32725722

GENERAL PLANNING CONSULTANT

TECHNICAL MEMORANDUM 6.1.3

DESCRIPTION OF TRANSPORTATION SYSTEM MANAGEMENT (TSM) ALTERNATIVE NETWORKS

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Southern California Rapid Transit District

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1. INTRODUCTION

The Southern California Rapid Transit District is currently considering three Los Angeles Metro Rail alternatives. The first alternative, termed the Locally-Preferred Alternative (LPA), is 18.6 miles in length and extends from the Los Angeles CBD to North Hollywood. The second alternative, termed the Minimum Operable Segment (MOS), is an 8.8 mile segment of the 18.6 mile LPA, extending from the Los Angeles CBD to Fairfax Avenue at Beverly Boulevard. The third alternative, termed the MOS-1, is a shorter segment of the LPA, extending 4 miles from the Los Angeles CBD to Alvarado Street at Wilshire Boulevard. In order to qualify for rail funding, the Urban Mass Transportation Administration (UMTA) requires the transit industry to calculate several cost effectiveness indices which guide UMTA in making decisions on major transit investments. These indices, representing a measure of transportation cost and benefits, are based upon a comparison between the rail alternatives and Transportation System Management (TSM) alternatives which are comparable in terms of the level of service provided. To this end, three additional non-rail alternatives were developed by SCRTD which reflect traffic operation and transit service improvements. A comparison of each rail alternative to its non-rail TSM-equivalent is then made in order to measure the cost-effectiveness of the rail alternatives.

The following text provides a detailed definition of the TSM alternatives, followed by a summary of TSM measures that have already been implemented, measures that have been considered, and most importantly, additional actions which are proposed to supplement the current TSM program. In each case, the impact of the TSM actions on the transit and highway level of service is quantified.

2. DEFINITION OF ALTERNATIVES

TSM alternatives were derived incrementally. The 4-mile alternative was developed from the 1985-base planned and committed system. The 8-mile TSM alternative was developed from the 4-mile TSM alternative. The TSM alternative was derived, in turn, from the 8-mile system.

2.1 4-MILE TSM ALTERNATIVE

Figure 1 shows the impact area of the 4-mile TSM alternative. This area is bounded on the north by the Hollywood and Pasadena Freeways; on the south by the Santa Monica Freeway; on the east by the Los Angeles River; and on the west by Hoover Street.

To arrive at this alternative, the following modifications were made to the 1985 base planned and committed transit system:

A. Prohibit left turns on 7th Street between Alvarado and the Harbor Freeway. This traffic management action has the effect of increasing the speeds of all highway and transit modes on 7th Street by 15 percent.

B. Implementation of a computerized signal control system affects limited stop transit route speeds (Routes 320 and 322 on Wilshire Boulevard, and Route 328 on Olympic Boulevard) as well as surface street arterial speeds. The effect of this action is to increase the speeds on the affected bus routes and arterial streets by 7 percent.

2.2 8-MILE TSM ALTERNATIVE

Figure 2 defines the impact area of the 8-mile TSM alternative. This area is bounded on the north by Melrose Avenue and the Hollywood and Pasadena Freeways; on the south by the Santa Monica Freeway; on the east by the Los Angeles River; and on the west it is bounded by Santa Monica Boulevard, Wilshire Boulevard and La Cienega Boulevard.

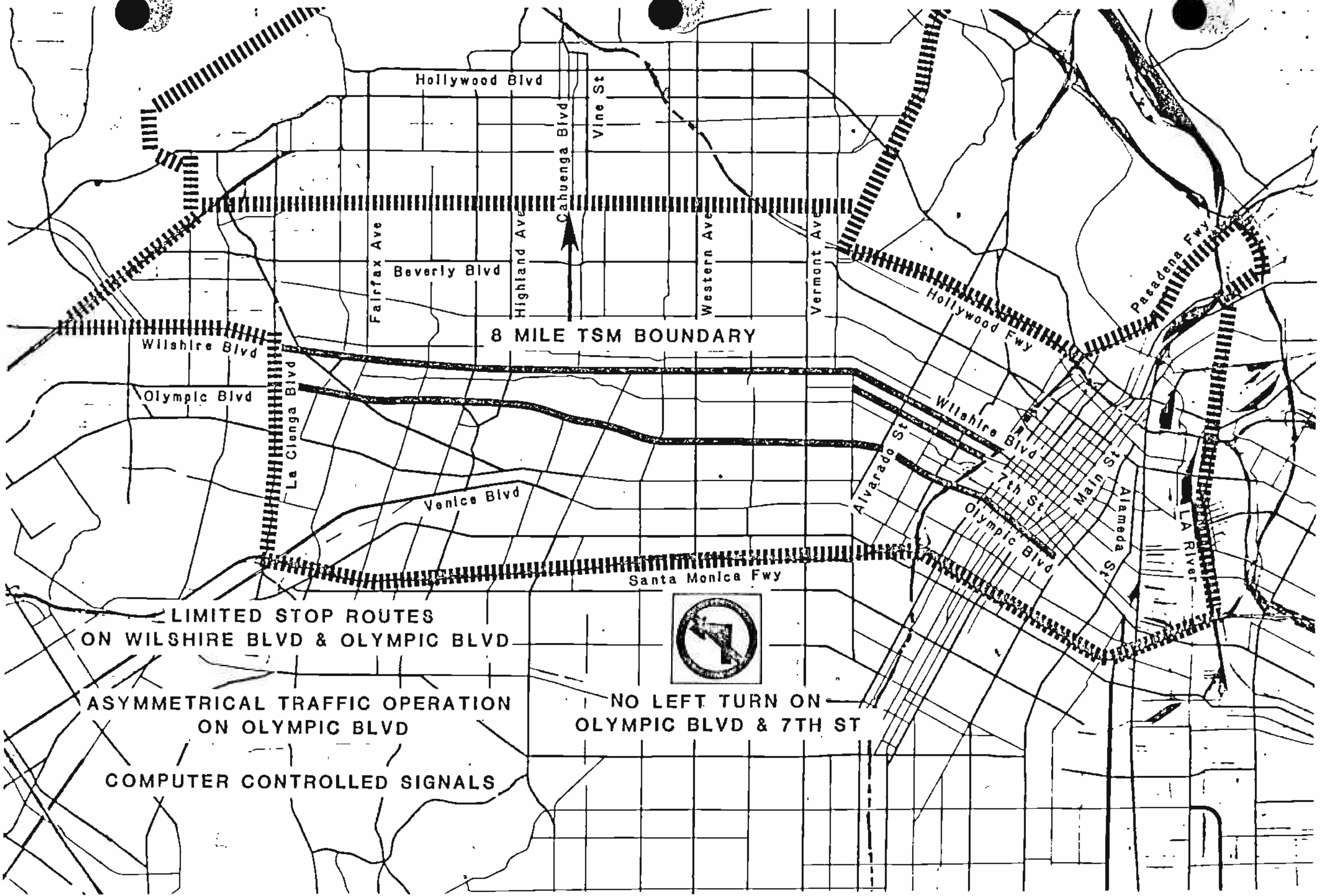
For this alternative, the following modifications were made to the 1985-base planned and committed transit system:

A. All changes described above for the 4-mile alternative.

B. Implement left-turn prohibition on Olympic Boulevard from San Pedro Street (Los Angeles CBD) to La Cienega Boulevard. The effect of this action is to increase transit and automobile speed by 15 percent

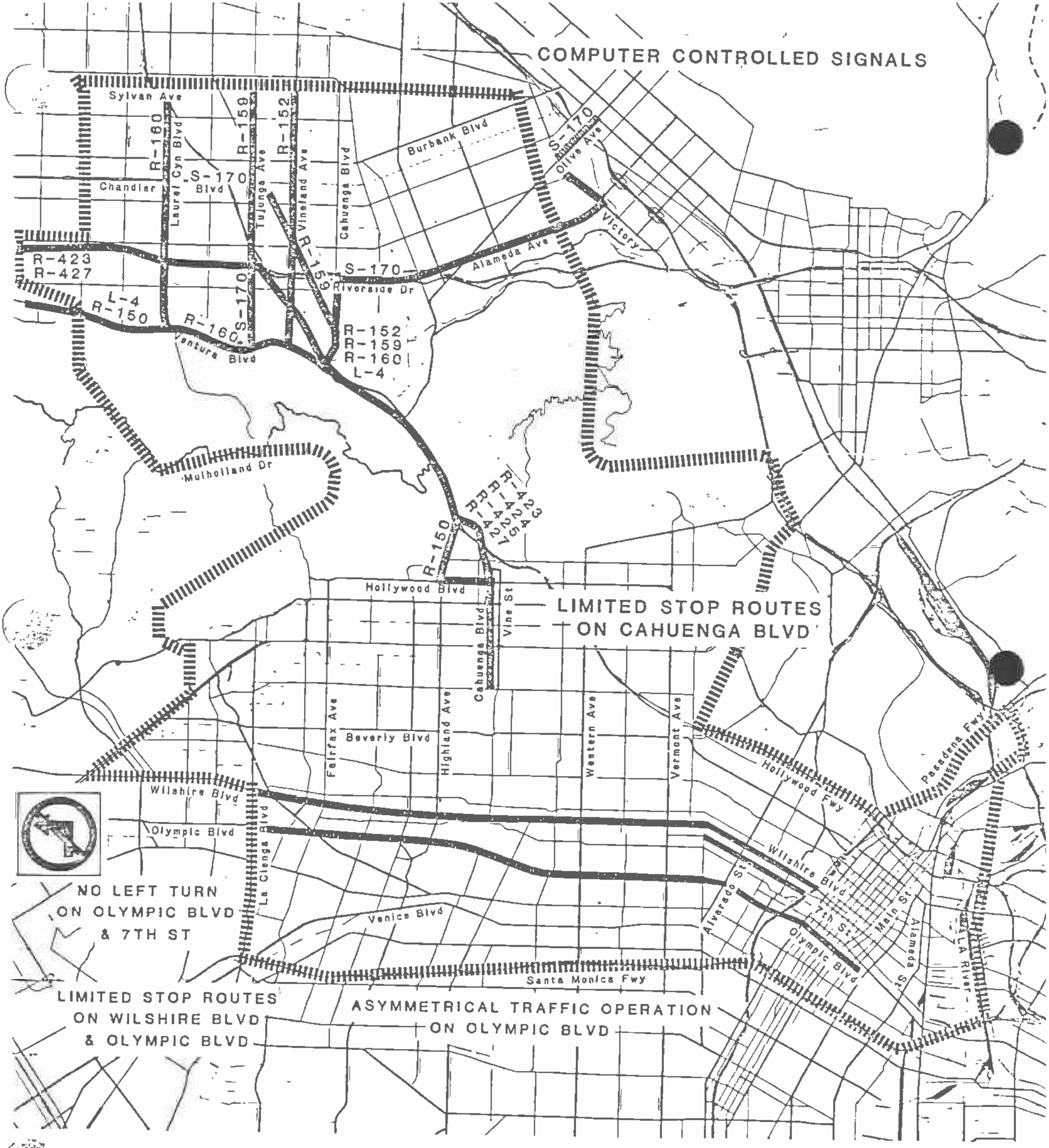
C. Implement asymmetrical traffic operation (reversible lanes) on Olympic Boulevard between San Pedro Street (Los Angeles CBD) and La Cienega Boulevard. The impact of this traffic operation change is to increase transit and automobile speed on Olympic Boulevard by an additional 10 percent.

D. Extend implementation of the computerized signal control system within the 8-mile TSM alternative impact area. The effect of this action is



8 MILE TSM ALTERNATIVE

FIGURE 2



18.6 MILE TSM ALTERNATIVE

FIGURE 3

to increase limited-stop bus route speeds on Olympic, Wilshire and Cahuenga Boulevards by 7 percent. Similarly, auto speed increases of 7 percent apply to the arterial street system in the area. Total speed increase on Olympic Boulevard is 32 percent.

2.3 18.6-MILE TSM ALTERNATIVE

Figure 3 shows the entire impact area of the 18.6-mile TSM alternative. In addition to the area defined for the 8-mile alternative, the 18.6-mile TSM impact area extends to Sylvan Street on the north.

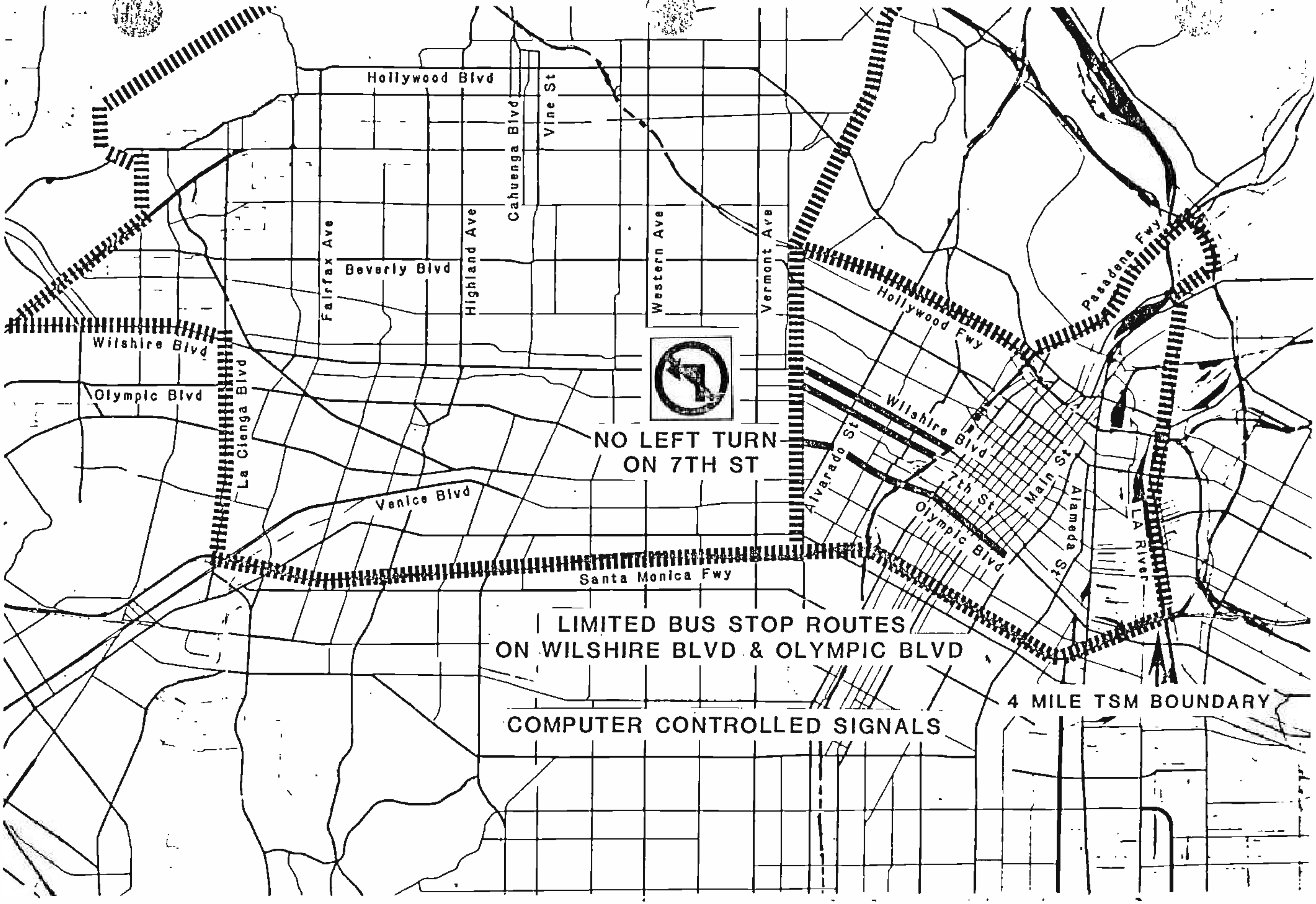
The 18.6-mile TSM Alternative is defined as follows:

A. All changes described above for the 4- and 8-mile alternatives.

B. Extend computerized signal control system within the expanded LPA impact area. The effect of this action is to increase limited-stop bus route speeds on Wilshire Boulevard and automobile speeds on arterial streets by 7 percent.

C. Incorporate the following route changes:

- Divert Route 150 to Universal City Transit Center (UCTC) via Lankershim. Peak headway: 7 minutes.
- Extend Route 152 to Universal City Transit Center (UCTC).
- Add Route S-170 service from Lankershim/Tujunga to Burbank CBD via Tujunga, Ventura, Lankershim, Cahuenga, Riverside, Main, Victory and Olive. Peak headway: 22 minutes; off-peak headway: 35 minutes.
- Extend Route 160 to UCTC.
- Add limited stop service (Route L-4) from Ventura Hills to UCTC via Ventura Boulevard. A.M. peak headway: 5 minutes, P.M. peak headway: 8 minutes.
- Eliminate express Route 424 west of UCTC; leave express to CBD.
- Divert Route 423 to UCTC.
- Eliminate express Route 425 west or north of UCTC; leave express to CBD.
- Divert Route 427 to UCTC.
- Add Route S-162 on Reseda from Devonshire to Ventura Boulevard. A.M. peak headway: 5 minutes; P.M. peak headway: 8 minutes; off-peak headway: 20 minutes.
- Delete Routes 421 and 422.
- Divert Routes 420, 420A, 426 and 426A into UCTC.



NO LEFT TURN ON 7TH ST

LIMITED BUS STOP ROUTES ON WILSHIRE BLVD & OLYMPIC BLVD

COMPUTER CONTROLLED SIGNALS

4 MILE TSM BOUNDARY

4 MILE TSM[illegible]LTERNATIVE

FIG[illegible]E 1

2.4 TSM IMPROVEMENTS

2.4.1 Recently Implemented TSM Improvements

The City of Los Angeles and SCRTD have actively pursued a rigorous TSM program to make effective use of its existing transportation resources. Since 1980 numerous TSM projects have been implemented for both highway and transit facilities.

The City of Los Angeles Department of Transportation's extensive list of recent TSM improvements range from the restriction of parking in commercial areas to the installation of a computerized traffic control system. The following list presents the types of TSM improvements implemented by LADOT and typical locations where the improvements were made. This list presents examples and do not represent all improvements made.

a. Channelization of traffic

  - Western Avenue between Santa Monica Freeway and Franklin Avenue.
  - Beverly Boulevard between Fairfax Avenue and Rossmore Avenue.

b. Reversible lane operation

  - Highland Avenue between Hollywood Freeway and Sunset Boulevard.

c. Downtown contra-flow bus lane

  - Spring Street from Ninth Street to Sunset Boulevard.

d. Fine-tuning of intersections signal timing

  - Various locations (100 to 200 per year).

e. Improvement of signal coordination

  - Wilshire Boulevard from Alvarado Avenue to La Brea Avenue.

f. Computerized traffic control operation

  - Los Angeles Coliseum area bounded by Santa Monica Freeway (north), Harbor Freeway (east), Vernon Street (south) and Western Avenue (west)

g. Bus pre-emption of traffic signals

  - Ventura Boulevard from Vineland Avenue to Reseda Boulevard.

h. Improvement of signal operation reliability

  - Various locations. Replaced electro-mechanical signal controls with micro procedures at multi-phase traffic signal locations.

i. Installation of left turn restrictions (except buses)

  - Wilshire Boulevard and Alvarado Avenue

- Wilshire Boulevard and La Brea Avenue
- Wilshire Boulevard and Fairfax Avenue

j. Widening of approaches to intersections

- Normandie Avenue and Olympic Boulevard
- Wilton Place and Wilshire Boulevard

k. Strict enforcement of traffic regulations and parking restrictions

- The City of Los Angeles recently established the Bureau of Parking Management. Their responsibility is to enforce traffic regulations and parking restrictions.

l. Restriction of on-street parking during peak periods

- Wilshire Boulevard between San Vincente Boulevard and Figueroa Street

m. Time-limited parking in commercial areas

- Wilshire Boulevard between Highland Avenue and La Brea Avenue

n. Neighborhood preferential parking programs

- Universal City area (sticker parking for residents)

o. Provision to permit reduced on-site parking in exchange for comprehensive employer-sponsored ridesharing incentive program (new development).

- City ordinance passed in 1982

p. Flexible work program

- City employees work eighty hours in a two-week period in nine working days and take Monday or Friday off.

q. Promotion of ridesharing programs

- A quasi-public agency formed to promote and encourage ridesharing (Commuter Transportation Services--Commuter Computer)

r. Development of bicycle routes and storage facilities

- Bicycle route on Venice Boulevard between La Brea Avenue and Pacific Avenue
- Shower facilities for bike riders in City Hall
- Enclosed bike storage lockers at City Hall

RTD has implemented its 1980 Sector Improvement Program (SIP). The SIP represented the biggest series of service changes in RTD history. A key feature of service in the 1980 Sector Improvement Program developed an expanded bus route grid of north-south and east-west bus lines with improved frequencies of ten minutes or better between Santa Monica Mountains and Manchester Boulevard, and between downtown Los Angeles and La Cienega Boulevard.

In addition to establishing a grid system, the SIP also used the concept of transit centers which are key locations where certain lines converge for the convenience of passengers (such as shopping center malls and employment centers). The transit centers simplified transferring and made possible the boarding of any of several routes at one location.

The grid network of bus lines simplified the system, spread passenger loads over more lines, and eliminated duplication.

The 1980 Sector Improvement Program simplified the bus system on a single street in a grid-like manner whenever possible. It reduced the number of transfers; provided faster service; and reduced overcrowding.

The 1980 SIP provides the following benefits to the public and to the District:

a. Produces a more comprehensive system. Recognizing urban growth and change in the last 30-40 years:

  - Replaces uncoordinated conglomeration of predecessor companies, lines with a coordinated system.

  - Fills in service voids and creates a basic grid in the core of RTD system.

b. Improve responsiveness. Implements requests, comments, and suggestions from the public which require change in more than a single line.

c. Simplify the system for users. By replacing circuitous, complex and/or confusing routings with simplified grid and improved service:

  - Reduces travel time in several major corridors.

  - Reduces the number of transfers required to complete a trip, thereby increasing usage by many who chose not to use previous services.

d. Open new opportunities for travel. New lines or connections of existing lines provide:

  - Better "crosstown" service in peripheral areas, allowing patrons to complete their trips without traveling through downtown Los Angeles.

  - Better linkage across topographic barriers (e.g., Hollywood Hills, Baldwin Hills, Elysian Valley - L.A. River).

  - Improved connections between sectors (e.g., San Fernando Valley to Pasadena, Highland Park to Hollywood, Glendale to West Los Angeles, North Los Angeles to Central Cities and East Los Angeles to the employment centers in Commerce, Vernon, and Cudahy).

Implementation of TSM improvements are hindered by discontinuities in the street system. Despite the grid pattern of the street system, there are only four through streets on an east-west axis in the entire corridor, namely, Third Street, Sixth Street, Wilshire, and Olympic. Fourth Street and Fifth Street are discontinuous at the Harbor Freeway and in the middle of the corridor. Sixth Street, while continuous, turns into a quiet residential street west of Western Avenue. Wilshire, while continuous throughout the corridor, dead-ends on the west side of the CBD necessitating major bus turning movements in the CBD.

Seventh, Eighth, and Ninth Streets are discontinuous in the mid-Wilshire area. Several north-south streets in the study area are also discontinuous. These include Rossmore Avenue/Crenshaw Boulevard, Wilton Place/Arlington Avenue, Normandie Avenue/Irolo Street and Virgil Avenue/Hoover Street. The discontinuous streets result in a concentration of vehicular movement on only a few arterial streets which are already at capacity, thus compounding the congestion problem. Figure 4 shows the discontinuities, including jogs and street mergers, which are an impediment to the normal flow of traffic. Congestion on Cahuenga/Highland in the vicinity of the access ramps to the Hollywood Freeway is also very severe, in spite of special traffic measures, such as using one lane as a reversible lane for peak direction travel.

2.4.2 Proposed TSM Measures

The previous chapter outlined various transportation system management (TSM) techniques which have already been implemented by the City of Los Angeles. In addition to these, three general TSM techniques were proposed to supplement the existing TSM program:

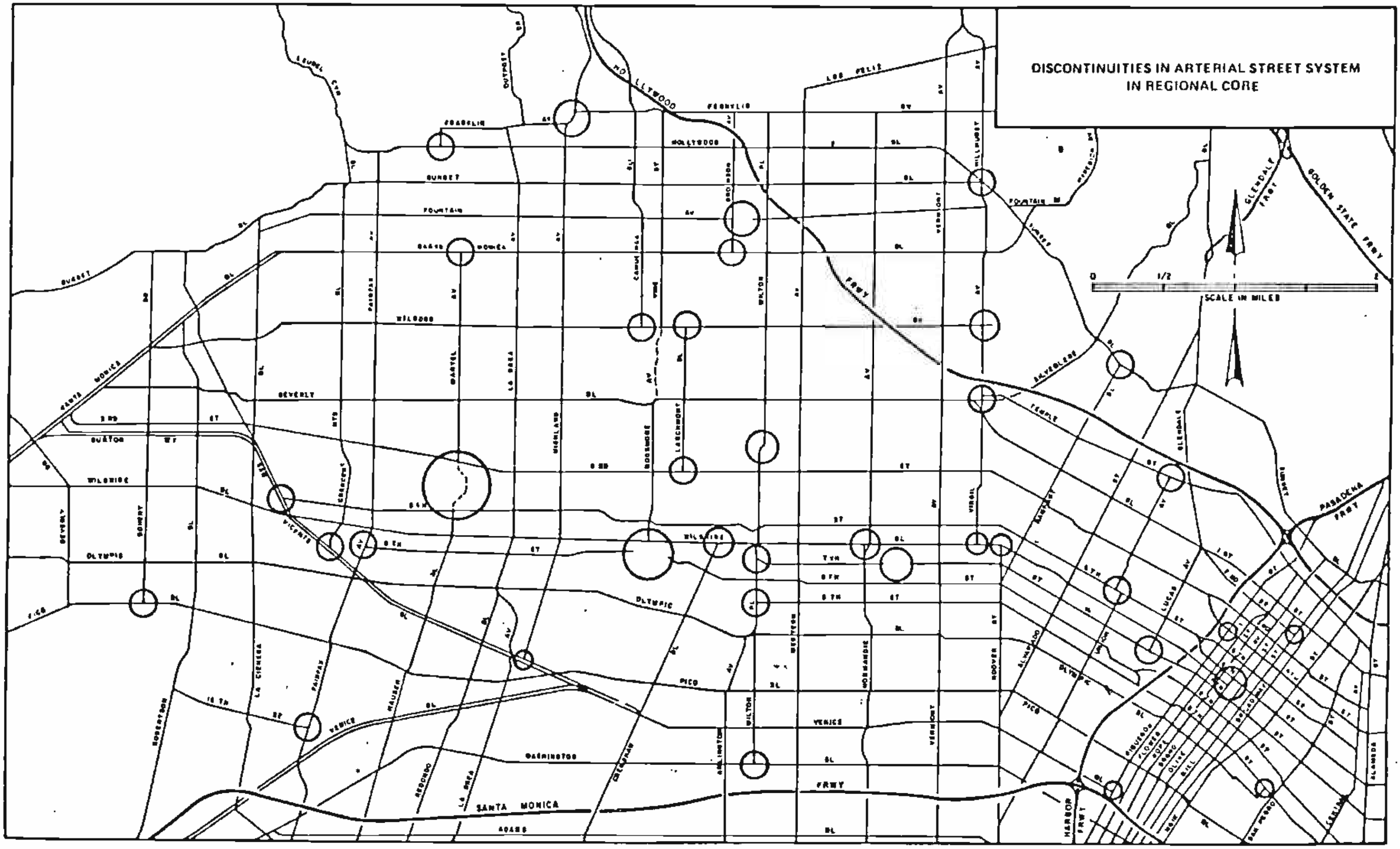
a. Expansion of Computerized Traffic Signal Control
b. Prohibition of left turns; and
c. Asymmetrical lane operation.
d. Development of Transit Centers

The following text provides documentation of the travel time savings which can be expected for each technique as it is applied to the transportation system.

2.4.2.1 Computerized Traffic Signal Control

The City of Los Angeles Department of Transportation has conducted two studies to measure the effectiveness of computerized signal control. The first study was conducted to quantify the benefits of installing a computerized traffic signal control system in Downtown Los Angeles. The results of the study showed significant improvements, with reductions in stops and delays of thirteen to seventeen percent for automobile and bus traffic. The second study was conducted to evaluate the TRANSYT model in Downtown Los Angeles. A TRANSYT-derived timing plan for the p.m. peak period was installed in the study network. Before-and-after field evaluations indicated that the TRANSYT timing plan produced a thirteen percent reduction in stops and delays, with an increase in average speed in the study network of seven percent.

Based on the results of the above studies, a seven percent increase in speed for auto traffic was assumed and incorporated into the highway networks used for the



SOURCE: FINAL AA/EIS ON TRANSIT SYSTEM IMPROVEMENT IN THE LOS ANGELES REGIONAL CORE, APRIL1980.

DISCONTINUITIES IN ARTERIAL STREET SYSTEM IN REGIONAL CORE

FIGURE 4

TSM alternatives. Since signals are not timed for local bus operation, no change in speed for local bus routes was assumed.(1) Limited-stop bus routes are affected, however, and therefore the same speed increases assumed for auto were assumed for limited-stop transit service.

2.4.2.2 Prohibition of Left Turns

The City of Los Angeles Department of Transportation conducted a study in 1980 to evaluate the effect of left-turn prohibitions on Seventh Street in Downtown Los Angeles. As shown in Table 1, the results of the speed study--conducted before and after the left-turn prohibition--indicate an overall reduction in travel time of thirteen percent and an overall increase in speed of fifteen percent.

Therefore, using the results of this study, a fifteen percent increase in speed was applied to auto and bus speeds in the networks used for the TSM alternatives.

2.4.2.3 Asymmetrical Lane Operation

Olympic Boulevard currently provides three travel lanes in each direction, and operates at a V/C ratio of approximately 0.90.

Asymmetrical lane operation, to be applied only to Olympic Boulevard, would provide four travel lanes in the peak direction and two travel lanes in the non-peak direction. This operation would provide one additional lane in the peak direction, thus theoretically increasing capacity in the peak direction by 33 percent.

According to a graphic representation of travel speed versus V/C ratio in the <u>Highway Capacity Manual</u>(2), an increase in capacity of 33 percent (to go from good to perfect progression) would result in an thirty percent increase in speed. However, since perfect progression can realistically seldom be achieved, and since adding 33 percent capacity cannot actually be attained by adding a fourth lane to Olympic Boulevard, this increase in speed may not be feasible. Therefore, as a conservative estimate, an increase in speed of ten percent was used for auto and bus traffic and incorporated into the highway networks used for the TSM alternative.

2.4.2.4 Development of Transit Centers

Implementation of the 18.6-mile TSM alternative would require the construction of transit centers (as defined in the 1980 Sector Improvement Plan) at Universal City and at Hollywood/Cahuenga.

TABLE 1

Left Turn Prohibition Results:
7th Street Between Figueroa Street and Los Angeles Street (3,630 ft.)

Period of Day	Direction	Time Trials Before "No Left Turn" September 1980		Time Trials After "No Left Turn" April 1981	
		Time, sec	Speed, mi/hr	Time, sec	Speed, mi/hr
AM Peak	EB WB	186.5 218.3	13.3 11.3	186.4 163.1	13.3 15.2
Mid-day	EB WB	293.7 309.1	8.4 8.0	305.9 278.8	8.1 8.9
PM Peak	EB WB	309.7 339.8	8.0 7.3	234.6 272.8	10.5 9.1
Average	Both	276.2	9.0	240.3	10.3

Overall Reduction in Time = 13.0%
Overall Increase in Speed = 15.0%

Source: Los Angeles Department of Transportation

REFERENCES

(1) Jovanis, Paul P. and Adolf D. May, "Alternative Objectives in Arterial Traffic Management," Transportation Research Record #682 - Urban System Operation and Freeways, Transportation Research Board, National Academy of Sciences, Washington, D.C., 1978, pp. 1-7.

(2) National Research Council, Highway Capacity Manual, Highway Research Board Special Report 87, Washington, D.C., 1965, pp. 320.

GENERAL PLANNING CONSULTANT

TECHNICAL MEMORANDUM 6.1.4

COST-EFFECTIVENESS CALCULATIONS

Prepared for:

Southern California Rapid Transit District

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I. Introduction

Metro Rail and Transportation System Management (TSM) alternatives have been defined for each of the three Metro Rail line extents (4,8.8, and 18.6 miles)[1]. Complete travel demand model simulations have been performed to estimate the ridership, travel time, and operating resource and cost implications of each of thse six alternatives.

Briefly sumarized in this memorandum are the results of the UMTA prescribed cost-effectivenss calculations aimed at comparing each rail alternative with the comparable non-rail alternative.

2. Cost-Effectiveness Inputs and Results

In addition to the data provided by the individual travel demand model simulations, other capital and operating costs were computed based upon the definition of the specific alernative being tested.

Rail system capital costs included the cost of the Metro Rail line and the corresponding cost of bus expansion and replacement. The rail system operating costs were derived from the respective rail and bus cost models, which are calibrated components of the travel demand models.

The TSM capital costs include the cost of bus fleet expansion and replacement for all alternatives. Computerized traffic signal constrol was also included in all alternatives at $40,000 per signal, with the following number of signals in each alternative:

TSM ALTERNATIVE	NUMBER OF SIGNALS EFFECTED
4.0 mile	334
8.8 mile	682
18.6 mile	960

In the 8.8 and 18.6 mile TSM alternatives, reversible lane control on Olympic Boulevard was included at $1.5 million. And finally, in the 18.6 TSM alternative, new transit centers at Universal City and Hollywood/Cahuenga were included at a total cost of $5.7 million. TSM operating costs include the Long Beach Light Rail line and regional bus operating costs plus the maintenance of the computerized traffic signal control system (at $700 per signal per year).

All cost-effectiveness inputs are presented in the attached tables together with the calculation results:

Extent (Mile)	Federal Index	Total Index
4.0	4.58	6.51
8.8	1.80	3.00
18.6	2.03	3.77

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[1] Technical Memorandum 6.1.3, Description of Transportation System Management (TSM) Alternative Networks, September, 1984

SCRTD COST-EFFECTIVENESS CALCULATIONS

Alternative Name: MOS-1

Item	Disc	Life	Quantity	Unit Price	Cost	Rate	Value	TOTALS
RAIL ALTERNATIVE								
Rail Capital Cost	0.1	30	1.175E+09	1	$1174900000.00	0.1060792	$124632508.77	
Initial Bus Expansion	0.1	12	84	$150000.00	$12600000.00	0.1467633	$1849217.77	
Other Bus Capital	0.1	30	0	$29000000.00	$0.00	0.1060792	$0.00	
Replacement Bus Costs	0.1	12	2294	$150000.00	$344100000.00	0.1467633	$50501256.73	
Other Capital Costs	0.1	30	0	1	$0.00	0.1060792	$0.00	$176982983.27
Local Capital Funding							$52970021.43	$52970021.43
Bus Operating Costs	1	1	525420800	1	$525420800.00	1	$525420800.00	
Rail Operating Costs	1	1	28380000	1	$28380000.00	1	$28380000.00	$553800800.00
Work Transit Travel Time	1	1	78311305	$4.00	$313245220.00	1	($313245220.00)	
Nonwork Travel Time	1	1	269973760	$2.00	$539947520.00	1	($539947520.00)	($853192740.00)
Ann. Linked Transit Trip	1	1	522732900	1	522732900	1	522732900	
TSM ALTERNATIVE								
Initial Bus Expansion	0.1	12	26	$150000.00	$3900000.00	0.1467633	$572376.93	
Other Bus Capital	0.1	30	0	$29000000.00	$0.00	0.1060792	$0.00	
Replacement Bus Costs	0.1	12	2236	$150000.00	$335400000.00	0.1467633	$49224415.88	
Other Capital Costs	0.1	30	13360000	1	$13360000.00	0.1060792	$1417218.76	$51214011.57
Local Capital Funding							$12803502.89	$12803502.89
Bus Operating Costs	1	1	518106880	1	$518106880.00	1	$518106880.00	
Other Operating Costs	1	1	13233800	1	$13233800.00	1	$13233800.00	$531340680.00
Work Transit Travel Time	1	1	79354485	$4.00	$319417940.00	1	($319417940.00)	
Nonwork Travel Time	1	1	273339760	$2.00	$546679520.00	1	($546679520.00)	($866097460.00)
Ann. Linked Transit Trip	1	1	501937200	1	501937200	1	501937200	

Cost-Effectiveness Index	6.5073
Federal Cost-Effectiveness Index	4.5758

SCRTD COST-EFFECTIVENESS CALCULATIONS

Alternative Name: MOS

Item	Disc	Life	Quantity	Unit Price	Cost	Rate	Value	TOTALS
RAIL ALTERNATIVE								
Rail Capital Cost	0.1	30	2.134E+09	1	$2133500000.00	0.1060792	$226320076.15	
Initial Bus Expansion	0.1	12	0	$150000.00	$0.00	0.1467633	$0.00	
Other Bus Capital	0.1	30	0	$29000000.00	$0.00	0.1060792	$0.00	
Replacement Bus Costs	0.1	12	2104	$150000.00	$315600000.00	0.1467633	$46318502.25	
Other Capital Costs	0.1	30	0	1	$0.00	0.1060792	$0.00	$272638578.39
Local Capital Funding							$84002049.93	$84002049.93
Bus Operating Costs	1	1	490281200	1	$490281200.00	1	$490281200.00	
Rail Operating Costs	1	1	44900000	1	$44900000.00	1	$44900000.00	$535181200.00
Work Transit Travel Time	1	1	89665840	$4.00	$358663360.00	1	($358663360.00)	
Nonwork Travel Time	1	1	268312400	$2.00	$536624800.00	1	($536624800.00)	($895288160.00)
Ann. Linked Transit Trip	1	1	576418500	1	576418500	1	576418500	
TSM ALTERNATIVE								
Initial Bus Expansion	0.1	12	208	$150000.00	$31200000.00	0.1467633	$4579015.43	
Other Bus Capital	0.1	30	1	$29000000.00	$29000000.00	0.1060792	$3076295.20	
Replacement Bus Costs	0.1	12	2418	$150000.00	$362700000.00	0.1467633	$53231054.39	
Other Capital Costs	0.1	30	28780000	1	$28780000.00	0.1060792	$3052960.76	$63939328.78
Local Capital Funding							$15984832.20	$15984832.20
Bus Operating Costs	1	1	544088832	1	$544088832.00	1	$544088832.00	
Other Operating Costs	1	1	13522400	1	$13522400.00	1	$13522400.00	$557611232.00
Work Transit Travel Time	1	1	91528800	$4.00	$366115200.00	1	($366115200.00)	
Nonwork Travel Time	1	1	273015440	$2.00	$546030880.00	1	($546030850.00)	($912146080.00)
Ann. Linked Transit Trip	1	1	519990700	1	519990900	1	519990900	

Cost-Effectiveness Index	3.0023
Federal Cost-Effectiveness Index	1.7969

SCRTD COST-EFFECTIVENESS CALCULATIONS

Alternative Name: LPA

Item	Disc	Life	Quantity	Unit Price	Cost	Rate	Value	TOTALS
RAIL ALTERNATIVE								
Rail Capital Cost	0.1	30	3.384E+09	1	$3384000000.00	0.1060792	$358972176.09	
Initial Bus Expansion	0.1	12	0	$150000.00	$0.00	0.1467633	$0.00	
Other Bus Capital	0.1	30	0	$29000000.00	$0.00	0.1060792	$0.00	
Replacement Bus Costs	0.1	12	1724	$150000.00	$258600000.00	0.1467633	$37952993.28	
Other Capital Costs	0.1	30	0	1	$0.00	0.1060792	$0.00	$396925169.37
Local Capital Funding							$124359344.67	$124359344.67
Bus Operating Costs	1	1	406346000	1	$406346000.00	1	$406346000.00	
Rail Operating Costs	1	1	61520000	1	$61520000.00	1	$61520000.00	$467866000.00
Work Transit Travel Time	1	1	90891040	$4.00	$363564160.00	1	($363564160.00)	
Nonwork Travel Time	1	1	265235040	$2.00	$530470080.00	1	($530470080.00)	($894034240.00)
Ann. Linked Transit Trip	1	1	582381600	1	582381600	1	582381600	
TSM ALTERNATIVE								
Initial Bus Expansion	0.1	12	161	$150000.00	$24150000.00	0.1467633	$3544334.06	
Other Bus Capital	0.1	30	1	$29000000.00	$29000000.00	0.1060792	$3076298.20	
Replacement Bus Costs	0.1	12	2371	$150000.00	$355650000.00	0.1467633	$52196373.02	
Other Capital Costs	0.1	30	45600000	1	$45600000.00	0.1060792	$4837213.72	$63654218.99
Local Capital Funding							$15913554.75	$15913554.75
Bus Operating Costs	1	1	533268000	1	$533268000.00	1	$533268000.00	
Other Operating Costs	1	1	13717000	1	$13717000.00	1	$13717000.00	$546985000.00
Work Transit Travel Time	1	1	91133920	$4.00	$364535680.00	1	($364535680.00)	
Nonwork Travel Time	1	1	273988560	$2.00	$547977120.00	1	($547977120.00)	($912512800.00)
Ann. Linked Transit Trip	1	1	519852300	1	519852300	1	519852300	
Cost-Effectiveness Index								3.7690
Federal Cost-Effectiveness Index								2.0347

==

GENERAL PLANNING CONSULTANT

TECHNICAL MEMORANDUM 6.1.4

COST-EFFECTIVENESS CALCULATIONS

==

Prepared for:

Southern California Rapid Transit District

Prepared by:

Barton-Aschman Associates, Inc.

in associaton with:

Schimpeler.Corradino Associates
Cordoba Corporation
Myra L. Frank & Associates
Robert J. Harmon & Associates
Deloitte Haskins & Sells
Manual Padron
The Planning Group, Inc.

September, 1984

I. Introduction

Metro Rail and Transportation System Management (TSM) alternatives have been defined for each of the three Metro Rail line extents (4,8.8, and 18.6 miles)[1]. Complete travel demand model simulations have been performed to estimate the ridership, travel time, and operating resource and cost implications of each of thse six alternatives.

Briefly sumarized in this memorandum are the results of the UMTA prescribed cost-effectivenss calculations aimed at comparing each rail alternative with the comparable non-rail alternative.

2. Cost-Effectiveness Inputs and Results

In addition to the data provided by the individual travel demand model simulations, other capital and operating costs were computed based upon the definition of the specific alernative being tested.

Rail system capital costs included the cost of the Metro Rail line and the corresponding cost of bus expansion and replacement. The rail system operating costs were derived from the respective rail and bus cost models, which are calibrated components of the travel demand models.

The TSM capital costs include the cost of bus fleet expansion and replacement for all alternatives. Computerized traffic signal constrol was also included in all alternatives at $40,000 per signal, with the following number of signals in each alternative:

TSM ALTERNATIVE	NUMBER OF SIGNALS EFFECTED
4.0 mile	334
8.8 mile	682
18.6 mile	960

In the 8.8 and 18.6 mile TSM alternatives, reversible lane control on Olympic Boulevard was included at $1.5 million. And finally, in the 18.6 TSM alternative, new transit centers at Universal City and Hollywood/ Cahuenga were included at a total cost of $5.7 million. TSM operating costs include the Long Beach Light Rail line and regional bus operating costs plus the maintenance of the computerized traffic signal control system (at $700 per signal per year).

All cost-effectiveness inputs are presented in the attached tables together with the calculation results:

Extent (Mile)	Federal Index	Total Index
4.0	4.58	6.51
8.8	1.80	3.00
18.6	2.03	3.77

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[1] Technical Memorandum 6.1.3, Description of Transportation System Management (TSM) Alternative Networks, September, 1984

SCRTD COST-EFFECTIVENESS CALCULATIONS

Alternative Name: MOS-1

Item	Disc	Life	Quantity	Unit Price	Cost	Rate	Value	TOTALS
RAIL ALTERNATIVE								
Rail Capital Cost	0.1	30	1.175E+09	1	$1174900000.00	0.1060792	$124632508.77	
Initial Bus Expansion	0.1	12	84	$150000.00	$12600000.00	0.1467633	$1849217.77	
Other Bus Capital	0.1	30	0	$29000000.00	$0.00	0.1060792	$0.00	
Replacement Bus Costs	0.1	12	2294	$150000.00	$344100000.00	0.1467633	$50501256.73	
Other Capital Costs	0.1	30	0	1	$0.00	0.1060792	$0.00	$176982983.27
Local Capital Funding							$52970021.43	$52970021.43
Bus Operating Costs	1	1	525420800	1	$525420800.00	1	$525420800.00	
Rail Operating Costs	1	1	28380000	1	$28380000.00	1	$28380000.00	$553800800.00
Work Transit Travel Time	1	1	78311305	$4.00	$313245220.00	1	($313245220.00)	
Nonwork Travel Time	1	1	269973760	$2.00	$539947520.00	1	($539947520.00)	($853192740.00)
Ann. Linked Transit Trip	1	1	522732900	1	522732900	1	522732900	
TSM ALTERNATIVE								
Initial Bus Expansion	0.1	12	26	$150000.00	$3900000.00	0.1467633	$572376.93	
Other Bus Capital	0.1	30	0	$29000000.00	$0.00	0.1060792	$0.00	
Replacement Bus Costs	0.1	12	2236	$150000.00	$335400000.00	0.1467633	$49224415.88	
Other Capital Costs	0.1	30	13360000	1	$13360000.00	0.1060792	$1417216.76	$51214011.57
Local Capital Funding							$12803502.89	$12803502.89
Bus Operating Costs	1	1	518106880	1	$518106880.00	1	$518106880.00	
Other Operating Costs	1	1	13233800	1	$13233800.00	1	$13233800.00	$531340680.00
Work Transit Travel Time	1	1	79854485	$4.00	$319417940.00	1	($319417940.00)	
Nonwork Travel Time	1	1	273339760	$2.00	$546679520.00	1	($546679520.00)	($866097460.00)
Ann. Linked Transit Trip	1	1	501937200	1	501937200	1	501937200	

Cost-Effectiveness Index	6.5073
Federal Cost-Effectiveness Index	4.5758

SCRTD COST-EFFECTIVENESS CALCULATIONS

Alternative Name: MOS

Item	Disc	Life	Quantity	Unit Price	Cost	Rate	Value	TOTALS
RAIL ALTERNATIVE								
Rail Capital Cost	0.1	30	2.134E+09	1	$2133500000.00	0.1060792	$226320076.15	
Initial Bus Expansion	0.1	12	0	$150000.00	$0.00	0.1467633	$0.00	
Other Bus Capital	0.1	30	0	$29000000.00	$0.00	0.1060792	$0.00	
Replacement Bus Costs	0.1	12	2104	$150000.00	$315600000.00	0.1467633	$46318502.25	
Other Capital Costs	0.1	30	0	1	$0.00	0.1060792	$0.00	$272638578.39
Local Capital Funding							$84002049.93	$84002049.93
Bus Operating Costs	1	1	490281200	1	$490281200.00	1	$490281200.00	
Rail Operating Costs	1	1	44900000	1	$44900000.00	1	$44900000.00	$535181200.00
Work Transit Travel Time	1	1	89665840	$4.00	$358663360.00	1	($358663360.00)	
Nonwork Travel Time	1	1	268312400	$2.00	$536624800.00	1	($536624800.00)	($895288160.00)
Ann. Linked Transit Trip	1	1	576418500	1	576418500	1	576418500	
TSM ALTERNATIVE								
Initial Bus Expansion	0.1	12	208	$150000.00	$31200000.00	0.1467633	$4579015.43	
Other Bus Capital	0.1	30	1	$29000000.00	$29000000.00	0.1060792	$3076298.20	
Replacement Bus Costs	0.1	12	2418	$150000.00	$362700000.00	0.1467633	$53231054.39	
Other Capital Costs	0.1	30	28780000	1	$28780000.00	0.1060792	$3052960.76	$63939328.78
Local Capital Funding							$15984832.20	$15984832.20
Bus Operating Costs	1	1	544088832	1	$544088832.00	1	$544088832.00	
Other Operating Costs	1	1	13522400	1	$13522400.00	1	$13522400.00	$557611232.00
Work Transit Travel Time	1	1	91528800	$4.00	$366115200.00	1	($366115200.00)	
Nonwork Travel Time	1	1	273015440	$2.00	$546030880.00	1	($546030880.00)	($912146080.00)
Ann. Linked Transit Trip	1	1	519990900	1	519990900	1	519990900	

Cost-Effectiveness Index	3.0023
Federal Cost-Effectiveness Index	1.7969

SCRTD COST-EFFECTIVENESS CALCULATIONS

Alternative Name: LPA

Item	Disc	Life	Quantity	Unit Price	Cost	Rate	Value	TOTALS
RAIL ALTERNATIVE								
Rail Capital Cost	0.1	30	3.384E+09	1	$3384000000.00	0.1060792	$358972176.09	
Initial Bus Expansion	0.1	12	0	$150000.00	$0.00	0.1467633	$0.00	
Other Bus Capital	0.1	30	0	$29000000.00	$0.00	0.1060792	$0.00	
Replacement Bus Costs	0.1	12	1724	$150000.00	$258600000.00	0.1467633	$37952993.28	
Other Capital Costs	0.1	30	0	1	$0.00	0.1060792	$0.00	$396925169.37
Local Capital Funding							$124359344.67	$124359344.67
Bus Operating Costs	1	1	406346000	1	$406346000.00	1	$406346000.00	
Rail Operating Costs	1	1	61520000	1	$61520000.00	1	$61520000.00	$467866000.00
Work Transit Travel Time	1	1	90891040	$4.00	$363564160.00	1	($363564160.00)	
Nonwork Travel Time	1	1	265235040	$2.00	$530470080.00	1	($530470080.00)	($894034240.00)
Ann. Linked Transit Trip	1	1	582381600	1	582381600	1	582381600	
TSM ALTERNATIVE								
Initial Bus Expansion	0.1	12	161	$150000.00	$24150000.00	0.1467633	$3544334.06	
Other Bus Capital	0.1	30	1	$29000000.00	$29000000.00	0.1060792	$3076298.20	
Replacement Bus Costs	0.1	12	2371	$150000.00	$355650000.00	0.1467633	$52196373.02	
Other Capital Costs	0.1	30	45600000	1	$45600000.00	0.1060792	$4837213.72	$63654218.99
Local Capital Funding							$15913554.75	$15913554.75
Bus Operating Costs	1	1	533268000	1	$533268000.00	1	$533268000.00	
Other Operating Costs	1	1	13717000	1	$13717000.00	1	$13717000.00	$546985000.00
Work Transit Travel Time	1	1	91133920	$4.00	$364535680.00	1	($364535680.00)	
Nonwork Travel Time	1	1	273988560	$2.00	$547977120.00	1	($547977120.00)	($912512800.00)
Ann. Linked Transit Trip	1	1	519852300	1	519852300	1	519852300	

Cost-Effectiveness Index	3.7690
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GENERAL PLANNING CONSULTANT

TECHNICAL MEMORANDUM 6.1.4

COST-EFFECTIVENESS CALCULATIONS

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Prepared for:

Southern California Rapid Transit District

Prepared by:

Barton-Aschman Associates, Inc.

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In addition to the data provided by the individual travel demand model simulations, other capital and operating costs were computed based upon the definition of the specific alernative being tested.

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In the 8.8 and 18.6 mile TSM alternatives, reversible lane control on Olympic Boulevard was included at $1.5 million. And finally, in the 18.6 TSM alternative, new transit centers at Universal City and Hollywood/ Cahuenga were included at a total cost of $5.7 million. TSM operating costs include the Long Beach Light Rail line and regional bus operating costs plus the maintenance of the computerized traffic signal control system (at $700 per signal per year).

All cost-effectiveness inputs are presented in the attached tables together with the calculation results:

Extent (Mile)	Federal Index	Total Index
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8.8	1.80	3.00
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[1] Technical Memorandum 6.1.3, Description of Transportation System Management (TSM) Alternative Networks, September, 1984

SCRTD COST-EFFECTIVENESS CALCULATIONS

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Item	Disc	Life	Quantity	Unit Price	Cost	Rate	Value	TOTALS
RAIL ALTERNATIVE								
Rail Capital Cost	0.1	30	1.175E+09	1	$1174900000.00	0.1060792	$124632508.77	
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Cost-Effectiveness Index	6.5073
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Cost-Effectiveness Index 3.0023

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Other Operating Costs	1	1	13717000	1	$13717000.00	1	$13717000.00	$546985000.00
Work Transit Travel Time	1	1	91133920	$4.00	$364535680.00	1	($364535680.00)	
Nonwork Travel Time	1	1	273988560	$2.00	$547977120.00	1	($547977120.00)	($912512800.00)
Ann. Linked Transit Trip	1	1	519852300	1	519852300	1	519852300	

Cost-Effectiveness Index	3.7690
Federal Cost-Effectiveness Index	2.0347

SCHIMPELER-CORRADINO ASSOCIATES
GENERAL PLANNING CONSULTANT to the Southern California Rapid Transit District

425 South Main Street
Los Angeles, California 90013
213/972-3239

Associate Consultants:
Barton-Aschman Associates
Del[illegible] Haskins & Sells
Ro[illegible] Harmon & Associates, Inc.
The Planning Group, Inc.
Cordoba Corporation
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Manuel Padron

November 16, 1984

Mr. Gary S. Spivack
Department of Planning
Southern California Rapid Transit District
425 South Main Street
Los Angeles, California 90013

Re: Revised Technical Memorandum 6.2.1
Alvarado Station Bus Interface
Traffic and Operational Analysis

Dear Mr. Spivack:

Attached is a revised Technical Memorandum 6.2.1 on the Alvarado Bus Interface. This paper was originally submitted to you in August in support of the expanded traffic analysis which appeared in the Environmental Assessment on MOS-1. Because of the importance of the information in this report as a technical backup document to the EA, we have taken the time to review the paper again. Minor revisions in format have been made. The recommendations and conclusions remain unchanged. This document was the second of such technical papers generated in Work Area 6, Environmental Assessments.

Very truly yours,

Charles C. Schimpeler

CHARLES C. SCHIMPELER, P.E.
Project Director
General Planning Consultant

CCS:dh

RECEIVED
NOV 16 1984
PLANNING DEPT.

====================================

GENERAL PLANNING CONSULTANT:

TECHNICAL MEMORANDUM 6.2.1

ALVARADO STATION BUS INTERFACE TRAFFIC AND OPERATIONAL ANALYSIS

====================================

Prepared for:

Southern California Rapid Transit District

Prepared by:

Schimpeler.Corradino Associates

in association with

Barton-Aschman Associates, Inc.
Cordoba Corporation
Myra L. Frank & Associates
Robert J. Harmon & Associates
Manuel Padron
The Planning Group, Inc.

November, 1984

SUMMARY

The Alvarado Station is proposed to serve initially as a terminal station for the Union Station to Wilshire Alvarado (MOS-1) segment of the Metro Rail system. Use of this station as a terminal facility necessitates the routing of express buses via a passenger drop-off area located adjacent to the station site. Two alternative bus routings have been identified to provide access to the station. These two routings, referred to as the "Alvarado Alternative" and the "Westlake Alternative," are described in detail in this report.

The purpose of this analysis is to determine if the proposed location of the Alvarado Station would affect surface traffic to the extent that it exceeds an acceptable level of service and if sufficient street capacity is available to accommodate the needed bus access to the station. Potential impacts could result from buses terminating at the station. Originally, the bus routing for limited routes was east on Wilshire Boulevard, south on Alvarado Street, and west on 7th Street. Discharge and pickup of passengers would have occurred on the west side of Alvarado Street opposite the station entrance. This pedestrian movement was deemed unsafe, undesirable, and impractical given the traffic volume on Alvarado.

In the Alvarado Alternative the limited routes were proposed to allow discharge and loading on the east side of Alvarado Street. The alternative routing would be east on Wilshire Boulevard, south on Hoover Street, east on 7th Street, north on Alvarado Street, then west on 6th Street and return to Wilshire via Rampart Boulevard or Lafayette Park Place. The westbound routing was placed on 6th Street rather than Wilshire Boulevard because the distance from the station to Wilshire Boulevard was too short for the buses leaving the station to cross Ethrough lanes of traffic to turn left on to Wilshire Boulevard.

A second alternative routing for the limited buses (Westlake Alternative) was to have them travel east on Wilshire Boulevard past Alvarado Street and then south on Westlake Avenue, one block east. The buses would discharge and load passengers near the kiss-and-ride area on the west side of Westlake Avenue. The buses would leave the station area traveling south on Westlake Avenue, then west on 7th Street, and north on Hoover Street to west on Wilshire Boulevard.

The results of analysis on the Alvarado Alternative show that this scenario will not work without improvements, whether considering traffic flow or bus operations. Under existing conditions, traffic flow is extremely congested at Wilshire/Alvarado and 6th/Alvarado in the p.m. peak hour. The Westlake Alternative operates much more efficiently. The additional bus traffic does not add to the p.m. peak surface traffic congestion. Based on results of this analysis, it is recommended that the Westlake Alternative be implemented to provide the necessary bus interface with the Alvarado Station.

As part of this analysis, it is further recommended that the curb radius on the southwest corner of Wilshire and Westlake be improved to a minimum of 36 feet to enhance bus operations for this right-turn movement.

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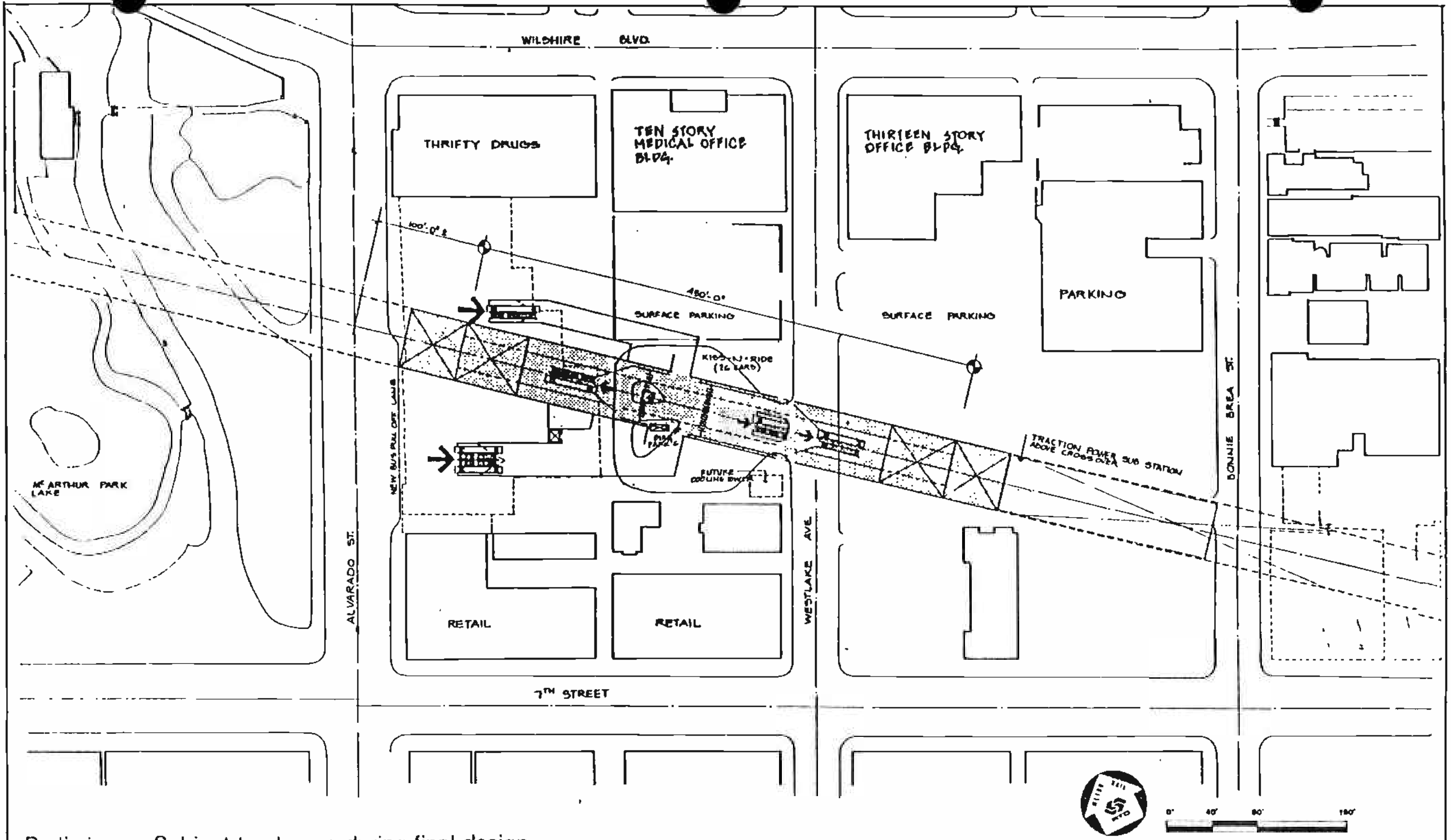
1. INTRODUCTION

The Alvarado Station is located in the block bounded by Alvarado Street, Wilshire Boulevard, Westlake Avenue and Seventh Street (Figure 1). The Alvarado Station is proposed to serve initially as a terminal station for the Union Station to Wilshire/Alvarado (MOS-1) segment of the Metro Rail system. Use of this station as a terminal facility necessitates the routing of express buses via passenger drop-off areas located adjacent to the station site. Two alternative bus routings have been identified to provide access to the station. These two routings, referred to as the "Alvarado Alternative" and the "Westlake Alternative," are described in detail later in this report.

Two basic operational elements are defined, evaluated, and documented herein. The first is an analysis of surface traffic (forecast to the Year 2000) including background vehicular and pedestrian traffic plus auto, bus, and pedestrian traffic interfacing with the station. The second is an evaluation of the bus operations for each of the alternative routings. The purposes of this analysis is to determine if the proposed location of the Alvarado Station would affect surface traffic to the extent that it exceeds an acceptable level of service and if sufficient street capacity is available to accommodate the needed bus access to the station.



Preliminary: Subject to change during final design

Southern California Rapid Transit District

Metro Rail Project

Figure 1 **Wilshire/Alvarado - Station Location for MOS -1 Alternative**

2. DESCRIPTION OF ALTERNATIVE BUS ROUTINGS

A traffic engineering analysis was conducted to determine the effect on traffic flow when the Alvarado Station is temporarily used as a terminal station. Potential impacts could occur as a result of buses terminating at the station. Originally, the bus routing for limited routes was east on Wilshire Boulevard, to south on Alvarado Street, and west on 7th Street. Discharge and pickup of passengers would have occurred on the west side of Alvarado Street opposite the station entrance. Bus patrons accessing the station would have to cross Alvarado Street. This pedestrian movement was deemed unsafe, undesirable and impractical given the traffic volume on Alvarado.

An alternative bus routing (Alvarado Alternative) for the limited routes was proposed to allow discharge and loading on the east side of Alvarado Street. The alternative routing would be east on Wilshire Boulevard, south on Hoover Street, east on 7th Street, north on Alvarado Street; then west on 6th Street and return to Wilshire via Rampart Boulevard on Lafayette Park Place. The westbound routing was placed on 6th Street rather than Wilshire Boulevard because the distance from the station to Wilshire Boulevard was too short for the buses leaving the station to cross through lanes of traffic to turn left on to Wilshire Boulevard.

A second alternative routing for the limited buses (Westlake Alternative) was to have them travel east on Wilshire Boulevard past Alvarado Street and then south on Westlake Avenue, one block east. The buses would discharge and load passengers near the kiss-and-ride area on the westside of Westlake Avenue. The buses would leave the station area south on Westlake Avenue, then travel west on 7th Street, north on Hoover Street, and west on Wilshire Boulevard.

The impact of the bus routing on traffic flow in the station area was determined for each alternative.

3. IDENTIFICATION OF CRITICAL INTERSECTIONS

Five intersections were identified as having potential for being impacted by the Alvarado bus routings. These are Hoover Street/Wilshire Boulevard, Hoover Street/7th Street, Alvarado Street/6th Street, Wilshire Boulevard/Alvarado Street, and Wilshire Boulevard/Hoover. A review of traffic control, traffic volumes, and observation of traffic operation in the field indicated that the three intersections with Alvarado Street would be the critical intersections for analysis. The traffic volume in the Hoover Street area is significantly less than that in the Alvarado area and Hoover Street has an additional exclusive lane for left turns.

Two intersections were identified as having potential traffic impacts with the Westlake routing. They are 7th/Alvarado and Wilshire/Alvarado.

4. METHODOLOGY

The key analytical methods used in this study were Critical Movement Analysis and bus operations analysis.

The "Operations and Design" application of the Critical Movement Analysis as presented in "Transportation Research Circular Number 212, Interim Materials on Highway Capacity" was utilized to calculate the level of service for the critical intersections. The "Operations and Design" application of Critical Movement Analysis allows for specific adjustments to be made for traffic and roadway conditions. There are four adjustments related to the factors of vehicle mix (trucks and buses), peaking characteristics, turns, lane utilization (i.e., volume distribution), and lane width.

The traffic volumes used in the analysis are Year 2000 volumes assuming the temporary terminal station at Alvarado Street. The volumes were derived from the previous work of the City of Los Angeles Department of Transportation as documented in the "Final Project Report - Traffic Analysis," June 1983 (Task 18CAA21). Also used were existing traffic count data provided by the City of Los Angeles Department of Transportation. The bus volumes for the alternative routings were generated by SCRTD's General Planning Consultant. The volumes were based on travel demand forecasts for the systems with Alvarado Street serving as the terminal station.

5. GEOMETRICS AND TRAVEL CONTROL

The Alvarado Street, 6th Street, Wilshire Boulevard, and 7th Street intersections have similar geometrics and lane utilization. Each street has three lanes in each direction with the curb lane used for parking during part of the day. The approaches to each intersection have parking restricted (except for westbound 7th Street at Alvarado) allowing right turns to be made from the curb lane. Left turns from all approaches at each intersection are prohibited during the hours of 7:00 a.m. and 6:00 p.m.. Buses may make left turns at all times throughout the day. Traffic signals are currently in operation at each of the critical or potentially critical intersections identified previously. These signals operate on a two-phase, fixed-time cycle length with approximately equal green-to-cycle (G/C) ratios. Specific signal timing was not considered critically essential in the analysis since it was assumed timings could be slightly modified as necessary to accommodate anticipated variations in traffic volumes.

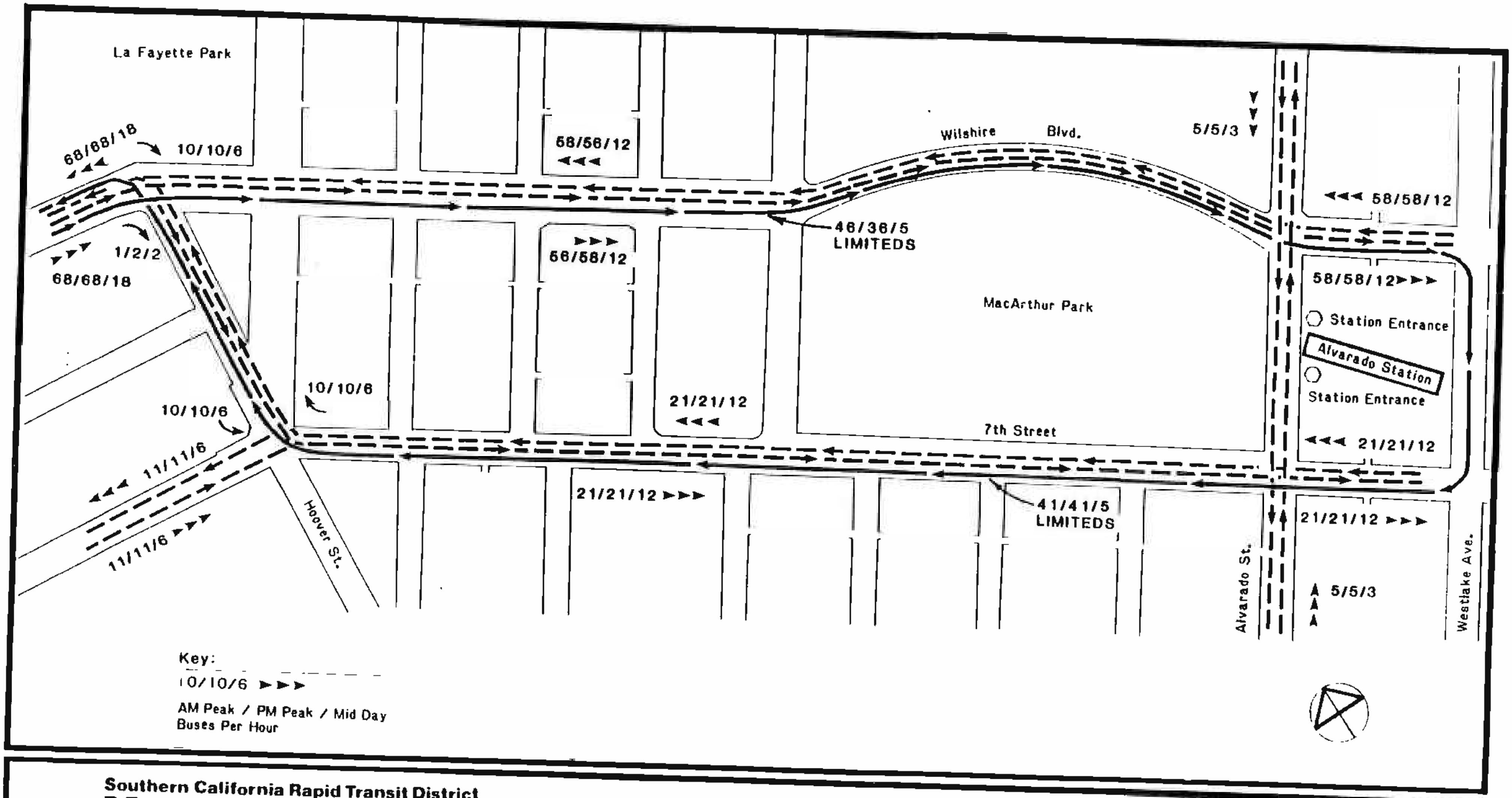
6. TRAFFIC VOLUME DATA

The traffic volume data used in this analysis were obtained from three sources. Existing traffic count data, including 24 hour volumes, turning movement data, pedestrian volumes, and peak 15 minute counts. The volume of trucks and buses was provided by the City of Los Angeles Department of Transportation. These detailed counts were provided for the intersections of 6th Street and 7th Street with Alvarado Street.

Also included with the turning movement counts are pedestrian volumes across each approach during the peak periods observed for the intersection of 7th Street & Alvarado Street. The pedestrian volumes are relatively light in the a.m. peak period when the average volume is around 150 persons per hour in each crosswalk. In the afternoon peak, however, pedestrian activity in the east-west crosswalks (crossing Alvarado) varies from 500 to 600 persons per hour. Pedestrians crossing 7th Street parallel to Alvarado Street range from 600 to 800 persons per hour.

Added to these traffic data and forecasts were the "limited" bus volumes associated with each alternative as forecasted by SCRTD's General Planning Consultant. These buses would be in addition to the local bus service and would only serve the Alvarado Station. The numbers of buses anticipated are 40 per hour in the a.m. peak, 35 per hour in the p.m. peak and 5 per hour during the mid-day (Hoover, 7th, Alvarado, 6th and Lafayette Park Place back to Wilshire). Wilshire Boulevard eastbound would have six "Limiteds" per hour in the a.m. and one in the p.m. Seventh Street westbound from the station would carry one in the a.m. and six in the p.m. (Figure 2).

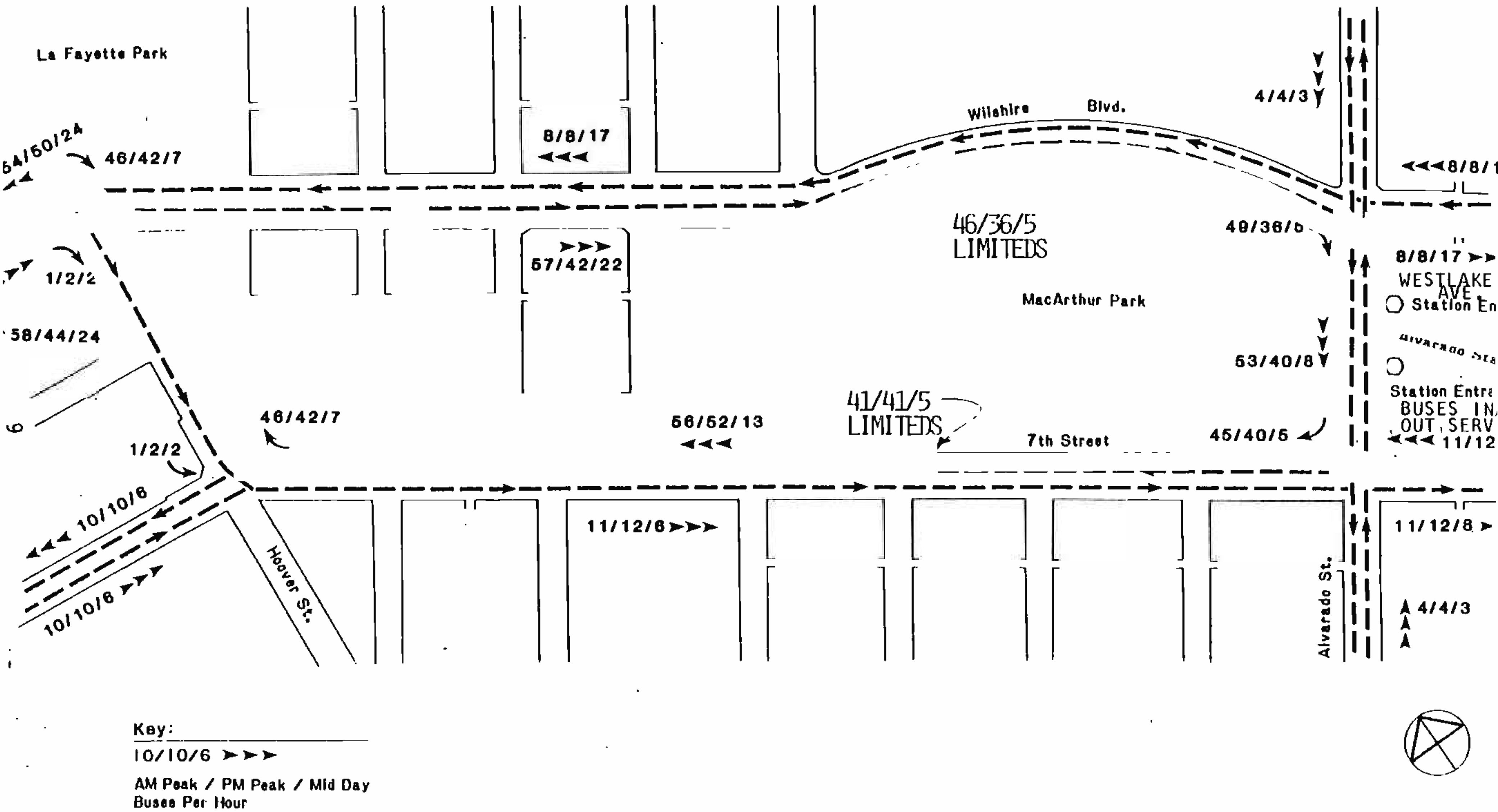
The "Westlake Alternative" (Figure 3) would have the same number of "limited" buses in each period; however, it would have a different routing system as described earlier. In addition, the document entitled "Final Project Report Traffic Analysis" (Task 18CAA21) by the City of Los Angeles Department of Transportation was used as a source for Year 2000 traffic forecasts in the vicinity of the Alvarado Station. Copies of these data are provided in Appendix A.



Southern California Rapid Transit District

Metro Rail Project

Figure 2 Alvarado Station Bus Interface



Southern California Rapid Transit District
Metro Rail Project

FIGURE 3 Alvarado Station Bus Interface

WESTLAKE ALTERNATIVE

7. ANALYSIS AND RESULTS

Critical intersections in the vicinity of the Alvarado Station were analyzed to determine the impacts created by buses, vehicular traffic, and pedestrians. This examination involved utilization of the Capacity and Critical Movement Analysis and an evaluation of bus operations were performed. The locations studied are presented in Table 1.

7.1 ALVARADO ALTERNATIVE

A Critical Movement Analysis was performed using the existing traffic control and street geometry conditions with Year 2000 background traffic control and street geometry conditions plus transit generated traffic and bus volumes. The traffic volume data and the detailed analysis results using existing conditions are presented in Appendix B for the Alvarado Alternative using existing conditions. Based on the level of service (LOS) ranges used in the referenced document for the "Operations and Design Application" (Table 2), it was determined that two of the intersections would experience unacceptable levels of service with transit traffic impacts during the p.m. peak period. With reference to Table 2, it should be noted that LOS D is generally acceptable during peak periods while LOS E is not. Level of service F represents breakdown conditions in the traffic flow. The CMA results (Table 3) show that the a.m. peak period experiences acceptable conditions and the p.m. peak conditions at Wilshire/Alvarado and at 6th/Alvarado are less than desirable before transit bus traffic is added.

Pedestrian traffic at the intersections of Alvarado Street with 7th Street, Wilshire Boulevard, and 6th Street is relatively heavy (600 to 800 per hour) in the p.m. peak. However, adjustments were made in the Critical Movement Analysis to account for up to 1,200 pedestrians per hour opposing the right turn movements. Since the right turns are in separate lanes with space for queueing, relatively minor impacts result for through traffic. Since the critical movements are in the through lanes, no decrease in service level is experienced due to pedestrians. This conclusion applies to both alternatives.

7.2 ALVARADO ALTERNATIVE WITH IMPROVEMENTS

The next step in the evaluation of the Alvarado Alternative is to identify improvements that would enable this scenario to operate at an acceptable level of service. A major objective in realizing this goal is to minimize capital expenditures through the use of transportation systems management (TSM) type traffic enhancements. Because the p.m. peak period is the only time when unacceptable levels of service are experienced, it was decided to test a traffic flow improvement that prohibits curbside parking (which is currently metered) during the p.m. peak (3-6 p.m.) on the east side of Alvarado from about 200 feet south of 7th Street north to Maryland Street, one block north of 6th. This parking restriction would provide three lanes for moving traffic during the time when it is most needed. The results of the Critical Movement Analysis with this improvement (Table 4) indicate the service level can be improved to D, which is acceptable in urban areas during a peak period.

TABLE 1

ALVARADO STATION
INTERSECTIONS STUDIED

Intersection	Alvarado Alternative	Westlake Alternative
7th & Alvarado	a.m. and p.m.	P.M. Only
Wilshire & Alvarado	a.m. and p.m.	P.M. Only
6th & Alvarado	a.m. and p.m.	Not Critical
7th & Hoover	Not Critical	Not Critical
Wilshire & Hoover	Not Critical	Not Critical

Source: Schimpeler.Corradino Associates, 1984.

TABLE 2

LEVEL OF SERVICE RANGES
OPERATIONS AND DESIGN APPLICATIONS
(IN PASSENGER CARS PER HOUR EQUIVALENCY)

FOR SIGNALIZED INTERSECTIONS

Level of Service	Maximum Sum of Critical Volumes		
	Two-Phase	Three-Phase	Four+ Phase
A	1,000	950	900
B	1,200	1,140	1,080
C	1,400	1,340	1,270
D	1,600	1,530	1,460
E	1,800	1,720	1,650
F	------------Not Applicable--------------		

Source: Transportation Research Circular 212 Interim Materials on Highway Capacity, Transportation Research Board, National Academy of Sciences, Washington, D.C.

TABLE 3

ALVARADO STATION
CRITICAL MOVEMENT ANALYSIS

Intersection	Alvarado Alternative Sum of Critical Volumes (pch)	Level of Service
7th & Alvarado		
a.m.	1,216	C
p.m.	1,433	D
Wilshire & Alvarado		
a.m.	1,399	C
p.m.	1,717	E
6th & Alvarado		
a.m.	1,491	D
p.m.	1,889	F

Source: Schimpeler.Corradino Associates, 1984.

TABLE 4

ALVARADO STATION

CRITICAL MOVEMENT ANALYSIS WITH IMPROVEMENTS

Intersection	Alvarado Alternative	
	Sum of Critical Volumes (pch)	Level of Service
Wilshire & Alvarado p.m.	1,538	D
6th & Alvarado p.m.	1,513	D

Source: Schimpeler.Corradino Associates, 1984.

7.3 WESTLAKE ALTERNATIVE

The Westlake Alternative allows buses eastbound on Wilshire Boulevard to continue east to Westlake, and then turn right with passenger drop-off/pick-up from the Westlake side of Alvarado Station. Buses then continue right onto 7th and back to Wilshire via Hoover. Based on the previous analysis it was determined that the a.m. operations would be at an acceptable level of service, but that two intersections were potentially critical during the p.m. peak period. The two intersections analyzed for this alternative were Wilshire/Alvarado and 7th/Alvarado. The traffic volume data and detailed analyses for this alternative are presented in Appendix D. The results of the analysis (Table 5) show that the 7th/Alvarado intersection operates acceptably. However, the Wilshire/Alvarado intersection operates at LOS E, which is unacceptable. However, a further examination reveals that the transit traffic, specifically the buses eastbound on Wilshire in the p.m. peak to serve the Alvarado Station, does not add to the critical movements. This is demonstrated in Table 6, which presents the equivalent passenger cars per lane per hour for each approach in the before-and-after transit condition. This table shows that the buses added to the intersection are added to the smallest traffic stream (588 PCV before vs. 629 PCV after, with buses added) and that this addition leaves the eastbound movement far short of the critical volume (841 PCV) on the westbound approach. Therefore, the additional bus traffic contributes nothing to cause deterioration to the level of service and, although the service level is E, no improvements are recommended since transit and the station's presence make no contribution to the problem.

TABLE 5

WESTLAKE ALTERNATIVE
CRITICAL MOVEMENT ANALYSIS

Intersection	Westlake Alternative Sum of Critical Volumes (pch)	Level of Service
Wilshire & Alvarado		
p.m.	1,676	E
7th & Alvarado		
p.m.	1,470	D

Source: Schimpeler.Corradino Associates.

TABLE 6

WESTLAKE ALTERNATIVE
WILSHIRE/ALVARADO APPROACH VOLUMES (PCV)

Intersection Approach	Total PCV (Passenger Car) Equivalents in Cars Per	
	Before	After
Wilshire & Alvarado	--	--
Eastbound (A1)	538	629
Westbound (A2)	841(c)	841(c)
Southbound (A3)	641	641
Northbound (A4)	835(c)	835(c)
Sum of Critical Volumes	1,676	1,676
Level of Service	E	E

Reference: Calculation #10, Appendix D.

Source: Schimpeler.Corradino Associates.

8. CONCLUSIONS AND RECOMMENDATIONS

Stated succinctly, the results of analysis on the Alvarado Alternative show that this scenario will not work without improvements, either from the traffic flow perspective or the bus operations viewpoint. Traffic flow, with existing conditions and experiences, present extreme congestion at Wilshire/Alvarado and 6th/Alvarado in the p.m. peak period. Bus operations are seriously impacted due to insufficient length of the pull-out bus bay to allow for efficient loading/unloading, much less having space for layover. This scenario would, therefore, require buses to circulate around the block to accomplish layover time, which is obviously undesirable for several reasons.

The Westlake Alternative (refer to Figure 3), on the other hand, operates much more efficiently. The additional bus traffic does not add to the p.m. peak surface traffic congestion since it operates eastbound on Wilshire against the major traffic flow and 7th/Hoover both have sufficient excess capacity to accept the additional buses. Bus operations are enhanced also through the provision of a layover space along the west curb face of Westlake Avenue south of Wilshire in addition to sufficient space for passsenger loading/unloading.

Based on results documented herein, it is strongly recommended that the Westlake Alternative be implemented to provide the necessary bus interface with the Alvarado Station.

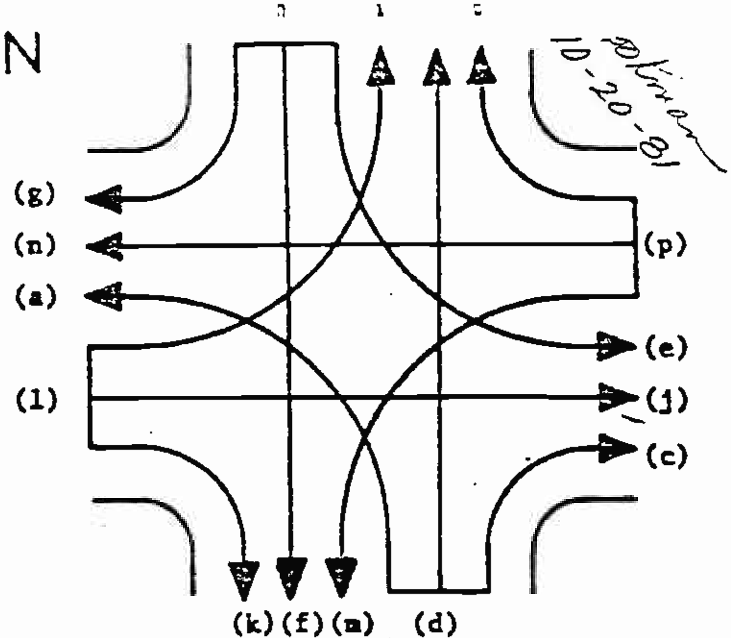
As part of this analysis, it is further recommended that the curb radius on the southwest corner of Wilshire and Westlake be improved to a minimum of 36 feet to enhance bus operations for this right turn movement, allowing the buses to turn.

APPENDIX A

TRAFFIC VOLUME DATA

DT 200 (3R-2/79)
City of Los Angeles
Department of Transportation

02010
NORTH/SOUTH Alvarado Street
82510
EAST/WEST 7th Street
DAY & DATE Fri. 10-9-81 **WEATHER** Clear
HOURS 7-10 **AM** 3-6 **PM**
SCHOOL DAY Yes **DISTRICT** Hollywood



10-20-81

	N/B	S/B	E/B	W/B
DUAL WHEELED	111	148	56	62
BUSES	37	42	91	95

	N/B	TIME	S/B	TIME	E/B	TIME	W/B	TIME
AM PEAK 15 MIN	180	7^{45}	302	7^{30}	141	8^{00}	127	7^{45}
PM PEAK 15 MIN	267	4^{45}	452	5^{30}	191	4^{15}	213	5^{00}
AM PEAK HOUR	700	7^{30}	1131	7^{30}	518	7^{30}	425	7^{45}
PM PEAK HOUR	$987^{.92}$	4^{45}	$1650^{.91}$	3^{45}	$681^{.89}$	4^{00}	$832^{.98}$	4^{45}

	NORTHBOUND APPROACH				SOUTHBOUND APPROACH				TOTAL	XING S/L(d)		XING N/L(h)	
HOURS	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	d + h	Ped	Sc Ch	Ped	Sc Ch
7-8	1	580	40	621	11	993	60	1064	1685	161	4	153	3
8-9	3	570	77	650	3	872	100	975	1625	144	4	162	2
9-10	10	490	73	573	12	665	90	767	1340	291	12	224	—
3-4	4	734	70	808	4	1067	91	1162	1970	386	21	272	—
4-5	3	873	89	965	6	1521	114	1641	2606	526	32	479	—
5-6	3	878	76	957	11	1464	115	1590	2547	513	31	614	—
TOTAL	24	4125	425	4574	47	6582	570	7199	11773	2021	104	1904	5

	EASTBOUND APPROACH				WESTBOUND APPROACH				TOTAL	XING W/L		XING E/L	
									l +	Ped	Sc Ch		
7-8	3	345	41	389	3	331	39	373	762	80	—	161	7
8-9	8	446	36	490	1	349	61	411	901	11	2	188	7
9-10	4	337	51	392	2	00	62	364	756	1	—	314	11
3	6	375	83	464	5	452	90	47	1011	589	—	520	46
4-	3	552	126	681	10	659	105	774	1455	816	—	611	26
5-6	4	493	100	597	4	704	97	805	1402	791	—	530	21
TOTAL	28	2548	437	3013	25	2795	454	3274	6287	25	2	2324	118

ty of Los Angeles
epartment of Traffic

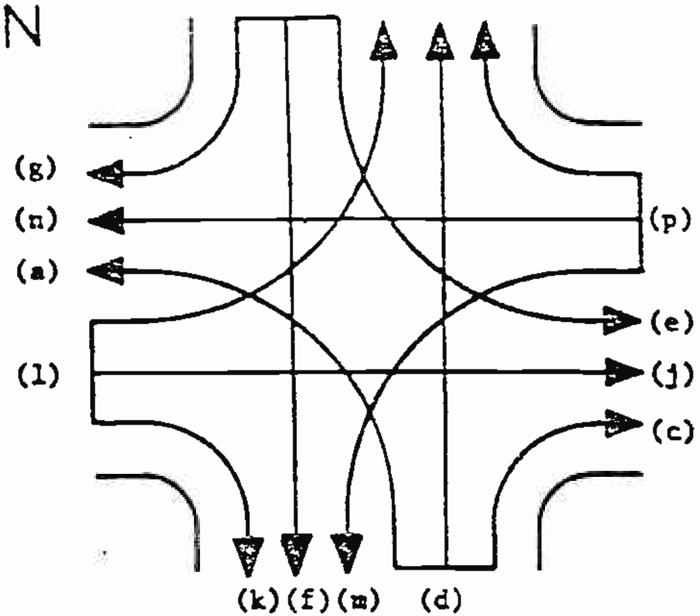
ORTH/SOUTH Alexander St

ST/WEST 6th St

Y & DATE Tues 9-20-80 WEATHER Clear

OURS 7-10 AM 10-12 noon PM

SCHOOL DAY Yes DISTRICT H,W



	N/B	S/B	E/B	W/B
DUAL WHEELED	110	125	63	67
BUSES	27	31	61	40

AM Count

	N/B	TIME	S/B	TIME	E/B	TIME	W/B	TIME
AM PEAK 15 MIN	154	815	336	800	268	745	181	1145
PM PEAK 15 MIN	— .96	—	— .94	—	— .88	—	— .89	—
AM PEAK HOUR	589	800	1268	745	941	745	647	1145
PM PEAK HOUR	—	—	—	—	—	—	—	—

Violations

	NORTHBOUND APPROACH			
HOUR	(a)	(b)	(c)	(d)
7-8	2	524	X	526
8-9	1	588		589
9-10	6	472		478
10-11	2	518		520
11-12	6	547		553
TOTAL	17	2649	X	2666

Illegal lefts OK (Official Vehicle)

SOUTHBOUND APPROACH				
(e)		(f)	(g)	(h)
1		1064	X	1065
5		1211		1216
6		866		872
6	1	694		701
4	1	840		845
22	2	4675	X	4699

TOTAL
d + h
1591
1805
1350
1221
1398
7365

XING S/L(d)		XING N/L(h)	
Ped	Sc Ch	Ped	Sc Ch
—	—	—	—
—	—	—	—
—	—	—	—
—	—	—	—
—	—	—	—
—	—	—	—

Violations

EASTBOUND APPROACH

	L	(		(	(
7-8	5		739		74
8-9	4	1	881		885
9-10	6		657		663
10-	|	/	/		614
11-	11		711		723
		|			
TOTAL	7	!	3589		29

Violations

WESTBOUND APPROACH			
(m)	(n)	(o)	(p)
11	388	X	399
5	475		480
3	348		351
5	491		496
15	632		647
39	2334	X	2373

TOTAL
l + p
1143
1365
1014
1110
1370
6002

XING W/L(l)		XING E/L(p)	
Ped	Sc Ch	Ped	Sc Ch
—	—	—	—
—	—	—	—
—	—	—	—
—	—	—	—
—	—	—	—
—	—	—	—

ty of Los Angeles
epartment of Traffic

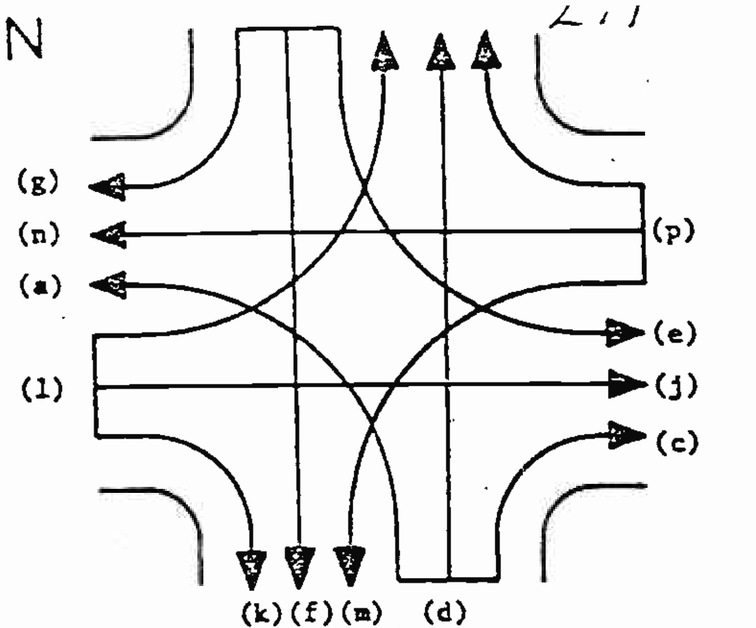
ORTH/SOUTH Alvarado St

T/WEST 6th St

Y & DATE Tues 10-7-80 WEATHER Clear

OURS 12- AM 6 PM

CHOOL DAY Yes DISTRICT H.W.



	N/B	S/B	E/B	W/B
UAL WHEELED	98	109	70	46
BUSES	36	30	47	51

P.M Counts

	N/B	TIME	S/B	TIME	E/B	TIME	W/B	TIME
	—	—	—	—	—	—	—	—
PEAK 15 MIN								
PM PEAK 15 MIN	309	500	296	515	250	500	312	500
PEAK HOUR	—	—	—	—	—	—	—	—
PM PEAK HOUR	1172	445	988	430	928	430	1137	445

Violations

ORTHBOUND APPROACH

HR	(a)	(b)	(c)	(d)
12-1	9	943		65
1-2	11			600
2-3	13	691		704
3-4	1	770		77
4-5	3	751		1054
5-	4	1157		1 6
TOTAL	41	4901		4942

Violations

SOUTHBOUND APPROACH				
L.(e)	OK	(f)	(g)	(h)
12	1	806	☒	819
14	1	752		767
15	-	709		724
3	1	864		868
2	-	886		888
6	-	969		975
52	3	4986	☒	5041

TOTAL
d + h
1471
1367
1428
1639
1942
2136
9983

XING S/L(d)		XING N/L(h)	
Ped	Sc Ch	Ped	Sc Ch
—	—	—	—
—	—	—	—
—	—	—	—
—	—	—	—
—	—	—	—
—	—	—	—
—	—	—	—

EASTBOUND APPROACH

	L (		(	(
12-1	2	987		6
1-2	14	757		767
2-3	15	709		724
3	17	685		702
4-5	7	716		1
5-6	6	89		900
TOTAL	81	4633		4715

WESTBOUND APPROACH			
(m)	(n)	(o)	(p)
15	673	☒	688
9	677		686
9	670		679
6	765		771
4	977		981
3	1099		1102
46	4861	☒	4907

TOTAL
l + p
1497
1453
1403
1473
1794
2002
9622

XING W/L		XING E/L	
Ped	Sc Ch	Ped	Sc Ch
—	—	—	—
—	—	—	—
—	—	—	—
—	—	—	—
—	—	—	—
—	—	—	—
—	—	—	—

DEPARTMENT OF TRANSPORTATION

OUR IRAFFIC OLUME

LOCATION	DATE	DESCRIPTION					DAY OF THE WEEK	
7TH ST AT HUOVER ST	05-10-82	C	080	30	2	2	MO	CA

HOUR BEGINNING	EAST BOUND					WEST BOUND					RATIO (E/W)				
	00-15	15-30	30-45	45-60	HOUR.TOTAL	00-15	15-30	30-45	45-60	HOUR TOTAL	00-15	15-30	30-45	45-60	HOUR TOTAL
12 AM	12	12	16	8	48	11	16	15	8	50	1.1	.6	1.1	1.0	98
1 AM	5	13	8	3	29	11	9	10	9	39	.5*	1.4	.8	.3*	68
2 AM	4	5	3	10	22	7	19	9	6	41	.6*	.3*	.3*	1.7*	63
3 AM	4	3	1	5	13	5	5	4	6	20	.8	.6*	.3*	.8	33
4 AM	6	2	2	2	12	2	2	5	7	16	3.0*	1.0	.4*	.3*	28
5 AM	3	10	10	9	32	5	5	16	17	43	.6*	2.0*	.6*	.5*	75
6 AM	14	34	45	42	135	16	24	37	54	131	.9	1.4	1.2	.8	266
7 AM	51	36	53	76	216	50	59	50	86	245	1.0	.6*	1.1	.9	461
8 AM	86	63	71	65	285	138	136	121	133	528	.6*	.5*	.6*	.5*	813
9 AM	64	46	56	50	216	102	98	84	93	377	.6*	.5*	.7*	.5*	593
10 AM	65	59	63	52	239	57	99	104	81	341	1.1	.6*	.6*	.6*	580
11 AM	52	72	67	75	266	82	112	93	109	396	.6*	.6*	.7*	.7*	662
12 PM	83	102	89	92	366	120	97	85	85	387	.7*	1.1	1.0	1.1	753
1 PM	95	74	87	87	343	90	93	92	107	382	1.1	.8	.9	.8	725
2 PM	79	83	69	72	303	88	100	102	81	371	.9	.8	.7*	.9	674
3 PM	84	82	76	79	321	116	91	117	136	460	.7*	.9	.6*	.6*	781
4 PM	98	141	101	138	478	154	141	121	158	574	.6*	1.0	.8	.9	1052
5 PM	134	134	109	129	506	142	155	164	127	588	.9	.9	.7*	1.0	1094
6 PM	117	88	78	60	343	74	94	90	74	332	1.6*	.9	.9	.8	675
7 PM	56	35	45	41	177	57	68	65	44	234	1.0	.5*	.7*	.9	411
8 PM	29	39	44	44	156	60	53	43	50	206	.5*	.7*	1.0	.9	362
9 PM	33	36	38	36	143	39	28	50	32	149	.8	1.3	.8	1.1	292
10 PM	27	35	37	18	117	23	17	20	15	75	1.2	2.1*	1.9*	1.2	192
11 PM	33	18	17	13	81	20	9	4	14	47	1.7*	2.0*	4.3*	.9	128

6 HOUR TOTAL	2022	2772	4794
16 HOUR TOTAL	4493	5701	10194
24 HOUR TOTAL	4847	6032	10879

PEAK HOURS		HOUR BEGINNING	VOLUME		HOUR BEGINNING	VOLUME		HOUR BEGINNING	VOLUME
	AM	11 15	297	AM	8 00	528	AM	8 00	813
	PM	4 45	515	PM	4 45	619	PM	4 45	1134

FORM NO. 283 REV.

82510 36990 6 05-10-82
A2 04

7TH ST AT HOOVER ST

CITY OF LOS ANGELES
'ARTMENT OF TRANSPORTATION

24 OUR RAFFIC OLUME

LOCATION	DATE	DESCRIPTION						DAY OF THE WEEK	
HOOVER ST AT 7TH ST	05-10-82	C	030	30	2	2		MO	CR

HOUR BEGINNING	NORTH BOUND					SOUTH BOUND					RATIO (N/S)				
	00-15	15-30	30-45	45-60	HOUR TOTAL	00-15	15-30	30-45	45-60	HOUR TOTAL	00-15	15-30	30-45	45-60	HOUR TOTAL
12 AM	21	31	10	21	83	23	17	18	7	65	.9	1.8*	.6*	3.0*	148
1 AM	6	8	8	8	30	10	8	5	6	29	.6*	1.0	1.6*	1.3	59
2 AM	11	15	6	2	34	11	13	3	2	29	1.0	1.2	2.0*	1.0	63
3 AM	3	5	5	7	20	8	1	4	7	20	.4*	5.0*	1.3	1.0	40
4 AM		2	10	5	17	8	3	5	6	22		.7*	2.0*	.8	39
5 AM	6	11	13	10	40	3	12	15	19	49	2.0*	.9	.9	.5*	89
6 AM	28	49	61	90	228	30	41	65	99	235	.9	1.2	.9	.9	463
7 AM	96	125	133	199	553	107	143	161	168	579	.9	.9	.8	1.2	1132
8 AM	205	185	187	198	775	164	193	165	123	645	1.3	1.0	1.1	1.6*	1420
9 AM	162	146	135	99	542		30	90	61	181		4.9*	1.5*	1.6*	723
10 AM	124	118	127	108	477		85	101	94	280		1.4	1.3	1.1	757
11 AM	108	130	124	128	490	97	116	121	111	445	1.1	1.1	1.0	1.2	935
12 PM	137	146	139	143	565	131	125	128	115	499	1.0	1.2	1.1	1.2	1064
1 PM	144	135	142	132	553	117	100	102	115	434	1.2	1.4	1.4	1.1	987
2 PM	131	147	144	158	580	113	127	116	140	496	1.2	1.2	1.2	1.1	1076
3 PM	162	181	189	170	702	113	151	123	153	540	1.4	1.2	1.5*	1.1	1242
4 PM	212	225	198	265	900	171	172	219	201	763	1.2	1.3	.9	1.3	1663
5 PM	231	252	206	237	926	220	185	162	150	717	1.1	1.4	1.3	1.6*	1643
6 PM	193	162	134	118	607	123	129	102	97	451	1.6*	1.3	1.3	1.2	1058
7 PM	87	93	95	84	359	84	83	89	58	314	1.0	1.1	1.1	1.4	673
8 PM	78	65	84	71	298	74	62	54	68	258	1.1	1.0	1.6*	1.0	556
9 PM	64	66	56	52	238	59	63	50	56	228	1.1	1.0	1.1	.9	466
10 PM	41	65	28	46	180	47	38	32	39	156	.9	1.7*	.9	1.2	336
11 PM	37	30	30	26	123	39	19	18	23	99	.9	1.6*	1.7*	1.1	222

	NORTH BOUND	SOUTH BOUND	HOUR TOTAL
6 HOUR TOTAL	4398	3425	7823
16 HOUR TOTAL	8793	7065	15858
24 HOUR TOTAL	9320	7534	16854

PEAK HOURS	HOUR BEGINNING	VOLUME		HOUR BEGINNING	VOLUME		HOUR BEGINNING	VOLUME
AM	7 45	776	AM	7 45	690	AM	7 45	1466
PM	4 45	954	PM	4 30	825	PM	4 30	1771

FORM NO. 263 REV.

36990 82510 5 05-10-82
82 05

HOOVER ST AT 7TH ST

ARTMENT OF TRANSPORTATION

OCATION	DATE	DESCRIPTION					DAY OF THE WEEK	
HOOVER ST S/O WILSHIRE BL	05-13-83	C	036	33	3	2	FR	CR

HOUR BEGINNING	NORTH BOUND					SOUTH BOUND					R A T I O (N/S)				
	00-15	15-30	30-45	45-60	HOUR TOTAL	00-15	15-30	30-45	45-60	HOUR TOTAL	00-15	15-30	30-45	45-60	HOUR TOTAL
12 AM	23	13	22	9	67	12	8	8	10	38	1.9*	1.6*	2.8*	.9	105
1 AM	7	11	5	4	27	9	2	7	6	24	.8	5.5*	.7*	.7*	51
2 AM	20	4	2	7	33	8	4	8	5	25	2.5*	1.0	.3*	1.4	58
3 AM	1	2	5	3	11	1	1	1	1	4	1.0	2.0*	5.0*	3.0*	15
4 AM	2	3	1	4	10	3	2	1	8	14	.7*	1.5*	1.0	.5*	24
5 AM	4	4	11	5	24	5	6	9	17	37	.8	.7*	1.2	.3*	61
6 AM	25	36	50	56	167	24	28	43	76	171	1.0	1.3	1.2	.7*	338
7 AM	78	74	125	164	441	102	126	107	211	546	.8	.6*	1.2	.8	987
8 AM	145	133	127	124	529	169	167	154	119	609	.9	.8	.8	1.0	1138
9 AM	125	122	110	118	475	137	111	105	92	445	.9	1.1	1.0	1.3	920
10 AM	102	106	100	77	385	95	95	103	77	370	1.1	1.1	1.0	1.0	755
11 AM	104	103	96	145	448	89	73	99	109	370	1.2	1.4	1.0	1.3	818
12 PM	133	105	134	128	500	99	108	108	102	417	1.3	1.0	1.2	1.3	917
1 PM	139	144	124	140	547	96	84	112	108	400	1.4	1.7*	1.1	1.3	947
2 PM	131	126	131	179	567	102	102	79	117	400	1.3	1.2	1.7*	1.5*	967
3 PM	143	177	176	164	660	102	147	129	160	538	1.4	1.2	1.4	1.0	1198
4 PM	193	204	194	195	786	174	157	164	159	654	1.1	1.3	1.2	1.2	1440
5 PM	215	217	215	168	815	165	212	103	124	604	1.3	1.0	2.1*	1.4	1419
6 PM	170	153	134	115	572	145	91	96	111	443	1.2	1.7*	1.4	1.0	1015
7 PM	122	98	93	88	401	91	84	62	63	300	1.3	1.2	1.5*	1.4	701
8 PM	85	72	50	67	274	58	60	46	38	202	1.5*	1.2	1.1	1.8*	476
9 PM	74	84	71	75	304	52	44	43	45	184	1.4	1.9*	1.7*	1.7*	488
10 PM	61	58	50	47	216	43	46	32	30	151	1.4	1.3	1.6*	1.6*	367
11 PM	39	57	38	43	177	43	36	41	39	159	.9	1.6*	.9	1.1	336

	NORTH BOUND	SOUTH BOUND	RATIO (N/S)
6 HOUR TOTAL	3706	3396	7102
16 HOUR TOTAL	7871	6653	14524
24 HOUR TOTAL	8436	7105	15541

PEAK HOURS		HOUR BEGINNING	VOLUME		HOUR BEGINNING	VOLUME		HOUR BEGINNING	VOLUME
	AM	7 45	569	AM	7 45	701	AM	7 45	1270
	PM	4 45	842	PM	4 30	700	PM	4 30	1521

ORM NO. 253 REV.

36990 79750 3 05-13-83 HOOVER ST S/O WILSHIRE BL
18 11

DEPARTMENT OF TRANSPORTATION

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LOCATION	DATE	DESCRIPTION					DAY OF THE WEEK	
ALVARADO ST AT WILSHIRE BL	07-20-82	C	030	30	3	3	TU	HW

HOUR BEGINNING	NORTH BOUND					SOUTH BOUND					RATIO (N/S)				
	00-15	15-30	30-45	45-60	HOUR. TOTAL	00-15	15-30	30-45	45-60	HOUR TOTAL	00-15	15-30	30-45	45-60	HOUR TOTAL
12 AM	64	69	33	37	203	65	57	54	36	212	1.0	1.2	.6*	1.0	415
1 AM	38	29	30	47	144	38	37	28	23	126	1.0	.8	1.1	2.0*	270
2 AM	43	35	37	20	135	32	40	31	36	139	1.3	.9	1.2	.6*	274
3 AM	16	12	4	11	43	21	24	13	12	70	.8	.5*	.3*	.9	113
4 AM	13	26	22	31	92	16	12	11	21	60	.8	2.2*	2.0*	1.5*	152
5 AM	17	17	23	89	146	25	38	45	51	159	.7*	.4*	.5*	1.7*	305
6 AM	75	107	102	103	387	86	96	134	173	489	.9	1.1	.8	.6*	876
7 AM	43	145	169	150	507	200	248	271	275	994	.2*	.6*	.6*	.5*	1501
8 AM	156	164	164	161	645	255	227	267	288	1037	.6*	.7*	.6*	.6*	1682
9 AM	163	153	152	144	612	250	178	217	171	816	.7*	.9	.7*	.8	1428
10 AM	148	196	168	162	674	207	187	192	207	793	.7*	1.0	.9	.8	1467
11 AM	163	165	188	203	719	175	197	205	200	777	.9	.8	.9	1.0	1496
12 PM	180	189	196	187	752	186	218	179	181	764	1.0	.9	1.1	1.0	1516
1 PM	170	190	204	165	729	208	172	166	191	737	.8	1.1	1.2	.9	1466
2 PM	177	205	206	163	751	181	149	176	159	665	1.0	1.4	1.2	1.0	1416
3 PM	208	229	237	229	903	197	220	207	216	840	1.1	1.0	1.1	1.1	1743
4 PM	228	261	266	289	1044	245	236	234	225	940	.9	1.1	1.1	1.3	1984
5 PM	268	255	235	229	987	229	227	219	194	869	1.2	1.1	1.1	1.2	1856
6 PM	231	281	206	102	820	174	185	141	182	682	1.3	1.5*	1.5*	.6*	1502
7 PM	215	196	158	139	708	172	159	152	163	646	1.3	1.2	1.0	.9	1354
8 PM	125	145	120	137	527	174	135	142	151	602	.7*	1.1	.8	.9	1129
9 PM	138	143	120	145	546	142	188	161	122	613	1.0	.8	.7*	1.2	1159
10 PM	121	132	110	89	452	128	131	147	124	530	.9	1.0	.7*	.7*	982
11 PM	81	84	65	57	287	107	96	90	73	366	.8	.9	.7*	.8	653
6 HOUR TOTAL					4698					5496					10194
16 HOUR TOTAL					11311					12264					23575
24 HOUR TOTAL					12813					13926					26739

PEAK HOURS		HOUR BEGINNING	VOLUME		HOUR BEGINNING	VOLUME		HOUR BEGINNING	VOLUME
	AM	11 15	736	AM	7 15	1049	AM	8 15	1684
	PM	4 15	1084	PM	4 00	940	PM	4 15	2008

FORM NO. 253 REV.

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ALVARADO ST | AT WILSHIRE BL

ARTMENT OF TRANSPORTATION

OCATION	DATE	DESCRIPTION						DAY OF TH[illegible]EEK	
WILSHIRE BL AT ALVARADO ST	07-20-82	C	030	30	3	2		TU	HW

HOUR BEGINNING	EAST BOUND					WEST BOUND					RATIO (E/W)				
	00-15	15-30	30-45	45-60	HOUR TOTAL	00-15	15-30	30-45	45-60	HOUR TOTAL	00-15	15-30	30-45	45-60	HOUR TOTAL
12 AM	33	44	25	31	133	41	30	21	26	118	.8	1.5*	1.2	1.2	251
1 AM	21	17	27	21	86	24	17	10	17	68	.9	1.0	2.7*	1.2	154
2 AM	19	13	11	10	53	11	9	13	14	47	1.7*	1.4	.8	.7*	100
3 AM	7	5	8	5	25	5	10	5	3	23	1.4	.5*	1.6*	1.7*	48
4 AM	2	3	7	7	19	10	8	4	3	25	.2*	.4*	1.8*	2.3*	44
5 AM	8	16	17	20	61	5	23	18	33	79	1.6*	.7*	.9	.6*	140
6 AM	9	88	68	92	257	34	48	77	93	252	.3*	1.8*	.9	1.0	509
7 AM	105	156	185	203	649	95	127	136	152	510	1.1	1.2	1.4	1.3	1159
8 AM	186	186	189	162	725	152	184	160	139	635	1.2	1.0	1.2	1.2	1360
9 AM	170	150	155	177	652	145	145	162	169	621	1.2	1.0	1.0	1.0	1273
10 AM	156	142	168	177	643	183	197	174	209	763	.9	.7*	1.0	.8	1406
11 AM	202	174	185	194	755	188	186	208	208	790	1.1	.9	.9	.9	1545
12 PM	151	190	175	213	729	253	216	185	191	845	.6*	.9	.9	1.1	1574
1 PM	209	208	218	165	800	181	201	187	201	770	1.2	1.0	1.2	.8	1570
2 PM	190	174	232	198	794	187	205	186	182	760	1.0	.8	1.2	1.1	1554
3 PM	198	192	175	155	720	194	200	212	191	797	1.0	1.0	.8	.8	1517
4 PM	187	179	191	185	742	221	213	233	276	943	.8	.8	.8	.7*	1685
5 PM	172	182	187	160	701	282	267	237	207	993	.6*	.7*	.8	.8	1694
6 PM	149	146	88	76	459	207	162	159	134	662	.7*	.9	.6*	.6*	1121
7 PM	95	89	86	81	351	123	120	97	100	440	.8	.7*	.9	.8	791
8 PM	79	78	71	87	315	109	84	77	66	336	.7*	.9	.9	1.3	651
9 PM	89	73	77	68	307	78	75	78	69	300	1.1	1.0	1.0	1.0	607
10 PM	78	92	123	69	362	58	76	65	62	261	1.3	1.2	1.9*	1.1	623
11 PM	56	55	56	37	204	39	71	56	43	209	1.4	.8	1.0	.9	413

6 HOUR TOTAL	4189	4499	8688
16 HOUR TOTAL	9599	10417	20016
24 HOUR TOTAL	10542	11247	21789

PEAK HOURS		HOUR BEGINNING	VOLUME		HOUR BEGINNING	VOLUME		HOUR BEGINNING	VOLUME
	AM	7 45	766	AM	11 15	855	AM	11 15	1559
	PM	12 45	848	PM	4 45	1062	PM	4 45	1788

FORM NO. 283 REV.

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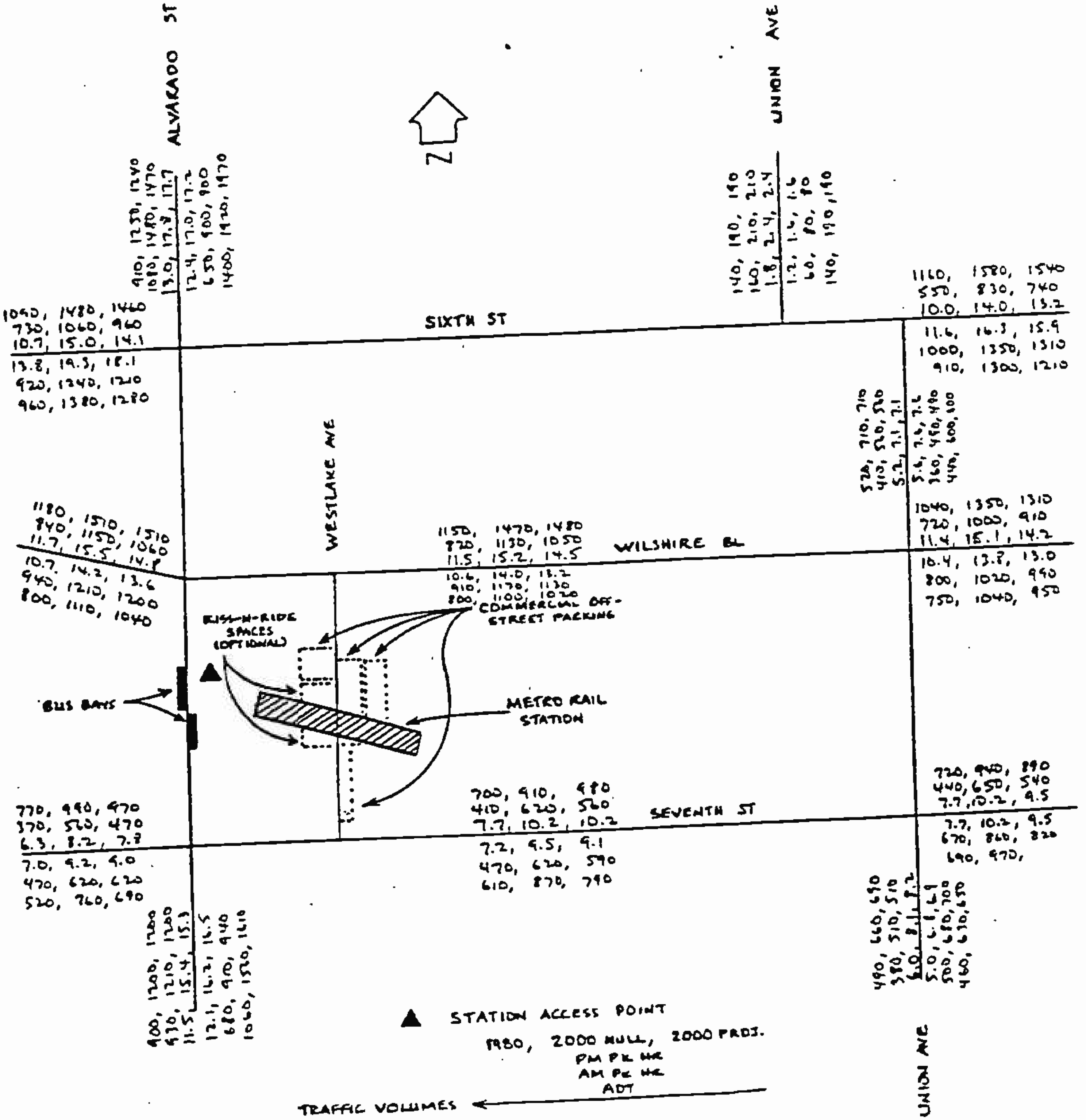
11 0?



ALVARADO/WILSHIRE STATION TRAFFIC VOLUMES

APPENDIX B

ALVARADO ALTERNATIVE

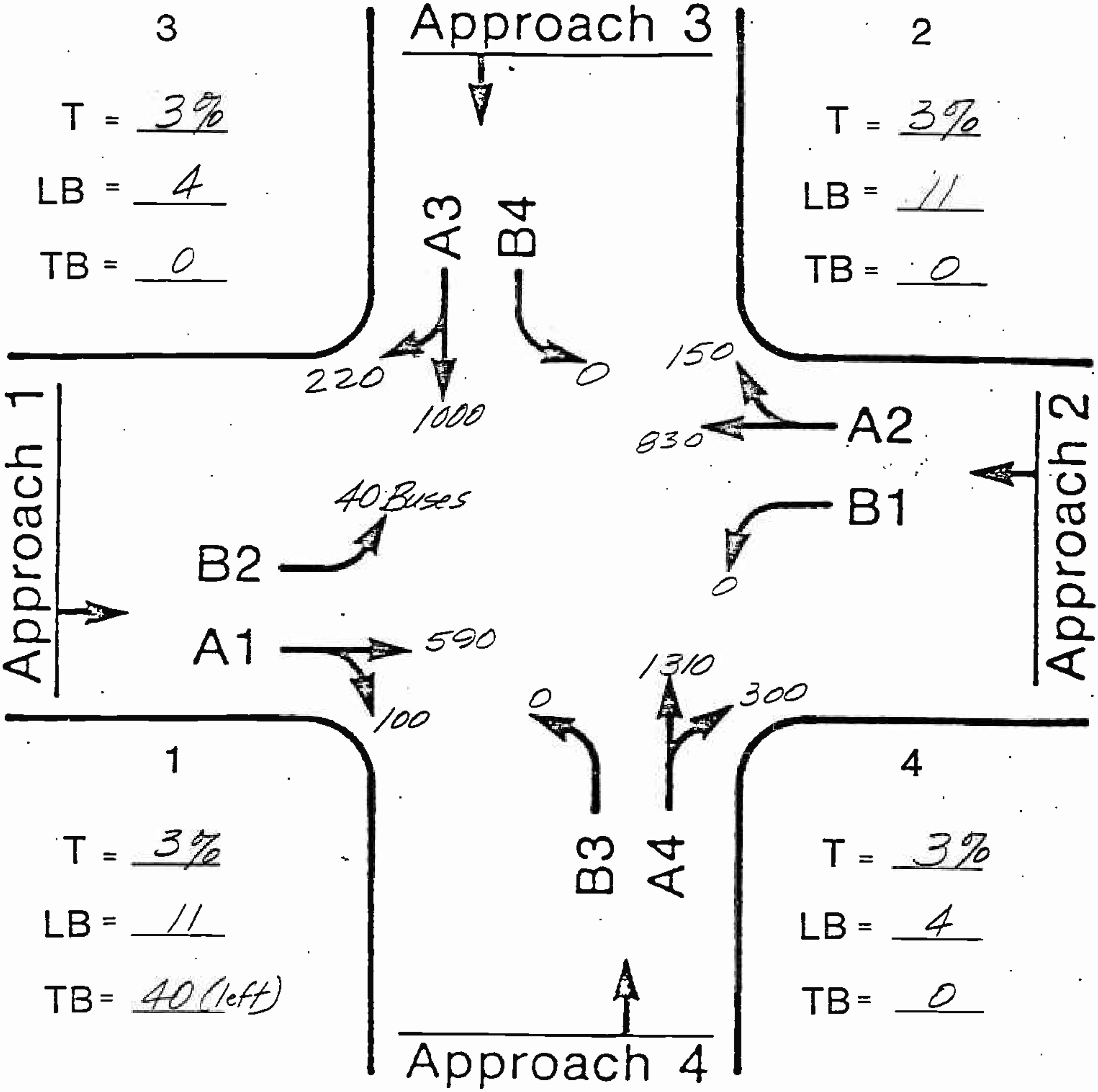
TRAFFIC VOLUME DATA
AND CMA RESULTS

EXISTING CONDITIONS

①

Traffic Volume Data

Identification of Intersection Movements



3

T = 3%

LB = 4

TB = 0

2

T = 3%

LB = 11

TB = 0

1

T = 3%

LB = 11

TB = 40 (left)

4

T = 3%

LB = 4

TB = 0

Design Year 2000

Design Hour AM

Intersection 7th Street and Alvarado

Test Case
Average Traffi
Volumes

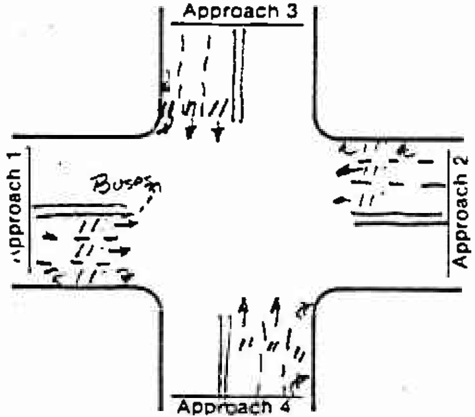
varo r 2 EXIS ug ions
Tes Case – Averaged 7+ 2 Volumes

Critical Movement Analysis: OPERATION AND DESIGN
Calculation Form 2

Intersection 7th Street and Alvarado St. **Design Hour** 7:30 - 9:00 AM

Problem Statement Determine Critical Lane Vols and LOS

Step 1. Identify Lane Geometry



Step 2. Identify Hourly Volumes (HV) in vph

Approach 3

RT = 220 TH = 1030 LT = 0

T= 3% LB= 4

RT = 150 TH = 830 LT = 0

Approach 1: T= 3% LB= 11

<600 <600 <600 <600

Approach 2: T= 3% LB= 11

LT = 40 Bus TH = 590 RT = 100

T= 3% LB= 4

Approach 4

LT = 0 TH = 1310 RT = 300

Step 3. Identify Phasing

Lt.: Buses Only

↵	A1A2 B2	☐	
↓↑	A3A4	☐	
☐		☐	

A1 → A3 ↓
A2 ← A4 ↑
B1 ↲ B3 ↰
B2 ↱ B4 ↳

Step 4. Left Turn Check

	Approach 1	2	3	4
a. Number of change intervals per hour	45	45	45	45
b. Left turn capacity on change interval, in vph	90	90	90	90
c. G/C Ratio	.50	.50	.50	.50
d. Opposing volume in vph	980	—	—	—
e. Left turn capacity on green, in vph	0	—	—	—
f. Left turn capacity in vph (b + e)	90	—	—	—
g. Left turn volume in vph	40	—	—	—
h. Is volume > capacity (g > f)?	No	No	No	No

Step 5. Develop Passenger Car Volumes (PCV) in pch

Approach 3

RT = 227 TH = 1050 LT = 0

RT = 155 TH = 910 LT = 0

Approach 1

Approach 2

LT = 80 TH = 663 RT = 103

Approach 4

LT = 0 TH = 1369 RT = 309

Step 6. Calculate Period Volumes (PV) in pch

Approach 3

PHF = 0.85 RT = 267 TH = 1235 LT = 0

PHF = 0.85 RT = 182 TH = 1070 LT = 0

Approach 1

Approach 2

PHF = 0.85 LT = 94 TH = 780 RT = 121

Approach 4

PHF = 0.85 LT = 0 TH = 1611 RT = 364

Step 7. Turn Adjustments

Approach	1	2	3	4
Movement	B2A1	A2	A3	A4
Turn	Lt Rt.	Rt	Rt	Rt
Turn volume (PV from Step 6)	94 121	182	267	364
Opposing vol. in vph from Step 2	980 —	—	—	—
Ped. vol hour	—	<600	—	—
PCE LT from Table 3	4.0 —	—	—	—
LT vol. in pch	376 —	—	—	—
PCE RT from Table 4	— 1.25	1.25	1.25	1.25
RT vol. in pch ✗	151	228	334	455
TH vol. in pch from Step 6	780	1070	1235	1611
Total PCV in pch	376 780	1070	1235	1611

Step 8. Adjusted Volumes
Step 9a. Calculate Lane Volumes

Movement	Total PCV (Step 7)	U	W	Adjusted PCV (U×W×PCV)	No. of Lanes	PCV per Lane
B2A1	1156	1.05	1.0	1214	2	607
A2	1070	1.05	1.0	1124	2	562
A3	1235	1.05	1.0	1297	2	648
A4	1611	1.05	1.0	1692	2	846

Step 9b. Volume Adjustment for Multiphase Signal Overlap

Probable Phase	Possible Critical Volume in pch	Volume Carryover to next phase	Adjusted Critical Volume in pch

2 φ

Step 10. Sum of Critical Volumes

B2A1 A4
607 + 846 + — + —
= 1453 pch

Step 11. Intersection Level of Service

(compare Step 10 with Table 6)

D

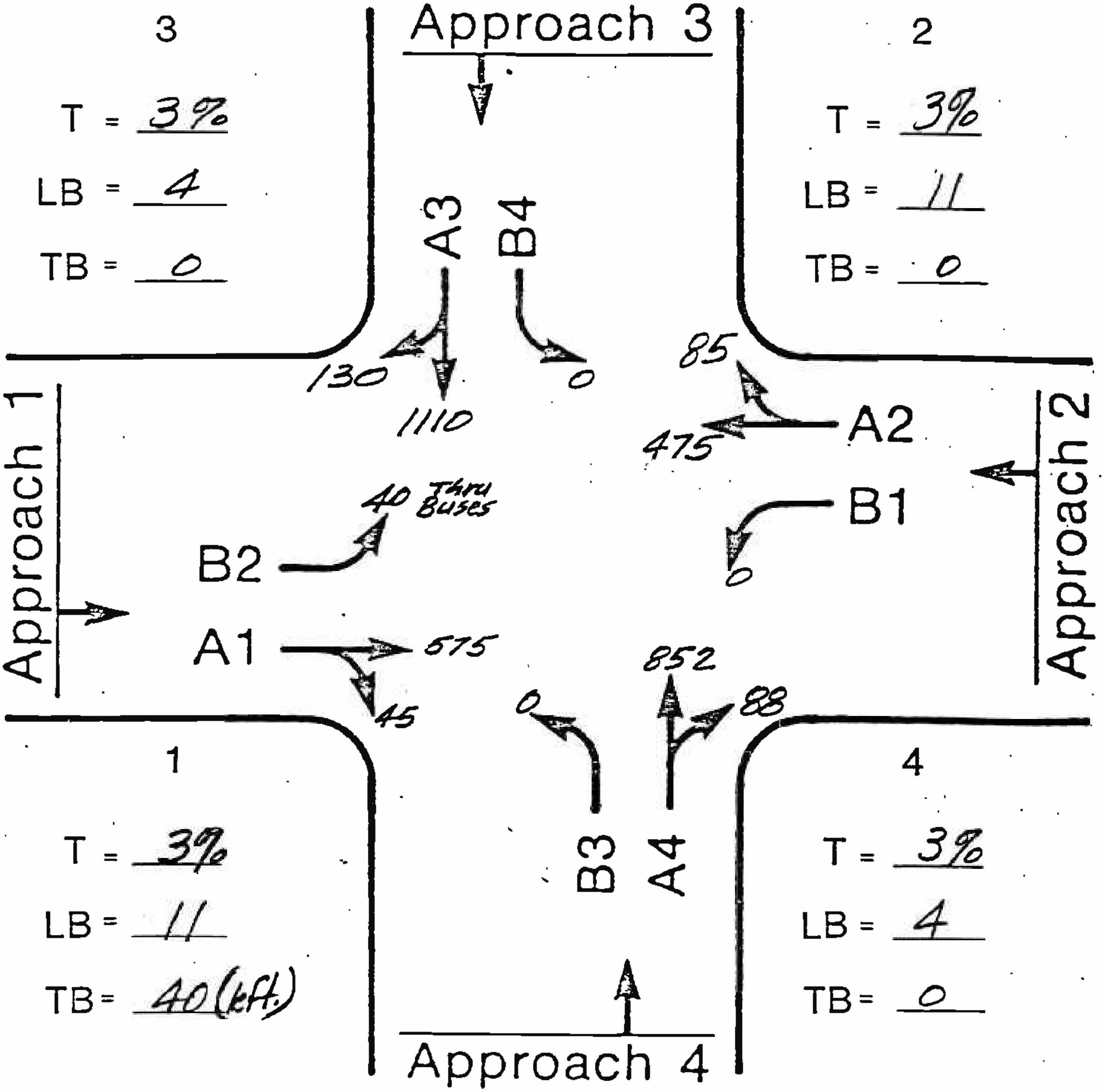
Step 12. Recalculate Not Necessary

Geometric Change
Signal Change
Volume Change

Comments

Traffic Volume Data

Identification of Intersection Movements



3

T = 3%

LB = 4

TB = 0

2

T = 3%

LB = 11

TB = 0

1

T = 3%

LB = 11

TB = 40 (kft.)

4

T = 3%

LB = 4

TB = 0

Design Year 2000

Design Hour AM Peak Hr.

Intersection 7th Street and Alvarado Street

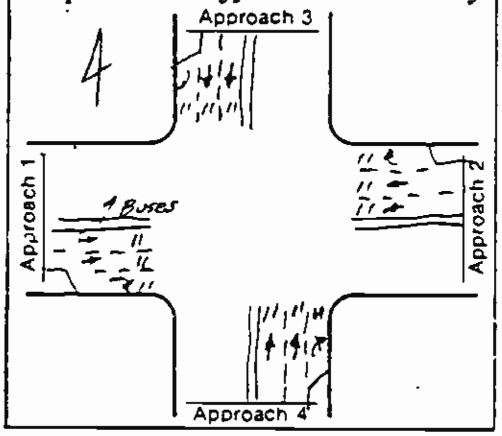
Alvarado Alternative Existing Conditions ②

Critical Movement Analysis: OPERATIONS AND DESIGN
Calculation Form 2

Intersection 7th Street and Alvarado St. **Design Hour** AM Peak Hr.

Problem Statement Determine Critical Lane Volumes and LOS

Step 1. Identify Lane Geometry



Step 2. Identify Hourly Volumes (HV) in vph

Approach 3: T= 3% LB= 4

RT = 130 TH = 1110 LT = 0

RT = 85 TH = 475 LT = 0

Approach 1: T= 3% LB= 11

195
162 ped 144
113

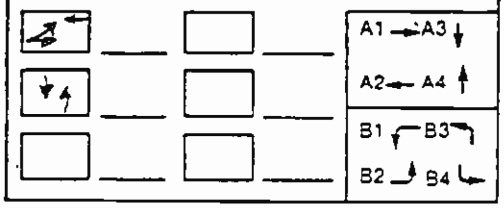
Approach 2: T= 3% LB= 11

LT = 40 Buses TH = 575 RT = 45

Approach 4: T= 3% LB= 4

LT = 0 TH = 852 RT = 88

Step 3. Identify Phasing



Step 4. Left Turn Check

	Approach 1	2	3	4
a. Number of change intervals per hour	45	45	45	45
b. Left turn capacity on change interval, in vph	90	90	90	90
c. G/C Ratio	.50	.50	.50	.50
d. Opposing volume in vph	560	—	—	—
e. Left turn capacity on green, in vph	40	—	—	—
f. Left turn capacity in vph (b + e)	130	—	—	—
g. Left turn volume in vph	40	—	—	—
h. Is volume > capacity (g > f)?	NO	NO	No	No

Step 5. Develop Passenger Car Volumes (PCV) in pch

Approach 3

RT = 134 TH = 1163 LT = 0

RT = 88 TH = 544 LT = 0

Approach 1 Approach 2

LT = 60 TH = 647 RT = 46

LT = 0 TH = 898 RT = 91

Approach 4

Step 6. Calculate Period Volumes (PV) in pch

Approach 3

PHF = 0.85 RT = 158 TH = 1368 LT = 0

PHF = 0.85 RT = 104 TH = 640 LT = 0

Approach 1 Approach 2

PHF = 0.85 LT = 94 TH = 761 RT = 54

PHF = 0.85 LT = 0 TH = 1056 RT = 107

Approach 4

Step 7. Turn Adjustments

Approach	1		2	3	4
Movement	B2A1		A2	A3	A4
Turn	Lt	Rt	Rt	Rt	Rt
Turn volume (PV from Step 6)	94	54	104	158	107
Opposing vol. in vph from Step 2	560	—	—	—	—
Ped. vol hour		113	195 - 162		144
PCE LT from Table 3	2.0	—	—	—	—
LT vol. in pch	188	—	—	—	—
PCE RT from Table 4	—	1.25	1.25	1.25	1.25
RT vol. in pch		68	130	198	134
TH vol. in pch from Step 6		761	640	1368	1056
Total PCV in pch	188	761	640	1368	1056

Step 8. Adjusted Volumes / Step 9a. Calculate Lane Volumes

Movement	Total PCV (Step 7)	U	W	Adjusted PCV (U×W×PCV)	No. of Lanes	PCV per lane
B2A1	949	1.05	1.0	996	2	498
A2	640	1.05	1.0	672	2	336
A3	1368	1.05	1.0	1436	2	718
A4	1056	1.05	1.0	1109	2	555

Step 9b. Volume Adjustment for Multiphase Signal Overlap

Probable Phase	Possible Critical Volume in pch	Volume Carryover to next phase	Adjusted Critical Volume in pch

2 Ø

Step 10. Sum of Critical Volumes

B2A1 A3
498 + 718 + ____ + ____
= 1216 pch

Step 11. Intersection Level of Service

(compare Step 10 with Table 6)

C

Step 12. Recalculate Not

Geometric Change ____

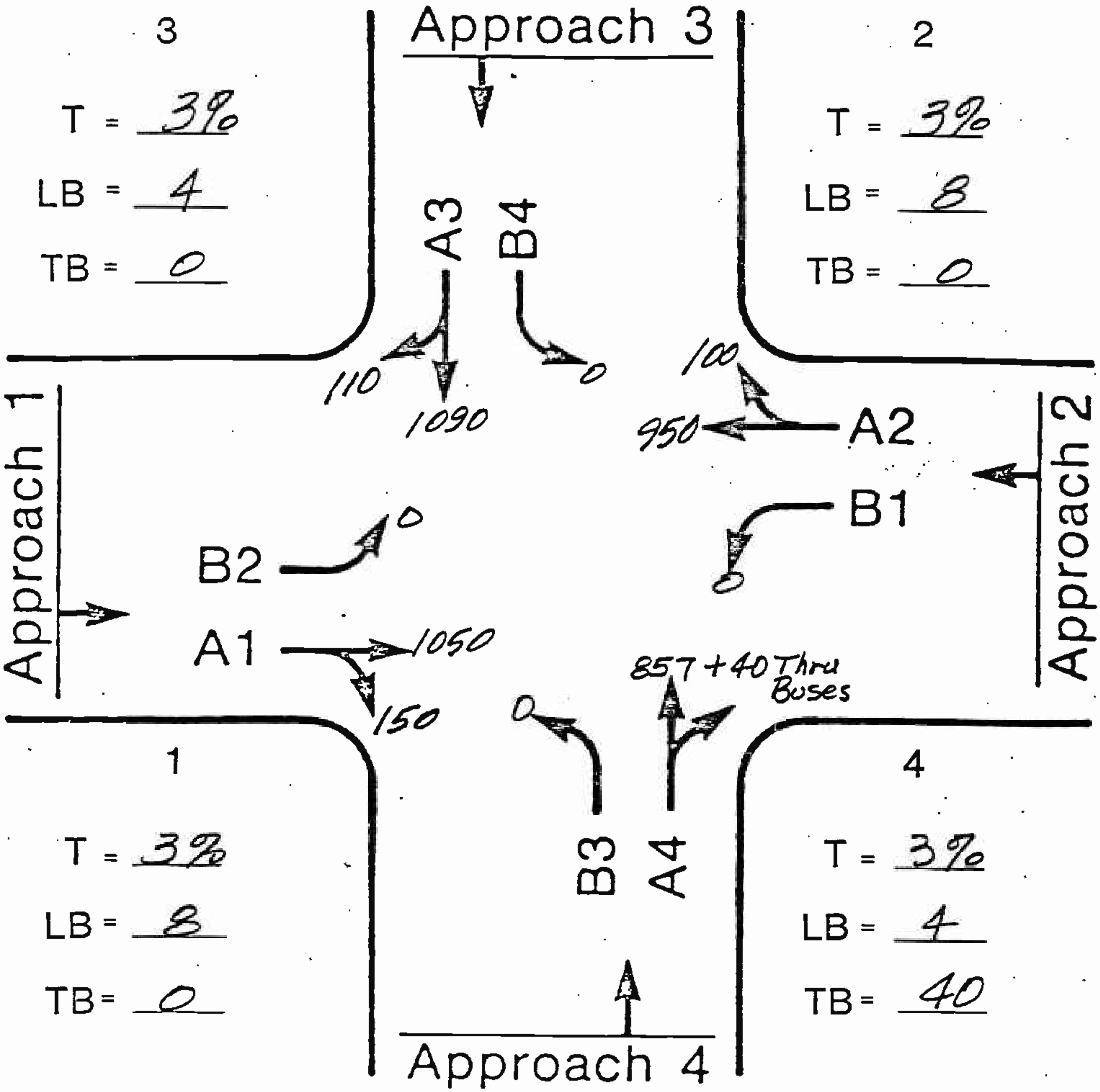
Signal Change Necessary

Volume Change ____

Comments ____

Traffic Volume Data

Identification of Intersection Movements



3

T = 3%

LB = 4

TB = 0

2

T = 3%

LB = 8

TB = 0

1

T = 3%

LB = 8

TB = 0

4

T = 3%

LB = 4

TB = 40

Design Year 2000

Design Hour AM Peak

Intersection Wilshire and Alvarado

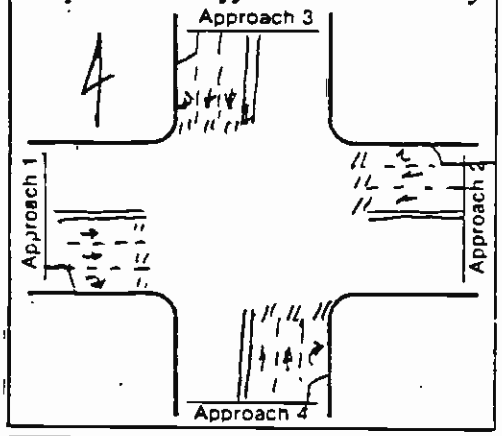
Alvarado Alternative Existing Conditions 31

Critical Movement Analysis: OPERATIONS AND DESIGN
Calculation Form 2

Intersection Wilshire and Alvarado **Design Hour** AM Peak Hour

Problem Statement Determine Critical Lane Volumes and LOS

Step 1. Identify Lane Geometry



Step 2. Identify Hourly Volumes (HV) in vph

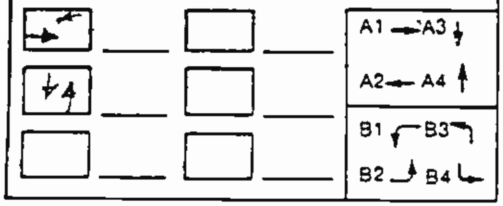
Approach 3
RT = 110
TH = 1090
LT = 0
T = 3%
LB = 4

Approach 2
RT = 100
TH = 950
LT = 0
T = 3%
LB = 8

Approach 1
T = 3%
LB = 8
LT = 0
TH = 1050
RT = 150

Approach 4
T = 3%
LB = 4
TB 40
LT = 0
TH = 857
RT = 80

Step 3. Identify Phasing



Step 4. Left Turn Check

	Approach 1	2	3	4
a. Number of change intervals per hour	45	45	45	45
b. Left turn capacity on change interval, in vph	90	90	90	90
c. G/C Ratio	No left Turns ∴ OK			
d. Opposing volume in vph				
e. Left turn capacity on green, in vph				
f. Left turn capacity in vph (b + e)				
g. Left turn volume in vph				
h. Is volume > capacity (g > f)?				

Step 5. Develop Passenger Car Volumes (PCV) in pch

Approach 3
RT = 113
TH = 1143
LT = 0

Approach 2
RT = 103
TH = 1019
LT = 0

Approach 1
LT = 0
TH = 1122
RT = 155

Approach 4
LT = 0
TH = 883
RT = 82

Step 6. Calculate Period Volumes (PV) in pch

Approach 3
PHF = 0.85
RT = 133
TH = 1345
LT = 0

Approach 2
PHF = 0.85
RT = 121
TH = 1199
LT = 0

Approach 1
PHF = 0.85
LT = 0
TH = 1320
RT = 182

Approach 4
PHF = 0.85
LT = 0
TH = 1156
RT = 96

Step 7. Turn Adjustments

	1	2	3	4
Approach				
Movement	Rt	Rt	Rt	Rt
Turn				
Turn volume (PV from Step 6)	182	121	133	96
Opposing vol. in vph from Step 2	—	—	—	—
Ped. vol hour	600	600	600	600
PCE LT from Table 3	—	—	—	—
LT vol. in pch	—	—	—	—
PCE RT from Table 4	1.25	1.25	1.25	1.25
RT vol. in pch	228	151	166	120
TH vol. in pch from Step 6	1320	1199	1345	1156
Total PCV in pch	1320	1199	1345	1156

Step 8. Adjusted Volumes / Step 9a. Calculate Lane Volumes

Movement	Total PCV (Step 7)	U	W	Adjusted PCV (U×W×PCV)	No. of Lanes	PCV per Lane
A1	1320	1.05	1.0	1386	2	693
A2	1199	1.05	1.0	1259	2	630
A3	1345	1.05	1.0	1412	2	706
A4	1156	1.05	1.0	1214	2	607

Step 9b. Volume Adjustment for Multiphase Signal Overlap

Probable Phase	Possible Critical Volume in pch	Volume Carryover to next phase	Adjusted Critical Volume in pch

2 Ø

Step 10. Sum of Critical Volumes

A1 693 + A3 706 + ____ + ____

= 1399 pch

Step 11. Intersection Level of Service

(compare Step 10 with Table 6)

C

Step 12. Recalculate

Geometric Change Not

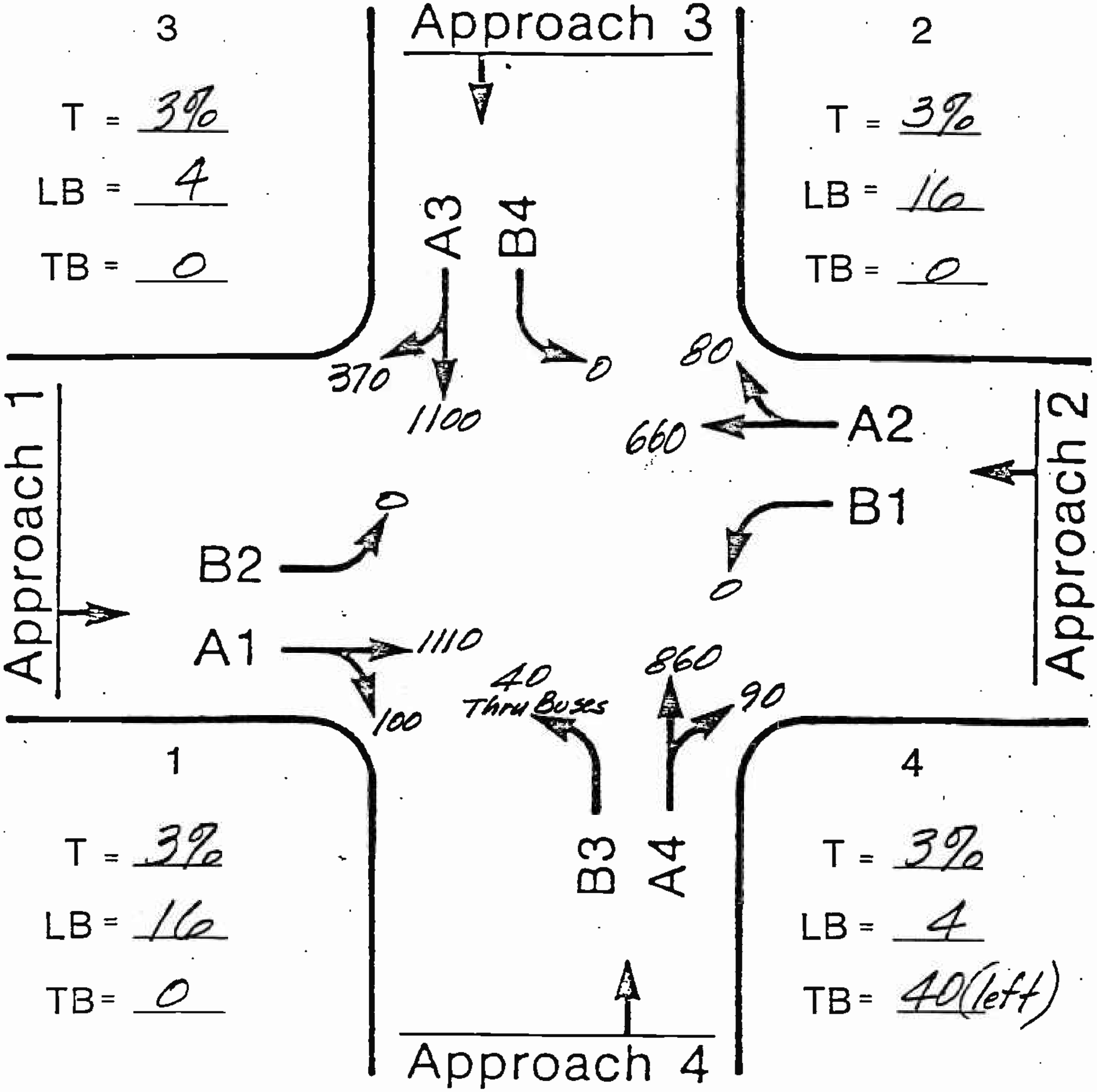
Signal Change Necessary

Volume Change ____

Comments ____

Traffic Volume Data

Identification of Intersection Movements



3

T = 3%

LB = 4

TB = 0

2

T = 3%

LB = 16

TB = 0

1

T = 3%

LB = 16

TB = 0

4

T = 3%

LB = 4

TB = 40(left)

Design Year 2000

Design Hour AM Peak

Intersection 6th Street and Alvarado

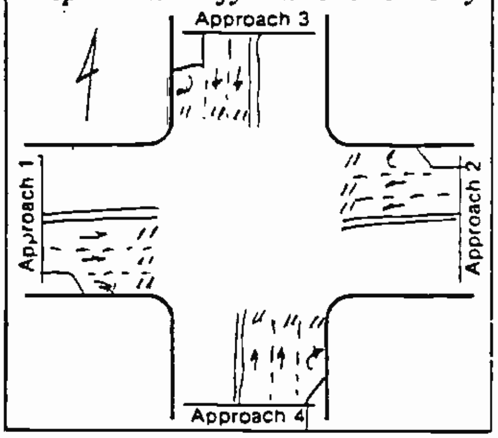
Alvarado Alternative Existing Conditions

Critical Movement Analysis: OPERATIONS AND DESIGN
Calculation Form 2

Intersection 6th Street and Alvarado **Design Hour** AM Peak Hr.

Problem Statement Define Critical Lane Volumes and LOS

Step 1. Identify Lane Geometry



Step 2. Identify Hourly Volumes (HV) in vph

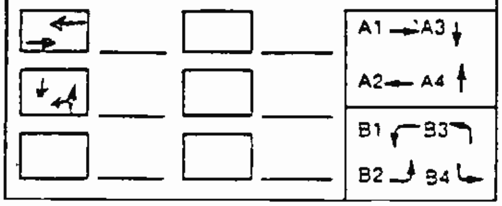
Approach 1: T= 3% LB= 16
RT = 370
TH = 1100
LT = 0

Approach 3: T= 3% LB= 4
RT = 80
TH = 660
LT = 0

Approach 2: T= 3% LB= 16
LT = 4010
TH = 860
RT = 90

Approach 4: T= 3% LB= 4
LT = 0
TH = 1110
RT = 100

Step 3. Identify Phasing



Step 4. Left Turn Check

	Approach			
a. Number of change intervals per hour	45	45	45	45
b. Left turn capacity on change interval, in vph	90	90	90	90
c. G/C Ratio	.5	.5	.5	.5
d. Opposing volume in vph	—	—	—	14
e. Left turn capacity on green, in vph	—	—	—	0
f. Left turn capacity in vph (b + e)	—	—	—	90
g. Left turn volume in vph	—	—	—	40
h. Is volume > capacity (g > f)?	NO	NO	NO	NO

Step 5. Develop Passenger Car Volumes (PCV) in pch

Approach 1:
RT = 381
TH = 1153
LT = 0

Approach 3:
RT = 82
TH = 760
LT = 0

Approach 2:
LT = 80
TH = 906
RT = 93

Approach 4:
LT = 0
TH = 1223
RT = 103

Step 6. Calculate Period Volumes (PV) in pch

Approach 1:
PHF = .94
RT = 405
TH = 1227
LT = 0

Approach 3:
PHF = .89
RT = 92
TH = 854
LT = 0

Approach 2:
PHF = .96
LT = 83
TH = 944
RT = 97

Approach 4:
PHF = .88
LT = 0
TH = 1390
RT = 117

Step 7. Turn Adjustments

Approach	1	2	3	4
Movement	A1	A2	A3	B3A4
Turn	Rt.	Rt.	Rt.	Lt. Rt
Turn volume (PV from Step 6)	117	92	405	83 97
Opposing vol. in vph from Step 2	—	—	—	1470 —
Ped. vol hour	—	<600	—	—
PCE LT from Table 3	—	—	—	6.0 —
LT vol. in pch	—	—	—	498 —
PCE RT from Table 4	1.25	1.25	1.25	— 1.25
RT vol. in pch	146	115	506	— 121
TH vol. in pch* from Step 6	1390	854	1227	— 944
Total PCV in pch	1390	854	1227	1450

Step 8. Adjusted Volumes / Step 9a. Calculate Lane Volumes

Movement	Total PCV (Step 7)	U	W	Adjusted PCV (U×W×PCV)	No. of Lanes	PCV per Lane
A1	1390	1.05	1.0	1460	2	730
A2	854	1.05	1.0	896	2	448
A3	1227	1.05	1.0	1288	2	644
B3A4	1450	105	1.0	1522	2	761

Step 9b. Volume Adjustment for Multiphase Signal Overlap

Probable Phase	Possible Critical Volume in pch	Volume Carryover to next phase	Adjusted Critical Volume in pch

28

Step 10. Sum of Critical Volumes

A1 730 + A4 761 + — + —
= 1491 pch

Step 11. Intersection Level of Service

(compare Step 10 with Table 6)

D

Step 12. Recalculate

Geometric Change ______

Signal Change ______

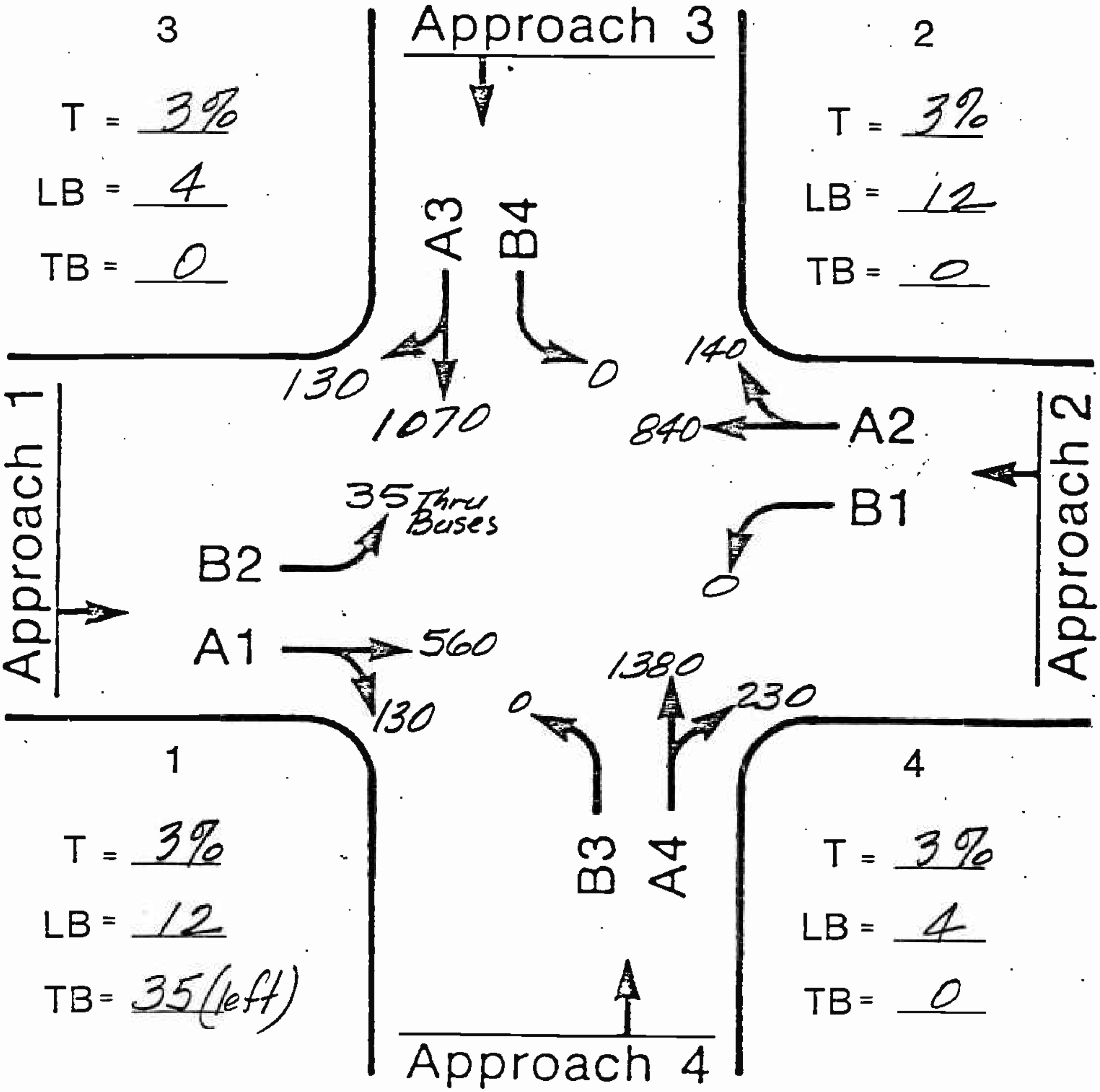
Volume Change ______

Comments ______

5

Traffic Volume Data

Identification of Intersection Movements



3

T = 3%

LB = 4

TB = 0

2

T = 3%

LB = 12

TB = 0

1

T = 3%

LB = 12

TB = 35 (left)

4

T = 3%

LB = 4

TB = 0

Design Year 2000

Design Hour PM Peak

Intersection 7th Street and Alvarado

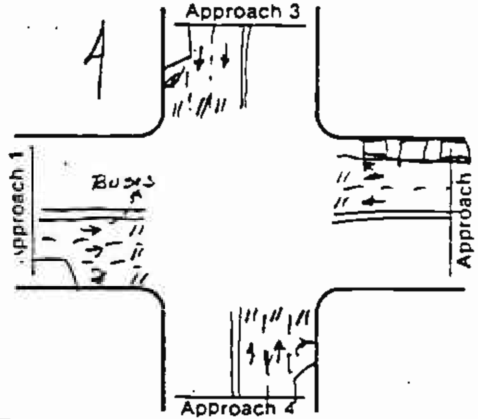
[illegible]

Critical Movement Analysis: OPERATIONS AND DESIGN
Calculation Form 2

Intersection 7th Street and Alvarado **Design Hour** PM Peak Hour

Problem Statement Determine Critical Lane Volumes and LOS

Step 1. Identify Lane Geometry



Step 2. Identify Hourly Volumes (HV) in vph

RT = 130
TH = 1070
LT = 0

Approach 3
T= 390
LB= 4

RT = 140
TH = 540
LT = 0

T= 390
LB= 12
Approach 1

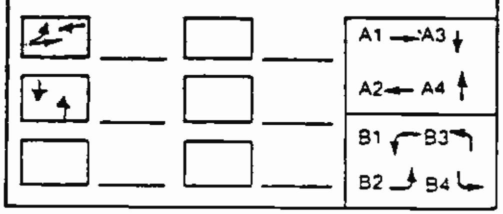
T= 390
LB= 12
Approach 2

LT = 35 Buses
TH = 560
RT = 130

T= 390
LB= 4
Approach 4

LT = 0
TH = 1380
RT = 230

Step 3. Identify Phasing



Step 4. Left Turn Check

	Approach 1	2	3	4
a. Number of change intervals per hour	45	45	45	45
b. Left turn capacity on change interval, in vph	90	90	90	90
c. G/C Ratio	0.50	0.50	0.50	0.50
d. Opposing volume in vph	980	—	—	—
e. Left turn capacity on green, in vph	0	—	—	—
f. Left turn capacity in vph (b + e)	90	—	—	—
g. Left turn volume in vph	35 Buses			
h. Is volume > capacity (g > f)?	No	No	No	No

** Peak Hour Factor based

Step 5. Develop Passenger Car Volumes (PCV) in pch

RT = 134
TH = 1122
LT = 0

Approach 3

RT = 144
TH = 925
LT = 0

Approach 1
Approach 2

LT = 70
TH = 637
RT = 134

Approach 4

LT = 0
TH = 1441
RT = 237

Step 6. Calculate Period Volumes (PV) in pch **

PHF = 0.91
RT = 147
TH = 1233
LT = 0

Approach 3

PHF = 0.98
RT = 147
TH = 944
LT = 0

Approach 1
Approach 2

PHF = 0.89
LT = 79
TH = 716
RT = 151

Approach 4

PHF = 0.92
LT = 0
TH = 1566
RT = 258

Step 7. Turn Adjustments

Approach	1		2	3	4
Movement	Lt	Rt	Rt	Lt	Rt
Turn	B2A1		A2	A3	A4
Turn volume (PV from Step 6)	79	151	147	147	258
Opposing vol. in vph from Step 2	980	—	—	—	—
Ped. vol hour	← < 1200 →				
PCE LT from Table 3	4.0	—	—	—	—
LT vol. in pch	316	—	—	—	—
PCE RT from Table 4		1.50	1.50	1.50	1.5
RT vol. in pch		227	220	220	[illegible]
TH vol. in pch from Step 6 *		716	944	1233	1566
Total PCV in pch *	1032		1164	1233	1566

Step 8. Adjusted Volumes / Step 9a. Calculate Lane Volumes

Movement	Total PCV (Step 7)	U	W	Adjusted PCV (U×W×PCV)	No. of Lanes	PCV per Lane
B2A1	1032	1.05	1.0	1084	2	542
A2	1164	1.05	1.0	1222	2	611
A3	1233	1.05	1.0	1295	2	648
A4	1566	1.05	1.0	1644	2	822

Step 9b. Volume Adjustment for Multiphase Signal Overlap

Probable Phase	Possible Critical Volume in pch	Volume Carryover to next phase	Adjusted Critical Volume in pch

2 Ø

Step 10. Sum of Critical Volumes

A2 A4
611 + 822 + — + —
= 1433 pch

Step 11. Intersection Level of Service

(compare Step 10 with Table 6)

D

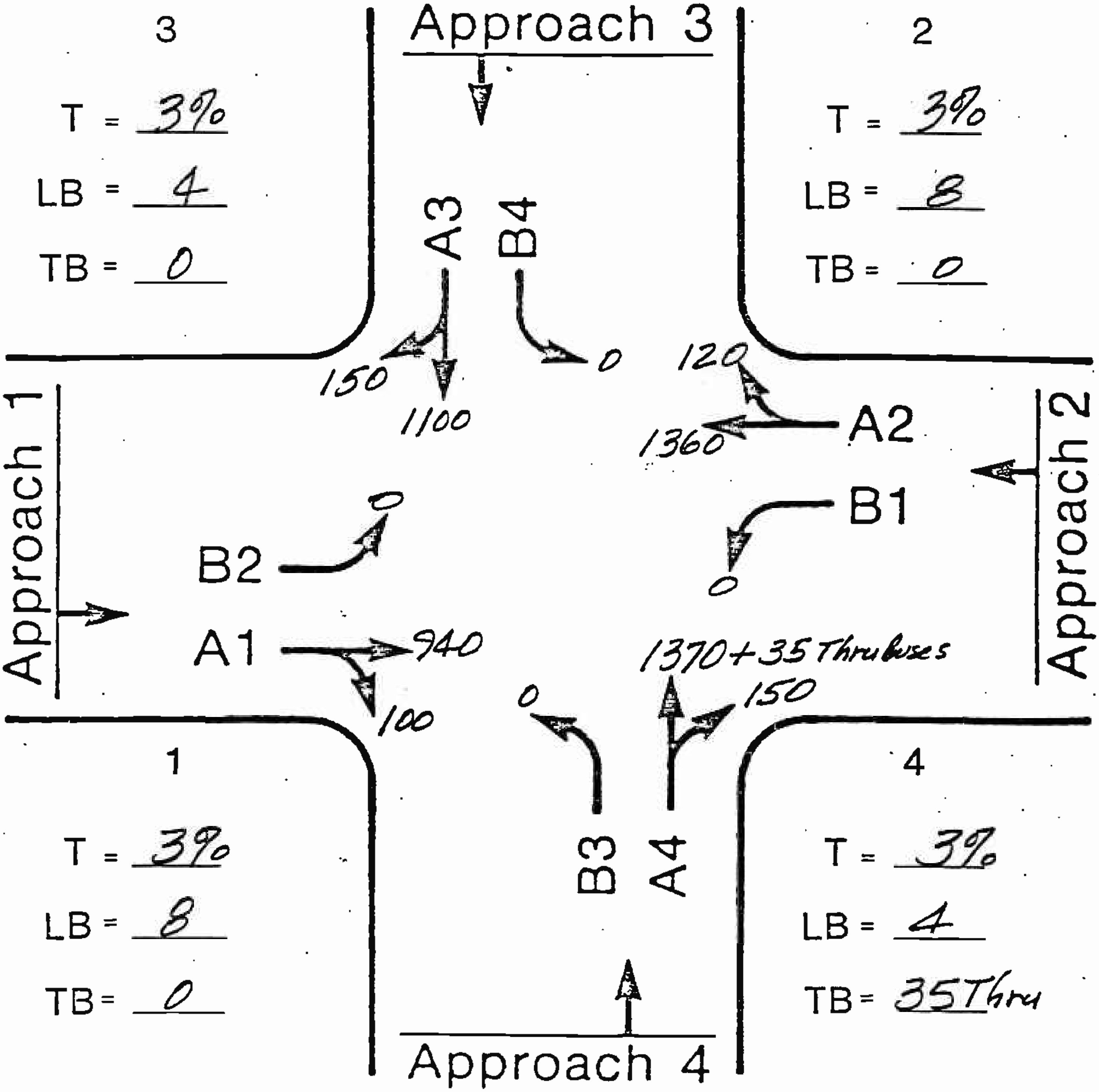
Step 12. Recalculate

Geometric Change Not
Signal Change Necessary
Volume Change

Comments

Traffic Volume Data

Identification of Intersection Movements



3

T = 3%

LB = 4

TB = 0

2

T = 3%

LB = 8

TB = 0

1

T = 3%

LB = 8

TB = 0

4

T = 3%

LB = 4

TB = 35 Thru

Design Year 2000

Design Hour PM Peak

Intersection Wilshire and Alvarado

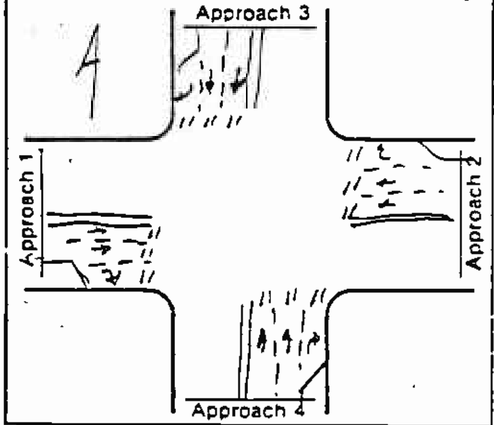
Vara ɔ . 'rna   Exis. 49   ons   6

Critical Movement Analysis: OPERATIONS AND DESIGN
Calculation Form 2

Intersection Wilshire and Alvarado **Design Hour** PM Peak Hour

Problem Statement Determine Critical Lane Volumes and LOS

Step 1. Identify Lane Geometry



Step 2. Identify Hourly Volumes (HV) in vph

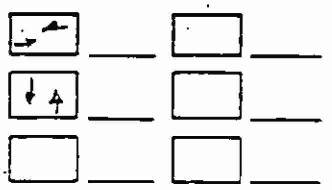
Approach 3
RT = 150
TH = 1180
LT = 0
T= 3%
LB= 4
RT = 120
TH = 1360
LT = 0

Approach 1
T= 3%
LB= 8

Approach 2
T= 3%
LB= 8

Approach 4
LT = 0
TH = 940
RT = 100
T= 3%
LB= 4
TB 35
LT = 0
TH = 1370
RT = 150

Step 3. Identify Phasing



A1 → A3 ↓

A2 ← A4 ↑

B1 ↱ B3 ↰

B2 ↲ B4 ↳

Step 4. Left Turn Check

Approach

a. Number of change intervals per hour

b. Left turn capacity on change interval, in vph

c. G/C Ratio

d. Opposing volume in vph

e. Left turn capacity on green, in vph

f. Left turn capacity in vph (b + e)

g. Left turn volume in vph

h. Is volume > capacity (g > f)?

No Left Turns

Step 5. Develop Passenger Car Volumes (PCV) in pch

Approach 3
RT = 155
TH = 1153
LT = 0
RT = 123
TH = 1441
LT = 0

Approach 1

Approach 2

Approach 4
LT = 0
TH = 1008
RT = 103
LT = 0
TH = 1501
RT = 155

Step 6. Calculate Period Volumes (PV) in pch

Approach 3
PHF = 0.90
RT = 172
TH = 1281
LT = 0
PHF = 0.90
RT = 137
TH = 1601
LT = 0

Approach 1

Approach 2

Approach 4
PHF = 0.90
LT = 0
TH = 1120
RT = 114
PHF = 0.90
LT = 0
TH = 1668
RT = 172

Step 7. Turn Adjustments

Approach	1	2	3	
Movement	A1	A2	A3	A4
Turn	Rt	Rt	Rt	
Turn volume (PV from Step 6)	114	137	172	172
Opposing vol. in vph from Step 2	—	—	—	
Ped. vol hour	—	< 1200		—
PCE LT from Table 3	—	—	—	—
LT vol. in pch	—	—	—	
PCE RT from Table 4	1.50	1.50	1.50	1.50
RT vol. in pch	17.1	20.6	25.8	25.8
TH vol. in pch from Step 6	1120	1601	1281	1665
Total PCV in pch	1120	1601	1281	1668

Step 8. Adjusted Volumes / *Step 9a. Calculate Lane Volumes*

Movement	Total PCV (Step 7)	U	W	Adjusted PCV (U×W×PCV)	No. of Lanes	PCV per Lane
A1	1120	1.05	1.0	1176	2	588
A2	1601	1.05	1.0	1681	2	841
A3	1281	1.05	1.0	1345	2	641
A4	1668	1.05	1.0	1751	2	876

Step 9b. Volume Adjustment for Multiphase Signal Overlap

Probable Phase	Possible Critical Volume in pch	Volume Carryover to next phase	Adjusted Critical Volume in pch

20

Step 10. Sum of Critical Volumes

A2

841 + 876 + ______ + ______

= 1717 pch

Step 11. Intersection Level of Service

(compare Step 10 with Table 6)

E

Step 12. Recalculate

Geometric Change ______

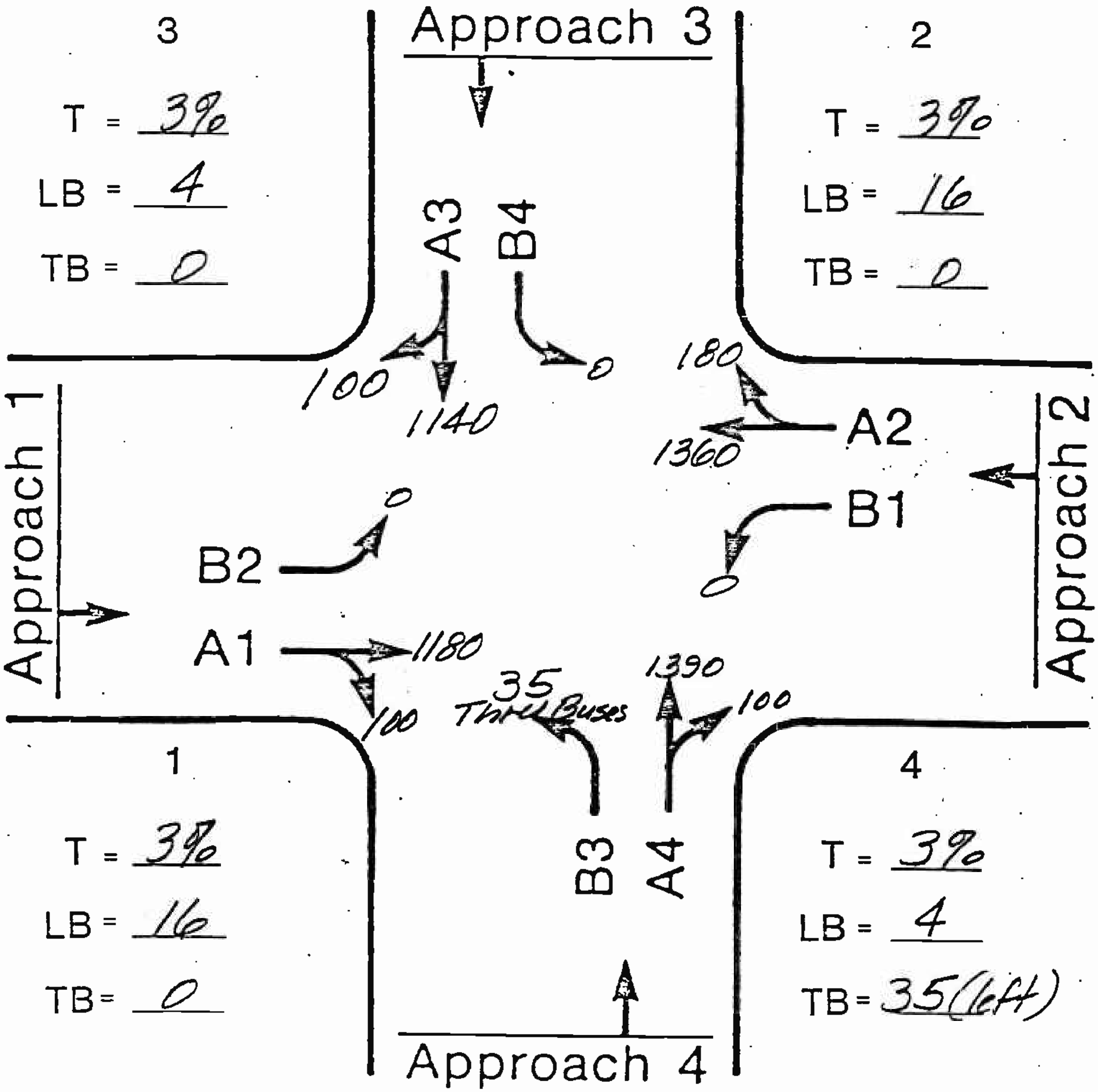
Signal Change ______

Volume Change ______

Comments ______

Traffic Volume Data

Identification of Intersection Movements



3

T = 3%

LB = 4

TB = 0

2

T = 3%

LB = 16

TB = 0

1

T = 3%

LB = 16

TB = 0

4

T = 3%

LB = 4

TB = 35(left)

Design Year 2000

Design Hour PM Peak

Intersection 6th Street and Alvarado

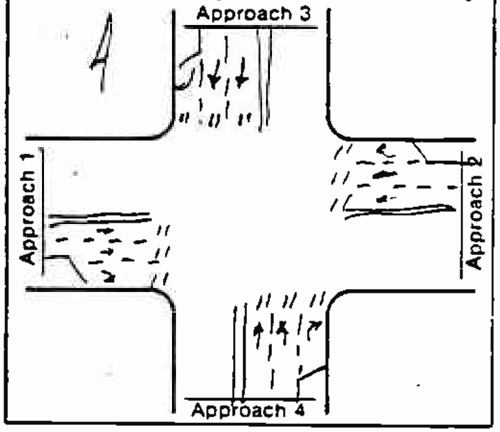
[illegible]

Critical Movement Analysis: OPERATIONS AND DESIGN
Calculation Form 2

Intersection 6th and Alvarado Streets **Design Hour** PM Peak Hr.

Problem Statement Define Critical Lane Volumes and LOS

Step 1. Identify Lane Geometry



Step 2. Identify Hourly Volumes (HV) in vph

Approach 3: RT = 100 TH = 1140 LT = 0
T= 3% LB= 4

Approach 2: RT = 180 TH = 1360 LT = 0
T= 3% LB= 16

Approach 1: T= 3% LB= 16
LT = 0 TH = 1180 RT = 100

Approach 4: T= 3% LB= 4
TB 35
LT = 35TB TH = 1390 RT = 100

Step 3. Identify Phasing

A1 → A3 ↓
A2 ← A4 ↑
B1 B3
B2 B4

Step 4. Left Turn Check

	Approach 1	2	3	4
a. Number of change intervals per hour	45	45	45	45
b. Left turn capacity on change interval, in vph	90	90	90	90
c. G/C Ratio	.5	.5	.5	.5
d. Opposing volume in vph	—	—	—	1240
e. Left turn capacity on green, in vph	—	—	—	0
f. Left turn capacity in vph (b + e)	—	—	—	90
g. Left turn volume in vph	—	—	—	35
h. Is volume > capacity (g > f)?	NO	No	No	No

Step 5. Develop Passenger Car Volumes (PCV) in pch

Approach 3: RT = 103 TH = 1194 LT = 0

Approach 2: RT = 185 TH = 1481 LT = 0

Approach 1: LT = 0 TH = 1295 RT = 103

Approach 4: LT = 70 TH = 1452 RT = 103

Step 6. Calculate Period Volumes (PV) in pch ✯✯

Approach 3: PHF = 0.85 RT = 121 TH = 1405 LT = 0

Approach 2: PHF = 0.91 RT = 203 TH = 1627 LT = 0

Approach 1: PHF = 0.93 LT = 0 TH = 1392 RT = 111

Approach 4: PHF = 0.95 LT = 74 TH = 1528 RT = 108

Step 7. Turn Adjustments

Approach	1	2	3	4
Movement	A1	A2	A3	B3A4
Turn	Rt	Rt	Rt	Lt Rt
Turn volume (PV from Step 6)	111	203	121	74 108
Opposing vol. in vph from Step 2	—	—	—	1240 —
Ped. vol hour	<1200			
PCE LT from Table 3	—	—	—	6.0 —
LT vol. in pch	—	—	—	444 —
PCE RT from Table 4	1.50	1.50	1.50	1.50
RT vol. in pch	167	305	182	162
TH vol. in pch from Step 6 ★	1392	1627	1405	1528
Total PCV in pch	1392	1627	1405	1972

Step 8. Adjusted Volumes / Step 9a. Calculate Lane Volumes

Movement	Total PCV (Step 7)	U	W	Adjusted PCV (U×W×PCV)	No. of lanes	PCV per lane
A1	1392	1.05	1.0	1462	2	731
A2	1627	1.05	1.0	1708	2	854
A3	1405	1.05	1.0	1475	2	738
B3A4	1972	1.05	1.0	2070	2	1035

Step 9b. Volume Adjustment for Multiphase Signal Overlap

Probable Phase	Possible Critical Volume in pch	Volume Carryover to next phase	Adjusted Critical Volume in pch

2 Ø

Step 10. Sum of Critical Volumes

A2 B3A4
854 + 1035 + ____ + ____
1889 = [illegible] pch

Step 11. Intersection Level of Service

(compare Step 10 with Table 6)

F

Step 12. Recalculate

Geometric Change ____
Signal Change ____
Volume Change ____

Comments ____

✯✯ Peak Hr. Factor bas d   ★ Rt. turns in 5 rate Rt. Lane : OK

APPENDIX C

ALVARADO ALTERNATIVE

CMA RESULTS

WITH IMPROVEMENTS

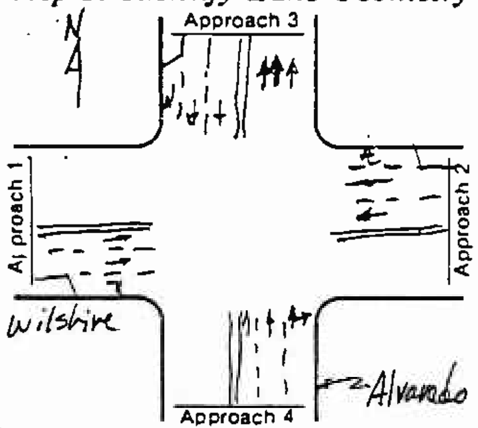
.lvara o rnativ / mprovemen

Critical Movement Analysis: OPERATIONS AND DESIGN
Calculation Form 2

[illegible]ersection Wilshire and Alvarado **Design Hour** PM Peak Hr.

Problem Statement Determine Critical Lane Volumes and LOS

Step 1. Identify Lane Geometry



Step 2. Identify Hourly Volumes (HV) in vph

Approach 3
RT = 150 TH = 1180 LT = 0
T= 3% LB= 4
RT = 120 TH = 1360 LT = 0

Approach 1
T= 3% LB= 8

Approach 2
T= 3% LB= 8

Approach 4
LT = 0 TH = 940 RT = 100
T= 3% LB= 4 TB 35
LT = 0 TH = 1370 RT = 150

Step 3. Identify Phasing

⇄	A1A2	☐	___	A1 → A3 ↓ A2 ← A4 ↑
⇅	A3A4	☐	___	
☐	___	☐	___	B1 B3 B2 B4

Step 4. Left Turn Check

Approach

a. Number of change intervals per hour
b. Left turn capacity on change interval, in vph
c. G/C Ratio
d. Opposing volume ... vph
...t turn ...pacity on green, in vph
f. Left turn capacity in vph (b + e)
g. Left turn volume in vph
h. Is volume > capacity (g > f)?

No Left Turns

Step 5. Develop Passenger Car Volumes (PCV) in pch

Approach 3
RT = 155 TH = 1153 LT = 0
RT = 123 TH = 1441 LT = 0

Approach 1

Approach 2

Approach 4
LT = 0 TH = 1008 RT = 103
LT = 0 TH = 1501 RT = 155

Step 6. Calculate Period Volumes (PV) in pch ☆☆

Approach 3
PHF = 0.90 RT = 172 TH = 1281 LT = 0
PHF = 0.90 RT = 137 TH = 1601 LT = 0

Approach 1

Approach 2

Approach 4
PHF = 0.90 LT = 0 TH = 1120 RT = 114
PHF = 0.90 LT = 0 TH = 1668 RT = 172

Step 7. Turn Adjustments

Approach	1	2	3	4
Movement	A1	A2	A3	
Turn	Rt.	Rt.	Rt.	Rt
Turn volume (PV from Step 6)	114	137	155	155
Opposing vol. in vph from Step 2	—	—	—	—
Ped. vol hour	—	<1200		
PCE LT from Table 3	—	—	—	
LT vol. in pch	—	—	—	
PCE RT from Table 4	1.50	1.50	1.50	1.50
RT vol. in pch ☆	171	205	232	232
TH vol. in pch from Step 6	1120	1601	1281	1668
Total PCV in pch ☆	1120	1601	1281	1900

Step 8. Adjusted Volumes

Step 9a. Calculate Lane Volumes

Movement	Total PCV (Step 7)	U	W	Adjusted PCV (U×W×PCV)	No. of Lanes	PCV per Lane
A1	1120	1.05	1.0	1176	2	588
A2	1601	1.05	1.0	1681	2	841
A3	1281	1.05	1.0	1345	2	673
A4	1900	1.10	1.0	2090	3	697

Step 9b. Volume Adjustment for Multiphase Signal Overlap

Probable Phase	Possible Critical Volume in pch	Volume Carryover to next phase	Adjusted Critical Volume in pch

2 Ø

Step 10. Sum of Critical Volumes

A2 841 + A4 697 + — + —
= 1538 pch

Step 11. Intersection Level of Service

(compare Step 10 with Table 6)

D

Step 12. Recalculate

Geometric Change Not
Signal Change Necessary
Volume Change

Comments See

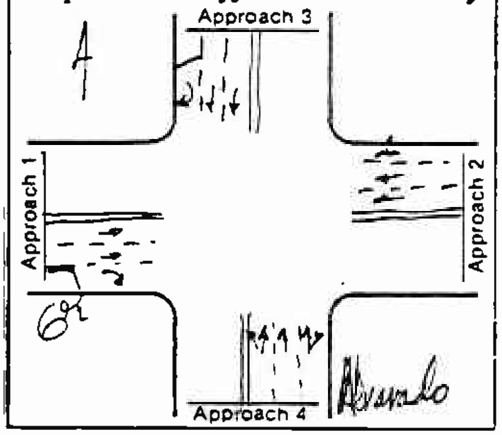
Alvarado Alternative With Improvements

Critical Movement Analysis: OPERATIONS AND DESIGN
Calculation Form 2

[illegible]ersection 6th Street and Alvarado **Design Hour** PM Peak Hr.

Problem Statement Define Critical Lane Volumes and LOS

Step 1. Identify Lane Geometry



Step 2. Identify Hourly Volumes (HV) in vph

Approach 3: RT = 100, TH = 1140, LT = 0, T= 3%, LB= 4

RT = 180, TH = 1360, LT = 0

Approach 1: T= 3%, LB= 16

Approach 2: T= 3%, LB= 16

LT = 0, TH = 1180, RT = 100

Approach 4: T= 3%, LB= 4

LT = 35, TH = 1390, RT = 100

Step 3. Identify Phasing

☐ A1 A2 ☐ ___

☐ A3B3A4 ☐ ___

☐ ___ ☐ ___

A1 → A3 ↓

A2 ← A4 ↑

B1 ↰ B3 ↱

B2 ↲ B4 ↳

Step 4. Left Turn Check

	Approach 1	2	3	4
a. Number of change intervals per hour	45	45	45	45
b. Left turn capacity on change interval, in vph	90	90	90	90
c. G/C Ratio	.5	.5	.5	.5
d. Opposing volume [illegible] vph	—	—	—	1240
[illegible]t turn capacity on green, in vph	—	—	—	0
[illegible]. Left turn capacity in vph (b + e)	—	—	—	90
g. Left turn volume in vph	—	—	—	35
h. Is volume > capacity (g > f)?	NO	NO	NO	NO

Step 5. Develop Passenger Car Volumes (PCV) in pch

Approach 3: RT = 103, TH = 1194, LT = 0

RT = 185, TH = 1481, LT = 0

Approach 1

Approach 2

LT = 0, TH = 1295, RT = 103

Approach 4: LT = 70, TH = 1452, RT = 103

Step 6. Calculate Period Volumes (PV) in pch

Approach 3: PHF = 0.85, RT = 121, TH = 1405, LT = 0

PHF = 0.91, RT = 203, TH = 1627, LT = 0

Approach 1

Approach 2

PHF = 0.93, LT = 0, TH = 1392, RT = 111

Approach 4: PHF = 0.95, LT = 74, TH = 1528, RT = 108

Step 7. Turn Adjustments

Approach	1	2	3		
Movement	A1	A2	A3	B3A	
Turn	R+	R+	R+	Lt.	Rt
Turn volume (PV from Step 6)	111	203	121	74	108
Opposing vol. in vph from Step 2	—	—	—	1240	—
Ped. vol hour	—	Z1700			
PCE LT from Table 3	—	—	—	6.0	
LT vol. in pch	—	—	—	444	—
PCE RT from Table 4	1.50	1.50	1.50		1.50
RT vol. in pch ★	167	304	182		1[illegible]
TH vol. in pch from Step 6	1392	1627	1405		1528
Total PCV in pch	1392	1931	1405		[illegible]

Step 8. Adjusted Volumes / Step 9a. Calculate Lane Volumes

Movement	Total PCV (Step 7)	U	W	Adjusted PCV (U×W×PCV)	No. of Lanes	PCV per lane
A1	1392	1.05	1.0	1462	2	731
A2	1931	1.10	1.0	2124	3	708
A3	1405	1.05	1.0	1475	2	738
B3A4	2134	1.10	1.0	2347	3	782

Step 9b. Volume Adjustment for Multiphase Signal Overlap

Probable Phase	Possible Critical Volume in pch	Volume Carryover to next phase	Adjusted Critical Volume in pch

2 Ø

Step 10. Sum of Critical Volumes

A1 731 + B3A4 782 + ___ + ___ = 1513 pch

Step 11. Intersection Level of Service

(compare Step 10 with Table 6)

D

Step 12. Recalculate

Geometric Change ___

Signal Change ___

Volume Change ___

Comments See Traffic Vol. Data Sheet #7

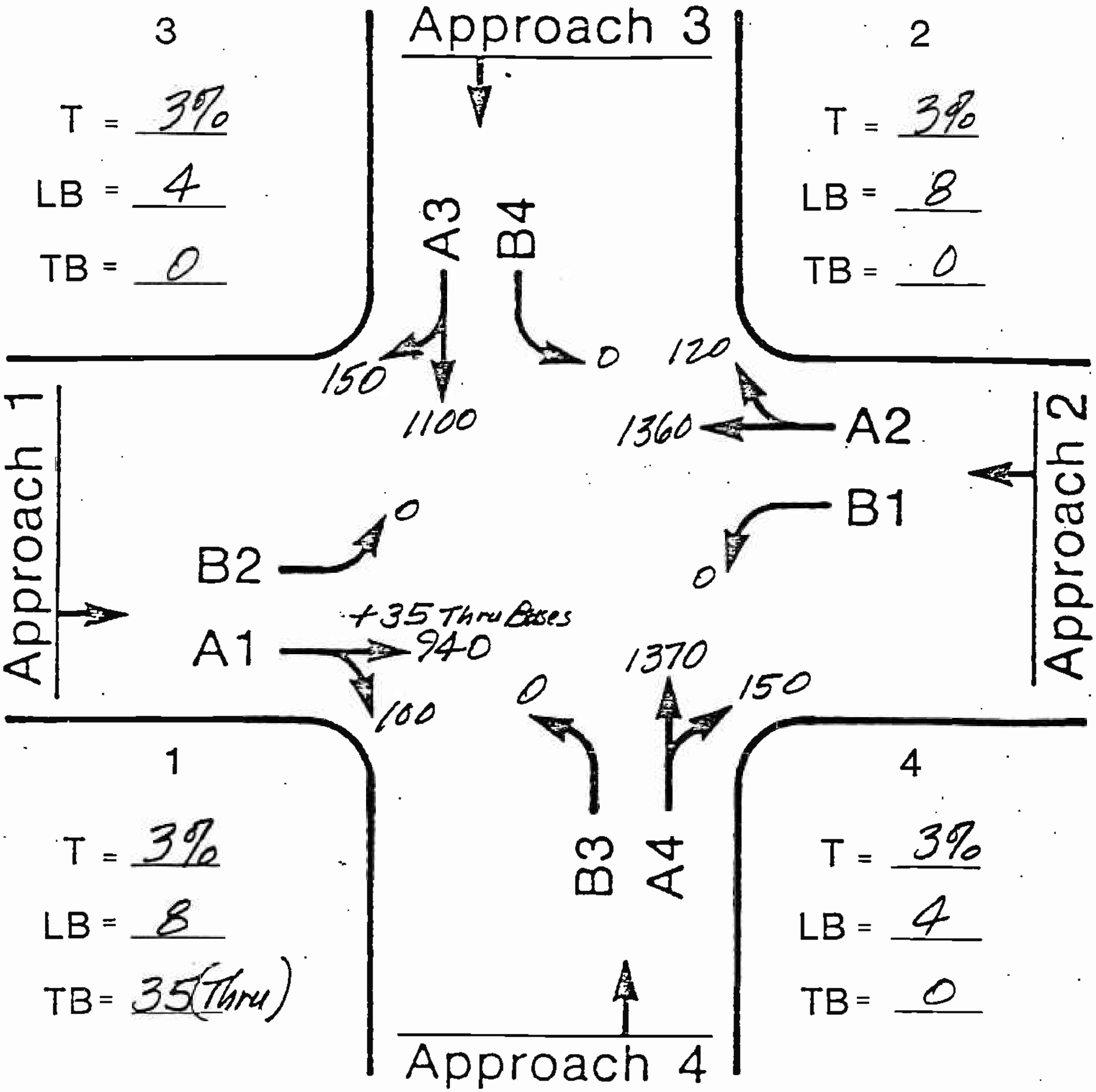
APPENDIX D

Westlake Alternative
Traffic Volume Data
and CMA Results
Existing Conditions

WI #

Traffic Volume Data

Identification of Intersection Movements



3

T = 3%

LB = 4

TB = 0

2

T = 3%

LB = 8

TB = 0

1

T = 3%

LB = 8

TB = 35(Thru)

4

T = 3%

LB = 4

TB = 0

Design Year 2000

Design Hour PM Peak

Intersection Wilshire and Alvarado

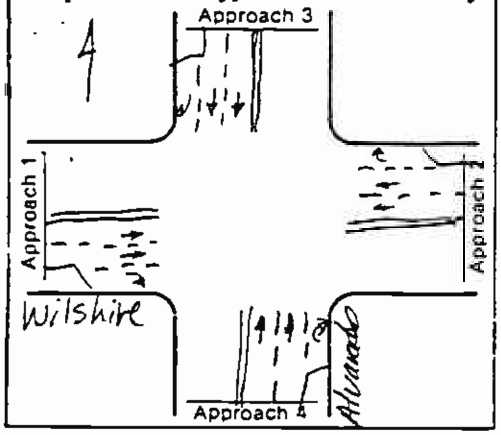
CS KE — — 15 VG . 1.15 10

Critical Movement Analysis: OPERATIONS AND DESIGN
Calculation Form 2

Intersection Wilshire and Alvarado **Design Hour** PM Peak Hr.

Problem Statement Determine Critical Lane Volumes and LOS

Step 1. Identify Lane Geometry



Step 2. Identify Hourly Volumes (HV) in vph

Approach 3: T= 3% LB= 4

RT = 150 TH = 1100 LT = 0

RT = 120 TH = 1360 LT = 0

Approach 1: T= 3% LB= 8 TB=35

Approach 2: T= 3% LB= 8

LT = 0 TH = 940 RT = 100 + 35TB

Approach 4: T= 3% LB= 4

LT = 0 TH = 1370 RT = 150

Step 3. Identify Phasing

A1A2

A3A4

A1 → A3 ↓

A2 ← A4 ↑

B1 B3

B2 B4

Step 4. Left Turn Check

a. Number of change intervals per hour
b. Left turn capacity on change interval, in vph
c. G/C Ratio
d. Opposing volume in vph
e. Left turn capacity on green, in vph
f. Left turn capacity in vph (b + e)
g. Left turn volume in vph
h. Is volume > capacity (g > f)?

Approach 1 2 3 4

No Left Turns

Step 5. Develop Passenger Car Volumes (PCV) in pch

Approach 3

RT = 155 TH = 1153 LT = 0

RT = 123 TH = 1441 LT = 0

Approach 1

Approach 2

LT = 0 TH = 1078 RT = 103

Approach 4

LT = 0 TH = 1431 RT = 155

*Step 6. Calculate Period Volumes (PV) in pch**

Approach 3

PHF = 0.90 RT = 172 TH = 1281 LT = 0

PHF = 0.90 RT = 137 TH = 1601 LT = 0

Approach 1

Approach 2

PHF = 0.90 LT = 0 TH = 1198 RT = 114

Approach 4

PHF = 0.90 LT = 0 TH = 1590 RT = 172

Step 7. Turn Adjustments

Approach
Movement
Turn
Turn volume (PV from Step 6)
Opposing vol. in vph from Step 2
Ped. vol hour
PCE LT from Table 3
LT vol. in pch.
PCE RT from Table 4
RT vol. in pch
TH vol. in pch from Step 6
Total PCV in pch

No Left Turns

Rt. Turns in Separate Lane ∴ No Adjustment Necessary — RT. Turn vols. are ok

Step 8. Adjusted Volumes / *Step 9a. Calculate Lane Volumes*

Move-ment	Total PCV (Step 7)	U	W	Adjusted PCV (U×W×PCV)	No. of Lanes	PCV per Lane
A1	1198	1.05	1.0	1258	2	629
A2	1601	1.05	1.0	1681	2	841
A3	1281	1.05	1.0	1345	2	641
A4	1590	1.05	1.0	1670	2	835

Step 9b. Volume Adjustment for Multiphase Signal Overlap

Probable Phase	Possible Critical Volume in pch	Volume Carryover to next phase	Adjusted Critical Volume in pch

2 Ø

Step 10. Sum of Critical Volumes

A2 841 + A4 835 + — + — = 1676 pch

Step 11. Intersection Level of Service

(compare Step 10 with Table 6)

E

Step 12. ~~Recalculate~~ Note:

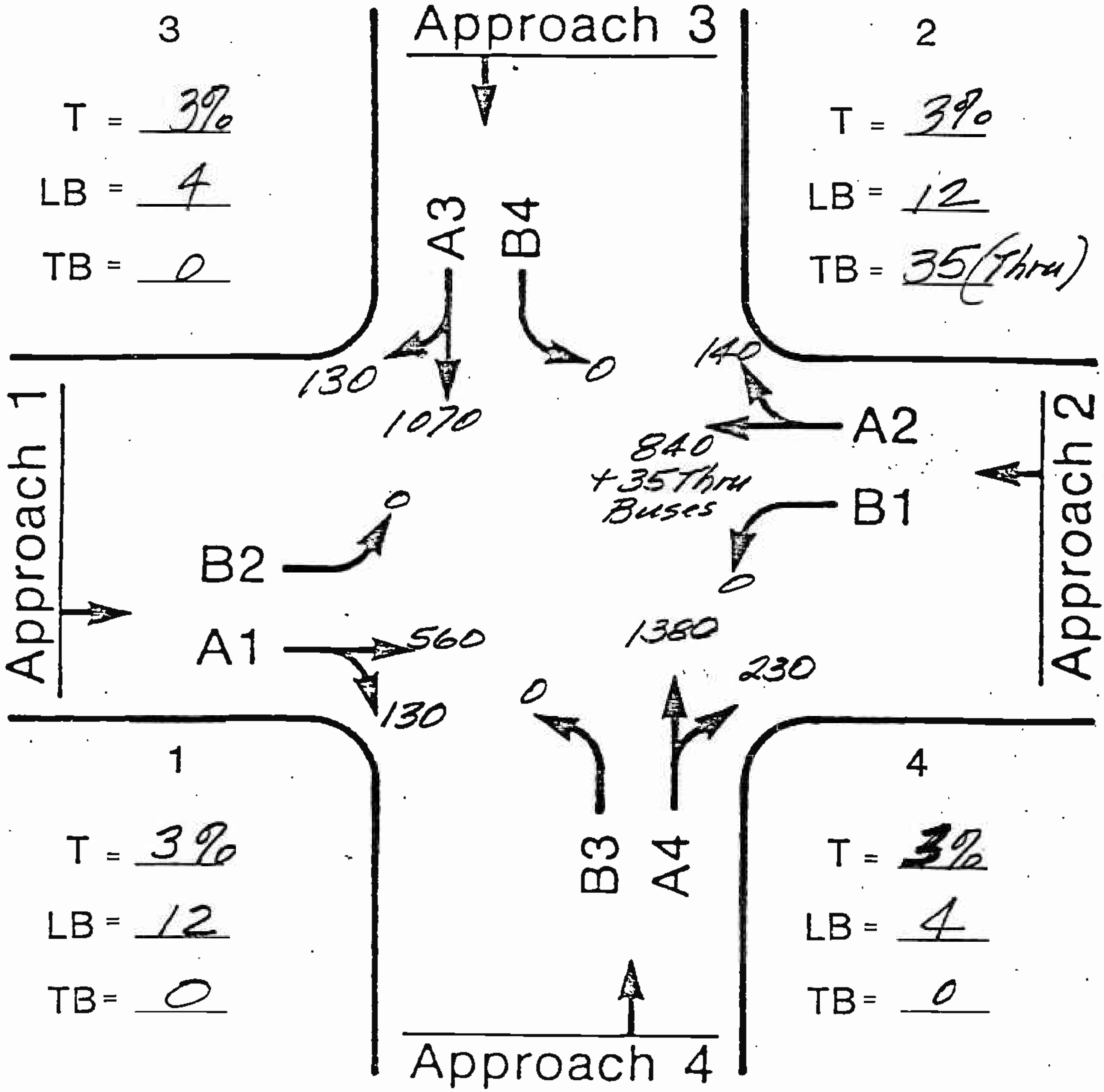
~~Geometric Change~~ See Traffic
~~Signal Change~~ Volume Data
~~Volume Change~~ Sheet # 10

Comments Assigned Bus Volume not in Critical Lane ∴ does not decrease LOS estLake Alternative

Traffic Volume Data

with #11

Identification of Intersection Movements



3

T = 3%

LB = 4

TB = 0

2

T = 3%

LB = 12

TB = 35(Thru)

1

T = 3%

LB = 12

TB = 0

4

T = 3%

LB = 4

TB = 0

Design Year 2000

Design Hour PM Peak

Intersection 7th and Alvarado Streets

CS 266 . rna. ve   EXIS 119 2 77

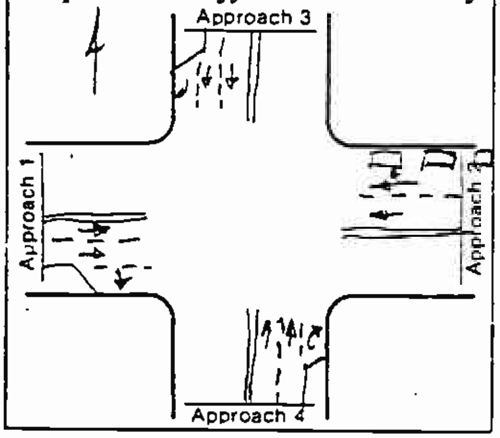
(11)

Critical Movement Analysis: OPERATIONS AND DESIGN
Calculation Form 2

Intersection 7th and Alvorado Streets **Design Hour** PM Peak Hr.

Problem Statement Define Critical Lane Volumes and LOS.

Step 1. Identify Lane Geometry



Step 2. Identify Hourly Volumes (HV) in vph

Approach 3: RT = 130, TH = 1070, LT = 0; T= 3%, LB= 4

Approach 2: RT = 140, TH = 840, LT = 0; T= 3%, LB= 12, TB = 25

Approach 1: T= 3%, LB= 12; LT = 0, TH = 560, RT = 130

Approach 4: T= 3%, LB= 4; LT = 0, TH = 1380, RT = 230

Step 3. Identify Phasing

→ ←	A1A2	☐	___
↓ ↑	A3A4	☐	___
☐	___	☐	___

A1 → A3 ↓
A2 ← A4 ↑
B1 ↱ B3 ↰
B2 ↲ B4 ↳

Step 4. Left Turn Check

	Approach 1	2	3	4
a. Number of change intervals per hour	No Left Turns			
b. Left turn capacity on change interval, in vph				
c. G/C Ratio				
d. Opposing volume in vph				
e. Left turn capacity on green, in vph				
f. Left turn capacity in vph (b + e)				
g. Left turn volume in vph				
h. Is volume > capacity (g > f)?				

Step 5. Develop Passenger Car Volumes (PCV) in pch

Approach 3: RT = 134, TH = 1122, LT = 0

Approach 2: RT = 144, TH = 995, LT = 0

Approach 1: LT = 0, TH = 637, RT = 134

Approach 4: LT = 0, TH = 1441, RT = 237

Step 6. Calculate Period Volumes (PV) in pch

Approach 3: PHF = 0.91, RT = 147, TH = 1233, LT = 0

Approach 2: PHF = 0.98, RT = 147, TH = 1015, LT = 0

Approach 1: PHF = 0.89, LT = 0, TH = 716, RT = 151

Approach 4: PHF = 0.92, LT = 0, TH = 1566, RT = 258

Step 7. Turn Adjustments

Approach	1	2	3	4
Movement	A1	A2	A3	A4
Turn	Rt.	Rt.	Rt.	Rt.
Turn volume (PV from Step 6)	151	147	147	258
Opposing vol. in vph from Step 2	0	0	0	0
Ped. vol hour	—	< 1200		—
PCE LT from Table 3	—	—	—	—
LT vol. in pch	—	—	—	—
PCE RT from Table 4	1.50	1.50	1.50	1.50
RT vol. in pch	226	220	220	387
TH vol. in pch from Step 6 ★	716	1015	1233	1566
Total PCV in pch	716	1235	1233	

Step 8. Adjusted Volumes / Step 9a. Calculate Lane Volumes

Movement	Total PCV (Step 7)	U	W	Adjusted PCV (U×W×PCV)	No. of Lanes	PCV per Lane
A1	716	1.05	1.0	752	2	376
A2	1235	1.05	1.0	1297	2	648
A3	1233	1.05	1.0	1295	2	648
A4	1566	1.05	1.0	1644	2	822

Step 9b. Volume Adjustment for Multiphase Signal Overlap

Probable Phase	Possible Critical Volume in pch	Volume Carryover to next phase	Adjusted Critical Volume in pch

2 Ø

Step 10. Sum of Critical Volumes

A2 648 + A4 822 + — + —

= 1470 pch

Step 11. Intersection Level of Service

(compare Step 10 with Table 6)

D

Step 12. Recalculate

Geometric Change ______

Signal Change ______

Volume Change ______

Comments ______

==

GENERAL PLANNING CONSULTANT

TECHNICAL MEMORANDUM 6.1.4

COST-EFFECTIVENESS CALCULATIONS

==

Prepared for:

Southern California Rapid Transit District

Prepared by:

Barton-Aschman Associates, Inc.

in associaton with:

Schimpeler.Corradino Associates
Cordoba Corporation
Myra L. Frank & Associates
Robert J. Harmon & Associates
Deloitte Haskins & Sells
Manual Padron
The Planning Group, Inc.

September, 1984

I. Introduction

Metro Rail and Transportation System Management (TSM) alternatives have been defined for each of the three Metro Rail line extents (4,8.8, and 18.6 miles)[1]. Complete travel demand model simulations have been performed to estimate the ridership, travel time, and operating resource and cost implications of each of thse six alternatives.

Briefly sumarized in this memorandum are the results of the UMTA prescribed cost-effectivenss calculations aimed at comparing each rail alternative with the comparable non-rail alternative.

2. Cost-Effectiveness Inputs and Results

In addition to the data provided by the individual travel demand model simulations, other capital and operating costs were computed based upon the definition of the specific alernative being tested.

Rail system capital costs included the cost of the Metro Rail line and the corresponding cost of bus expansion and replacement. The rail system operating costs were derived from the respective rail and bus cost models, which are calibrated components of the travel demand models.

The TSM capital costs include the cost of bus fleet expansion and replacement for all alternatives. Computerized traffic signal constrol was also included in all alternatives at $40,000 per signal, with the following number of signals in each alternative:

TSM ALTERNATIVE	NUMBER OF SIGNALS EFFECTED
4.0 mile	334
8.8 mile	682
18.6 mile	960

In the 8.8 and 18.6 mile TSM alternatives, reversible lane control on Olympic Boulevard was included at $1.5 million. And finally, in the 18.6 TSM alternative, new transit centers at Universal City and Hollywood/ Cahuenga were included at a total cost of $5.7 million. TSM operating costs include the Long Beach Light Rail line and regional bus operating costs plus the maintenance of the computerized traffic signal control system (at $700 per signal per year).

All cost-effectiveness inputs are presented in the attached tables together with the calculation results:

Extent (Mile)	Federal Index	Total Index
4.0	4.58	6.51
8.8	1.80	3.00
18.6	2.03	3.77

---

[1] Technical Memorandum 6.1.3, Description of Transportation System Management (TSM) Alternative Networks, September, 1984

SCRTD COST-EFFECTIVENESS CALCULATIONS

Alternative Name: MOS-1

Item	Disc	Life	Quantity	Unit Price	Cost	Rate	Value	TOTALS
RAIL ALTERNATIVE								
Rail Capital Cost	0.1	30	1.175E+09	1	$1174900000.00	0.1060792	$124632508.77	
Initial Bus Expansion	0.1	12	84	$150000.00	$12600000.00	0.1467633	$1849217.77	
Other Bus Capital	0.1	30	0	$29000000.00	$0.00	0.1060792	$0.00	
Replacement Bus Costs	0.1	12	2294	$150000.00	$344100000.00	0.1467633	$50501256.73	
Other Capital Costs	0.1	30	0	1	$0.00	0.1060792	$0.00	$176982983.27
Local Capital Funding							$52970021.43	$52970021.43
Bus Operating Costs	1	1	525420800	1	$525420800.00	1	$525420800.00	
Rail Operating Costs	1	1	28380000	1	$28380000.00	1	$28380000.00	$553800800.00
Work Transit Travel Time	1	1	78311305	$4.00	$313245220.00	1	($313245220.00)	
Nonwork Travel Time	1	1	269973760	$2.00	$539947520.00	1	($539947520.00)	($853192740.00)
Ann. Linked Transit Trip	1	1	522732900	1	522732900	1	522732900	
TSM ALTERNATIVE								
Initial Bus Expansion	0.1	12	26	$150000.00	$3900000.00	0.1467633	$572376.93	
Other Bus Capital	0.1	30	0	$29000000.00	$0.00	0.1060792	$0.00	
Replacement Bus Costs	0.1	12	2236	$150000.00	$335400000.00	0.1467633	$49224415.88	
Other Capital Costs	0.1	30	13360000	1	$13360000.00	0.1060792	$1417218.76	$51214011.57
Local Capital Funding							$12803502.89	$12803502.89
Bus Operating Costs	1	1	518106880	1	$518106880.00	1	$518106880.00	
Other Operating Costs	1	1	13233800	1	$13233800.00	1	$13233800.00	$531340680.00
Work Transit Travel Time	1	1	79854485	$4.00	$319417940.00	1	($319417940.00)	
Nonwork Travel Time	1	1	273339760	$2.00	$546679520.00	1	($546679520.00)	($866097460.00)
Ann. Linked Transit Trip	1	1	501937200	1	501937200	1	501937200	

Cost-Effectiveness Index	6.5073
Federal Cost-Effectiveness Index	4.5759

SCRTD COST-EFFECTIVENESS CALCULATIONS

Alternative Name: MOS

Item	Disc	Life	Quantity	Unit Price	Cost	Rate	Value	TOTALS
RAIL ALTERNATIVE								
Rail Capital Cost	0.1	30	2.134E+09	1	$2133500000.00	0.1060792	$226320076.15	
Initial Bus Expansion	0.1	12	0	$150000.00	$0.00	0.1467633	$0.00	
Other Bus Capital	0.1	30	0	$29000000.00	$0.00	0.1060792	$0.00	
Replacement Bus Costs	0.1	12	2104	$150000.00	$315600000.00	0.1467633	$46318502.25	
Other Capital Costs	0.1	30	0	1	$0.00	0.1060792	$0.00	$272638578.39
Local Capital Funding							$84002049.93	$84002049.93
Bus Operating Costs	1	1	490281200	1	$490281200.00	1	$490281200.00	
Rail Operating Costs	1	1	44900000	1	$44900000.00	1	$44900000.00	$535181200.00
Work Transit Travel Time	1	1	89665840	$4.00	$358663360.00	1	($358663360.00)	
Nonwork Travel Time	1	1	268312400	$2.00	$536624800.00	1	($536624800.00)	($895288160.00)
Ann. Linked Transit Trip	1	1	576418500	1	576418500	1	576418500	
TSM ALTERNATIVE								
Initial Bus Expansion	0.1	12	208	$150000.00	$31200000.00	0.1467633	$4579015.43	
Other Bus Capital	0.1	30	1	$29000000.00	$29000000.00	0.1060792	$3076255.20	
Replacement Bus Costs	0.1	12	2418	$150000.00	$362700000.00	0.1467633	$53231054.39	
Other Capital Costs	0.1	30	28790000	1	$28790000.00	0.1060792	$3053940.76	$63939929.75
Local Capital Funding							$15984832.20	$15984832.20
Bus Operating Costs	1	1	544088832	1	$544088832.00	1	$544088832.00	
Other Operating Costs	1	1	13522400	1	$13522400.00	1	$13522400.00	$557611232.00
Work Transit Travel Time	1	1	91528800	$4.00	$366115200.00	1	($366115200.00)	
Nonwork Travel Time	1	1	273015440	$2.00	$546030880.00	1	($546030880.00)	($912146080.00)
Ann. Linked Transit Trip	1	1	519990900	1	519990900	1	519990900	

Cost-Effectiveness Index 5.0023

Federal Cost-Effectiveness Index 1.7939

SCRTD COST-EFFECTIVENESS CALCULATIONS

Alternative Name: LPA

Item	Disc	Life	Quantity	Unit Price	Cost	Rate	Value	TOTALS
RAIL ALTERNATIVE								
Rail Capital Cost	0.1	30	3.364E+09	1	$3364000000.00	0.1060792	$356972176.09	
Initial Bus Expansion	0.1	12	0	$150000.00	$0.00	0.1467633	$0.00	
Other Bus Capital	0.1	30	0	$29000000.00	$0.00	0.1060792	$0.00	
Replacement Bus Costs	0.1	12	1724	$150000.00	$258600000.00	0.1467633	$37952993.28	
Other Capital Costs	0.1	30	0	1	$0.00	0.1060792	$0.00	$394925169.37
Local Capital Funding							$124359344.67	$124359344.67
Bus Operating Costs	1	1	406346000	1	$406346000.00	1	$406346000.00	
Rail Operating Costs	1	1	61520000	1	$61520000.00	1	$61520000.00	$467866000.00
Work Transit Travel Time	1	1	90891040	$4.00	$363564160.00	1	($363564160.00)	
Nonwork Travel Time	1	1	265235040	$2.00	$530470080.00	1	($530470080.00)	($894034240.00)
Ann. Linked Transit Trip	1	1	582381600	1	582381600	1	582381600	
TSM ALTERNATIVE								
Initial Bus Expansion	0.1	12	161	$150000.00	$24150000.00	0.1467633	$3544334.06	
Other Bus Capital	0.1	30	1	$29000000.00	$29000000.00	0.1060792	$3076298.20	
Replacement Bus Costs	0.1	12	2371	$150000.00	$355650000.00	0.1467633	$52196373.02	
Other Capital Costs	0.1	30	45600000	1	$45600000.00	0.1060792	$4837213.72	$63654218.99
Local Capital Funding							$15913554.75	$15913554.75
Bus Operating Costs	1	1	533268000	1	$533268000.00	1	$533268000.00	
Other Operating Costs	1	1	13717000	1	$13717000.00	1	$13717000.00	$546985000.00
Work Transit Travel Time	1	1	91133920	$4.00	$364535680.00	1	($364535680.00)	
Nonwork Travel Time	1	1	273988560	$2.00	$547977120.00	1	($547977120.00)	($912512800.00)
Ann. Linked Transit Trip	1	1	519952300	1	519952300	1	519952300	

Cost-Effectiveness Index	3.7691
Federal Cost-Effectiveness Index	2.0347