station platforms were projected to be 500 feet long. This restricts train lengths to six, 75-foot vehicles.

VERMONT HRT STATIONS

Union Station
First and Broadway
Fifth and Broadway
Olympic & Broadway
Convention Center
Adams & Figueroa
Jefferson
Santa Barbara

Slauson
Manchester
Imperial
Rosecrans
Artesia
I-405
Carson
Sepulveda
Pacific Coast Highway
Channel Street
Ports-of-Call

Round-trip route mileage between Ports-of-Call and Union Station is 48.6 miles. Between Artesia and Union Station, round trip route mileage is approximately 28.7 miles. Total running time, including average 20-second dwell times at all stations, was estimated to be 78 minutes over the entire line, and 47 minutes between Union Station and Artesia. Performance estimates were based on operation of 6-car trains, all powered. Trains would be powered from both ends, simplifying turnback operations.

To analyze opportunity for turnbacks at Artesia, maximum load point link volumes were estimated for sections of line between Ports-of-Call and Artesia, and between Artesia and Union Station. These estimates were prepared using the methods described above and indicate a maximum load point directional volume of 1,780 riders on the link between Artesia and 190th Street for the segment south of Artesia. North of Artesia, the maximum load point link would lie between stations at Adams and Pico. The directional volume on this link would be 6,530 riders in the peak hour.

Service would begin at 5:00 A.M. with 20-minute headways and 5-car consists operating between line termini, with no reversals at Artesia.

At 6 A.M., the morning pre-peak shoulder would begin. South of Artesia, service frequency would be 15 minutes over the entire

peak period (6 - 9 A.M.), dictated by policy headway assumptions and indicated earlier in this report. Trains would consist of two cars in the shoulder hours and three cars in the peak hour, except that one peak-hour train would have four cars.

North of Artesia, trains would operate every 15 minutes in the shoulder hours and every 10 minutes in the peak hour to accommodate ridership at the maximum load point. In the pre-peak shoulder, 5-car trains would operate, while 6-car trains would be needed in the post-peak shoulder. During the peak hour, five 6-car trains and one 4-car train would be required.

To satisfy the peak 20 minutes within the peak hour, one 5-car tripper would operate between Ports-of-Call and Union Station.

The same operational scheme described for the morning peak would apply to the afternoon peak period (3 - 6 P.M.).

During the base period (9 A.M. - 3 P.M.), service south of Artesia would be provided at 15-minute intervals with 2-car trains. North of Artesia, 6-car trains would operate every 15 minutes.

During the early (6 - 9 P.M.) and late evening (9 P.M. - midnight), service would be provided over the entire line with no turnbacks at Artesia. The early evening would have 15-minute headways and 6-car trains; the late evening, 30-minute headways and 5-car trains.

A maximum of 52 cars are required on line at one time. Allowing for 15% spares, the total fleet requirement would be 60.

Applying the above principles, estimates of operating statistics for the Vermont rapid transit option with turnbacks at Artesia

were derived using 308 equivalent weekdays per year. These are presented in Table 32.

Table 32

Operating Statistics Summary

Vermont Avenue (HRT) Alternative with Turnbacks

Item	North of Artesia	South of Artesia
Minimum Cycle Time, min.	84	53
Peak Headway, min.	10	15
Base Headway, min.	15	15
Average Speed, mph.	36	38
Corridor Route-Miles	15	24
Fleet Size	61	
Annual Train-hours (thousands).	51.6	
Annual Car-Miles (millions).	6.5	
Annual Passenger-Space-Miles (millions).	713.2	
Annual Gross Ton-Miles (millions).	306.0	

OPERATING PLANS
SANTA ANA FREEWAY CORRIDOR

III. TRANSIT OPERATING PLANS
SANTA ANA FREEWAY CORRIDOR

The process of operating plan formulation described previously for the Harbor Freeway Corridor alternatives was also followed in developing plans for the Santa Freeway Corridor. All basic assumptions were the same. Thus, the sequence was as follows:

(1) A "Base Case" ICTS rail alternative was defined with adequate capacity to accommodate specified peak period demand at the maximum load point on the line, and to represent a "full service" plan with all trains travelling the full length of the line between Union Station and Fullerton.

(2) An equivalent LRT rail alternative was then specified assuming a maximum train length of three cars.

(3) Operating plans were then developed for two concepts for Freeway Transit;
   a) A two-direction-two-lane Busway with Trunk Line "Limited Service" Freeway Transit plus feeders;
   b) The same service concept as 3(a) but with a single lane reversible busway.

(4) A variation on the basic LRT plan was developed assuming a 6 car train (unconstrained platform length).

(5) A No-Build all bus service plan was specified consisting essentially of the existing transit system operating system under 1995 conditions.

(6) A TSM all-bus service plan was developed, including certain operational improvements and limited service expansion.

The following sub-sections document these operating plans developed for the Santa Ana Freeway Corridor alternatives analysis. Basic planning assumptions were the same as those described for the Harbor Freeway Corridor (see the beginning sections of Chapter II).

ALTERNATIVE B-1
NO-BUILD BUS OPERATING PLAN
SANTA ANA FREEWAY CORRIDOR

As in the case of the Harbor Freeway Corridor "No-Build" Alternative, the No-Build Alternative for the Santa Ana Freeway Corridor was defined to consist essentially of the existing transportation system operating under future year (1995) conditions.

The Year 1995 No-Build Highway System

The background highway system assumed to be in place for the No-Build Alternative in this corridor included the freeway widening, ramp reconstruction, and ramp metering facilities now under construction from the I-605 to I-10 freeway interchanges on I-5. Otherwise it was the same as the existing system. Bus operations on all roadways were assumed to be in mixed traffic.

It was assumed, for purposes of this analysis, that the positive travel time benefits of the programmed Santa Ana Freeway improvements would be off-set by normal traffic growth and increased patronage (hence increased loading/unloading times), and that bus operating speeds on the Freeway would, consequently, remain the same as today. This dual effect of patronage growth and background traffic growth was assumed to reduce travel speeds on surface streets by two (2) miles per hour.

The Year 1995 No-Build Transit System

The No-Build Transit System was based on June 21, 1981 service levels. Operating characteristics for the SCRTD system were as documented in the SCRTD 4-24 Report of that date.

Operating characteristics of municipal systems were based on current operations.

The 1995 No-Build Transit System can be categorized into three (3) components as described below:

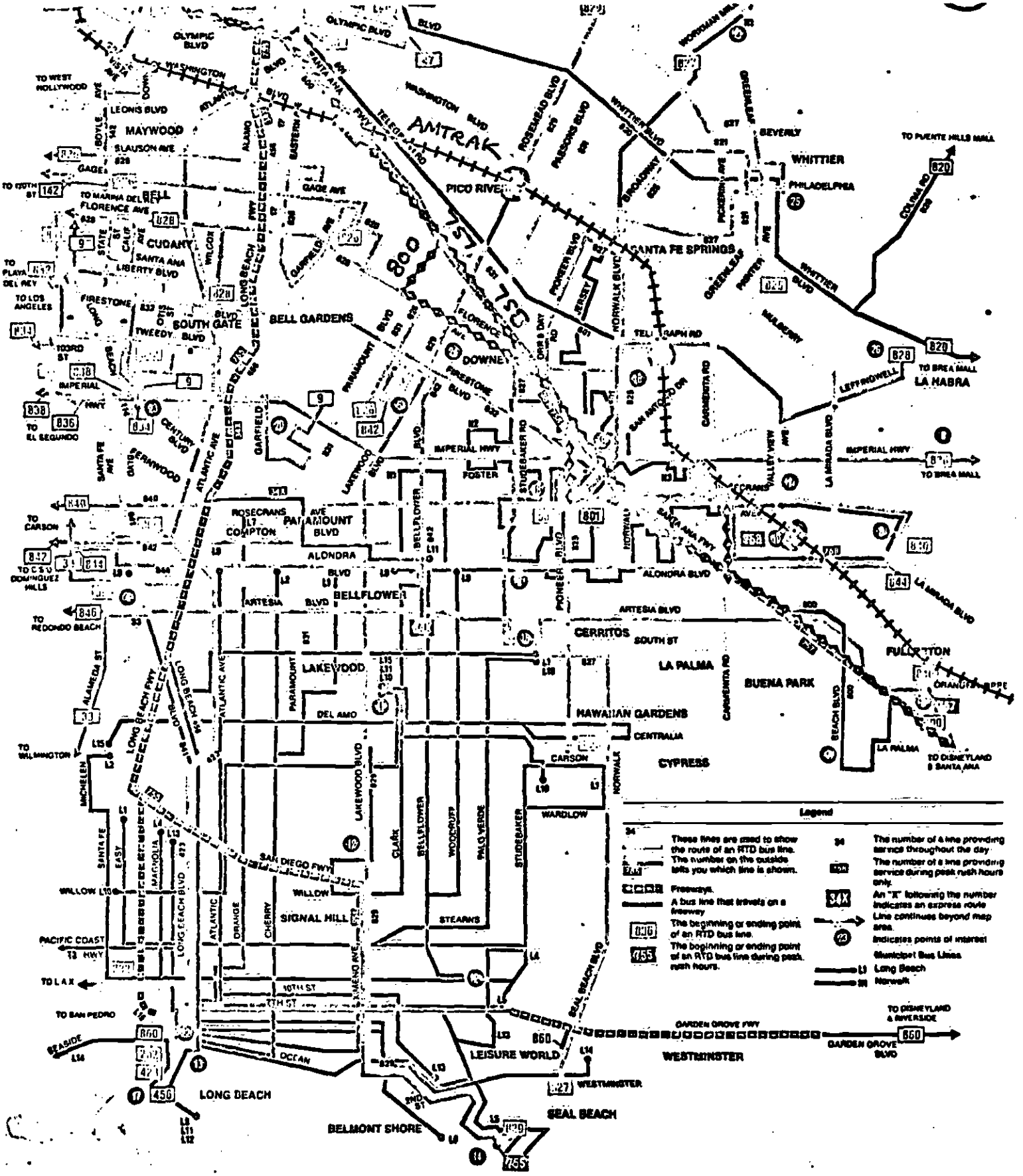
1) Freeway transit lines;

2) Feeder lines to Freeway transit lines; and

3) "Background" corridor lines unaffected by various build alternatives. These include trans-corridor lines and cross-corridor lines with incidental feeder characteristics.

The route network for the 1995 No-Build Transit System in the Santa Ana corridor is illustrated in Figure 13. Freeway transit lines and feeders to Freeway transit lines are listed in Table 33. The principal Freeway transit lines for the No-Build Alternative are lines 757, 758 and 800. Combined bus frequencies for the peak period in the peak direction on the Santa Ana Freeway would be 15 buses per hour. This includes 11 peak hour express bus trips which would not serve intermediate stops. Lines 801, 831, 832 and 836 are included as part of the plan because they are subject to modifications under the "build" alternatives.

Other corridor lines (background service) are listed in Table 34. These include SCRTD and Norwalk lines. Although Orange County Transit District lines also act as feeders for Santa Ana Freeway Buses, these are not specifically treated in this study because of the corridor definition.



NO-BUILD ALTERNATIVE BUS PLAN
Santa Ana Freeway Corridor

Wilbur Smith and Associates

Figure 13

TABLE 33

OPERATING CHARACTERISTICS - NO-BUILD ALTERNATIVE
FREEWAY TRANSIT AND PRINCIPAL FEEDER LINES
Santa Ana Freeway Corridor

LINE	ROUTE - TYPE	ROUTE DESCRIPTION	BUS TYPE	TIME OPERATED	VEHICLE-MILES[a]			BUS HOURS	PEAK BUSES REQUIRED
					Freeway	Surface	Total		
757	Freeway Transit	Fullerton-LACBD Non-Stop	ADB	Pk Only	1,593	306	1,899	73.8	14
758	Freeway Transit	La Mirada-LACBD Non-Stop	ADB	Pk Only	801	274	1,075	39.7	7
800[c]	Freeway Transit	Santa Ana-LACBD Semi-Express	ADB	All Day	1,939	1,603	3,542	227.5	19
801[d]	Parallel Arterial	Norwalk - LACBD via Telegraph Rd.	ADB	All Day	183	941	1,124	65.2	7
831	Feeder	Pico Rivera Lakewood via Paramount	ADB	All Day	-	589	589	33.4	3
832	Feeder	Norwalk - Playa del Rey via Firestone	ADB	All Day	-	3,246	3,246	294.2	18
836	Feeder	Brea-El Segundo via Imperial	ADB	All Day	-	3,093	3,093	217.7	14
		SUBTOTAL ADB			4,516	10,052	14,568	951.5	82
		SUBTOTAL ARTIC			-	-	-		
		TOTAL			4,516	10,052	14,568	951.5	82

a) Scheduled vehicle miles including non-ravenue mileage to and from garages.
b) Scheduled bus hours including non-revenue vehicle time but not operator premium time.
c) Includes Orange County portion.
d) Included because "Build" alternatives may reduce peak demand on this line.

TABLE 34

OPERATING CHARACTERISTICS

CONSTANT "BACKGROUND" SERVICE

Santa Ana Freeway Corridor

ROUTE - TYPE	ROUTE	D E S C R I P T I O N	VEHICLE HOURS	VEHICLE MILES	PEAK BUSES REQUIRED
Trans-Corridor	18	West Sixth St. - Whittier Blvd.	349.0	3,970	29
Trans-Corridor	47	East Olympic Blvd.	204.4	2,277	17
Cross-Corridor	423	Long Beach - Pasadena via Atlanti	154.4	2,444	10
Trans-Corridor	820	Los Angeles-Whittier-La Habra-Brea	270.1	4,985	22
Trans-Corridor	822	Los Angeles - Whittier - La Mirada	44.2	704	3
Cross-Corridor	825	Hawaiian Gardens-Norwalk-Whittier	29.6	488	2
Cross-Corridor	826	Huntington Park - Downey	138.5	1,958	10
Cross-Corridor	827	El Monte - Cerritos - Seal Beach	87.2	1,380	6
Cross-Corridor	828	Marina Del Rel-Huntington Park-Whittier	222.9	3,010	15
Cross-Corridor	821	Cerritos-Whittier-Pico Rivera	22.2	456	2
Cross-Corridor	829	Rosemead Blvd. - Lakewood Blvd.	187.7	3,116	14
Cross-Corridor	840	Rosecrans Avenue	110.7	1,905	8
Norwalk Local Service			223.8	2,996	16

ALTERNATIVE B-2
TSM BUS OPERATING PLAN
SANTA ANA FREEWAY CORRIDOR

The TSM Bus Operating Plan for the Santa Ana Freeway Corridor represents an improved line-haul transit concept for the corridor recognizing physical constraints. This plan was developed for purposes of the study in the absence of any alternative bus service development plan for the corridor.

Existing Conditions and Service

The existing line-haul infrastructure in the corridor consists of the Santa Ana Freeway and the Santa Fe Railroad. The Freeway has six lanes, plus auxiliary lanes at some interchanges, between Irvine and the Long Beach Freeway and eight lanes from the Long Beach Freeway to the East Los Angeles Interchange (where the I-5, I-10 and Route 60 freeways connect). It is congested (Service Levels E or F) in one or both directions from 6 A.M. to 7 P.M. each weekday. The Santa Fe Railroad has one track with sidings from San Diego to Fullerton, and two tracks from Fullerton to Los Angeles, maintained and signaled for passenger train speeds of 80 miles per hour or more. Two AMTRAK/Caltrack passenger trains operate in the dominant direction each weekday during commuter hours (7-9:30 A.M., 4-6:30 P.M.), and there are five other weekday San Diego-Los Angeles trains. The heavy transcontinental freight trains of the Santa Fe share the double-track portion of the line between Fullerton and the East Los Angeles freight yards, making it difficult to schedule additional commuter trains.

The SCRTD operates a number of bus lines in the corridor, of which four perform some kind of line-haul express service on the Santa Ana Freeway (see Figure 13 in the previous section). Lines 757 and 758 provide

non-stop peak-hour express service from park-and-ride lots at Fullerton and La Mirada respectively. The Fullerton service (line 757) has the highest patronage of any of SCRTD's park-and-ride bus lines (1,600 weekday passenger on 39 peak-only trips). Line 800 provides an all-day "semi-express" service between Santa Ana and the SCRTD terminal on Los Angeles Street in Downtown Los Angeles. This line detours from the Freeway to serve Disneyland, Knott's Berry Farm, Norwalk (Rosecrans and Pioneer), and Downey (Florence and Paramount), requiring approximately two hours for the 36-mile trip. Line 800 buses enter LACBD via Soto Street, Whittier Boulevard, Central Avenue, and Seventh Street; their outbound route uses Sixth Street, Whittier Boulevard, Boule Avenue and Eighth Street. Passengers using line 800 to reach the Financial District or the Civic Center must transfer at the SCRTD terminal on Los Angeles Street. Line 801 runs between Norwalk and Eastern Avenue along Telegraph Road, and uses the Santa Ana Freeway from Eastern to Soto. Like Line 800, 801 operates via Whittier Boulevard and Sixth and Seventh Streets, terminating at SCRTD's Los Angeles Street Terminal.

Planned Improvements

The following TSM improvements were assumed to be committed by CalTrans and SCRTD:

1. Constructing an additional traffic lane and installing ramp meters on the northbound Santa Ana Freeway from I-605 to East Los Angeles (under construction);

2. Adding one or two commuter trains (some San Diego trains would be switched from peak to off-peak at the same time) from San Juan Capistrano to Los Angeles, and additional commuter train stops on the Santa Fe at Anaheim, La Mirada, Norwalk, and Pico Rivera (recommended in July 1981 by CalTrans for SB-620 funding);

3. Rerouting lines 800 and 801 to run through to the Financial District (Figueroa Street) via Fifth and Sixth Streets west of Central Avenue in Downtown Los Angeles (instead of Via Seventh and Sixth and the Los Angeles Street terminal); and

4. With Proposition A, an increase of approximately 20 percent in SCRTD's peak bus fleet by 1983.

The commuter trains will not serve quite the same territory within the corridor as the bus lines, since the Santa Fe stations are all some distance north of the Santa Ana Freeway. Experience with existing rail commuter service suggests that the new trains would tend to attract auto commuters away from the freeway and arterial routes but would not compete with the park-and-ride express buses. The move out of the SCRTD terminal will likely generate more patronage for lines 800 and 801 because passengers from the financial district will be able to board throughout the downtown area and will not need to either change buses or walk through the "Skid Row" neighborhood for several blocks in order to board one these two lines. The widening and ramp metering on the Santa Ana should improve its level of service, even though the freeway is so overloaded that peak hour demands will likely continue to exceed available capacity.

TSM Opportunities

TSM improvements are intended to utilize existing plant and equipment more intensively with relatively small increases in capital and operating costs. Typical TSM opportunities identified in this study include the following:

1. Use buses now operating peak-only in all-day service;

2. Adapt bus services so that people can use a train one-way and a bus for the return trip, and vice versa;

3. Add more park-and-ride lines (possibly to be operated by private sector or municipal bus lines of SCRTD budget/fare constraints preclude additional peak-hour commuter runs);

4. Extend commuter bus routes to self-collect and self-distribute (e.g. to the Wilshire Corridor, or USC), unless such extensions will involve excessive overtime[16];

5. Provide one or more intermediate stops on a commuter express if such stops would serve a major activity center by means of a single transfer from the express line; and

6. Such marketing/promotional techniques as providing joint fares (tickets or monthly passes) and transfers between commuter trains and connecting buses in LA CBD and at suburban stations.

Assumed TSM Plan

The following improvements were assumed in developing the TSM bus operating plan for purposes of the study:

(16) Peak hour commuter runs in the morning and evening are combined into a single run where possible. Overtime occurs when the "split" exceeds a time span specified in the labor union contract (currently 10 hours), or when single trips in the morning or evening peaks cannot be combined with other runs. The latter are put up for bid as overtime runs by drivers already working a regular eight hour day. Employment of part-time drivers and computerized run cutting may reduce this overtime problem in future years.

1. Completing of CalTrans' current widening and ramp metering projects of the Santa Ana Freeway;

2. Freeway bus turnouts similar in concept to those on the Hollywood and San Bernardino Freeways at Norwalk Boulevard in Norwalk and at Rosemead/Lakewood Boulevard in Downey;

3. Revised line 800, to run entirely on I-5 Freeway between Knott/Artesia interchange in Buena Park and Soto Street in Los Angeles, stopping at the proposed Norwalk, and Rosemead Stations;

4. Revised line 800, to operate all the way through Downtown Los Angeles via Fifth and Sixth Streets, terminating on Beaudry Street between Fourth and Fifth (similar as routing to line 820)[17];

5. Increased base service frequency on Line 800 to 3 buses per hour (from 2), and the peak service to 5 buses per hour (from 4);

6. Assignment of high performance articulated buses (comparable in performance to advanced design buses) to line 800;

7. Operation of lines 757 and 758 on present schedules with high performance articulated buses or double-deck buses to increase their capacity; and

---

(17) SCRTD may wish to consider interim extension of these lines to the Hollywood Freeway, Wilshire, or Santa Ana Corridors, pending construction of the Starter Line, if Proposition A funds permit.

8. Improved City police enforcement of existing parking controls on Fifth and Sixth Streets in Downtown Los Angeles.

Current schedules and proposed line distances indicated that line 800 would cover the distance from Sixth and Flower in Santa Ana to its Beaudry Street terminus in approximately one hour and 48 minutes, allowing the base service to be operated on 30-minute headways with 8 buses (now 9), and the proposed 20 minute base headway would need 12 buses. The present P.M. peak headway requires 14 buses, 13 buses with proposed route changes; the proposed 12-minute P.M. peak headway would require 17 buses, approximately 20 percent more than the existing 800 service. If only the Fullerton-LACBD portion of the line were considered, (since the balance of the line serves the Orange County portion of the corridor), then 5 buses would be needed for a 30-minute base headway, 7 buses for a 20-minute base headway, and 11 buses for a 12-minute peak headway. In essence, the peak bus increase on the 800 line as a whole would be 20 percent relative to existing service -- which is consistent with Proposition "A" assumptions.

Although logical system planning principles appear to favor either extension of all-day express bus service to the Orangefair Mall at Harbor Boulevard and Orangethorpe or to the planned Fullerton Transportation Center at Pomona and Santa Fe (AMTRAK Station), such Orange County branches of the Freeway Transit lines were not considered within the scope of this study. A joint transit planning effort with Orange County Transportation Commission will presumably be undertaken in a subsequent project in this corridor.

A peak-hour Norwalk-LACBD express originating at the I-105/I-605/Studebaker Road Station or at the Norwalk State Hospital

may also be worth considering if projections appear to justify extra buses past the Rosemead Station. Such a line could replace the existing short service (Carmenita Road-LACBD) on line 800.

Bus Priority Treatments

In a TSM concept, the most useful operational improvements are those now programmed and additional treatments allowing buses to bypass queues upstream from congestion points. On the Santa Ana Freeway the existing main congestion points are:

1. Northbound, the forced merge north of the I-605 interchange, from which queues may extend as far back as Firestone;

2. Northbound, the two-lane off-ramp into the Santa Monica Freeway (which does not affect buses as much as other vehicles);

3. Southbound, the forced merge of the Washington Street interchange, just north of the Santa Fe Railroad underpass;

4. Southbound, the lane drop at Triggs Street south of the Long Beach Freeway; and

5. Southbound, the Imperial/Pioneer off-ramp where the peak-period "shoulder lane" presently terminates.

The operational improvement now under construction from I-605 north will improve freeway service levels through the existing bottleneck at the merge point and construction of the Century Freeway (I-105), will likely further relieve the bottlenect at the northbound merge of I-5 and I-605. Traffic from

Orange County to the Century Freeway will likely also use the Artesia and I-605, and Imperial, Firestone, and Rosecrans will likely be fully utilized for Century Freeway access. With these improvements in place, the following segments of the northbound Santa Ana Freeway will likely limit its service levels:

1. The capacity of four lanes in the Paramount-Slauson segment of the Santa Ana Freeway will likely be fully utilized, and some congestion (avoidable by using Telegraph Road) can be expected south of Paramount at the height of the A.M. peak;

2. Again, even with an added lane north of the I-605, the Santa Monica/Pomona Freeway Convergency in East Los Angeles will likely be fully utilized, with peak hour queueing in the two rightmost northbound lanes upstream from the East Los Angeles interchange. (Buses can usually avoid the worst part of these queues by using the Soto Street exit. In extreme cases they might be rerouted via the Long Beach and Pomona Freeways.)

The southbound (outbound) direction is likely to have less critical impact on mode split than the northbound (inbound) movement. However, constructing the Century Freeway will likely intensify the present southbound problems at the Pioneer/Imperial interchange. One possibility would be to build a bus-only lane by extending the present peak-hour shoulder lane (now limited to autos) through the interchange to the turnout at Norwalk Boulevard.

Suburban Feeder Bus Service Improvements

If the TSM line-haul bus service in the Santa Ana Freeway Corridor proves to be capacity constrained, then no additional feeder service will be necessary. However, to improve connec-

tions at the Norwalk and Rosemead Stations, the following local line rearrangements were assumed:

1. Line 836 (Imperial) -- via Firestone Boulevard from Orr and Day Road to San Antonio, then San Antonio, Freeway Transit Station, Norwalk north to Imperial and resume Imperial route (adds approximately 0.6 mile and 2 to 3 minutes to running time in each direction, which appears to be feasible without adding buses);

2. Line 832 (Firestone) -- from Rosecrans-San Antonio-Pioneer intersection, turn left (special bus signal phase from Pioneer to San Antonio, north on San Antonio Freeway Transit Station, Norwalk to Imperial, Imperial back to Firestone and west on Firestone to present route (adds approximately 1.0 mile and an estimated 3 to 4 minutes to reversal time at Norwalk but does not appear to affect run time or bus needs); and

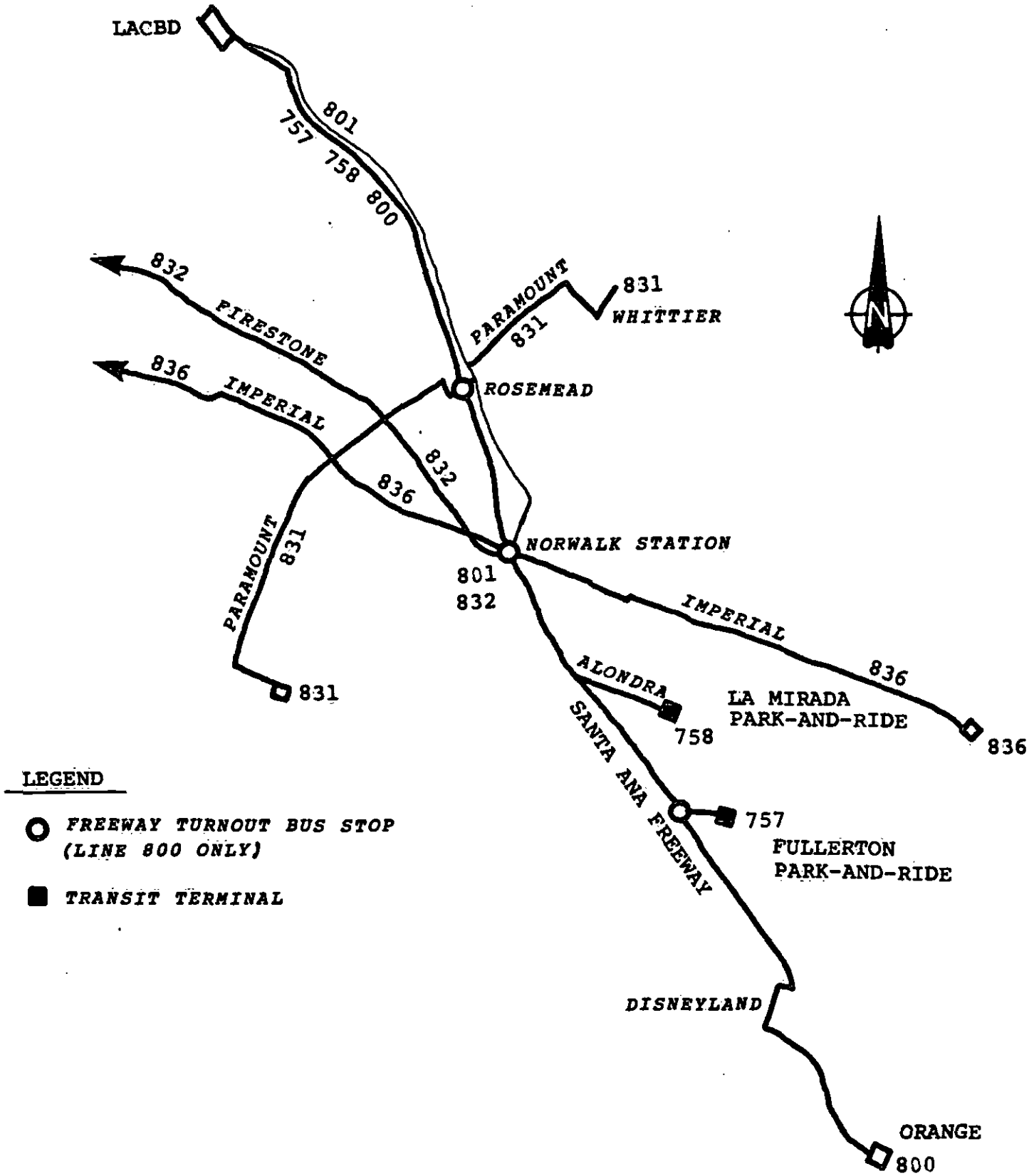
3. Originally the use of Montebello Line #60 as a logical feeder to the Rosemead Freeway transit station was suggested, which would require restoring pre-1981 service levels. While desirable for planning purposes, such an eventuality cannot be taken as a "given". Consequently, a slight rerouting and service augmentation of SCRTD Line #831 to better serve the Rosemead station was assumed for cost purposes in lieu of Montebellos Line #60. Proposed southbound routing of SCRTD Line #831 would be the current route to Paramount and Telegraph, left on Telegraph, right on Rosemead to Rosemead Freeway Transit station, right on Gallatin, left on Paramount to current route. Northbound Line #831 would follow the reverse path.

These suggestions are made for the purpose of developing representative system costs. They are too small in scale to affect regional transportation model projections of patronage. Although there may be minor effects on Paddison Square patronage, (positive from line 832 changes, uncertain from line 836 changes), other system schedule features (such as presence or absence of timed transfer at Norwalk) will likely have more effect on patronage than the reroutings suggested above.

Peak frequencies on feeder lines were assumed to be increased (assuming Proposition A funding). In view of the relatively long peak headways (30 minutes on both 832 and 836 at the Norwalk end), the service improvement would likely take the form of an extra "tripper" bus on each line during the peak period.

Operating Characteristics

Operating characteristics for the two major elements of the TSM plan -- freeway transit and "background" bus services -- are summarized in Tables 35 and 36, respectively. Freeway Transit lines and feeders included in this plan are shown in Figure 14.



TSM Alternative Bus Plan
Santa Ana Freeway Corridor

Wilbur Smith and Associates

Figure 14

TABLE 35

OPERATING CHARACTERISTICS - TSM ALTERNATIVE

FREEWAY TRANSIT AND PRINCIPAL FEEDER LINES

Santa Ana Freeway Corridor

LINE	ROUTE - TYPE	ROUTE DESCRIPTION	BUS TYPE	TIME PERIOD	VEHICLE-MILES[a] Freeway	Surface	Total	BUS HOURS	PEAK BUSES REQUIRED
757	Freeway Transit	Fullerton-LACBD Non-Stop	ARTIC	PM Only	1,593	306	1,899	73.8	14
758	Freeway Transit	La Mirada-LACBD Non-Stop	ARTIC	PM Only	801	274	1,075	39.7	7
800[c]	Freeway Transit	Santa Ana-LACBD Semi-Express	ARTIC	All Day	3,967	756	4,723	249.3	4
801[d]	Parallel Arterial	Norwalk - LACBD via Telegraph Rd.	ADB	All Day	183	941	1,124	65.2	7
831	Feeder	Pico Rivera Lakewood via Paramount	ADB	All Day	-	677	677	38.4	4
832	Feeder	Norwalk - Playa del Rey via Firestone	ADB	All Day	-	3,343	3,343	303.0	19
836	Feeder	Brea-El Segundo via Imperial	ADB	All Day	-	3,186	3,186	224.2	15
		SUBTOTAL ADB			183	8,147	8,330	630.8	45
		SUBTOTAL ARTIC			6,361	1,336	7,697	362.8	42
		TOTAL			6,544	9,483	16,027	993.6	87

a) Scheduled vehicle miles including non-revenue mileage to and from garages.

b) Scheduled bus hours including non-revenue vehicle time but not operator premium time.

c) Includes Orange County portion.

d) Included because "Build" alternatives may reduce peak demand on this line.

TABLE 36

OPERATING CHARACTERISTICS

CONSTANT "BACKGROUND" SERVICE

Santa Ana Freeway Corridor

ROUTE - TYPE	ROUTE	D E S C R I P T I O N	VEHICLE HOURS	VEHICLE MILES	PEAK BUSES REQUIRED
Trans-Corridor	18	West Sixth St. - Whittier Blvd.	349.0	3,970	29
Trans-Corridor	47	East Olympic Blvd.	204.4	2,277	17
Cross-Corridor	423	Long Beach - Pasadena via Atlantic	154.4	2,444	10
Trans-Corridor	820	Los Angeles-Whittier-La Habra-Brea	270.1	4,985	22
Trans-Corridor	822	Los Angeles - Whittier - La Mirada	44.2	704	3
Cross-Corridor	825	Hawaiian Gardens-Norwalk-Whittier	29.6	488	2
Cross-Corridor	826	Huntington Park - Downey	138.5	1,958	10
Cross-Corridor	827	El Monte - Cerritos - Seal Beach	87.2	1,380	6
Cross-Corridor	828	Marina Del Rel-Huntington Park-Whittier	222.9	3,010	15
Cross-Corridor	821	Cerritos-Whittier-Pico Rivera	22.2	456	2
Cross-Corridor	829	Rosemead Blvd. - Lakewood Blvd.	187.7	3,116	14
Cross-Corridor	840	Rosecrans Avenue	110.7	1,905	8
Norwalk Local Service			223.8	2,996	16

ALTERNATIVE B-3
ICTS OPERATING PLAN
SANTA ANA FREEWAY CORRIDOR

The same assumptions used in Harbor Corridor analyses were applied to the Santa Ana Corridor ICTS and light rail transit alternatives. Of particular significance is the fact that 3-car trains were assumed for the Santa Ana Corridor. Depending on the platform lengths that would be acceptable for this corridor, significant operating efficiencies could be obtained through use of longer trains.

The station stop locations assumed in this analysis were drawn directly from Caltrans alignment and profile drawings, and were the same for the ICTS and LRT alternatives. These are listed below:

Santa Ana Station Locations

Union
Indiana
Atlantic
Washington
Greenwood
Slauson
Lakewood
Florence
Norwalk
Carmenita
Knott (Artesia)
Fullerton

Operating Plan

One-way mileage between Union Station and the station at Fullerton would be 20.6 miles. The round-trip travel time,

excluding turn time was estimated to be 59 minutes. Allowing for turn time at each end of the route, minimum one-way cycle time for the ICTS option would be 67 minutes.

Performance estimates were made using 2 powered cars in a 3-car train, and 85 passengers per car. On this basis, estimated average speed of the ICTS option would be approximately 42 miles per hour.

Preliminary patronage estimates for the Santa Ana route were forecast at 86,000 riders per weekday. To accommodate this volume, ICTS trains would operate at 3-minute headways during the peak, 3-1/2 minutes between peak hours, 4-1/2 minutes in the early morning, 4 minutes in the early evening and 10 minutes in the late evening.

To accommodate peaking within the peak hour, three peak hour trippers with three cars per train would operate in addition to the normal peak hour service.

The fleet size requirement for Santa Ana ICTS service would be 75, plus 11 spares, for a total of 83.

Annualized operating statistics are presented in Table 37.

Table 37
Operating Statistics Summary
ICTS - Full Service Option
Santa Ana Freeway Corridor

Item	
Minimum Cycle Time, min.	65
Peak Headway, min.	3
Base Headway, min.	3.5
Average Speed, mph.	42
Corridor Route-Miles.	20.55
Fleet Size.	87
Annual Revenue Train-Hours (thousands).	103.2
Annual Revenue Car-Miles (millions).	11.1
Annual Passenger Space-Miles (millions).	528.1
Annual Passengers (millions).	25.9
Annual Gross Ton-Miles (millions).	229.2

The feeder bus plan for this and all other "build" alternatives was essentially the plan devised for the Santa Ana Freeway TSM Alternative except that the ICTS line subsumes the line haul functions of TSM lines #757, #758 and #800. The #800 line was converted to feeder operation in this plan, connecting downtown Santa Ana with the Fullerton Park-and-Ride terminus of the ICTS line. La Mirada Park-and-Ride was assumed to be abandoned under this alternative, hence no feeder service replaces the arterial portion of TSM line #758.

Feeder lines #831, #832 and #836 were assumed to have the function and routings defined in the feeder plan for the Santa Ana TSM alternative. For preliminary costing purposes, feeders were assumed to have headways equivalent to those of the TSM Alternative or policy headways of 15 minutes during the peak and midday, whichever were greater. Operational details of these feeder lines may be found in the discussion of the all-bus transitway plan.

ALTERNATIVE B-4
LRT OPERATING PLAN
SANTA ANA FREEWAY CORRIDOR

Performance estimates for the Santa Ana light rail option were made using 2-car trains, with both cars powered, and a loading standard of 154 passengers per car. The results indicate round-trip running time of approximately 60 minutes. Allowing for turns, minimum cycle time would be approximately 68 minutes.

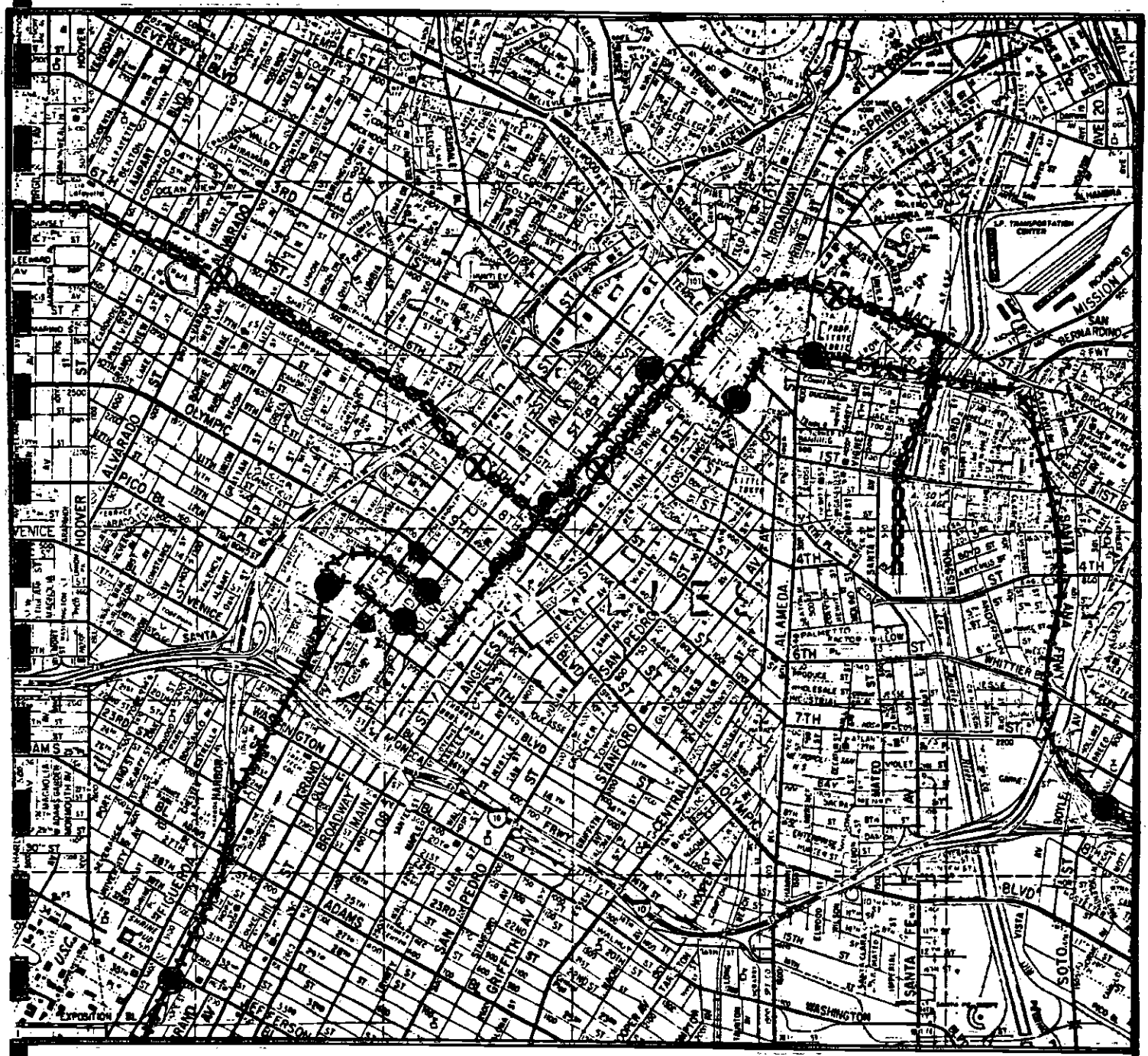
Required headways for the light rail option were estimated to be 5 minutes during the peak, 8 minutes during the early morning, 10 minutes between 8:00 AM and 4:00 PM, 20 minutes in the early morning, and 30 minutes in the late evening. All trains would have 3 cars.

To accommodate peaking within the peak hour, two trippers with two cars per train would operate in addition to the normal peak-hour service.

The light rail option would require 49 cars on line during the peak hour. Allowing for 15% spares, the total car requirement would be 57.

Estimated operating statistics for the light rail option in the Santa Ana Freeway Corridor are presented in Table 38.

The routing assumed for LRT in the Los Angeles CBD with this alternative is shown in Figure 15.



LEGEND:

Starter Line

LRT

Assumed Downtown LRT Routing
Via Union Station
Los Angeles Central Business District

Wilbur Smith and Associates

Figure 15

Table 38
Operating Statistics Summary
LRT - Full Service Option
Santa Ana Freeway Corridor

Item	
Minimum Cycle Time, min.	68
Peak Headway, min.	5
Base Headway, min.	10
Average Speed, mph.	41
Corridor Route-Miles.	20.55
Fleet Size.	57
Annual Revenue Train-Hours (thousands).	45.9
Annual Revenue Car-Miles (millions).	4.7
Annual Passenger Space-Miles (millions).	537.5
Annual Passengers (millions).	25.9
Annual Gross Ton-Miles (millions).	226.8

The feeder bus plan for this and all other "build" alternatives was essentially the plan devised for the Santa Ana Freeway TSM Alternative except that the LRT line subsumes the line haul functions of TSM lines #757, #758 and #800. The #800 line was converted to feeder operation in this plan, connecting downtown Santa Ana with the Fullerton Park-and-Ride. La Mirada Park-and-Ride was assumed to be abandoned under this alternative, hence no feeder service replaces the arterial portion of TSM line #758.

Feeder lines #831, #832 and #836 were assumed to have the function and routings defined in the feeder plan for the Santa Ana TSM alternative. For preliminary costing purposes, feeders were assumed to have headways equivalent to those of the TSM Alternative or policy headways of 15 minutes during the peak and midday, whichever were greater. Operational details of these feeder lines may be found in the discussion of the all-bus transitway plan.

ALTERNATIVE B-5a
FREEWAY BUS TRANSIT OPERATING PLAN
SANTA ANA FREEWAY CORRIDOR

The Freeway Bus Transit plan developed for this study was designed to operate in a manner similar to the rail alternatives. It would function as a limited service-trunk line with a bus feeder system serving stations from the surrounding service area.

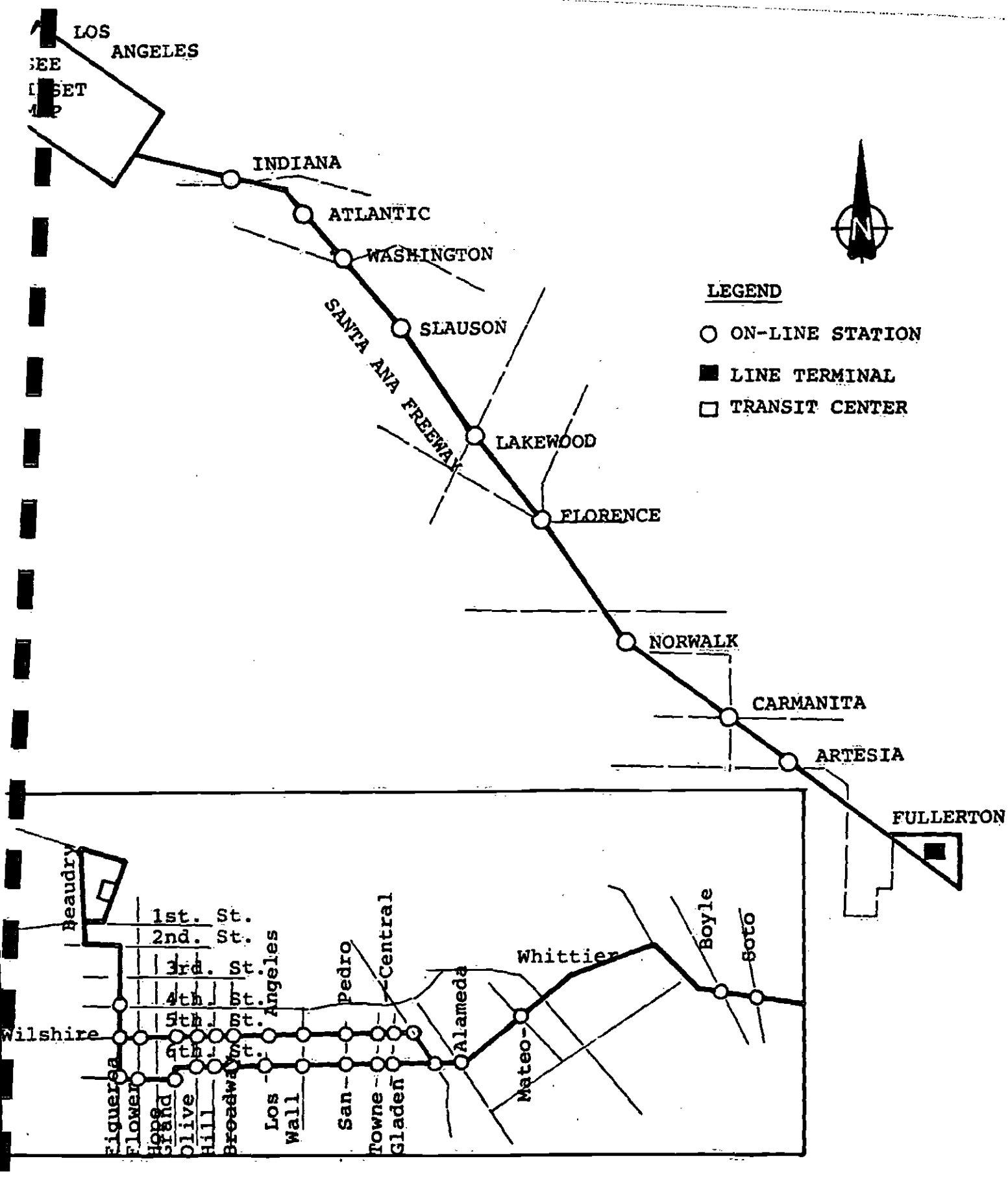
Physical Features of the Busway

This plan assumed that a bus/HOV roadway would to be constructed over I-5 from Orangethorpe Avenue in Anaheim to Whittier Boulevard in Los Angeles. The bus/HOV roadway would be two-directional with shoulders and provisions for carpool and express bus by-pass at on-line bus stops. Through service, to the Los Angeles Central Business District (LACBD) would be provided via existing surface streets in mixed traffic for both alternatives. Ingress and egress, to and from the busway, would be limited and restricted to bus/high-occupancy-vehicles (BUS/HOV) use.

Nine (9) passenger stations would be located along the busway as illustrated by Figure 16. Buses, entering the busway stations, would transition to an exclusive bus lane which would be separated from the through lane by a 10' buffer strip. Passenger boarding would be from a 200' long platform.

Planning Assumptions

Certain assumptions relative to equipment used and its performance characteristics, operational policies of the RTD, and boarding/de-boarding characteristics of the projected patron population were necessary for the development of this



ASSUMED FREEWAY TRANSIT ROUTE
SANTA ANA FREEWAY BUSWAY

Wilbur Smith and Associates

FIGURE 16

plan. These were as follows:

Vehicles

This alternative assumes the use of articulated buses (ARTIC'S) which have a seating capacity of 69 passengers and a design capacity of 97 passengers with standees.

Fare Collection

This operating plan assumes that fares would be pre-paid while entering and leaving busway stations, thus allowing loading in the LACBD through front and center doors.

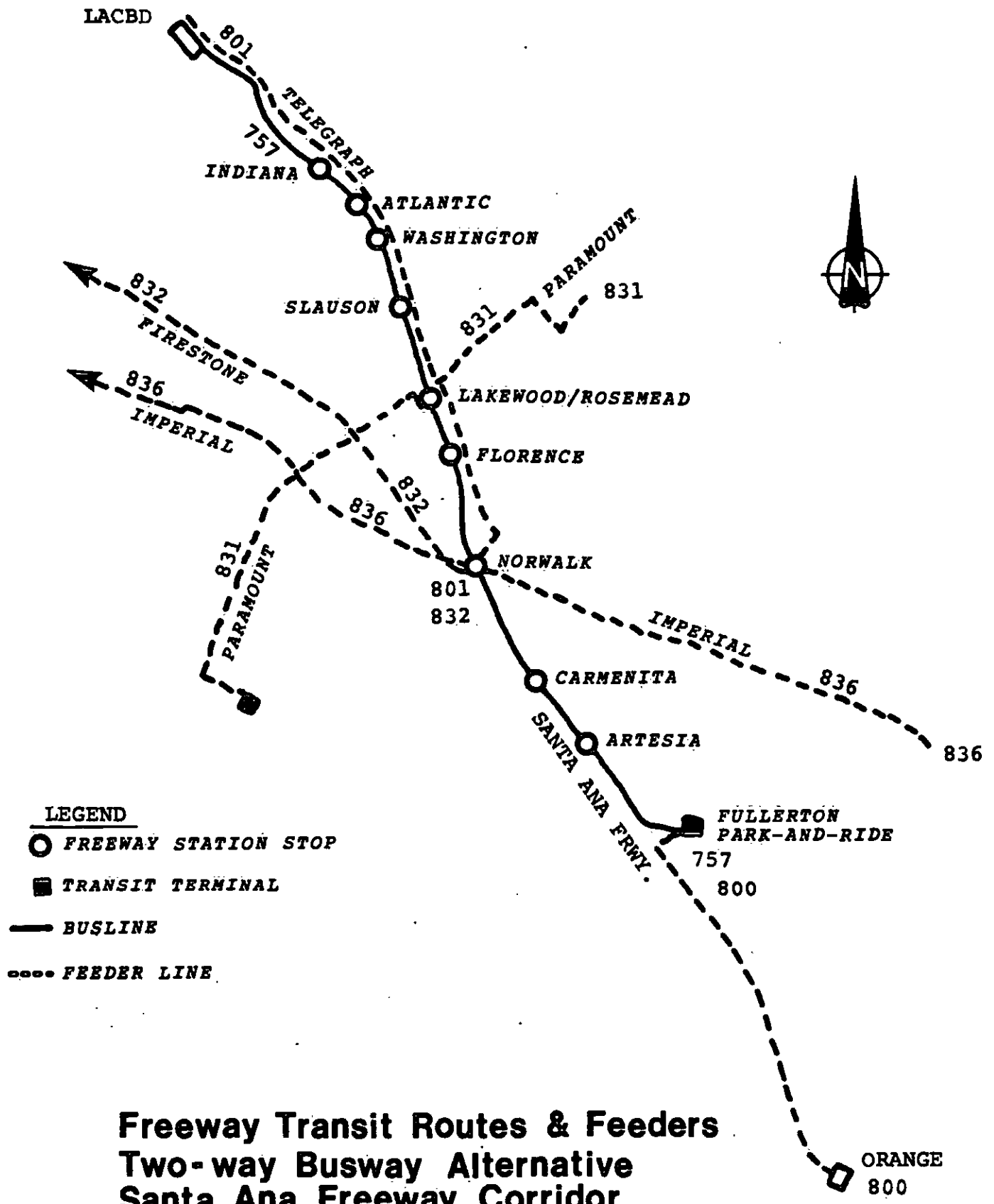
Patronage Projections

The transit demand projection, utilized for development of this plan was as shown in Table 37. The maximum load point volume was specified as 5200 passengers per hour in the peak direction of flow.

Operating Plan

Figure 17 illustrates the bus routing plan assumed for the Santa Ana Freeway busway alternative. Freeway Transit service would be provided by line 757. Details concerning the assumed operating characteristics of this Freeway Transit line are shown in Tables 40and 41. The average bus headway for the peak hour in the peak direction would be 54 seconds.

The feeder bus plan for this alternative was essentially the plan devised for the Santa Ana Freeway TSM Alternative except that the single freeway transit line (#757) subsumes the line haul functions of TSM lines #757, #758 and #800. The #800 line was converted to feeder operation in this plan, connecting downtown Santa Ana with the Fullerton Park-and-Ride terminus of line #757. La Mirada Park-and-Ride was assumed to be abandoned under this alternative, hence no feeder service replaces the



Freeway Transit Routes & Feeders
Two-way Busway Alternative
Santa Ana Freeway Corridor

Wilbur Smith and Associates

Figure 17

Table 39

PEAK HOUR DIRECTIONAL PASSENGER VOLUMES

SANTA ANA FREEWAY BUSWAY

BETWEEN STATIONS/STOPS	NUMBER OF PASSENGER CARRIED		
	WESTBOUND (A.M.) EASTBOUND (P.M.)	EASTBOUND (A.M.) WESTBOUND (P.M.)	TWO-WAY TOTAL
Artesia and Carmenitia	4,435	1,901	6,336
Carmenitia and Norwalk	3,428	1,469	4,897
Norwalk and Florence	3,750	1,607	5,357
Florence and Lakewood	3,758	1,611	5,369
Lakewood and Slauson	4,255	1,823	6,078
Slauson and Washington	4,864	2,085	6,949
Washington and Olympic	4,904	2,102	7,006
Olympic and Soto	4,792	2,054	6,846
Soto and Boyle/Whittier	5,199*	2,228*	7,427*
Boyle/Whittier and Mateo/6th	5,168	2,215	7,383
Mateo/6th and Alameda/6th	5,137	2,202	7,339
Alameda/6th and Central/5th-6th	5,111	2,190	7,301
Central/5th-6th and Gladay's/5ht-6th	5,054	2,166	7,220
Gladay's/5th-6th and Towne/5th-6th	5,038	2,159	7,197
Towne/5th-6th and San Pedro/5ht-6th	5,032	2,157	7,189

*Maximum Load Point of Corridor.

Table 39 (Continued)

PEAK HOUR DIRECTIONAL PASSENGER VOLUMES

SANTA ANA FREEWAY BUSWAY

BETWEEN STATIONS/STOPS	NUMBER OF PASSENGER CARRIED WESTBOUND (A.M.) EASTBOUND (P.M.)	 EASTBOUND (A.M.) WESTBOUND (P.M.)	 TWO-WAY TOTAL
San Pedro/5th-6th and Wall/5th-6th	4,971	2,130	7,101
Wall/5th-6th and Los Angeles/5th-6th	4,934	2,115	7,049
Los Angeles/5th-6th and Broadway/5th-6th	4,539	1,945	6,484
Broadway/5th-6th and Hill/5th-6th	3,588	1,538	5,126
Hill/5th-6th and Olive/5th-6th	2,636	1,130	3,766
Olive/5th-6th and Grand/5th-Wilshire	1,768	758	2,526
Grand/5th-Wilshire and Flower/5th-Wilshire	1,143	490	1,633
Flower/5th-Wilshire and Figueroa/5th-Wilshire	520	223	743
Figueroa/5th-Wilshire and Figueroa/4th	223	96	319

Source: Caltrans interpretation of LARTS projections combined with LACBD projections by WSA staff.

TABLE 40

BUS ASSIGNMENTS BY HOUR OF THE DAY

SANTA ANA FREEWAY BUSWAY - LINE 757

SCHEDULE HOUR	DESIGN PASSENGER VOLUME/HOUR		BUSES/HOUR (or one-way revenue trips)		TOTAL BUSES/HOUR	DESIGN HEADWAY (MIN)	
	(IN)	(OUT)	(IN)	(OUT)		(IN)	(OUT)
5-6 AM	500	500	8	8	16	7.50	7.50
6-7	2,600	1,300	34	20	54	1.76	3.00
7-8	5,200	2,100	67	34	101	0.90	1.76
8-9	2,600	2,100	34	27	61	1.76	2.22
9-10	1,300	1,300	20	20	40	3.00	3.00
10-11	1,300	1,300	20	20	40	3.00	3.00
11-12	1,300	1,300	20	20	40	3.00	3.00
12-1 PM	1,300	1,300	20	20	40	3.00	3.00
1-2	1,300	1,300	20	20	40	3.00	3.00
2-3	1,300	1,300	20	20	40	3.00	3.00
3-4	2,100	2,000	27	27	54	2.22	2.22
4-5	2,100	3,600	27	46	73	2.22	1.30
5-6	2,100	5,200	27	67	94	2.22	0.90
6-7	1,300	2,000	20	26	46	3.00	2.31
7-8	1,300	1,300	20	20	40	3.00	3.00
8-9	1,300	1,300	20	20	40	3.00	3.00
9-10	500	500	8	8	16	7.50	7.50
10-11	500	500	8	8	16	7.50	7.50
11-mid night	500	500	8	8	16	7.50	7.50
					867		

Table 41

SUMMARY OF OPERATING CHARACTERISTICS

SANTA ANA FREEWAY BUS TRANSIT - LINE 757

TRIPS DAY (19-HOURS)	LINE LENGTH (MIL)	CYCLE TIME (MIN	BUSES NEEDED				BUS HOURS (1)			BUS MILES		
			AM PEAK	BASE	PM PEAK	NIGHT	REVENUE	NON-REVENUE	TOTAL	REVENUE	NON-REVENUE	TOTAL
867	22.47 (2)	126.08 (3)	144	44	144	18	911	220	1,131	19,481	4,392	23,873

(1) Bus-Hours = [(Running time X Bus Trips) ÷ 60] + [Base Buses X $\frac{54}{60}$ + (Peak-Only buses X $\frac{108}{60}$]

(2) Based upon westbound direction

(3) Roundtrip including layover factor = 1.10 (See Tech Memo #11)

arterial portion of TSM line #758.

Feeder lines #831, #832 and #836 were assumed to have the function and routings defined in the feeder plan for the Santa Ana TSM alternative. For preliminary costing purposes, feeders were assumed to have headways equivalent to those of the TSM Alternative or policy headways of 15 minutes during the peak and midday, whichever were greater.

Table 42 summarizes the operating characteristics of the Freeway Transit and feeder lines for the Santa Ana Busway plan. Table 43 presents the constant "background" service.

Table 42

OPERATING CHARACTERISTICS - BUSWAY WITH FEEDERS
FREEWAY TRANSIT AND PRINCIPAL FEEDER LINES
Santa Ana Freeway Corridor

Route Type	Route Direction	Bus Type	Time Operated	Vehicle Miles			Bus Hours	Peak Bus Required
				Freeway	Surface	Total		
Freeway Transit	LABCD - Fullerton	ARTIC	All Day	17,791	6,082	23,873	1131.0	144
Feeder	Santa Ana-Fullerton P&R	ADB	All Day	1,561	288	1,849	106.4	8
Parallel Arterial	Norwalk-LACBD via Telegraph	ADB	All Day	183	941	1,124	65.2	7
Feeder	Pico Rivera-Lakewood via Paramount	ADB	All Day	-	2,844	2,844	160.4	8
Feeder	Norwalk-Playa Del Ray via Firestone	ADB	All Day	-	3,343	3,343	303.0	19
Feeder	Brea-El Segundo via Imperial	ADB	All Day	-	3,186	3,186	224.2	15
	Subtotal ADB			1,744	10,602	12,346	859.2	57
	Subtotal ARTIC			17,791	6,082	23,873	1131.0	144
	TOTAL			19,535	16,684	36,219	1990.2	201

IN THE 43

OPERATI[illegible] CHARACTERISTICS

CONSTANT [illegible]AROUND" SERVICE

Santa [illegible] Freeway Corridor

ROUTE - TYPE	ROUTE	D E S C R I P T I O N	VEHICLE HOURS	VEHICLE MILES	PEAK BUSES REQUIRED
Trans-Corridor	18	West Sixth St. - Whittier Blvd.	[illegible]	3,970	29
Trans-Corridor	47	East Olympic Blvd.	[illegible]	2,277	17
Cross-Corridor	423	Long Beach - Pasadena via Atlanti	154.4	2,444	10
Trans-Corridor	820	Los Angeles-Whittier-La Habra-Bro	270.1	4,985	22
Trans-Corridor	822	Los Angeles - Whittier - La Mirad	44.2	704	3
Cross-Corridor	825	Hawaiian Gardens-Norwalk-Whittier	29.6	408	2
Cross-Corridor	826	Huntington Park - Downey	136.5	1,958	10
Cross-Corridor	827	El Monte - Cerritos - Seal Beach	87.2	1,380	6
Cross-Corridor	828	Marina Del Rel-Huntington Park-Wh tier	252.9	3,610	15
Cross-Corridor	821	Cerritos-Whittier-Pico Rivera	28.2	456	2
Cross-Corridor	829	Rosemead Blvd. - Lakewood Blvd.	137.7	3,116	14
Cross-Corridor	840	Rosecrans Avenue	110.7	1,905	8
Norwalk Local Service			223.8	2,996	16

ALTERNATIVE B-5b
REVERSIBLE LANE BUSWAY OPERATING PLAN
SANTA ANA FREEWAY CORRIDOR

As defined for this project, the Santa Ana Freeway reversible lane busway would operate inbound to Los Angeles in the A.M. peak. Off-peak direction buses would operate via a combination of mixed-flow on the freeway and along arterial streets parallel and adjacent to the freeway. Stations on the busway were assumed at Atlantic Boulevard, Greenwood Avenue, Lakewood Boulevard, Florence Avenue, Norwalk Boulevard, Carmenita Road and Knott Avenue.

Although busway and off-peak routes would extend as far south as Santa Ana, only the Los Angeles to Fullerton portions were included in this analysis to maintain comparability with the previously defined two-way busway trunk line. The Santa Ana-to-Fullerton portion of the route was defined as a feeder line equivalant to the #800 line defined for the two-way busway alternative.

The Operating Plan

The Santa Ana Busway trunk line was designated line #757 in this alternative. As with the two-way busway plan, service levels were based on projected demand, with peak direction headways ranging from 54 seconds during the peak hour to three minutes midday and 7.5 minutes in the evening. Off-peak direction headways were also assumed to be comparable to those of the two-way busway, but due to the longer routing and slower travel times of the off-peak direction service, more vehicle travel times of the off-peak direction service, more vehicle miles and hours would be required to provide comparable service. Table 44 summarizes operating characteristics of the trunk line under the reversible-

lane busway plan.

Feeder service to the reversible-lane busway was assumed to be of the same route configuration and level as that of the two-way busway plan, with a notable exception. Since the off-peak direction route of the trunk line duplicates most of parallel arterial line #801, service requirements for the 801 line were assumed to be fifty percent of existing levels.

Table 45 lists the service characteristics of the trunk line and the allied feeder and parallel arterial routes. Table 46 documents the assumed "background" service.

Table 44

SUMMARY OF OPERATING CHARACTERISTICS
REVERSIBLE LANE BUSWAY

TRIPS DAY (19 Hours)	LINE LENGTH (MIL)	CYCLE TIME (MIN)	BUSES NEEDED				BUS HOURS (1)			BUS MILES		
			AM PEAK	BASE	PM PEAK	NIGHT	REVENUE	NON-REVENUE	TOTAL	REVENUE	NON-REVENUE	TOTAL
867	25.93 (2)	177 (3)	198	59	198	24	1,279	301	1,580	22,481	6,066	28,135

(1) Bus Hours = [(Running time X Bus Trips) ÷ 60] + [Base Buses X $\frac{54}{60}$ + (Peak Only Buses X $\frac{108}{60}$)]

(2) Average of peak direction (22.47 busway) and off-peak direction (29.39 non-busway)

(3) Roundtrip including layover factor = 1.10 (See Technical Memorandum #11)

Table 45
OPERATING CHARACTERISTICS - REVERSIBLE LANE BUSWAY WITH FEEDERS
FREEWAY TRANSIT AND PRINCIPAL FEEDER LINES
Santa Ana Freeway Corridor

Line	Route Type	Route Direction	Bus Type	Time Operated	Vehicle Miles			Bus Hours	Peak Bus Required
					Freeway	Surface	Total		
757	Freeway Transit	LABCD - Fullerton	ARTIC	All Day	13,280	14,855	28,135	1580.0	198
800	Feeder	Santa Ana-Fullerton P&R	ADB	All Day	1,561	288	1,849	106.4	8
801	Parallel Arterial	Norwalk-LACBD via Telegraph	ADB	All Day	92	471	563	32.6	7
831	Feeder	Pico Rivera-Lakewood via Paramount	ADB	All Day	-	2,844	2,844	160.4	8
832	Feeder	Norwalk-Playa Del Ray via	ADB	All Day	-	3,343	3,343	303.0	19
836	Feeder	Brea-El Segundo via Imperial	ADB	All Day	-	3,186	3,186	224.2	15
		Subtotal ADB			1,653	10,132	11,785	826.6	57
		Subtotal ARTIC			13,280	14,855	28,835	1558.0	198
		TOTAL			14,933	24,987	39,920	2384.6	255

TABLE 4.6

OPERATING CHARACTERISTICS

CONSTANT "BACKGROUND" SERVICE

Santa Ana Freeway Corridor

ROUTE - TYPE	ROUTE	D E S C R I P T I O N	VEHICLE HOURS	VEHICLE MILES	PEAK BUSES REQUIRED
Trans-Corridor	18	West Sixth St. - Whittier Blvd.	349.0	3,970	29
Trans-Corridor	47	East Olympic Blvd.	204.4	2,277	17
Cross-Corridor	423	Long Beach - Pasadena via Atlantic	154.4	2,444	10
Trans-Corridor	820	Los Angeles-Whittier-La Habra-Brea	270.1	4,985	22
Trans-Corridor	822	Los Angeles - Whittier - La Mirada	44.2	704	3
Cross-Corridor	825	Hawaiian Gardens-Norwalk-Whittier	29.6	488	2
Cross-Corridor	826	Huntington Park - Downey	138.5	1,958	10
Cross-Corridor	827	El Monte - Cerritos - Seal Beach	87.2	1,380	6
Cross-Corridor	828	Marina Del Rel-Huntington Park-Whittier	222.9	3,010	15
Cross-Corridor	821	Cerritos-Whittier-Pico Rivera	22.2	456	2
Cross-Corridor	829	Rosemead Blvd. - Lakewood Blvd.	187.7	3,116	14
Cross-Corridor	840	Rosecrana Avenue	110.7	1,905	8
Norwalk Local Service			223.8	2,996	16

SUPPLEMENTAL FEEDER SERVICE TO LINE HAUL SERVICES IN THE SANTA ANA FREEWAY CORRIDOR

Each of the transit plans described in above sections assumes a feeder element designed to connect line-haul services with park-and-ride sites and other concentrations of potential patrons. Other feeder services will be provided by cross corridor lines in the assumed "background" service (i.e., existing routes unaffected by the various transit plans presented herein). However, since the amount of reserve capacity which will exist on these lines in 1990 is unknown, it was assumed for purposes of this analysis that the existing service levels on these lines would have no reserve capacity to perform feeder functions. Consequently, a supplemental feeder plan was developed for each alternative based on increments to existing cross-corridor lines.

Tables 47 through 49 define the supplemental feeder service required to fully serve projected transit access patronage at each transit station for each Santa Ana Freeway alternative. Service levels are based on mode-of-access station volumes provided by Caltrans, and routes are defined as service increments ("trippers") on existing routes or portions thereof.

Table 47

SUPPLEMENTARY FEEDER SERVICE

SANTA ANA FREEWAY CORRIDOR

LRT AND ICTS

Station Served	Line	Area Served	Pk. Hr. Buses/ Hr.	Daily Trips	Peak Buses Require	Daily Bus Miles	Daily Bus Hours
Indiana	32A	LACBD to Cal State	1	6	2	199	16.6
	47A	LACBD to Garfield	1	6	3	156	19.7
Atlantic	259A	Firestone to Whittier	1.5	9	1	146	10.1
	423A	Santa Ana St. to Beverly	1.5	9	2	184	12.5
Greenwood	801A	Atlantic to Rosemead	2	12	2	185	11.6
Lakewood	829A	Alondra to Whittier	1	6	2	185	12.8
	831A	Alondra to EOL	2	12	4	290	28.4
Flormer	828A	Santa Ana to La Habra	2	12	4	348	27.4
	827A	Cerritos to Whittier	1	6	2	214	14.6
Norwalk	825A	Whittier to Hawaiian Gardens	1.5	9	3	322	23.3
	836A	Brea to Long Beach Boulevard	1.5	9	5	536	36.5
Carmsnita	821A	Pioneer to Whittier	1.5	9	3	342	23.6
	844A	Bellflower to La Mirada	1.5	9	2	220	16.2
Knott	0C29A	Cerritos to Central	2	12	4	403	28.4
	846A	Studebaker to EOL	2	12	2	228	16.4
					41	3,958	298.1

Table 48

SUPPLEMENTARY FEEDER SERVICE

SANTA ANA FREEWAY CORRIDOR

TWO-WAY BUSWAY

Station Served	Line	Area Served	Pk. Hr. Buses/ Hr.	Daily Trips	Peak Buses Require	Daily Bus Miles	Daily Bus Hours
Indiana	32A	LACBD to Cal State	1	6	2	199	16.6
	47A	LACBD to Garfield	1	6	3	156	19.7
Atlantic	259A	Firestone to Whittier	1	6	1	109	7.3
	423A	Santa Ana St. to Beverly	1	6	1	110	7.7
Greenwood	801A	Atlantic to Rosemead	2	12	2	185	11.6
Lakewood	829A	Alondra to Whittier	1	6	2	185	12.8
	831A	Alondra to EOL	2	12	4	290	28.4
Flormer	828A	Santa Ana to La Habra	2	12	4	348	27.4
	827A	Cerritos to Whittier	1	6	2	214	14.6
Norwalk	825A	Whittier to Hawaiian Gardens	1.5	9	3	322	23.3
	836A	Brea to Long Beach Boulevard	1.5	9	5	536	36.5
Carmsnita	821A	Pioneer to Whittier	1.5	9	3	342	23.6
	844A	Bellflower to La Mirada	1.5	9	2	220	16.2
Knott	0C29A	Cerritos to Central	2	12	4	403	28.4
	846A	Studebaker to EOL	2	12	2	228	16.4
					40	3,847	290.5

Table 49

SUPPLEMENTARY FEEDER SERVICE

SANTA ANA FREEWAY CORRIDOR

PEAK DIRECTION BUSWAY

Station Served	Line	Area Served	Pk. Hr. Buses/ Hr.	Daily Trips	Peak Buses Require	Daily Bus Miles	Daily Bus Hours
Indiana	32A	LACBD to Cal State	1	6	2	199	16.6
	47A	LACBD to Garfield	1	6	3	156	19.7
Atlantic	259A	Firestone to Whittier	1	6	1	109	7.3
	423A	Santa Ana St. to Beverly	1	6	1	110	7.7
Greenwood	801A	Atlantic to Rosemead	1	6	1	92	5.8
Lakewood	829A	Alondra to Whittier	1.5	9	3	277	19.2
	831A	Alondra to EOL	1.5	9	3	328	21.3
Flormer	828A	Santa Ana to La Habra	1	6	2	174	13.7
	827A	Cerritos to Whittier	1	6	2	214	14.6
Norwalk	825A	Whittier to Hawaiian Gardens	1	6	2	215	15.5
	836A	Brea to Long Beach Boulevard	1	6	3	346	23.7
Carmsnita	821A	Pioneer to Whittier	1	6	2	228	15.7
	844A	Bellflower to La Mirada	1	6	2	170	12.0
Knott	0C29A	Cerritos to Central	1.5	9	3	302	21.3
	846A	Studebaker to EOL	1.5	9	2	189	13.2
					32	3,109	227.3

OPERATING COST ESTIMATES

IV. OPERATING COST ESTIMATES

Estimates of annual operating costs were developed in this study for at least one operating plan for each modal alternative in each corridor, as well as for some of the operating plan variations. These estimates are presented in this chapter, along with the basic assumptions upon which they were based.

Emphasis was given to achieving consistency in basic costing assumptions used in assessing the rail and bus alternatives, although different methodologies were employed. For the bus transit alternatives, cost estimates were based on unit cost parameters reflecting the recorded experience of SCRTD. The resulting cost model was reviewed with SCRTD staff and refinements were made as requested for purposes of this planning study. For rail alternatives, a unit cost approach was considered inappropriate, and estimates were developed based on specified manpower requirements and other cost parameters, utilizing the experience of operators of similar rail systems in other areas, adjusted as appropriate for conditions in Los Angeles. All estimates reflect current prices in the Los Angeles area and SCRTD wage levels existing at the time of study.

Methodology for Estimating Rail Operating Costs

All of the procedures employed in the process of estimating rail operating costs provided for uniform treatment of alternatives. The estimates included manpower resources required to support the alternatives, and estimates of material and purchased service expenses. Costs were segregated by the following categories:

1) Transportation
2) Maintenance-of-Equipment
3) Maintenance of Way
4) Insurance and Damages

5) Electrical Energy
6) General and Administrative

For all of the operating and maintenance departments, it was assumed that first-line supervision would be paid at rates higher than the maximum for skilled labor.

As indicated above, the rail cost estimates were prepared using current price experience in the Los Angeles area and present SCRTD wage levels as base. Rates of compensation typical of rail systems elsewhere were available and were adjusted to account for local conditions. Table 50 lists representative wage and salary rates used in the cost analysis.

The existing labor agreement between the United Transportation Union and SCRTD (expiration date, 31 May 1982) included reference to rail transit operations. Provisions of this agreement pertinent to the analysis were:

1) Average vacation time of 3 weeks per year.
2) Provision of 11 holidays per year for full time operators.
3) An average of 8 paid sick days per year for full-time operators.
4) Use of part-time operators, not to exceed 10 percent of total operator work force.
5) Overtime (greater than 8 hours per day) at 1.5 times base wage rate.
6) Car marshalling by qualified "switchers".
7) Straight time compensation of $9.46 per hour for operators.

Other assumptions used in developing the operating and maintenance cost estimates for all of the rail alternatives included the following:

1) Crew assignments consisting of one attendant per train, with crew relief permitted while trains remain in service.

Table 50

ASSUMED 1981 ANNUAL AVERAGE WAGE AND SALARY RATES (EXCLUDING FRINGES)

Transportation	
Operators and Car Marshallers	$19,750
Dispatchers and Train Control Personnel	19,000
Patrolmen	19,000
Revenue Collectors	20,950
Passengers Services Personnel	18,480
Supervision	29,000
Office Support	15,900
Supervisor - Operations	38,500
Maintenance-of-Equipment	
Mechanics & Electricians	$24,640
Supervision	31,000
Car Cleaners	18,480
Storekeepers	22,180
Clerks & Office Support	17,000
Supervisor - M & E	41,000
Maintenance-of-Way	
Machine Operators	$23,400
Technicians	22,000
Laborers	18,850
Supervision	31,000
General and Administrative	
Supervisory Personnel	$32,000
Accounting Support	18,300
Purchasing Support	20,900
Ticket Encoders, Retrievers, Sorters	15,600
Office Support	17,250
General Manager	61,200

2) Recovery (layover) time equal to approximately 10% of estimated running time.

3) Allowance for operator sick time consistent with current SCRTD experience.

4) Use of automatic fare collection equipment to simplify revenue collection and maximize passenger accommodation.

5) Use of trained personnel for passenger, revenue and facility security.

6) Use of automated car washing and cleaning equipment, with daily cleaning and weekly washing of cars.

7) Efficient deployment and utilization of manpower in equipment maintenance and servicing.

8) Incremental general and administrative costs related directly to initiation of rail service in the corridor.

9) Application of 1981 wage and price levels to all of the rail alternatives.

10) Operation and maintenance requirements sized to 1995 service conditions.

11) Fringe benefits drawn from current SCRTD experience, representing 45% of direct labor expense.

12) Uniform annual material replacement expenses, representing levels of expenditure befitting a normal year of steady-state operation.

13) Electrical energy obtained under conjunctive billing arrangements covering multiple supply points.

Operator hours available for actual train operation were estimated with recognition of non-productive time due to provisions defined in the present SCRTD labor agreement. Based on actual SCRTD experience, an allowance of 8.5% of assigned work hours per operator lost due to sick time was included. An allowance of $125 per operator for uniform expense was included as provided for in the labor agreement. Operator overtime was estimated to represent 5% of direct labor costs for operators, consistent with current SCRTD experience.

Transportation expense was also defined to include dispatching and control, passenger services, security, revenue collection, car marshalling and supervision. Resources required to staff

these departments were estimated using experience of rail transit operators as a guide. Wages in the transportation department were assumed to range between $38,500 and $15,900.

Security needs were estimated based on number of stations, system route-miles and anticipated passenger volumes. Patrols required for security at yard and maintenance facilities were also included. Patrolman salaries were estimated at $19,000. The average supervisory wage was estimated to be $29,000.

Revenue collection would be accomplished using two-man teams. Duties would include revenue collection, filling change machines, cash receipts transportation and reconciliation.

Estimates of maintenance-of-equipment cost were based on a schedule for preventive maintenance inspection and repair, daily defect repair, car cleaning and washing, motor blowing, repair and maintenance of the yard and shop facility, backshop repair of components, storekeepers and supervision.

The preventive maintenance inspection and repair schedule that was developed calls for inspection intervals based on mileage or monthly frequency, whichever comes first. Vehicle components were divided into categories that would be serviced at differing intervals based on their complexity and anticipated rates of failure during normal operations. The preventive maintenance inspection and repair department would perform minor repair work. Most repair of vehicle components would, however, be done in a daily defect repair department. For the rail transit alternatives under consideration in this study, annual car-miles per car would vary between 70,000 and 100,000.

Components requiring repair would be serviced primarily in-house. A branch of the maintenance-of-equipment department would provide spare parts for equipment needs. Also included was

sufficient manpower for repair and maintenance of the yard facility and shop building.

Annual salaries in the maintenance-of-equipment department were assumed to range from $15,725 to $43,000. Mechanics, electricians and other skilled maintenance personnel would be paid $24,640 annually on average.

Material expenses for maintenance-of-equipment were approximately 12.5¢ per car-mile. This is consistent with estimates of materials expense for rail transit systems comparable to those being considered in the Santa Ana and Harbor Freeway Corridors. An additional allowance of 5% of maintenance-of-equipment expense was included to account for contracted services.

Estimates of maintenance-of-way cost were prepared for track and guideway, signals, power supply, station cleaning and buildings and signs. Maintenance of fare collection equipment was included in costs of maintenance-of-way.

All of the systems under consideration were assumed to be double-track throughout, with track constructed using conventional railroad materials. Crew sizes and manpower requirements for track maintenance will varied for each of the systems under consideration based upon differences in track-miles, car-miles, and gross ton-miles.

Material expenses for maintenance of track were estimated by annualizing the cost of track components over a normal service life. Estimates of manpower and material requirements for maintenance of the power and signal systems were developed using the same methods.

Costs for station cleaning were estimated based on the number of stations and projected passenger volumes. Work would

consist of cleaning, spot painting, trash removal, and other minor maintenance as needed.

Material expense for track maintenance was estimated at $10,500 per track-mile. For maintenance of the power and signal systems, material requirements were estimated at 16% of total cost. An additional allowance of 5% of total cost was included for contracted services related to maintenance of the power and signal system.

Material for fare collection equipment maintenance was included at approximately 8% of total costs. This is consistent with experience of other systems employing self-service, barrier-type fare collection systems similar to that under consideration in Los Angeles.

Also included was an annual allowance of $10,000 for painting the shop building and repair of signs. The shop building would be painted every 10 years.

One aspect of the operating and maintenance cost estimates deserves emphasis. In developing estimates of material requirements for maintenance of fixed facilities along the rail line, estimates of service life were based on experience in the rail transit industry at large. A uniform annual rate of material replacement was assumed in all cases. The estimates represent annual levels of expenditure that would be incurred in a normal year of operation. Maintenance expenses for material replacement could be expected to fall below the indicated levels during early years of operation. Expenses would increase gradually until a stable situation, involving normal cyclical material replacement, would be achieved. This condition could be anticipated by the 15th year of operation.

Insurance, injuries and damages expense were estimated using the cost experience of rail transit operators and SCRTD as a base. Variance among alternatives arises from changes in passenger volumes, car-miles, and train-hours.

Electrical energy expense was estimated based on energy consumption rates calculated by a train performance model. The estimated rates include recognition of differing capabilities, requirements, and characteristics of the candidate technologies. The estimates include allowances for distribution and conversion losses of 5% and 3%, respectively. An allowance of approximately 30% was included to account for auxiliary loads and energy consumed in other than train operations. A charge of 6.7¢ per KWH was used in estimating energy costs, and conjunctive billing was assumed to apply.

General and administrative requirements were limited to the incremental expansion of SCRTD staff that would be required for initiation of rail service in the Harbor and Santa Ana Freeway Corridors. Additions to the personnel, accounting, purchasing, planning and scheduling departments would be made. The rail services would be staffed with a general manager, administrative assistant and secretary. A small personnel group would supplement existing SCRTD staff.

Accounting staff would be supplemented by an accountant, clerks and data processing support who would be assigned to the rail transit operation. In addition to normal staff requirements, new positions would be created for ticket retrievers, and ticket sorting and encoding clerks. Incremental additions in purchasing would also be required. These would include a purchasing manager, purchasing agents, clerks and a secretary. Finally, a planner and clerk typist were included to support the general manager in planning, development and scheduling.

It was assumed that administrative salaries would range from approximately $61,000to $14,800. An additional allowance of 5% of total general and administrative costs was included to account for professional services and contracted assistance. Material expenses for administrative functions were estimated based on general experience in the rail transit industry.

Methodology for Estimating Bus Operating Costs

For estimating 1995 bus operating costs, the following incremental cost formula was applied:

1995 Incremental Costs (1981 dollars) = $18.00 x bus hours + $1.29 x ARTIC bus miles on freeways + $0.92 x ADB bus miles on freeways + $1.45 x ARTIC bus miles on surface streets + 1.10 x ADB bus miles on surface streets + G&A costs (5% of variable costs)

The 1995 cost factors used in this cost formulae (see Table 51) assume the following:

1. Hourly labor and fringe benefit costs will approximate 1980 SCRTD values (excluding inflation);
2. Fuel prices will increase (in real terms) by approximately 50 per cent from 1980 levels due to declining reserves of low cost crude oils:
3. Assignable General and Administrative Overhead costs will constitute approximately 5 per cent of total mileage and hour costs;
4. Articulated buses will require approximately 40 per cent more fuel per mile and 29 per cent more maintenance costs than standard buses; and
5. Buses running on freeways will be about 17 per cent less costly per mile for fuel and maintenance than the system as a whole.

Table 51

FUTURE (1995) UNIT BUS OPERATING COSTS
(1981 dollars)

Representative Express Bus Operators
I-110 and I-5 Freeway Corridors

	BUS-HOUR FACTOR[a]	BUS-MILE FACTORS[a]			OVERHEAD FACTORS
		Fuel[b]	Other	Total	
Freeway Lines					
Articulated Buses	$18.00	$0.35[c]	$0.94	1.29	Five per cent surcharge on variable costs.
Improved ADB[d]	18.00	0.25[c]	0.67	0.92	
On-Street Lines					
Improved ADB[d]	18.00	0.30[c]	0.80	1.10	Five per cent surcharge on variable costs.
Articulated Buses	18.00	0.42	1.03	1.45	

(a) These factors are applied to an estimate of total scheduled hours and miles, including pull-out and pull-in times and mileages. See Tech. Memo 3, "Methodology for Developing Transit System Operating Data", Appendix A, item 1.

(b) Does not include fuel tax. SCRTD system fuel cost per mile is increased by dominance of high-density local lines in Los Angeles. Other operators' fuel costs appear representative of freeway conditions and also of older, pre-ADB fuel-efficient buses.

(c) Assumed 1995 fuel costs, 50 per cent above 1980 prices.

(d) Assumes that future generations of Advanced Design Buses (ADB's) will be comparable to older "new look" designs.

The $18.00 unit cost value related to bus hours in the formula represents operator wages and fringes and other direct operating costs such as line supervision and dispatching. The operator wages include pay for non-driving time such as being a witness in court, training, and standby (extra board) time, and the pay for this time is allocated to on-duty hours. Fringes include sick leave, vacation, holidays (including premium pay for holiday work), military leave and jury duty. Such absent-from-work time has a value of about 14 per cent of SCRTD operators' total pay. Private sector fringes include pension contributions, health care and insurance, uniform allowances, and workmen's compensation. Private sector fringes include only social security, SDI, and workmen's compensation taxes.

The use of "bus hours" as a parameter rather than "pay hours" implies that premium time will be uniformly distributed in the future, whereas in the past (before part-time drivers could be employed by SCRTD) the peak-hour express lines had an unusually high ratio of pay hours to bus hours.

Fuel and lubricants costs were related to bus miles, with a different coefficient being assumed for articulated and single-unit buses, and for freeway and local street service.

The unit factor for "other costs" represent the costs of parts, mechanics' time, tires, other vehicle maintenance items, and the general-administrative portion of casualty and liability costs. SCRTD is self-insured and has a staff of attorneys to defend the district in lawsuits. These casualty and liability costs arise mainly from SCRTD bus accidents (employees are covered by workmen's compensation), and they are therefore allocated to bus miles -- an index of accident exposure. The overhead cost factor assumes that approximately 5 per cent of system operating costs represent overheads which vary with on-the road vehicle miles and vehicle hours. This assumption is consistent with the approach used to develop rail operating

costs. The other overhead costs (from 11 to 25 per cent of the total) were assumed to be independent of the choice of mode for this project.

Additional details concerning the derivation of the cost formulae used are contained in Technical Memorandum No. 10.[18]

Estimated Annual O&M Costs - Harbor Freeway Corridor

Tables 52 to 62 summarize the estimates of annual operating costs (operations and maintenance) which were developed for the the primary Harbor Corridor alternatives by applying the costing procedures described above in conjunction with operating statistics documented in Chapter III. Costs for rail and bus system elements are shown separately. A comparative summary is provided in Table 63.

(18) Technical Memorandum No. 10, estimating Bus Service Operating Costs for I-110/I-5 Freeway Corridor Studies, Wilbur Smith and Associates.

Table 52

SUMMARY OF OPERATING STATISTICS AND COSTS
HARBOR FREEWAY CORRIDOR

NO-BUILD ALTERNATIVE (A-1)

CATEGORY	LINE HAUL	FEEDER	BACKGROUND	TOTAL PLAN
Daily Rail Car Miles	--	NA	NA	--
Daily Train Hours	--	NA	NA	--
Daily ADB Bus Miles	3,371	--	94,961	93,332
Daily ARTIC Bus Miles	14,377	--	--	14,377
Total Daily Bus Miles	17,748		94,961	112,709
Daily ADB Bus Hours	200.6	--	7,403.2	7,603.8
Daily ARTIC Bus Hours	840.0	--	--	840.0
Total Daily Bus Hours	1,040.6	--	7,403.2	9,283.8
Peak Rail Car Requirement	--	--	--	--
Peak ADB Bus Requirement	27	--	551	578
Peak ARTIC Bus Requirement	97	--	--	97
Annual Cost - Rail	--	NA	NA	--
Annual Cost - Bus	$ 13,429,000	--	$76,877,000	$76,877,000
Total Annual Cost	$ 13,429,000	--	$76,877,000	$90,306,000

Table 53

SUMMARY OF OPERATING STATISTICS AND COSTS
HARBOR FREEWAY CORRIDOR

TSM ALTERNATIVE (A-2)

CATEGORY	LINE HAUL	FEEDER	BACKGROUND	TOTAL PLAN
Daily Rail Car Miles	--	NA	NA	--
Daily Train Hours	--	NA	NA	--
Daily ADB Bus Miles	3,877	--	109,205	113,082
Daily ARTIC Bus Miles	26,840	--	--	26,840
Total Daily Bus Miles	30,717	--	109,205	139,922
Daily ADB Bus Hours	230.7	--	8,513.7	8,744.4
Daily ARTIC Bus Hours	1,595.9	--	--	1,595.9
Total Daily Bus Hours	1,826.6	--	8,513.7	10,340.3
Peak Rail Car Requirement	--	--	--	--
Peak ADB Bus Requirement	29	--	634	663
Peak ARTIC Bus Requirement	150	--	--	150
Annual Cost - Rail	--	NA	NA	--
Annual Cost - Bus	$ 26,656,000	--	$ 88,409,000	$115,065,000
Total Annual Cost	$ 26,656,000	--	$ 88,409,000	$115,065,000

Table 54

SUMMARY OF OPERATING STATISTICS AND COSTS
HARBOR FREEWAY CORRIDOR

TWO-WAY BUSWAY (A-3a)

CATEGORY	LINE HAUL	FEEDER	BACKGROUND	TOTAL PLAN
Daily Rail Car Miles	--	NA	NA	--
Daily Train Hours	--	NA	NA	--
Daily ADB Bus Miles	--	15,892	109,205	125,097
Daily ARTIC Bus Miles	28,382	--	--	28,382
Total Daily Bus Miles	28,382	15,892	109,205	153,479
Daily ADB Bus Hours	--	1,077.1	8,513.7	9,590.8
Daily ARTIC Bus Hours	1,386.6	--	--	1,386.6
Total Daily Bus Hours	1,386.6	1,077.1	8,513.7	10,977.4
Peak Rail Car Requirement	--	--	--	--
Peak ADB Bus Requirement	--	101	634	735
Peak ARTIC Bus Requirement	174	--	--	174
Annual Cost - Rail	--	NA	NA	--
Annual Cost - Bus	$ 20,186,000	$ 11,822,000	$ 88,409,000	$120,417,000
Total Annual Cost	$ 20,186,000	$ 11,822,000	$ 88,409,000	$120,417,000

Table 55

SUMMARY OF OPERATING STATISTICS AND COSTS
HARBOR FREEWAY CORRIDOR

PEAK DIRECTION BUSWAY (A-3c)

CATEGORY	LINE HAUL	FEEDER	BACKGROUND	TOTAL PLAN
Daily Rail Car Miles	--	NA	NA	--
Daily Train Hours	--	NA	NA	--
Daily ADB Bus Miles	--	15,128	109,205	124,333
Daily ARTIC Bus Miles	28,974	--	--	28,974
Total Daily Bus Miles	28,974	15,128	109,205	153,307
Daily ADB Bus Hours	--	1,029.9	8,513.7	9,543.6
Daily ARTIC Bus Hours	1,480.9	--	--	1,480.9
Total Daily Bus Hours	1,480.9	1,029.9	8,513.7	11,024.5
Peak Rail Car Requirement	--	--	--	--
Peak ADB Bus Requirement	--	93	634	727
Peak ARTIC Bus Requirement	185	--	--	185
Annual Cost - Rail	--	NA	NA	--
Annual Cost - Bus	$ 20,985,000	$ 11,276,000	$ 88,409,000	$102,670,000
Total Annual Cost	$ 20,985,000	$ 11,276,000	$ 88,409,000	$120,670,000

Table 56a

SUMMARY OF OPERATING STATISTICS AND COSTS
HARBOR FREEWAY CORRIDOR

ICTS FULL SERVICE (A-4a)

CATEGORY	LINE HAUL	FEEDER	BACKGROUND	TOTAL PLAN
Daily Rail Car Miles	53,700	NA	NA	53,700
Daily Train Hours	503.0	NA	NA	503.0
Daily ADB Bus Miles	--	15,615	109,205	124,820
Daily ARTIC Bus Miles	8,551	--	--	8,551
Total Daily Bus Miles	8,551	15,615	109,205	133,371
Daily ADB Bus Hours	--	1,108.1	8,513.7	9,621.8
Daily ARTIC Bus Hours	364.2	--	--	364.2
Total Daily Bus Hours	364.2	1,108.1	8,513.7	9,986.0
Peak Rail Car Requirement	120	--	--	120
Peak ADB Bus Requirement	--	102	634	736
Peak ARTIC Bus Requirement	45	--	--	45
Annual Cost - Rail	$ 30,389,000	NA	NA	$ 30,389,000
Annual Cost - Bus	$ 5,798,000	$ 11,950,000	$ 88,409,000	$106,157,000
Total Annual Cost	$ 36,187,000	$ 11,950,000	$ 88,409,000	$136,546,000

Table 56b

HARBOR FREEWAY CORRIDOR RAIL TRANSIT ALTERNATIVES
ESTIMATED MANPOWER REQUIREMENTS ICTS FULL SERVICE ALTERNATIVE

Department/Function	Estimated Manpower	
Transportation:		
Operators (including supervision)	144	
Dispatching and Control	26	
Passenger Services	21	
Security	44	
Revenue Collection	20	
Car Marshalling	10	
Traffic	5	
Supervision	7	
Total Transportation		277
Maintenance-of-Equipment:		
Foremen	12	
Mechanics	42	
Electricians	42	
Welders	2	
Machinists	4	
Air Conditioning Electricians	8	
Electronic Technicians	33	
Car Cleaners	24	
Storekeepers	5	
Clerks	4	
Supervision and Other	6	
Total Maintenance-of-Equipment		182
Maintenance-of-Way and Structures:		
Trackwork	37	
Power and Signal System	56	
Station Cleaning	19	
Fare Collection Equipment	20	
Total Maintenance-of-Way & Structures		132
General and Administrative:		
System Management	3	
Personnel	4	
Accounting	13	
Purchasing	6	
Planning and Scheduling	2	
Safety	4	
Total General and Administrative		32
Total Employees		623

Table 56c

ESTIMATED COSTS OF OPERATIONS AND MAINTENANCE
HARBOR CORRIDOR, ICTS FULL SERVICE ALTERNATIVE

Cost Category:	No. of Employees	Annual Cost
Transportation.	277	$8,415,400
Maintenance-of-Equipment.	182	8,561,100
Maintenance-of-Way.	132	5,237,400
Electrical Energy.		4,602,000
Injuries and Damages.		2,360,000
General and Administrative.	32	1,213,300
Totals	623	$30,389,200

Estimated Annual Operating Statistics:	
Cycle Time, min.	83
Peak Headway, min.	2
Base Headway, min.	3
Annual Revenue Train-Hours (000).	154.9
Annual Car-Miles (000,000).	16.54
Annual Passenger-Space-Miles (000,000).	795.9
Annual Passengers (000,000).	40.6
Annual Gross Ton-Miles (000,000).	352.8
Fleet Size, vehicles.	138
Route-Miles	25

Estimated Average Cost Per:	
Revenue Car-Mile, $.	1.84
Passenger Space-Mile, ¢.	3.8
Passenger, ¢.	75
Employee, $000.	48.8

Table 57a

SUMMARY OF OPERATING STATISTICS AND COSTS
HARBOR FREEWAY CORRIDOR
ICTS WITH TURNBACKS (A-4b)

CATEGORY	LINE HAUL	FEEDER	BACKGROUND	TOTAL PLAN
Daily Rail Car Miles	41,006	NA	NA	41,006
Daily Train Hours	454	NA	NA	454
Daily ADB Bus Miles	--	15,615	109,205	124,820
Daily ARTIC Bus Miles	8,551	--	--	8,551
Total Daily Bus Miles	8,551	15,615	109,205	133,371
Daily ADB Bus Hours	--	1,108.1	8,513.7	9,621.8
Daily ARTIC Bus Hours	364.2	--	--	364.2
Total Daily Bus Hours	364.2	1,108.1	8,513.7	9,986.0
Peak Rail Car Requirement	102	--	--	102
Peak ADB Bus Requirement	--	102	634	736
Peak ARTIC Bus Requirement	45	--	--	45
Annual Cost - Rail	$26,362,500	NA	NA	$ 26,362,500
Annual Cost - Bus	$ 5,798,000	$ 11,950,000	$ 88,409,000	$106,157,000
Total Annual Cost	$32,160,500	$ 11,950,000	$ 88,409,000	$132,519,500

Table 57b

HARBOR CORRIDOR ICTS ALTERNATIVE, ARTESIA TURNBACKS
ESTIMATED MANPOWER REQUIREMENTS

Department/Function	Estimated Manpower	
Transportation:		
Operators (including supervision)	130	
Dispatching and Control	26	
Passenger Services	21	
Security	44	
Revenue Collection	20	
Car Marshalling	10	
Traffic	5	
Supervision	7	
Total Transportation		263
Maintenance-of-Equipment:		
Foremen	10	
Mechanics	32	
Electricians	32	
Welders	2	
Machinists	2	
Air Conditioning Electricians	7	
Electronic Technicians	28	
Car Cleaners	20	
Storekeepers	4	
Clerks	3	
Supervision and Other	3	
Total Maintenance-of-Equipment		143
Maintenance-of-Way and Structures:		
Trackwork	34	
Power and Signal System	56	
Station Cleaning	19	
Fare Collection Equipment	20	
Total Maintenance-of-Way & Structures		129
General and Administrative:		
System Management	3	
Personnel	4	
Accounting	13	
Purchasing	6	
Planning and Scheduling	2	
Safety	4	
Total General and Administrative		32
Total Employees		567

Table 57c

ESTIMATED COSTS OF OPERATIONS AND MAINTENANCE
HARBOR FREEWAY CORRIDOR ICTS ALTERNATIVE, ARTESIA TURNBACKS

Cost Category:	No. of Employees	Annual Cost
Transportation.	263	$7,988,200
Maintenance-of-Equipment.	143	6,456,000
Maintenance-of-Way.	129	5,100,000
Electrical Energy.		3,481,000
Injuries and Damages.		2,124,000
General and Administrative	32	1,213,300
Totals	567	$26,362,500

Estimated Annual Operating Statistics	North of Artesia	South of Artesia
Cycle Time, min.	59	87
Peak Headway, min.	3	8.5
Base Headway, min.	3.5	10
Route Miles	14.6	25
Annual Revenue Train-Hours (000).	139.9	
Annual Car-Miles (000,000).	12.63	
Annual Passenger-Space-Miles (000,000).	608.8	
Annual Passengers.	40.6	
Annual Gross Ton-Miles (000,000).	282.4	
Fleet Size, vehicles.	118	
Estimated Average Cost Per:		
Revenue Car-Mile, $.	2.09	
Passenger Space-Mile, ¢.	4.3	
Passenger, ¢.	65	
Employee, $000.	46.5	

Table 58a

SUMMARY OF OPERATING STATISTICS AND COSTS
HARBOR FREEWAY CORRIDOR

LRT-FULL SERVICE (A-5b)

CATEGORY	LINE HAUL	FEEDER	BACKGROUND	TOTAL PLAN
Daily Rail Car Miles	18,300	NA	NA	18,300
Daily Train Hours	133.8	NA	NA	133.8
Daily ADB Bus Miles	--	18,102	109,205	127,307
Daily ARTIC Bus Miles	8,551	--	--	8,551
Total Daily Bus Miles	8,551	18,102	109,205	135,858
Daily ADB Bus Hours	--	1,391.0	8,513.7	9,904.7
Daily ARTIC Bus Hours	364.2	--	--	362.4
Total Daily Bus Hours	364.2	1,391.0	8,513.7	10,268.9
Peak Rail Car Requirement	56	--	--	56
Peak ADB Bus Requirement	--	129	634	763
Peak ARTIC Bus Requirement	45	--	--	45
Annual Cost - Rail	$ 16,406,000	NA	NA	$ 16,406,000
Annual Cost - Bus	$ 5,798,000	$ 14,482,000	$ 88,409,000	$108,689,000
Total Annual Cost	$ 22,204,000	$ 14,482,000	$ 88,409,000	$125,095,000

Table 58b
Harbor Freeway Corridor Rail Transit Alternatives
Estimated Manpower Requirements; LRT Full Service Alternative

Department/Function	Estimated Manpower	
Transportation:		
Operators (including supervision)	39	
Dispatching and Control	17	
Passenger Services	14	
Security	30	
Revenue Collection	12	
Car Marshalling	7	
Traffic	2	
Supervision	3	
Total Transportation		124
Maintenance-of-Equipment:		
Foremen	9	
Mechanics	20	
Electricians	20	
Welders	1	
Machinists	2	
Air Conditioning Electricians	5	
Electronic Technicians	16	
Car Cleaners	12	
Storekeepers	3	
Clerks	1	
Supervision and Other	4	
Total Maintenance-of-Equipment		93
Maintenance-of-Way and Structures:		
Trackwork	37	
Power and Signal System	41	
Station Cleaning	13	
Fare Collection Equipment	14	
Total Maintenance-of-Way & Structures		105
General and Administrative:		
System Management	2	
Personnel	2	
Accounting	8	
Purchasing	4	
Planning and Scheduling	2	
Safety	2	
Total General and Administrative		20
Total Employees		342

Table 58c
Estimated Costs of Operations and Maintenance
Harbor Corridor, LRT Full Service Alternative

Cost Category:	No. of Employees	Annual Cost
Transportation.	124	$3,810,500
Maintenance-of-Equipment.	93	4,080,800
Maintenance-of-Way.	105	3,894,900
Electrical Energy.		2,653,200
Injuries and Damages.		1,180,000
General and Administrative.	20	786,600
Totals	342	$16,406,000

Estimated Annual Operating Statistics:

Cycle Time, min.	73
Peak Headway, min.	5.5
Base Headway, min.	15
Annual Revenue Train-Hours (000).	41.2
Annual Car-Miles (000,000).	5.64
Annual Passenger-Space-Miles (000,000).	648.3
Annual Passengers (000,000).	25.3
Annual Gross Ton-Miles (000,000).	268.2
Fleet Size, vehicles.	65
Route-Miles	23

Estimated Average Light Rail Cost Per:

Revenue Car-Mile, $.	2.91
Passenger Space-Mile, ¢.	2.5
Passenger, ¢.	65
Employee, $000.	48.0

Table 59a

SUMMARY OF OPERATING STATISTICS AND COSTS
HARBOR FREEWAY CORRIDOR

LRT WITH TURNBACKS (A-5c)

CATEGORY	LINE HAUL	FEEDER	BACKGROUND	TOTAL PLAN
Daily Rail Car Miles	16,201	NA	NA	16,201
Daily Train Hours	120	NA	NA	120
Daily ADB Bus Miles	--	18,102	109,205	127,307
Daily ARTIC Bus Miles	8,551	--	--	8,551
Total Daily Bus Miles	8,551	18,102	109,205	135,858
Daily ADB Bus Hours	--	1,391.0	8,513.7	9,904.7
Daily ARTIC Bus Hours	364.2	--	--	364.2
Total Daily Bus Hours	364.2	1,391.0	8,513.7	10,268.9
Peak Rail Car Requirement	56	--	--	56
Peak ADB Bus Requirement	--	129	634	763
Peak ARTIC Bus Requirement	45	--	--	45
Annual Cost - Rail	$ 15,469,500	NA	NA	$ 15,469,500
Annual Cost - Bus	$ 5,798,000	$ 14,482,000	$ 88,409,000	$108,689,000
Total Annual Cost	$ 21,267,500	$ 14,482,000	$ 88,409,000	$124,158,500

Table 59b
Harbor Corridor LRT Alternative, Artesia Turnbacks
Estimated Manpower Requirements

Department/Function	Estimated Manpower	
Transportation:		
Operators (including supervision)	36	
Dispatching and Control	17	
Passenger Services	14	
Security	30	
Revenue Collection	12	
Car Marshalling	7	
Traffic	2	
Supervision	3	
Total Transportation		121
Maintenance-of-Equipment:		
Foremen	9	
Mechanics	20	
Electricians	20	
Welders	1	
Machinists	2	
Air Conditioning Electricians	5	
Electronic Technicians	16	
Car Cleaners	12	
Storekeepers	3	
Clerks	1	
Supervision and Other	4	
Total Maintenance-of-Equipment		93
Maintenance-of-Way and Structures:		
Trackwork	30	
Power and Signal System	38	
Station Cleaning	13	
Fare Collection Equipment	14	
Total Maintenance-of-Way & Structures		95
General and Administrative:		
System Management	2	
Personnel	2	
Accounting	8	
Purchasing	4	
Planning and Scheduling	2	
Safety	2	
Total General and Administrative		20
Total Employees		329

Table 59c
Estimated Costs of Operations and Maintenance
Harbor Freeway Corridor, LRT Alternative, Artesia Turnbacks

Cost Category:	No. of Employees	Annual Cost
Transportation.	121	$3,715,500
Maintenance-of-Equipment.	93	3,718,200
Maintenance-of-Way.	95	3,720,300
Electrical Energy.		2,348,900
Injuries and Damages.		1,180,000
General and Administrative	20	786,600
Totals	329	$15,469,500

Estimated Annual Operating Statistics	North of Artesia	South of Artesia
Cycle Time, min.	43	73
Peak Headway, min.	5.5	8.5
Base Headway, min.	15	15
Route Miles	12.0	22.9
Annual Revenue Train-Hours (000).	37.0	
Annual Car-Miles (000,000).	4.99	
Annual Passenger-Space-Miles (000,000).	597.7	
Annual Passengers (000,000).	25.3	
Annual Gross Ton-Miles (000,000).	241.1	
Fleet Size, vehicles.	65	
Estimated Average Cost Per:		
Revenue Car-Mile, $.	3.10	
Passenger Space-Mile, ¢.	2.6	
Passenger, ¢.	61	
Employee, $000.	47.0	

Table 60a

SUMMARY OF OPERATING STATISTICS AND COSTS
HARBOR FREEWAY CORRIDOR

VERMONT HRT-FULL SERVICE (A-6a)

CATEGORY	LINE HAUL	FEEDER	BACKGROUND	TOTAL PLAN
Daily Rail Car Miles	24,500	NA	NA	24,500
Daily Train Hours	123.4	NA	NA	123.4
Daily ADB Bus Miles	--	15,949	109,205	125,154
Daily ARTIC Bus Miles	8,551	--	--	8,551
Total Daily Bus Miles	8,551	15,949	109,205	133,705
Daily ADB Bus Hours	--	1,115.0	8,513.7	9,628.7
Daily ARTIC Bus Hours	364.2	--	--	364.2
Total Daily Bus Hours	364.2	1,115.0	8,513.7	9,992.9
Peak Rail Car Requirement	53	--	--	53
Peak ADB Bus Requirement	--	106	634	740
Peak ARTIC Bus Requirement	45	--	--	45
Annual Cost - Rail	$ 20,519,000	NA	NA	$ 20,519,000
Annual Cost - Bus	$ 5,798,000	$ 12,109,000	$ 88,409,000	$106,316,000
Total Annual Cost	$ 26,317,000	$ 12,109,000	$ 88,409,000	$126,835,000

Table 60b
Vermont HRT Full Service Alternative
Estimated Manpower Requirements

Department/Function	Estimated Manpower	
Transportation:		
Operators (including supervision)	35	
Dispatching and Control	19	
Passenger Services	21	
Security	44	
Revenue Collection	20	
Car Marshalling	7	
Traffic	2	
Supervision	5	
Total Transportation		153
Maintenance-of-Equipment:		
Foremen	9	
Mechanics	19	
Electricians	18	
Welders	1	
Machinists	1	
Air Conditioning Electricians	4	
Electronic Technicians	17	
Car Cleaners	11	
Storekeepers	3	
Clerks	2	
Supervision and Other	3	
Total Maintenance-of-Equipment		88
Maintenance-of-Way and Structures:		
Trackwork	37	
Power and Signal System	42	
Station Cleaning	19	
Fare Collection Equipment	20	
Total Maintenance-of-Way & Structures		118
General and Administrative:		
System Management	2	
Personnel	2	
Accounting	12	
Purchasing	4	
Planning and Scheduling	2	
Safety	2	
Total General and Administrative		24
Total Employees		383

Table 60c
Estimated Costs of Operations and Maintenance
Vermont Avenue Alignment, HRT Full Service Alternative

Cost Category:	No. of Employees	Annual Cost
Transportation.	153	$4,758,300
Maintenance-of-Equipment.	88	4,084,300
Maintenance-of-Way.	118	4,619,600
Electrical Energy.		4,567,450
Injuries and Damages.		1,534,000
General and Administrative.	24	955,400
Totals	383	$20,519,050

Estimated Annual Operating Statistics:

Cycle Time, min.	84
Peak Headway, min.	10
Base Headway, min.	12
Annual Revenue Train-Hours (000).	38.0
Annual Car-Miles (000,000).	7.55
Annual Passenger-Space-Miles (000,000).	816.7
Annual Gross Ton-Miles (000,000).	344.6
Fleet Size, vehicles.	61
Employees.	396
Route-Miles.	24

Estimated Average Cost Per:

Revenue Car-Mile, $.	2.72
Passenger Space-Mile, ¢.	2.5
Employee, $000.	53.5

Table 61a

SUMMARY OF OPERATING STATISTICS AND COSTS
HARBOR FREEWAY CORRIDOR

VERMONT HRT WITH TURNBACKS (A-6b)

CATEGORY	LINE HAUL	FEEDER	BACKGROUND	TOTAL PLAN
Daily Rail Car Miles	21,104	NA	NA	
Daily Train Hours	167.5	NA	NA	
Daily ADB Bus Miles	--	15,949	109,205	125,154
Daily ARTIC Bus Miles	8,551	--	--	8,551
Total Daily Bus Miles	8,551	15,949	109,205	133,705
Daily ADB Bus Hours	--	1,115.0	8,513.7	9,628.7
Daily ARTIC Bus Hours	364.2	--	--	364.2
Total Daily Bus Hours	364.2	1,115.0	8,513.7	9,992.9
Peak Rail Car Requirement	53	--	--	
Peak ADB Bus Requirement	--	106	634	740
Peak ARTIC Bus Requirement	45	--	--	45
Annual Cost - Rail	$ 20,127,300	NA	NA	$ 20,127,300
Annual Cost - Bus	$ 5,798,000	$ 12,109,000	$ 88,409,000	$106,316,000
Total Annual Cost	$ 25,925,300	$ 12,109,000	$ 88,409,000	$126,443,300

Table 61b
Vermont HRT Alternative, Artesia Turnbacks
Estimated Manpower Requirements

Department/Function	Estimated Manpower	
Transportation:		
Operators (including supervision)	48	
Dispatching and Control	19	
Passenger Services	21	
Security	44	
Revenue Collection	20	
Car Marshalling	7	
Traffic	2	
Supervision	5	
Total Transportation		166
Maintenance-of-Equipment:		
Foremen	9	
Mechanics	19	
Electricians	18	
Welders	1	
Machinists	1	
Air Conditioning Electricians	4	
Electronic Technicians	17	
Car Cleaners	11	
Storekeepers	3	
Clerks	2	
Supervision and Other	3	
Total Maintenance-of-Equipment		88
Maintenance-of-Way and Structures:		
Trackwork	37	
Power and Signal System	42	
Station Cleaning	19	
Fare Collection Equipment	20	
Total Maintenance-of-Way & Structures		118
General and Administrative:		
System Management	2	
Personnel	2	
Accounting	12	
Purchasing	4	
Planning and Scheduling	2	
Safety	2	
Total General and Administrative		24
Total Employees		396

Table 61c
Estimated Costs of Operations and Maintenance
Vermont Avenue Alignment, HRT Alternative, Artesia Turnbacks

Cost Category:	No. of Employees	Annual Cost
Transportation.	166	$5,141,200
Maintenance-of-Equipment.	88	3,945,900
Maintenance-of-Way.	118	4,619,600
Electrical Energy.		3,931,200
Injuries and Damages.		1,534,000
General and Administrative	24	955,400
Totals	396	$20,127,300

Estimated Annual Operating Statistics	North of Artesia	South of Artesia
Cycle Time, min.	53	84
Peak Headway, min.	10	15
Base Headway, min.	15	15
Route Miles	15	24
Annual Revenue Train-Hours (000).	51.6	
Annual Car-Miles (000,000).	6.5	
Annual Passenger-Space-Miles (000,000).	713.2	
Annual Gross Ton-Miles (000,000).	306.0	
Fleet Size, vehicles.	61	
Estimated Average Cost Per:		
Revenue Car-Mile, $.	3.10	
Passenger Space-Mile, ¢.	2.8	
Employee, $000.	50.8	

Table 62

ESTIMATED COST OF "BACKGROUND" SERVICE

Harbor Freeway Corridor

ALTERNATIVE	ANNUAL COST OF BACKGROUND SERVICE
No Build	$ 76,877,000
TSM	$ 88,409,000
Two-Way Busway	$ 88,409,000
Reversible Busway	$ 88,409,000
LRT	$ 88,409,000
ICTS	$ 88,409,000
Vermont HRT	$ 88,409,000

Table 63

SUMMARY COST COMPARISON OF ALTERNATIVES

Harbor Freedor Corridor

Alternative	Annual Cost (Thousands of Dollars)			
	Line Haul	Feeder	Background	Total Corridor
No-Build	13,429	-	76,877	90,306
TSM	26,656	-	88,409	115,065
Two Way Busway	20,186	11,822	88,409	120,417
Peak Direction Busway	20,985	11,276	88,409	120,670
LRT Full Service	22,204	14,482	88,409	125,095
LRT With Turnbacks	21,268	14,482	88,409	124,159
ICTS Full Service	36,187	11,950	88,409	136,546
ICTS With Turnbacks	32,161	11,950	88,409	132,520
Vermont HRT - Full Service	26,317	12,109	88,409	126,835
Vermont HRT with Turnbacks	25,925	12,109	88,409	126,443

Estimated Annual O & M Costs - Santa Ana Freeway Corridor

Tables 64 to 70 summarize the resulting estimates of annual operating costs for Santa Ana Freeway Corridor alternatives. A comparative summary is provided in Table 71.

Table 64

SUMMARY OF OPERATING STATISTICS AND COSTS

SANTA ANA FREEWAY CORRIDOR

NO-BUILD ALTERNATIVE (B-1)

Category	Line Haul	Feeder	Background	Total Corridor
Daily Rail Car Miles	-	NA	NA	-
Daily Train Hours	-	NA	NA	-
Daily ADB Bus Miles	-	8,075	29,689	37,764
Daily ARTIC Bus Miles	6,516	-	-	6,516
Total Daily Bus Miles	6,516	8,075	29,689	44,280
Daily ADB Bus Hours	-	620.4	2,044.7	2,665.1
Daily ARTIC Bus Hours	341.0	-	-	341.0
Total Daily Bus Hours	341.0	620.4	2,044.7	3,006.1
Peak Rail Car Requirement	-	-	-	-
Peak ADB Bus Requirement	-	43	154	197
Peak ARTIC Bus Requirement	40	-	-	40
Annual Cost - Rail	-	NA	NA	-
Annual Cost - Bus	$4,816,000	$6,743,000	$22,464,000	$34,023,000
Total Annual Cost	$4,816,000	$6,743,000	$22,464,000	$34,023,000

Table 65

SUMMARY OF OPERATING STATISTICS AND COSTS

SANTA ANA FREEWAY CORRIDOR

TSM ALTERNATIVE (B-2)

Category	Line Haul	Feeder	Background	Total Corridor
Daily Rail Car Miles	-	NA	NA	-
Daily Train Hours	-	NA	NA	-
Daily ADB Bus Miles	-	8,525	34,142	42,667
Daily ARTIC Bus Miles	7,697	-	-	7,697
Total Daily Bus Miles	7,697	8,525	34,142	
Daily ADB Bus Hours	-	652.0	2,351.4	3,003.4
Daily ARTIC Bus Hours	362.8	-	-	362.8
Total Daily Bus Hours	362.8	652.0	2,351.4	3,366.2
Peak Rail Car Requirement	-	-	-	-
Peak ADB Bus Requirement	-	47	177	224
Peak ARTIC Bus Requirement	42	-	-	42
Annual Cost - Rail	-	NA	NA	
Annual Cost - Bus	$5,392,000	$6,816,000	$25,834,000	$38,042,000
Total Annual Cost	$5,392,000	$6,816,000	$25,834,000	$38,042,000

Table 66a

SUMMARY OF OPERATING STATISTICS AND COSTS

SANTA ANA FREEWAY CORRIDOR

ICTS ALTERNATIVE (B-3)

Category	Line Haul	Feeder	Background	Total Corridor
Daily Rail Car Miles	36,136	NA	NA	
Daily Train Hours	335	NA	NA	
Daily ADB Bus Miles	-	16,327	34,142	50,469
Daily ARTIC Bus Miles	-	-	-	-
Total Daily Bus Miles	-	16,327	34,142	50,469
Daily ADB Bus Hours	-	1,167.2	2,351.4	3,518.6
Daily ARTIC Bus Hours	-	-	-	-
Total Daily Bus Hours	-	1,167.2	2,351.4	3,518.6
Peak Rail Car Requirement	75	-	-	-
Peak ADB Bus Requirement	-	99	177	276
Peak ARTIC Bus Requirement	-	-	-	-
Annual Cost - Rail	$20,261,000	NA	NA	$20,261,000
Annual Cost - Bus	-	$12,501,000	$25,384,000	$37,885,000
Total Annual Cost	$20,261,000	$12,501,000	$25,384,000	$58,146,000

Table 66b

Estimated Rail Manpower Requirements;

ITCS Alternative (Full Service)

Santa Ana Freeway Corridor

Department/Function	Estimated Manpower	
Transportation:		
Operators (including supervision)	95	
Dispatching and Control	19	
Passenger Services	15	
Security	34	
Revenue Collection	13	
Car Marshalling	9	
Traffic	4	
Supervision	5	
Total Transportation		194
Maintenance-of-Equipment:		
Foremen	9	
Mechanics	27	
Electricians	27	
Welders	1	
Machinists	2	
Air Conditioning Electricians	6	
Electronic Technicians	20	
Car Cleaners	15	
Storekeepers	5	
Clerks	2	
Supervision and Other	4	
Total Maintenance-of-Equipment		118
Maintenance-of-Way and Structures:		
Trackwork	29	
Power and Signal System	43	
Station Cleaning	14	
Fare Collection Equipment	14	
Total Maintenance-of-Way & Structures		100
General and Administrative:		
System Management	3	
Personnel	3	
Accounting	8	
Purchasing	5	
Planning and Scheduling	2	
Safety	3	
Total General and Administrative		24
Total Employees		436

Table 66c

Estimated Costs of Rail Operations and Maintenance

ITCS Alternative (Full Service)

Santa Ana Freeway Corridor

Cost Category:	No. of Employees	Annual Cost
Transportation.	194	$5,976,400
Maintenance-of-Equipment.	118	5,668,000
Maintenance-of-Way.	100	3,888,100
Electrical Energy.		2,206,500
Injuries and Damages.		1,557,600
General and Administrative.	24	965,300
Totals	436	$20,261,900

Estimated Annual Operating Statistics:

Cycle Time, min.	65
Peak Headway, min.	3
Base Headway, min.	3.5
Annual Revenue Train-Hours (000).	103.2
Annual Car-Miles (000,000).	11.13
Annual Passenger-Space-Miles (000,000).	528.1
Annual Passengers (000,000).	25.9
Annual Gross Ton-Miles (000,000).	229.2
Fleet Size, vehicles.	87
Route-Miles	21

Estimated Average Cost Per:

Revenue Car-Mile, $.	1.82
Passenger Space-Mile, ¢.	3.8
Passenger, ¢.	78
Employee, $000.	46.5

Table 67a

SUMMARY OF OPERATING STATISTICS AND COSTS

SANTA ANA FREEWAY CORRIDOR

LRT ALTERNATIVE (B-4)

Category	Line Haul	Feeder	Background	Total Corridor
Daily Rail Car Miles	15,260	NA	NA	15,260
Daily Train Hours	149	NA	NA	149
Daily ADB Bus Miles	-	16,327	34,142	66,796
Daily ARTIC Bus Miles	-	-	-	-
Total Daily Bus Miles	-	16,327	34,142	50,469
Daily ADB Bus Hours	-	1,167.2	2,351.4	3,518.6
Daily ARTIC Bus Hours	-	-	-	-
Total Daily Bus Hours	-	1,167.2	2,351.4	3,518.6
Peak Rail Car Requirement	49	-	-	49
Peak ADB Bus Requirement	-	99	177	276
Peak ARTIC Bus Requirement	-	-	-	-
Annual Cost - Rail	$15,361,800	NA	NA	$15,361,800
Annual Cost - Bus	-	$12,501,000	$25,834,000	$38,335,000
Total Annual Cost	$15,361,800	$12,501,000	$25,834,000	$53,696,800

Table 67b

Esitmated Rail Manpower Requirements:

LRT Alternative (Full Service)

Santa Ana Freeway Corridor

Department/Function	Estimated Manpower	
Transportation:		
Operators (including supervision)	44	
Dispatching and Control	17	
Passenger Services	14	
Security	30	
Revenue Collection	12	
Car Marshalling	7	
Traffic	2	
Supervision	3	
Total Transportation		129
Maintenance-of-Equipment:		
Foremen	9	
Mechanics	19	
Electricians	19	
Welders	1	
Machinists	2	
Air Conditioning Electricians	5	
Electronic Technicians	15	
Car Cleaners	11	
Storekeepers	3	
Clerks	2	
Supervision and Other	3	
Total Maintenance-of-Equipment		89
Maintenance-of-Way and Structures:		
Trackwork	29	
Power and Signal System	36	
Station Cleaning	13	
Fare Collection Equipment	13	
Total Maintenance-of-Way & Structures		91
General and Administrative:		
System Management	2	
Personnel	2	
Accounting	8	
Purchasing	4	
Planning and Scheduling	2	
Safety	2	
Total General and Administrative		20
Total Employees		329

Table 67c

Estimated Costs of Rail Operations and Maintenance

LRT Alternative (Full Service)

Santa [illegible] Freeway Corridor

Cost Category:	No. of Employees	Annual Cost
Transportation.	129	$3,959,300
Maintenance-of-Equipment.	89	3,804,700
Maintenance-of-Way.	91	3,540,900
Electrical Energy.		2,090,300
Injuries and Damages.		1,180,000
General and Administrative.	20	786,600
Totals	329	$15,361,800

Estimated Annual Operating Statistics:

Cycle Time, min.	68
Peak Headway, min.	5
Base Headway, min.	10
Annual Revenue Train-Hours (000).	45.9
Annual Car-Miles (000,000).	4.7
Annual Passenger-Space-Miles (000,000).	537.5
Annual Passengers (000,000).	25.9
Annual Gross Ton-Miles (000,000).	226.8
Fleet Size, vehicles.	57
Route-Miles	21

Estimated Average Cost Per:

Revenue Car-Mile, $.	3.27
Passenger Space-Mile, ¢.	2.9
Passenger, ¢.	59
Employee, $000.	46.7

Table 68

SUMMARY OF OPERATING STATISTICS AND COSTS

SANTA ANA FREEWAY CORRIDOR

TWO WAY BUSWAY (B-5a)

Category	Line Haul	Feeder	Background	Total Corridor
Daily Rail Car Miles	-	NA	NA	-
Daily Train Hours	-	NA	NA	-
Daily ADB Bus Miles	-	16,216	34,142	50,358
Daily ARTIC Bus Miles	23,872	-	-	23,872
Total Daily Bus Miles	23,872	16,216	34,142	74,230
Daily ADB Bus Hours	-	1,159.6	2,351.4	3,511.0
Daily ARTIC Bus Hours	1,131.0	-	-	1,131.0
Total Daily Bus Hours	1,131.0	1,159.6	2,351.4	4,642.0
Peak Rail Car Requirement	-	-	-	-
Peak ADB Bus Requirement	-	98	177	275
Peak ARTIC Bus Requirement	144	-	-	144
Annual Cost - Rail	-	NA	NA	
Annual Cost - Bus	$16,858,000	$12,417,000	$25,834,000	$55,109,000
Total Annual Cost	$16,858,000	$12,417,000	$25,834,000	$55,109,000

Table 69

SUMMARY OF OPERATING STATISTICS AND COSTS

SANTA ANA FREEWAY CORRIDOR

PEAK DIRECTION BUSWAY (B-5b)

Category	Line Haul	Feeder	Background	Total Corridor
Daily Rail Car Miles	-	NA	NA	-
Daily Train Hours	-	NA	NA	-
Daily ADB Bus Miles	-	14,905	34,142	49,047
Daily ARTIC Bus Miles	28,135	-	-	28,135
Total Daily Bus Miles	28,135	14,905	34,142	77,182
Daily ADB Bus Hours	-	1,058.9	2,351.4	3,410.3
Daily ARTIC Bus Hours	1,580.0	-	-	1,580.0
Total Daily Bus Hours	1,580.0	1,058.9	2,351.4	4,990.3
Peak Rail Car Requirement	-	-	-	-
Peak ADB Bus Requirement	-	86	177	263
Peak ARTIC Bus Requirement	198	-	-	198
Annual Cost - Rail	-	NA	NA	
Annual Cost - Bus	$21,704,000	$11,370,000	$25,834,000	$58,908,000
Total Annual Cost	$21,704,000	$11,370,000	$25,834,000	$58,908,000

Table 70

Estimated Cost of "Background" Service

Santa Ana Freeway Corridor

Alternative	Annual Cost of Background Service
No-Build	$22,464,000
TSM	$25,834,000
Two-Way Busway	$25,834,000
Peak Direction Busway	$25,834,000
LRT	$25,834,000
ICTS	$25,834,000

Table 71

SUMMARY COST COMPARISON ALTERNATIVES

SANTA ANA FREEWAY CORRIDOR

Alternative	Annual Costs (Thousands of Dollars)			
	Line Haul	Feeder	Background	Total Corridor
No-Build	4,816	6,743	22,464	34,023
TSM	5,392	6,816	25,834	38,042
Two-way Busway	16,858	12,417	25,834	55,109
Peak Direction Busway	21,704	11,370	25,834	58,908
LRT	15,361	12,501	25,834	53,696
ICTS	20,261	12,501	25,834	58,146

SUMMARY COMPARISONS

V. SUMMARY COMPARISONS

Tables 72 to 76 provide a summary of operating statistics and operating costs for the alternatives studied for each corridor.

In interpreting these estimates, the following qualifications should be recognized:

(1) The cost estimates shown in this report are the results of numerous basic assumptions which were agreed upon by the study sponsors and documented in working papers prior to operating plan development. Several of these assumptions had a significant effect on the comparative operating costs.

(2) The operating plans (and cost estimates) developed in this study were based on transit patronage forecasts developed prior to this study and supplied by Caltrans. It was not within the scope of this study to refine or revise these demand forecasts. It is also important to note that the basic source of patronage estimates for the Vermont Avenue HRT alternative was different than the source of estimates used for intermediate capacity rail and Freeway Bus Transit alternatives. Thus, a high degree of confidence cannot be placed on the specified differences between modal alternatives in design patronage values.

(3) The rail systems were sized to accomodate higher levels of demand than the bus alternatives, and this partially explains the higher operating costs indicated for the rail alternatives.

(4) Another critical factor affecting the rail vs bus cost comparisons was the policy adopted regarding off-peak service levels. Further analysis would be needed to establish the senstivity of comparative costs to policy service level assumptions; however, it is clear that the rail alternatives would look more favorable than shown herein if off-peak service levels were keyed to off-peak demand rather than the assumed policy minimums.

(5) Overall cost comparisons are significantly influenced by supplementary feeder bus requirements. These depend on both the line-haul demand levels projected for rail vs bus alternatives and differing downtown distribution requirements.

(6) Vehicle capacity values used assumed for both rail and bus alternatives were calculated on "the basis of" number of seats plus standees at 4 square feet per standee. It can be argued that this favors the bus alternatives with respect to cost comparisons since rail systems typically function with higher "crush" loads in peak periods than the design capacity values used in this study. In addition, previous studies in Los Angeles assumed no standees on freeway express bus services, whereas this study assumed design level standing loads in peak hours in calculating service requirements.

(7) It was assumed that ICTS trains would be manned. This may not be a requirement of the ICTS technology; security and passenger service aspects were considerations.

(8) Barrier type fare collection was assumed for the ICTS and heavy rail systems, whereas less costly self-validating systems were assumed for other alternatives.

(9) An annualization factor of 308 was prescribed by SCRTD, and was used for all alternatives. This presumes that weekend operations would be equivalent to about half of those on a typical weekday, an assumption which works to the disadvantage of rail alternatives (because of prescribed policy headway assumptions).

(10) Elevated stations in freeway median locations requiring escalators and/or elevators were assumed, with consequent impacts on O & M costs.

(11) Local labor agreement requirements were assumed throughout, including provisions in rail estimates for qualified "switchers" in yard marshalling activities, which may be relaxed in practice.

(12) Prescribed limitations on train lengths, particularly with the ICTS alternatives in the Harbor Corridor, had a significant adverse impact on cost estimates for that alternative. Use of trains with more than 3 cars would reduce costs for this alternative.

(13) Century Freeway bus services required to feed the rail alternatives for trips to downtown Los Angeles were included in the rail cost estimates; for the bus alternatives, Century Freeway bus lines would utilize the Harbor Freeway Busway without transfer requirements for downtown trips.

(14) Sufficiently detailed data was not readily available to establish feeder bus requirements with precision, since many cross corridor bus lines provide a variety of functions. The feeder bus cost estimates must be received as less precise than the estimates for line haul services.

Table 72

SUMMARY COMPARISON OF OPERATING STATISTICS
Harbor Freeway Corridor

Service Measure	No Build	TSM	Trunk W/Feeders	Trunk W/Arterial Extensions
Improved ADB Bus Miles-Freeway	1,657	1,905	1,066	-
Improved ADB Bus Miles-Surface	1,714	1,972	5,050	1,460
ARTIC Bus Miles - Freeway	9,136	16,077	24,468	25,422
ARTIC Bus Miles - Surface	5,241	10,763	9,316	13,260
TOTAL Bus Miles	17,748	30,717	39,900	40,142
Improved ADB Bus Hours	200.6	230.7	359.8	122.9
ARTIC Bus Hours	840.0	1595.9	1723.1	1995.9
TOTAL Bus Hours	1040.6	1826.6	2082.9	2118.8
Improved ADB Peak Bus. Req.	27	29	33	12
ARTIC Peak Bus. Req.	97	150	203	211
TOTAL Bus Requirement	124	179	236	223
Peak One-Way Capacity[1]	4,113	5,510	8,245	8,245

[1] Peak hour-peak direction north of Manchester

Table 73

SUMMARY COMPARISON OF OPERATING STATISTICS
Santa Ana Freeway Corridor

Service Measure	No Build	TSM	Two-Way Trunk W/Feeders	Reversible Lane Trunk with Feeders
Improved ADB Bus Miles-Freeway	183	183	1,744	1,653
Improved ADB Bus Miles-Surface	7,869	8,147	10,602	10,132
ARTIC Bus Miles - Freeway	4,333	6,361	17,791	13,280
ARTIC Bus Miles - Surface	2,183	1,336	6,082	14,855
TOTAL Bus Miles	14,568	16,027	36,219	39,920
Improved ADB Bus Hours	610.5	630.8	859.2	826.6
ARTIC Bus Hours	341.0	362.8	1131.0	1558.0
TOTAL Bus Hours	951.5	993.6	1990.2	2384.6
Improved ADB Peak Bus. Req.	42	45	57	57
ARTIC Peak Bus. Req.	40	42	144	198
TOTAL Bus Requirement	82	87	201	255
Peak One-Way Capacity[1]	1,455	1,552	6,499	6,499
Annual Operating Cost of Plan	$11,224,000	12,643,000	26,150,000	30,484,000

[1] Peak hour-peak direction north of Manchester, assumes a capacity of 97 passengers per bus

Table 74

COMPARISON OF RAIL O&M COST ESTIMATES

LINE HAUL RAIL SERVICES ONLY

	Estimated Employees	Estimated Rail Annual O&M Expense ($)	Cost Per Car-Mile ($)	Cost Per Passenger-Space-Mile (¢)
Harbor Freeway Corridor:				
Full Service ICTS	623	30,389,200	1.84	3.8
Turnback ICTS	567	26,362,500	2.09	4.3
Full Service LRT	342	16,406,000	2.91	2.5
Turnback LRT	329	15,469,500	3.10	2.6
Santa Ana Freeway Corridor				
Full Service ICTS	436	20,261,900	1.82	3.8
Full Servcie LRT (3-car trains)	329	15,361,800	3.27	2.9
Full Service LRT (6-car trains)	306	14,203,500	3.23	2.7
Vermont Alignment				
Full Service HRT	385	20,519,050	2.72	2.5
Turnback	396	20,127,300	3.10	2.8

Table 75

SUMMARY COST COMPARISON OF ALTERNATIVES

Harbor Freeway Corridor

Alternative	Annual Cost (Thousands of Dollars)			
	Line Haul	Feeder	Background	Total Corridor
No-Build	13,429	-	76,877	90,306
TSM	26,656	-	88,409	115,065
Two Way Busway	20,186	11,822	88,409	120,417
Peak Direction Busway	20,985	11,276	88,409	120,670
LRT Full Service	22,204*	14,482	88,409	125,095
LRT With Turnbacks	21,268*	14,482	88,409	124,159
ICTS Full Service	36,187*	11,950	88,409	136,546
ICTS With Turnbacks	32,161*	11,950	88,409	132,520
Vermont HRT - Full Service	26,317*	12,109	88,409	126,835
Vermont HRT with Turnbacks	25,925*	12,109	88,409	126,443

*Includes both bus and rail line haul services as required for comparisons. See Table 74 for rail costs.

Table 76

SUMMARY COST COMPARISON OF ALTERNATIVES
SANTA ANA FREEWAY CORRIDOR

Alternative	Annual Costs (Thousands of Dollars)			
	Line Haul	Feeder	Background	Total Corridor
No-Build	4,816	6,743	22,464	34,023
TSM	5,392	6,816	25,834	38,042
Two-way Busway	16,858	12,417	25,834	55,109
Peak Direction Busway	21,704	11,370	25,834	58,908
LRT	15,361	12,501	25,834	53,696
ICTS	20,261	12,501	25,834	58,146