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GENERAL PLANNING CONSULTANT

TECHNICAL MEMORANDUM 89.5.1:

MILESTONE 6B

COST EFFECTIVENESS ANALYSIS

==========

Prepared for:

Southern California Rapid Transit District

Prepared by:

Schimpeler•Corradino Associates

in association with

Cordoba Corporation

The Planning Group

March, 1989

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1. INTRODUCTION

The Southern California Rapid Transit District (SCRTD) is in the process of selecting an alternative alignment for a Metro Rail extension beyond MOS-1. MOS-1 is the first operable segment of Metro Rail and is under construction at a total estimated cost of $1.25 billion. MOS-1 extends from Union Station in downtown Los Angeles to Wilshire/Alvarado, a distance of about 4.4 miles. The dangers associated with methane gas seepage in a widespread area to be penetrated by the locally preferred alternative (LPA) of 1983 gave rise to a legislatively imposed ban on tunneling through methane risk zones and a mandate to SCRTD for a Congressionally Ordered Re-Engineering Study (CORE Study) of alternative routes. A portion of the revised LPA will constitute the second minimum operable segment (MOS-2) of Metro Rail. For purposes of this document, sample calculations for MOS-2B of Candidate Alignment 4 are presented. However, data on all alignments are included.

This report provides a detailed cost effectiveness analysis of the Los Angeles Metro Rail Project using UMTA guidelines for rating major transit investments. Current UMTA methodology focuses on data produced during planning and engineering studies. However, UMTA is proposing modifications in the measurement of transportation benefits accruing from proposed major investments. As such, this report provides both a cost effectiveness analysis of alternatives using current UMTA methodology, and a cost effectiveness analysis using proposed changes in methodology.

1.1 RATIONALE

In May 1984, UMTA published a document entitled:

> "A Detailed Description of UMTA's System for Rating Proposed Major Transit Investments"

This document outlined UMTA's revised policy for the planning and development of major transit systems. The criteria for evaluating transit projects competing for limited Federal assistance are articulated clearly and the methodology for quantification of the evaluation factors are described in detail. Some shortcomings in the indices of cost effectiveness became apparent quickly and UMTA issued a proposed revision in September, 1984 entitled:

> "Application of the Major Investment Policy for Fiscal Year 1986: Calculation of Indices, Possible Revisions and Data Requirements"

The guidelines and procedures included in the above documents are followed closely in the analyses described in this report. For the most part, data requirements are restricted to that available in the normal conduct of a planning study.

The UMTA rating system is used only to compare transit projects with projects from throughout the United States and to identify the relative merits of each project. No attempt is made to establish the merits of individual projects. Thus, it is important to follow, as closely as possible, the guidelines and procedures included in the two documents mentioned above. The revisions proposed in the second document have not been approved. Therefore, UMTA requires that the originally proposed indices be calculated in addition to the revised indices.

1.2 OBJECTIVES

The purpose of UMTA's cost effectiveness methodology is to provide an objective basis on which to compare investment proposals. The guidelines are based on the overall objectives of the UMTA program, derived from the Urban Mass Transportation Act. The primary purposes of the program are to "...assist in the development of improved mass transportation facilities..." and "...to encourage the planning and establishment of area wide urban mass transportation systems..." It appears the overriding Federal interest in transit is in providing urban mobility through financial assistance for the development of transit systems.

The primary emphasis of the evaluation system is on transportation service and the mobility it provides. Secondary considerations range from economic development to pollutant reduction to energy conservation. However, these factors are directly included in the evaluation system.

1.3 EVALUATION CRITERIA

UMTA's selection of evaluation criteria is predicated on the degree to which they reflect the attainment of Congressional objectives for major transit projects.

1.3.1 Cost Effectiveness

Cost effectiveness is defined as the extent to which a project returns benefits relative to its costs. In this context, benefits and costs must be determined by directly comparing the project alternative to a non-project alternative and calculating the impacts. Each alternative includes the existing highway and transit networks with those transit components already committed such as MOS-1 and the Long Beach-Los Angeles and Norwalk-El Segundo light rail lines. The project alternative adds the second minimum operable segment, MOS-2, of Metro Rail. The non-project alternative adds a set of Transportation System Management (TSM) improvements to the network. TSM improvements consist of low capital cost options generally concerned with improving traffic flow conditions for highway traffic including buses. The TSM network is an attempt to ameliorate transit corridor problems without the expense of a major new project. Thus, the TSM network is the baseline case for evaluating the proposed new investment.

The benefits to be evaluated are the attraction of new riders, improvements in travel times for existing riders, and reduction in operating and maintenance costs. In general, these benefits reflect the Federal objective of providing urban mobility and constitute a comprehensive, objective basis for comparisons among proposed investment opportunities.

1.3.1.1 Current Cost Effectiveness Indices

The current indices are computed by summing changes in annualized costs and benefits to existing riders and dividing this total by the change in annual transit ridership.

To aid in the assignment of ratings to proposals for Federal funding assistance, UMTA currently uses two indices that represent the cost effectiveness of the proposals from two perspectives. One perspective is that of the Federal government in which the Federal funds needed for the project are compared to its total benefits. The other perspective is that of society in general, in which total funds needed -- regardless of their source -- are compared to total benefits.

In both the Federal index and the total index, the "existing" riders are transit patrons carried by the TSM alternative in the forecast year -- that is, those riders who would exist without a new transit guideway.

While both indices produce ratios with units of "added cost per new rider," they both reflect benefits to existing riders and savings in operating costs as well as the attraction of new riders. The indices can be interpreted as ratios between the necessary capital investment and the return in transit ridership, with credits for O&M cost savings, travel time savings, and local funding used to offset some (or all) of the capital costs.

1.3.1.2 Revised Cost Effectiveness Indices

Apparent weaknesses of the current methodology are directly related to the measures of transportation benefits used in the indices. Benefits to existing riders are measured in terms of hours of travel time and appear in the numerator, while benefits to new riders are measured as trips and comprise the only term in the denominator. A significant improvement in the indices would be the measurement of both types of benefits in common units. This approach puts all transportation benefits on common ground and, more importantly, permits them to be summed and used together in computing indices. In the revised indices, benefits to both existing and new riders are calculated in terms of consumer surplus and expressed in hours of user benefits. The assignment of a dollar value per hour of benefits enables all terms in the indices to be expressed in dollars.

Another problem with the current indices concerns those projects which result in major benefits to existing riders but with a small increase or decrease in number of riders. In instances when the numerator and/or the denominator assume negative value, the indices behave erratically and are difficult to interpret. The calculation of user benefits eliminates this problem entirely.

1.3.2 Local Fiscal Effort

Local funds are capital contributions derived from local and state governments including public transportation and other agencies. The degree of local fiscal effort is directly related to overall project merit:

1. Excess local matching funds enables more UMTA assistance for other projects.

2. Local matching funds are a measure of local commitment to the transit project.

3. Stable funding sources reduce the risk of future financial problems in operating the system.

Any local overmatch funds beyond the statutory minimum of 25 percent serves to make the transit project more attractive from the Federal viewpoint. Local funding for the MOS-2 alternative is close to fifty percent of costs.

1.3.3 Private Sector Funds

Private sector funds are a measure of local support for the project. Benefit Assessment Districts in the vicinity of Metro Rail stations are the principal source of private funds. The assessments generated annually will provide debt service on a bond issue, the proceeds of which will help fund construction activity. Private sector funds are considered part of the local fiscal effort in the cost effectiveness analysis.

1.3.4 Alternatives Analysis

One outcome of alternatives analysis is the potential cost effectiveness of project alternatives. These data are shown graphically to determine the "frontier" which serves to define the impact of increasing investment levels.

1.3.5 Disadvantaged Business Enterprises

Section 105 (f) of the Surface Transportation Assistance Act of 1982 requires 10 percent participation by Disadvantaged Business Enterprises (DBE). In the evaluation process, UMTA considers the extent to which this minimum may be exceeded.

1.3.6 Local Government and Community Support

One of the best indicators of local support is the extent of local contributions to the project by the funding partners as mentioned above. Other indicators of local support include the adoption of ordinances and policies in areas such as land use, parking, and zoning which will have a long term impact on improving the overall effectiveness of the project in achieving UMTA and regional objectives.

1.4 SUMMARY

The purpose of this report is to present the Cost Effectiveness Analysis for the second minimum operable segment of Metro Rail. This chapter provides brief background material on UMTA's objectives for transit projects and their methodology for evaluating the effectiveness of transit projects in achieving those objectives.

2. DATA COLLECTION

Most of the data required to implement the cost effectiveness methodology is used in calculating the indices of cost effectiveness. A relatively small amount of data is needed for the other five evaluation criteria.

The calculation of the current indices requires the accumulation of five data items including:

1. Annualized capital cost
2. Annual operating and maintenance costs
3. Annualized value of local capital match contributions
4. Annual ridership
5. Annual travel time savings for TSM (existing) riders.

A sixth data item, Annual User Benefits, is needed in calculating the revised indices. The concept of consumer surplus is employed in the determination of user benefits.

In general, the measurement of annual ridership, travel time savings, and hours of user benefits are calculated for the year 2000. Thus, the year 2000 trip tables are used to load the transportation system networks and to make the necessary forecasts for these data items. On the other hand, all cost information is expressed in December 1985 dollars.

The purpose of this chapter is to present both the methodology used to collect the data and the data which will be used in calculating the indices. The basic data have been developed through appropriate procedures and studies as detailed in the Urban Transportation Planning System (UTPS) with UMTA cooperation and concurrence.

2.1 NETWORKS

Essentially, three networks are of interest in a cost effectiveness analysis for a major transit project: the Committed network, the TSM network, and the Project network. The Committed network includes all components of the transportation network which are committed and which will be in service prior to the completion of the proposed project. The TSM network consists of the committed network plus a number of low capital cost improvements designed to improve traffic service in the corridor served by the proposed project. The Project network consists of the committed network and the proposed transit project.

2.1.1 Committed Network

The Committed network consists of the existing highway and freeway network, MOS-1 of Metro Rail, the Long Beach-Los Angeles light rail line, the Norwalk-El Segundo light rail line, and the Harbor Busway. The highway and freeway network will continue to handle the majority of trip-making in automobiles and in bus transit vehicles throughout Los Angeles and the surrounding counties of Ventura, Orange, San Bernardino and Riverside.

MOS-1 consists of 4.4 miles of heavy rail guideway in subway configuration extending from Union Station to the Wilshire/Alvarado intersection. Five stations are included in this initial section of Metro Rail. MOS-1 is under construction and is scheduled for revenue service in December 1992. Additional data and details relative to each transit component of the committed system are given in Appendix 1.

The Long Beach-Los Angeles light rail line extends from the Seventh/Flower station of Metro Rail to the intersection of First and Pacific in Long Beach. The line is more than 21 miles long and consists of 21 stations not including the Seventh/Flower Metro Rail station. This line is under construction and is scheduled to begin revenue service in 1991. The Norwalk-El Segundo light rail line extends from Norwalk in the median of the Century Freeway to near Los Angeles International Airport and then South towards El Segundo. The line is about 20 miles long and consists of 13 stations not including the Wilmington Station which is common to the Long Beach-Los Angeles light rail line. This line is under construction and is scheduled to begin revenue service in 1993.

The Harbor Busway is an exclusive transitway extending from downtown Los Angeles near the Central Business District along the Harbor Freeway South to a transit center at Artesia Boulevard. The transitway is about 12 miles in length, is under construction and is scheduled to open concurrently with the Norwalk-El Segundo Light Rail Line and the Century Freeway.

2.1.2 TSM Network

The TSM Network is the base network against which the effectiveness of the proposed transit project will be measured. The TSM network consists of all elements of the Committed network plus a number of TSM improvements. TSM improvements are low capital cost projects designed to improve traffic conditions for auto and bus operations. The improvements and bus route modifications are described in Appendix 2.

Improvements consist of left turn prohibitions at certain intersections, implementation of reversible lanes on portions of some streets, implementation of computerized signal control systems along several arterial streets and the construction of transit centers at Universal City and Hollywood/Cahuenga.

2.1.3 Project Network

The Project network consists of the committed network plus the major transit project under analysis. The new project used as an example in this analysis is MOS-2B of Candidate Alignment 4. MOS-2B extends Metro Rail in subway configuration from Wilshire/Alvarado to Wilshire/Vermont and then north along Vermont Avenue. The line emerges in aerial configuration just north of Wilshire and continues along Vermont until it turns west at Sunset Boulevard. The line returns to subway configuration just East of the Sunset/Vine station and continues in a Northwesterly direction to Universal City. MOS-2B is about 9.5 miles in length and includes 8 stations. Additional data and details relative

to this network are included in Appendix 3. However, similar data are developed for other alternatives and are presented in this report.

In the cost effectiveness analysis, the Project network involving a substantial investment in transit is compared to the TSM network involving a relatively modest investment in several traffic improvements. Note that the approximately $2.42 billion of rail transit construction now underway is considered part of the Committed system and does not enter into the cost effectiveness analysis of MOS-2, the new start rail project.

2.2 TRIP TABLES

Trip tables for the Los Angeles region are supplied by the Southern California Association of Governments (SCAG). SCAG used the Los Angeles Regional Transportation Study (LARTS) traffic zone system in presenting the trip tables. LARTS consists of 1,325 zones which cover all of Los Angeles County and the contiguous metropolitan areas of Ventura, San Bernardino, Orange and Riverside Counties. These 1,325 zones represent a 1980 population of 11.2 million people and a projected 2000 population of 14.9 million people. An average of 38 million person trips per day are estimated for 1980. The LARTS zone system is not fine-grained enough to do adequate rail transit planning. Thus, it is necessary to subdivide traffic zones in the vicinity of potential rail links. The subdivision of zones resulted in a total of 1,628 traffic zones for rail transit planning purposes. SCAG developed an extensive data base for each traffic zone consisting of a variety of demographic and socioeconomic characteristics. These data are used to develop estimated trip generation rates for each traffic zone and subsequently to distribute these generated trips over the trip attracting zones. The output of these models is validated with screen line counts. Trip tables are available for 1990 and 2000 for zone to zone trip interchanges for three trip purposes:

1) Home to work trips
2) Other to work trips
3) All other trips

Each trip table is a matrix consisting of 1,628 rows representing the "from zones" (zone i) and 1628 columns representing the "to zones" (zone j). The intersection of a row and column is a cell representing the trip interchanges from zone i to zone j. There are 2,650,384 cells in each matrix. The trip tables are down-loaded to the transit-highway network under analysis. The network is characterized mathematically as a series of links. Each link is described by its two end nodes, length, speed, and other descriptors needed to fully analyze the link as a component of a potential trip path. In simplest terms, nodes represent intersections or stations and links represent the length of street or guideway between the intersections or stations.

The estimated trip interchanges between a given zone pair are assigned to a series of links connecting the zones. The series of links which represent the zone to zone trip path is selected on the basis of a minimum time path between zones or some other criterion. The demographic and socioeconomic characteristics of a zone are incorporated into a modal split model to estimate the proportion of trips made by transit. When all trip assignments

are completed, the total trips assigned to individual links may be well beyond the capacity of the link. In this event, a capacity restraint assignment model may be used to assign trip overloads to alternative routes. This brief description of the process is not meant to downplay the complexity of the process. All the models are part of the Urban Transportation Planning System (UTPS) of UMTA and installed on a mainframe computer. An enormous number of calculations are required to solve each component of the process. Thus, although the data required to compute travel time savings and user benefits are determined in the normal "routine" of the process, an extraordinary amount of effort and computer time is required to generate the requisite data.

Trip end data at transit stations are analyzed by mode of arrival models to determine the distribution of arrivals by walking, park-and-ride, kiss-and-ride, and feeder buses. The appropriate manipulation of the input and output data enable the calculation of many descriptive statistics such as numbers of linked and unlinked transit trips, the calculation of transit fare box revenue, the determination of travel time savings and an estimate of the equivalent hours of user benefits.

2.3 ANNUALIZED CAPITAL COSTS

The conversion of the capital cost of a project to an equivalent annualized capital cost is carried out according to UMTA Guidelines for Cost Effectiveness analysis. The annualized cost of a capital cost item is computed by multiplying the constant dollar cost of the item by the capital recovery factor. The magnitude of the capital recovery factor is a function of the discount rate and the economic life of the item. The discount rate for all Federally funded projects is fixed at 10 percent. UMTA's guidelines include a set of recommended economic lives for various capital cost items:

o Right-of-Way	100 years
o Rail Vehicles	25 years
o Buses	12 years
o Rail Guideway and Components	30 years
o Contingencies, Design, Insurance	Prorated

The contingencies, design, and insurance costs are included as add-on items for cost estimate purposes. The add-on items are assumed to take the life of the cost item to which they apply when calculating annualized costs.

The capital recovery factor is calculated as follows:

$$CRF(i,n) = [i*(1+i)^n]/[(1+i)^n-1]$$

where i is the discount rate and n is the economic life.

2.3.1 New Project Cost

The constant dollar cost estimate of MOS-2B of Candidate Alignment 4 is $1,132,152,000 in December 1985 dollars. The annualized cost of this alternative is calculated as follows:

1. Right-of-Way.
   The constant dollar cost of right-of-way is estimated as $126,500,000. A contingency of 30 percent is included in this cost. The CRF (10%, 100 years) of 0.10000726 is multiplied by the total cost to yield an annualized ROW cost of $12,651,000.

2. Rail Vehicles.
   The constant dollar cost of rail vehicles is estimated as $54,600,000. A management fee of 5 percent and an insurance fee of about 4.4 percent are added. Other add-on fees do not apply because a contract is in effect for vehicle purchases for MOS-2. The total cost of rail vehicles is computed as $59,750,000. The CRF (10%, 25 years) of 0.110168 is multiplied by the total cost to yield an annualized rail vehicle cost of $6,583,000.

3. Rail Guideway and Components.
   Subtraction of the total cost of ROW and Rail Vehicles from the Total Project cost yields the total cost of rail guideway and components. The total cost of rail guideway in thus $945,902,000. The CRF (10%, 30 years) of 0.106079 is multiplied by the total cost to yield and annualized guideway and components cost of $100,340,000.

4. Total Annualized Cost
   The total annualized cost of the rail project is the sum of the three capital cost items considered which is $119, 574,000.

2.3.2 TSM Improvement Costs

The cost estimates for TSM improvements are listed in Table 2.1. The total cost of all improvements if $5,075,000. An average economic life for these suggested improvements is about ten years. The CRF (10%, 10 years) of 0.16275 is multiplied by the total cost to yield an annualized TSM improvement cost of $826,000.

2.4 ANNUAL OPERATING AND MAINTENANCE COSTS

Models for computing annual operating and maintenance (O&M) costs for bus and Metro Rail transit systems have been developed by the SCRTD. Complete UTPS simulations are performed for the TSM and Project networks. Values for the bus cost model variables are read from the UTPS output and the O&M costs calculated.

TABLE 2-1
TRANSPORTATION SYSTEM MANAGEMENT
ALTERNATIVE TO MOS-2 TRANSPORTATION NETWORK
CAPITAL COST ESTIMATE IN CONSTANT DOLLARS FOR
ANTICIPATED IMPROVEMENTS

I. LEFT TURN PROHIBITIONS	
A. 7th Street from Alvarado Street to Harbor Freeway	
Capital cost estimate: $4,500/Intersection (1 intersection)	$ 4,500
B. Olympic Boulevard from San Pedro St. to La Cienega Blvd.	
Capital cost estimate: $4,500/Intersection (25 intersections)	$ 112,000
Subtotal	$ 116,500
II. REVERSIBLE LANES	
A. Olympic Boulevard from San Pedro Street to La Cienega Blvd.	
Capital cost estimate: $125,000/mile (1.8 miles)	$ 225,000
Subtotal	$ 225,000
III. COMPUTERIZED SIGNAL CONTROL SYSTEM	
A. Olympic Boulevard (25 intersections)	
Capital cost estimate: $50,000/Intersection	$1,250,000
B. Wilshire Boulevard (15 intersections)	
Capital cost estimate: $50,000/Intersection	$ 750,000
C. Cahuenga Boulevard (6 intersections)	
Capital cost estimate: $65,000/Intersection	$ 390,000
Subtotal	$2,615,000
IV. BUS ROUTE DIVERSION	
A. Relocate approximately 15 routes	
Capital cost estimate	$ 7,500
Subtotal	$ 7,500
V. CONSTRUCTION OF TRANSIT CENTERS (5 bus bays, 5 kiss & ride/ dropoffs and a passenger waiting shelter)	
A. Universal City	
Capital cost estimate	$ 250,000
B. Hollywood/Cahuenga Boulevard	
Capital cost estimate	$ 250,000
Subtotal	$ 500,000
Total Capital	$3,464,000
VI. ADD-ON PERCENTAGES	
A. Design and Construction Management (15% of $3,464,000)	$ 519,600
B. Agency Fees (9% of $3,464,000)	$ 311,760
C. Insurance Fees (7.5% of $3,464,000)	$ 260,000
Subtotal	$4,555,360
D. Contingency (15% of $3,464,000)	$ 519,600
Subtotal	$5,074,960

The annual estimates of O&M costs are for year 2000 trip interchanges but expressed in December 1985 dollars. The annual O&M costs for bus operation in the TSM network are $542,600,000 while they are $539,900,000 for the Project network. Annual O&M costs for MOS-1 of Metro Rail are estimated at $15,400,000 by SCRTD. An O&M cost of $30,900,000 is the estimate for MOS-1 and MOS-2B of Metro Rail. All O&M costs are taken directly from Table 4-4 of the Draft Final SEIS/SEIR (July, 1988). There is assumed to be no difference in annual O&M costs for the Long Beach-Los Angeles and Norwalk-El Segundo light rail lines between the TSM and Project network configurations.

2.5 ANNUALIZED LOCAL, STATE, PRIVATE FUNDING

The Cost Effectiveness procedure as outlined in UMTA guidelines requires a determination of the non-Federal or local share of the New Project cost. This cost differentiation permits the calculation of a Federal cost effectiveness index as well as a total (societal) cost effectiveness index. The procedure outlined below generally follows UMTA guidelines for determining the local share.

The constant dollar cost of MOS-2B is estimated at $1,132,152,000 in December, 1985 dollars. The current dollar cost is $1,441,908,000 if one makes the following assumptions:

- Escalation rate of four percent annually.
- A construction duration of seven years.
- A standard construction curve.
- Open to revenue service in FY 1996.

The Federal share of this project is projected at 0.685 of the total while the local share is 0.315 of the total. The Federal share of 0.685 is derived from the Final FEIS of 1983. Section 3 and Section 9 involvement in the 1983 LPA is listed as $2,099 million and $215.0 million respectively. The total of $2,314 million amounted to 68.5% of the total project cost of $3,384 million. The same percentage participation is assumed as the starting point in this analysis. The application of these same share percentages to the constant dollar cost results in the following distribution of costs:

- Local share.....$356,628,000 constant dollars
- Federal share...$775,524,000 constant dollars

However, UMTA does not participate in the cost of rail vehicles. The constant dollar cost for rail vehicles is established in Section 2.3.1 as $59,750,000. Thus, the local share of the non-vehicle portion of MOS-2B is $296,878,000. The revised initial shares for local and Federal participation are computed as 0.2768 and 0.7232 respectively for non-vehicle costs.

The annualized capital cost of the three capital cost components are developed in Sections 2.3.1:

o	Facilities and Systems	$100,340,000
o	Right-of-Way	$ 12,651,000
o	Rail Vehicles	$ 6,583,000

The annualized value of the local match is the annualized capital cost times the local share and summed over all cost elements. In the event that a local overmatch is proposed for the initial investment, the local match for replacement costs at the end of the economic life of a cost element will generally be lower than the overmatch. In this case, it is necessary to calculate an average or composite local match as follows:

$$P = P1 - (P1-P2)[1/(1+i)]^n$$

where: P = average local match percent
P1 = initial local match percent
P2 = replacement local match percent
i = discount rate
n = economic life of cost element.

This easily derived expression is equivalent to reducing the initial local match percent by the present value of the change in local match percent at the time of replacement.

The initial local match is 0.2768 for the right-of-way and facilities and systems cost elements. After an economic life of thirty years for facilities and systems, the local match, P2, is assumed to be the minimum value of 0.25. The right-of-way will not have to be replaced so that P2 is 0.00. The initial local match for rail vehicles is 1.00 and the minimum value of 0.25 is assumed for P2. The development of composite local matches and the sequence of calculations is shown in Table 2.2. The annualized local shares are $27.62 million for facilities and systems, $3.50 million for right-of-way, and $6.13 million for rail vehicles. The total average local share is $37.25 million which is 31.15 percent of the total annual cost. The local share for the non-vehicle portion was determined to be 0.2754.

2.6 ANNUAL TRANSIT RIDERSHIP

The output of a UTPS simulation for a given trip table - network pairing includes information on linked transit trips. In the pairing of the 2000 trip table and the TSM network, transit ridership estimates are 331,000 HBW (Home Based Work) trips per day

TABLE 2.2
COMPOSITE LOCAL MATCHES
CALCULATIONS

	CAPITAL COST $000,000	LIFE N YEARS	CRF I= 10%	ANNUAL COST $000,000	LOCAL SHARE INITIAL P1	LOCAL SHARE SUBSEQUENT P2	LOCAL SHARE COMPOSITE P	ANNUAL LOCAL SHARE $000,000
FACILITY--SYSTEM	945.902	30	0.106079	100.34	0.2768	0.25	0.2753	27.62
RIGHT-OF-WAY	126.500	100	0.100007	12.65	0.2768	0.00	0.2768	3.50
RAIL VEHICLES	59.750	25	0.110168	6.58	1.0000	0.25	0.9308	6.13
TOTAL	1,132.152			119.57				37.25
						LOC SHARE=	0.3115	

and 1,099,000 HOOOOW (Home to Other, Other to Other, Other to Work) trips per day. Linked daily ridership is converted to linked annual ridership:

331,000 HBW Trips/day * 255 = 84,405,000 HBW Trips/Year
1,099,000 HOOOOW Trips/day * 439.5 = 483,010,000 HOOOOW Trips/Year
Total Linked Trips = 567,415,500 per Year

The factor, 255, is based on 255 work days per year on which Home-Based Work trips are made. The factor, 439.5, is derived on the basis of off-peak travel during weekdays and extended travel periods on weekends. It may be interpreted as the equivalent of 439.5 typical weekdays per year as such a typical weekday is defined in a UTPS simulation.

In the pairing of the Year 2000 trip table and the Project network (MOS-2B of Alignment 4), transit ridership estimates are 605,800 HBW trips per day and 1,074,900 HOOOOW trips per day. Linked daily ridership is converted to linked annual ridership:

605,800 HBW Trips/day * 255 = 154,479,000 HBW Trips/year
1,074,900 HOOOOW Trips/day * 439.5 = 472,419,000 HOOOOW Trips/Year
Total Linked Trips = 626,898,000 per Year

2.7 ANNUAL TRAVEL TIME SAVINGS

One anticipated benefit of any transit project is a savings in travel time for transit patrons. In the cost effectiveness methodology, travel time savings are computed for those transit patrons who would exist with the TSM network. When the UTPS simulation is performed with the Year 2000 trip table and TSM network, the matrices defining transit link travel volumes and the transit link travel times are saved. These same matrices are saved for the simulated pairing of the trip table and the New Project network. For a particular origin-destination pair, four quantities may be observed:

T(TSM); Travel time on the TSM network
T(NP); Travel time on the NP network
R(TSM); Riders on the TSM network
R(NP); Riders on the NP network

Thus, changes in travel time and ridership that result from the development of a new transit project may be calculated for a given trip interchange. The change in travel time is measured on the basis of door-to-door travel times such that both in-vehicle and out-of-vehicle travel times are included.

The value of travel time varies with trip purpose. The SCRTD has grouped trips into two purpose categories:

Home Based Work Trips - HBW
Home to Other, Other to Other, and Other to Work Trips - HOOOOW

Thus, travel time savings are calculated for each origin-destination pair separately for each trip purpose. This calculation is simplified by UMTA's assumption that all work trips occur in the peak hour with peak period travel times and that all non-work trips occur in the off-peak with off-peak period travel times. The total travel time savings for a given alternative are computed as the number of transit trips in the TSM alternative times the reduction in travel time, summed over all origin-destination pairs:

Eq.1; Time Saved = R(TSM)*[T(NP)-T(TSM)]

However, there are certain origin-destination pairs for which travel time increases. In general, this results in a decrease in riders due to conversion to other travel modes such as the automobile. The increases in travel times for those riders remaining on transit are computed as the number of transit trips in the NP alternative times the reduction in travel time, summed over all origin-destination pairs:

Eq.2; Time Lost = R(NP)*[T(NP)-T(TSM)]

The procedure for calculating travel time savings is summarized in the following decision rule:

TTS = (If T(NP)<T(TSM), Eq. 1)
(If T(NP)>T(TSM), Eq. 2)

summed over all origin-destination pairs, first for HBW trips and second for HOOOOW trips.

This procedure proves inaccurate when applied to the Los Angeles regional transit system. In comparing the matrices for certain origin-destination pairs, the following situations are observed frequently:

1) Travel time decreases but ridership decreases as well.
2) Travel time increases but ridership increases as well.

Reasons for this seeming inconsistency are related to interactions with the background bus network assumed for each new project alternative and the mode choice model developed for Los Angeles. The decision rule for calculating travel time savings is modified as follows:

NO! due largely to the failure of reflect cost in path building !

TTS = (If R(NP)>R(TSM), Eq. 1)
(If R(NP)<R(TSM), Eq. 2)

summed over all origin-destination pairs, first for HBW trips and second for HOOOW trips. The summation must be performed in strict accordance with the sign of the travel time difference.

The modified procedure follows UMTA guidelines but takes into account travel time-ridership interactions that are significant in the Los Angeles region. These interactions are

illustrated in Figure 2.1 which shows an idealized relationship between a travel time-ridership curve and a demand function. Each origin-destination pair investigated will fall into one of the four areas highlighted in Figure 2.1. The intersection of the demand curve with the TSM time-rider curve fixes the values of T(TSM) and R(TSM). The intersection of the demand curve with the NP time-rider curve fixes the values of T(NP) and R(NP). Areas 1 and 2 of Figure 2.1A correspond to the two cases in the UMTA guidelines while areas 3 and 4 of Figure 2.1B correspond to the two cases added for the Los Angeles region. Areas 1 and 4 result in travel time savings and are calculated by Equations 1 and 2 respectively. Areas 2 and 3 result in travel time increases and are calculated by Equations 2 and 1 respectively.

The results of a set of calculations for MOS-2B of Candidate Alignment 4 are illustrated below. Annual travel time savings are:

- HBW Linked Trips
  38,038 person hours/day * 255 = 9,699,700 person hours/year
- HOOOOW Linked Trips
  9,304 person hours/day * 439.5 = 4,089,100 person hours/year

Threshold value, not value of travel time

However, the methodology requires that travel time savings be expressed in dollars. The UMTA guidelines suggest a time value of $12 per hour. The value of travel time savings for work trips is assumed to be one-third of the time value or $4.00 per hour. The value of travel time savings for non-work trips is assumed to be one-sixth of the time value or $2.00 per hour. The dollar value of travel time savings is calculated:

What does this rationale come from

- HBW Linked Trips
  9,699,700 person hours/year * $4/hour = $38,798,800/year
- HOOOOW Linked Trips
  4,089,100 person hours/year * $2/hour = $8,178,200/year
- Total Travel Time Savings $46,977,000/year

This savings is projected for Year 2000 transit travel in terms of 1986 constant dollars.

In the analysis of cost effectiveness presented in this report, the values of travel time savings used are those calculated according to UMTA Guidelines. The impact of the suggested correction for Los Angeles is shown in Appendix 4.

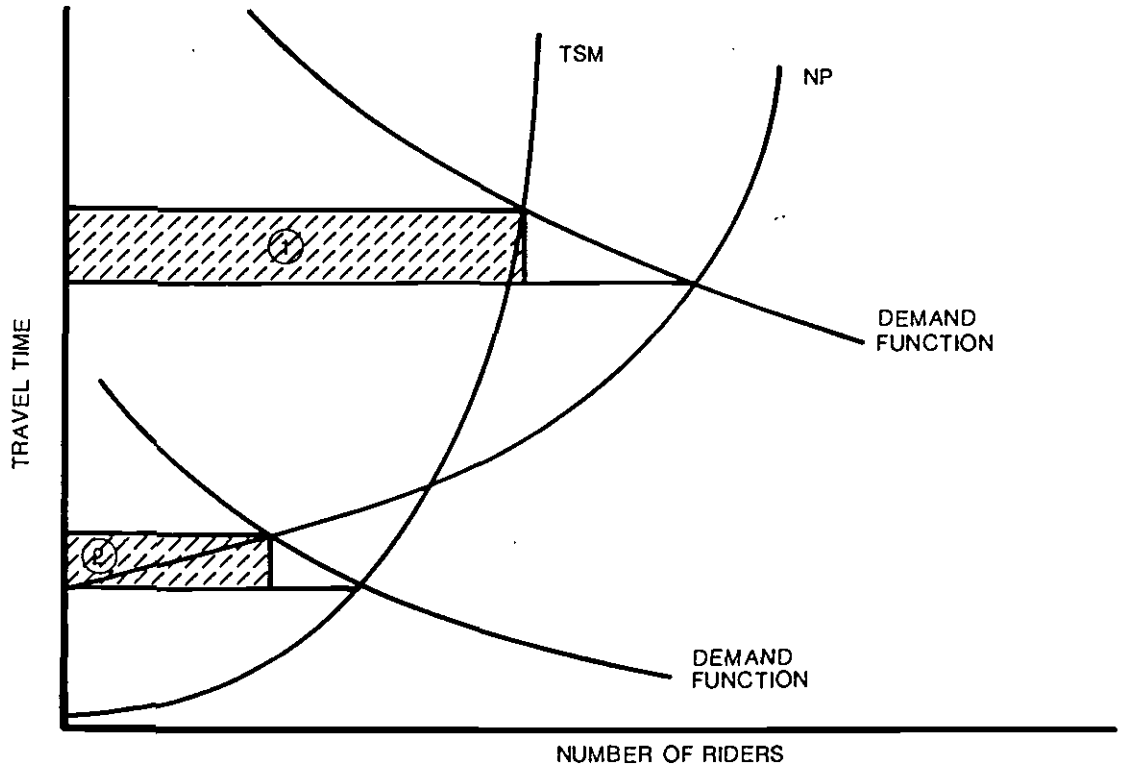


FIGURE 2.1A. TRAVEL TIME SAVINGS--STANDARD CASES

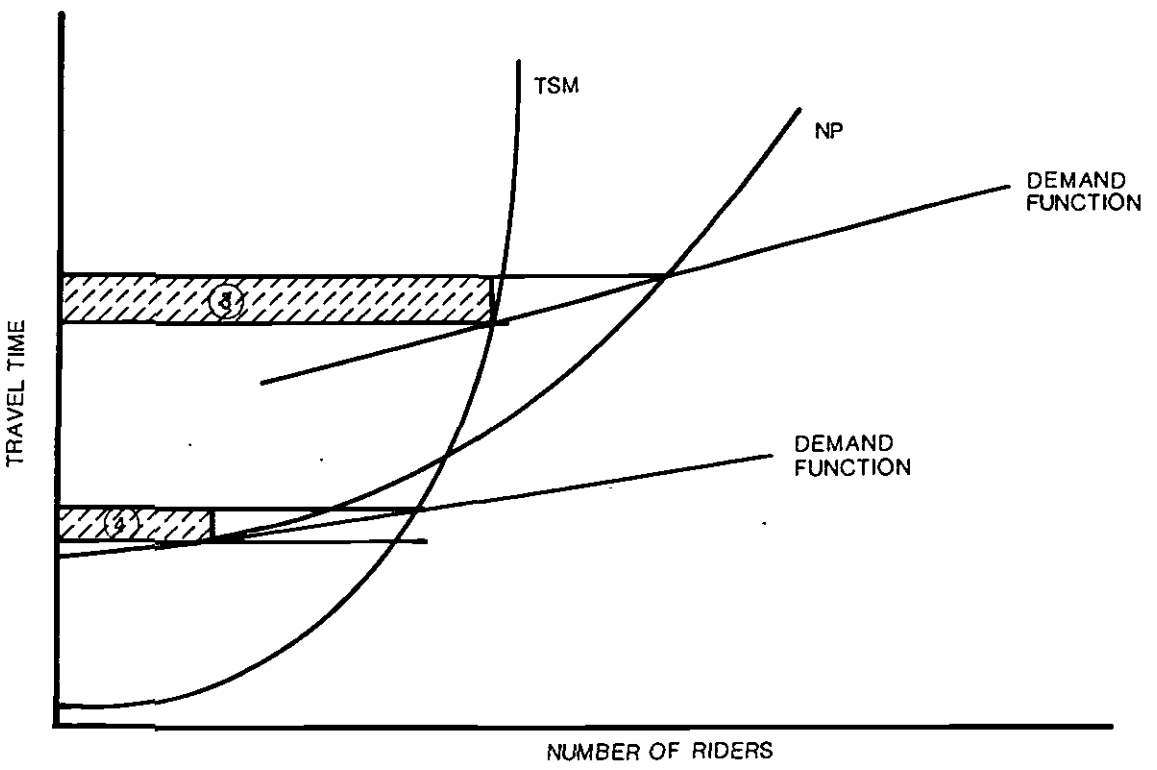


FIGURE 2.1B. TRAVEL TIME SAVINGS--ADDITIONAL CASES

FIGURE 2.1. TRAVEL TIME SAVINGS: NP VS. TSM

2.8 ANNUAL USER BENEFITS

The method of determining benefits of a new transit project results in problems with the calculation and interpretation of cost effectiveness indices. Benefits to existing users are measured in terms of travel time savings expressed in dollars while benefits to new users are measured in terms of trips. A revised approach in which benefits are expressed in common units for all patrons is preferred. An approach suggested by micro-economic theory is the measurement of change in "consumer surplus."

The generalized price of transit includes all perceived costs including the fare, travel time, transfer time and fees, parking charges, etc. At a price, P_o, for transit service between two points, R_o riders will be attracted to the transit mode. In the typical price demand relationship, the number of riders will decrease if the price goes up but ridership will increase if the price goes down. The addition of a new transit project will result in time savings for existing transit riders and the associated decrease in perceived price will result in additional riders attracted to transit.

The benefits to existing riders are evident in Figure 2-2. Each existing rider now pays P_o in exchange for the benefits of a transit trip. When the new transit project is in operation, the price to each existing rider would be only P_1 for essentially the same benefits. Each existing rider has a savings or surplus of (P_o-P_1). The total savings for existing riders are:

$$\text{Benefits (Existing Riders)} = (P_o-P_1) * R_o$$

These savings are represented by the shaded rectangle in Figure 2-3. These benefits are similar to the travel time savings for existing riders discussed in Section 2.7.

The benefits to new riders may be visualized by referring to Figure 2-2. A new rider is attracted to transit when the total perceived price or disutility of transit becomes equal to or less than the total perceived price or disutility of the alternative transport mode, generally a private automobile. Thus, the first new rider attracted to transit will realize a total savings of (P_o-P_1) but the last new rider attracted will realize no savings at all. The average new rider realizes a savings of $(P_o-P_1)/2$.

The total benefits for new riders are the average savings per new rider times the number of new riders:

$$\text{Benefits (New Riders)} = [(P_o-P_1)/2]*(R_1-R_o)$$

These savings are represented by the shaded triangle in Figure 2.3.

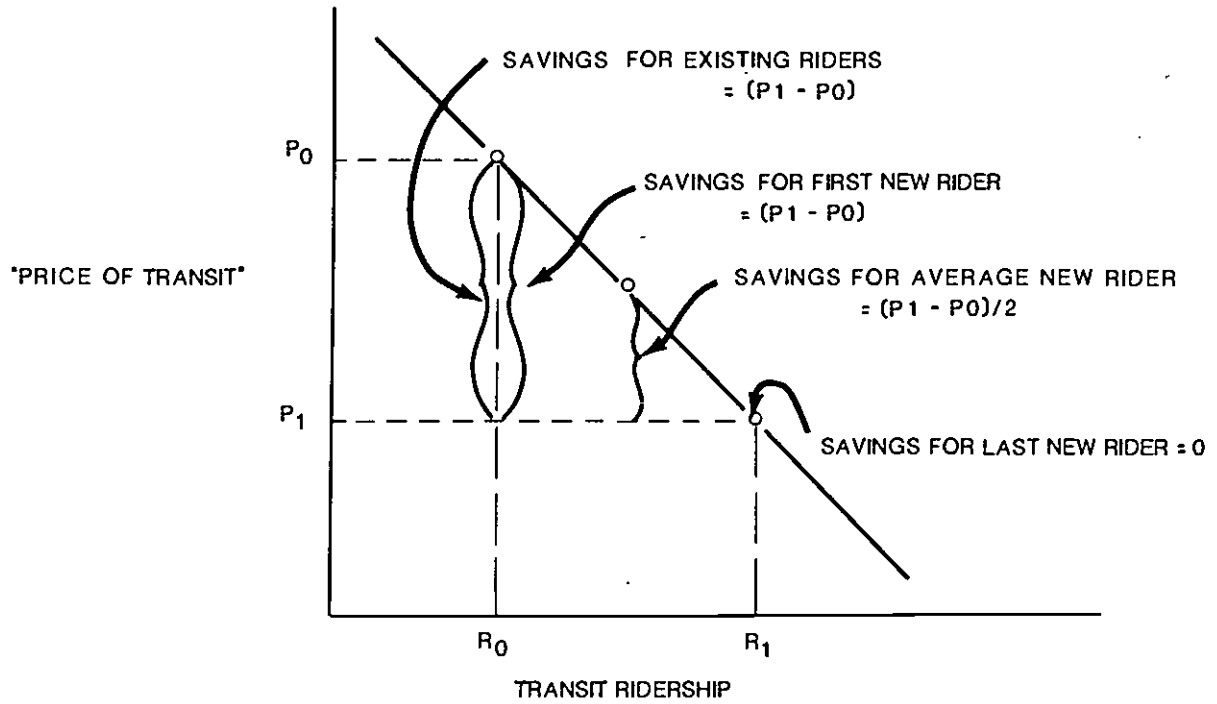


FIGURE 2.2
BENEFITS TO THREE INDIVIDUALS

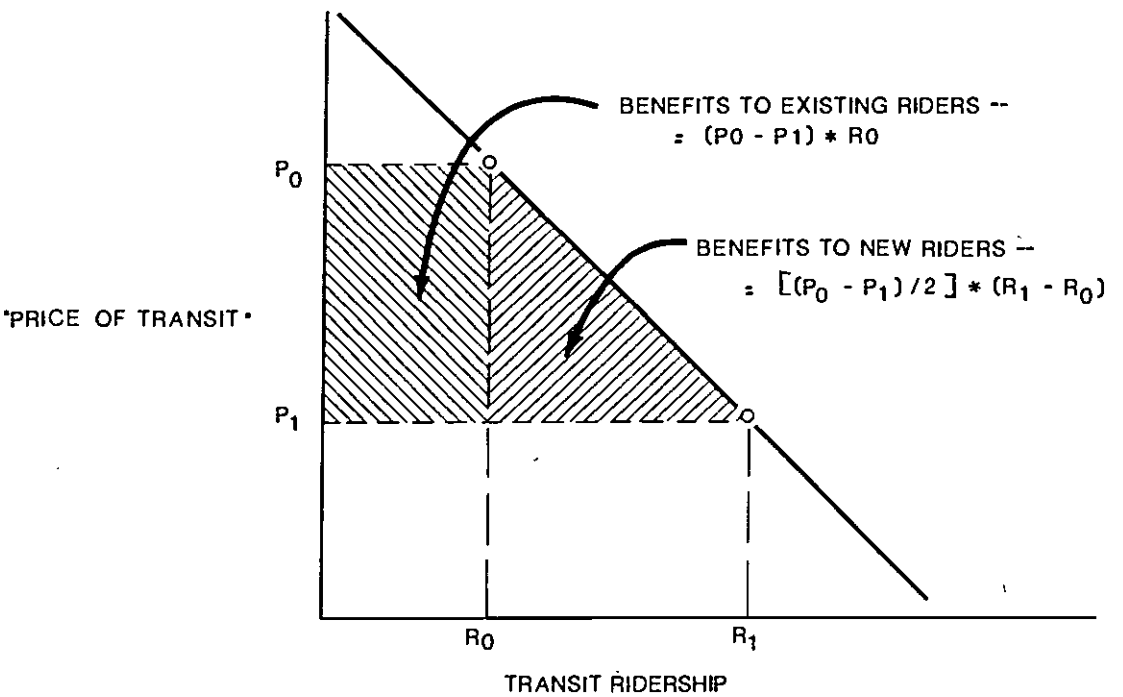


FIGURE 2.3
COMPONENTS OF CONSUMER SURPLUS

Total benefits due to the new transit project are the sum of benefits to existing and new riders:

$$\text{Benefits (Total)} = (P_o - P_1)^* R_o + [(P_o - P_1)/2]^* (R_1 - R_o) \quad (1)$$

which reduces to:

$$\text{Benefits (Total)} = (P_o - P_1)^* [R_o + R_1)/2] \quad (2)$$

Although this is the basic expression for the calculation of user benefits, several issues relative to its application must be resolved:

1. Units of Consumer Surplus. Hours of user benefits are preferred because the most common savings between alternatives is in travel time. The fare structure often is consistent between alternatives so that savings due to fares do not occur for most riders. The use of hours permits cost effectiveness indices to be expressed in cost per hour of benefits as opposed to unitless indices of dollars of cost per dollar of benefits.

2. Value of Travel Time. The price of transit travel must be expressed in terms of equivalent hours of travel time. The value of in-vehicle travel time for work trips is assumed to be $4.00 per hour. The value of in-vehicle travel time for non-work trips is assumed to be one-half the value for work trips. The value of out-of-vehicle travel time for either purpose is twice that of in-vehicle travel time for the same purpose.

3. Transit Networks Compared. For all the data collected to this point, differences between the Project Network and the TSM Network are considered. However, UMTA guidelines suggest that for user benefits, the Project Network be compared to the Do-Nothing Network. The Do-Nothing Network is identically the Committed Network as defined in Section 2.2.1. It does not include any TSM improvements. However, in this analysis the TSM network is used in the calculation of user benefits. The difference between the Do-Nothing and TSM networks on transit ridership is quite limited and difficult to evaluate. The use of the TSM network is regarded as conservative in that its use would tend to understate the magnitude of user benefits if there is any discernible impact between the Do-Nothing and TSM networks on transit ridership.

The expressions for transit price measured in equivalent hours of work trip travel time are:

$$TP_w = IVT_w + 2*OVT_w + FARE_w/\$4.00/hour$$

$$TP_{nw} = 0.5 * IVT_{nw} + OVT_{nw} + FARE_{nw}/\$4.00/hour$$

where:

TP	=	Transit Price
IVT	=	In Vehicle Travel Time
OVT	=	Out-of-Vehicle Travel Time
FARE	=	Transit Fare, Transfer Fee, Parking Costs, Other Costs
W	=	Work Trip Purpose
NW	=	Non-Work Trip Purposes

User benefits are calculated separately for work trips which are assumed to occur in the peak period and for non-work trips which are assumed to occur in the off-peak period. Work trip benefits are computed for each trip interchange pair and summed over the region. The same step is carried out for non-work trips.

Just as in the case for travel time savings, the procedure proves inaccurate when applied to the Los Angeles regional transit system. The trip interchanges in which travel time decreases while ridership decreases and in which travel time increases while ridership increases must be accounted for to adequately reflect user benefits. These trip interchanges are illustrated in Figure 2.4 which shows idealized supply demand curves for the New Project and TSM transit networks. Each trip interchange is characterized by unique supply demand functions and will fall into one of the 4 cases illustrated in Figure 2.4.

The two standard cases are shown in Figure 2.4A. Area 1 indicates that 118,000 existing riders will experience 4,348,000 equivalent in-vehicle travel time minutes of user benefits per day. Area 2 indicates that 305,000 new riders will experience 8,355,000 equivalent minutes of user benefits. Areas 5 and 6 represent existing and new riders with reductions in user benefits. Areas 3 and 4 represent remaining and lost riders with reductions in user benefits while Areas 7 and 8 represent remaining and lost riders with increases in user benefits.

The numerical values for riders and user benefits which appear in Figure 2.4 represent the calculation results for MOS-2B of Candidate Alignment 4. The summation of Areas 1 through 8 yield 485,900 riders experiencing 13,112,200 equivalent in-vehicle travel time minutes of user benefits per day for HBW trips. Similar calculations for HOOOOW trips yield 350,400 riders experiencing -220,600 equivalent minutes of user benefits per day. The estimated annual hours of user benefits are calculated as follows:

1. Home Base Work Trips
   13,112,200 min/day = 218,537 hours/day
   218,537 * 255 days = 55,726,850 hours of benefits per year

FIGURE 2.4. USER BENEFITS: NP VS. TSM

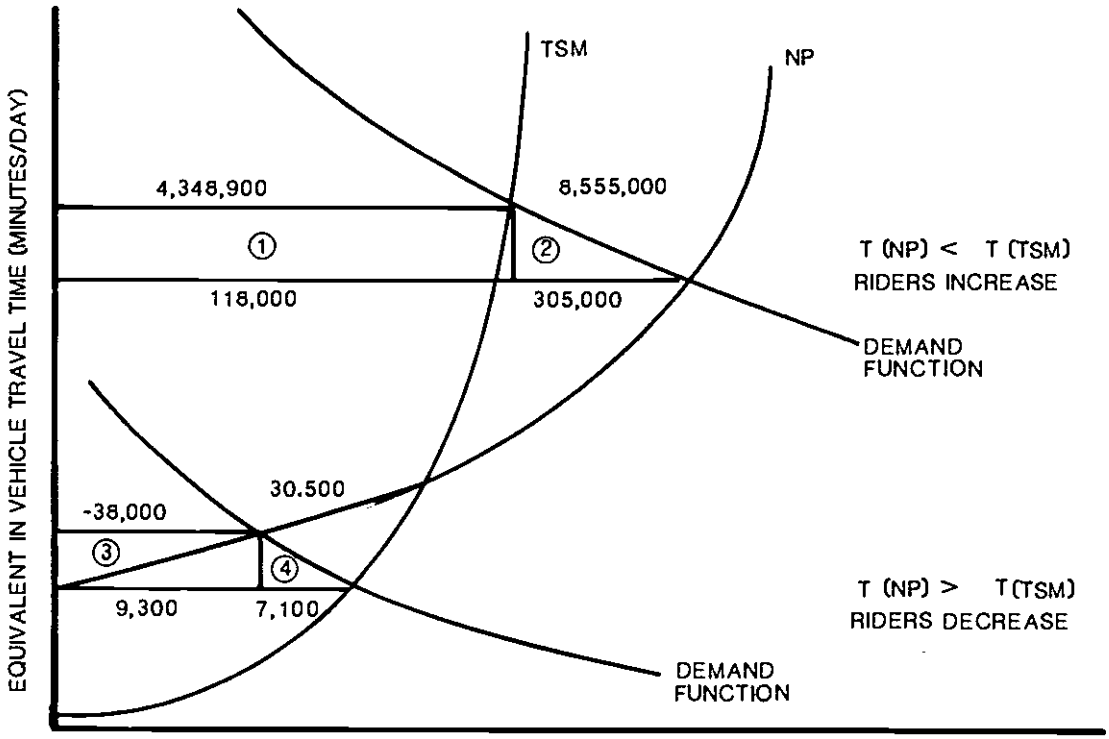


FIGURE 2.4A. USER BENEFITS - STANDARD CASES

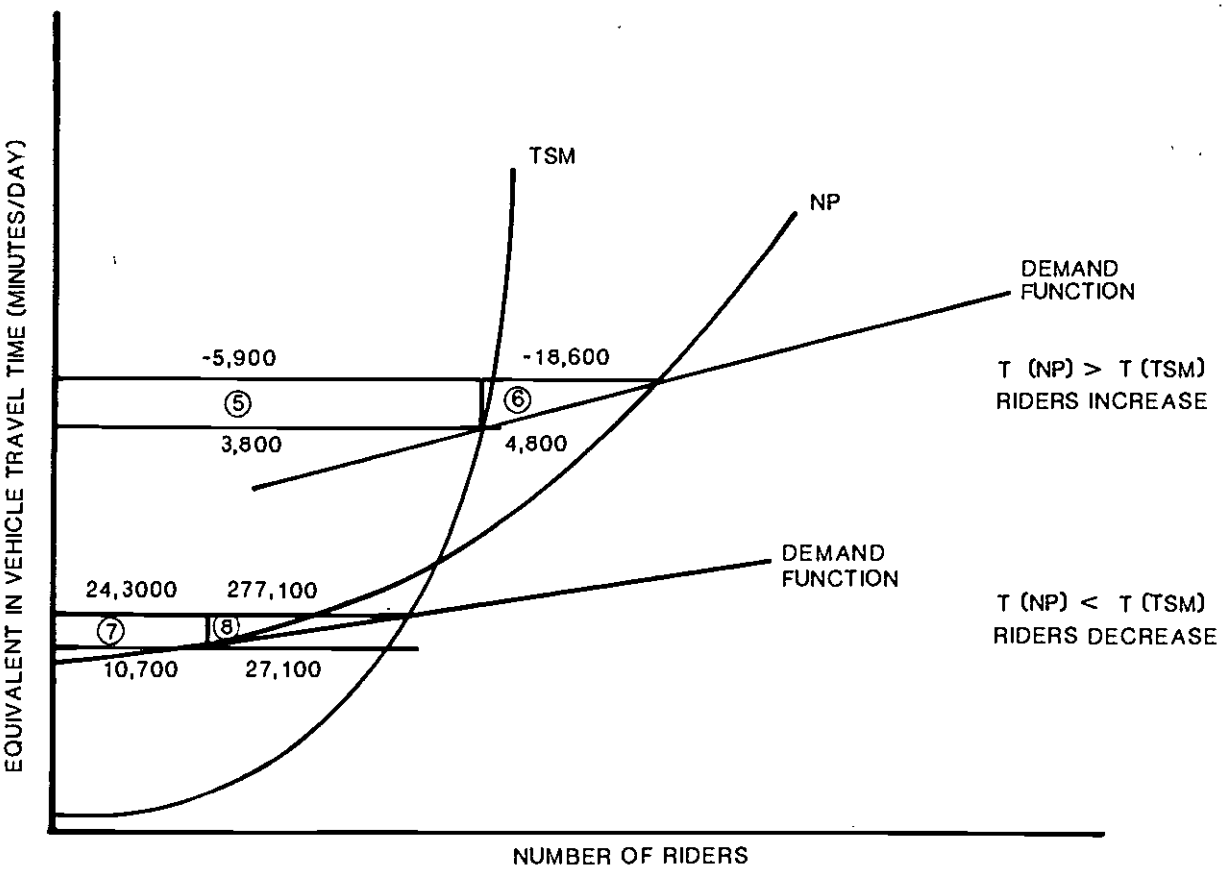


FIGURE 2.4B. USER BENEFITS - ADDITIONAL CASES

2. Home to Other, Other to Other, Other to Work Trips

-220,600 min/day = -3,677 hours/day
-3,677 * 439.5 days = -1,615,900 hours of benefits per year

3. Total User Benefits

54,111,000 hours of benefits per year

Just as for travel time savings, the values of user benefits used in preparing this report are those calculated in accordance with UMTA Guidelines. The impact of the suggested correction for Los Angeles is shown in Appendix 4.

2.9 SUMMARY

The transit networks used in this cost effectiveness analysis have been described. Additional details on the networks are in Appendices 1, 2, and 3.

The data necessary to compute cost effectiveness indices have been discussed in this Chapter. The rationale behind the data, the methodology for accumulating the data, the background for any calculations, and the computed values of each data item are included in the discussion.

3. COST EFFECTIVENESS INDICES

Cost effectiveness as applied to new transit projects is a measure of the extent to which an alternative returns benefits relative to its costs. The implication is clear that cost effectiveness is measured in terms of the added benefits and costs of a proposed project to some lower cost option. The lower cost option for cost effectiveness analysis is most often the Transportation System Management (TSM) alternative. As described earlier in this report, the TSM alternative includes all components of the Committed transit program plus a variety of low cost improvements within the corridor(s) to be served by the new transit project. Low cost improvements are designed to upgrade transit and highway service through operational and physical modifications.

The expressions for the calculations of indices are presented in the next sections. Calculations are illustrated with the data developed in the text of Chapter 2 for MOS-2B of Candidate Alignment 4. Cost Effectiveness Indices for the candidate alignments and operable segment options are presented in Sections 3.4 and 3.5 of this Chapter. The Cost Effectiveness Indices of Phase II of the Locally Preferred Alternative are presented in Section 3.6.

3.1 ORIGINAL INDICES

The cost effectiveness indices as published originally by UMTA and which are still in force are expressed in terms of cost per new rider. Two indices are used to provide two perspectives on a proposed new transit project, the Federal perspective and the Societal perspective.

3.1.1 Federal Index

The Federal perspective involves only the Federal funds needed for the project. However, the Federal funds are compared to total project benefits. The Federal funds required for the Project are calculated by subtracting the annualized value of all non-Federal funds from the annualized capital cost of the project. The index which represents the Federal perspective is given:

$$F.I. = \frac{d\$CAP + d\$O\&M + d\$TTS - d\$LOC}{dRIDERS}$$

where the d's represent differences in costs and benefits compared to the TSM alternative and:

$CAP =	Total capital costs, annualized over the life of the project
$O&M =	Annual operating and maintenance costs;
$TTS =	Annual value of traveltime savings for existing riders;
$LOC =	Annualized value of State, local, and private capital funding;
RIDERS =	Annual transit ridership, measured in linked trips.

All data requisite to the calculation of the indices are discussed in Chapter 2. In every case, the difference is calculated as New Project (NP) minus the Transportation System Management (TSM) Project. The following values are determined:

$$\$CAP(NP) = \$119,574,000$$
$$\$CAP(TSM) = \$826,000$$
$$d\$CAP = \$118,748,000$$

$$\$O\&M(NP) = \$570,800,000$$
$$\$O\&M(TSM) = \$558,000,000$$
$$d\$O\&M = \$12,800,000$$

$$TTS = \$38,907,800$$
$$d\$TTS = -\$38,907,800$$

$$\$LOC = \$37,670,000$$
$$d\$LOC = \$37,670,000$$

$$RIDERS(NP) = 626,890,000$$
$$RIDERS(TSM) = 567,415,000$$
$$dRIDERS = 59,475,000$$

The Federal Index is calculated:

$$F.I. = \frac{\$118,748,000 + \$12,800,000 - \$38,907,800 - \$37,670,000}{59,475,000}$$

$$+\frac{\$54,970,200}{59,475,000} = \$0.952/\text{NEW RIDER}$$

3.1.2 Total Index

The societal perspective concerns all funds regardless of their source. The index which represents society's concerns is called the Total Index. The Total Index is expressed:

$$T.I. = \frac{d\$CAP + d\$O\&M + d\$TTS}{dRIDERS}$$

$$T.I. = \frac{\$118,748,000 + \$12,800,000 - \$38,907,800}{59,475,000}$$

$$T.I. = \frac{\$92,640,200}{59,475,000} = \$1.56/\text{NEW RIDER}$$

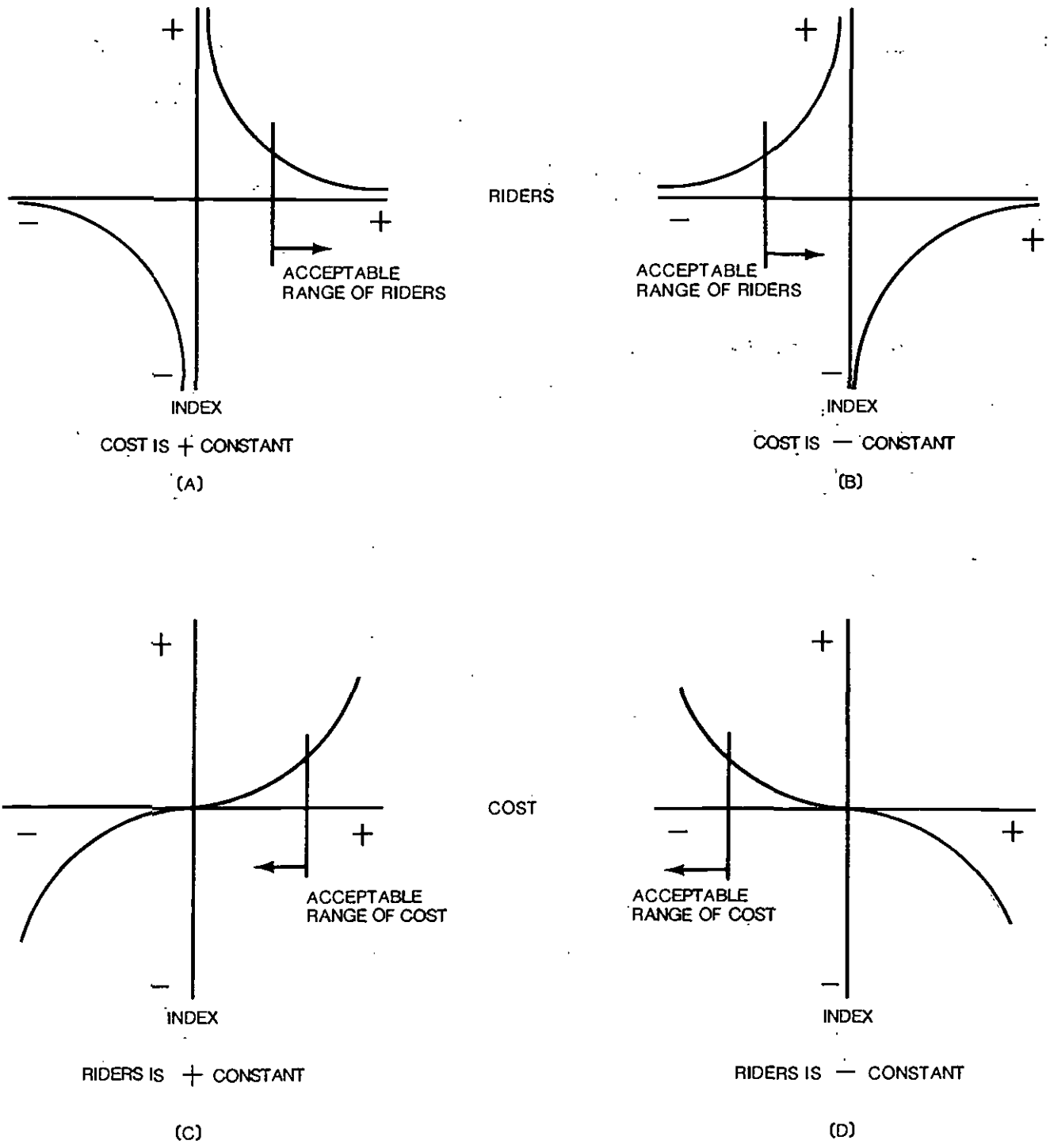


FIGURE 3.1

BEHAVIOR OF COST EFFECTIVENESS INDEX WITH VARIATION IN COST AND RIDERS

3.3 REVISED INDICES

The revised indices include a Federal Index representing the Federal perspective and a Total Index representing the societal perspective.

3.3.1 Federal Index-Revised

The index which represents the Federal perspective is given as:

$$F.I.(R) = \frac{d\$CAP + d\$O\&M - d\$LOC}{dUSER\ BENEFITS}$$

Where all terms are as defined earlier and

USER BENEFITS = Benefits to both existing and new transit riders, measured in equivalent hours of in-vehicle travel time.

$$F.I.(R) = \frac{\$118,748,000 + \$12,800,000 - \$37,670,000}{52,416,000\ hours}$$

$$F.I.(R) = \frac{\$93,878,000}{52,416,000} = \$1.79/hour\ of\ benefits$$

3.3.2 Total Index - Revised

The Total Index, which represents society's perspective, is expressed:

$$T.I.(R) = \frac{d\$CAP + d\$O\&M}{dUser\ Benefits}$$

$$T.I.(R) = \frac{\$118,748,000 + \$12,800,000}{52,416,000\ hours}$$

$$T.I.(R) = \frac{\$131,548,000}{52,416,000} = \$2.51/hour\ of\ benefits$$

3.4 COST EFFECTIVENESS - FULL ALIGNMENTS

The requisite data for calculating the several indices for the full alignment of the six candidate alignments and the LPA are displayed in Table 3.1. The basis for these data, including sample calculations, are presented in Chapter 2.

TABLE 3.1

COST EFFECTIVENESS VALUES
LOCALLY PREFERRED ALTERNATIVE
METRO RAIL
(December 1985 Constant Dollars)
(Year 2000 Transit Travel Estimates)

CANDIDATE ALIGNMENT NO.	TERMINAL STATIONS	LENGTH IN MILES	NUMBER OF STATIONS	ANNUAL CAPITAL COST N.P.-TSM $Millions (1)	ANNUAL O&M COST N.P.-TSM $Millions (2)	ANNUAL LOCAL SHARE N.P. $Millions (3)	ANNUAL FEDERAL SHARE N.P. $Millions	ANNUAL RIDERSHIP INCREASE N.P.-TSM Millions (4)	ANNUAL TRAVEL TIME SAVED N.P. $Millions (5)	ANNUAL USER BENEFITS N.P. Millions (6)	COST EFFECTIVENESS INDICES: ORIGINAL INDICES: TRAVEL TIME SAVING: FEDERAL (7)	ORIGINAL INDICES: TRAVEL TIME SAVING: TOTAL (8)	REVISED INDICES: EST. USER BENEFITS: FEDERAL (9)	REVISED INDICES: EST. USER BENEFITS: TOTAL (10)
1	W/W::NH	12.74	10	166.2	8.2	52.6	114.4	60.7	39.9	51.3	1.35	2.22	2.37	3.40
2	W/F::NH	15.91	13	184.4	-1.3	58.4	126.9	59.9	39.8	53.0	1.42	2.39	2.36	3.46
3	P/SV::NH	15.36	13	190.8	-3.2	60.3	131.2	57.7	37.8	51.6	1.55	2.60	2.47	3.64
4	W/F::NH	16.04	14	190.9	-3.8	60.4	131.3	60.5	38.5	51.6	1.46	2.46	2.46	3.63
5	W/F::NH	15.03	11	176.4	-0.1	55.8	121.4	65.9	40.3	52.4	1.22	2.06	2.30	3.37
6	W/F::NH	15.92	14	192.5	-4.8	60.9	132.4	60.7	38.3	51.6	1.46	2.46	2.46	3.64
LPA	W/W::NH	12.89	11	171.6	8.1	54.3	118.1	60.6	40.0	51.4	1.41	2.30	2.44	3.50

LEGEND
- W/W ; WILSHIRE AND WESTERN STATION
- W/F ; WILSHIRE AND FAIRFAX STATION
- P/SV ; PICO AND SAN VICENTE STATION
- NH ; NORTH HOLLYWOOD STATION
- N.P. ; NEW TRANSIT PROJECT
- TSM ; TRANSPORTATION SYSTEM MANAGEMENT

NOTE 1. MOS-1 IS 4.4 MILES IN LENGTH AND HAS 5 STATIONS.
NOTE 2. THE LPA IS CANDIDATE ALIGNMENT 1-MODIFIED.

CALCULATIONS
- COL. 7 = (COL.1+COL.2-COL.3-COL.5)/COL.4
- COL. 8 = (COL.1+COL.2-COL.5)/COL.4
- COL. 9 = (COL.1+COL.2-COL.3)/COL.6
- COL. 10 = (COL.1+COL.2)/COL.6

The procedure for calculating travel time savings and user benefits for the full alignments is slightly modified. The bulk of network analyses performed by SCRTD involve the so-called CORE networks. These CORE networks do not include coding for the under-construction light rail lines, namely the Long Beach-Los Angeles and the Norwalk-El Segundo. However, the Financial Operating Plan (FOP) networks are to include all elements of the Committed System such as the two light rail lines mentioned above, the Harbor Busway, the bus and highway network, and MOS-1. The Committed System and the TSM network need only to be coded once. However, every candidate alignment including each operable segment option would need to be coded to carry out the procedure as outlined in Chapter 2. This would entail a quite substantial investment of time, effort, and money. Consequently, some means of providing adequate data within the time and funding limitations are necessary.

For the full alignments, the CORE networks are used. The full alignment networks are compared to the MOS-1 networks and travel time savings and user benefits are calculated from the appropriate saved matrices. CORE networks for MOS-2 options of Alignments 1M and 4 are used to calculate travel time savings and user benefits from the appropriate saved matrices. These data provided pivot points to convert travel time savings and user benefits calculated with the CORE networks to estimates of similar measures obtained if the FOP networks were used. The following relationship is used:

$$\frac{\text{TTS (Full:FOP)}}{\text{TTS (Full:CORE)}} = \frac{\text{TTS (MOS-2:FOP)}}{\text{TTS (MOS-2:CORE)}}$$

The value of TTS (Full:FOP) is solved for in this expression for each alignment. Estimates of user benefits are calculated with the same expression. Data for Alignments 1,2, and 3 are pivoted about Alignment 1M while data for alignments 5 and 6 are pivoted about Alignment 4. This procedure is based on the similarity of these groups of alignments although no other alignment is really similar to Alignment 5.

The values of the Original indices from the Federal perspective range from 1.22 to 1.55 dollars per new rider for alignments 5 and 3 respectively. The index for the LPA is 1.41 which is equal to the average index of 1.41. The original index from the Societal perspective ranges from 2.06 to 2.60 dollars per new rider for alignments 5 and 3 respectively. The index for the LPA is 2.30 which is lower than the average index of 2.36.

The values of the Revised indices from the Federal perspective range from 2.30 to 2.47 dollars per hour of user benefits for alignments 5 and 3 respectively. The index for the LPA is 2.44 while the average index is 2.41. The Revised indices from the Societal perspective ranges from 3.37 to 3.64 dollars per hour of user benefits for alignments 5 and 3 respectively. The index for the LPA is 3.50 while the average index is 3.52.

3.5 COST EFFECTIVENESS - OPERABLE SEGMENTS

The indices calculated for second minimum operable segments are displayed in Table 3.2. In the table, the 19 second segment options are divided into 4 groups such that options within a group have similar costs and provide service to virtually the same termini. The

options in Group I are very short and are not considered viable options. All options in Group II extend to Wilshire/Western and to either Hollywood/Vine or Sunset/Vine. All options in Group III extend to Wilshire/Vermont and Universal City while those in Group IV extend to Wilshire/Western and Universal City.

Resources are not available to code a Project Network for each of these 19 options and to perform the simulations necessary to construct the matrices needed to calculate travel time savings and user benefits. Thus, only the starred options on Table 3.2 are carried out in full. The other options are factored. The factoring is carried out as follows:

1. In Group II options, the alignment and stations for Candidate Alignments 1M, 2, and 3 are identical. Thus, the ridership increase, travel time savings, and user benefits of Alignment 1M are transferred to Alignments 2 and 3.

2. For Group III options, an average factor is calculated for the ridership increase between MOS-2B and MOS-2 for Alignments 4 and 6. The MOS-2 ridership value of Alignment 1M is multiplied by this average factor to yield the MOS-2B ridership value for Alignment 1M. The MOS-2B ridership value for Alignment 1M is transferred to the MOS-2A value for Alignment 3 because the alignments are identical. The ridership value is decreased by 0.1 and transferred to Alignments 1 and 2 which differ by only the Hollywood/Highland station. For Group IV options, the average factor is calculated for the ridership increase between MOS-2A and MOS-2 for Alignments 4 and 6. Factored ridership values for MOS-2A of Alignments 1M and 2 are calculated as described above.

3. In Group II, it is observed that the values of travel time savings and user benefits for Alignment 1M are very nearly the average value observed for Alignments 4 and 6. An average factor is calculated by dividing the Group III user benefit average of Alignments 4 and 6 by the Group II user benefit average of Alignments 4 and 6. This factor is multiplied by the MOS-2 user benefit value of Alignment 1M to yield the user benefit value for MOS-2B. The same procedure is followed individually for travel timesavings and user benefits for Groups III and IV.

3.5.1 Cost Effectiveness - Group II

The options in Group II extend Metro Rail to Wilshire/Western and to Hollywood/Vine or Sunset/Vine.

The values of the Original indices from the Federal perspective range from - 0.44 to 0.60 dollars per new rider for alignments 4 and the LPA respectively. The average value is 0.49. The values from the societal perspective vary from 0.94 to 1.16 dollars per new rider for alignments 4 and the LPA respectively. The average is 1.00.

TABLE 3.2

COST EFFECTIVENESS VALUES
SECOND MINIMUM OPERABLE SEGMENT
METRO RAIL
(December 1985 Constant Dollars)
(Year 2000 Transit Travel Estimates)

CANDIDATE ALIGNMENT NO.	SECOND MINIMUM OPERABLE SEGMENT	TEMPORARY TERMINAL STATIONS	LENGTH IN MILES	NUMBER OF STATIONS	ANNUAL CAPITAL COST N.P.-TSM $Millions (1)	ANNUAL O&M COST N.P.-TSM $Millions (2)	ANNUAL LOCAL SHARE N.P. $Millions (3)	ANNUAL FEDERAL SHARE N.P. $Millions	ANNUAL RIDERSHIP INCREASE N.P.-TSM Millions (4)	ANNUAL TRAVEL TIME SAVED N.P. $Millions (5)	ANNUAL USER BENEFITS N.P. Millions (6)	COST EFFECTIVENESS INDICES: ORIGINAL INDICES: TRAVEL TIME SAVING: FEDERAL (7)	ORIGINAL INDICES: TRAVEL TIME SAVING: TOTAL (8)	REVISED INDICES: EST. USER BENEFITS: FEDERAL (9)	REVISED INDICES: EST. USER BENEFITS: TOTAL (10)
GROUP I															
1	MOS-2	W/W::V/S	4.55	6	73.5	3.4	23.4	50.9	--	--	--	--	--	--	--
1	MOS-2A	W/W::V/SM	4.13	5	66.3	9.0	21.1	46.0	--	--	--	--	--	--	--
5	MOS-2A	W/W::W/SM	4.49	5	68.6	3.7	21.9	47.6	--	--	--	--	--	--	--
GROUP II															
1	MOS-2	W/W::B/V	6.95	8	99.0	5.1	31.4	68.3	56.5	38.5	50.1 *	0.60	1.16	1.45	2.08
2	MOS-2	W/W::B/V	6.95	8	88.7	5.1	28.2	61.3	56.5	38.5	50.1	0.48	0.98	1.31	1.87
3	MOS-2	W/W::H/V	6.95	8	88.3	5.1	28.1	61.0	56.5	38.5	50.1	0.48	0.97	1.30	1.86
4	MOS-2	W/W::S/V	6.81	8	90.2	0.6	28.7	62.4	56.9	37.4	48.9 *	0.44	0.94	1.27	1.86
5	MOS-2	W/W::S/V	5.80	6	80.0	1.1	25.5	55.4	--	--	--	--	--	--	--
6	MOS-2	W/W::H/V	6.80	8	92.8	2.2	29.5	64.1	57.7	39.1	50.8 *	0.46	0.97	1.29	1.87
LPA	MOS-2	W/W::B/V	6.95	8	99.0	5.1	31.4	68.3	56.5	38.5	50.1 *	0.60	1.16	1.45	2.08
GROUP III															
1	MOS-2B	W/V::UC	9.39	7	121.7	11.3	38.6	83.9	59.0	39.2	52.8	0.94	1.59	1.79	2.52
2	MOS-2B	W/V::UC	9.38	7	111.6	12.7	35.4	77.0	59.0	39.2	52.8	0.84	1.44	1.68	2.35
3	MOS-2A	W/V::UC	9.54	8	116.3	12.8	36.9	80.2	59.0	39.2	52.8	0.90	1.52	1.74	2.44
4	MOS-2B	W/V::UC	9.51	8	118.7	12.8	37.7	81.9	59.5	38.9	52.4 *	0.92	1.56	1.79	2.51
6	MOS-2B	W/V::UC	9.39	8	120.3	14.4	38.2	83.0	60.1	39.0	52.7 *	0.96	1.59	1.83	2.56
LPA	MOS-2B	W/V::UC	9.55	8	127.0	15.7	40.3	87.6	59.3	39.4	53.3	1.06	1.74	1.92	2.68
GROUP IV															
2	MOS-2A	W/W::UC	10.46	9	129.5	4.0	41.1	89.3	56.2	37.9	51.2	0.97	1.70	1.81	2.61
4	MOS-2A	W/W::UC	10.59	10	135.9	3.7	43.1	93.7	56.6	37.5	50.7 *	1.04	1.80	1.91	2.76
6	MOS-2A	W/W::UC	10.47	10	137.6	3.3	43.6	94.8	57.4	37.9	51.1 *	1.03	1.79	1.90	2.75
LPA	MOS-2A	W/W::UC	10.62	10	142.7	7.6	45.2	98.3	56.2	37.9	51.2	1.20	2.00	2.05	2.94

LEGEND
- W/W ; WILSHIRE AND WESTERN STATION
- W/V ; WILSHIRE AND VERMONT STATION
- V/S ; VERMONT AND SUNSET STATION
- V/SM ; VERMONT AND SANTA MONICA STATION
- W/SM ; WESTERN AND SANTA MONICA STATION
- H/V ; HOLLYWOOD AND VINE STATION
- S/V ; SUNSET AND VINE STATION
- UC ; UNIVERSAL CITY STATION
- N.P. ; NEW TRANSIT PROJECT
- TSM ; TRANSPORTATION SYSTEM MANAGEMENT

CALCULATIONS
- COL. 7 = (COL.1+COL.2-COL.3-COL.5)/COL.4
- COL. 8 = (COL.1+COL.2-COL.5)/COL.4
- COL. 9 = (COL.1+COL.2-COL.3)/COL.6
- COL. 10 = (COL.1+COL.2)/COL.6

* TRAVEL TIME SAVINGS AND USER BENEFITS FOR STARRED OPTIONS ARE CALCULATED FROM SIMULATION. VALUES FOR OTHER OPTIONS ARE FACTORED.

The revised indices from the Federal perspective range from 1.27 to 1.45 dollars per hour of user benefits for alignments 4 and the LPA respectively. The average value is 1.32. The values from the societal perspective range from 1.86 to 2.08 for alignment 4 and the LPA respectively. The average value is 1.91.

3.5.2 Cost Effectiveness - Group III

The options in Group III extend Metro Rail to Wilshire/Vermont and Universal City.

The values of the Original indices from the Federal perspective range from 0.84 to 1.06 dollars per new rider for alignments 2 and the LPA respectively. The average is 0.94. The values from the societal perspective range from 1.44 to 1.74 dollars per new rider for alignments 2 and the LPA respectively. The average is 1.57.

The values of the Revised indices from the Federal perspective range from 1.68 to 1.92 dollars per hour of user benefits for alignments 2 and the LPA respectively. The average is 1.79. The values from the societal perspective range from 2.35 to 2.68 dollars per hour of user benefits for alignments 2 and the LPA respectively. The average is 2.51.

3.5.3 Cost Effectiveness - Group IV

The options in Group IV extend Metro Rail to Wilshire/Western and Universal City.

For all four indices, alignment 2 is the lowest and the LPA the highest. The range is from 0.97 to 1.20 for the Original Federal index and from 1.70 to 2.00 for the Original Societal index. The range is from 1.81 to 2.05 for the Revised Federal index and from 2.61 to 2.94 for the Revised Societal index.

3.6 COST EFFECTIVENESS - LOCALLY PREFERRED ALTERNATIVE

The cost effectiveness indices presented in Sections 3.4 and 3.5 are based on the cost data available at that time for all proposed alignments. The SCRTD Board of Directors announced the selection of Candidate Alignment 1 - Modified as the new Locally Preferred Alternative, the New LPA, in July of 1988. Shortly after this date, revisions and updates to construction cost estimates were restricted to the New LPA. The cost estimates for the proposed operable segments of the New LPA as used in this section were prepared in January, 1989. These latest cost estimates appear in the Final SEIS/SEIR as well.

The Committed and TSM Networks as described in Chapter 2 are used in this analysis. The Project Network adds Phase II of the New LPA to the Committed Network. The New LPA is entirely in subway configuration. The line extends from the end of MOS-1, Wilshire/Alvarado, to Wilshire/Western toward the west with a northbound branch beginning at Wilshire/Vermont. The line progresses along Vermont Avenue and turns west at Hollywood Boulevard toward the station at Hollywood and Highland. The line continues in a northwesterly direction toward Universal City and North Hollywood. The portion of the New LPA not including MOS-1 is called Phase II.

Cost effectiveness values are calculated for four proposed second minimum operable segments which are referred to as Cases 1, 2, 3, and 4:

1) Case 1: This segment extends from Wilshire/Alvarado to Wilshire/Western and Hollywood/Vine.

2) Case 2: This segment extends from Wilshire/Alvarado to Wilshire/Western and University City.

3) Case 3: This segment extends from Wilshire/Alvarado to Wilshire/Vermont and Universal City.

4) Case 4: This is the full alignment from Wilshire/Alvarado to Wilshire/Western and North Hollywood (Phase II).

Cost effectiveness values for each of the segments are prepared for three funding scenarios related to UMTA Section 3 funding for Phase II:

1) Federal involvement at the 1983 FEIS level. Federal involvement was projected at 68.5% for the Original LPA (see Section 2.5). This involvement level defines the base case from which Federal involvement is expected to decrease upon the application of the Threshold tests relative to the Cost Effectiveness Frontier.

2) Federal involvement maintained at a level corresponding to the UMTA funding authorization of $666.3 million for a second minimum operable segment of Metro Rail. This is projected to be Case 1 for purposes of this document.

3) Federal involvement will be $666.3 million for all of Phase II with no future UMTA Section 3 funding authorizations for Phase II.

3.6.1 Cost Effectiveness - 1983 FEIS Federal Funding Level

The indices calculated for Cases 1 through 4 for the New LPA are presented in Table 3.3. Note that Federal involvement in this Table is quite high and does not represent a realistic level of such involvement. However, the Table is presented as the base case.

The order of the Cases in terms of increasing length and increasing cost is Case 1, Case 3, Case 2, and Case 4. In every instance the indices increase in this sequence. The values of the original indices vary from 0.77 to 1.68 dollars for new rider from the Federal perspective and from 1.40 to 2.72 dollars per new rider from the societal perspective.

The values of the revised indices range from 1.64 to 2.53 dollars per hour of user benefits from the Federal perspective and from 2.34 to 3.61 dollars per hour of user benefits from the societal perspective.

TABLE 3.3

COST EFFECTIVENESS VALUES
LOCALLY PREFERRED ALTERNATIVE FOR METRO RAIL
FEDERAL INVOLVEMENT AT 1983 FEIS LEVEL
(December 1985 Constant Dollars)
(Year 2000 Transit Travel Estimates)

CASE NO.	TERMINAL STATIONS	LENGTH IN MILES	NUMBER OF STATIONS	ANNUAL CAPITAL COST N.P.-TSM $Millions (1)	ANNUAL O&M COST N.P.-TSM $Millions (2)	ANNUAL LOCAL SHARE N.P. $Millions (3)	ANNUAL FEDERAL SHARE N.P. $Millions	ANNUAL RIDERSHIP INCREASE N.P.-TSM Millions (4)	ANNUAL TRAVEL TIME SAVED N.P. $Millions (5)	ANNUAL USER BENEFITS N.P. Millions (6)	COST EFFECTIVENESS INDICES: ORIGINAL INDICES: TRAVEL TIME SAVING: FEDERAL (7)	ORIGINAL INDICES: TRAVEL TIME SAVING: TOTAL (8)	REVISED INDICES: EST. USER BENEFITS: FEDERAL (9)	REVISED INDICES: EST. USER BENEFITS: TOTAL (10)
1	W/W::H/V	8.32	8	112.3	5.1	35.2	77.9	56.5	38.5	50.1	0.77	1.40	1.64	2.34
2	W/W::UC	10.63	8	159.0	15.7	49.8	110.1	59.3	39.4	53.3	1.44	2.28	2.34	3.28
3	W/V::UC	9.55	10	141.7	7.6	44.4	98.2	56.2	37.9	51.2	1.19	1.98	2.05	2.92
4	W/W::NH	12.90	11	178.9	8.1	56.0	123.8	53.8	40.8	51.8	1.68	2.72	2.53	3.61

LEGEND
- W/W ; WILSHIRE AND WESTERN STATION
- H/V ; HOLLYWOOD AND VINE STATION
- UC ; UNIVERSAL CITY
- W/V ; WILSHIRE AND VERMONT STATION
- NH ; NORTH HOLLYWOOD STATION
- N.P. ; NEW TRANSIT PROJECT
- TSM ; TRANSPORTATION SYSTEM MANAGEMENT

NOTE 1. MOS-1 IS 4.4 MILES IN LENGTH AND HAS 5 STATIONS.
NOTE 2. THE LPA IS CANDIDATE ALIGNMENT 1-MODIFIED.

CALCULATIONS
- COL. 7 = (COL.1+COL.2-COL.3-COL.5)/COL.4
- COL. 8 = (COL.1+COL.2-COL.5)/COL.4
- COL. 9 = (COL.1+COL.2-COL.3)/COL.6
- COL. 10 = (COL.1+COL.2)/COL.6

Note that as Federal involvement in Phase II funding changes, there is no change in the indices from a societal perspective. However, as federal involvement decreases, the indices from the Federal perspective decrease as well.

3.6.2 Cost Effectiveness - Federal Funding Maintained at Case I Level

The indices calculated for Cases 1 through 4 for the New LPA are presented in Table 3.4. The assumption for this federal funding level is that UMTA Section 3 grants will continue throughout Phase II construction at the Case 1 level. The Federal share for Case 1 amounts to $666.3 million or 47.3% of the total cost. This is considered the most likely scenario for future Federal participation in Phase II of Metro Rail.

The value of the indices from the Federal perspective ranges from 0.37 to 1.01 dollars per new rider for the original index and from 1.19 to 1.84 dollars per hour of user benefits for the revised index. The cases are in order of increasing costs, namely Case 1, Case 3, Case 2, Case 4.

3.6.3 Cost Effectiveness - UMTA Section 3 Grants End

The indices calculated for Cases 1 through 4 for the New LPA are presented in Table 3.5. The assumption for this federal funding level is that the UMTA Section 3 grants program ends and that the current authorization of $666.3 million is the final one for Phase II construction. This is considered the worse case scenario and is unlikely to occur.

The Federal share in all four cases is almost the same. The variation is due to the increasing cost of the vehicles as the alignment lengthens. Vehicle cost is a local cost with no federal participation. Thus, the indices for Cases 1, 3, and 4 are almost equal while that for Case 2 is somewhat larger.

TABLE 3.4

COST EFFECTIVENESS VALUES
LOCALLY PREFERRED ALTERNATIVE FOR METRO RAIL
FEDERAL INVOLVEMENT MAINTAINED AT CASE 1 LEVEL
(December 1985 Constant Dollars)
(Year 2000 Transit Travel Estimates)

CASE NO.	TERMINAL STATIONS	LENGTH IN MILES	NUMBER OF STATIONS	ANNUAL CAPITAL COST N.P.-TSM $Millions (1)	ANNUAL O&M COST N.P.-TSM $Millions (2)	ANNUAL LOCAL SHARE N.P. $Millions (3)	ANNUAL FEDERAL SHARE N.P. $Millions	ANNUAL RIDERSHIP INCREASE N.P.-TSM Millions (4)	ANNUAL TRAVEL TIME SAVED N.P. $Millions (5)	ANNUAL USER BENEFITS N.P. Millions (6)	COST EFFECTIVENESS INDICES: ORIGINAL INDICES: TRAVEL TIME SAVING: FEDERAL (7)	ORIGINAL INDICES: TRAVEL TIME SAVING: TOTAL (8)	REVISED INDICES: EST. USER BENEFITS: FEDERAL (9)	REVISED INDICES: EST. USER BENEFITS: TOTAL (10)
1	W/W::H/V	8.32	8	112.3	5.1	57.9	55.3	56.5	38.5	50.1	0.37	1.40	1.19	2.34
2	W/W::UC	10.63	8	159.0	15.7	81.8	78.0	59.3	39.4	53.3	0.90	2.28	1.74	3.28
3	W/V::UC	9.55	10	141.7	7.6	73.0	69.6	56.2	37.9	51.2	0.68	1.98	1.49	2.92
4	W/W::NH	12.90	11	178.9	8.1	92.0	87.7	53.8	40.8	51.8	1.01	2.72	1.84	3.61

LEGEND
- W/W ; WILSHIRE AND WESTERN STATION
- H/V ; HOLLYWOOD AND VINE STATION
- UC ; UNIVERSAL CITY
- W/V ; WILSHIRE AND VERMONT STATION
- NH ; NORTH HOLLYWOOD STATION
- N.P. ; NEW TRANSIT PROJECT
- TSM ; TRANSPORTATION SYSTEM MANAGEMENT

CALCULATIONS
- COL. 7 = (COL.1+COL.2-COL.3-COL.5)/COL.4
- COL. 8 = (COL.1+COL.2-COL.5)/COL.4
- COL. 9 = (COL.1+COL.2-COL.3)/COL.6
- COL. 10 = (COL.1+COL.2)/COL.6

NOTE 1. MOS-1 IS 4.4 MILES IN LENGTH AND HAS 5 STATIONS.
NOTE 2. THE LPA IS CANDIDATE ALIGNMENT 1-MODIFIED.
NOTE 3. THE CASE 1 FEDERAL INVOLVEMENT AMOUNTS TO 47.3% BASED ON UMTA SECTION 3 FUNDS OF $666.3 MILLION CONTRIBUTION TO ESTIMATED COST OF $1410 MILLION.

TABLE 3.5

COST EFFECTIVENESS VALUES
LOCALLY PREFERRED ALTERNATIVE FOR METRO RAIL
FEDERAL INVOLVEMENT IS $666.3 MILLION FOR ALL OF PHASE II
(December 1985 Constant Dollars)
(Year 2000 Transit Travel Estimates)

CASE NO.	TERMINAL STATIONS	LENGTH IN MILES	NUMBER OF STATIONS	ANNUAL CAPITAL COST N.P.-TSM $Millions (1)	ANNUAL O&M COST N.P.-TSM $Millions (2)	ANNUAL LOCAL SHARE N.P. $Millions (3)	ANNUAL FEDERAL SHARE N.P. $Millions	ANNUAL RIDERSHIP INCREASE N.P.-TSM Millions (4)	ANNUAL TRAVEL TIME SAVED N.P. $Millions (5)	ANNUAL USER BENEFITS N.P. Millions (6)	COST EFFECTIVENESS INDICES: ORIGINAL INDICES: TRAVEL TIME SAVING: FEDERAL (7)	ORIGINAL INDICES: TRAVEL TIME SAVING: TOTAL (8)	REVISED INDICES: EST. USER BENEFITS: FEDERAL (9)	REVISED INDICES: EST. USER BENEFITS: TOTAL (10)
1	W/W::H/V	8.32	8	112.3	5.1	57.9	55.3	56.5	38.5	50.1	0.37	1.40	1.19	2.34
2	W/W::UC	10.63	8	159.0	15.7	102.7	57.1	59.3	39.4	53.3	0.55	2.28	1.35	3.28
3	W/V::UC	9.55	10	141.7	7.6	86.1	56.4	56.2	37.9	51.2	0.45	1.98	1.23	2.92
4	W/W::NH	12.90	11	178.9	8.1	121.8	57.9	53.8	40.8	51.8	0.45	2.72	1.26	3.61

LEGEND
- W/W ; WILSHIRE AND WESTERN STATION
- H/V ; HOLLYWOOD AND VINE STATION
- UC ; UNIVERSAL CITY
- W/V ; WILSHIRE AND VERMONT STATION
- NH ; NORTH HOLLYWOOD STATION
- N.P. ; NEW TRANSIT PROJECT
- TSM ; TRANSPORTATION SYSTEM MANAGEMENT

NOTE 1. MOS-1 IS 4.4 MILES IN LENGTH AND HAS 5 STATIONS.
NOTE 2. THE LPA IS CANDIDATE ALIGNMENT 1-MODIFIED.

CALCULATIONS
- COL. 7 = (COL.1+COL.2-COL.3-COL.5)/COL.4
- COL. 8 = (COL.1+COL.2-COL.5)/COL.4
- COL. 9 = (COL.1+COL.2-COL.3)/COL.6
- COL. 10 = (COL.1+COL.2)/COL.6

4. OTHER CRITERIA AND THRESHOLDS

UMTA guidelines list six criteria that are incorporated into the evaluation process. These are discussed briefly in Chapter 1.3. In addition, UMTA employs a set of threshold tests that are used in the evaluation process.

4.1 OTHER CRITERIA

The six criteria listed by UMTA are:

1. Cost effectiveness;
2. Local fiscal effort;
3. Private sector participation;
4. Alternatives analysis results;
5. Disadvantaged business enterprises; and
6. Local government and community support.

The first four of these criteria are included in the computation of the indices of project merit as presented in Chapter 3. The statutory minimum for local participation in a new transit project is 25 percent. Local participation in all the proposed second operable segments of each candidate alignment is higher than the minimum. It should be pointed out that local involvement in rail transit in the Los Angeles region is very strong. Local funds will account for about 44.3 percent of the $1,250 million cost of Metro Rail's MOS-1 and 100 percent of the approximately $1,170 million cost of the Long Beach-Los Angeles and Norwalk-El Segundo Light Rail Lines. Local participation in Metro Rail is derived from 3 sources:

1) State of California Guideway Fund - These funds are derived from a per gallon fuel tax in California. Thus far, the State has pledged $400 million from this fund for Metro Rail construction.

2) City of Los Angeles - Funds from the City of Los Angeles represent a portion of the Local return distributed to Los Angeles County cities from the Proposition A sales tax for transit.

3) Los Angeles County Transportation Commission - The LACTC administers the Proposition A sales tax program and allocates funds to rail transit construction including Metro Rail and light rail lines.

Private sector participation is derived chiefly from the Benefit Assessment District Program. It is anticipated that private properties in the vicinity of rail stations will benefit from such proximity. Benefit assessments are an attempt to capture some of these benefits for the construction program. These sources of local and private funds are considered to be stable and reliable over the life of the transit project.

Over the course of the CORE Study, some 30 different alternative alignments were studied. In the mechanics of the CORE Study process, a total of five candidate alignments were selected for detailed study. A sixth mix-and-match alignment was added later in direct response to recording and television industry concerns related to possible noise impacts along the route of some alignments. The LPA as selected by the SCRTD Board of Directors is a modified version of Candidate Alignment 1. The LPA includes a station at Hollywood/Highland while no such station is included in Candidate Alignment 1. Furthermore, the inclusion of the Hollywood/Highland station precludes any future consideration of a Hollywood Bowl station for the LPA. Thus, a total of seven alignments were reviewed. For these alignments, a total of 19 operable segments were reviewed as possible options.

Section 105(f) of the Surface Transportation Act of 1982 requires a minimum of 10 percent participation by Disadvantaged Business Enterprise (DBE) firms. The SCRTD is well aware of such requirements and closely monitors the participation of DBE firms in Metro Rail related work. The following statistics are reported:

1. Metro Rail Facilities Contracts: As of the end of March, 1988, an amount equivalent to 20.4 percent of base contracts are allocated to DBE firms.

2. Metro Rail System Contracts: As of the end of March, 1988, only four relatively small contracts have been awarded but they include an amount equivalent to 10.4 percent of base contracts allocated to DBE firms.

3. Metro Rail Professional Service Contracts: As of the end of March 1988, a total of 31.4 percent of all invoices were for services provided by DBE firms.

The final criterion is related to local government and community support for the new rail project. Strong indications of community involvement are CORE Forum components of the CORE Study Process. A total of 137 CORE Forum members participated in a series of informational meetings and open discussion on the realignment of Metro Rail. Membership was distributed approximately as follows:

- o 50 Elected and Appointed Government officials
- o 36 Representatives of Firms and Businesses
- o 23 Representative of Associations
- o 19 Representatives of Civic Groups
- o 9 Representatives of Chambers of Commerce.

A substantial number of this group participated in the sessions and generated a significant level of community support for the transit project.

Many local government officials including Los Angeles Mayor Tom Bradley have voiced their support of Metro Rail and travelled to Washington, D.C. and Sacramento, California to appear before various legislative committees to express support of Metro Rail and funding for its construction. Representatives of other government units and agencies have offered support including but not limited to: Los Angeles City Council; Los Angeles County Board of Supervisors; Los Angeles County Transportation Commission; Community Redevelopment Agency; and the Southern California Association of Governments. Refer to Chapter 6 of the Final SEIS/SEIR for additional insights into the Community Participation program developed by SCRTD.

The City of Los Angeles is committed to the implementation of a nine-point "traffic congestion-busting" strategy designed to reduce traffic congestion, air pollution, parking demand, and commuting related stress. A major component of the plan is development of a ride-sharing plan for the 7,500 Los Angeles municipal employees working in the Civic Center. Other measures include a ban on rush-hour truck deliveries and higher fines for parking violations. Moreover, the South Coast Air Quality Management District (SCAQMD) is in the process of implementing and enforcing Regulation XV (Commuter Program) which ultimately will require all employers of 100 or more people to develop and implement a ridesharing plan designed to reduce driving to and from work. Ridesharing includes car- and vanpooling programs, transit, and other alternatives to driving to work alone in an automobile. Thus, the City of Los Angeles and the SCAQMD are actively engaged in a program which should have beneficial impacts on regional transit ridership.

4.2 THRESHOLD TESTS

UMTA guidelines suggest several threshold tests to be applied to new transit projects. The purpose of these threshold tests is to ensure minimum levels of cost effectiveness and other criteria measures for all transit projects under consideration for Federal funds.

4.2.1 Transit Market

The corridor to be served must have at least 15,000 daily transit trips. Ridership figures are readily available for the alternative alignments in the SEIS/SEIR. Daily rail transit boardings are expected to be 55,000 in the year 2000 on MOS-1. The second operable segment is expected to generate daily rail transit boardings ranging from 184,000 to 241,000 depending on the candidate alignment selected.

This threshold test is more than satisfied for the corridor in question.

4.2.2 Potential Cost Effectiveness

The threshold value in 1984 is $10.00 per new transit trip. Reference to Figure 3.1 shows that the Federal index varies from $1.22 to $1.55 per new transit trip for Alignments 5 and 3 respectively. The Federal index for the New LPA ranges from $0.77 per new transit trip for Case 1 to $1.68 per new transit trip for Phase II as shown in Table 3.3 for the 1983 FEIS Federal participation level. The range in Table 3.4 for the more likely Case 1

Federal funding level is $0.37 for Case 1 and $1.01 per new transit rider for Phase II. This threshold test is more than satisfied for the New LPA.

Reference to Tables 3.3 and 3.4 show the following progression in the Original indices as additional segments are added to the New LPA alignment:

TABLE 3.3
FEDERAL
PARTICIPATION - 68.5%

TABLE 3.4
FEDERAL
PARTICIPATION - 47.3%

CASE	Federal Index	Total Index	Federal Index	Total Index
Case 1	0.77	1.40	0.37	1.40
Case 3	1.19	1.98	0.68	1.98
Case 2	1.44	2.28	0.90	2.28
Full Alignment Phase II	1.68	2.72	1.01	2.72

Thus, the indices rise as the transit system accumulates length and stations, just as one would expect.

4.2.3 Transit Ridership

The new transit project must produce a gain in ridership in comparison to the TSM alternative. Reference to Tables 3.1 and 3.2 indicate the ridership gains resulting from the implementation of any of the proposed alignments will be substantial. For the full alignments shown in Table 3.1, the ridership gain is estimated at 57.7 million annually for Alignment 3 to as high as 65.9 million annually for Alignment 5. The gain for the New LPA is estimated as 53.8 million annually. This threshold is satisfied.

4.2.4 Cost Effectiveness Frontier

The cost effectiveness frontier is plotted in Figure 4.1 for the Federal perspective and in Figure 4.2 for the societal perspective. In both cases, only Alignment 5 lies on the frontier but all the other alignments are very close to Alignment 5.

According to UMTA Guidelines, the annual Federal involvement in an alternative which does not lie on the Frontier must be reduced such that the selected alternative lies on the Frontier. The annual Federal involvement in the New LPA must be reduced by $11.6 million per year. This translates to a present value of about $109.4 million in December 85 constant dollars or about $142.3 million in current dollars. The projected percent of

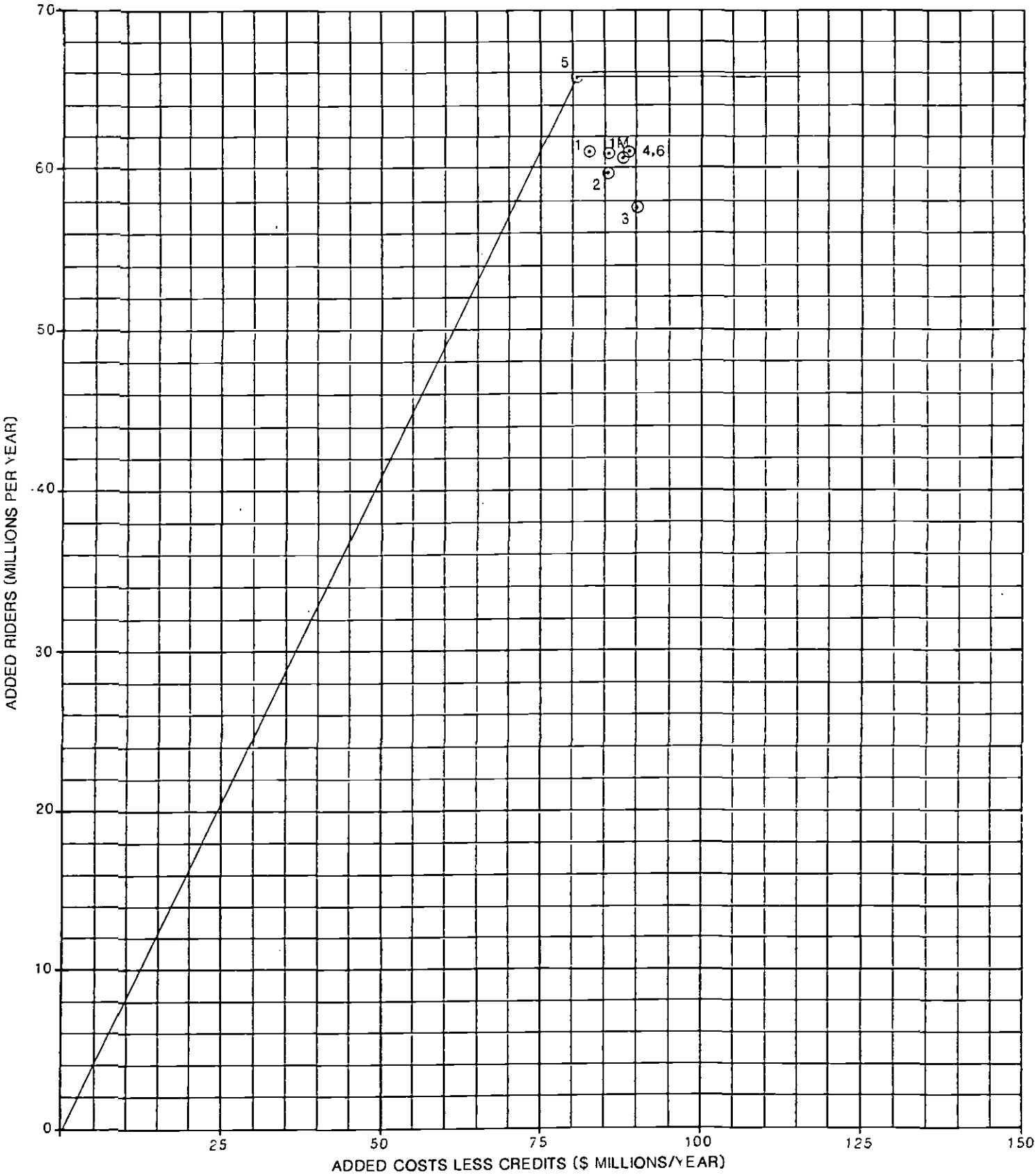


FIGURE 4.1

ORIGINAL COST EFFECTIVENESS INDEX, FEDERAL PERSPECTIVE, FULL ALIGNMENT

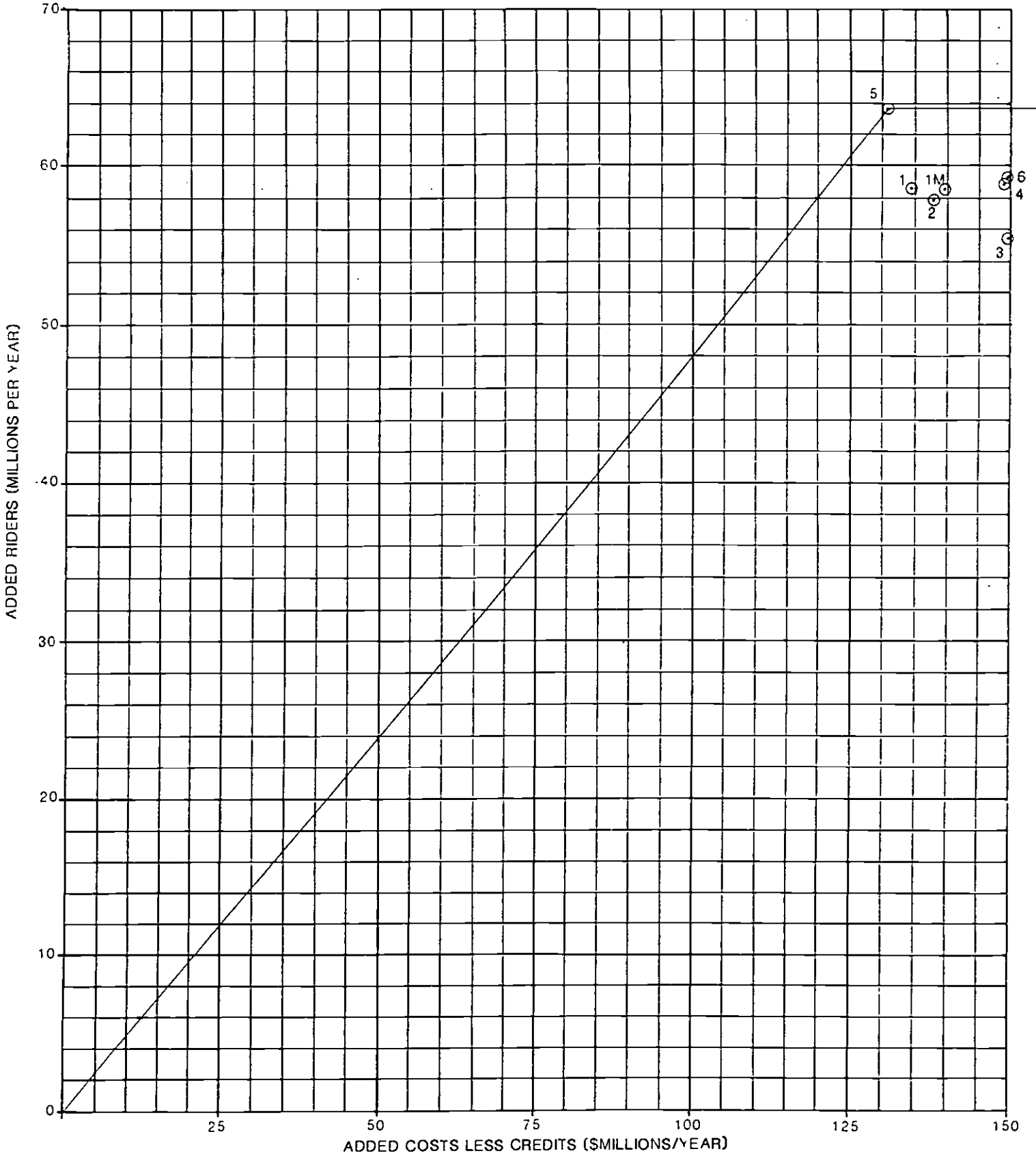


FIGURE 4.2

ORIGINAL COST EFFECTIVENESS INDEX, SOCIETAL PERSPECTIVE, FULL ALIGNMENT

Federal involvement is reduced from the 68.5% reported in the 1983 FEIS to about 62.00% for the New LPA. The reduced Federal involvement of $142.3 million must be made up by additional local funds. Current Federal involvement in Case 1 of the New LPA is projected at about 47%.

4.2.5 Composite Index

The composite index from the Federal perspective is 1.22 for the New LPA if Federal involvement is reduced from 68.5% to 62% or about $142.3 million. The threshold value for 1984 is $6.00 per new transit trip. Thus, the threshold test is satisfied at the reduced level of Federal involvement. This composite index cannot be calculated for the January, 1989 cost estimates inasmuch as revised costs are available for only the New LPA. However, if the costs of other alignments were expected to increase as did the costs of the New LPA, the above statements would still be applicable.

4.2.6 Potential Cost Effectiveness - Revised

The threshold value for 1985 is $12.00 per hour of user benefits for the potential cost effectiveness of the revised indices. Reference to Table 3.1 shows that the Revised indices from the Federal perspective vary from $2.30 to $2.47 per hour of user benefits for alignments 5 and 3 respectively.

This threshold test is satisfied.

4.2.7 Composite Index - Revised

The graphical presentation of the revised indices from the Federal and Societal perspectives are shown in Figures 4.3 and 4.4 respectively. Only Alignment 5 lies on the frontier as shown in Figure 4.3. In order for the New LPA to lie on the frontier, Federal involvement must be reduced by $7.2 million annually. This translates to a present value of $67.0 million in December 1985 constant dollars or $88.3 million in current dollars. Federal involvement must be reduced from the assumed level of 68.5% to 64.5%. If Federal involvement is reduced as suggested, the New LPA will lie on the frontier and the composite index will be 2.30. This is well within the threshold value of $8.00 per hour of user benefits for 1984.

4.3 SUMMARY

This chapter includes an assessment of the New LPA's conformance with other criteria and several threshold tests. All criteria are satisfied. All the threshold tests are met provided that Federal involvement is reduced from 68.5% to 62.00% for the original index and from 68.5% to 64.5% for the revised index. Thus, the new base level of Federal involvement for future application of the threshold test is 62.0% when additions to Metro Rail are contemplated.

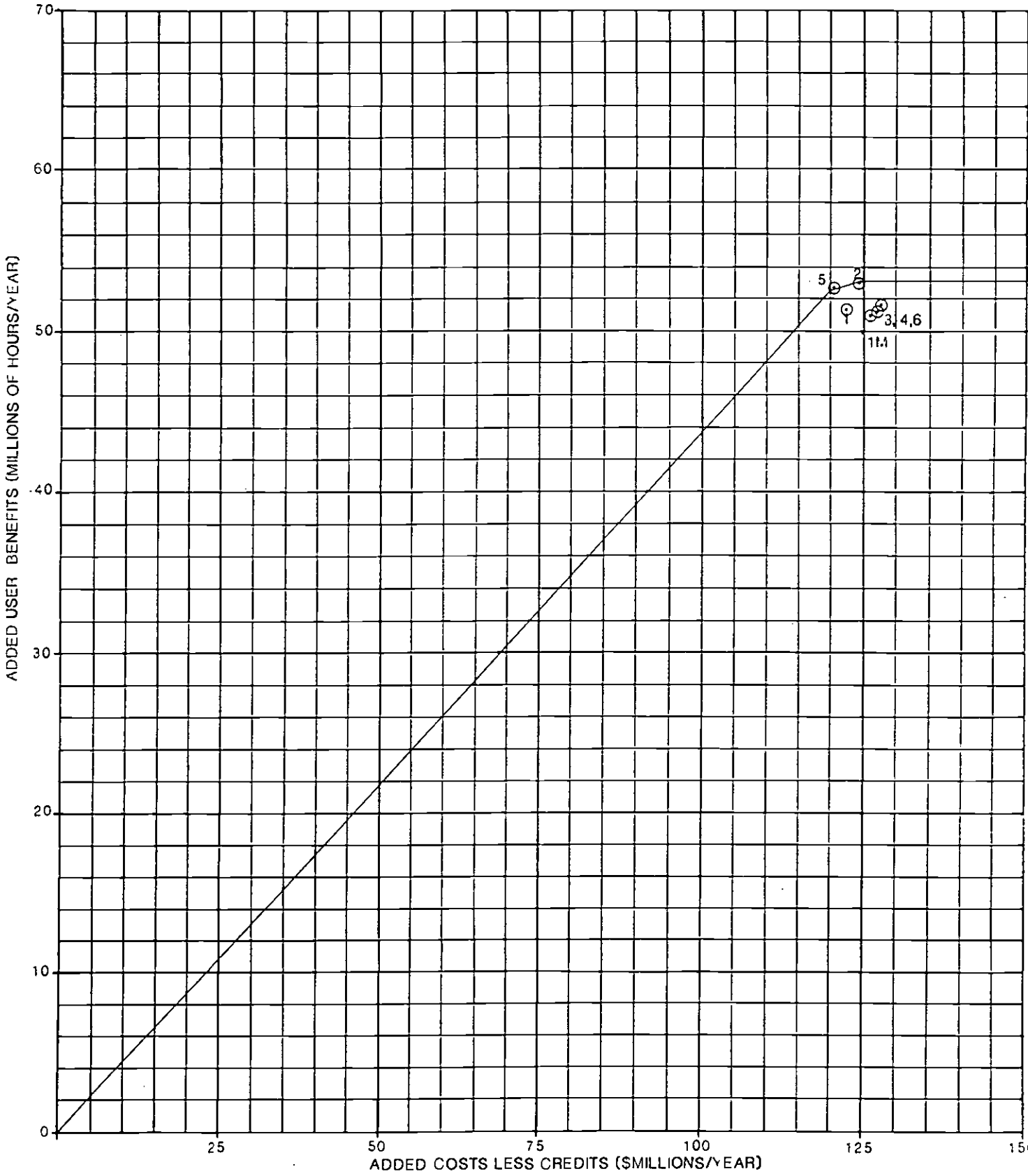


FIGURE 4.3

REVISED COST EFFECTIVENESS INDEX, FEDERAL PERSPECTIVE, FULL ALIGNMENT

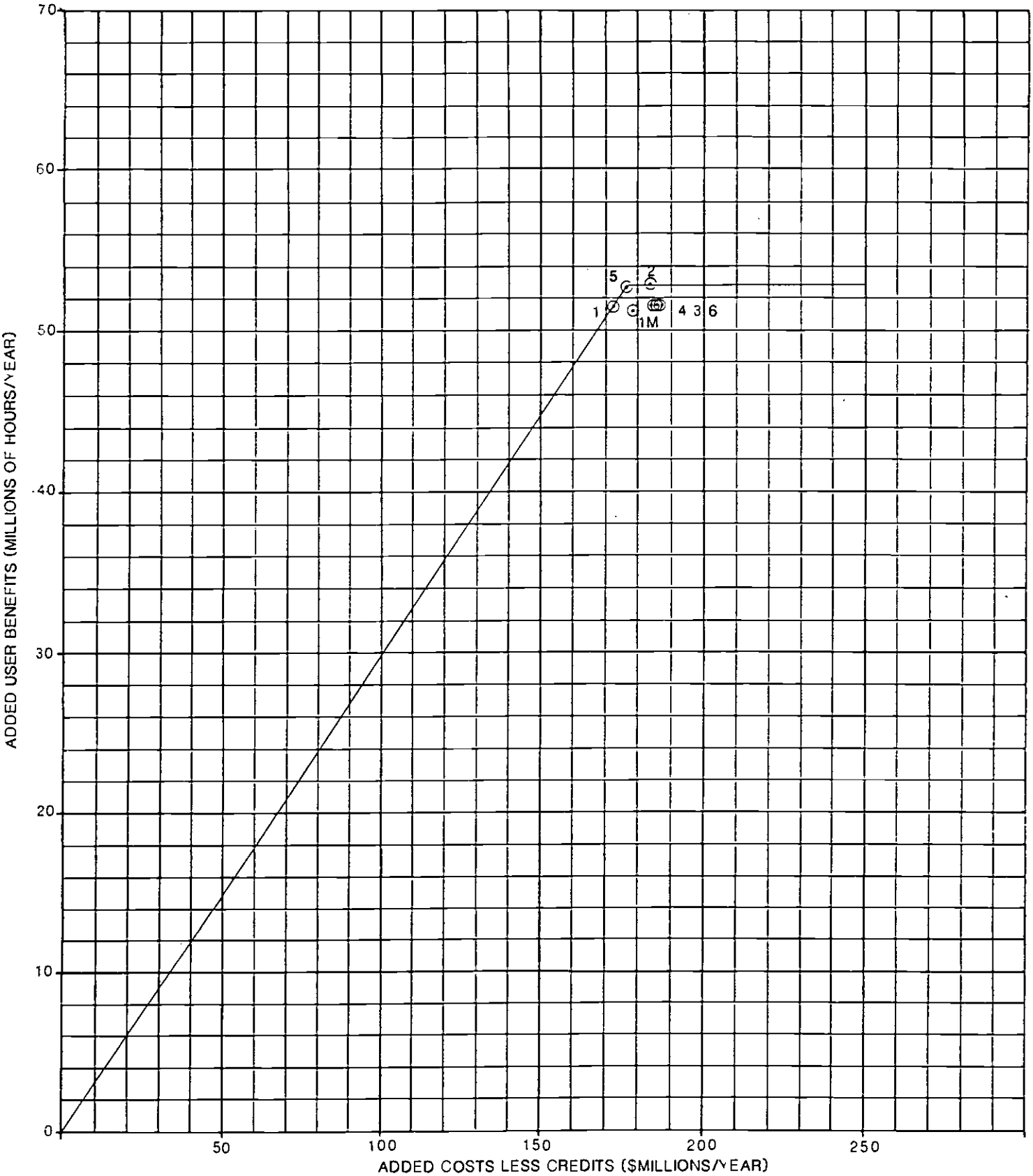


FIGURE 4.4

REVISED COST EFFECTIVENESS INDEX, SOCIETAL PERSPECTIVE, FULL ALIGNMENT

5. CONCLUSION

The primary conclusion drawn from this study is that Phase II of the New LPA is a cost effective project. All threshold tests from both the original and revised cost effectiveness methodology are well satisfied.

The data in Tables 3.1 and 3.2 are based on the latest cost data available when all Candidate Alignments were still in consideration for selection as the New LPA. The principal result of this analysis is that Federal participation in the New LPA must be reduced from the base percentage of 68.5% to 62.0% maximum so that the New LPA would lie on the cost effectiveness frontier.

Subsequent to the selection of Candidate Alignment 1 - Modified as the New LPA, revised cost estimates were prepared for only the New LPA. The cost effectiveness values presented in Tables 3.3, 3.4, and 3.5 reflect the latest cost estimates (January, 1989) for three assumed levels of Federal participation in Phase II. The Cost Effectiveness values for the New LPA for the maintenance of Case 1 funding level (47.25% Federal participation) are shown below (Reference Table 3.4):

	Original Index		Revised Index	
Case	Federal	Total	Federal	Total
Case 1	0.37	1.40	1.19	2.34
Case 2	0.90	2.28	1.74	3.28
Case 3	0.68	1.98	1.49	2.92
Case 4	1.01	2.72	1.84	3.61

Note that even the total indices expressed from a societal perspective are well within the threshold limits prescribed for the Federal Indices. All threshold tests are easily satisfied. The New LPA appears to be a cost effective rail transit project.

APPENDIX 1

THE COMMITTED NETWORK

APPENDIX-1

COMMITTED NETWORK (FOP3VER1)

The 'committed network' or Network 3 (FOP3VER1) of the Financial Operating Plan series consists of the MOS-1 of Metro Rail with the addition of the Long Beach-Los Angeles and Century-El Segundo light rail transit systems (see Figure A1-1) and the Harbor Busway. These interlinked systems are expected to be operational by 1995. Appendix-1 provides a brief project description for each service alternative.

A1.1 MOS-1 (MINIMUM OPERABLE SEGMENT - 1)

MOS-1 consists of five stations extending 4.4 miles from a yard and shop facility south of Union Station to the intersection of Wilshire and Alvarado. (see Table A1-1 and Figure A1-2). Patronage and operating cost estimates for the MOS-1 only alternative are included in the Draft Supplemental Environmental Impact Statement/Subsequent Environmental Impact Report (SEIS/SEIR), November, 1987.

TABLE A1-1

MOS-1 STATIONS

UNION STATION P(2500)
CIVIC CENTER (1ST/HILL)
5TH/HILL
7TH/FLOWER
WILSHIRE ALVARADO

P - PARK-AND-RIDE(CAPACITY)

FIGURE A1-1

FINANCIAL OPERATING PLAN NETWORK–3

MOS–1 + LB–LA LRT + CENTURY/EL SEGUNDO LRT

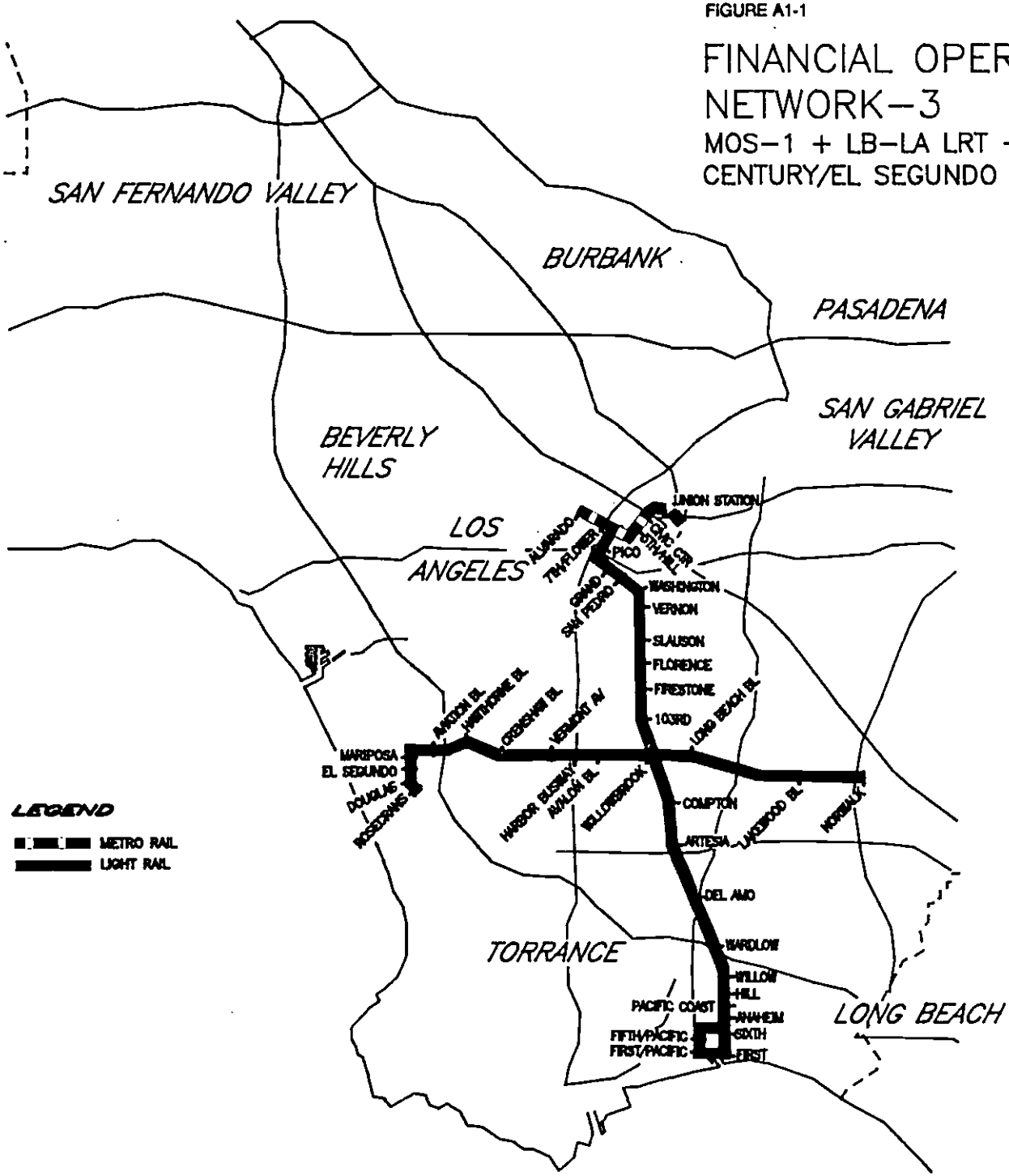
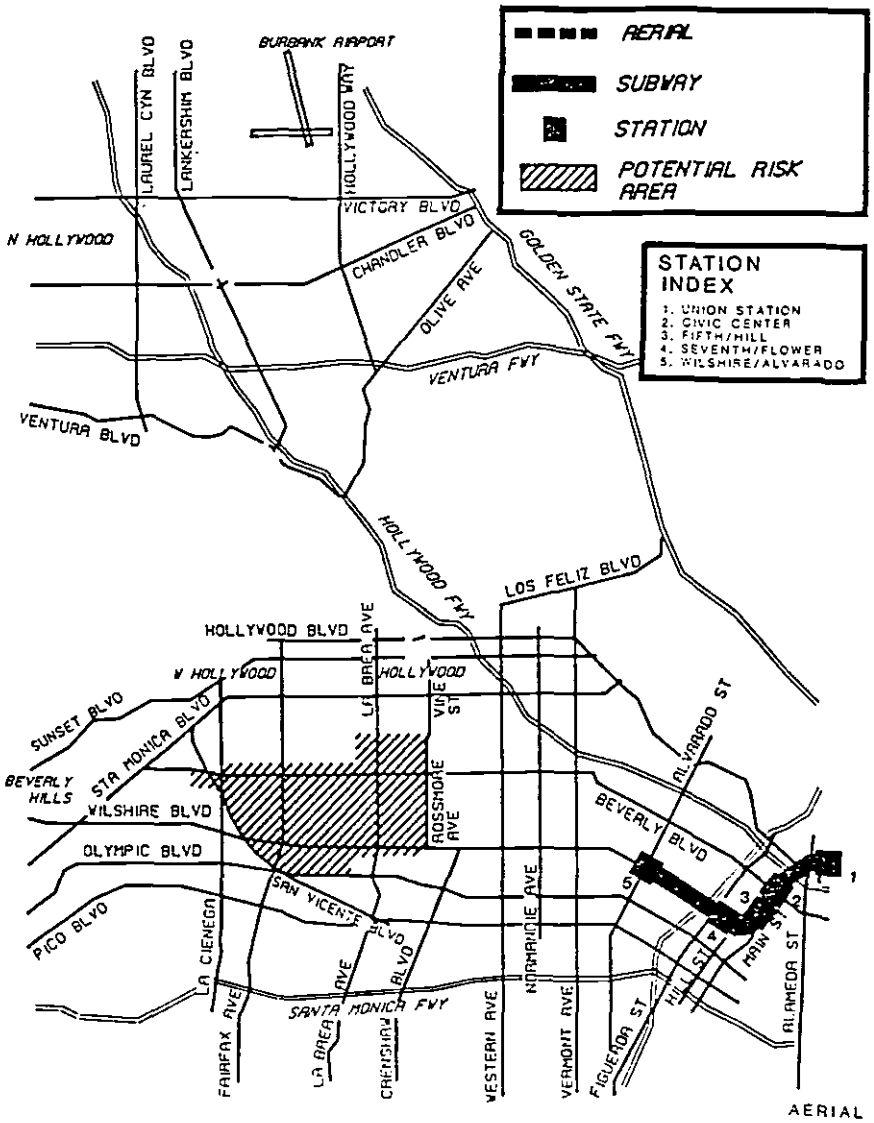


FIGURE A1-2

NULL ALTERNATIVE (MOS-1)
CBD/WILSHIRE SUBWAY



AERIAL 0 MILES
SUBWAY 4.4 MILES

SOURCE: SCRTD

A1.2 LONG BEACH - LOS ANGELES LIGHT RAIL TRANSIT PROJECT

The Long Beach - Los Angeles transit project is a conventional light rail system connecting downtown Los Angeles with downtown Long Beach. The 23 mile alignment will consist of 22 stations (Table A1-2) and will pass through the cities of Compton and Carson beach with approximately 18 miles of the alignment combining with the Southern Pacific Transportation Company right-of-way. Network coding for the LA-LB LRT entailed modifications to the routes of 19 bus lines in addition to the definition of park-and-ride, kiss-and-ride, and walk networks associated with each station.

TABLE A1-2

LB-LA-LRT STATIONS

7TH/FLOWER (ALSO SERVES MOS-1)
PICO/FLOWER
WASHINGTON/GRAND
WASHINGTON/SAN PEDRO
WASHINGTON/LONG BEACH
LONG BEACH/VERNON
SPTC ROW/SLAUSON
SPTC ROW/FLORENCE
SPTC ROW/FIRESTONE
SPTC ROW/103RD
SPTC ROW/IMPERIAL/WILMINGTON P(940)
(Also serves the Century-El Segundo LRT)
SPTC ROW/COMPTON P(130)
SPTC ROW/ARTESIA P(390)
SPTC ROW/DEL ALMO P(275)
SPTC ROW/WARDLOW P(35)
SPTC ROW/WILLOW P(195)
LONG BEACH/HILL
LONG BEACH/P.C.H.
LONG BEACH/ANAHEIM
LONG BEACH/6TH
LONG BEACH/FIRST
FIRST/PACIFIC
FIFTH/PACIFIC

P - PARK-AND-RIDE(CAPACITY)

Figure A1-3 and Table A1-3 define the bus interface scheme for the LB-LA LRT coding development. Table A1-4 gives the LB-LA LRT link travel times as were coded by direction into the network links.

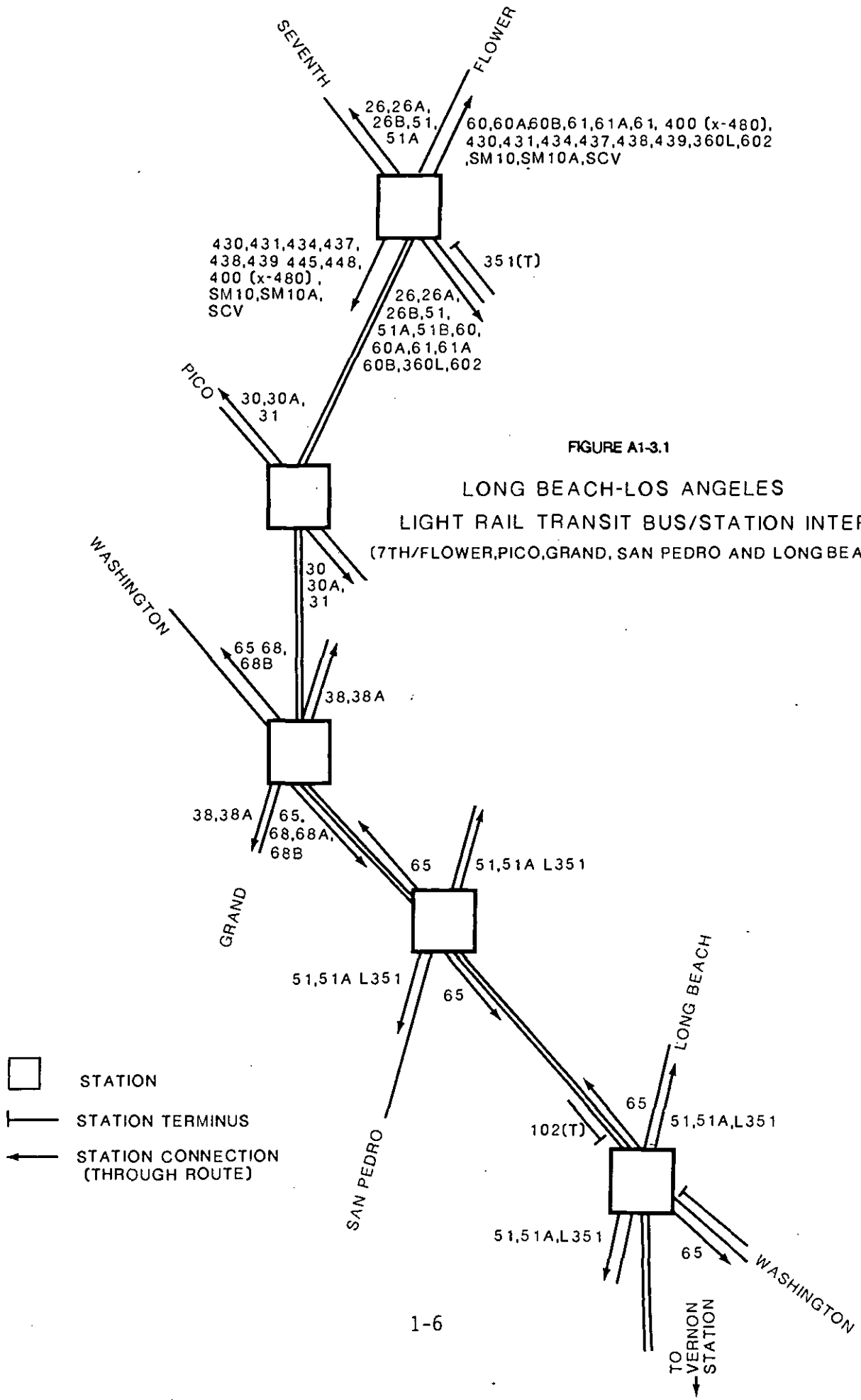


FIGURE A1-3.1

LONG BEACH-LOS ANGELES

LIGHT RAIL TRANSIT BUS/STATION INTERFACE

(7TH/FLOWER,PICO,GRAND, SAN PEDRO AND LONG BEACH STATIONS)

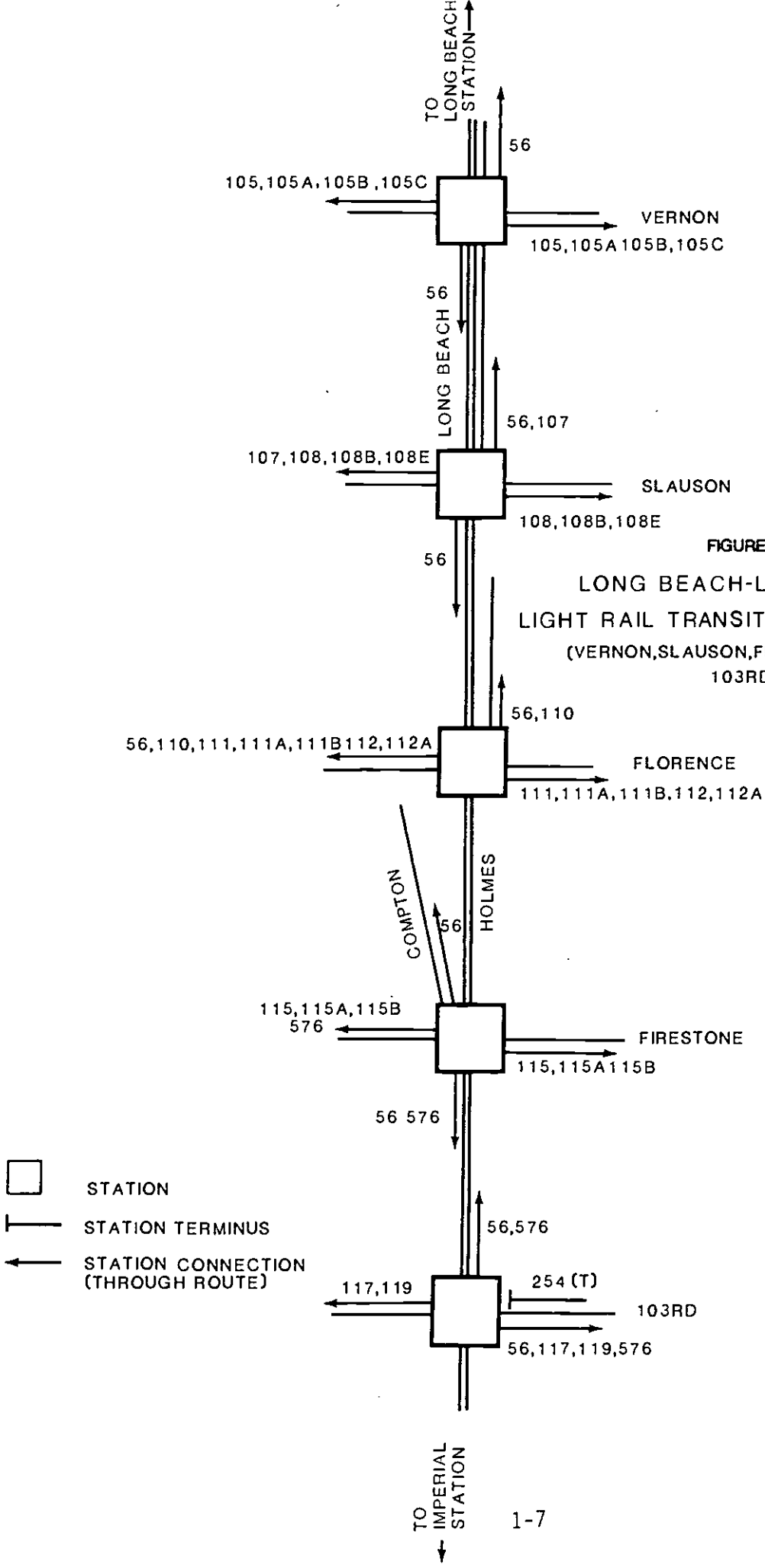


FIGURE A1-3.2

LONG BEACH-LOS ANGELES

LIGHT RAIL TRANSIT BUS/STATION INTERFACE

(VERNON,SLAUSON,FLORENCE, FIRESTONE, AND 103RD STATIONS)

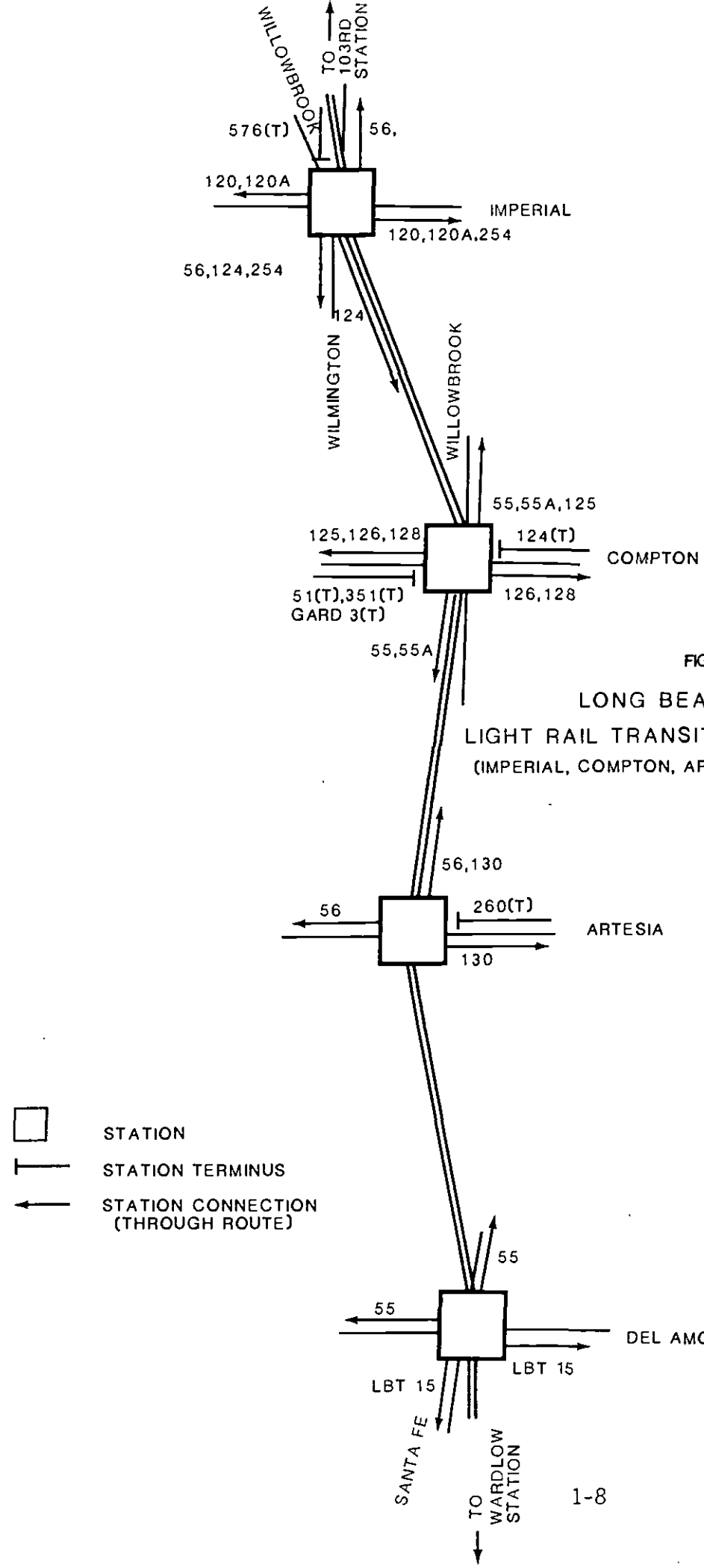


FIGURE A1-3.3

LONG BEACH-LOS ANGELES

LIGHT RAIL TRANSIT BUS/STATION INTERFACE

(IMPERIAL, COMPTON, ARTESIA, AND DEL AMO STATIONS)

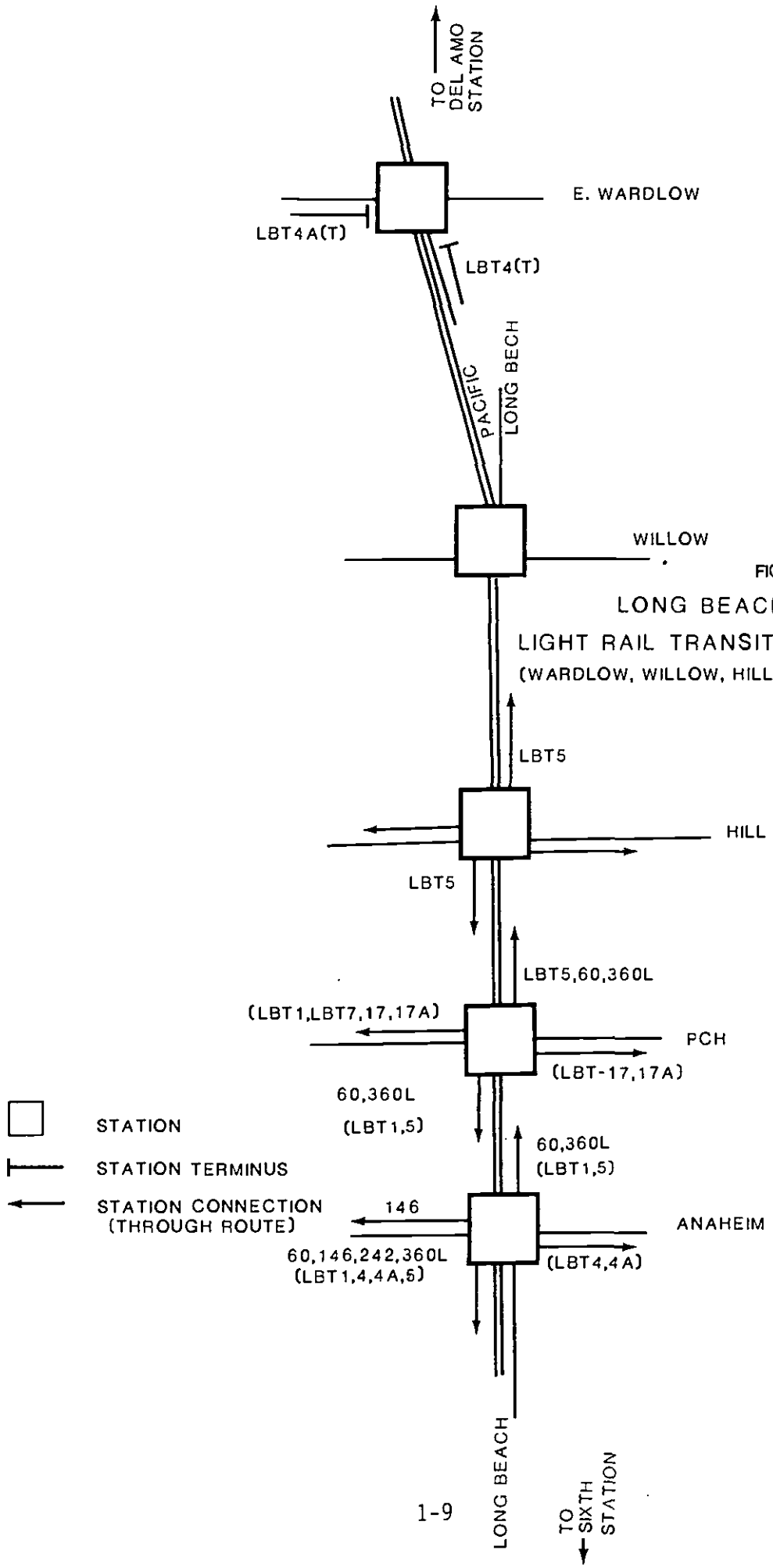


FIGURE A1-3.4

LONG BEACH-LOS ANGELES

LIGHT RAIL TRANSIT BUS/STATION INTERFACE

(WARDLOW, WILLOW, HILL, P.C.H. AND ANHEIM STATIONS)

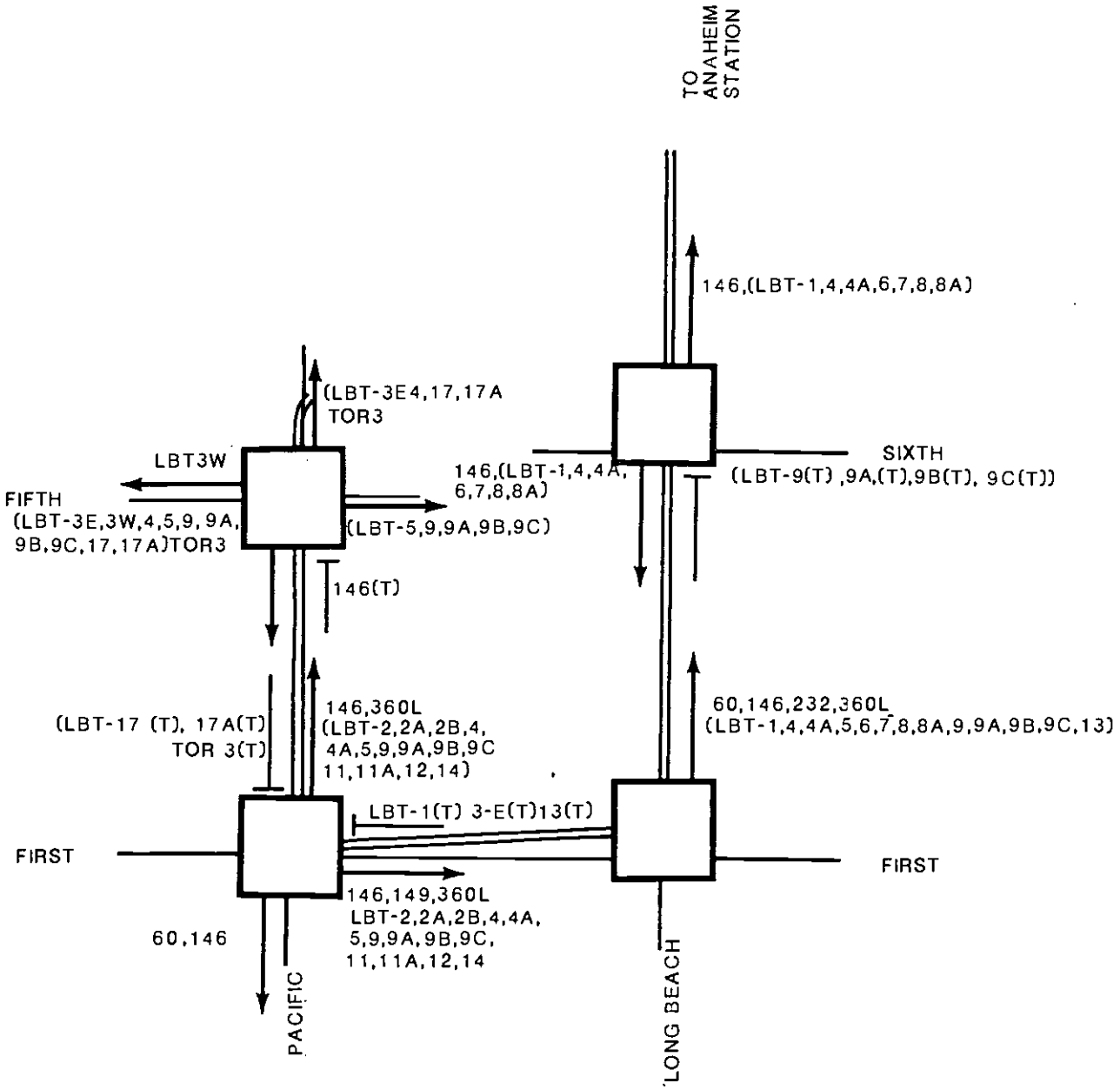


FIGURE A1-3.5

LONG BEACH-LOS ANGELES

LIGHT RAIL TRANSIT BUS/STATION INTERFACE

(SIXTH/LONG BEACH, FIRST/LONG BEACH, FIRST/PACIFIC, AND FIFTH/PACIFIC)

STATION

STATION TERMINUS

STATION CONNECTION (THROUGH ROUTE)

TABLE A1-3

BUS/STATION INTERFACE FOR NETWORKS-3 AND 4

LONG BEACH - LOS ANGELES LRT

LINE #	BUS ROUTE / + CODED DESCRIPTION
55	LOS ANGELES, COMPTON, WILMINGTON VIA COMPTON AVE.
	o Extended from Compton via 104th, Grandee, and 103rd to serve the 103rd street station. Also in service to Imperial station, the line is extended north from 119th via Wilmington and Imperial Highway, returning via Willowbrook. rerouted between intersections of Victoria/ Susana and Alameda/Del Almo, west on Del Almo to serve the Del Almo station, leaving north on Santa Fe.
56	LOS ANGELES, CARSON VIA WILMINGTON AVE.
	o Rerouted from Wilmington on Walnut through the Artesia station, then back to regular routing via Acacia ave to Wilmington.
102	EAST JEFFERSON BLVD - COLISEUM ST
	o Routed north from 41st st to serve the Washington station via Compton Ave, Washington Blvd, and Long Beach Ave.
104	LOS ANGELES - LA MIRADA VIA EAST WASHINGTON BLVD
	o Extended from Washington/Soto via Washington to the Washington station. Present service between Washington/ Soto and Olympic/Boyle discontinued
107	FAIRVIEW BLVD - 54TH STREET - SANTA ANA STREET
	o Extended south from 55th to serve the Slauson station operating via Compton, Slauson, and Holmes.
110	GAGE AVE - CENTINELA BLVD - FOX HILLS MALL
	o Routed south off Gage to serve the Florence station via Compton, Florence, and Holmes.

TABLE A1-3 (CONTINUED)

BUS/STATION INTERFACE FOR NETWORKS-3 and 4

LONG BEACH - LOS ANGELES LRT

LINE #	BUS ROUTE / + CODED DESCRIPTION
119	FERNWOOD AVE - 108TH ST.
	o Service continued northwest on Santa Ana to Willowbrook, north on Willowbrook to the 103rd st. station, circulating through and returning south on Willowbrook to resume regular service operations along 1o8th st.
124	EL SEGUNDO BLVD - SANTA FE AVE
	o Line extended to Compton station. also diverted to serve Imperial station, from 119th/Wilmington, north on Wilmington to Imperial Highway, through the Imperial station and south on Willowbrook to 119th.
125	ROSECRANS AVE
	o Service routed down Willowbrook from Rosecrans to the Compton Station and Compton Transit Center at Palmer.
127	COMPTON BLVD - BELLFLOWER BLVD
	o Extended north from Compton blvd to the Compton station and Compton Transit Center at Palmer.
128	ALONDRA BLVD
	o Western terminus extended north from Compton/Willowbrook two blocks to the Compton station and proposed Compton Transit Center
130	ARTESIA BLVD.
	o Line serves the Artesia station per existing coding.
250	BOYLE AVE
	o Extended from Southern terminus at Boyle/Olympic to the Washington Station via Olympic, Santa Fe, 15th, and Long Beach Ave to 20th.

TABLE A1-3 (CONTINUED)

BUS/STATION INTERFACE FOR NETWORKS-3 and 4

LONG BEACH - LOS ANGELES LRT

LINE #	BUS ROUTE / + CODED DESCRIPTION
254	120TH ST - HUNTINGTON PARK - LORENA AVE
	o Diverted between 119/Wilmington and Imperial/Mona. Extended west from 103rd/Grape, via 103rd and Graham to serve the 103rd station.
260	LONG BEACH - PASADENA - ALTADENA VIA ATLANTIC BLVD
	o Service south of Artesia and into Long Beach discontinued. line extended west from Atlantic along Artesia and Acacia to the Artesia station.
358	LOS ANGELES - LYNWOOD - PARAMOUNT LIMITED
	o Deleted from network. Line proposed for cancellation. Service to be assumed by LA-LB LRT and a peak hour extension of line 119.
456	LOS ANGELES - LONG BEACH EXPRESS
	o Deleted from network. Line proposed for cancellation. Service to be assumed by LA-LB LRT and line 51.
457	LOS ANGELES - EAST LONG BEACH EXPRESS
	o Deleted from network. Line proposed for cancellation. access to LA-LB LRT to be accomodated by Long Beach transit, east/west lines.
576	SOUTH LOS ANGELES - PACIFIC PALISADES EXPRESS
	o Line cut-back three blocks from south terminus at 119th/ Wilmington to a new terminus at the Imperial station. Also routed by the 103rd St station via Wilmington, Santa Ana Blvd, Graham, 103rd, Beach, Century, and back to present route.

TABLE A1-4

LONG BEACH - LOS ANGELES LINK TRAVEL TIMES

STATION	SOUTHBOUND (MILES)	SOUTHBOUND (MINUTES)	NORTHBOUND (MILES)	NORTHBOUND (MINUTES)
	<<READ DOWN>>		<<READ UP>>	
7TH/FLOWER	-	-	0.74	2.13
PICO	0.74	1.98	0.65	3.75
GRAND	0.65	2.47	0.80	2.43
SAN PEDRO	0.80	4.32	0.98	3.93
WASHINGTON	0.98	5.23	1.13	2.42
VERNON	1.13	2.13	1.01	1.87
SLAUSON	1.01	1.90	1.00	3.10
FLORENCE	1.00	3.00	1.01	1.92
FIRESTONE	1.01	1.93	1.16	2.08
103RD	1.16	2.00	1.07	2.07
IMPERIAL	1.07	1.90	2.34	3:38
COMPTON	2.34	3.40	1.43	2.37
ARTESIA	1.43	2.30	2.09	3.05
DEL ALMO	2.09	3.07	2.17	3.33
WARDLOW	2.17	3.23	0.80	1.63
WILLOW	0.80	1.60	1.25	5.13
P.C.H.	1.25	5.47	0.49	2.00
ANAHEIM	0.49	2.13	0.93	7.30
LONG BEACH/SIXTH	0.60	3.77	-	-
LONG BEACH/FIRST	0.33	2.67	-	-
FIRST/PACIFIC	0.24	1.62	-	-
FIFTH/PACIFIC	-	-	-	-
FIRST/PACIFIC	-	-	0.29	3.52

A1.3 CENTURY LIGHT RAIL TRANSIT PROJECT

The Century LRT is a 17 mile line which when completed will run from the vicinity of LAX on the west to Norwalk on the east, along the median of the Century Freeway. Both freeway and LRT are concurrently under construction. The Century line will consist of 10 stations (Table A1-5) with stops connecting to the proposed Harbor Transitway and the Long Beach-Los Angeles LRT.

TABLE A1-5

CENTURY LRT STATIONS

I-105/AVIATION P(1165)
I-105/HAWTHORNE P(812)
I-105/CRENSHAW P(539)
I-105/VERMONT P(274)
I-105/I-110 P(373)
I-105/AVALON P(178)
I-105/IMPERIAL/WILMINGTON (ALSO SERVES LA-LB LRT) P(940)
I-105/LONG BEACH BLVD P(820)
I-105/LAKEWOOD P(450)
I-105/I-605 (NORWALK) P(2058)

P - PARK-AND-RIDE(CAPACITY)

Figure A1-4 and Table A1-6 describe the bus intercept scheme for the Century LRT coding development. Table A1-7 shows the Century LRT link speeds and conversion to travel time as coded into the network links.

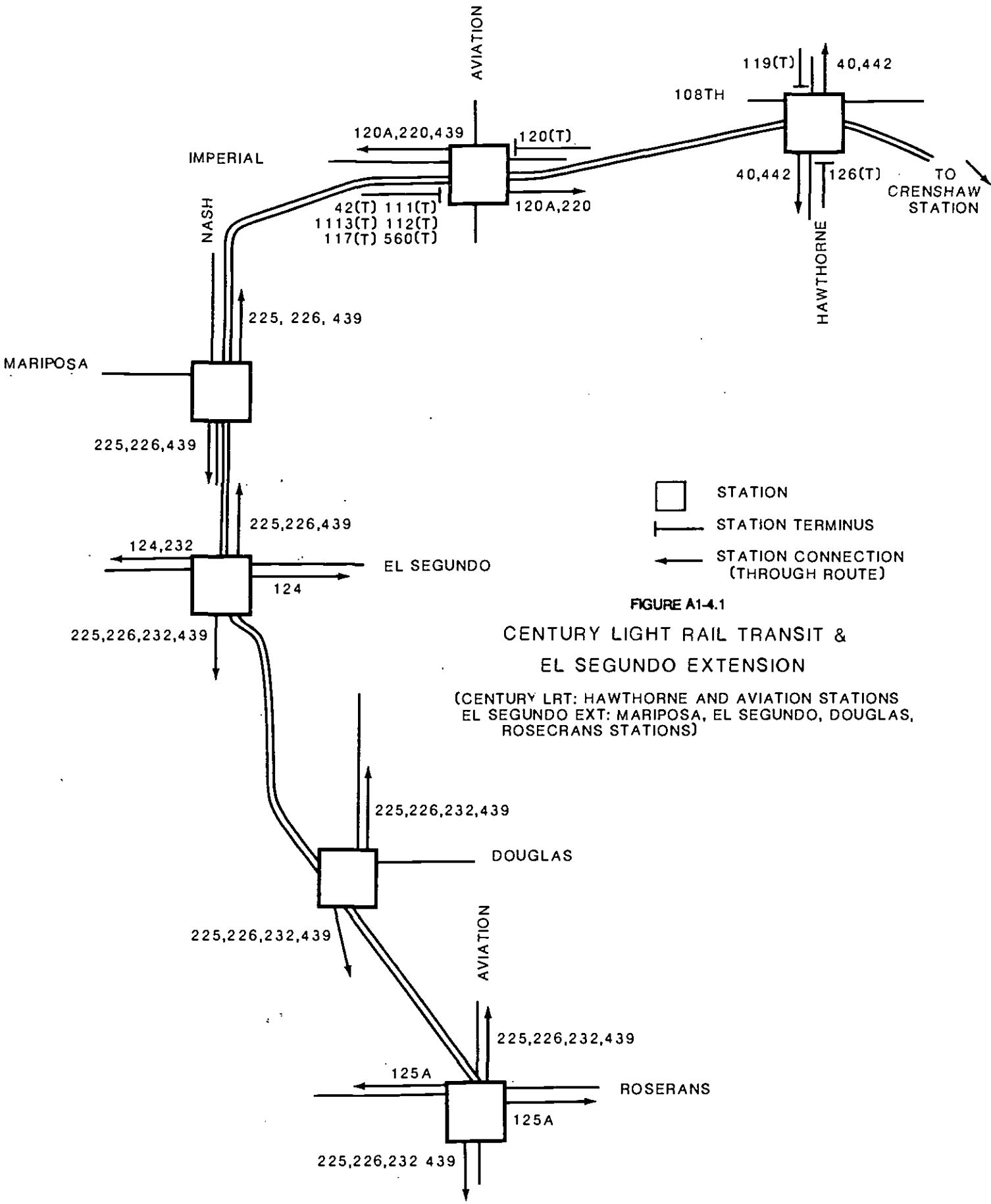


FIGURE A1-4.1

CENTURY LIGHT RAIL TRANSIT &

EL SEGUNDO EXTENSION

(CENTURY LRT: HAWTHORNE AND AVIATION STATIONS
EL SEGUNDO EXT: MARIPOSA, EL SEGUNDO, DOUGLAS,
ROSECRANS STATIONS)

FIGURE A1-4.2

CENTURY LIGHT RAIL TRANSIT

(CRENSHAW, VERMONT, HARBOR, AVALON, AND WILMINGTON STATIONS)

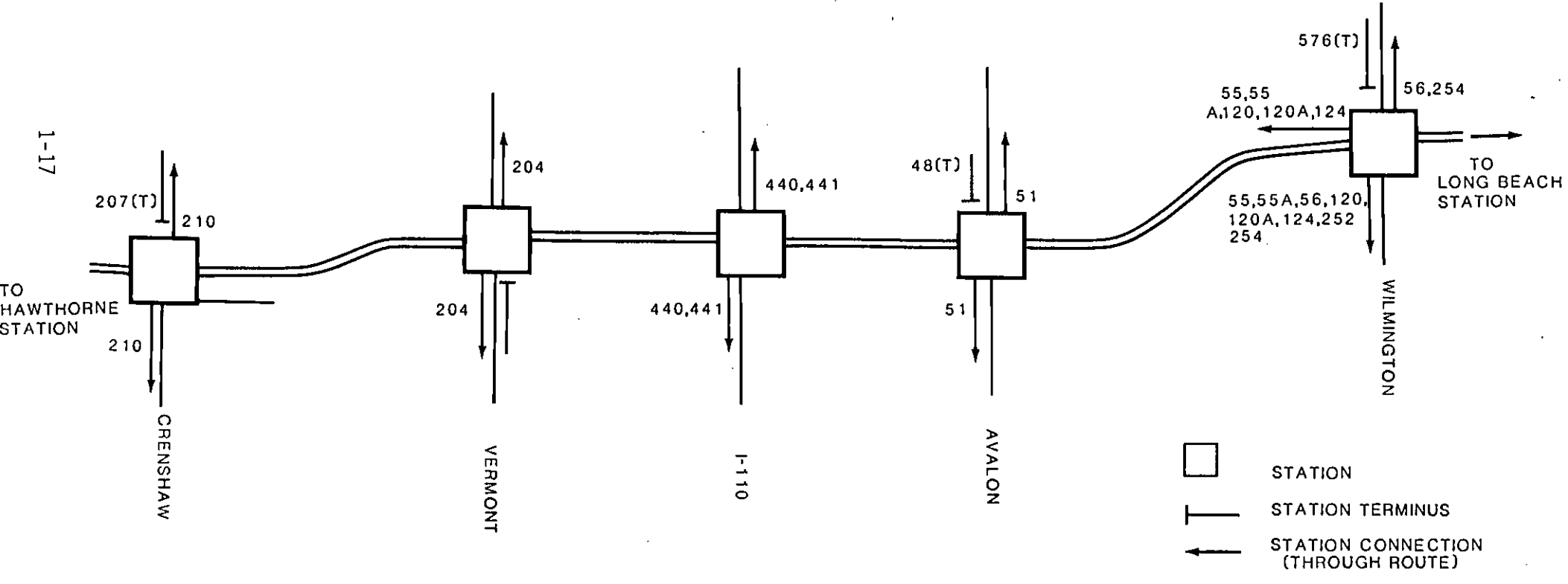


FIGURE A1-4.3

CENTURY LIGHT RAIL TRANSIT

(LONG BEACH, LAKEWOOD,AND NORWALK, STATIONS)

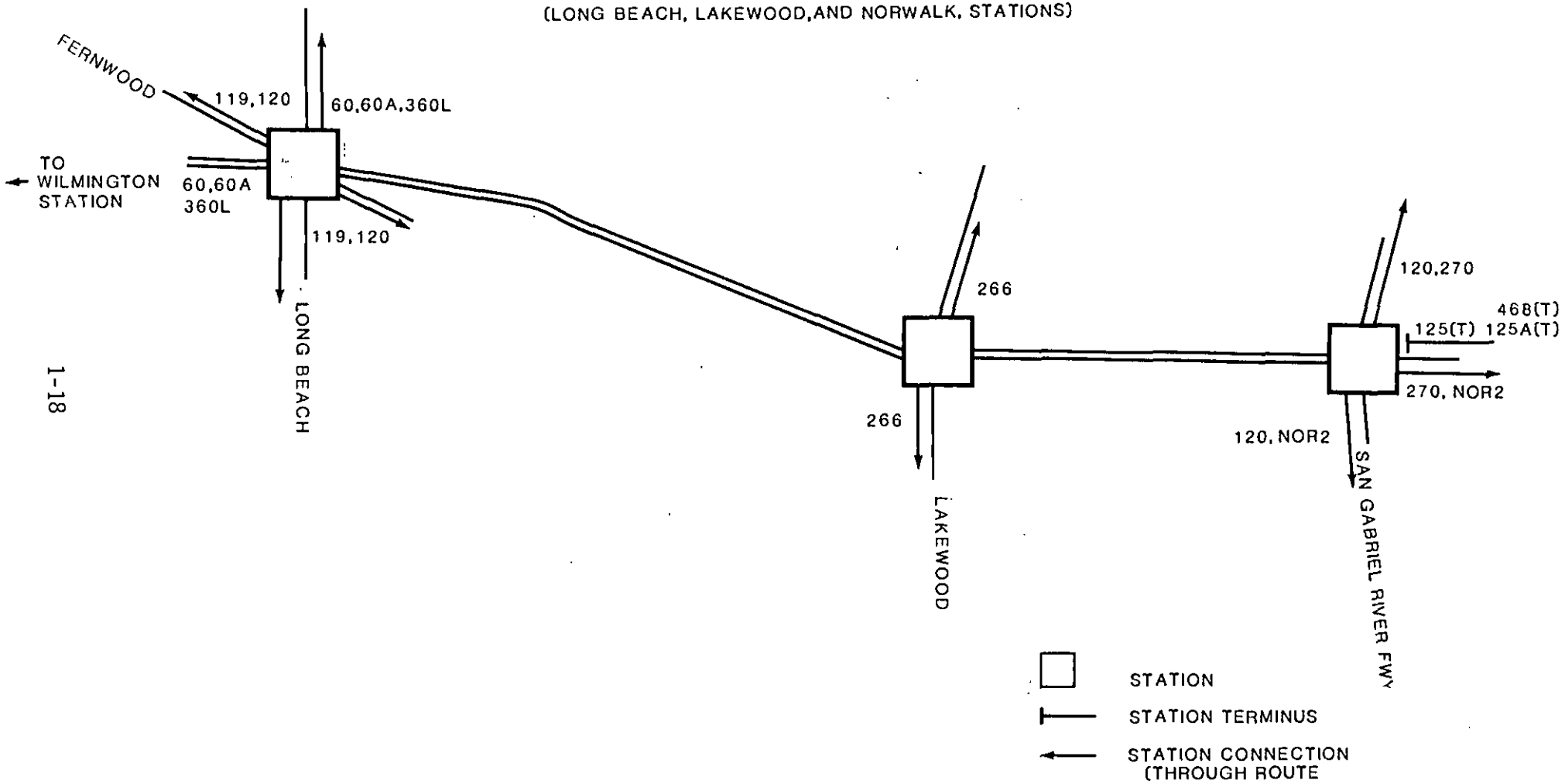


TABLE A1-6

BUS/STATION INTERFACE FOR NETWORKS-3 and 4

CENTURY/EL SEGUNDO LRT

LINE #	BUS ROUTE / + CODED DESCRIPTION
42	LOS ANGELES, WESTCHESTER, REDONDO BEACH
	o Extended south from LAX Transit Center to terminate at Aviation station.
48	MAPLE AVE, SOUTH MAIN
	o Extended south from current terminus at San Pedro/Firestone to the Avalon station via Firestone and Artesia.
55	WILMINGTON - LOS ANGELES VIA COMPTON
	o Extended north from 119th to serve the Imperial station
56	CARSON - LOS ANGELES VIA WILMINGTON
	o Diverted off Wilmington ave to serve the Imperial station.
111	LAX, FLORENCE AVE, LEFFINGWELL RD
	o Line extended south from LAX Transit Center to terminate at the Aviation station.
112	LAX, FLORENCE AVE, OTIS ST
	o Line extended south from LAX transit center to terminate at the Aviation station.
117	CENTURY BLVD
	o Line extended south from LAX transit center to terminate at the Aviation station.
119	108TH ST, FERNWOOD AVE
	o Southern-most terminus at Hawthorne station

TABLE A1-6(CONTINUED)

BUS/STATION INTERFACE FOR NETWORKS-3 and 4

CENTURY/EL SEGUNDO LRT

LINE #	BUS ROUTE / + CODED DESCRIPTION
120	IMPERIAL HWY
	o Western terminus at Aviation station, following alignment to interface with Imperial station and with the Norwalk Transit Center.
124	EL SEGUNDO BLVD, SANTA FE AVE
	o Rerouted north of 119th to serve the Imperial station also serves El Segundo station.
125	ROSECRANS AVE
	o Service rerouted north on Rosecrans to terminate at the Norwalk Transit Center. Short-line connects with Rosecrans station in western service extent.
126	YUKON AVE, MANHATTAN BEACH BLVD
	o Northern-most terminus at Hawthorne station
207	WESTERN AVE.
	o Extended south from its terminal at Imperial/Western to terminate at the Crenshaw station.
220	ROBERTSON BLVD, CULVER CITY, LAX
	o Extended east from Sepulveda to serve the Aviation Station via Imperial, continuing to the LAX Transit Center.
254	120TH ST, HUNTINGTON PARK, LORENA ST
	o rerouted north to serve the Imperial station.
270	EL MONTE, CERRITOS
	o Rerouted west of Studebaker to serve the Norwalk Transit Center.

TABLE A1-6(CONTINUED)

BUS/STATION INTERFACE FOR NETWORKS-3 and 4

CENTURY/EL SEGUNDO LRT

LINE #	BUS ROUTE / + CODED DESCRIPTION
439	LA, LAX, REDONDO BEACH
	o Rerouted east from Douglas/Imperial to serve the Aviation station.
468	SOUTH LOS ANGELES - PACIFIC PALISADES EXPRESS
	o New service to operate from Fullerton park-and-ride on Orangethrope near the Santa Ana Fwy. Line 468 will operate on the Santa Ana Fwy to Rosecrans, then west on Rosecrans to Studebaker, north to Foster, and west on Foster to terminate at the norwalk LRT station. Headways are coded at 12/12 minutes (am/pm).
560	LAX, SAN DIEGO FWY, VAN NUYS BLVD
	o Extended south from the LAX Transit Center to a terminus at the Aviation station.
576	SOUTH LOS ANGELES - PACIFIC PALISADES EXPRESS
	o Line cut-back three blocks from south terminus at 119th/ Wilmington to a new terminus at the Imperial station.

TABLE A1-7

CENTURY LRT LINK SPEEDS

STATION LINK	DISTANCE (MILES)	CODED TRAVEL TIME* (MINUTES)	LINK SPEED (MPH)
NORWALK-LAKEWOOD	2.10	3.13	40.26
LAKEWOOD-LONG BEACH	4.20	5.41	46.58
LONG BEACH-WILMINGTON	1.71	2.70	38.00
WILMINGTON-AVALON	1.57	2.55	36.94
AVALON-HARBOR FWY	0.87	1.78	29.33
HARBOR FWY-VERMONT	0.65	1.55	25.16
VERMONT-CRENSHAW	2.03	3.04	40.07
CRENSHAW-HAWTHORNE	1.58	2.56	37.03
HAWTHORNE-AVIATION	1.58	2.56	37.03
TOTALS	16.29	25.28	

* INCLUDES RUNNING TIME + STATION DWELL TIME

A1.4 EL SEGUNDO LRT EXTENSION

The El Segundo extension to the Century LRT will tie into the Century line at the Aviation station. With four additional stations in El Segundo (Table A1-8) , the alignment will run south south-east to a terminal station near Compton Blvd.

TABLE A1-8

EL SEGUNDO EXTENSION LRT STATIONS

MARIPOSA/NASH
EL SEGUNDO/NASH
DOUGLAS ST
ROSECRANS/AVIATION

Figure A1-5 and Table A1-9 describe the bus intercept scheme for the Century/ El Segundo extension LRT coding development. Table A1-10 shows the El Segundo link speeds and conversion to travel time as coded into the network links file.

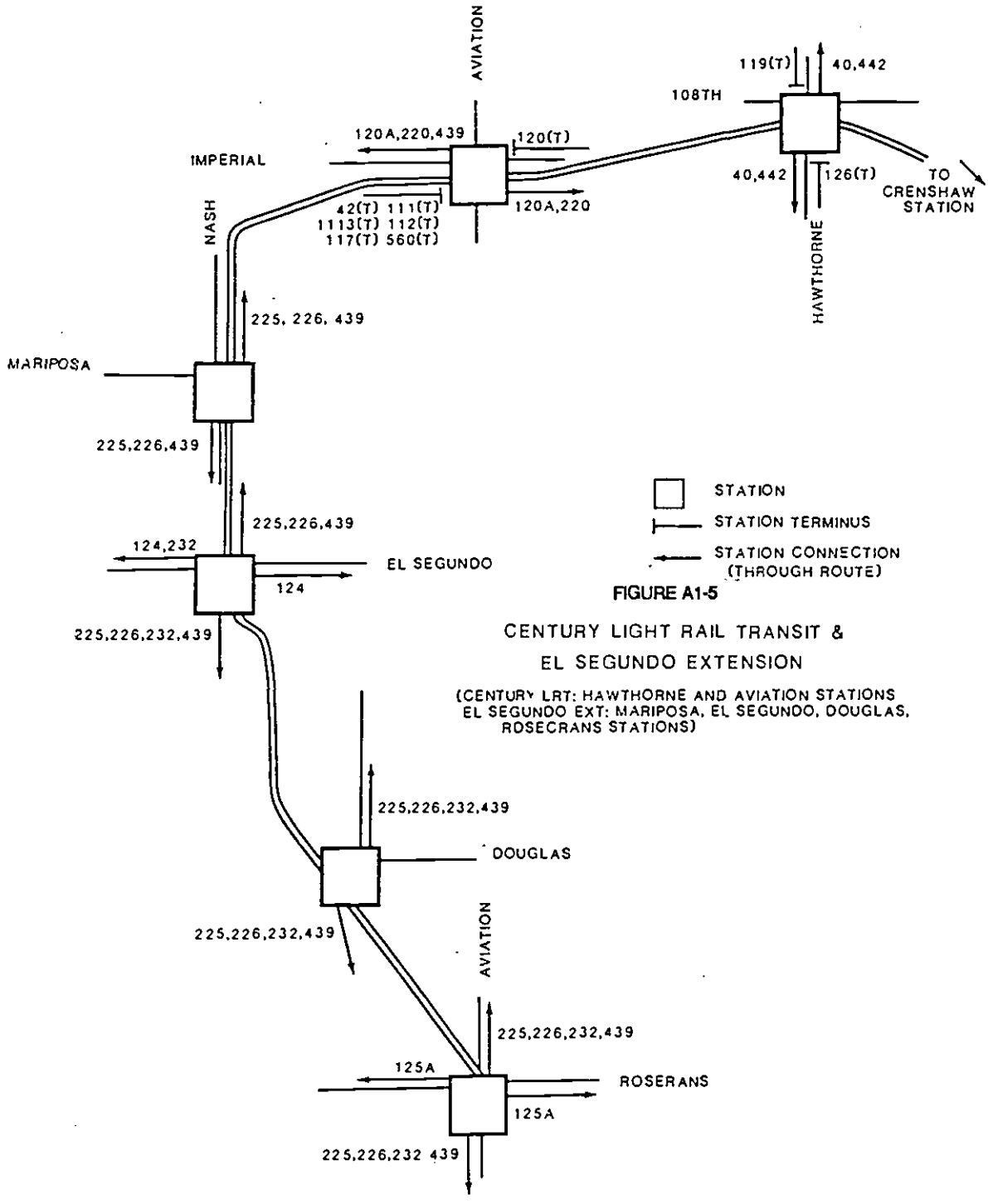


FIGURE A1-5

CENTURY LIGHT RAIL TRANSIT &
EL SEGUNDO EXTENSION

(CENTURY LRT: HAWTHORNE AND AVIATION STATIONS
EL SEGUNDO EXT: MARIPOSA, EL SEGUNDO, DOUGLAS,
ROSECRANS STATIONS)

TABLE A1-9

BUS/STATION INTERFACE FOR NETWORKS-3 AND 4

CENTURY/EL SEGUNDO LRT

LINE #	BUS ROUTE / + CODED DESCRIPTION
124	EL SEGUNDO BLVD, SANTA FE AVE
	o Rerouted north of 119th to serve the Imperial station also serves El Segundo station.
125	ROSECRANS AVE
	o Service rerouted north on Rosecrans to terminate at the Norwalk Transit Center. Short-line connects with Rosecrans station in western service extent.
126	YUKON AVE, MANHATTAN BEACH BLVD
	o Northern-most terminus at Hawthorne station
225	AVIATION BLVD, PALOS VERDES DRIVE N., MARINELAND
	o Serves Rosecrans, Douglas, El Segundo, Mariposa, and Aviation stations.
226	AVIATION BLVD, PALOS VERDES DRIVE N., MARINELAND
	o Serves Rosecrans, Douglas, El Segundo, Mariposa, and Aviation stations.
232	LONG BEACH, LAX
	o Serves Rosecrans, Douglas, and El Segundo stations.

TABLE A1-10

EL SEGUNDO EXTENSION CODED TRAVEL TIMES AND LINK SPEEDS

STATION LINK	DISTANCE (MILES)	CODED TRAVEL TIME* (MINUTES)	LINK SPEED (MPH)
AVIATION-MARIPOSA	0.95	1.87	30.48
MARIPOSA-EL SEGUNDO	0.61	1.50	24.40
EL SEGUNDO-DOUGLAS	0.66	1.55	25.55
DOUGLAS-COMPTON	0.66	1.55	25.55

A1.5 HARBOR BUSWAY

The initial portion of the Harbor Busway is planned to open concurrent with the opening of the Century Freeway and LRT. The Harbor Transitway will connect LA-CBD with points south, operating as an exclusive guideway.

Stations with parking capacities as coded into the network for inclusion with the Century/El Segundo LRT, LB-LA LRT, and MOS-1 in Network-3 (FOP3VER1) are given in Table A1-11. Figure A1-6 and Table A1-12 describe the bus intercept scheme for the Harbor Transitway coding development. Express service coded link speeds were increased to 38 mph, representative of the full Transitway completion to the Artesia Transit Center.

TABLE A1-11

HARBOR TRANSITWAY STATIONS AND PARKING CAPACITIES

STATION	LOT CAPACITY
EXPOSITION	200
SLAUSON	200
MANCHESTER	200
I-105	373
ROSECRANS	300
ARTESIA TRANSIT CENTER	1000
CARSON	600
PACIFIC COAST HWY.	500
SAN PEDRO TRANSIT CENTER	700

FIGURE A1-6

HARBOR TRANSITWAY OPERATING PLAN

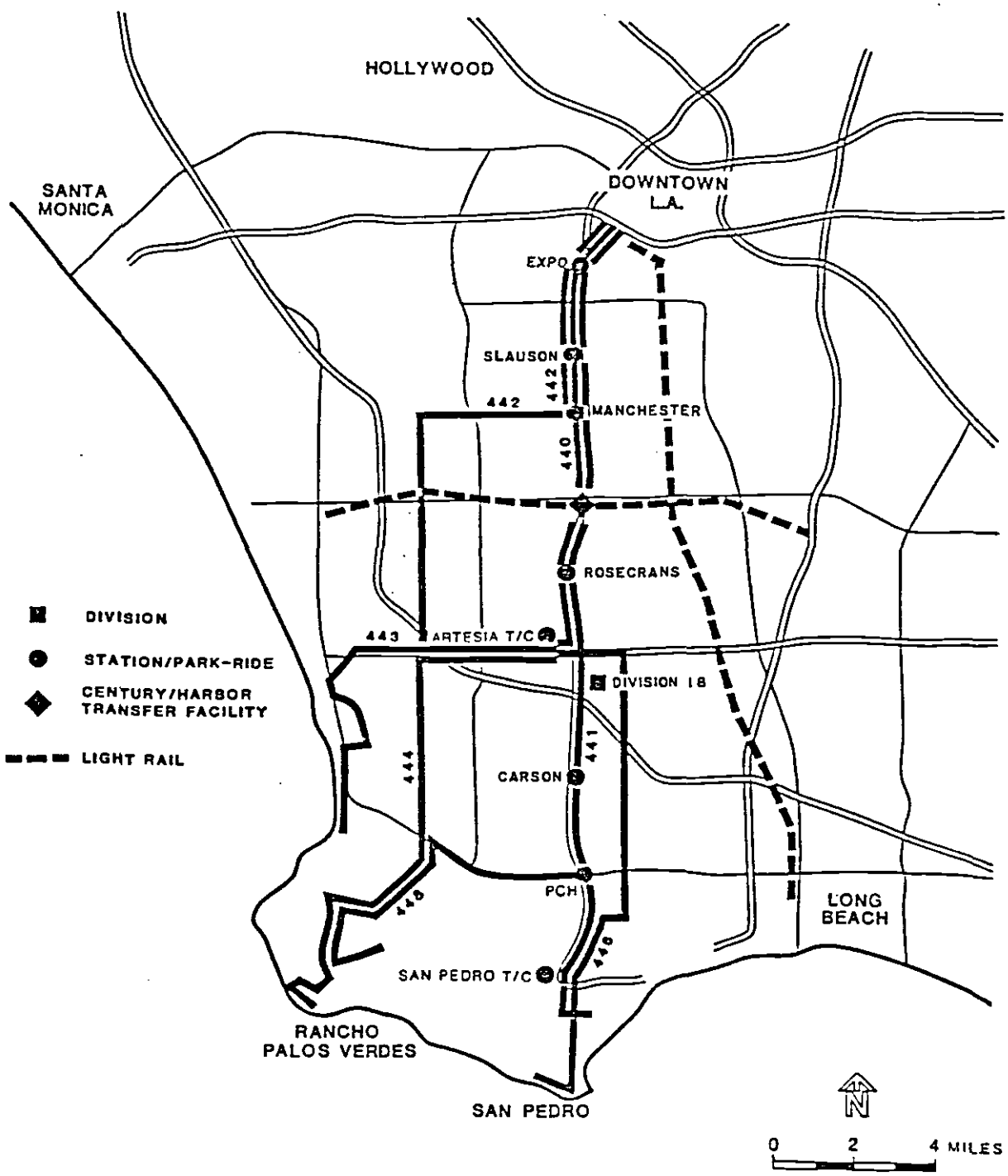


TABLE A1-12

BUS/STATION INTERFACE FOR NETWORKS 3 AND 4

HARBOR TRANSIT OPERATING PLAN

LINE #	BUS ROUTE / + CODED DESCRIPTION
440	LA, TORRANCE, REDONDO BEACH, PALOS VERDES
	o Service originates at the Artesia Transit Center, operating on the Harbor Transitway to LACBD via Artesia Blvd on/off ramps. Headways are coded at 5/5/15 (am/pm/midday)
443	LA, TORRANCE, REDONDO BEACH, PALOS VERDES
	o Turned off Aviation at Artesia, routed east on Artesia terminated at the Artesia Transit Center at Artesia and the Harbor Transitway. Headways are 35/60 (am/pm).
444	LA, WEST TORRANCE, ROLLING HILLS, MARINELAND
	o Turned off Hawthorne Blvd at Artesia, routed east on Artesia and terminated at the Artesia Transit Center at Artesia and the Harbor Transitway. Headways are 20/25/35 (am/pm/midday).
445	LA, ALPINE VILLAGE, SAN PEDRO PARK-AND-RIDE
	o Service suspended. Replaced by line 441.
446	LA, CARSON, WILMINGTON, SAN PEDRO
	o Line routed west off Avalon on Artesia to a terminus at the Artesia Transit Center. Headways are 50/30/50 minutes (am/pm/midday).
448	LA, PALOS VERDES PENNINSULA EXPRESS
	o Service terminated on Pacific Coast Highway routing at the PCH transit terminal at the Harbor Transitway. Headways are coded at 60/60 minutes (am/pm).

APPENDIX 2

COMMITTED/TSM NETWORK

APPENDIX-2

COMMITTED/TSM NETWORK (FOP3TSM1)

Several TSM ALternatives have been applied to Network-3 to offer a comparative base with which to compare the Metro Rail MOS-2 project. Appendix-2 provides network coding documentation which overlay a variety of TSM improvements affecting bus transit performance onto the system defined as Network-3 in Appendix-1.

The TSM improvements associated with Network-3 include:

1. Prohibition of left turns on 7th Street from Alvarado to the Harbor Freeway, increasing 7th Street speeds by 15 percent.

2. Prohibition of left turns on Olympic Blvd from San Pedro Street to La Cienega Blvd., increasing Olympic Blvd speeds by 15 percent.

3. Implementation of reversible lanes on Olympic Blvd between San Pedro Street and La Cienega Blvd., increasing speeds by an additional 10 percent.

4. Implementation of the LADOT computerized signal control system, increasing speeds on the bus routes on Olympic, Wilshire, and Cahuenga Boulevards by 7 percent, and increasing auto speeds by 7 percent on all arterial streets in the LADOT program area, as shown in Figure A2-1.

5. Implementation of bus route diversions listed in Table A2-11 (Bus/Station Interface) affecting routes L-4, 423, 424, 425, 426/426A, and 426 (see Figure A2-1)

6. Construction of transit centers at Universal City and at Hollywood/Cahuenga

The station interface for rail and busway are otherwise identical to the changes ascribed to Network-3 (FOP3VER1) as shown in Appendix-1.

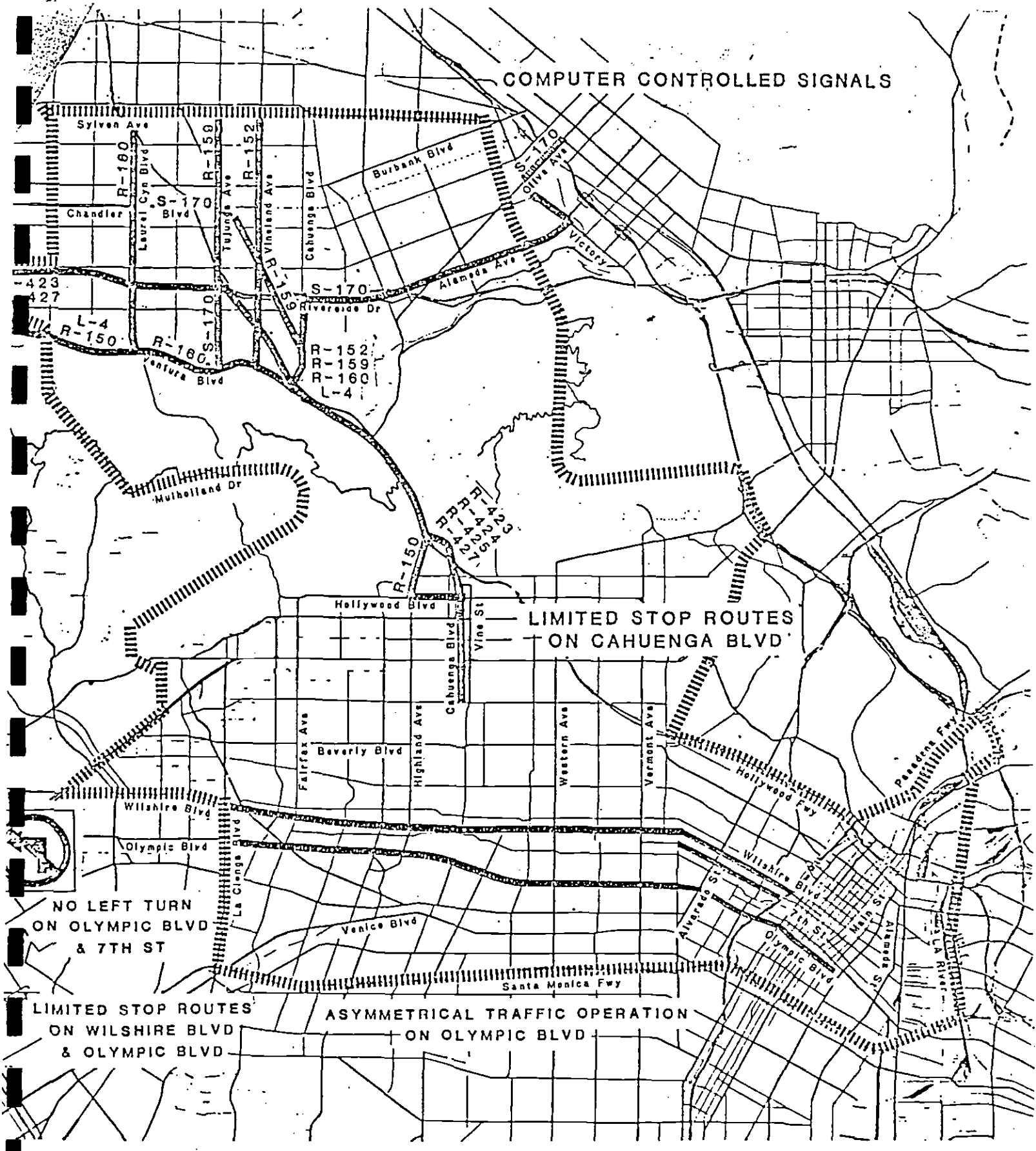


FIGURE A2-1

18.6 MILE TSM ALTERNATIVE

TABLE A2-1

BUS/STATION INTERFACE FOR ROUTES AFFECTED BY 18.6 MILE TSM ALTERNATIVE ADJUSTMENTS TO NETWORK-3 AS CODED

LINE #	BUS ROUTE / + CODED DESCRIPTION
L4	(LIMITED) VENTURA HILLS TO UNIVERSAL CITY TRANSIT CENTER
	o Routed along Ventura, headways are coded at 5/8 (am-peak/ pm peak)
423	(EXPRESS) LA, WOODLAND HILLS, WESTLAKE VILLAGE
	o Diverted to serve Universal City Transit Center
424	(EXPRESS) LA-CBD, VENTURA BLVD.
	o Service from Universal City Transit Center to LA-CBD
425	(EXPRESS) LA-CBD, VENTURA BLVD.
	o Service from Universal City Transit Center to LA-CBD
426	EXPRESS) LA-CBD, WILSHIRE BLVD., SAN FERNANDO VALLEY
	o Diverted to serve Universal City Transit Center
427	(EXPRESS) LA-CBD, TARZANA, WOODLAND HILLS, CANOGA PARK
	o Diverted to serve Universal City Transit Center

APPENDIX 3

COMMITTED/MOS-2 NETWORK

APPENDIX-3

COMMITTED NETWORK/MOS-2B (FOP4VER3)

A-3.1 CANDIDATE ALIGNMENT 4: MOS-2B

The MOS-2B configuration of Alignment 4 has temporary terminals at Wilshire/Vermont and Universal City stations and is comprised of the 9 stations listed in Table A3-1 in addition to MOS-1 (see Figure A3-1).

TABLE A3-1

CANDIDATE ALIGNMENT 4: MOS-2B

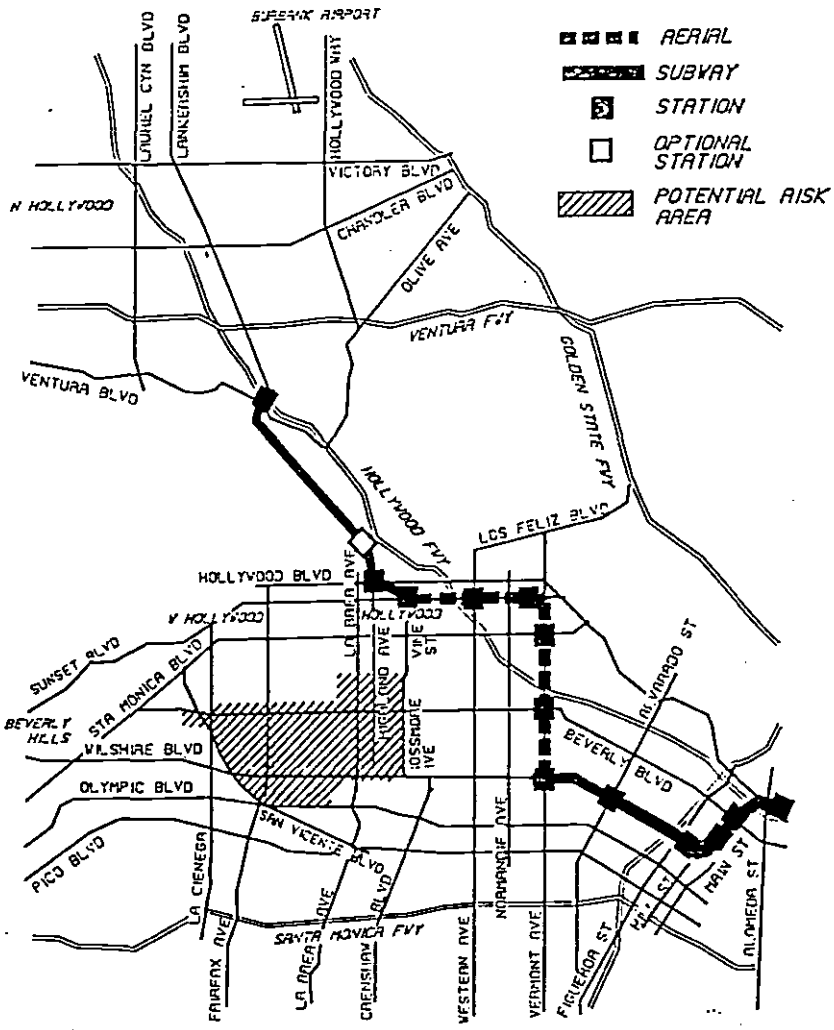
WILSHIRE/VERMONT
VERMONT/BEVERLY
VERMONT/SANTA MONICA
SUNSET/EDGEMONT
SUNSET/WESTERN
SUNSET/VINE
HOLLYWOOD/HIGHLAND
HOLLYWOOD BOWL (OPTIONAL)
UNIVERSAL CITY

P-PARK-AND-RIDE (CAPACITY)

The bus/rail interface and kiss-and-ride/walk link configuration for MOS-2B as appended to former Network-3 (FOP3VER1) are the same as those applied to the original development of this alignment in the C.O.R.E. alternatives analysis (see figure A3-2 and table A3-2)

FIGURE A3-1

CORE STUDY AREA:
CANDIDATE ALIGNMENT 4: MOS-2B



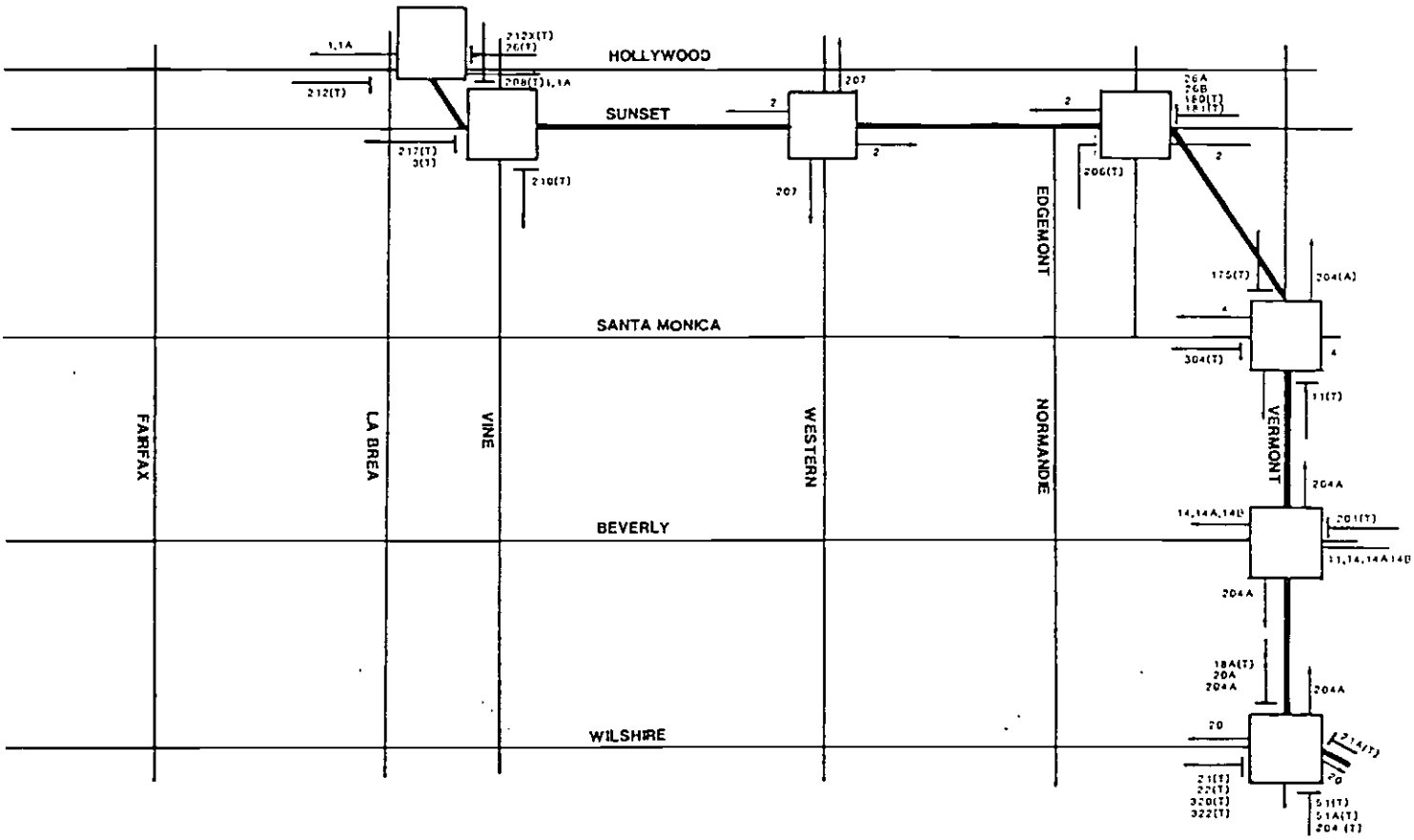


FIGURE A-3-2

CANDIDATE ALIGNMENT 4: MOS2-B
BUS/STATION INTERFACE

STATION

ROUTE TERMINUS

ROUTE CONNECTION
(THROUGH ROUTE)

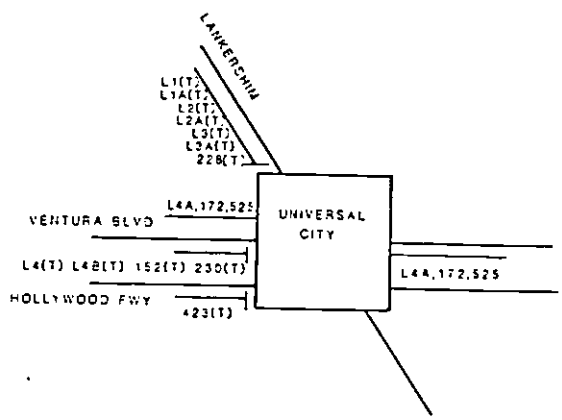


TABLE A3-2

BUS/STATION INTERFACE FOR CANDIDATE ALIGNMENT 4: MOS-2B

METRO RAIL

LINE #	BUS ROUTE / + CODED DESCRIPTION
<WEST/NORTH BRANCH LINES>	
3	SUNSET BLVD., BEVERLY DR. - BEVERLY HILLS
o	Service terminated on Sunset at the Sunset/Vine station.
21	WILSHIRE BLVD., UCLA - WESTWOOD TO LA-CBD
o	Service terminated at the Wilshire/Vermont station.
22	WILSHIRE BLVD., UCLA - SANTA MONICA TO LA-CBD
o	Service terminated at the Wilshire/Vermont station.
26	7TH ST., VIRGIL AVE., FRANKLIN AVE.
o	Franklin Ave. service turns south on Vine and terminates at the Sunset/Vine station, accounting for approximately half of the service frequency with the other half intercepting the Sunset/Edgemont station via Sunset Blvd.
180	HOLLYWOOD, GLENDALE, PASADENA VIA COLORADO BLVD.
o	Turned south off Franklin on Vermont to Sunset to a terminus at the Sunset/Edgemont station.
181	HOLLYWOOD, GLENDALE, PASADENA VIA YOSEMITE DR.
o	Turned south off Franklin on Vermont to Sunset to a terminus at the Sunset/Edgemont station.
201	SILVERLAKE BLVD. - GLENDALE TO MID-WILSHIRE
o	Service from Silverlake terminated at the Vermont/ Beverly station.

TABLE A3-2 (CONTINUED)

BUS/STATION INTERFACE FOR CANDIDATE ALIGNMENT 4: MOS-2B

METRO RAIL

LINE #	BUS ROUTE / + CODED DESCRIPTION
204	VERMONT AVE. - USC TO LA-CBD
	o Full-frequency service suspended at Wilshire/Vermont station with headways doubled for a short-line operation along Vermont; serving Vermont/Beverly, Vermont/Santa Monica stations and terminating at Hollywood Blvd.
208	BEACHWOOD SHUTTLE - HOLLYWOOD, HOLLYWOOD HILLS
	o Turns through the Sunset/Vine station at its southern-most terminus.
210	VINE ST., CRENSHAW BLVE. - HOLLYWOOD TO LAWNDALE
	o Regular service turns around at the Hollywood/Highland station.
217	FAIRFAX, HOLLYWOOD BLVD.
	o Service turns east off Fairfax onto Sunset to a terminus at the Sunset/Vine station.
304	(LIMITED) SANTA MONICA BLVD. - SANTA MONICA TO LA-CBD
	o Service to downtown terminates at the Vermont/Santa Monica station.
320	(LIMITED) WILSHIRE BLVD. - SANTA MONICA TO LA-CBD
	o Service terminates at the Wilshire/Vermont station.
322	(LIMITED) WILSHIRE BLVD. - SANTA MONICA TO LA-CBD
	o Service terminates at the Wilshire/Vermont station.
<VALLEY BRANCH LINES>	
228	COLDWATER CANYON, SHELDON ST., LANKERSHIM
	o Service terminates at the Universal City station.

TABLE A3-2 (CONTINUED)

BUS/STATION INTERFACE FOR CANDIDATE ALIGNMENT 4: MOS-2B

METRO RAIL

LINE #	BUS ROUTE / + CODED DESCRIPTION
420	(EXPRESS) LA-CBD, VAN NUYS, NORTHRIDGE
	o Full service replaced by a limited-stop operation feeding the Universal City station via Lankershim.
423	(EXPRESS) LA, WOODLAND HILLS, WESTLAKE VILLAGE
	o Service terminates at the Universal City station.
424	(EXPRESS) LA-CBD, VENTURA BLVD.
	o Full service replaced by a limited-stop operation feeding the Universal City station via Lankershim.
425	(EXPRESS) LA-CBD, VENTURA BLVD.
	o Full service replaced by a limited-stop operation feeding the Universal City station via Vineland and Ventura Blvd.
426	(EXPRESS) LA-CBD, WILSHIRE BLVD., SAN FERNANDO VALLEY
	o Full service replaced by a limited-stop operation feeding the Universal City station via Vineland and Ventura Blvd.
427	(EXPRESS) LA-CBD, TARZANA, WOODLAND HILLS, CANOGA PARK
	o Full service replaced by a limited-stop operation feeding the Universal City station via Vineland and Ventura Blvd.

APPENDIX 4

IMPACT ON COST EFFECTIVENESS VALUES OF CORRECTION FOR LOS ANGELES TRIP INTERACTIONS

APPENDIX A

IMPACT ON COST EFFECTIVENESS VALUES OF CORRECTION FOR LOS ANGELES TRIP INTERACTIONS

Sections 2.7 and 2.8 includes a discussion of certain anomalies observed in the Los Angeles regional transit system when calculating travel time savings and user benefits.

In applying UMTA methodology, the following situations are accounted for:

1) Travel time decreases - ridership increases.
2) Travel time increases - ridership decreases.

The calculations of travel time savings and user benefits included in Tables 3.1 through 3.5 are based on the UMTA methodology.

However, the following situations observed Los Angeles are not accounted for:

1) Travel time decreases - ridership decreases.
2) Travel time increases - ridership increases.

These seeming inconsistencies are related to interactions with the background bus network assumed for each new project alternative and the mode choice model developed for Los Angeles.

Tables A-4.1 and A-4.2 are included to show the impact of correcting for these situations. These Tables may be compared with Tables 3.1 and 3.2 respectively.

TABLE A-4.1

COST EFFECTIVENESS VALUES
LOCALLY PREFERRED ALTERNATIVE
CORRECTED FOR LOS ANGELES TRIP INTERACTIONS
(December 1985 Constant Dollars)
(Year 2000 Transit Travel Estimates)

CANDIDATE ALIGNMENT NO.	TERMINAL STATIONS	LENGTH IN MILES	NUMBER OF STATIONS	ANNUAL CAPITAL COST N.P.-TSM $Millions (1)	ANNUAL O&M COST N.P.-TSM $Millions (2)	ANNUAL LOCAL SHARE N.P. $Millions (3)	ANNUAL FEDERAL SHARE N.P. $Millions	ANNUAL RIDERSHIP INCREASE N.P.-TSM Millions (4)	ANNUAL TRAVEL TIME SAVED N.P. $Millions (5)	ANNUAL USER BENEFITS N.P. Millions (6)	COST EFFECTIVENESS INDICES: ORIGINAL INDICES TRAVEL TIME SAVING FEDERAL (7)	ORIGINAL INDICES TRAVEL TIME SAVING TOTAL (8)	REVISED INDICES EST. USER BENEFITS FEDERAL (9)	REVISED INDICES EST. USER BENEFITS TOTAL (10)
1	W/W::NH	12.74	10	166.2	8.2	52.6	114.4	60.7	49.1	53.4	1.20	2.06	2.28	3.27
2	W/F::NH	15.91	13	184.4	-1.3	58.4	126.9	59.9	50.7	55.0	1.24	2.21	2.27	3.33
3	P/SV::NH	15.36	13	190.8	-3.2	60.3	131.2	57.7	48.1	53.5	1.37	2.42	2.38	3.51
4	W/F::NH	16.04	14	190.9	-3.8	60.4	131.3	60.5	49.4	53.6	1.28	2.28	2.36	3.49
5	W/F::NH	15.03	11	176.4	-0.1	55.8	121.4	65.9	52.1	54.5	1.04	1.88	2.21	3.24
6	W/F::NH	15.92	14	192.5	-4.8	60.9	132.4	60.7	49.3	53.6	1.28	2.28	2.37	3.50
LPA	W/W::NH	12.89	11	171.6	8.1	54.3	118.1	60.6	49.4	53.4	1.25	2.15	2.35	3.37

LEGEND
- W/W ; WILSHIRE AND WESTERN STATION
- W/F ; WILSHIRE AND FAIRFAX STATION
- P/SV ; PICO AND SAN VICENTE STATION
- NH ; NORTH HOLLYWOOD STATION
- N.P. ; NEW TRANSIT PROJECT
- TSM ; TRANSPORTATION SYSTEM MANAGEMENT

NOTE 1. MOS-1 IS 4.4 MILES IN LENGTH AND HAS 5 STATIONS.
NOTE 2. THE LPA IS CANDIDATE ALIGNMENT 1-MODIFIED.

CALCULATIONS
- COL. 7 = (COL.1+COL.2-COL.3-COL.5)/COL.4
- COL. 8 = (COL.1+COL.2-COL.5)/COL.4
- COL. 9 = (COL.1+COL.2-COL.3)/COL.6
- COL. 10 = (COL.1+COL.2)/COL.6

TABLE A-4.2

COST EFFECTIVENESS VALUES
SECOND MINIMUM OPERABLE SEGMENT
CORRECTED FOR LOS ANGELES TRIP INTERACTIONS
(December 1985 Constant Dollars)
(Year 2000 Transit Travel Estimates)

CANDIDATE ALIGNMENT NO.	SECOND MINIMUM OPERABLE SEGMENT	TEMPORARY TERMINAL STATIONS	LENGTH IN MILES	NUMBER OF STATIONS	ANNUAL CAPITAL COST N.P.-TSM $Millions (1)	ANNUAL O&M COST N.P.-TSM $Millions (2)	ANNUAL LOCAL SHARE N.P. $Millions (3)	ANNUAL FEDERAL SHARE N.P. $Millions	ANNUAL RIDERSHIP INCREASE N.P.-TSM Millions (4)	ANNUAL TRAVEL TIME SAVED N.P. $Millions (5)	ANNUAL USER BENEFITS N.P. Millions (6)	COST EFFECTIVENESS INDICES: ORIGINAL INDICES: TRAVEL TIME SAVING: FEDERAL (7)	ORIGINAL INDICES: TRAVEL TIME SAVING: TOTAL (8)	REVISED INDICES: EST. USER BENEFITS: FEDERAL (9)	REVISED INDICES: EST. USER BENEFITS: TOTAL (10)
GROUP I															
1	MOS-2	W/W::V/S	4.55	6	73.5	3.4	23.4	50.9	--	--	--	--	--	--	--
1	MOS-2A	W/W::V/SM	4.13	5	66.3	9.0	21.1	46.0	--	--	--	--	--	--	--
5	MOS-2A	W/W::W/SM	4.49	5	68.6	3.7	21.9	47.6	--	--	--	--	--	--	--
GROUP II															
1	MOS-2	W/W::H/V	6.95	8	99.0	5.1	31.4	68.3	56.5	46.4	52.0	0.46	1.02	1.40	2.00
2	MOS-2	W/W::H/V	6.95	8	88.7	5.1	28.2	61.3	56.5	46.4	52.0	0.34	0.84	1.26	1.80
3	MOS-2	W/W::H/V	6.95	8	88.3	5.1	28.1	61.0	56.5	46.4	52.0	0.34	0.83	1.26	1.80
4	MOS-2	W/W::S/V	6.81	8	90.2	0.6	28.7	62.4	56.9	45.5	50.8 *	0.29	0.80	1.22	1.79
5	MOS-2	W/W::S/V	5.80	6	80.0	1.1	25.5	55.4	--	--	--	--	--	--	--
6	MOS-2	W/W::H/V	6.80	8	92.8	2.2	29.5	64.1	57.7	47.3	52.7 *	0.32	0.83	1.24	1.80
LPA	MOS-2	W/W::H/V	6.95	8	99.0	5.1	31.4	68.3	56.5	46.4	52.0 *	0.46	1.02	1.40	2.00
GROUP III															
1	MOS-2B	W/V::UC	9.39	7	121.7	11.3	38.6	83.9	58.9	46.5	54.1	0.81	1.47	1.74	2.46
2	MOS-2B	W/V::UC	9.38	7	111.6	12.7	35.4	77.0	58.9	46.5	54.1	0.72	1.32	1.64	2.30
3	MOS-2A	W/V::UC	9.54	8	116.3	12.8	36.9	80.2	59.0	47.0	54.6	0.77	1.39	1.69	2.36
4	MOS-2B	W/V::UC	9.51	8	118.7	12.8	37.7	81.9	59.5	47.0	54.1 *	0.79	1.42	1.73	2.43
6	MOS-2B	W/V::UC	9.39	8	120.3	14.4	38.2	83.0	60.1	47.0	54.7 *	0.82	1.46	1.77	2.46
LPA	MOS-2B	W/V::UC	9.55	8	127.0	15.7	40.3	87.6	59.0	47.0	54.6	0.94	1.62	1.88	2.61
GROUP IV															
2	MOS-2A	W/W::UC	10.46	9	129.5	4.0	41.1	89.3	56.1	45.3	52.1	0.84	1.57	1.77	2.56
4	MOS-2A	W/W::UC	10.59	10	135.9	3.7	43.1	93.7	56.6	45.7	52.6 *	0.90	1.66	1.84	2.66
6	MOS-2A	W/W::UC	10.47	10	137.6	3.3	43.6	94.8	57.4	45.9	53.1 *	0.90	1.66	1.83	2.66
LPA	MOS-2A	W/W::UC	10.62	10	142.7	7.6	45.2	98.3	56.2	45.8	52.6	1.06	1.86	2.00	2.86

LEGEND
- W/W ; WILSHIRE AND WESTERN STATION
- W/V ; WILSHIRE AND VERMONT STATION
- V/S ; VERMONT AND SUNSET STATION
- V/SM ; VERMONT AND SANTA MONICA STATION
- W/SM ; WESTERN AND SANTA MONICA STATION
- H/V ; HOLLYWOOD AND VINE STATION
- S/V ; SUNSET AND VINE STATION
- UC ; UNIVERSAL CITY STATION
- N.P. ; NEW TRANSIT PROJECT
- TSM ; TRANSPORTATION SYSTEM MANAGEMENT

CALCULATIONS
- COL. 7 = (COL.1+COL.2-COL.3-COL.5)/COL.4
- COL. 8 = (COL.1+COL.2-COL.5)/COL.4
- COL. 9 = (COL.1+COL.2-COL.3)/COL.6
- COL. 10 = (COL.1+COL.2)/COL.6

* TRAVEL TIME SAVINGS AND USER BENEFITS FOR STARRED OPTIONS ARE CALCULATED FROM SIMULATION. VALUES FOR OTHER OPTIONS ARE FACTORED.